APPENDIX G

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (WQMP)

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WQ XX-XXXX

County of Orange/Santa Ana Region Priority Project Water Quality Management Plan (WQMP)

Project Name:

Orange County Workforce Reentry Project

GP # __________ BP # __________

561 THE CITY DRIVE SOUTH

ORANGE, CA 92868

Prepared for:

County of Orange

601 N. Ross Street

Santa Ana, CA 92701

(714) 667-4924

Prepared by:

LPA Design Studios

5301 California Ave, Suite #100

Irvine, CA 92617

(949) 261-1001

REGISTERED PROFESSIONAL ENGINEER

KATHEREEN M. SHINKAI

R.C.E. 68369

EXP 9-30-25

CIVIL

STATE OF CALIFORNIA

Prepared 1/09/2025

Project Owner's Certification			
Planning Application No. (If applicable)		Grading Permit No.	
Tract/Parcel Map and Lot(s) No.		Building Permit No.	
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			561 The City Drive South, Orange, CA 92868 231-091-02, 231-091-03, 231-091-09, 988-071-42

This Water Quality Management Plan (WQMP) has been prepared for The County of Orange by LPA Design Studios. The WQMP is intended to comply with the requirements of the County of Orange NPDES Stormwater Program requiring the preparation of the plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan , including the ongoing operation and maintenance of all best management practices (BMPs), and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner:			
Title			
Company	County of Orange		
Address			
Email			
Telephone #			
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature		Date	

Preparer (Engineer):			
Title	Director of Civil Engineering	PE Registration #	C68369
Company	LPA Design Studios		
Address	5301 California Ave, Shite 100, Irvine, CA 92617		
Email	kshinkai@lpadesignstudios.com		
Telephone #	949-261-1001		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	
Place Stamp Here			

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Attachments

Section I Permit(s) and Water Quality Conditions of Approval or Issuance

Provide discretionary or grading/building permit information and water quality conditions of approval, or permit issuance, applied to the project. If conditions are unknown, please request applicable conditions from staff. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available on the OC Planning website (ocplanning.net).*

Project Infomation			
Permit/Application No. (If applicable)		Grading or Building Permit No. (If applicable)	
Address of Project Site (or Tract Map and Lot Number if no address) and APN	561 The City Drive South, Orange, CA 92868		

Water Quality Conditions of Approval or Issuance	
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	The project is subject to the water quality conditions set forth by the City of Orange Municipal Code (7.01.060), which requires that a Water Quality Management Plan (WQMP) be prepared and submitted for all priority development and significant redevelopment projects, for nonpriority projects as described in the DAMP and for projects as required by the Public Works Director.

Conceptual WQMP	
Was a Conceptual Water Quality Management Plan previously approved for this project?	No Conceptual WQMP has been previously approved for this project.

Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	A WIHMP has not been developed for the Santa Ana River. No TMDLs exist for the Santa Ana River.

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas;
- Land uses;
- Land cover;
- Design elements;
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the Technical Guidance Document (TGD) for information that must be included in the project description.*

<table>
<tr><th colspan="5">Description of Proposed Project</th></tr>
<tr><td>Development Category (From Model WQMP, Table 7.11-2; or -3):</td><td colspan="4">New development project creating 10,000 square feet or more of impervious surface.</td></tr>
<tr><td>Project Area (ft²): 200,610</td><td colspan="2">Number of Dwelling Units: 34</td><td colspan="2">SIC Code: 7521, 8299, 8322, 8331, 8361</td></tr>
<tr><td rowspan="2">Project Area</td><td colspan="2">Pervious</td><td colspan="2">Impervious</td></tr>
<tr><td>Area
(acres or sq ft)</td><td>Percentage</td><td>Area
(acres or sq ft)</td><td>Percentage</td></tr>
<tr><td>Pre-Project Conditions</td><td>55,677 sq ft</td><td>28%</td><td>144,933</td><td>72%</td></tr>
<tr><td>Post-Project Conditions</td><td>34,718 sq ft</td><td>17%</td><td>165,892</td><td>83%</td></tr>
<tr><td>Drainage Patterns/Connections</td><td colspan="4">Two existing storm drain pipes exist beneath the project site. A 45” storm drain pipe travels through the middle of the site, from The City Drive South and discharging into the Santa Ana River. A 66” storm drain pipe travels from The City Drive South, along the southern boundary of the project within a Caltrans easement, traveling southward along the west edge of the Santa Ana River for approximately 800 feet before discharging into the River.

The proposed development will capture approximately 93% of the runoff through drain inlets and catch basins. Runoff will enter a new underground storm drain system where it will infiltrate the required volume. Due to grading constraints,</td></tr>
</table>

	the remaining 7% of the runoff will drain as surface flow onto The City Drive South, as it does in existing condition.
Narrative Project Description: (Use as much space as necessary.)	The project is located between The City Drive South and the Santa Ana River, just north of State Route 22, in the City of Orange, CA. The existing site encompasses approximately 4.61 acres of previously developed land that consists of old buildings and structures, to be replaced with improvements consisting of three buildings and surrounding parking lot and landscaped areas. The buildings will be for vocational, rehabilitation and residential uses. The total project disturbed area is equal to the property area and is 4.61 acres. The disturbed area will be treated to the maximum extent practicable, as runoff from 0.31 acres of land along the western property boundary cannot reasonably be captured and treated within the site's storm drain system due to site and grading constraints. These areas include 0.08 acres of landscaping and driveway in the northwest corner of the site, and 0.23 acres of landscaping and driveway from the main entry. The infiltration systems will be oversized to offset the untreated areas. The site has no offsite run-on. The building footprints will total approximately 45,500 square feet. Landscaped areas will include trees and shrubs compliant with the City of Orange landscaping requirements and specifications. Landscaping will have low water usage and be appropriate for the Southern California climate. Hardscaped areas will include the new parking lot and sidewalks. The site will have no loading docks, vehicular or maintenance repair areas, hazardous storage areas, or food preparation areas. However, there will be several outdoor patio areas with tables for eating. The site will have three roofed trash enclosures, each with sewer connections, designed in compliance with __. An electrical equipment yard and cell tower yard will be located in the southwest corner of the site.

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the Technical Guidance Document (TGD) for guidance.*

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	
Nutrients	E ☒	N ☐	
Heavy Metals	E ☒	N ☐	
Pathogens (Bacteria/Virus)	E ☒	N ☐	
Pesticides	E ☒	N ☐	
Oil and Grease	E ☒	N ☐	
Toxic Organic Compounds	E ☒	N ☐	
Trash and Debris	E ☒	N ☐	

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the Technical Guidance Document (TGD) for North Orange County or Section 2.2.3.2 for South Orange County.*

☐ No – Show map

☐ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the Technical Guidance Document (TGD).*

In the North Orange County permit area, HCOCs are considered to exist if any streams located downstream from the project are determined to be potentially susceptible to hydromodification impacts and either of the following conditions exists:

- Post-development runoff volume for the 2-yr, 24-hr storm exceeds the pre-development runoff volume for the 2-yr, 24-hr storm by more than 5 percent
OR
- Time of concentration of pre-development runoff for the 2-yr, 24-hr storm event exceeds the time of concentration of the post-development condition for the 2-yr, 24-hr storm event by more than 5 percent

At the project site, the Santa Ana River is listed as stabilized earth by Figure XVI.3, included in Attachment A. Downstream of the project site, the Santa Ana River is listed as stabilized, with sections of stabilized earth. The project site is located within an area of potential erosion, habitat, or physical structure susceptibility.

Runoff volumes are calculated per TGD Section IV.1, which refers to Section C of the Orange County Hydrology Manual. Impervious area increased in the post-development condition. Therefore, the post-development runoff volume exceeds the pre-development runoff volume for the 2-yr, 24-hr storm.

The time of concentration is calculated using rational method calculations prepared in accordance with the Orange County Hydrology Manual. The time of concentration remained the same between pre-development and post-development conditions, at 6.3 minutes.

The runoff volume criteria for HCOC are satisfied. Therefore, the project has an HCOC. Calculations are summarized in Section IV.1.

Refer to Attachment A for references and calculations.

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the Technical Guidance Document (TGD).*

The project site consists of three (3) Drainage Management Areas, DMAs A, B and C. Runoff from approximately 93% of these areas will be captured in a new underground storm drain system, where it will be pretreated in hydrodynamic separators before discharging into a separate infiltration system for each DMA. Each infiltration system will have an overflow pipe that connects to existing storm drain pipes as described in Section II.1. Runoff from the remaining 7% cannot be captured within the site, and discharge onto The City Drive South, like they do in existing condition. These areas include 0.23 acres of the main entry drive and 0.08 acres of the northern entry drive. The infiltration systems within DMAs A, B and C will be oversized to account for these untreated areas. The total disturbed area is 4.61 acres.

> DMA A is 1.24 acres and encompasses the northwest portion of parking lot and entry drives off The City Drive South. Runoff from DMA A enters storm drain inlets into an underground infiltration system, with an overflow pipe connecting to the existing 45 inch storm drain pipe at Discharge Point A.
>
> DMA B consists of 1.74 acres that includes two buildings and most of the north and east portions of the site. Runoff from DMA B enters storm drain inlets into a second underground infiltration system, with an overflow pipe connecting to the existing 45 inch storm drain pipe and Discharge Point B.
>
> DMA C is 1.63 acres and encompasses the southern portion of the site, including the third building. Runoff from DMA C enters storm drain inlets into a third underground infiltration system, with an overflow pipe connecting to the existing 66 inch storm drain pipe at Discharge Point C.

Refer to the WQMP exhibit in Section VI.

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the Technical Guidance Document (TGD).*

The County of Orange owns the property and will be responsible for maintenance.

<Discuss private/public infrastructure?>

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the Technical Guidance Document (TGD).*

Name of Planned Community/Planning Area (if applicable)	N/A
Location/Address	561 The City Drive South
	Orange, CA 92868
General Plan Land Use Designation	GC – General Commercial
Zoning	C1 – Limited Business
Acreage of Project Site	4.61 acres
Predominant Soil Type	Hydrologic Soil Group B

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.2 in the Technical Guidance Document (TGD).*

Site Characteristics	
Precipitation Zone	0.80
Topography	The site is relatively flat, with slopes ranging from 0.5% to 3%, generally sloping from north to south in the eastern portion of the site, and from east to west towards The City Drive South in the western portion of the site. Maximum elevation differential across the site is approximately 9 ft.

Drainage Patterns/Connections	Runoff from the existing site drains mostly into two existing underground storm drain systems, a 45" and a 66" pipe, running from west to east beneath the site. Small subareas along the western property boundary drain toward The City Drive South. Runoff from the post-development site will drain almost entirely into the new underground storm drain system, where it will infiltrate into the ground, except for runoff from approximately 7% of the area, which will drain towards The City Drive South, similar to existing condition.
Soil Type, Geology, and Infiltration Properties	Hydrologic Soil Group B, per National Resources Conservation Service (NRCS) WebSoil Survey. Type A soils, per the Orange County Technical Guidance Document Exhibit XVI-2a. The site is underlain by undocumented artificial fill materials ranging between 2 to 7.5 feet and consisting of silty sand and sandy silt with minor to abundant amounts of debris. The fill is underlain by alluvial fan deposits. Reference: Geotechnical Exploration Report, Proposed Workforce Reentry Center, 591 The City Drive South, City of Orange, California. Prepared by Verdantas, August 7, 2024, Project No. 20833. See Attachment C.
Hydrogeologic (Groundwater) Conditions	Groundwater was encountered between 27.8 feet and 35.9 feet below ground surface.
Geotechnical Conditions (relevant to infiltration)	Infiltration rates measured at two sites were 60.4 and 76.6 inches per hour. With a recommended factor of safety of 2, and using the more conservative value, the recommended infiltration rate is 30.2. Infiltration is feasible on the site. Reference: Geotechnical Exploration Report, Proposed Workforce Reentry Center, 591 The City Drive South, City of Orange, California. Prepared by Verdantas, August 7, 2024, Project No. 20833. See Attachment C.
Off-Site Drainage	The project has no off-site drainage.
Utility and Infrastructure Information	An existing 45 inch city storm drain pipe travels from west to east through the middle of the site, carrying flows from The City Drive South to the Santa Ana River. An existing 66 inch regional storm drain pipe also travels from west to east, along the southern boundary of the site, carrying flows from The City Drive South to the Santa Ana River.

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the Technical Guidance Document (TGD).*

Receiving Waters	Pacific Ocean
303(d) Listed Impairments	Santa Ana River – Cadmium
Applicable TMDLs	None
Pollutants of Concern for the Project	As a result of the proposed improvements, the type of potential pollutants from the project site may change from the existing condition. Anticipated pollutants for the site include the following: • Sediments, or TSS (Total Suspended Solids), are anticipated from drive aisles, roofs and landscaped areas. • Nutrients, including nitrogen and phosphorous found in organic litter, fertilizers and waste, are anticipated from the drive aisles, landscaped areas and outdoor eating areas. • Pesticides are anticipated from the landscaped areas. • Bacteria, viruses and pathogens are anticipated from animal waste within the landscaped areas, and trash container handling areas. • Petroleum products, such as oil, grease and gasoline, are anticipated from motor vehicles within and drive aisles. • Heavy metals, including copper, lead, cadmium, chromium, nickel and zinc, are anticipated from motor vehicles. • Toxic organic compounds are anticipated from automotive fluids, pesticides and fertilizers. • Trash and debris are anticipated from outdoor eating areas and trash container handling areas. Pollutants of concern for the project site include those expected pollutants that coincide with pollutants on the 303(d) list for receiving waters, and includes heavy metals.
Environmentally Sensitive and Special Biological Significant Areas	The proposed project is not within 200ft of, and does not discharge directly into, an Environmentally Sensitive Area (ESA). Areas of Special Biological Significance for the Santa Ana River Reach 1 and Reach 2 are listed in Table 3-1 of the Santa Ana River Basin Plan and include but are not limited to: 1. Agricultural Supply (AGR) 2. Ground Water Recharge (GWR)

	3. Water Contact Recreation (REC1) 4. Non-contact Recreation (REC2) 5. Warm Freshwater Habitat (WARM) 6. Wildlife Habitat (WILD) 7. Rare, Threatened, or Endangered Species (RARE) 8. Spawning, Reproduction, and Development (SPWN)

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. (Please ask your assigned planner or plan checker regarding whether your project is part of an approved WIHMP or equivalent.)
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-*3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	N/A	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	Based on Figure XVI-3a from the TGD, this project is in an area of potential erosion, habitat, and physical structure susceptibility. Runoff volumes are calculated below per TGD Section IV.1, which refers to Section C of the Orange County Hydrology Manual. Impervious area increased in the post-development condition. Therefore, the post-development runoff volume exceeds the pre-development runoff volume for the 2-yr, 24-hr storm. The time of concentration is calculated using rational method calculations prepared in accordance with the Orange County Hydrology Manual. The time of concentration decreased significantly. Refer to Attachment A for detailed calculations and references. V = (0.75 x imp + 0.15) x d x A x 43560 / 12 d = 2.05 in (per OC TGD Section IV.1.1) <u>Pre-development runoff volume and Tc</u>: V = (0.75 x 0.72+ 0.15) x 2.05 x 4.61 x 43560 / 12 = **23,670 cu ft** Tc: 6.3 **minutes** <u>Post-development runoff volume and Tc</u>: V = (0.75 x 0.83 + 0.15) x 2.05 x 4.61 x 43560 / 12 = **26,500 cu ft** Tc: **6.3 minutes** **Delta Volume = 2,830 cu ft increase** **Delta Tc = 0 min** Hydromodification controls will be required.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	The LID performance criteria for North Orange County are as follows: - Priority projects must infiltrate, harvest and use, evapotranspire, or biotreat/biofilter the 85th percentile, 24-hour storm event (Design Capture Volume) - A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotranspiration cannot be feasible implemented for the full Design Capture Volume.

List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	Selection of LID performance criteria also fully satisfies treatment control performance criteria.
Calculate LID design storm capture volume for Project.	LID design storm capture volume is calculated per Worksheet B, included in Attachment A: DCV = C x d x A = 0.77 x 0.80 x 4.605 x 43560 / 12 = 10297 cu ft

IV.2. Site Design and Drainage

Describe site design and drainage including

- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP "BMP Exhibit."
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs.

Refer to Section 2.4.2 in the Technical Guidance Document (TGD).

Site design practices include:

1. Minimize Impervious Area – Landscaped areas are utilized where possible to minimize impervious area.

2. Maximize Infiltration Capacity – Infiltration is incorporated by three underground retention systems.

3. Preserve Existing Drainage Patterns – Existing Drainage Pattern from north to south is mostly preserved. Runoff discharges into the same systems as the existing condition.

4. Disconnect Impervious Areas – Surface runoff flows to the landscaped areas where possible, before entering the underground storm drain system, to reduce the amount of Directly Connected Impervious Areas.

The BMP Exhibit (Site Plan) in Section VI shows six (6) Drainage Management Areas (DMAs) for the project. Refer to Worksheet C in Attachment A.

DMA	**Area** (acres)	**Impervious Area, imp** (%)	**Runoff Coefficient, C**	**Design Storm Depth, D (in)**	**DCV** (cu ft)
DMA A	1.24	80%	0.75	0.80	2701
DMA B	1.74	86%	0.80	0.80	4042
DMA C	1.63	83%	0.77	0.80	3644
				Total	10368*

*Varies slightly from DCV in previous section due to rounding

IV.3 LID BMP Selection and Project Conformance Analysis

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the Technical Guidance Document (TGD) for selecting LID BMPs and Section 2.4.3 in the Technical Guidance Document (TGD) for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls (HSCs)

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met, state why.

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☒
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with infiltration BMPs. If not, document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

The Lid Design Storm Capture Volume can be met with infiltration BMPs. Infiltration Rate = 30.2 in/hr.

Required DCV = 10308

Depth of water within BMP chambers = 5.5 ft, Drawdown time = 2.2 hours   <-- OK

DMA A

Required volume 2701 cf

70ft of double 60" HDPE surrounded by gravel with 30% voids

DMA B

Required volume = 4024 cf

65ft of double 60" HDPE surrounded by gravel with 30% voids

DMA C

Required volume = 3644 cf

75ft of double 60" HDPE surrounded by gravel with 30% voids

Note: Total required volume varies slightly from DCV in previous section due to rounding

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration and/or rainwater harvesting BMPs included.

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs included. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☐
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not, document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with these BMP categories.

BMP Name	**BMP Description**	**Required DCV (CF)**	**Volume Provided (CF)**
BMP A	Infiltration system: 70 ft of double 60" HDPE pipe surrounded by gravel	2701	Approx 4200
BMP B	Infiltration system: 65 ft of double 60" HDPE pipe surrounded by gravel	4042	Approx 4100
BMP C	Infiltration system: 75 ft of double 60" HDPE pipe surrounded by gravel	3644	Approx 4300

The total volume provided in the three retention systems is a minimum of 12600 cf, which is greater than the project DCV of 10308 cf. The entire LID DCV can be met with infiltration.

A full trash capture device will be included at the outlet for each infiltration system.

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. *See Section 5 of the Technical Guidance Document (TGD).* Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval (if applicable).

Hydromodification Control BMPs	
BMP Name	BMP Description
BMP A	Infiltration system: 70 ft of double 60" HDPE pipe reduces 2-year peak flows to zero
BMP B	Infiltration system: 65 ft of double 60" HDPE pipe reduces 2-year peak flows to zero
BMP C	Infiltration system: 75 ft of double 60" HDPE pipe reduces 2-year peak flows to zero

IV.3.6 Regional/Sub-Regional LID BMPs

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP*.

Regional/Sub-Regional LID BMPs

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	BMP Description

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Industrial Permit Compliance	☒	☐	
N7	Spill Contingency Plan	☒	☐	
N8	Underground Storage Tank Compliance	☒	☐	
N9	Hazardous Materials Disclosure Compliance	☒	☐	
N10	Uniform Fire Code Implementation	☒	☐	
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☐	☒	No loading docks are proposed
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	No retail gasoline outlets are proposed

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if structural source controls were not used.

Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☒	☐	
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☐	
S6	Dock areas	☐	☐	
S7	Maintenance bays	☐	☒	No maintenance bays are proposed
S8	Vehicle wash areas	☐	☒	No vehicle wash areas are proposed
S9	Outdoor processing areas	☐	☒	No outdoor processing areas are proposed
S10	Equipment wash areas	☐	☒	No equipment wash areas are proposed
S11	Fueling areas	☐	☒	No fueling areas are proposed
S12	Hillside landscaping	☐	☒	No hillside landscaping areas are proposed
S13	Wash water control for food preparation areas	☐	☒	No outdoor food preparation areas are proposed
S14	Community car wash racks	☐	☒	No community car washes are proposed

IV.4 Alternative Compliance Plan (If Applicable)

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the Technical Guidance Document (TGD) for calculation methods for applying water quality credits.*

<table>
<tr><th colspan="6">Description of Proposed Project</th></tr>
<tr><td colspan="6">Project Types that Qualify for Water Quality Credits (Select all that apply):</td></tr>
<tr><td>☐Redevelopment projects that reduce the overall impervious footprint of the project site.</td><td colspan="3">☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.</td><td colspan="2">☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).</td></tr>
<tr><td colspan="2">☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).</td><td colspan="3">☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned</td><td>☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).</td></tr>
<tr><td>☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.</td><td>☐ Developments in a city center area.</td><td>☐ Developments in historic districts or historic preservation areas.</td><td colspan="2">☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.</td><td>☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.</td></tr>
</table>

Calculation of Water Quality Credits (if applicable)	Not applicable

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the Model WQMP.*

Not applicable

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the funding mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Hydrodynamic Separator	County of Orange	Inspect and remove trash and debris. Inspect and clean when 75% full in the isolated sump, or per manufacturer's recommendations.	Twice per year
ADS HDPE Retention System	County of Orange	Regular inspections of system to observe sediment built up and infiltration capacity. Cleaning of accumulated trash, debris, and sediment as determined by inspections. See manufacturer's recommendations for additional maintenance activities.	Annually and within 48 hours following a significant storm event to verify there is no standing water in the chambers
ADS FlexStorm Connector Pipe Screen	County of Orange	Inspect and remove trash debris from screening device. Clean when over 40% full, or per manufacturer's recommendations.	Twice per year and after major storm events
N1. Education for Property Owners, Tenants and Occupants	County of Orange	The educational program and materials for the protection of stormwater shall be prepared by IMI Critical Engineering and provided to the first tenants and occupants. Education of employees/owner(s) shall be done within four weeks of startup and continue on an annual basis with each new onsite	Ongoing

		employee/owner(s) being given a water quality orientation using this WQMP as a reference within two weeks of hire date.	
N2. Activity Restrictions	County of Orange	The owner shall develop activity restrictions to minimize the threat of hazardous waste or contamination into the storm drainage system. Car washing, vehicle maintenance, and vehicle repair are not allowed on-site at any time.	Monthly
N3. Common Area Landscape Management	County of Orange	Maintenance staff shall be trained annually on landscape management BMPs consistent with MS4 Permit Program and CASQA BMP SC-41 Guidelines or City equivalent, plus pesticide usage consistent with product labels and state code.	Yearly
N4. BMP Maintenance	County of Orange	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP.	Weekly
N5. Title 22 CCR Compliance	County of Orange	Owner shall comply with the applicable hazardous waste section(s) of Title 22.	Ongoing
N6. Local Industrial Permit Compliance	County of Orange	Owner shall comply with any applicable local water quality ordinances from the local jurisdiction to ensure clean storm water discharges from the site.	Ongoing
N7. Spill Contingency Plan	County of Orange	Owner shall provide the Spill Contingency Plan guided by CASQA BMP Handbook SC-11 that mandates stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.	Ongoing

N8. Underground Storage Tank Compliance	County of Orange	Owner shall comply with State regulations dealing with underground storage tanks, enforced by Orange County Health Care Agency (OCHCA) on behalf of the state.	Ongoing
N9. Hazardous Materials Disclosure	County of Orange	Owner shall comply with local ordinances and local fire protection agencies for the management of hazardous materials.	Ongoing
N10. Uniform Fire Code Implementation	County of Orange	Owner to comply with Article 80 of the Uniform Fire code and will be enforced by the local fire protection agency. Implementation shall occur upon tenant occupancy.	Ongoing
N11. Common Area Litter Control	County of Orange	Litter patrol, violations investigation, reporting and other little control activities shall be performed in conjunction with maintenance activities.	Weekly
N12. Employee Training	County of Orange	The property owner shall develop an education program to train future, tenants, occupants, and employees, and provide them with educational materials about the storm water management practices outlined in this document.	Ongoing
N14. Common Area Catch Basin Inspection	County of Orange	Litter and debris removal, illicit discharge violations investigation and reporting shall be performed in conjunction with maintenance activities.	Minimum of once a year prior to rainy season
N15. Street Sweeping Private Streets and Parking Lots	County of Orange	Parking lots within the project shall be vacuum swept at a minimum frequency of once a month.	Monthly
S1. Provide Storm Drain System Stenciling and Signage	County of Orange	All proposed inlets shall be marked with the appropriate "No Dumping. Drains to Ocean." stencil with annual inspections for legibility. The stencils must be repainted	Yearly

		when they become illegible, but at a minimum once every five years.	
S3. Trash and Waste Storage Areas	County of Orange	Sweet trash area at least once per week. Maintain area clean of trash and debris.	Weekly
S4. Efficient Irrigation Systems & Landscape Design, Water Conservation, Smart Controllers, and Source Control	County of Orange	Perform weekly/monthly inspections for damaged or leaking irrigation pipes and applicators and repair, as needed. Verify that landscape design continues to function properly by correctly adjusting to eliminate overspray to hardscape areas. Verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, and day or night time temperatures.	Weekly/Monthly

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

Include a BMP Exhibit (Site Plan), at a size no less than 24" by 36," which includes the following minimum information:

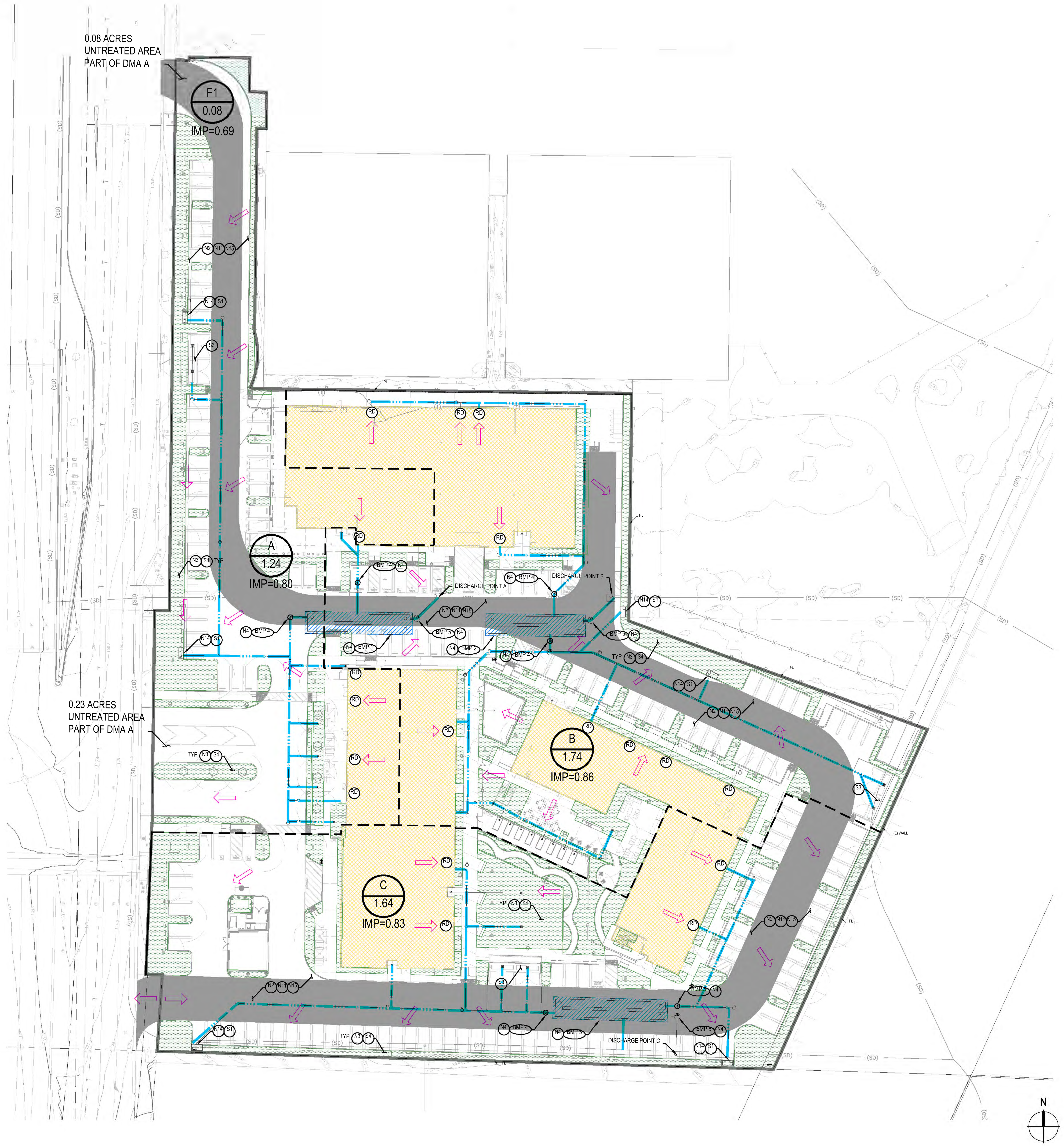
- Insert in the title block (lower right hand corner) of BMP Exhibit: the WQMP Number (assigned by staff) and the grading/building or Planning Application permit numbers
- Project location (address, tract/lot number(s), etc.)
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Delineate the area being treated by each structural BMP
- GIS coordinates for LID and Treatment Control BMPs
- Drainage connections
- BMP details
- Preparer name and stamp

Please do not include any areas outside of the project area or any information not related to drainage or water quality. The approved BMP Exhibit (Site Plan) shall be submitted as a plan sheet on all grading and building plan sets submitted for plan check review and approval. The BMP Exhibit shall be at the same size as the rest of the plan sheets in the submittal and shall have an approval stamp and signature prior to plan check submittal.

VI.2 Submittal and Recordation of Water Quality Management Plan

Following approval of the Final Project-Specific WQMP, three copies of the approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be submitted. In addition, these documents shall be submitted in a PDF format.

Each approved WQMP (including BMP Exhibit, Operations and Maintenance (O&M) Plan, and Appendices) shall be recorded in the Orange County Clerk-Recorder's Office, prior to close-out of grading and/or building permit. Educational Materials are not required to be included.



WATER QUALITY EXHIBIT | 1" = 30' | 01

COUNTY APPROVAL STAMP

LEGEND

	PERVIOUS LANDSCAPE AREA (N3)(S4)
	RETENTION SYSTEM
	PROPOSED BUILDING
	SURFACE FLOW DIRECTION
	STORM DRAIN FLOW DIRECTION
	STORM DRAIN PIPE FLOW
	LIMIT OF WORK / DISTURBED AREA = 4.61 AC
	DELINEATION BETWEEN DMAS
NAME	DRAINAGE MANAGEMENT AREA
X.XX	AREA (ACRES)
IMP=0.XX	IMPERVIOUS RATIO
RD	PROPOSED ROOF DRAIN

STRUCTURAL BMPS / HYDROMODIFICATION CONTROL BMPS

		DMA	REQUIRED VOLUME	PROVIDED VOLUME
BMP 1	ADS RETENTION/DETENTION PIPE SYSTEM 70 FT DOUBLE 60" HDPE PIPE	A	2701 CF	4200 CF
BMP 2	ADS RETENTION/DETENTION PIPE SYSTEM 65 FT DOUBLE 60" HDPE PIPE	B	4042 CF	4100 CF
BMP 3	ADS RETENTION/DETENTION PIPE SYSTEM 75 FT DOUBLE 60" HDPE PIPE	C	3644 CF	4300 CF
BMP 4	ADS BARRACUDA HYDRODYNAMIC SEPARATOR			
BMP 5	ADS FLEXSTORM CONNECTOR PIPE SCREEN PER DETAIL 02 ON THIS SHEET.			

NON-STRUCTURAL SOURCE CONTROL BMPs

N2	ACTIVITY RESTRICTIONS
N3	COMMON AREA LANDSCAPE MANAGEMENT
N4	BMP MAINTENANCE
N11	LITTER CONTROL
N14	COMMON AREA CATCH BASIN INSPECTION
N15	VACUUM SWEEPING OF PRIVATE STREETS AND PARKING LOTS

STRUCTURAL SOURCE CONTROL BMPs

S1	STORM DRAIN STENCILING - "NO DUMPING - DRAINS TO OCEAN".
S3	ROOFED TRASH ENCLOSURE WITH REGULAR MAINTENANCE.
S4	EFFICIENT IRRIGATION WITH WEEKLY MAINTENANCE.

County of Orange
OC PUBLIC WORKS
OC Facilities Design & Construction

Revisions
Sym. Descrip. Date By

Consultants
Drawn Chkd. Date

A-E Seal
Design AT Chkd. KS Date 11/15/2024

A-E
LPA

Sht Title
Project County of Orange Workforce Reentry Center 561 The City Drive South Orange, CA 92868
PROJ. NO. 31327

Plan Check No.
GRD XX-XXXX

Sheet
1 of 1

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. Please only attach the educational materials specifically applicable to this project. Other materials specific to the project may be included as well and must be attached.

Education Materials			
CASQA Fact Sheets (http://www.casqa.org)	Check If Applicable	Business Material (http://www.ocwatersheds.com)	Check If Applicable
	☐		☐
SD-10 – Site Design & Landscape Planning	☒		☐
SD-12 – Efficient Irrigation	☒		☐
SD-20 – Storm Drain Signage	☒		☐
SD-32 – Trash Storage Areas	☒	Other Material	Check If Attached
SD-34 – Outdoor Material Storage Areas	☒		
SC-10 – Non-Stormwater Discharges	☒		☐
SC-11 – Spill Prevention, Control and Cleanup	☒		☐
SC-34 – Waste Handling and Disposal	☒		☐
SC-41 – Building Grounds and Maintenance	☒		☐
SC-42 – Building Repair and Construction	☒		☐
SC-43 – Parking and Storage Area Maintenance	☒		☐
SC-44 – Drainage System Maintenance	☒		☐
SC-73 – Landscape Maintenance	☒		☐
WM-1 – Material Delivery and Storage	☒		☐
WM-2 – Material Use	☒		☐
WM-4 – Spill Prevention and Control	☒		☐
WM-5 – Solid Waste Management	☒		☐
WM-10 – Liquid Waste Management	☒		☐

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage

CALIFORNIA STORMWATER QUALITY ASSOCIATION

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, create new opportunities, and protect slopes and channels.

Applicability

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design considerations provided are applicable to new development and redevelopment as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

Design Considerations

Design requirements for site design and landscape planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

Landscape plans should be developed with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Landscape/Outdoor Pesticide Use

- Design landscaping to minimize water use, runoff, and the use of fertilizers and pesticides.
- Specify plants that are tolerant of saturated soil conditions in areas where landscape is used to detain or retain stormwater.
- Design landscaping grounds to optimize surface infiltration where appropriate.
- Design grading and drainage systems so that drain inlets are located outside of lawn areas, or include non-turf buffers around inlets.
- Preserve existing native trees, shrubs, and ground cover and incorporate in the landscape plan to the maximum extent practicable.
- Select plants used for erosion control in steep hillside areas.
- Select pest resistant plants as much as possible (especially in landscaped areas adjacent to hardscape).
- Design for successful plant growth and maximum habitat by selecting plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions. Use native vegetation where possible.

Conserve Natural Areas During Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize the use of trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Use natural vegetation in parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities within the Landscape

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.
- Improve and maintain the quality of soil through soil amendments and the creation of a microbial community.
- Evaluate infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Preserve or create stream setbacks – vegetated areas, including trees, shrubs, and herbaceous vegetation, that protect a stream system, lake reservoir, or coastal estuarine area.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.

- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Minimizing and Disconnecting Impervious Areas

- Refer to Fact Sheet SD-10 – Minimizing and Disconnecting Impervious Areas for information on spill cleanup.

Figure 1. Swale at city hall in Brisbane, CA.

Figure 2. Railroad rails and rip rap to slow stormwater flows in a creek daylighting project in Paso Robles, CA.

Redeveloping Existing Installations

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas, and incorporate other applicable recommendations described above.

Figure 3. Energy dissipation, erosion control, and stream buffers at Strawberry Creek in Berkeley, CA.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.


Photo: SFPUC Urban Watershed Management Program

Design Objectives

☑ Maximize Infiltration
☑ Provide Retention
☑ Slow Runoff
Minimize Impervious Land Coverage

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water, plant selection, and landscape design that minimize runoff of excess irrigation water into the stormwater conveyance system.

Applicability

This fact sheet is applicable to planting and irrigation systems of residential, commercial, and industrial areas in new development and redevelopment projects as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

Design Considerations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where applicable and feasible:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area’s specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.

- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.
- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species).
- Consider design features such as:
  - Using mulches (such as wood chips or bark) in planter areas without ground cover to minimize sediment in runoff;
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect;
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible; and
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth.
- Employ other comparable, equally effective methods to reduce irrigation water runoff.
- Note that Assembly Bill 1881, the Model Water Efficiency Landscape Ordinance, requires the use of efficient irrigation and compatible plantings for any project over 2055 square feet.

Figure 1. Swale at San Diego Airport with rock mulch, low-water plantings, and irrigation controls.

Figure 2. Mulched landscape area adjacent to permeable concrete at a public park in San Francisco.

Figure 3. Downspout to mulched flow-through planter bed in project courtyard.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage

Photo: Silicon Valley Clean Water

http://www.svcw.org/facilities/sitePages/discharge to sf bay.aspx

Design Objectives	
	Cover
	Contain
	Reduce/Minimize
☑	Prohibit Dumping
	Collect & Convey

Targeted Constituents	
☑	Sediment
☑	Nutrients
☑	Trash
☑	Metals
☑	Bacteria
☑	Oil & Grease
☑	Synthetic Organics
☑	Pesticides

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

Description

Waste materials dumped into storm drain inlets can have impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Applicability

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas as well as any other area where contributions or dumping to storm drains is likely.

Design considerations provided are applicable to new development and redevelopment as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING – DRAINS TO OCEAN” and/or other graphical icons to discourage illegal dumping.
- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note that some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Additional Information

Maintenance Considerations

Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner’s association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Examples

Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Design Objectives

- ☑ Cover
- ☑ Contain
- Reduce/Minimize
- ☑ Prohibit Dumping
- ☑ Collect & Convey

Targeted Constituents

- Sediment
- ☑ Nutrients
- ☑ Trash
- Metals
- ☑ Bacteria
- ☑ Oil & Grease
- ☑ Synthetic Organics
- ☑ Pesticides

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION®

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design considerations provided are applicable to new development and redevelopment as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash and minimize pest entry options.
- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Photo Credit: Shauna Dunton

Design Objectives

☑ Cover

☑ Contain

Reduce/Minimize

☑ Prohibit Dumping

☑ Collect & Convey

Targeted Constituents

☑ Sediment

Nutrients

☑ Trash

☑ Metals

Bacteria

Oil & Grease

☑ Synthetic Organics

Pesticides

Description

Proper design of outdoor storage areas for materials reduces opportunity for toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to enter the stormwater conveyance system. Materials may be in the form of raw products, by-products, finished products, and waste products. The type of pollutants associated with the materials will vary depending on the type of commercial or industrial activity.

Approach

Outdoor storage areas require a drainage approach different from the typical infiltration/detention strategy. In outdoor storage areas, infiltration is discouraged. Containment is encouraged. Preventative measures include enclosures, secondary containment structures and impervious surfaces.

Applicability

Appropriate applications include residential, commercial, and industrial areas planned for development or redevelopment.

Design considerations provided are applicable to new development and redevelopment as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

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Design Considerations

Some materials are more of a concern than others. Toxic and hazardous materials must be prevented from coming in contact with stormwater. Non-toxic or non-hazardous materials do not have to be prevented from stormwater contact. However, these materials may have toxic effects on receiving waters if allowed to be discharged with stormwater in significant quantities. Accumulated material on an impervious surface could result in significant impact on the rivers or streams that receive the runoff.

Material may be stored in a variety of ways including bulk piles, containers, shelving, stacking, and tanks. Stormwater contamination may be prevented by eliminating the possibility of stormwater contact with the material storage areas either through diversion, cover, or capture of the stormwater. Control measures may also include minimizing the storage area. Design requirements for material storage areas are governed by Building and Fire Codes, and by current City or County ordinances and zoning requirements. Control measures are site specific and must meet local agency requirements.

Where proposed project plans include outdoor areas for storage of materials that may contribute pollutants to the stormwater conveyance system, the following structural or treatment BMPS should be considered:

- Materials with the potential to contaminate stormwater should be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the stormwater conveyance system, or (2) protected by secondary containment structures such as berms, dikes, or curbs.
- The storage area should be paved and sufficiently impervious to contain leaks and spills.
- The storage area should slope towards a dead-end sump to contain spills and direct runoff from downspouts/roofs should be directed away from storage areas.
- The storage area should have a roof or awning that extends beyond the storage area to minimize collection of stormwater within the secondary containment area. A manufactured storage shed may be used for small containers.

Note that the location(s) of installations of where these preventative measures will be employed must be included on the map or plans identifying BMPs.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permits.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Graphic by: Margie Winter

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	✓
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓
Oxygen Demanding	✓

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. For municipalities non-stormwater discharges present themselves in two situations. One is from fixed facilities owned and/or operated by the municipality. The other situation is non-stormwater discharges that are discovered during the normal operation of a field program. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, and surface cleaning. However, there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances (such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants) into storm drains. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges.

Approach

The municipality must address non-stormwater discharges from its fixed facilities by assessing the types of non-stormwater discharges and implementing BMPs for the discharges determined to pose environmental concern. For field programs the field staff must be

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trained to now what to look for regarding non-stormwater discharges and the procedures to follow in investigating the detected discharges.

Suggested Protocols

Fixed Facility

General

- Post "No Dumping" signs with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.

- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- Landscaping and beautification efforts of hot spots might also discourage future dumping, as well as provide open space and increase property values.

- Lighting or barriers may also be needed to discourage future dumping.

Illicit Connections

- Locate discharges from the fixed facility drainage system to the municipal storm drain system through review of "as-built" piping schematics.

- Use techniques such as smoke testing, dye testing and television camera inspection (as noted below) to verify physical connections.

- Isolate problem areas and plug illicit discharge points.

Visual Inspection and Inventory

- Inventory and inspect each discharge point during dry weather.

- Keep in mind that drainage from a storm event can continue for several days following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

Review Infield Piping

- Review the "as-built" piping schematic as a way to determine if there are any connections to the stormwater collection system.

- Inspect the path of floor drains in older buildings.

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.

- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

  Dye Testing

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

TV Inspection of Storm Sewer

- TV Cameras can be employed to visually identify illicit connections to the fixed facility storm drain system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Clean up spills on paved surfaces with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.
- See fact sheet SC-11 Spill Prevention, Control, and Clean Up.

Field Program

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially ones that involve more than one jurisdiction and those that are not classified as hazardous, which are often not responded to as effectively as they need to be.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- See SC-74 Stormwater Drainage System Maintenance for additional information.

Field Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- During routine field program maintenance field staff should look for evidence of illegal discharges or illicit connection:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections and notify appropriate investigating agency.
- If trained, conduct field investigation of non-stormwater discharges to determine whether they pose a threat to water quality.

Recommended Complaint Investigation Equipment

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms.
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms

- Educational materials

Reporting

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any onsite drainage points observed.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

Enforcement

- Educate the responsible party if identified on the impacts of their actions, explain the stormwater requirements, and provide information regarding Best Management Practices (BMP), as appropriate. Initiate follow-up and/or enforcement procedures.
- If an illegal discharge is traced to a commercial, residential or industrial source, conduct the following activities or coordinate the following activities with the appropriate agency:
  - Contact the responsible party to discuss methods of eliminating the non-stormwater discharge, including disposal options, recycling, and possible discharge to the sanitary sewer (if within POTW limits).
  - Provide information regarding BMPs to the responsible party, where appropriate.
  - Begin enforcement procedures, if appropriate.
  - Continue inspection and follow-up activities until the illicit discharge activity has ceased.
- If an illegal discharge is traced to a commercial or industrial activity, coordinate information on the discharge with the jurisdiction's commercial and industrial facility inspection program.

Training

- Train technical staff to identify and document illegal dumping incidents.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Train employees to identify non-stormwater discharges and report them to the appropriate departments.
- Train staff who have the authority to conduct surveillance and inspections, and write citations for those caught illegally dumping.

- Train municipal staff responsible for surveillance and inspection in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).
  - OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and federal OSHA 29 CFR 1910.146).
  - Procedural training (field screening, sampling, smoke/dye testing, TV inspection).
- Educate the identified responsible party on the impacts of his or her actions.

Spill Response and Prevention

- See SC-11 Spill Prevention Control and Clean Up

Other Considerations

- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The cost of fees for dumping at a proper waste disposal facility are often more than the fine for an illegal dumping offense, thereby discouraging people from complying with the law. The absence of routine or affordable pickup service for trash and recyclables in some communities also encourages illegal dumping. A lack of understanding regarding applicable laws or the inadequacy of existing laws may also contribute to the problem.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Many facilities do not have accurate, up-to-date schematic drawings.
- Can be difficult to locate illicit connections especially if there is groundwater infiltration.

Requirements

Costs

- Eliminating illicit connections can be expensive especially if structural modifications are required such re-plumbing cross connections under an existing slab.
- Minor cost to train field crews regarding the identification of non-stormwater discharges. The primary cost is for a fully integrated program to identify and eliminate illicit connections and illegal dumping. However, by combining with other municipal programs (i.e. pretreatment program) cost may be lowered.
- Municipal cost for containment and disposal may be borne by the discharger.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges are discharges not made up entirely of stormwater and include water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, landscape irrigation, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Current municipal NPDES permits require municipalities to effectively prohibit non-stormwater discharges unless authorized by a separate NPDES permit or allowed in accordance with the current NPDES permit conditions. Typically the current permits allow certain non-stormwater discharges in the storm drain system as long as the discharges are not significant sources of pollutants. In this context the following non-stormwater discharges are typically allowed:

  - Diverted stream flows;
  - Rising found waters;
  - Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));
  - Uncontaminated pumped ground water;
  - Foundation drains;
  - Springs;
  - Water from crawl space pumps;
  - Footing drains;
  - Air conditioning condensation;
  - Flows from riparian habitats and wetlands;
  - Water line and hydrant flushing ;
  - Landscape irrigation;
  - Planned and unplanned discharges from potable water sources;
  - Irrigation water;
  - Individual residential car washing; and
  - Lawn watering.

Municipal facilities subject to industrial general permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The state's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

Illegal Dumping

- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties

Outreach

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people on the street who are aware of the problem and who have the tools to at least identify the incident, if not correct it. There we a number of ways of accomplishing this:

- Train municipal staff from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report the incidents.
- Deputize municipal staff who may come into contact with illegal dumping with the authority to write illegal dumping tickets for offenders caught in the act (see below).
- Educate the public. As many as 3 out of 4 people do not understand that in most communities the storm drain does not go to the wastewater treatment plant. Unfortunately, with the heavy emphasis in recent years on public education about solid waste management, including recycling and household hazardous waste, the sewer system (both storm and sanitary) has been the likely recipient of cross-media transfers of waste.
- Provide the public with a mechanism for reporting incidents such as a hot line and/or door hanger (see below).
- Help areas where incidents occur more frequently set up environmental watch programs (like crime watch programs).
- Train volunteers to notice and report the presence and suspected source of an observed pollutant to the appropriate public agency.

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  - Footing drains;
  - Air conditioning condensation;
  - Flows from riparian habitats and wetlands;
  - Water line and hydrant flushing ;
  - Landscape irrigation;
  - Planned and unplanned discharges from potable water sources;
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  - Individual residential car washing; and
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Municipal facilities subject to industrial general permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The state's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

Storm Drain Stenciling

- Stencil storm drain inlets with a message to prohibit illegal dumpings, especially in areas with waste handling facilities.

- Encourage public reporting of improper waste disposal by a HOTLINE number stenciled onto the storm drain inlet.

- See Supplemental Information section of this fact sheet for further detail on stenciling program approach.

Oil Recycling

- Contract collection and hauling of used oil to a private licensed used oil hauler/recycler.

- Comply with all applicable state and federal regulations regarding storage, handling, and transport of petroleum products.

- Create procedures for collection such as; collection locations and schedule, acceptable containers, and maximum amounts accepted.

- The California Integrated Waste Management Board has a Recycling Hotline, (800) 553-2962, that provides information and recycling locations for used oil.

Household Hazardous Waste

- Provide household hazardous waste (HHW) collection facilities. Several types of collection approaches are available including permanent, periodic, or mobile centers, curbside collection, or a combination of these systems.

Training

- Train municipal employees and contractors in proper and consistent methods for waste disposal.

- Train municipal employees to recognize and report illegal dumping.

- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Federal Regulations (RCRA, SARA, CERCLA) and state regulations exist regarding the disposal of hazardous waste.
- Municipalities are required to have a used oil recycling and a HHW element within their integrate waste management plan.
- Significant liability issues are involved with the collection, handling, and disposal of HHW.

Examples

The City of Palo Alto has developed a public participation program for reporting dumping violations. When a concerned citizen or public employee encounters evidence of illegal dumping, a door hanger (similar in format to hotel "Do Not Disturb" signs) is placed on the front doors in the neighborhood. The door hanger notes that a violation has occurred in the neighborhood, informs the reader why illegal dumping is a problem, and notes that illegal dumping carries a significant financial penalty. Information is also provided on what citizens can do as well as contact numbers for more information or to report a violation.

The Port of Long Beach has a state of the art database incorporating storm drain infrastructure, potential pollutant sources, facility management practices, and a pollutant tracking system.

The State Department of Fish and Game has a hotline for reporting violations called CalTIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

References and Resources

http://www.stormwatercenter.net/

California's Nonpoint Source Program Plan http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program,
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program
(http://www.projectcleanwater.org)

Santa Clara Valley Urban Runoff Pollution Prevention Program
http://www.scvurppp-w2k.com/pdf%20documents/PS_ICID.PDF

Spill Prevention, Control & Cleanup SC-11

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓
Oxygen Demanding	✓

Description

Spills and leaks, if not properly controlled, can adversely impact the storm drain system and receiving waters. Due to the type of work or the materials involved, many activities that occur either at a municipal facility or as a part of municipal field programs have the potential for accidental spills and leaks. Proper spill response planning and preparation can enable municipal employees to effectively respond to problems when they occur and minimize the discharge of pollutants to the environment.

Approach

- An effective spill response and control plan should include:
  - Spill/leak prevention measures;
  - Spill response procedures;
  - Spill cleanup procedures;
  - Reporting; and
  - Training
- A well thought out and implemented plan can prevent pollutants from entering the storm drainage system and can be used as a tool for training personnel to prevent and control future spills as well.

Pollution Prevention

- Develop and implement a Spill Prevention Control and Response Plan. The plan should include:

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- A description of the facility, the address, activities and materials involved
- Identification of key spill response personnel
- Identification of the potential spill areas or operations prone to spills/leaks
- Identification of which areas should be or are bermed to contain spills/leaks
- Facility map identifying the key locations of areas, activities, materials, structural BMPs, etc.
- Material handling procedures
- Spill response procedures including:
  - Assessment of the site and potential impacts
  - Containment of the material
  - Notification of the proper personnel and evacuation procedures
  - Clean up of the site
  - Disposal of the waste material and
  - Proper record keeping

- Product substitution – use less toxic materials (i.e. use water based paints instead of oil based paints)
- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of materials that are brought into the facility or into the field.

Suggested Protocols

Spill/Leak Prevention Measures

- If possible, move material handling indoors, under cover, or away from storm drains or sensitive water bodies.
- Properly label all containers so that the contents are easily identifiable.
- Berm storage areas so that if a spill or leak occurs, the material is contained.
- Cover outside storage areas either with a permanent structure or with a seasonal one such as a tarp so that rain can not come into contact with the materials.
- Check containers (and any containment sumps) often for leaks and spills. Replace containers that are leaking, corroded, or otherwise deteriorating with containers in good condition. Collect all spilled liquids and properly dispose of them.

- Store, contain and transfer liquid materials in such a manner that if the container is ruptured or the contents spilled, they will not discharge, flow or be washed into the storm drainage system, surface waters, or groundwater.

- Place drip pans or absorbent materials beneath all mounted taps and at all potential drip and spill locations during the filling and unloading of containers. Any collected liquids or soiled absorbent materials should be reused/recycled or properly disposed of.

- For field programs, only transport the minimum amount of material needed for the daily activities and transfer materials between containers at a municipal yard where leaks and spill are easier to control.

- If paved, sweep and clean storage areas monthly, do not use water to hose down the area unless all of the water will be collected and disposed of properly.

- Install a spill control device (such as a tee section) in any catch basins that collect runoff from any storage areas if the materials stored are oil, gas, or other materials that separate from and float on water. This will allow for easier cleanup if a spill occurs.

- If necessary, protect catch basins while conducting field activities so that if a spill occurs, the material will be contained.

Training

- Educate employees about spill prevention, spill response and cleanup on a routine basis.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employees should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan if one is available.

- Training of staff from all municipal departments should focus on recognizing and reporting potential or current spills/leaks and who they should contact.

- Employees responsible for aboveground storage tanks and liquid transfers for large bulk containers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

Spill Response and Prevention

- Identify key spill response personnel and train employees on who they are.

- Store and maintain appropriate spill cleanup materials in a clearly marked location near storage areas; and train employees to ensure familiarity with the site's spill control plan and/or proper spill cleanup procedures.

- Locate spill cleanup materials, such as absorbents, where they will be readily accessible (e.g. near storage and maintenance areas, on field trucks).

- Follow the Spill Prevention Control and Countermeasure Plan if one is available.
- If a spill occurs, notify the key spill response personnel immediately. If the material is unknown or hazardous, the local fire department may also need to be contacted.
- If safe to do so, attempt to contain the material and block the nearby storm drains so that the area impacted is minimized. If the material is unknown or hazardous wait for properly trained personnel to contain the materials.
- Perform an assessment of the area where the spill occurred and the downstream area that it could impact. Relay this information to the key spill response and clean up personnel.

Spill Cleanup Procedures

- Small non-hazardous spills
  - Use a rag, damp cloth or absorbent materials for general clean up of liquids
  - Use brooms or shovels for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- Large non-hazardous spills
  - Use absorbent materials for general clean up of liquids
  - Use brooms, shovels or street sweepers for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- For hazardous or very large spills, a private cleanup company or Hazmat team may need to be contacted to assess the situation and conduct the cleanup and disposal of the materials.
- Chemical cleanups of material can be achieved with the use of absorbents, gels, and foams. Remove the adsorbent materials promptly and dispose of according to regulations.
- If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

Reporting

- Report any spills immediately to the identified key municipal spill response personnel.

- Report spills in accordance with applicable reporting laws. Spills that pose an immediate threat to human health or the environment must be reported immediately to the Office of Emergency Service (OES)

- Spills that pose an immediate threat to human health or the environment may also need to be reported within 24 hours to the Regional Water Quality Control Board.

- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour)

- After the spill has been contained and cleaned up, a detailed report about the incident should be generated and kept on file (see the section on Reporting below). The incident may also be used in briefing staff about proper procedures

Other Considerations

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure Plan (SPCC) Plan (Health & Safety Code Chapter 6.67).

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, if permitted to do so, prohibiting any hard connections to the storm drain.

Requirements

Costs

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of wastes, contaminated soil and water is very expensive

Maintenance

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the response and containment of a spill. A good record keeping system helps the municipality minimize incident recurrence, correctly respond with appropriate containment and cleanup activities, and comply with legal requirements.

A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm drain.

These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Examples

The City of Palo Alto includes spill prevention and control as a major element of its highly effective program for municipal vehicle maintenance shops.

References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	✓
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓
Oxygen Demanding	✓

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, re-use, and recycling; and preventing runon and runoff.

Approach

Pollution Prevention

- Reduction in the amount of waste generated can be accomplished using the following source controls such as:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

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Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater runon and runoff with a berm. The waste containers or piles must be covered except when in use.

- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.

- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.

- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.

- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.

- Transfer waste from damaged containers into safe containers.

- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.

- Provide a sufficient number of litter receptacles for the facility.

- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.

- Inspect solid waste containers for structural damage or leaks regularly. Repair or replace damaged containers as necessary.

- Secure solid waste containers; containers must be closed tightly when not in use.

- Place waste containers under cover if possible.

- Do not fill waste containers with washout water or any other liquid.

- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g. sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Stencil storm drains on the facility's property with prohibitive message regarding waste disposal.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers protected from vandalism, and in compliance with fire and hazardous waste codes.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

Runon/Runoff Prevention

- Prevent stormwater runon from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent the waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.
- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff pollution prevention measures and proper disposal methods.
- Train employees and contractors proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.
- Vehicles transporting waste should have spill prevention equipment that can prevent spills during transport. The spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations

- Hazardous waste cannot be re-used or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

- Capital and operation and maintenance costs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

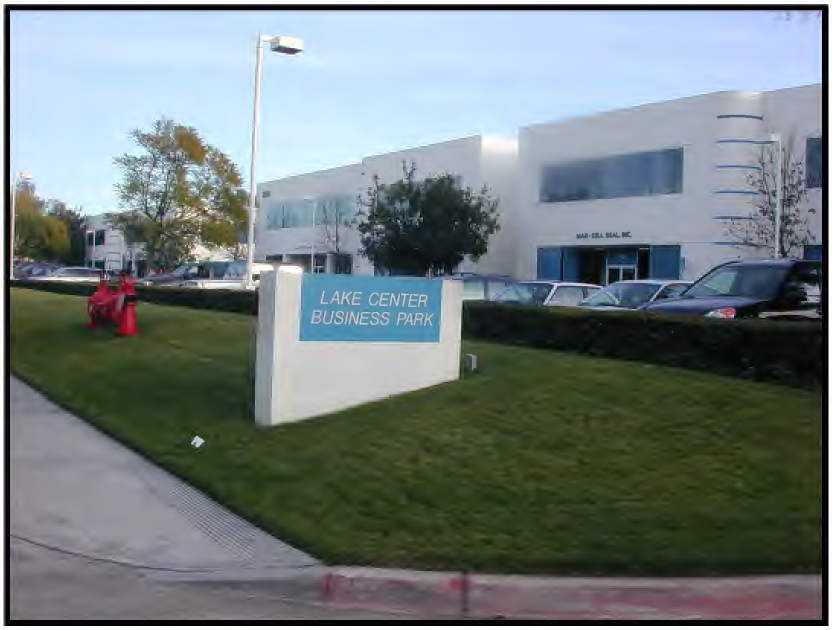
- Minimize the runoff of polluted stormwater from land application of municipal waste on-site by:
  - Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, there is a closed drainage system.
  - Avoiding application of waste to the site when it is raining or when the ground is saturated with water.
  - Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site.
  - Maintaining adequate barriers between the land application site and the receiving waters. Planted strips are particularly good.
  - Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins.
  - Performing routine maintenance to ensure the erosion control or site stabilization measures are working.

References and Resources

King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Associations (BASMAA). On-line: http://www.basmaa.org



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	✓
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓
Oxygen Demanding	✓

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, and abnormal pH. Utilizing the following protocols will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.
- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

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Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a waste water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- If soaps or detergents are not used, and the surrounding area is paved, wash water runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in he catch basin to trap the particles in wash water runoff.

- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement. Ensure that this practice does not kill grass.

Landscaping Activities

- Do not apply any chemicals (insecticide, herbicide, or fertilizer) directly to surface waters, unless the application is approved and permitted by the state.

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures on exposed soils.

- Check irrigation schedules so pesticides will not be washed away and to minimize non-stormwater discharge.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. In which case you should direct the water through hay bales and filter fabric or use other sediment filters or traps.

- Store toxic material under cover with secondary containment during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures when soils are exposed.

- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Consider an alternative approach when bailing out muddy water; do not put it in the storm drain, pour over landscaped areas.

- Use hand or mechanical weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Follow manufacturers' recommendations and label directions. Pesticides must never be applied if precipitation is occuring or predicted. Do not apply insecticides within 100 feet of surface waters such as lakes, ponds, wetlands, and streams.

- Use less toxic pesticides that will do the job, whenever possible. Avoid use of copper-based pesticides if possible.

- Do not use pesticides if rain is expected.

- Do not mix or prepare pesticides for application near storm drains.

- Use the minimum amount needed for the job.

- Calibrate fertilizer distributors to avoid excessive application.

- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.
- Work fertilizers into the soil rather than dumping or broadcasting them onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.
- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Overall costs should be low in comparison to other BMPs.

Maintenance

- Sweep paved areas regularly to collect loose particles, and wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping but it is subject to rusting and results in lower quality water. Initially the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time, typically a year, between flushes and may accumulate iron, manganese, lead, copper, nickel and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASSMA) http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basmaa.org/

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

SC-42 Building Repair and Construction

Description

Site modifications are common, particularly at large industrial sites. The activity can range from minor and normal building repair to major remodeling and the construction of new facilities. These activities can generate pollutants that include solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos insulation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and minor construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

This fact sheet is intended to be used for minor repairs and construction. If major construction is required, the guidelines in the Construction BMP Handbook should be followed.

Approach

The best management practice (BMP) approach is to reduce the potential for pollutant discharges through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Recycle residual paints, solvents, lumber, and other materials to the maximum extent practicable.
- ☐ Avoid outdoor repairs and construction during periods of wet weather.
- ☐ Use safer alternative products to the maximum extent practicable. See also SC-35 Safer Alternative Products for more information.

Objectives

- ■ Cover
- ■ Contain
- ■ Educate
- ■ Reduce/Minimize
- ■ Substitute Products

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered

Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	✓
Erosion and Sediment Controls	✓
Employee Training Program	✓
Quality Assurance Record Keeping	✓

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- Buy recycled products to the maximum extent practicable.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contracts to ensure that certain proper housekeeping and disposal practices are implemented.
- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

Good Housekeeping

Repair and Remodeling

- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep and vacuum the area regularly to remove sediment and small debris.
- Cover raw materials of particular concern that must be left outside, especially during the rainy season. See also SC-33 Outdoor Storage of Raw Materials for more information.
- Use equipment and tools such as bag sanders to reduce accumulation of debris.
- Limit/prohibit work on windy days; implement roll-down walls or other measures to reduce wind transport of pollutants.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store liquid materials properly that are normally used in repair and remodeling such as paints and solvents. See also SC-31 Outdoor Liquid Container Storage for more information.
- Sweep out rain gutters or wash the gutter and trap the particles at the outlet of the downspout. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vactor truck, and clean the catch basin sump where you placed the plug.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed. See also SC-44 Drainage System Maintenance for more information.

Painting

- Enclose painting operations consistent with local air quality and Occupational Safety and Health Administration (OSHA) regulations.
- Local air pollution regulations may, in many areas of the state, specify painting procedures that, if properly carried out, are usually sufficient to protect water quality.
- Develop paint-handling procedures for proper use, storage, and disposal.

- ☐ **Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.**
- ☐ **Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.**
- ☐ **Mix paint indoors before using it so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100 percent effective.**
- ☐ **Transfer and load paint and hot thermoplastic away from storm drain inlets.**
- ☐ **When there is risk of a spill reaching storm drains, plug nearby storm drain inlets prior to starting to paint and remove the plugs when the job is complete.**
- ☐ **If sandblasting is used to remove paint, cover nearby storm drain inlets prior to starting work.**
- ☐ **If painting requires scraping or sandblasting of the existing surface, use a ground cloth to collect the chips. Dispose of the residue properly.**
- ☐ **Cover or enclose painting operations properly to avoid drift.**
- ☐ **If water-based paints are being used, clean the application equipment in a sink that is connected to the sanitary sewer.**
- ☐ **Capture all cleanup-water and dispose of it properly.**
- ☐ **Dispose properly of paints containing lead or tributyl tin and considered a hazardous waste.**
- ☐ **If leftover paints are to be kept for the next job, store them properly, or dispose of them properly.**
- ☐ **Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.**

Spill and Leak Prevention and Response

- ☐ **Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.**
- ☐ **Place a stockpile of spill cleanup materials where they are readily accessible.**
- ☐ **Clean up spills immediately.**
- ☐ **Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.**

Material Handling and Waste Management

- ☐ **Post “No littering” signs, and enforce antilitter laws.**
- ☐ **Provide a sufficient number of litter receptacles for the facility.**

- Clean out litter receptacles frequently and cover them to prevent spillage.

- Keep waste collection areas clean.

- Inspect solid waste containers regularly for structural damage. Repair or replace damaged containers as necessary.

- Secure solid waste containers; containers must be closed tightly when not in use.

- Do not fill waste containers with washout water or any other liquid.

- Ensure that only appropriate solid wastes are put in the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, and pesticides may not be disposed of in solid waste containers

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal. Affix labels to all waste containers clearly stating what they contain.

- Make sure that hazardous waste is collected, removed, and disposed of properly. See also SC-34 Waste Handling and Disposal for more information.

Erosion and Sediment Controls

- Limit disturbance of bare soils and preserve natural vegetation whenever possible. See also EC-2 Preservation of Existing Vegetation in the Construction BMP Handbook.

- Stabilize loose soils by revegetating whenever possible. See also EC-4 Hydroseeding in the Construction BMP Handbook.

- Use nonvegetative stabilization methods for areas prone to erosion where vegetative options are not feasible. Examples include:

  - ✓ Areas of vehicular or pedestrian traffic such as roads or paths;

  - ✓ Arid environments where vegetation would not provide timely ground coverage, or would require excessive irrigation;

  - ✓ Rocky substrate, infertile or droughty soils where vegetation would be difficult to establish; and

  - ✓ Areas where vegetation will not grow adequately within the construction time frame.

  There are several nonvegetative stabilization methods and selection should be based on site-specific conditions. See also EC-16 Non-Vegetative Stabilization in the Construction BMP Handbook.

- Use chemical stabilization when needed. See also EC-5 Soil Binders in the Construction BMP Handbook.

- Use geosynthetic membranes to control erosion if feasible. See also EC-7 Geotextiles and Mats in the Construction BMP Handbook.

- Stabilize all roadways, entrances, and exits to sufficiently control discharges of erodible materials from discharging or being tracked off the site. See also TC 1-3 Tracking Control in the Construction BMP Handbook.

- Refer to the supplemental information later in this fact sheet for projects that involve more extensive soil disturbance activities.

Employee Training Program

- Educate employees about pollution prevention measures and goals.

- Train employees how to properly implement the source control BMPs described above. Detailed information for erosion and sediment control BMPs is provided in the Construction BMP Handbook.

- Proper education of off-site contractors is often overlooked. The conscientious efforts of well-trained employees can be wasted by unknowing off-site contractors, so make sure they are well informed about pollutant source control responsibilities.

- Use a training log or similar method to document training.

Quality Assurance and Record Keeping

- Keep accurate maintenance logs that document minimum BMP activities performed for building repair and construction, types and quantities of waste disposed of, and any improvement actions.

- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method used to dispose of the waste.

- Establish procedures to complete logs and file them in the central office.

Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing, and time limitations that preclude implementation of BMPs. The following are typical limitations and recommended work-arounds.

- This BMP is for minor construction only. The state's General Construction Activity Stormwater Permit has more extensive requirements for larger projects that would disturb 1 or more acres of surface.

  - ✓ Refer to the companion Construction BMP Handbook for specific guidance and BMPs for larger scale projects.

- Time constraints might require some outdoor repairs and construction during wet weather.

- ✓ **Require employees to understand and follow good housekeeping and spill and leak prevention BMPs.**

- ✓ **Inspect erosion and sediment control BMPs daily during periods of wet weather and repair or improve BMP implementation as necessary.**

- □ **Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.**

  - ✓ **Minimize use of hazardous materials to the maximum extent practicable.**

- □ **Be certain that actions to help stormwater quality are consistent with Cal/ and Fed/OSHA and air quality regulations.**

- □ **Prices for recycled/safer alternative materials and fluids may be higher than those of conventional materials.**

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- □ **Limited capital investments may be required at some sites if cover and containment facilities are inadequate for construction materials and wastes.**

- □ **Purchase and installation of erosion and sediment controls, if needed, will require additional capital investments, and this amount will vary depending on site characteristics and the types of BMPs being implemented.**

- □ **Minimize costs by maintaining existing vegetation and limiting construction operations on bare soils.**

Maintenance

- □ **The erosion and sediment control BMPs described above require periodic inspection and maintenance to remain effective. The cost of these actions will vary depending on site characteristics and the types of BMPs being implemented.**

- □ **Irrigation costs may be required to establish and maintain vegetation.**

Supplemental Information

Soil/Erosion Control

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the Construction BMP Handbook. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated and Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If, because of the remodeling, a new drainage system is

to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective "in-line" treatment devices. Include in the catch basin a "turn-down" elbow or similar device to trap floatables.

References and Resources

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Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	✓
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓
Oxygen Demanding	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).

- Keep accurate maintenance logs to evaluate BMP implementation.

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.

- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

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- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

Surface cleaning

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

Surface Repair

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

- Use only as much water as necessary for dust control, to avoid runoff.

- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.

- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.

- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.

- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, nad implement accordingly.

- Have spill cleanup materials readily available and in a known location.

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot to minimize cleaning with water.

- Clean out oil/water/sand separators regularly, especially after heavy storms.

- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

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SC-44 Drainage System Maintenance

Description

As a consequence of its function, the stormwater drainage facilities on site convey stormwater that may contain certain pollutants either to the off-site conveyance system that collects and transports urban runoff and stormwater, or directly to receiving waters. The protocols in this fact sheet are intended to reduce pollutants leaving the site to the offsite drainage infrastructure or to receiving waters through proper on-site conveyance system operation and maintenance. The targeted constituents will vary depending on site characteristics and operations.

Approach

Successful implementation depends on effective training of employees on applicable best management practices (BMPs) and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the proper hydraulic functioning of the system to avoid flooding.

- ☐ Develop and follow a site-specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.

Good Housekeeping

Illicit Connections and Discharges

- ☐ Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Targeted Constituents	
Sediment	✓
Nutrients	✓
Trash	✓
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	✓
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

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- ✓ Identify evidence of spills such as paints, discoloring, and odors.
- ✓ Record locations of apparent illegal discharges or illicit connections.
- ✓ Track flows back to potential discharges and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques that include zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, and television camera inspection.
- ✓ Eliminate the discharge once the origin of the flow is established.

- ☐ Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste—Drains to Stream" or similar wording stenciled on or next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- ☐ Refer to fact sheet SC-10 Non-stormwater Discharges for additional information.

Illegal Dumping

- ☐ Inspect regularly and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- ☐ Establish a system for tracking incidents. The system should be designed to identify the following:
  - ✓ Illegal dumping hot spots
  - ✓ Types and quantities (in some cases) of wastes
  - ✓ Patterns in time of occurrence (time of day/night, month, or year)
  - ✓ Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - ✓ Responsible parties
- ☐ Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- ☐ Refer to fact sheet SC-10 Non-stormwater Discharges for additional information.

Preventative Maintenance

Catch Basins/Inlet Structures

- ☐ Staff should regularly inspect facilities to ensure compliance with the following:
  - ✓ Immediate repair of any deterioration threatening structural integrity.
  - ✓ Cleaning before the sump is 40 percent full. Catch basins should be cleaned as frequently as necessary to meet this standard.

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.

- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Prioritize storm drain inlets; clean and repair them as needed.

- Keep accurate logs of the number of catch basins cleaned.

- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.

- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and disposed of properly. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of the storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.

- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.

- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.

- Conduct routine maintenance at each pump station.

- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removal, and enhance channel/creek aesthetic and habitat value.

- Conduct channel modification and improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural state of any river, stream, or lake in California must enter into a stream or lake alteration agreement with the Department of Fish and Wildlife. The developer-applicant should also contact local governments (city, county, or special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, or Department of Water Resources), and the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service.

Spill and Leak Prevention and Response

- ☐ Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.
- ☐ Investigate promptly all reports of spills, leaks, and illegal dumping.
- ☐ Place a stockpile of spill cleanup materials where they are readily accessible or at a central location.
- ☐ Clean up all spills and leaks using dry methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.

Employee Training Program

- ☐ Educate employees about pollution prevention measures and goals.
- ☐ Train employees how to properly handle and dispose of waste using the source control BMPs described above.
- ☐ Train employees and subcontractors in proper hazardous waste management.
- ☐ Use a training log or similar method to document training.
- ☐ Ensure that employees are familiar with the site's SPCC plan and/or proper spill cleanup procedures.
- ☐ Have staff involved in detection and removal of illicit connections trained in the following:
  - ✓ OSHA-required health and safety training (Title 29 of the Code of Federal Regulations [CFR] 1910.120) plus annual refresher training (as needed).
  - ✓ OSHA confined space entry training (Cal/OSHA Confined Space, Title 8 and Federal/OSHA 29 CFR 1910.146).
  - ✓ Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Quality Assurance and Record Keeping

- ☐ Keep accurate maintenance logs that document minimum BMP activities performed for drainage system maintenance, types and quantities of waste disposed of, and any improvement actions.
- ☐ Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method used to dispose of the waste.
- ☐ Keep accurate logs of illicit connections, illicit discharges, and illegal dumping into the storm drain system, including how wastes were cleaned up and disposed of.
- ☐ Establish procedures to complete logs and file them in the central office.

Potential Limitations and Work-Arounds

The following are typical limitations and recommended work-arounds for drainage system maintenance:

- **Cleanup activities might create a slight disturbance for local aquatic species. Access to items and material on private property might be limited. Trade-offs might exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.**
  - ✓ **Perform all maintenance on-site and do not flush accumulated material downstream to private property or riparian habitats.**
- **Storm drain flushing is most effective in small-diameter pipes (i.e., a pipe 36 inches in diameter or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing include the availability of a water source, finding a downstream area to collect sediments, and liquid/sediment disposal.**
  - ✓ **Develop and follow a site-specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.**
- **Regulations might include adoption of substantial penalties for illegal dumping and disposal.**
  - ✓ **Do not dump illegal materials anywhere on-site.**
  - ✓ **Identify illicit connections, illicit discharge, and illegal dumping.**
  - ✓ **Clean up spills immediately, and properly dispose of wastes.**
- **Local municipal codes might include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the sanitary sewer system.**
  - ✓ **Collect all materials and pollutants accumulated in the drainage system and dispose of them according to local regulations.**
  - ✓ **Install debris excluders in areas with a trash total maximum daily load.**

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- **Capital costs will vary substantially depending on the size of the facility and characteristics of the drainage system. Significant capital costs may be associated with purchasing water trucks, vacuum trucks, and any other necessary cleaning equipment or improving the drainage infrastructure to reduce the potential.**

- Developing and implementing a site-specific drainage system maintenance plan will require additional capital if a similar program is not already in place.

Maintenance

- Two-person teams might be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.
- Methods used for illicit connection detection (e.g., smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors such as the amount of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Supplemental Information

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants from storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents plug flow discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drains usually are flushed along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An inflatable device is placed in an upstream manhole to temporarily plug the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed-up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream might be used to recollect the water after the force of the flushing wave has dissipated. A pump could then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure might be more practical or required to recollect the flushed waters.

Cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65–75 percent for organics and 55–65 percent for dry weather grit/inorganic

material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used if allowed or that fire hydrant line flushing coincide with storm sewer flushing.

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Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.

- Choose low water using flowers, trees, shrubs, and groundcover.

- Consider alternative landscaping techniques such as naturescaping and xeriscaping.

- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.

- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.

- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.

- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.

- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).

- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.

- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.

- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.

- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.

- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.

- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.

- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.

- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.

- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:

  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.

  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.

  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.

  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.

  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).

  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.

  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.

- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup

- Have spill cleanup materials readily available and in a know in location

- Cleanup spills immediately and use dry methods if possible.

- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.

- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.

- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

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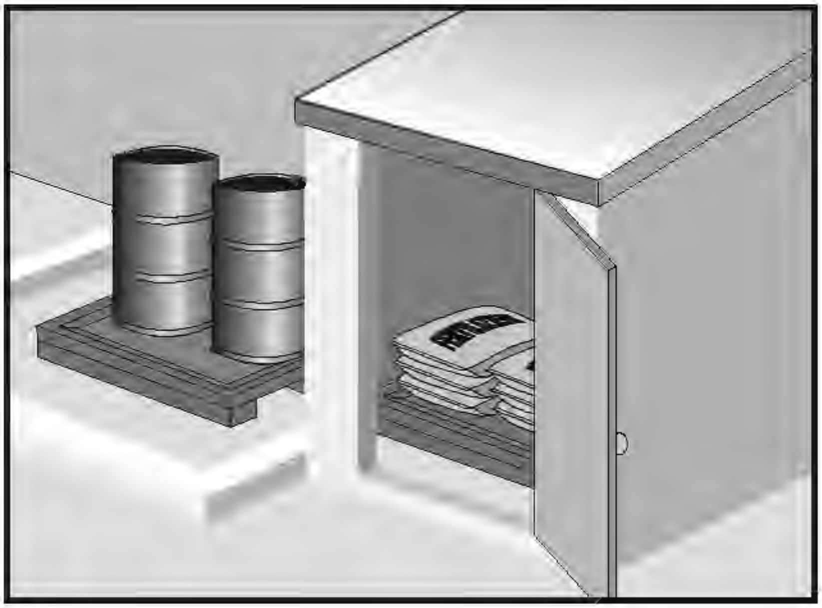


Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ Primary Category

☒ Secondary Category

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in watertight containers and/or a completely enclosed designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease

- Asphalt and concrete components
- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

Limitations

- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

Implementation

The following steps should be taken to minimize risk:

- Chemicals must be stored in water tight containers with appropriate secondary containment or in a storage shed.
- When a material storage area is located on bare soil, the area should be lined and bermed.
- Use containment pallets or other practical and available solutions, such as storing materials within newly constructed buildings or garages, to meet material storage requirements.
- Stack erodible landscape material on pallets and cover when not in use.
- Contain all fertilizers and other landscape materials when not in use.
- Temporary storage areas should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be available on-site for all materials stored that have the potential to effect water quality.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located away from waterways, if possible.
  - Avoid transport near drainage paths or waterways.
  - Surround with earth berms or other appropriate containment BMP. See EC-9, Earth Dikes and Drainage Swales.
  - Place in an area that will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.

- Hazardous materials storage onsite should be minimized.

- Hazardous materials should be handled as infrequently as possible.

- Keep ample spill cleanup supplies appropriate for the materials being stored. Ensure that cleanup supplies are in a conspicuous, labeled area.

- Employees and subcontractors should be trained on the proper material delivery and storage practices.

- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.

- If significant residual materials remain on the ground after construction is complete, properly remove and dispose of materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

Material Storage Areas and Practices

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.

- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25-year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.

- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.

- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.

- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.

- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.

- Materials should be covered prior to, and during rain events.

- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.
- Stockpiles should be protected in accordance with WM-3, Stockpile Management.
- Materials should be stored indoors within existing structures or completely enclosed storage sheds when available.
- Proper storage instructions should be posted at all times in an open and conspicuous location.
- An ample supply of appropriate spill clean up material should be kept near storage areas.
- Also see WM-6, Hazardous Waste Management, for storing of hazardous wastes.

Material Delivery Practices

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.
- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

Spill Cleanup

- Contain and clean up any spill immediately.
- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.
- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.
- If spills or leaks of materials occur that are not contained and could discharge to surface waters, non-visible sampling of site discharge may be required. Refer to the General Permit or to your project specific Construction Site Monitoring Plan to determine if and where sampling is required.

Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Keep storage areas clean and well organized, including a current list of all materials onsite.
- Inspect labels on containers for legibility and accuracy.

- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.

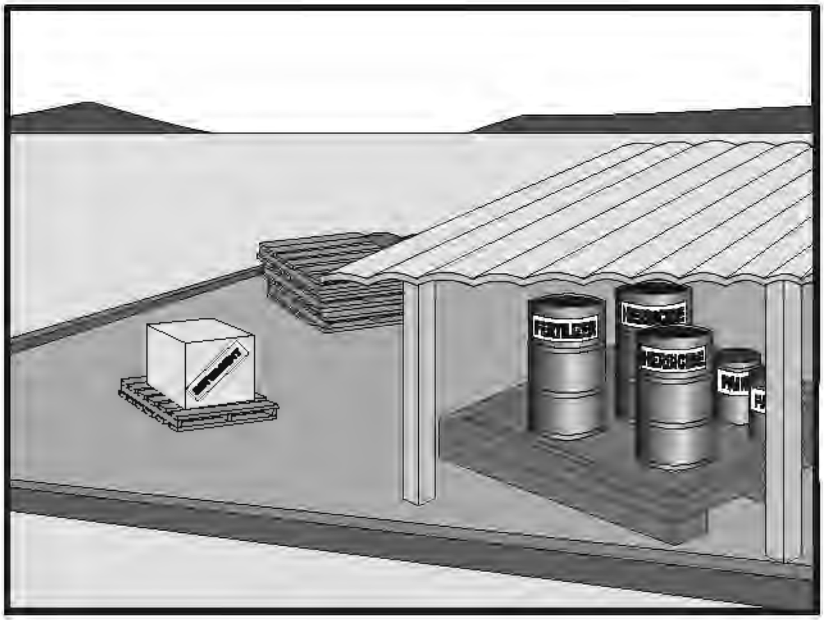
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:
☑ Primary Category
☒ Secondary Category

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

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Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Other materials that may be detrimental if released to the environment

Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

Implementation

The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.
- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.
- The preferred method of termiticide application is soil injection near the existing or proposed structure foundation/slab; however, if not feasible, soil drench application of termiticides should follow EPA label guidelines and the following recommendations (most of which are applicable to most pesticide applications):
  - Do not treat soil that is water-saturated or frozen.
  - Application shall not commence within 24-hours of a predicted precipitation event with a 40% or greater probability. Weather tracking must be performed on a daily basis prior to termiticide application and during the period of termiticide application.
  - Do not allow treatment chemicals to runoff from the target area. Apply proper quantity to prevent excess runoff. Provide containment for and divert stormwater from application areas using berms or diversion ditches during application.
  - Dry season: Do not apply within 10 feet of storm drains. Do not apply within 25 feet of aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds).
  - Wet season: Do not apply within 50 feet of storm drains or aquatic habitats (such as, but not limited to, lakes; reservoirs; rivers; permanent streams; marshes or ponds; estuaries; and commercial fish farm ponds) unless a vegetative buffer is present (if so, refer to dry season requirements).
  - Do not make on-grade applications when sustained wind speeds are above 10 mph (at application site) at nozzle end height.
  - Cover treatment site prior to a rain event in order to prevent run-off of the pesticide into non-target areas. The treated area should be limited to a size that can be backfilled and/or covered by the end of the work shift. Backfilling or covering of the treated area shall be done by the end of the same work shift in which the application is made.
  - The applicator must either cover the soil him/herself or provide written notification of the above requirement to the contractor on site and to the person commissioning the

application (if different than the contractor). If notice is provided to the contractor or the person commissioning the application, then they are responsible under the Federal Insecticide Fungicide, and Rodenticide Act (FIFRA) to ensure that: 1) if the concrete slab cannot be poured over the treated soil within 24 hours of application, the treated soil is covered with a waterproof covering (such as polyethylene sheeting), and 2) the treated soil is covered if precipitation is predicted to occur before the concrete slab is scheduled to be poured.

- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydraulic application. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals before predicted rainfall.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted or contain for proper disposal off site. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.
- Document the location, time, chemicals applied, and applicator's name and qualifications.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.
- Discontinue use of erodible landscape material within 2 days prior to a forecasted rain event and materials should be covered and/or bermed.

- Provide containment for material use areas such as masons' areas or paint mixing/preparation areas to prevent materials/pollutants from entering stormwater.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Ensure employees and subcontractors throughout the job are using appropriate practices.

References

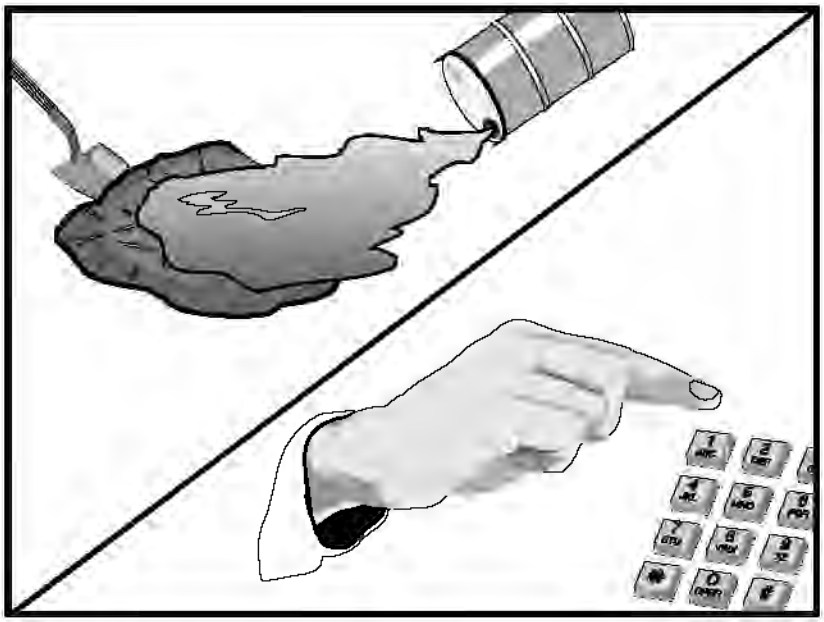
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Comments on Risk Assessments Risk Reduction Options for Cypermethrin: Docket No. OPP–2005–0293; California Stormwater Quality Association (CASQA) letter to USEPA, 2006.Environmental Hazard and General Labeling for Pyrethroid Non-Agricultural Outdoor Products, EPA-HQ-OPP-2008-0331-0021; USEPA, 2008.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ Primary Objective

☒ Secondary Objective

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

- Fuels
- Lubricants
- Other petroleum distillates

Limitations

- In some cases, it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

Education

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

General Measures

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.

- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.

- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.

- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.

- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

Cleanup

- Clean up leaks and spills immediately.

- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.

- Use absorbent materials on small spills rather than hosing down or burying the spill.

- Absorbent materials should be promptly removed and disposed of properly.

- Follow the practice below for a minor spill:

  - Contain the spread of the spill.

  - Recover spilled materials.

  - Clean the contaminated area and properly dispose of contaminated materials.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spill's contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

Reporting

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

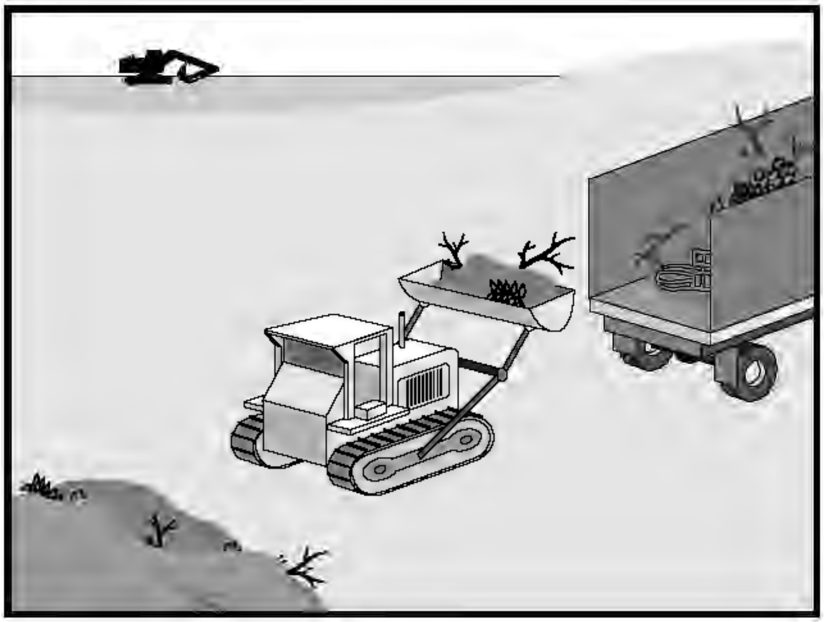
References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

Solid Waste Management WM-5



Description and Purpose

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction
- Packaging materials including wood, paper, and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces, and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials

Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ Primary Objective

☒ Secondary Objective

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Potential Alternatives

None

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- Highway planting wastes, including vegetative material, plant containers, and packaging materials

Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Cover waste containers at the end of each work day and when it is raining.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

Education

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.

- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

- Require that employees and subcontractors follow solid waste handling and storage procedures.

- Prohibit littering by employees, subcontractors, and visitors.

- Minimize production of solid waste materials wherever possible.

Collection, Storage, and Disposal

- Littering on the project site should be prohibited.

- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.

- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.

- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.

- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.

- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.

- Construction debris and waste should be removed from the site biweekly or more frequently as needed.

- Construction material visible to the public should be stored or stacked in an orderly manner.

- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.

- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.

- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.

- Segregate potentially hazardous waste from non-hazardous construction site waste.

- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

Costs

All of the above are low cost measures.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur

- Inspect construction waste area regularly.

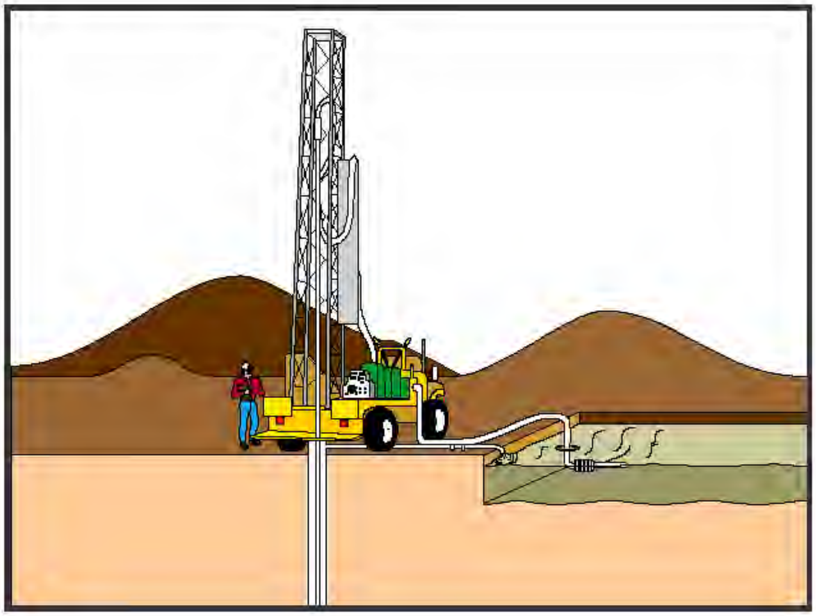
- Arrange for regular waste collection.

References

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.



Categories

EC	Erosion Control	
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	☑

Legend:

☑ Primary Objective

☒ Secondary Objective

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

None

Description and Purpose

Liquid waste management includes procedures and practices to prevent discharge of pollutants to the storm drain system or to watercourses as a result of the creation, collection, and disposal of non-hazardous liquid wastes.

Suitable Applications

Liquid waste management is applicable to construction projects that generate any of the following non-hazardous by-products, residuals, or wastes:

- Drilling slurries and drilling fluids
- Grease-free and oil-free wastewater and rinse water
- Dredgings
- Other non-stormwater liquid discharges not permitted by separate permits

Limitations

- Disposal of some liquid wastes may be subject to specific laws and regulations or to requirements of other permits secured for the construction project (e.g., NPDES permits, Army Corps permits, Coastal Commission permits, etc.).
- Liquid waste management does not apply to dewatering operations (NS-2 Dewatering Operations), solid waste management (WM-5, Solid Waste Management), hazardous wastes (WM-6, Hazardous Waste Management), or

concrete slurry residue (WM-8, Concrete Waste Management).

- Typical permitted non-stormwater discharges can include: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated pumped ground water; discharges from potable water sources; foundation drains; irrigation water; springs; water from crawl space pumps; footing drains; lawn watering; flows from riparian habitats and wetlands; and discharges or flows from emergency fire fighting activities.

Implementation

General Practices

- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquid waste and potential or known hazardous liquid waste.
- Instruct employees, subcontractors, and suppliers that it is unacceptable for any liquid waste to enter any storm drainage device, waterway, or receiving water.
- Educate employees and subcontractors on liquid waste generating activities and liquid waste storage and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Verify which non-stormwater discharges are permitted by the statewide NPDES permit; different regions might have different requirements not outlined in this permit.
- Apply NS-8, Vehicle and Equipment Cleaning for managing wash water and rinse water from vehicle and equipment cleaning operations.

Containing Liquid Wastes

- Drilling residue and drilling fluids should not be allowed to enter storm drains and watercourses and should be disposed of.
- If an appropriate location is available, drilling residue and drilling fluids that are exempt under Title 23, CCR § 2511(g) may be dried by infiltration and evaporation in a containment facility constructed in conformance with the provisions concerning the Temporary Concrete Washout Facilities detailed in WM-8, Concrete Waste Management.
- Liquid wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, should be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.
- Liquid wastes should be contained in a controlled area such as a holding pit, sediment basin, roll-off bin, or portable tank.
- Containment devices must be structurally sound and leak free.
- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated.

- Precautions should be taken to avoid spills or accidental releases of contained liquid wastes. Apply the education measures and spill response procedures outlined in WM-4, Spill Prevention and Control.

- Containment areas or devices should not be located where accidental release of the contained liquid can threaten health or safety or discharge to water bodies, channels, or storm drains.

Capturing Liquid Wastes

- Capture all liquid wastes that have the potential to affect the storm drainage system (such as wash water and rinse water from cleaning walls or pavement), before they run off a surface.

- Do not allow liquid wastes to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.

- Use a sediment trap (SE-3, Sediment Trap) for capturing and treating sediment laden liquid waste or capture in a containment device and allow sediment to settle.

Disposing of Liquid Wastes

- A typical method to handle liquid waste is to dewater the contained liquid waste, using procedures such as described in NS-2, Dewatering Operations, and SE-2, Sediment Basin, and dispose of resulting solids per WM-5, Solid Waste Management.

- Methods of disposal for some liquid wastes may be prescribed in Water Quality Reports, NPDES permits, Environmental Impact Reports, 401 or 404 permits, and local agency discharge permits, etc. Review the SWPPP to see if disposal methods are identified.

- Liquid wastes, such as from dredged material, may require testing and certification whether it is hazardous or not before a disposal method can be determined.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management.

- If necessary, further treat liquid wastes prior to disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

Costs

Prevention costs for liquid waste management are minimal. Costs increase if cleanup or fines are involved.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Remove deposited solids in containment areas and capturing devices as needed and at the completion of the task. Dispose of any solids as described in WM-5, Solid Waste Management.

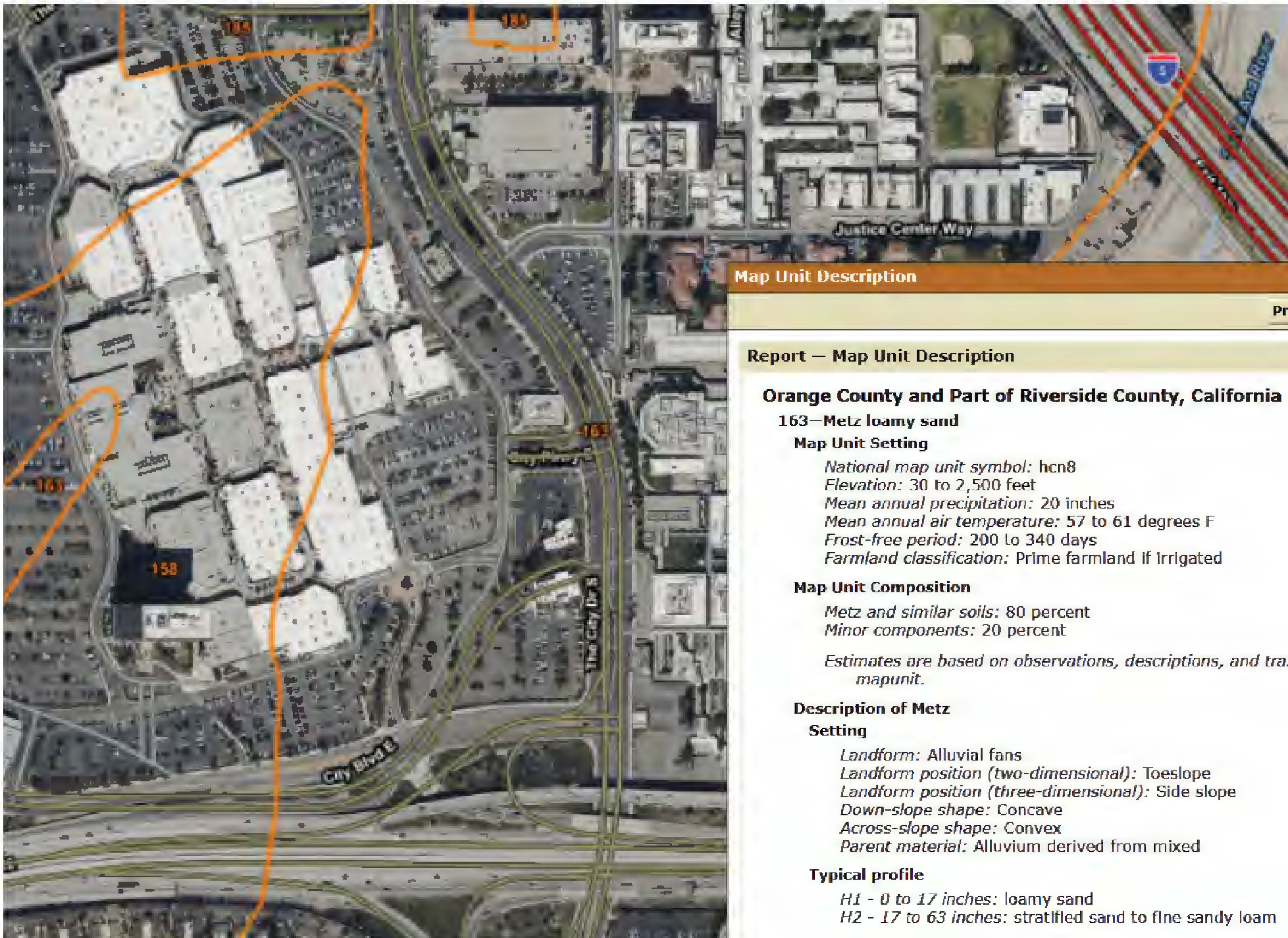
- Inspect containment areas and capturing devices and repair as needed.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Attachment A

Calculations and Details



Map Unit Description

Printable Version

Report — Map Unit Description

Orange County and Part of Riverside County, California

163—Metz loamy sand

Map Unit Setting

National map unit symbol: hcn8
Elevation: 30 to 2,500 feet
Mean annual precipitation: 20 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 200 to 340 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Metz and similar soils: 80 percent
Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Metz

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Alluvium derived from mixed

Typical profile

H1 - 0 to 17 inches: loamy sand
H2 - 17 to 63 inches: stratified sand to fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R019XD035CA - SANDY
Hydric soil rating: No

Minor Components

San emigdio, fine sandy loam

Percent of map unit: 4 percent
Hydric soil rating: No

Hueneme, fine sandy loam

Percent of map unit: 4 percent
Hydric soil rating: No

Corralitos, loamy sand

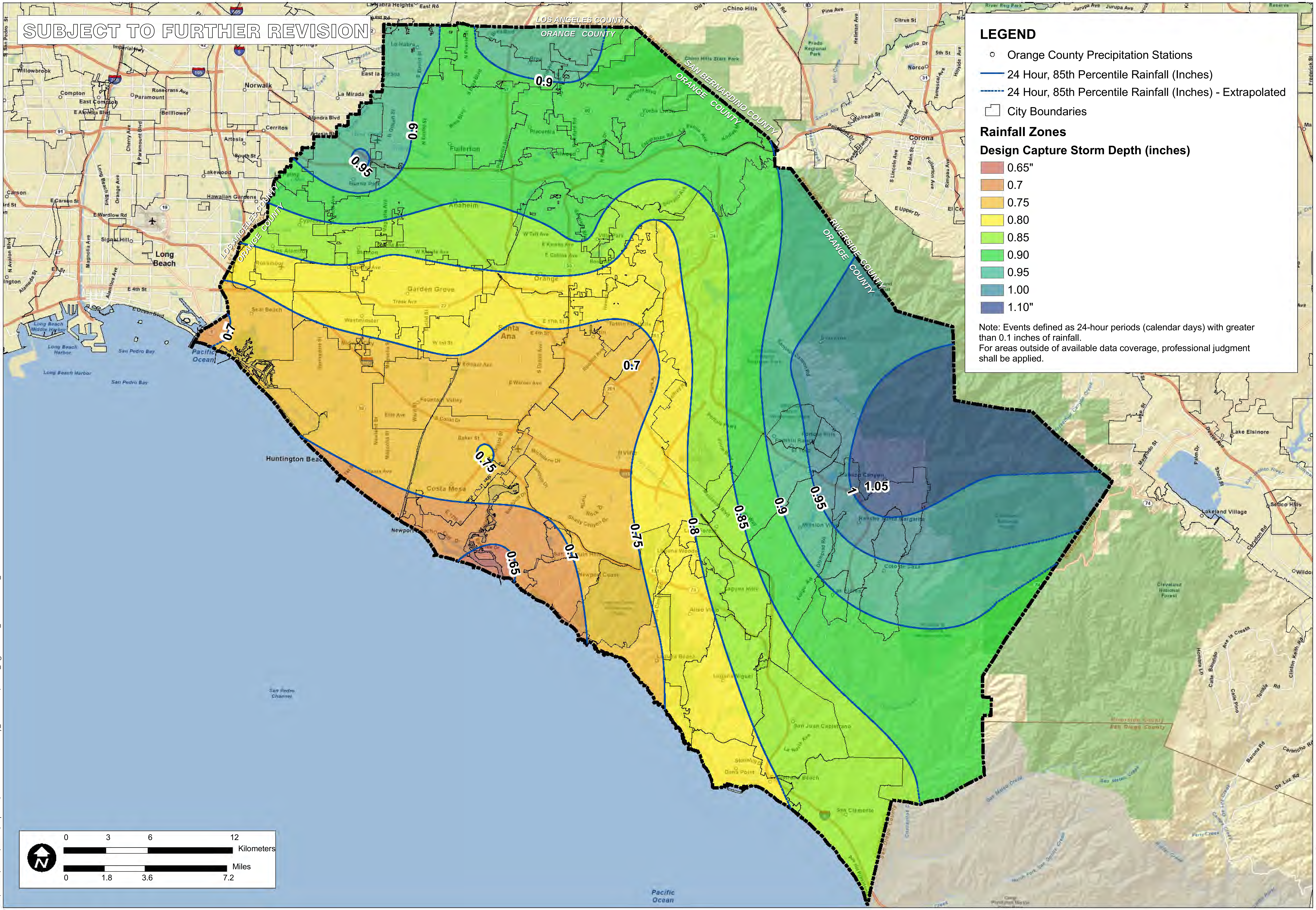
Percent of map unit: 4 percent
Hydric soil rating: No

Metz, mod fine substratum

Percent of map unit: 4 percent
Hydric soil rating: No

Riverwash

Percent of map unit: 4 percent
Landform: Fans
Hydric soil rating: Yes



TITLE

RAINFALL ZONES

ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT

JOB

ORANGE CO. CA

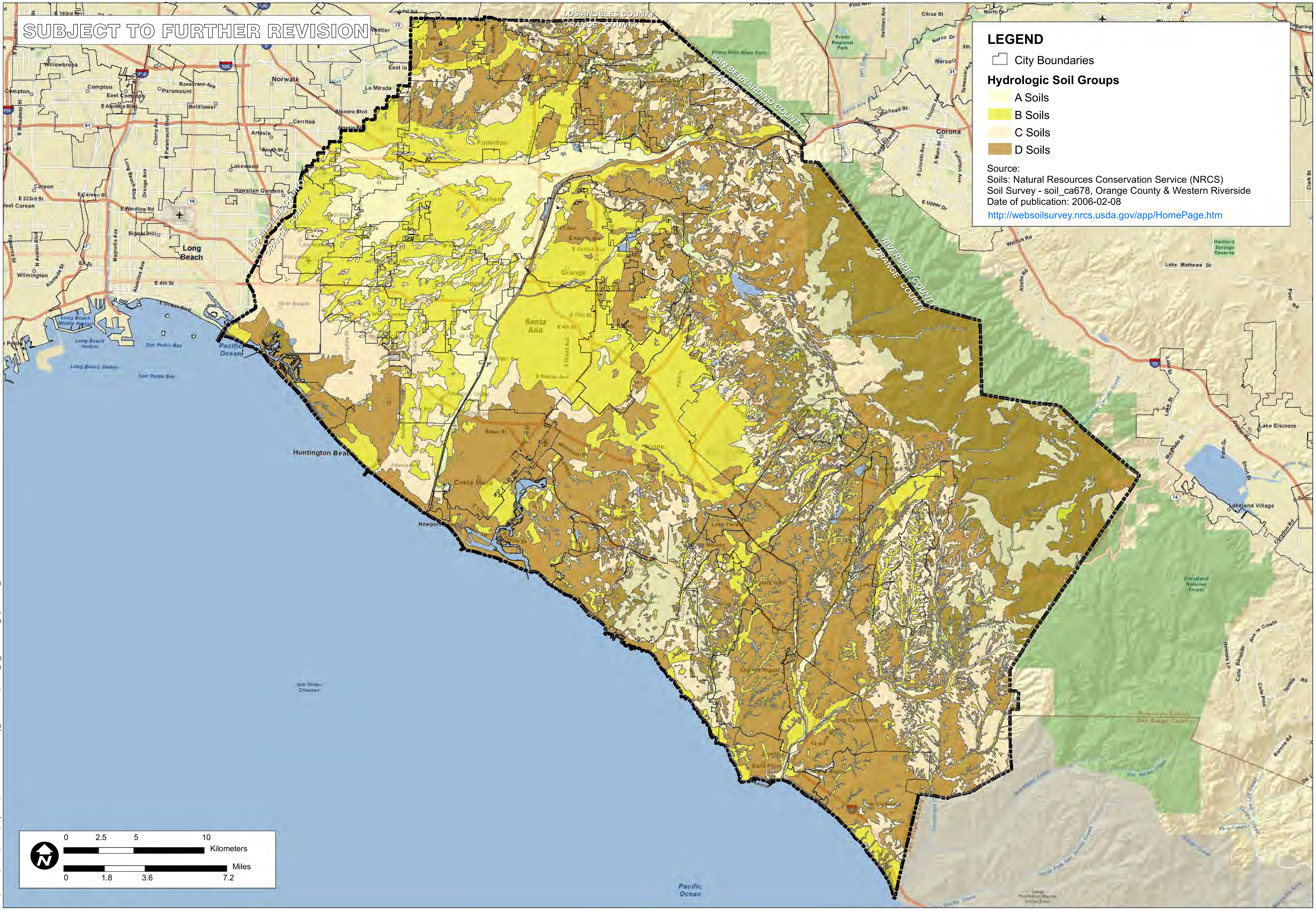
SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE

XVI-1

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd



TITLE
NRCS HYDROLOGIC SOILS GROUPS

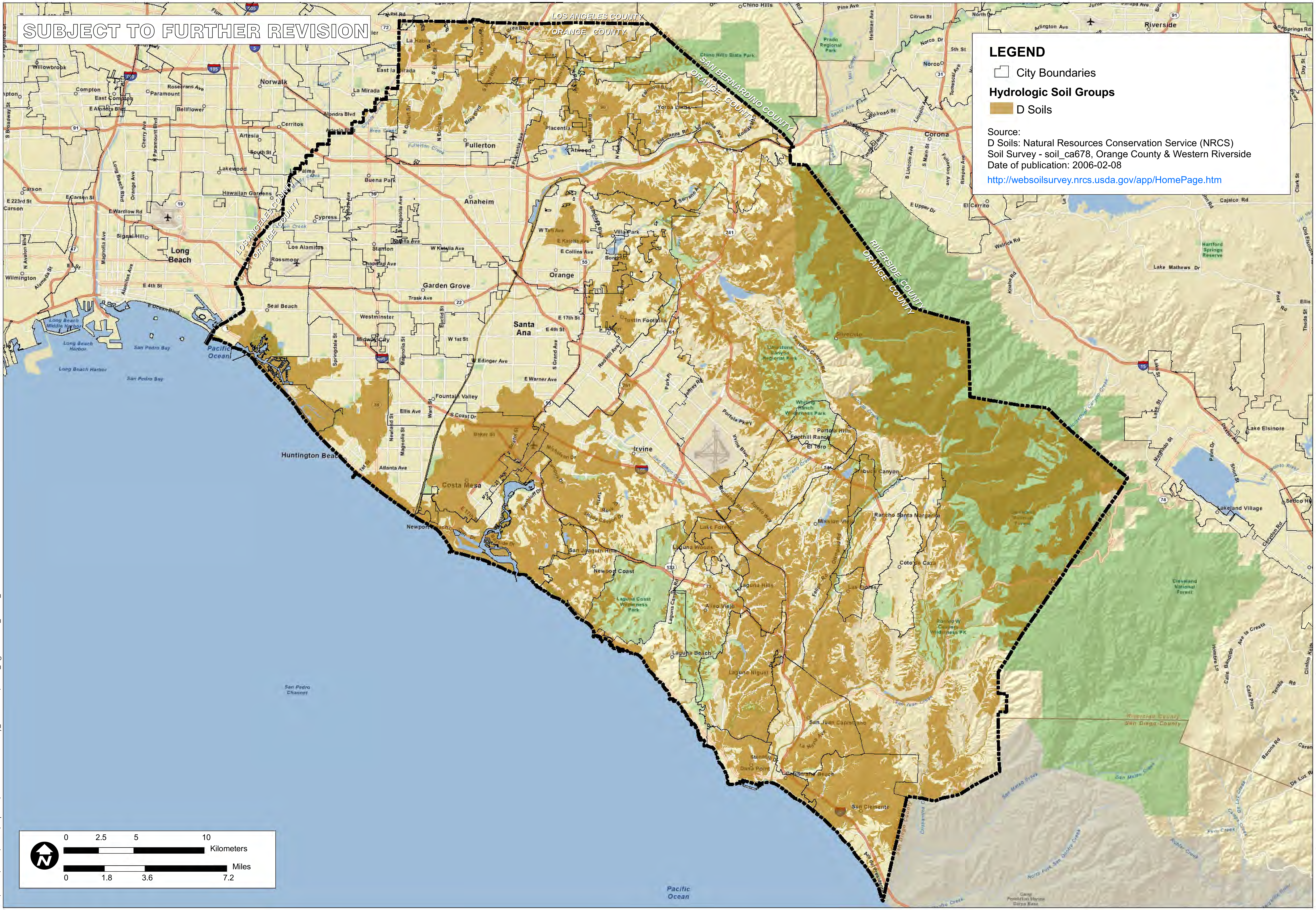
JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2a

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd



TITLE
HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

JOB
ORANGE COUNTY
INFILTRATION STUDY

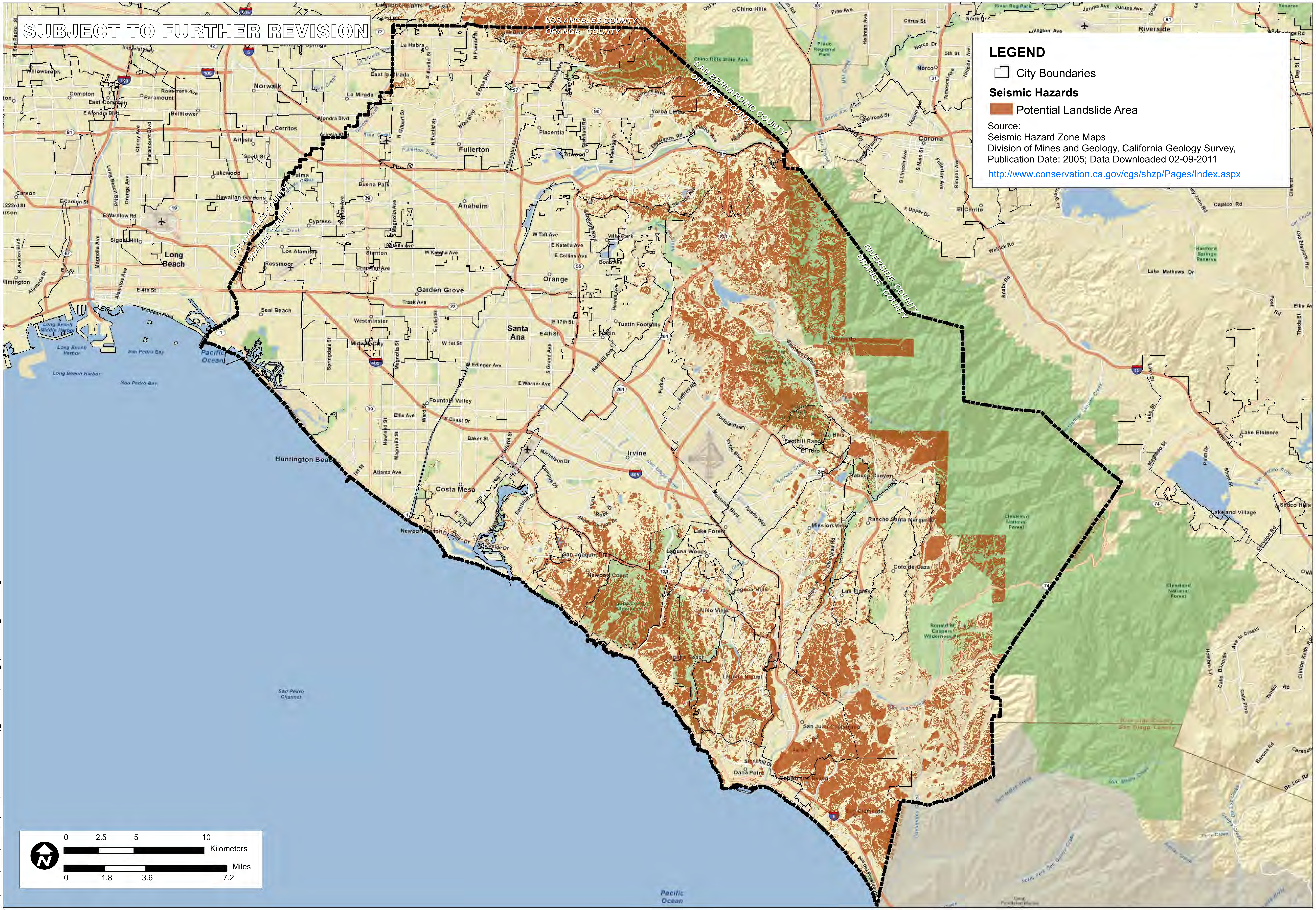
ORANGE CO. CA

SCALE 1" = 1.8 miles
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 02/09/11
JOB NO. 9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2b

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2b_D-Soils_20110215.mxd



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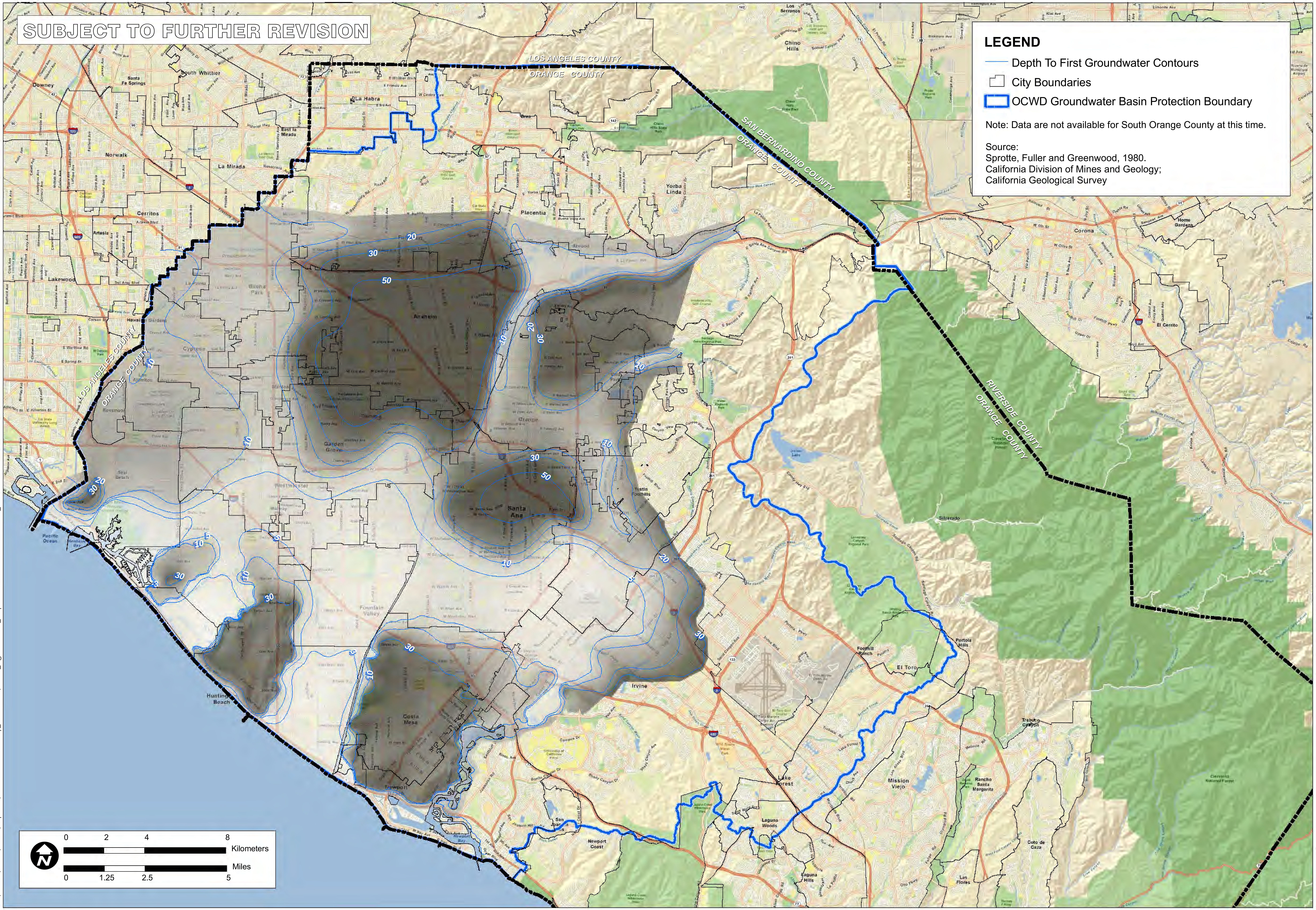
TITLE
HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2c



TITLE
NORTH ORANGE COUNTY
MAPPED DEPTH TO FIRST
GROUNDWATER

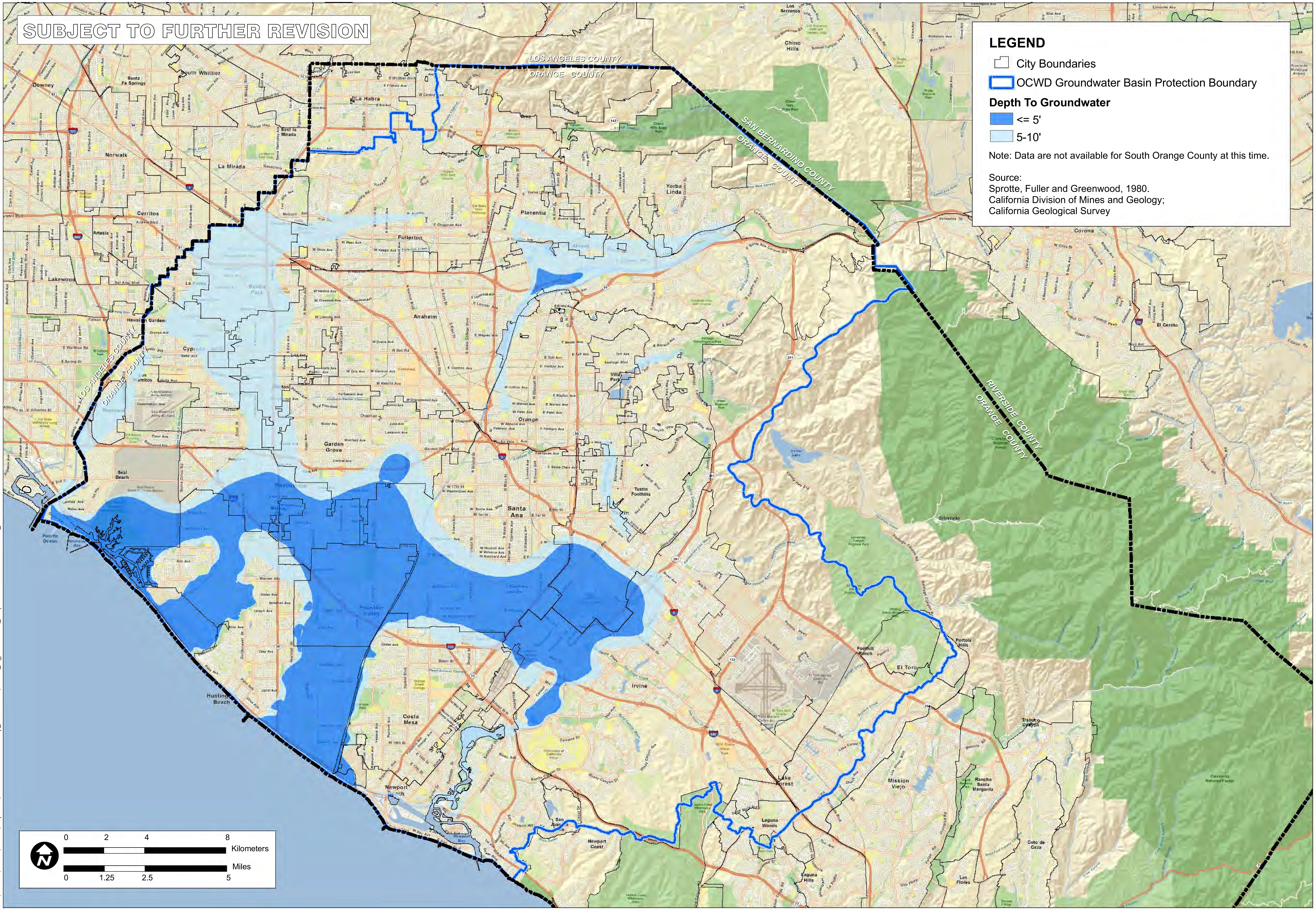
JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2d

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2d_DepthtoGroundwaterOverview_20110215.mxd



TITLE
NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

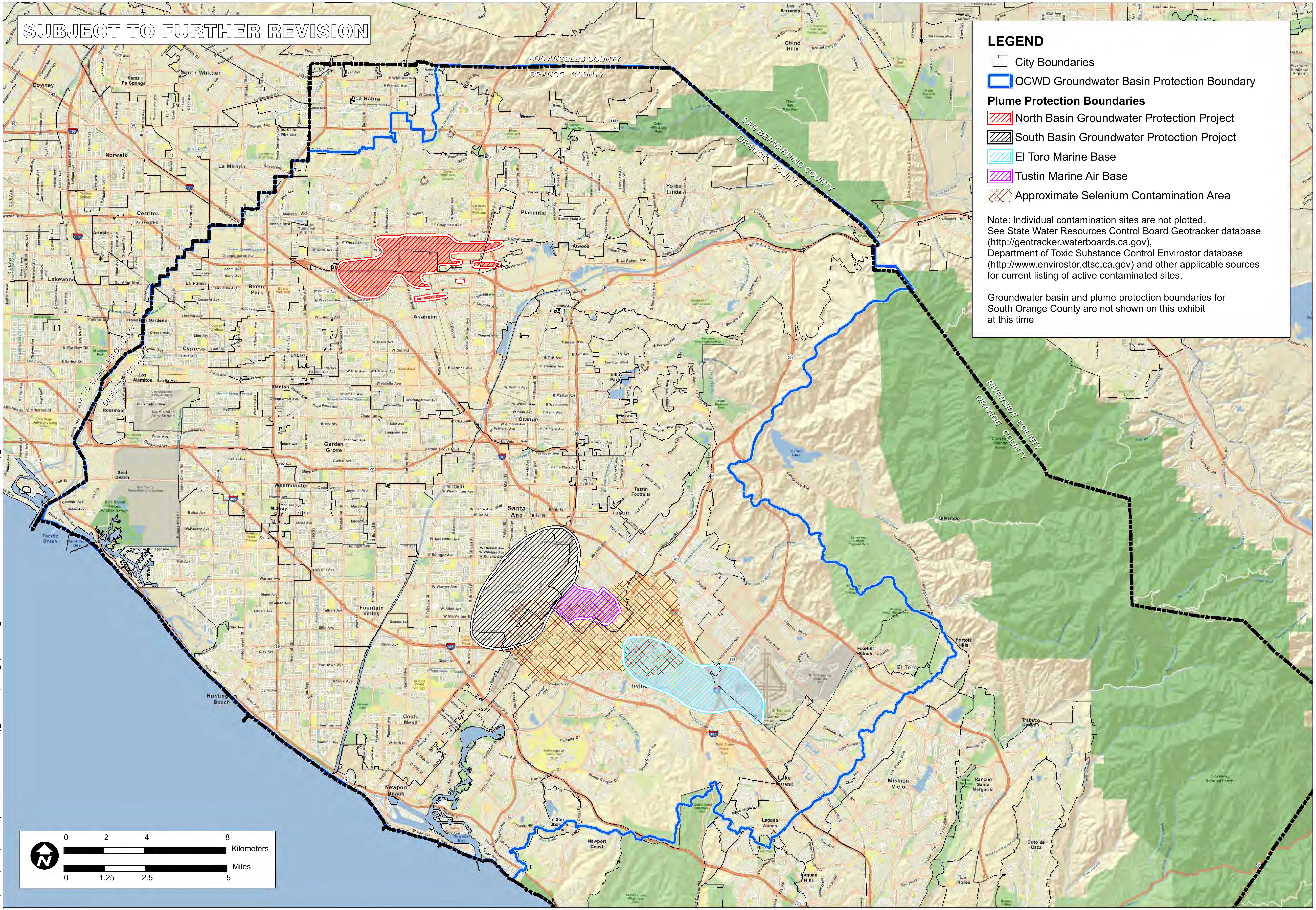
JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE
XVI-2e

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2e_DepthToGroundwaterLt5ft_20110215.mxd



TITLE
NORTH ORANGE COUNTY GROUNDWATER PROTECTION AREAS

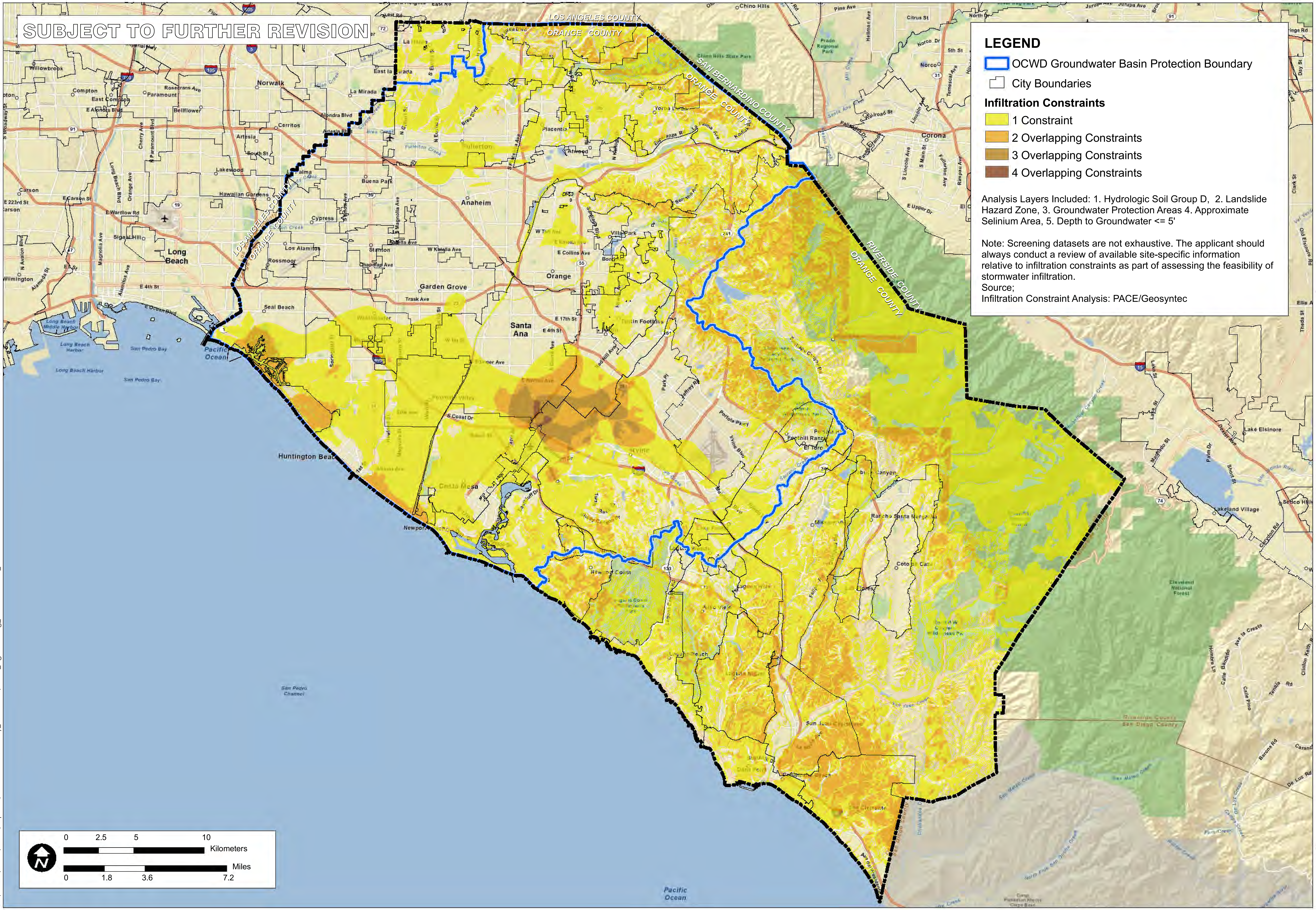
JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE
XVI-2f

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2f_NorthOCGroundwaterProtectionAreasStreetMap_20110215.mxd



TITLE

INFILTRATION ANALYSIS OVERLAPPING CONSTRAINT LOCATIONS

JOB

ORANGE COUNTY INFILTRATION STUDY

ORANGE CO. CA

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

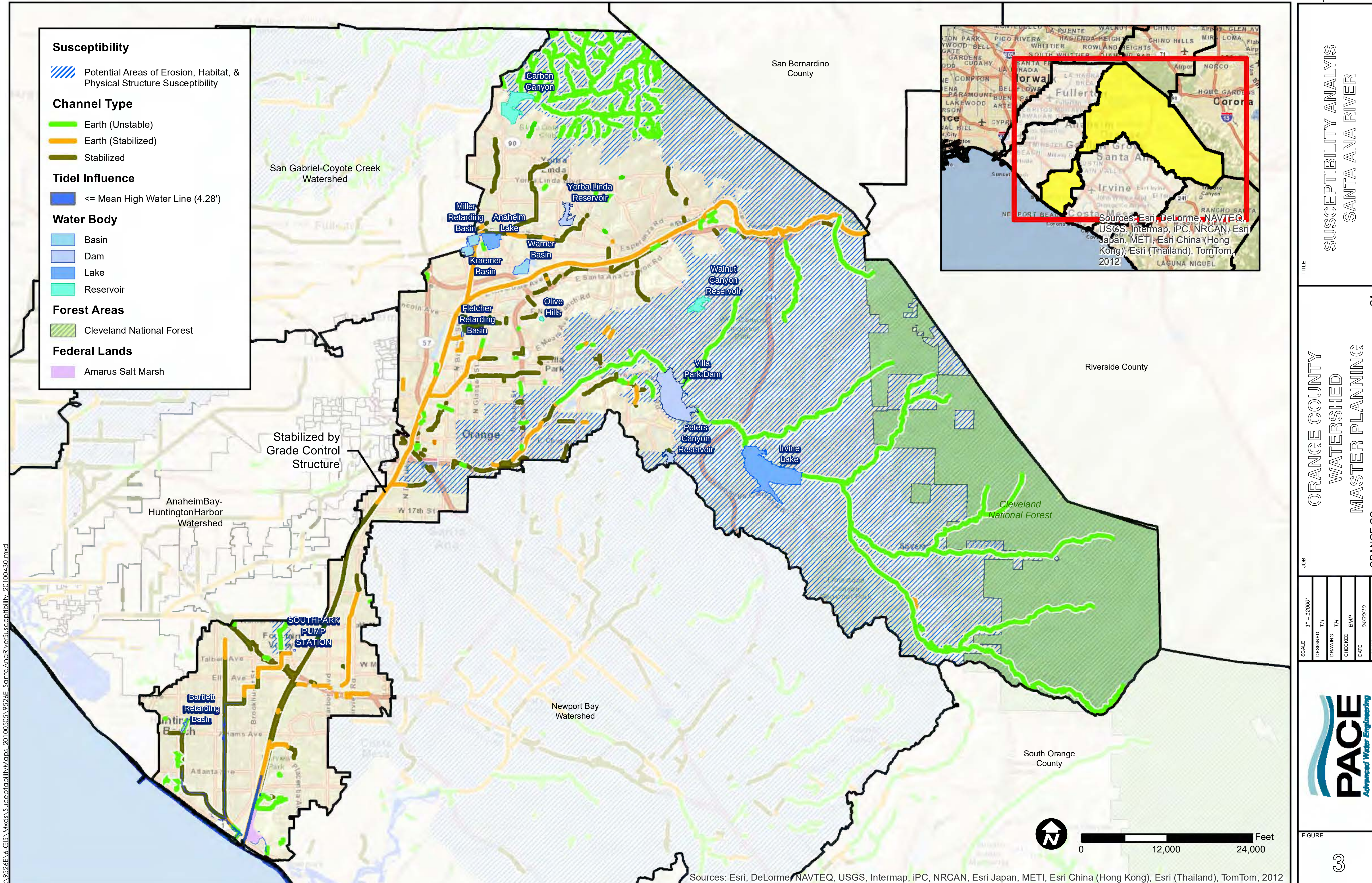
PACE Advanced Water Engineering

FIGURE

XVI-2g

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2g_InfiltrationFinal_20110215.mxd

SUSCEPTIBILITY MAP UPATE (FEB 2013)



Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=		inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=		inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=		inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=		acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=		
4	Calculate runoff volume, $V_{design}= (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=		cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}$[1] (in/hr) (Appendix VII)	$K_{observed}$=		In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	S_{total}=		
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	K_{design}=		In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=		Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

[1]$K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

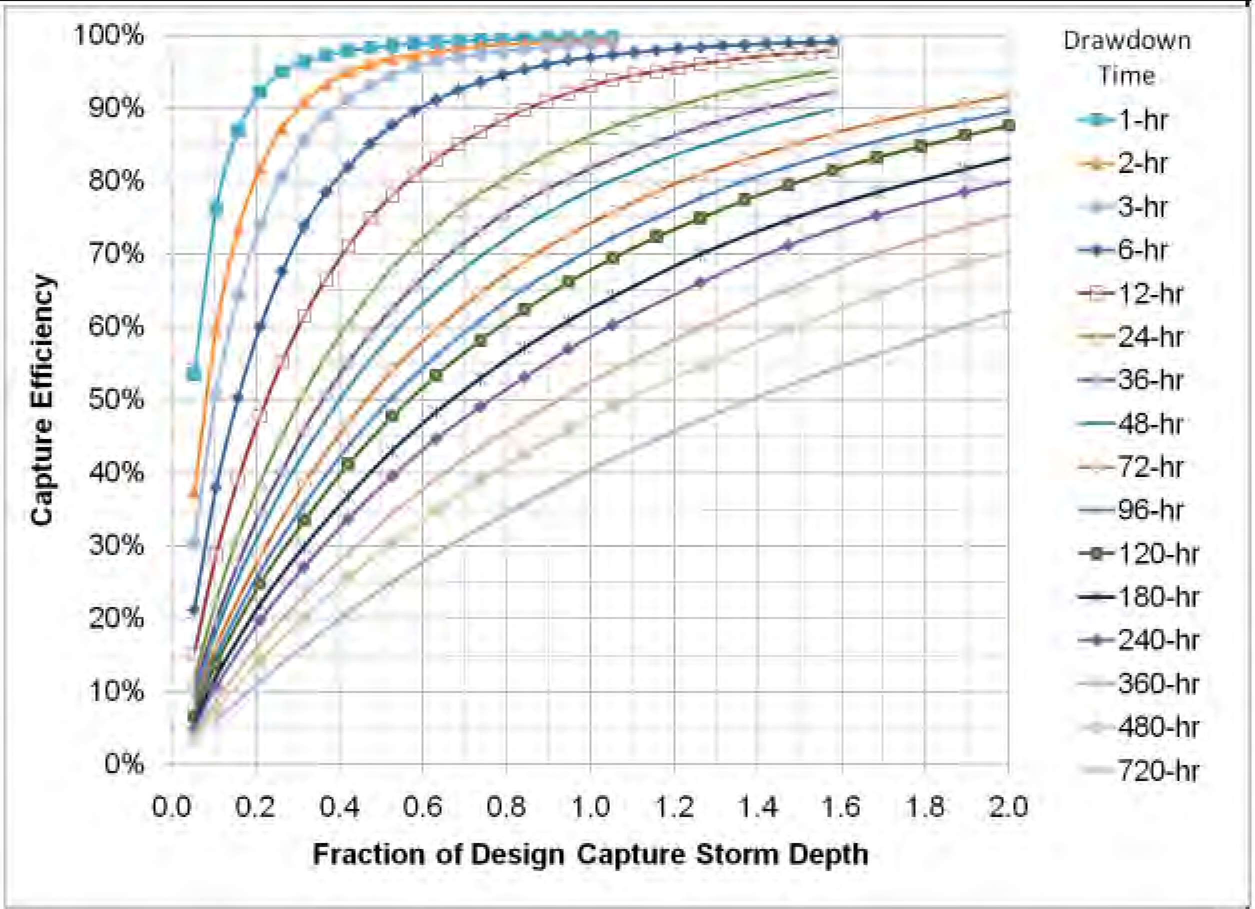
Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=		inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, *T* (hours)	T=		hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=		
4	Enter the effective depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=		inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=		%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=		
7	Calculate the fraction of design volume that must be provided by BMP, $fraction = X_1 – X_2$	fraction=		
8	Calculate the resultant design capture storm depth (inches), $d_{fraction} = fraction \times d$	$d_{fraction}$=		inches
9	SOC Only: When using this method for biofiltration sizing, check that the resulting volume in pre-filter detention volume plus pore spaces is at least 0.75 of the remaining DCV (See Section III.7 and Worksheet SOC-1).		Y / N / NA	
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=		acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=		
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=		
4	Calculate runoff volume, $V_{design}= (C \times d_{rfraction} \times A \times 43560 \times (1/12))$	V_{design}=		cu-ft
Supporting Calculations				
Describe system:				

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Provide drawdown time calculations per applicable BMP Fact Sheet:

Graphical Operations



Provide supporting graphical operations. See Example III.6.

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
             (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
          (c) Copyright 1983-2016 Advanced Engineering Software (aes)
              Ver. 23.0  Release Date: 07/01/2016  License ID 1618

                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
 * OCWRE                                                                    *
 * 2-YEAR STORM EVENT                                                       *
 * EXISTING CONDITION                                                       *
 **************************************************************************

  FILE NAME: OCWRE_EX.DAT
  TIME/DATE OF STUDY: 09:17 01/07/2025
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                  --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.02 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   260.00
  ELEVATION DATA: UPSTREAM(FEET) =    128.20  DOWNSTREAM(FEET) =    124.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.710
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.765
```

```
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 CONDOMINIUMS               B        0.32      0.30     0.350    36    7.71
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
 SUBAREA RUNOFF(CFS) =      0.48
 TOTAL AREA(ACRES) =      0.32   PEAK FLOW RATE(CFS) =      0.48

****************************************************************************
 FLOW PROCESS FROM NODE      1.02 TO NODE      1.05 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   123.45  DOWNSTREAM(FEET) =   121.16
 FLOW LENGTH(FEET) =    90.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.85
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.48
 PIPE TRAVEL TIME(MIN.) =   0.31    Tc(MIN.) =    8.02
 LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     350.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      1.05 TO NODE      1.05 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.02
 RAINFALL INTENSITY(INCH/HR) =   1.73
 AREA-AVERAGED Fm(INCH/HR) =  0.10
 AREA-AVERAGED Fp(INCH/HR) =  0.30
 AREA-AVERAGED Ap =  0.35
 EFFECTIVE STREAM AREA(ACRES) =       0.32
 TOTAL STREAM AREA(ACRES) =       0.32
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.48

****************************************************************************
 FLOW PROCESS FROM NODE      1.03 TO NODE      1.05 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   200.00
 ELEVATION DATA: UPSTREAM(FEET) =    126.30  DOWNSTREAM(FEET) =    123.08

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.780
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.083
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 B        0.69      0.30     0.100    36    5.78
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      1.27
```

```
 TOTAL AREA(ACRES) =      0.69   PEAK FLOW RATE(CFS) =      1.27

****************************************************************************
 FLOW PROCESS FROM NODE      1.05 TO NODE      1.05 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    5.78
 RAINFALL INTENSITY(INCH/HR) =   2.08
 AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.30
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =       0.69
 TOTAL STREAM AREA(ACRES) =       0.69
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.27

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        0.48    8.02    1.726  0.30( 0.11) 0.35       0.3       1.01
     2        1.27    5.78    2.083  0.30( 0.03) 0.10       0.7       1.03

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        1.70    5.78    2.083  0.30( 0.05) 0.16       0.9       1.03
     2        1.53    8.02    1.726  0.30( 0.05) 0.18       1.0       1.01

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       1.70    Tc(MIN.) =     5.78
 EFFECTIVE AREA(ACRES) =       0.92   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.16
 TOTAL AREA(ACRES) =       1.0
 LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     350.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      1.05 TO NODE      1.07 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   121.16  DOWNSTREAM(FEET) =   120.00
 FLOW LENGTH(FEET) =   150.00   MANNING'S N =  0.011
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.53
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.70
 PIPE TRAVEL TIME(MIN.) =   0.55    Tc(MIN.) =    6.33
 LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.07 =     500.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      1.07 TO NODE      1.07 IS CODE =  82
----------------------------------------------------------------------------
 >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
```

```
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   170.00
  ELEVATION DATA: UPSTREAM(FEET) =    125.20  DOWNSTREAM(FEET) =    121.37

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.997
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.039
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        0.52      0.30     0.350    36    6.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.52   INITIAL SUBAREA RUNOFF(CFS) =    0.91

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =    6.33
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.977
  SUBAREA AREA(ACRES) =    0.52      SUBAREA RUNOFF(CFS) =    0.88
  EFFECTIVE AREA(ACRES) =      1.44   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.23
  TOTAL AREA(ACRES) =       1.5       PEAK FLOW RATE(CFS) =       2.47

****************************************************************************
  FLOW PROCESS FROM NODE      1.07 TO NODE      1.12 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   120.00  DOWNSTREAM(FEET) =   112.00
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.29
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.47
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    6.37
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.12 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.37
  RAINFALL INTENSITY(INCH/HR) =   1.97
  AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.23
  EFFECTIVE STREAM AREA(ACRES) =       1.44
  TOTAL STREAM AREA(ACRES) =       1.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.47

****************************************************************************
  FLOW PROCESS FROM NODE      1.09 TO NODE      1.10 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   245.00
  ELEVATION DATA: UPSTREAM(FEET) =    127.50  DOWNSTREAM(FEET) =    123.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.932
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.527
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.86      0.30     0.850    36    9.93
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.98
  TOTAL AREA(ACRES) =      0.86   PEAK FLOW RATE(CFS) =      0.98

****************************************************************************
  FLOW PROCESS FROM NODE      1.10 TO NODE      1.12 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    123.50  DOWNSTREAM(FEET) =    120.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   155.00   CHANNEL SLOPE =  0.0174
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.445
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.31      0.30     0.100    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.18
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.57
  AVERAGE FLOW DEPTH(FEET) =   0.09   TRAVEL TIME(MIN.) =   1.00
  Tc(MIN.) =   10.94
  SUBAREA AREA(ACRES) =     0.31       SUBAREA RUNOFF(CFS) =    0.39
  EFFECTIVE AREA(ACRES) =      1.17     AREA-AVERAGED Fm(INCH/HR) =   0.20
  AREA-AVERAGED Fp(INCH/HR) =   0.30  AREA-AVERAGED Ap =   0.65
  TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =      1.32

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.10   FLOW VELOCITY(FEET/SEC.) =   2.63
  LONGEST FLOWPATH FROM NODE      1.09 TO NODE      1.12 =     400.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.94
  RAINFALL INTENSITY(INCH/HR) =   1.44
  AREA-AVERAGED Fm(INCH/HR) =  0.20
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.65
  EFFECTIVE STREAM AREA(ACRES) =      1.17
```

```
  TOTAL STREAM AREA(ACRES) =       1.17
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.32

****************************************************************************
  FLOW PROCESS FROM NODE      1.11 TO NODE      1.12 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =    127.20  DOWNSTREAM(FEET) =    120.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.296
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.983
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.60      0.30     0.100    36    6.30
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.05
  TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.05

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.30
  RAINFALL INTENSITY(INCH/HR) =   1.98
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.60
  TOTAL STREAM AREA(ACRES) =       0.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.05

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.47    6.37    1.969  0.30( 0.07) 0.23       1.4       1.03
      1        2.19    8.63    1.655  0.30( 0.07) 0.24       1.5       1.01
      2        1.32   10.94    1.445  0.30( 0.20) 0.65       1.2       1.09
      3        1.05    6.30    1.983  0.30( 0.03) 0.10       0.6       1.11

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.60    6.30    1.983  0.30( 0.09) 0.31       2.7       1.11
      2        4.61    6.37    1.969  0.30( 0.09) 0.31       2.7       1.03
      3        4.28    8.63    1.655  0.30( 0.10) 0.34       3.1       1.01
      4        3.98   10.94    1.445  0.30( 0.11) 0.36       3.3       1.09
```

```
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.61    Tc(MIN.) =     6.37
  EFFECTIVE AREA(ACRES) =       2.72   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.31
  TOTAL AREA(ACRES) =       3.3
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.12 =    540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.01 TO NODE      2.02 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   215.00
  ELEVATION DATA: UPSTREAM(FEET) =    129.20  DOWNSTREAM(FEET) =    125.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.971
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.044
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       0.20      0.30     0.100    36    5.97
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.20   INITIAL SUBAREA RUNOFF(CFS) =    0.36

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =    6.37
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.969
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    0.35
  EFFECTIVE AREA(ACRES) =      2.92   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.29
  TOTAL AREA(ACRES) =       3.5       PEAK FLOW RATE(CFS) =       4.95

****************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.02 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.37
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.969
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.06      0.30     0.100    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.06      SUBAREA RUNOFF(CFS) =    0.10
  EFFECTIVE AREA(ACRES) =      2.98   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.29
  TOTAL AREA(ACRES) =       3.6       PEAK FLOW RATE(CFS) =       5.05

****************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.02 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.37
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.969
```

```
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B       0.07      0.30     0.100    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.07      SUBAREA RUNOFF(CFS) =    0.12
 EFFECTIVE AREA(ACRES) =      3.05   AREA-AVERAGED Fm(INCH/HR) =  0.09
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.28
 TOTAL AREA(ACRES) =        3.6       PEAK FLOW RATE(CFS) =       5.18

****************************************************************************
 FLOW PROCESS FROM NODE      5.01 TO NODE      5.02 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.37
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.969
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B       0.06      0.30     0.100    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.06      SUBAREA RUNOFF(CFS) =    0.10
 EFFECTIVE AREA(ACRES) =      3.11   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.28
 TOTAL AREA(ACRES) =        3.7       PEAK FLOW RATE(CFS) =       5.28

****************************************************************************
 FLOW PROCESS FROM NODE      6.01 TO NODE      6.02 IS CODE =  82
----------------------------------------------------------------------------
 >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
 >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   165.00
 ELEVATION DATA: UPSTREAM(FEET) =    127.40  DOWNSTREAM(FEET) =    124.90

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.774
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.084
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 APARTMENTS                 B       0.38      0.30     0.200    36    5.77
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =    0.38   INITIAL SUBAREA RUNOFF(CFS) =    0.69

 ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
 MAINLINE Tc(MIN.) =    6.37
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.969
 SUBAREA AREA(ACRES) =    0.38      SUBAREA RUNOFF(CFS) =    0.65
 EFFECTIVE AREA(ACRES) =      3.49   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.27
 TOTAL AREA(ACRES) =        4.1       PEAK FLOW RATE(CFS) =       5.93

****************************************************************************
 FLOW PROCESS FROM NODE      6.02 TO NODE      7.03 IS CODE =   1
----------------------------------------------------------------------------
```

```
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.37
  RAINFALL INTENSITY(INCH/HR) =   1.97
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.27
  EFFECTIVE STREAM AREA(ACRES) =       3.49
  TOTAL STREAM AREA(ACRES) =       4.07
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.93

****************************************************************************
  FLOW PROCESS FROM NODE      7.01 TO NODE      7.02 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    40.00
  ELEVATION DATA: UPSTREAM(FEET) =    126.20  DOWNSTREAM(FEET) =    125.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 B        0.04      0.30     0.200    36    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.08
  TOTAL AREA(ACRES) =      0.04   PEAK FLOW RATE(CFS) =      0.08

****************************************************************************
  FLOW PROCESS FROM NODE      7.02 TO NODE      7.03 IS CODE =  31
----------------------------------------------------------------------------
  ** WARNING: Computed Flowrate is less than 0.1 cfs,
              Routing Algorithm is UNAVAILABLE.

****************************************************************************
  FLOW PROCESS FROM NODE      7.03 TO NODE      8.02 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.00
  RAINFALL INTENSITY(INCH/HR) =   2.26
  AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.04
  TOTAL STREAM AREA(ACRES) =       0.04
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.08

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
```

```
    1        5.93    6.30    1.983  0.30( 0.08) 0.27       3.5       1.11
    1        5.93    6.37    1.969  0.30( 0.08) 0.27       3.5       1.03
    1        5.39    8.63    1.655  0.30( 0.09) 0.30       3.8       1.01
    1        4.94   10.94    1.445  0.30( 0.10) 0.32       4.1       1.09
    2        0.08    5.00    2.264  0.30( 0.06) 0.20       0.0       7.01

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        5.49    5.00    2.264  0.30( 0.08) 0.27       2.8       7.01
    2        6.00    6.30    1.983  0.30( 0.08) 0.27       3.5       1.11
    3        6.00    6.37    1.969  0.30( 0.08) 0.27       3.5       1.03
    4        5.44    8.63    1.655  0.30( 0.09) 0.30       3.9       1.01
    5        4.99   10.94    1.445  0.30( 0.10) 0.32       4.1       1.09

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.00    Tc(MIN.) =     6.30
  EFFECTIVE AREA(ACRES) =       3.51   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.27
  TOTAL AREA(ACRES) =       4.1
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      8.02 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      8.01 TO NODE      8.02 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   220.00
  ELEVATION DATA: UPSTREAM(FEET) =    126.60  DOWNSTREAM(FEET) =    124.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.954
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.873
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       0.45      0.30     0.100    36    6.95
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.45   INITIAL SUBAREA RUNOFF(CFS) =    0.75

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =    6.30
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.983
  SUBAREA AREA(ACRES) =    0.45      SUBAREA RUNOFF(CFS) =    0.79
  EFFECTIVE AREA(ACRES) =      3.96   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.25
  TOTAL AREA(ACRES) =       4.6       PEAK FLOW RATE(CFS) =       6.79

****************************************************************************
  FLOW PROCESS FROM NODE      9.01 TO NODE      9.01 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.30
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.983
```

```
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B        0.05      0.30     0.100    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.05      SUBAREA RUNOFF(CFS) =    0.09
  EFFECTIVE AREA(ACRES) =      4.01   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.25
  TOTAL AREA(ACRES) =        4.6       PEAK FLOW RATE(CFS) =       6.88
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.6  TC(MIN.) =      6.30
  EFFECTIVE AREA(ACRES) =      4.01  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.249
  PEAK FLOW RATE(CFS)   =       6.88

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)   NODE
      1        6.49    5.00    2.264  0.30( 0.07) 0.24       3.3       7.01
      2        6.88    6.30    1.983  0.30( 0.07) 0.25       4.0       1.11
      3        6.87    6.37    1.969  0.30( 0.08) 0.25       4.0       1.03
      4        6.18    8.63    1.655  0.30( 0.08) 0.27       4.4       1.01
      5        5.63   10.94    1.445  0.30( 0.09) 0.29       4.6       1.09
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1618

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
 * OCWRE                                                                    *
 * 2-YEAR STORM EVENT                                                       *
 * PROPOSED CONDITION                                                       *
 **************************************************************************

  FILE NAME: OCWRE_PR.DAT
  TIME/DATE OF STUDY: 09:17 01/07/2025
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE      1.01 TO NODE      1.02 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   135.00
  ELEVATION DATA: UPSTREAM(FEET) =    127.95  DOWNSTREAM(FEET) =    125.35

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.643
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.112
```

```
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 CONDOMINIUMS               B        0.15      0.30     0.350    36    5.64
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
 SUBAREA RUNOFF(CFS) =      0.27
 TOTAL AREA(ACRES) =      0.15   PEAK FLOW RATE(CFS) =      0.27

****************************************************************************
 FLOW PROCESS FROM NODE      1.02 TO NODE      1.05 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   122.35  DOWNSTREAM(FEET) =   120.00
 FLOW LENGTH(FEET) =   250.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   2.90
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.27
 PIPE TRAVEL TIME(MIN.) =   1.44    Tc(MIN.) =    7.08
 LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     385.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      1.05 TO NODE      1.05 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    7.08
 RAINFALL INTENSITY(INCH/HR) =   1.85
 AREA-AVERAGED Fm(INCH/HR) =  0.10
 AREA-AVERAGED Fp(INCH/HR) =  0.30
 AREA-AVERAGED Ap =  0.35
 EFFECTIVE STREAM AREA(ACRES) =       0.15
 TOTAL STREAM AREA(ACRES) =       0.15
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.27

****************************************************************************
 FLOW PROCESS FROM NODE      1.03 TO NODE      1.04 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
 ELEVATION DATA: UPSTREAM(FEET) =    128.20  DOWNSTREAM(FEET) =    123.40

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.743
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.907
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 MOBILE HOME PARK           B        0.50      0.30     0.250    36    6.74
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
 SUBAREA RUNOFF(CFS) =      0.82
```

```
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      0.82

****************************************************************************
  FLOW PROCESS FROM NODE      1.04 TO NODE      1.05 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   120.40  DOWNSTREAM(FEET) =   120.00
  FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.82
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.82
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    6.83
  LONGEST FLOWPATH FROM NODE      1.03 TO NODE      1.05 =     275.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.05 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.83
  RAINFALL INTENSITY(INCH/HR) =   1.89
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.25
  EFFECTIVE STREAM AREA(ACRES) =       0.50
  TOTAL STREAM AREA(ACRES) =       0.50
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.82

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        0.27    7.08    1.854  0.30( 0.10) 0.35       0.2       1.01
      2        0.82    6.83    1.893  0.30( 0.08) 0.25       0.5       1.03

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.09    6.83    1.893  0.30( 0.08) 0.27       0.6       1.03
      2        1.08    7.08    1.854  0.30( 0.08) 0.27       0.6       1.01

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       1.09    Tc(MIN.) =     6.83
  EFFECTIVE AREA(ACRES) =       0.64   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.27
  TOTAL AREA(ACRES) =        0.6
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.05 =     385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.05 TO NODE      1.10 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   120.00  DOWNSTREAM(FEET) =   119.50
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.43
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.09
  PIPE TRAVEL TIME(MIN.) =   0.19    Tc(MIN.) =    7.02
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.10 =    435.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.10 TO NODE      1.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =    7.02
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.863
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 B       0.16      0.30     0.200    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.16      SUBAREA RUNOFF(CFS) =    0.26
  EFFECTIVE AREA(ACRES) =      0.80   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.26
  TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =       1.29

****************************************************************************
  FLOW PROCESS FROM NODE      1.10 TO NODE      1.12 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   119.50  DOWNSTREAM(FEET) =   119.10
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.63
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.29
  PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =    7.16
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.12 =    475.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.12 TO NODE      1.12 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =    7.16
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.842
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.11      0.30     0.100    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
 SUBAREA AREA(ACRES) =    0.11      SUBAREA RUNOFF(CFS) =    0.18
 EFFECTIVE AREA(ACRES) =      0.91   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.24
 TOTAL AREA(ACRES) =        0.9       PEAK FLOW RATE(CFS) =       1.46

****************************************************************************
 FLOW PROCESS FROM NODE      1.12 TO NODE      1.13 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   119.10  DOWNSTREAM(FEET) =   117.00
 FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.28
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.46
 PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    7.20
 LONGEST FLOWPATH FROM NODE      1.01 TO NODE      1.13 =     500.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      1.13 TO NODE      1.13 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      1.13 TO NODE      1.13 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      2.01 TO NODE      2.02 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    80.00
 ELEVATION DATA: UPSTREAM(FEET) =    130.00  DOWNSTREAM(FEET) =    129.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 B       0.12      0.30     0.100    36    5.00
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.24
 TOTAL AREA(ACRES) =      0.12   PEAK FLOW RATE(CFS) =      0.24

****************************************************************************
 FLOW PROCESS FROM NODE      2.02 TO NODE      2.03 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
 ELEVATION DATA: UPSTREAM(FEET) =   124.00  DOWNSTREAM(FEET) =   123.20
 FLOW LENGTH(FEET) =    75.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   2.89
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.24
 PIPE TRAVEL TIME(MIN.) =   0.43    Tc(MIN.) =    5.43
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.03 =    155.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.03 TO NODE      2.03 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    5.43
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.159
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.12      0.30     0.100    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.12      SUBAREA RUNOFF(CFS) =    0.23
 EFFECTIVE AREA(ACRES) =      0.24   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        0.2       PEAK FLOW RATE(CFS) =       0.46

****************************************************************************
 FLOW PROCESS FROM NODE      2.03 TO NODE      2.04 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   123.20  DOWNSTREAM(FEET) =   119.00
 FLOW LENGTH(FEET) =   170.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.73
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.46
 PIPE TRAVEL TIME(MIN.) =   0.60    Tc(MIN.) =    6.03
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.04 =    325.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.04 TO NODE      2.04 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.03
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.033
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.11      0.30     0.100    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.11      SUBAREA RUNOFF(CFS) =    0.20
 EFFECTIVE AREA(ACRES) =      0.35   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.10
```

```
 TOTAL AREA(ACRES) =       0.3      PEAK FLOW RATE(CFS) =      0.63

****************************************************************************
 FLOW PROCESS FROM NODE      2.04 TO NODE      2.20 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   119.00  DOWNSTREAM(FEET) =   118.50
 FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   3.77
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.63
 PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =    6.25
 LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.20 =     375.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.20 TO NODE      2.20 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      2.20 TO NODE      2.20 IS CODE =  13
----------------------------------------------------------------------------
 >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      2.05 TO NODE      2.06 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   160.00
 ELEVATION DATA: UPSTREAM(FEET) =    126.10  DOWNSTREAM(FEET) =    124.10

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.927
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.053
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 APARTMENTS                 B       0.11      0.30     0.200    36    5.93
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =      0.20
 TOTAL AREA(ACRES) =      0.11   PEAK FLOW RATE(CFS) =      0.20

****************************************************************************
 FLOW PROCESS FROM NODE      2.06 TO NODE      2.06 IS CODE =  82
----------------------------------------------------------------------------
 >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
 >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   220.00
 ELEVATION DATA: UPSTREAM(FEET) =    126.90  DOWNSTREAM(FEET) =    124.10
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.294
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.984
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.42      0.30     0.100    36    6.29
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.42   INITIAL SUBAREA RUNOFF(CFS) =    0.74

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =    5.93
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.053
  SUBAREA AREA(ACRES) =    0.42      SUBAREA RUNOFF(CFS) =    0.76
  EFFECTIVE AREA(ACRES) =      0.53   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.12
  TOTAL AREA(ACRES) =        0.5       PEAK FLOW RATE(CFS) =       0.96

****************************************************************************
  FLOW PROCESS FROM NODE      2.06 TO NODE      2.10 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   121.00  DOWNSTREAM(FEET) =   120.00
  FLOW LENGTH(FEET) =    35.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.22
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.96
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    6.02
  LONGEST FLOWPATH FROM NODE      2.05 TO NODE      2.10 =     195.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.10 TO NODE      2.10 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.02
  RAINFALL INTENSITY(INCH/HR) =   2.03
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.12
  EFFECTIVE STREAM AREA(ACRES) =      0.53
  TOTAL STREAM AREA(ACRES) =      0.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.96

****************************************************************************
  FLOW PROCESS FROM NODE      2.07 TO NODE      2.08 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   160.00
  ELEVATION DATA: UPSTREAM(FEET) =    125.50  DOWNSTREAM(FEET) =    124.50
```

```
 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.808
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.896
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 APARTMENTS                 B       0.38      0.30     0.200    36    6.81
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =      0.63
 TOTAL AREA(ACRES) =      0.38   PEAK FLOW RATE(CFS) =      0.63

****************************************************************************
 FLOW PROCESS FROM NODE      2.08 TO NODE      2.09 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   121.50  DOWNSTREAM(FEET) =   120.80
 FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   3.79
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.63
 PIPE TRAVEL TIME(MIN.) =   0.31    Tc(MIN.) =    7.12
 LONGEST FLOWPATH FROM NODE      2.07 TO NODE      2.09 =     230.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      2.09 TO NODE      2.09 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    7.12
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.849
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B       0.15      0.30     0.100    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.15      SUBAREA RUNOFF(CFS) =    0.25
 EFFECTIVE AREA(ACRES) =      0.53   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.17
 TOTAL AREA(ACRES) =       0.5       PEAK FLOW RATE(CFS) =       0.86

****************************************************************************
 FLOW PROCESS FROM NODE      2.09 TO NODE      2.10 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   120.80  DOWNSTREAM(FEET) =   120.00
 FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.88
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.86
 PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    7.20
```

```
  LONGEST FLOWPATH FROM NODE      2.07 TO NODE      2.10 =    260.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.10 TO NODE      2.10 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.20
  RAINFALL INTENSITY(INCH/HR) =   1.84
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.17
  EFFECTIVE STREAM AREA(ACRES) =       0.53
  TOTAL STREAM AREA(ACRES) =       0.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.86

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)   NODE
      1        0.96    6.02    2.035  0.30( 0.04) 0.12       0.5       2.05
      2        0.86    7.20    1.836  0.30( 0.05) 0.17       0.5       2.07

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)   NODE
      1        1.76    6.02    2.035  0.30( 0.04) 0.14       1.0       2.05
      2        1.72    7.20    1.836  0.30( 0.04) 0.15       1.1       2.07

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       1.76    Tc(MIN.) =     6.02
  EFFECTIVE AREA(ACRES) =       0.97   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.14
  TOTAL AREA(ACRES) =        1.1
  LONGEST FLOWPATH FROM NODE      2.07 TO NODE      2.10 =    260.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.10 TO NODE      2.15 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   120.00  DOWNSTREAM(FEET) =   119.80
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.02
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.76
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    6.09
  LONGEST FLOWPATH FROM NODE      2.07 TO NODE      2.15 =    280.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.15 TO NODE      2.15 IS CODE =   1
----------------------------------------------------------------------------
```

```
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.09
  RAINFALL INTENSITY(INCH/HR) =   2.02
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.14
  EFFECTIVE STREAM AREA(ACRES) =       0.97
  TOTAL STREAM AREA(ACRES) =       1.06
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.76

****************************************************************************
  FLOW PROCESS FROM NODE      2.11 TO NODE      2.12 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    40.00
  ELEVATION DATA: UPSTREAM(FEET) =    126.30  DOWNSTREAM(FEET) =    125.90

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  CONDOMINIUMS               B        0.23      0.30     0.350    36    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      0.45
  TOTAL AREA(ACRES) =      0.23   PEAK FLOW RATE(CFS) =      0.45

****************************************************************************
  FLOW PROCESS FROM NODE      2.12 TO NODE      2.13 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   123.90  DOWNSTREAM(FEET) =   122.00
  FLOW LENGTH(FEET) =   170.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.56
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.45
  PIPE TRAVEL TIME(MIN.) =   0.80    Tc(MIN.) =    5.80
  LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.13 =     210.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.13 TO NODE      2.13 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.80
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.080
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
```

```
  COMMERCIAL                 B        0.09      0.30     0.100    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.09      SUBAREA RUNOFF(CFS) =    0.17
  EFFECTIVE AREA(ACRES) =      0.32   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.28
  TOTAL AREA(ACRES) =        0.3       PEAK FLOW RATE(CFS) =       0.57

****************************************************************************
  FLOW PROCESS FROM NODE      2.13 TO NODE      2.15 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   122.00  DOWNSTREAM(FEET) =   119.80
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.87
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.57
  PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =    6.14
  LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.15 =     310.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.15 TO NODE      2.15 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.14
  RAINFALL INTENSITY(INCH/HR) =   2.01
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.28
  EFFECTIVE STREAM AREA(ACRES) =       0.32
  TOTAL STREAM AREA(ACRES) =       0.32
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.57

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.76    6.09    2.022  0.30( 0.04) 0.14       1.0       2.05
      1        1.72    7.27    1.826  0.30( 0.04) 0.15       1.1       2.07
      2        0.57    6.14    2.012  0.30( 0.08) 0.28       0.3       2.11

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.33    6.09    2.022  0.30( 0.05) 0.18       1.3       2.05
      2        2.33    6.14    2.012  0.30( 0.05) 0.18       1.3       2.11
      3        2.24    7.27    1.826  0.30( 0.05) 0.18       1.4       2.07

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.33    Tc(MIN.) =     6.14
```

```
  EFFECTIVE AREA(ACRES) =       1.30   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =       1.4
  LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.15 =     310.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.15 TO NODE      2.20 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   119.80  DOWNSTREAM(FEET) =   118.50
  FLOW LENGTH(FEET) =    10.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.75
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.33
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.15
  LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.20 =     320.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.20 TO NODE      2.20 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       2.33    6.10    2.020  0.30( 0.05) 0.18       1.3       2.05
      2       2.33    6.15    2.010  0.30( 0.05) 0.18       1.3       2.11
      3       2.24    7.28    1.825  0.30( 0.05) 0.18       1.4       2.07
  LONGEST FLOWPATH FROM NODE      2.11 TO NODE      2.20 =     320.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       0.63    6.25    1.991  0.30( 0.03) 0.10       0.3       2.01
  LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.20 =     375.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       2.96    6.10    2.020  0.30( 0.05) 0.16       1.6       2.05
      2       2.96    6.15    2.010  0.30( 0.05) 0.16       1.6       2.11
      3       2.95    6.25    1.991  0.30( 0.05) 0.16       1.7       2.01
      4       2.82    7.28    1.825  0.30( 0.05) 0.16       1.7       2.07
    TOTAL AREA(ACRES) =        1.7

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        2.96  Tc(MIN.) =    6.150
  EFFECTIVE AREA(ACRES) =      1.64  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =       1.7
  LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.20 =     375.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.20 TO NODE      2.20 IS CODE =  12
----------------------------------------------------------------------------
```

```
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      2.20 TO NODE      2.21 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   118.50  DOWNSTREAM(FEET) =   118.00
  FLOW LENGTH(FEET) =    25.00   MANNING'S N =  0.011
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.42
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.96
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    6.21
  LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.21 =     400.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.21 TO NODE      2.21 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.96    6.16    2.009  0.30( 0.05) 0.16       1.6       2.05
      2        2.96    6.21    2.000  0.30( 0.05) 0.16       1.6       2.11
      3        2.95    6.31    1.981  0.30( 0.05) 0.16       1.7       2.01
      4        2.82    7.34    1.816  0.30( 0.05) 0.16       1.7       2.07
  LONGEST FLOWPATH FROM NODE      2.01 TO NODE      2.21 =     400.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.46    7.20    1.836  0.30( 0.07) 0.24       0.9       1.03
      2        1.44    7.45    1.800  0.30( 0.07) 0.24       0.9       1.01
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      2.21 =     500.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.32    6.16    2.009  0.30( 0.06) 0.19       2.4       2.05
      2        4.33    6.21    2.000  0.30( 0.06) 0.19       2.4       2.11
      3        4.34    6.31    1.981  0.30( 0.06) 0.19       2.5       2.01
      4        4.30    7.20    1.836  0.30( 0.06) 0.19       2.6       1.03
      5        4.27    7.34    1.816  0.30( 0.06) 0.19       2.6       2.07
      6        4.23    7.45    1.800  0.30( 0.06) 0.19       2.6       1.01
    TOTAL AREA(ACRES) =         2.6

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        4.34  Tc(MIN.) =    6.309
  EFFECTIVE AREA(ACRES) =      2.46  AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =       2.6
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      2.21 =     500.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.21 TO NODE      2.21 IS CODE =  12
```

```
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      2.20 TO NODE      2.20 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      2.20 TO NODE      2.20 IS CODE =  13
----------------------------------------------------------------------------
  >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      3.01 TO NODE      3.02 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   185.00
  ELEVATION DATA: UPSTREAM(FEET) =    126.00  DOWNSTREAM(FEET) =    123.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.962
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.046
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 B       0.49      0.30     0.200    36    5.96
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.88
  TOTAL AREA(ACRES) =      0.49   PEAK FLOW RATE(CFS) =      0.88

****************************************************************************
  FLOW PROCESS FROM NODE      3.02 TO NODE      3.10 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   120.00  DOWNSTREAM(FEET) =   117.90
  FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.23
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.88
  PIPE TRAVEL TIME(MIN.) =   0.79    Tc(MIN.) =    6.75
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.10 =     385.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.10 TO NODE      3.10 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
```

```
  TIME OF CONCENTRATION(MIN.) =    6.75
  RAINFALL INTENSITY(INCH/HR) =   1.91
  AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       0.49
  TOTAL STREAM AREA(ACRES) =       0.49
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.88

****************************************************************************
  FLOW PROCESS FROM NODE      3.03 TO NODE      3.04 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   110.00
  ELEVATION DATA: UPSTREAM(FEET) =    130.00  DOWNSTREAM(FEET) =    129.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.102
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.238
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.17      0.30     0.100    36    5.10
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.34
  TOTAL AREA(ACRES) =      0.17   PEAK FLOW RATE(CFS) =      0.34

****************************************************************************
  FLOW PROCESS FROM NODE      3.04 TO NODE      3.05 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   124.20  DOWNSTREAM(FEET) =   123.60
  FLOW LENGTH(FEET) =    60.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.17
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.34
  PIPE TRAVEL TIME(MIN.) =   0.32    Tc(MIN.) =    5.42
  LONGEST FLOWPATH FROM NODE      3.03 TO NODE      3.05 =     170.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.05 TO NODE      3.05 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.42
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.162
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.17      0.30     0.350    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =    0.17      SUBAREA RUNOFF(CFS) =    0.31
```

```
 EFFECTIVE AREA(ACRES) =      0.34   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.22
 TOTAL AREA(ACRES) =       0.3       PEAK FLOW RATE(CFS) =       0.64

****************************************************************************
 FLOW PROCESS FROM NODE      3.05 TO NODE      3.10 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   123.60  DOWNSTREAM(FEET) =   117.90
 FLOW LENGTH(FEET) =   110.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.77
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       0.64
 PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =    5.69
 LONGEST FLOWPATH FROM NODE      3.03 TO NODE      3.10 =     280.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.10 TO NODE      3.10 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    5.69
 RAINFALL INTENSITY(INCH/HR) =   2.10
 AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.30
 AREA-AVERAGED Ap =  0.22
 EFFECTIVE STREAM AREA(ACRES) =       0.34
 TOTAL STREAM AREA(ACRES) =       0.34
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.64

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)   NODE
     1        0.88    6.75    1.905  0.30( 0.06) 0.20       0.5       3.01
     2        0.64    5.69    2.102  0.30( 0.07) 0.22       0.3       3.03

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)   NODE
     1        1.46    5.69    2.102  0.30( 0.06) 0.21       0.8       3.03
     2        1.45    6.75    1.905  0.30( 0.06) 0.21       0.8       3.01

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       1.46    Tc(MIN.) =     5.69
 EFFECTIVE AREA(ACRES) =       0.75   AREA-AVERAGED Fm(INCH/HR) =  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.21
 TOTAL AREA(ACRES) =       0.8
 LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.10 =     385.00 FEET.

****************************************************************************
```

```
 FLOW PROCESS FROM NODE      3.10 TO NODE      3.20 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   117.90  DOWNSTREAM(FEET) =   117.40
 FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.011
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   4.78
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.46
 PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =    5.86
 LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.20 =     435.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      3.20 TO NODE      3.20 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    5.86
 RAINFALL INTENSITY(INCH/HR) =   2.07
 AREA-AVERAGED Fm(INCH/HR) =  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.30
 AREA-AVERAGED Ap =  0.21
 EFFECTIVE STREAM AREA(ACRES) =       0.75
 TOTAL STREAM AREA(ACRES) =       0.83
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.46

****************************************************************************
 FLOW PROCESS FROM NODE      3.11 TO NODE      3.12 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   275.00
 ELEVATION DATA: UPSTREAM(FEET) =    125.50  DOWNSTREAM(FEET) =    122.90

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.303
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.821
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                B       0.35      0.30     0.100    36    7.30
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      0.56
 TOTAL AREA(ACRES) =      0.35   PEAK FLOW RATE(CFS) =      0.56

****************************************************************************
 FLOW PROCESS FROM NODE      3.12 TO NODE      3.12 IS CODE =  82
----------------------------------------------------------------------------
 >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
 >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   220.00
 ELEVATION DATA: UPSTREAM(FEET) =    125.50  DOWNSTREAM(FEET) =    122.90
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.808
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.896
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 B       0.32      0.30     0.200    36    6.81
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.32   INITIAL SUBAREA RUNOFF(CFS) =    0.53

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =    7.30
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.821
  SUBAREA AREA(ACRES) =    0.32      SUBAREA RUNOFF(CFS) =    0.51
  EFFECTIVE AREA(ACRES) =      0.67   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.15
  TOTAL AREA(ACRES) =        0.7       PEAK FLOW RATE(CFS) =       1.07

****************************************************************************
  FLOW PROCESS FROM NODE      3.12 TO NODE      3.14 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   119.90  DOWNSTREAM(FEET) =   119.30
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   4.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.69
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.07
  PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =    7.48
  LONGEST FLOWPATH FROM NODE      3.11 TO NODE      3.14 =     325.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.14 TO NODE      3.14 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.48
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.796
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.12      0.30     0.100    36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.12      SUBAREA RUNOFF(CFS) =    0.19
  EFFECTIVE AREA(ACRES) =      0.79   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.14
  TOTAL AREA(ACRES) =        0.8       PEAK FLOW RATE(CFS) =       1.25

****************************************************************************
  FLOW PROCESS FROM NODE      3.14 TO NODE      3.20 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =   119.30  DOWNSTREAM(FEET) =   117.40
  FLOW LENGTH(FEET) =    35.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   2.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.42
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.25
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    7.55
  LONGEST FLOWPATH FROM NODE      3.11 TO NODE      3.20 =     360.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.20 TO NODE      3.20 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.55
  RAINFALL INTENSITY(INCH/HR) =   1.79
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.14
  EFFECTIVE STREAM AREA(ACRES) =       0.79
  TOTAL STREAM AREA(ACRES) =       0.79
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.25

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.46    5.86    2.066  0.30( 0.06) 0.21       0.8       3.03
      1        1.45    6.93    1.878  0.30( 0.06) 0.21       0.8       3.01
      2        1.25    7.55    1.787  0.30( 0.04) 0.14       0.8       3.11

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.58    5.86    2.066  0.30( 0.05) 0.18       1.4       3.03
      2        2.66    6.93    1.878  0.30( 0.05) 0.18       1.6       3.01
      3        2.63    7.55    1.787  0.30( 0.05) 0.18       1.6       3.11

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.66    Tc(MIN.) =     6.93
  EFFECTIVE AREA(ACRES) =       1.55   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =       1.6
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.20 =     435.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.20 TO NODE      3.21 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   117.40  DOWNSTREAM(FEET) =   114.00
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.011
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
```

```
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   3.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.71
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.66
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    6.95
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.21 =     455.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.21 TO NODE      3.21 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.58    5.88    2.062  0.30( 0.05) 0.18       1.4       3.03
      2        2.66    6.95    1.874  0.30( 0.05) 0.18       1.6       3.01
      3        2.63    7.57    1.784  0.30( 0.05) 0.18       1.6       3.11
  LONGEST FLOWPATH FROM NODE      3.01 TO NODE      3.21 =     455.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.32    6.16    2.009  0.30( 0.06) 0.19       2.4       2.05
      2        4.33    6.21    2.000  0.30( 0.06) 0.19       2.4       2.11
      3        4.34    6.31    1.981  0.30( 0.06) 0.19       2.5       2.01
      4        4.30    7.20    1.836  0.30( 0.06) 0.19       2.6       1.03
      5        4.27    7.34    1.816  0.30( 0.06) 0.19       2.6       2.07
      6        4.23    7.45    1.800  0.30( 0.06) 0.19       2.6       1.01
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      3.21 =     500.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.83    5.88    2.062  0.30( 0.06) 0.18       3.7       3.03
      2        6.92    6.16    2.009  0.30( 0.06) 0.18       3.8       2.05
      3        6.94    6.21    2.000  0.30( 0.06) 0.18       3.9       2.11
      4        6.95    6.31    1.981  0.30( 0.06) 0.18       3.9       2.01
      5        6.97    6.95    1.874  0.30( 0.06) 0.18       4.1       3.01
      6        6.94    7.20    1.836  0.30( 0.06) 0.18       4.2       1.03
      7        6.91    7.34    1.816  0.30( 0.06) 0.18       4.2       2.07
      8        6.86    7.45    1.800  0.30( 0.06) 0.18       4.3       1.01
      9        6.82    7.57    1.784  0.30( 0.06) 0.18       4.3       3.11
    TOTAL AREA(ACRES) =        4.3

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        6.97  Tc(MIN.) =    6.947
  EFFECTIVE AREA(ACRES) =      4.14  AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.18
  TOTAL AREA(ACRES) =       4.3
  LONGEST FLOWPATH FROM NODE      1.01 TO NODE      3.21 =     500.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.01 TO NODE      4.01 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    6.95
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.874
```

```
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.23      0.30     0.100    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.38
 EFFECTIVE AREA(ACRES) =      4.37   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.18
 TOTAL AREA(ACRES) =        4.5       PEAK FLOW RATE(CFS) =       7.16

****************************************************************************
 FLOW PROCESS FROM NODE      5.01 TO NODE      5.01 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.95
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.874
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.01      0.30     0.100    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.01      SUBAREA RUNOFF(CFS) =    0.02
 EFFECTIVE AREA(ACRES) =      4.38   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.18
 TOTAL AREA(ACRES) =        4.5       PEAK FLOW RATE(CFS) =       7.17

****************************************************************************
 FLOW PROCESS FROM NODE      6.01 TO NODE      6.01 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.95
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.874
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 CONDOMINIUMS               B        0.08      0.30     0.350    36
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
 SUBAREA AREA(ACRES) =    0.08      SUBAREA RUNOFF(CFS) =    0.13
 EFFECTIVE AREA(ACRES) =      4.46   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.18
 TOTAL AREA(ACRES) =        4.6       PEAK FLOW RATE(CFS) =       7.30

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        7.21    5.88    2.062  0.30( 0.05) 0.18       4.0       3.03
     2        7.30    6.16    2.009  0.30( 0.05) 0.18       4.1       2.05
     3        7.30    6.21    2.000  0.30( 0.05) 0.18       4.2       2.11
     4        7.31    6.31    1.981  0.30( 0.05) 0.18       4.2       2.01
     5        7.30    6.95    1.874  0.30( 0.05) 0.18       4.5       3.01
     6        7.27    7.20    1.836  0.30( 0.05) 0.18       4.5       1.03
     7        7.23    7.34    1.816  0.30( 0.05) 0.18       4.6       2.07
     8        7.19    7.45    1.800  0.30( 0.05) 0.18       4.6       1.01
     9        7.14    7.57    1.784  0.30( 0.05) 0.18       4.6       3.11
 NEW PEAK FLOW DATA ARE:
```

```
  PEAK FLOW RATE(CFS) =       7.31  Tc(MIN.) =    6.31
  AREA-AVERAGED Fm(INCH/HR) =  0.05  AREA-AVERAGED Fp(INCH/HR) =  0.30
  AREA-AVERAGED Ap =  0.18  EFFECTIVE AREA(ACRES) =      4.22
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.6  TC(MIN.) =      6.31
  EFFECTIVE AREA(ACRES) =      4.22  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.182
  PEAK FLOW RATE(CFS)   =       7.31

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.21    5.88    2.062  0.30( 0.05) 0.18       4.0       3.03
      2        7.30    6.16    2.009  0.30( 0.05) 0.18       4.1       2.05
      3        7.30    6.21    2.000  0.30( 0.05) 0.18       4.2       2.11
      4        7.31    6.31    1.981  0.30( 0.05) 0.18       4.2       2.01
      5        7.30    6.95    1.874  0.30( 0.05) 0.18       4.5       3.01
      6        7.27    7.20    1.836  0.30( 0.05) 0.18       4.5       1.03
      7        7.23    7.34    1.816  0.30( 0.05) 0.18       4.6       2.07
      8        7.19    7.45    1.800  0.30( 0.05) 0.18       4.6       1.01
      9        7.14    7.57    1.784  0.30( 0.05) 0.18       4.6       3.11
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER:	AVERY SCOTT 971-227-0854 AVERY.SCOTT@ADSPIPE.COM
ADS SALES REP:	ROHIT CHANDER 909-203-2201 ROHIT.CHANDER@ADSPIPE.COM
PROJECT NO:	S448828

Advanced Drainage Systems, Inc.

WORKFORCE REENTRY CENTER NW SYS

ORANGE, CA

ADS RETENTION/DETENTION PIPE SYSTEM SPECIFICATION

SCOPE
THIS SPECIFICATION DESCRIBES ADS RETENTION/DETENTION PIPE SYSTEMS FOR USE IN NON-PRESSURE GRAVITY-FLOW STORM WATER COLLECTION SYSTEMS UTILIZING A CONTINUOUS OUTFALL STRUCTURE.

PIPE REQUIREMENTS
ADS RETENTION/DETENTION SYSTEMS MAY UTILIZE ANY OF THE VARIOUS PIPE PRODUCTS BELOW:

- N-12® PIPE (PER AASHTO) SHALL MEET AASHTO M 294, TYPE S OR ASTM F2306
- N-12® PIPE (PER ASTM F2648) SHALL MEET ASTM F2648
- N-12® MEGA GREEN™ SHALL MEET ASTM F2648

ALL PRODUCTS SHALL HAVE A SMOOTH INTERIOR AND ANNULAR EXTERIOR CORRUGATIONS. ALL PIPE PRODUCTS ARE AVAILABLE AS PERFORATED OR NON-PERFORATED. PRODUCT-SPECIFIC PIPE SPECIFICATIONS ARE AVAILABLE IN THE DRAINAGE HANDBOOK SECTION 1 "SPECIFICATIONS".

JOINT PERFORMANCE
INTEGRATED BELL (IB):
INTEGRATED BELL (IB) PIPE, SOIL-TIGHT OR WATER-TIGHT, SHALL BE JOINED USING A BELL AND SPIGOT JOINT. THE BELL AND SPIGOT JOINT SHALL MEET OR EXCEED THE SOIL-TIGHT REQUIREMENTS OF ASTM F2306 AND GASKETS SHALL MEET THE REQUIREMENTS OF ASTM F477.

PLAIN END:
PLAIN END PIPE AND FITTINGS CONNECTIONS SHALL BE JOINED WITH COUPLING BANDS COVERING AT LEAST TWO FULL CORRUGATIONS ON EACH END OF THE PIPE. GASKETED SOIL-TIGHT COUPLING BAND CONNECTIONS SHALL INCORPORATE A CLOSED-CELL SYNTHETIC EXPANDED RUBBER GASKET MEETING THE REQUIREMENTS OF ASTM D1056 GRADE 2A2. GASKETS, WHEN APPLICABLE, SHALL BE INSTALLED BY THE PIPE MANUFACTURER.

FITTINGS
FITTINGS SHALL CONFORM TO ASTM F2306 AND MEET JOINT PERFORMANCE INDICATED ABOVE FOR FITTINGS CONNECTIONS. CUSTOM FITTINGS ARE AVAILABLE AND MAY REQUIRE SPECIAL INSTALLATION CRITERION.

INSTALLATION
INSTALLATION SHALL BE IN ACCORDANCE WITH ASTM D2321 AND ADS RECOMMENDED INSTALLATION GUIDELINES, WITH THE EXCEPTION THAT MINIMUM COVER IN NON-TRAFFIC AREAS FOR 12-60 INCH (300-1500 mm) DIAMETERS SHALL BE 1 FT (0.3 m). MINIMUM COVER IN TRAFFICKED AREAS FOR 12-36 INCH (300-900 mm) DIAMETERS SHALL BE 1 FT (0.3 m) AND FOR 42-60 INCH (1050-1500 mm) DIAMETERS, THE MINIMUM COVER SHALL BE 2 FT (0.6 m). BACKFILL SHALL CONSIST OF CLASS I (COMPACTED) OR CLASS II (MINIMUM 95% SPD) MATERIAL, WITH THE EXCEPTION THAT 60 INCH (1500 mm) SYSTEMS SHALL USE CLASS I MATERIAL ONLY. MINIMUM COVER HEIGHTS DO NOT ACCOUNT FOR PIPE BUOYANCY. REFER TO ADS TECHNICAL NOTE 5.05 "PIPE FLOTATION" FOR BUOYANCY DESIGN CONSIDERATIONS. MAXIMUM COVER OVER SYSTEM USING STANDARD BACKFILL IS 8 FT (2.4 m); CONTACT A REPRESENTATIVE WHEN MAXIMUM FILL HEIGHT MAY BE EXCEEDED. ADDITIONAL INSTALLATION REQUIREMENTS ARE PROVIDED IN THE DRAINAGE HANDBOOK SECTION 6 "RETENTION/DETENTION".

ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES:

1) ALL ELEVATIONS, DIMENSIONS AND LOCATIONS OF RISERS, INLETS AND OUTLETS, SHALL BE VERIFIED BY THE ENGINEER PRIOR TO RELEASING FOR FABRICATION.

2) IN SITUATIONS WHERE A FINE-GRAINED BACKFILL MATERIAL IS USED ADJACENT TO THE PIPE SYSTEM, AND ESPECIALLY INVOLVING GROUND WATER CONDITIONS, CONSIDERATION SHOULD BE GIVEN TO THE USE OF GASKETED PIPE JOINTS. AT THE VERY LEAST THE PIPE JOINTS SHOULD BE WRAPPED IN A SUITABLE, NON-WOVEN GEOTEXTILE FABRIC TO PREVENT INFILTRATION OF FINES INTO THE PIPE SYSTEM.

3) CONSIDERATION FOR CONSTRUCTION EQUIPMENT LOADS MUST BE TAKEN INTO ACCOUNT.

4) ALL PIPE DIMENSIONS ARE SUBJECT TO MANUFACTURERS TOLERANCES.

5) ALL RISERS TO BE FIELD EXTENDED OR TRIMMED TO FINAL GRADE.

THE UNDERSIGNED HEREBY APPROVES THE ATTACHED PAGES.

CUSTOMER DATE

BILL OF MATERIALS

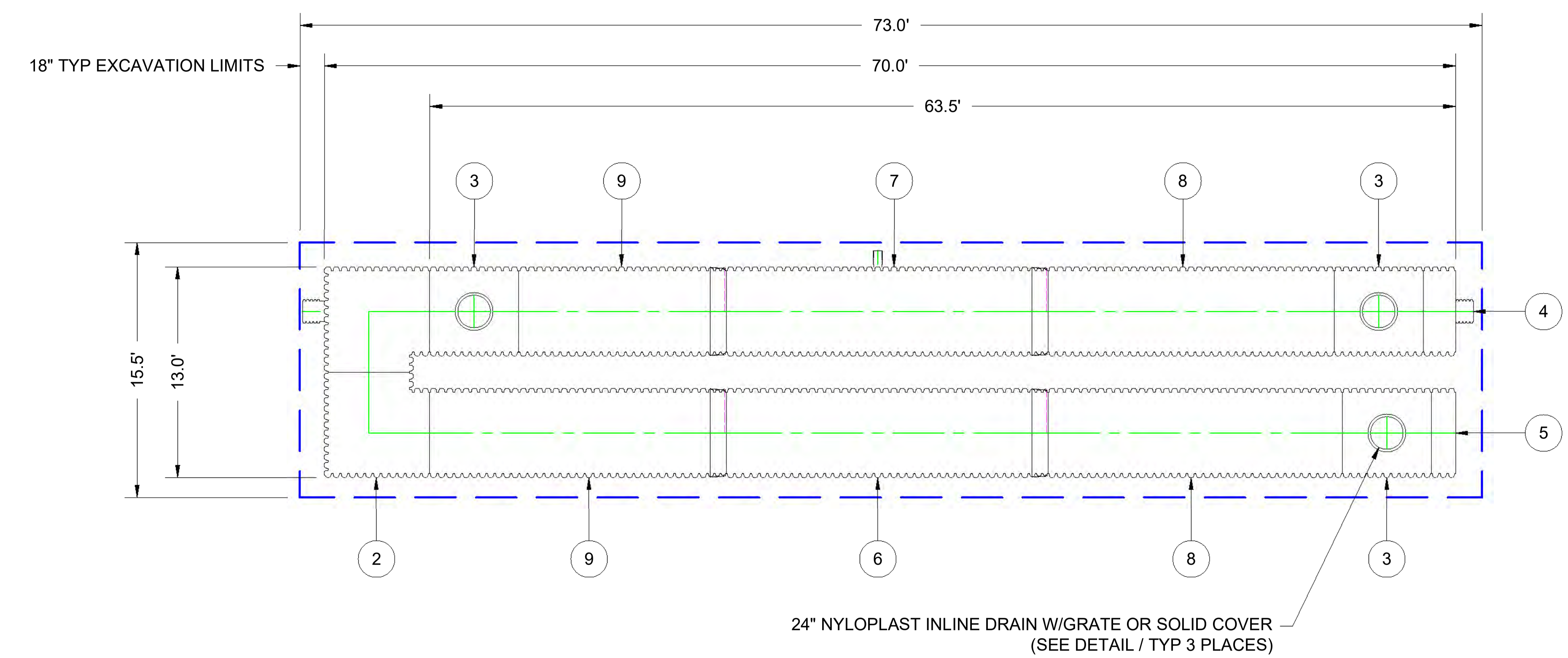
*THE COMPONENTS AND QUANTITIES LISTED HEREIN ARE NOT INTENDED TO BE A COMPREHENSIVE MATERIAL LIST. EXTRA COMPONENTS, NOT LISTED HEREIN, MAY BE NECESSARY TO COMPLETE THE CONSTRUCTION OF THE SYSTEM.

ITEM	QTY.	PART #	DESCRIPTION	MATERIAL	VENDOR	NOTE
1	1	6098ANC-1	60" X 90° MANIFOLD BEND	HDPE	ADS	SEE DETAIL
1-1	1	1506AN	15" STUB	HDPE	ADS	COMPONENT
2	1	6098AN	60" X 90° MANIFOLD BEND	HDPE	ADS	SEE DETAIL
3	3	6067AN	60" X 24" REDUCING TEE	HDPE	ADS	SEE DETAIL
4	1	REDUCER-1	60" X 15" REDUCER	HDPE	ADS	SEE DETAIL
5	1	6001AN	60" END CAP	HDPE	ADS	SEE DETAIL
6	1	6061-0020IB	60" PIPE STICK : PERF	HDPE	ADS	WTIB
7	1	STICK-1	60" PIPE STICK : PERF	HDPE	ADS	SEE DETAIL
8	2	STICK-2	60" PIPE STICK : PERF	HDPE	ADS	FIELD CUT
9	2	STICK-3	60" PIPE STICK : PERF	HDPE	ADS	FIELD CUT
	8	6065AA	60" SPLIT COUPLER	HDPE	ADS	NOT SHOWN
	3	2724AG	24" NYLOPLAST INLINE DRAIN	AS SPECIFIED	ADS	SEE DETAIL
	1	AS SPECIFIED	ADS GEOTEXTILE FABRIC	AS SPECIFIED	ADS	AS NEEDED

NOTES

- STUB SIZES AND INVERTS TO BE VERIFIED BY THE SITE DESIGN ENGINEER PRIOR TO FABRICATION.
- REDUCERS CAN BE ROTATED IN THE FIELD TO MATCH CONNECTING INVERTS.

- **ATTENTION**: THIS DRAWING IS NOT INTENDED FOR USE IN BIDDING OR CONSTRUCTION WITHOUT THE PRIOR APPROVAL OF THE PROJECT'S ENGINEER OF RECORD (EOR). AS WITH ALL PROPOSED ADS LAYOUTS, THE EOR SHOULD REVIEW AND APPROVE THIS DRAWING PRIOR TO USE IN BIDDING AND/OR CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE EOR TO ENSURE THAT THE PRODUCT(S) DEPICTED AND THE ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.



ADS GEOTEXTILE FABRIC
(IF REQUIRED BY SITE DESIGN ENGINEER)

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

0 10' 20'

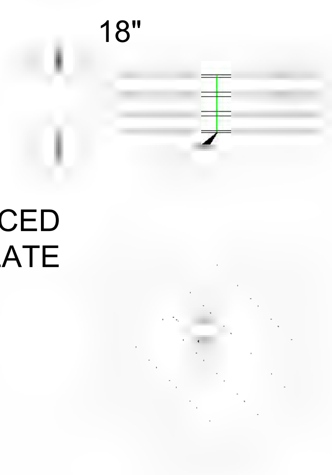
60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

DATE	DRWN	CHKD	DESCRIPTION

WORKFORCE REENTRY CENTER
NW SYS
ORANGE, CA

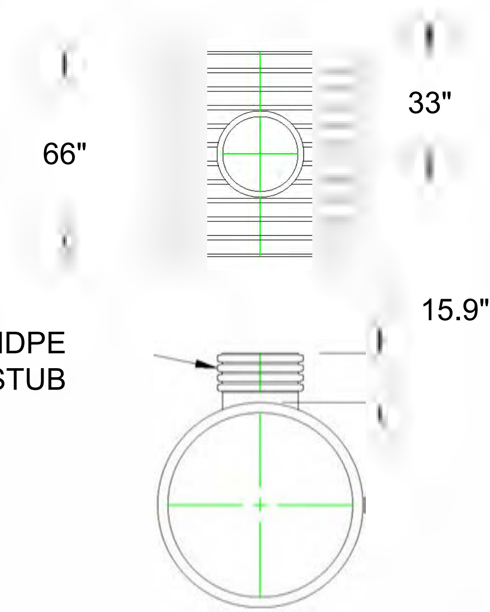
DATE:	1-8-25	DRAWN:	TLN
PROJECT #:	S448828	CHECKED:	TLN

60" END CAP



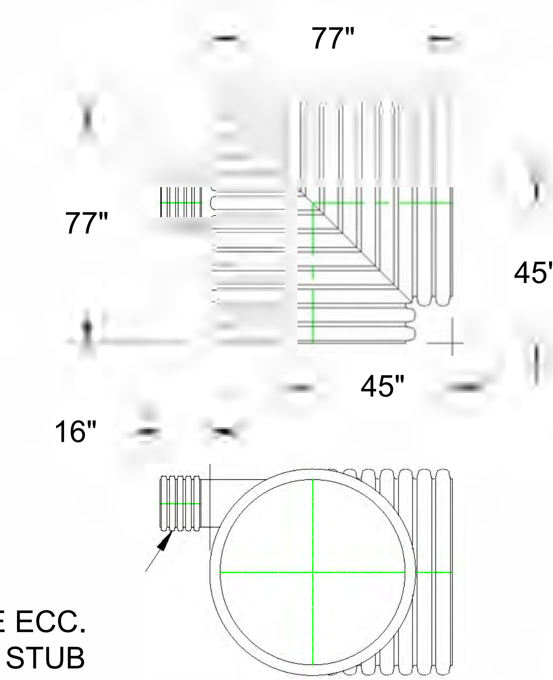
ITEM #:	5
QTY:	1
6001AN	

60" X 24" REDUCING TEE (USE AS RISER)



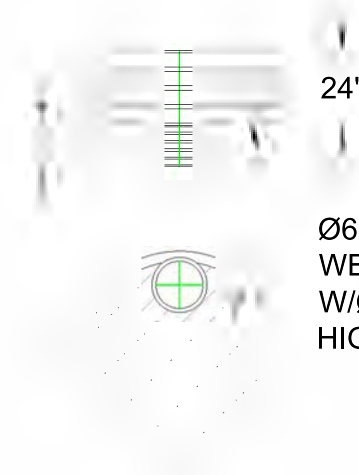
ITEM #:	3
QTY:	3
6067AN	

60" X 90° MANIFOLD BEND W15" STUB



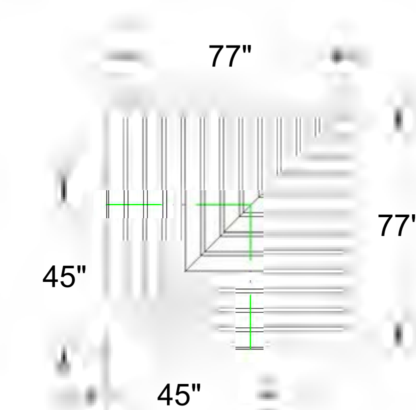
ITEM #:	1
QTY:	1
6098ANC-1	

60" X 15" REDUCER



ITEM #:	4
QTY:	1
REDUCER-1	

60" X 90° MANIFOLD BEND



ITEM #:	2
QTY:	1
6098AN	

WORKFORCE REENTRY CENTER
NW SYS
ORANGE, CA

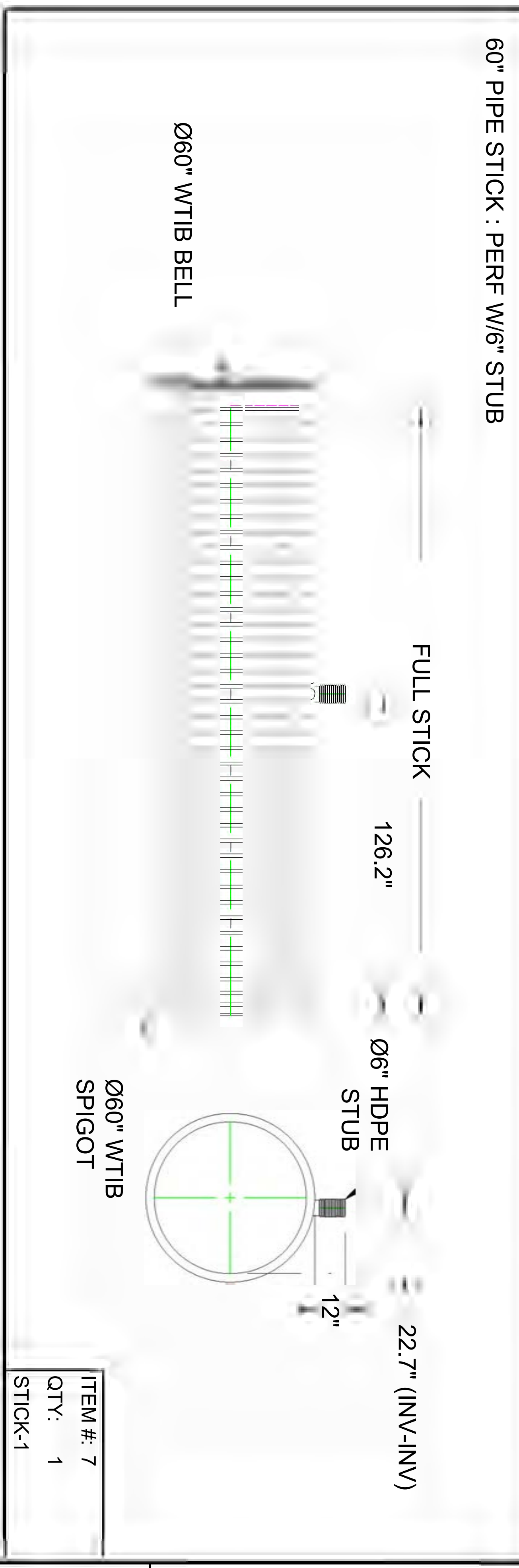
DATE:	1-8-25	DRAWN:	TLN
PROJECT #:	S448828	CHECKED:	TLN

DATE	DRWN	CHKD	DESCRIPTION

60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

SHEET 3 OF 6



DATE	DRWN	CHKD	DESCRIPTION

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

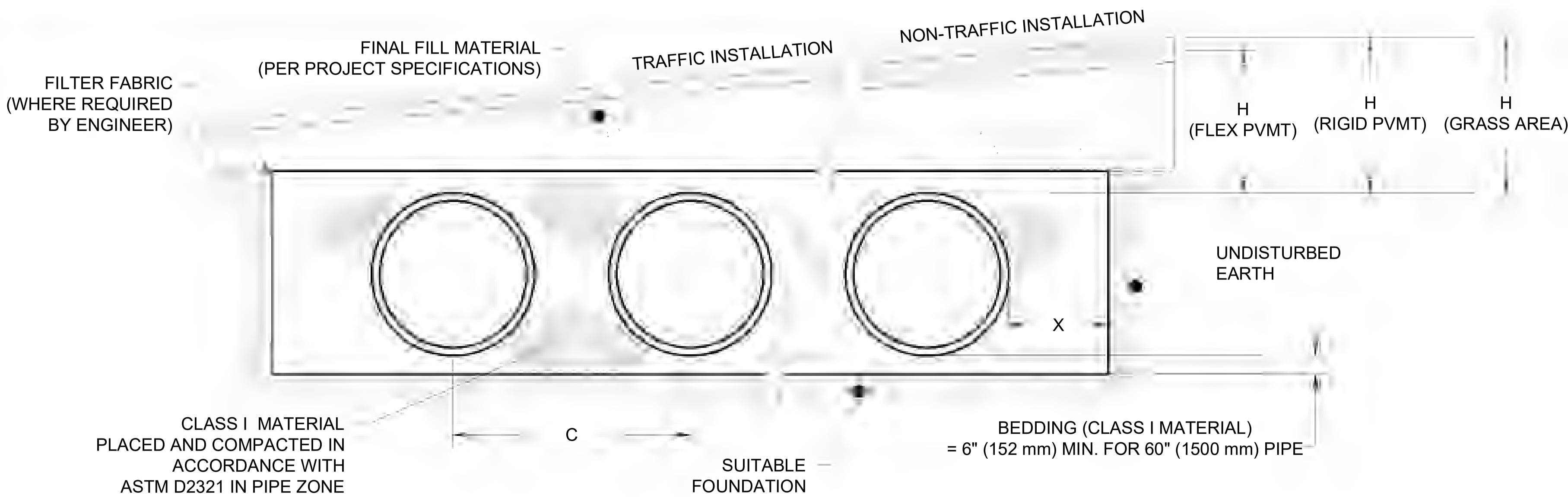
60" WTIB : PERF DETENTION

LandMax
Stormwater Management System

WORKFORCE REENTRY CENTER
NW SYS
ORANGE, CA

DATE:	1-8-25	DRAWN:	TLN
PROJECT #:	S448828	CHECKED:	TLN

SHEET 4 OF 6



NOMINAL DIAMETER	NOMINAL O.D.	STANDARD SPACING "C"	TYPICAL SIDE WALL "X"	MIN. H (NON-TRAFFIC)	MIN. H (TRAFFIC)	MAX. H*
60" (1500 mm)	67" (1702 mm)	90" (2286 mm)	18" (457 mm)	12" (305 mm)	24" (610 mm)	8' (2.4 m)

* MAXIMUM FILL HEIGHTS OVER MANIFOLD FITTINGS. CONTACT MANUFACTURER'S REPRESENTATIVE FOR INSTALLATION CONSIDERATIONS WHEN COVER EXCEEDS 8 FT (2.4 m).
**60" (1500 mm) SYSTEMS REQUIRE CLASS I BACKFILL AROUND ALL LATERALS AND FITTINGS.

NOTES:

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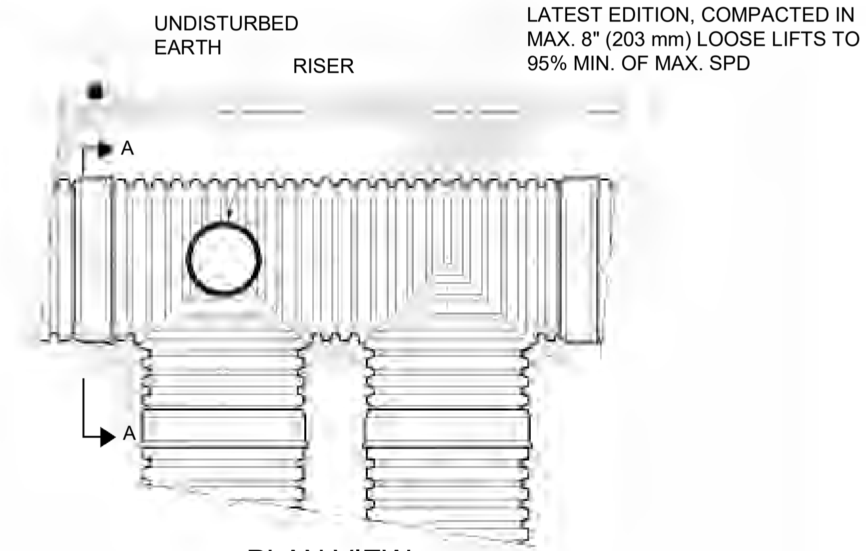
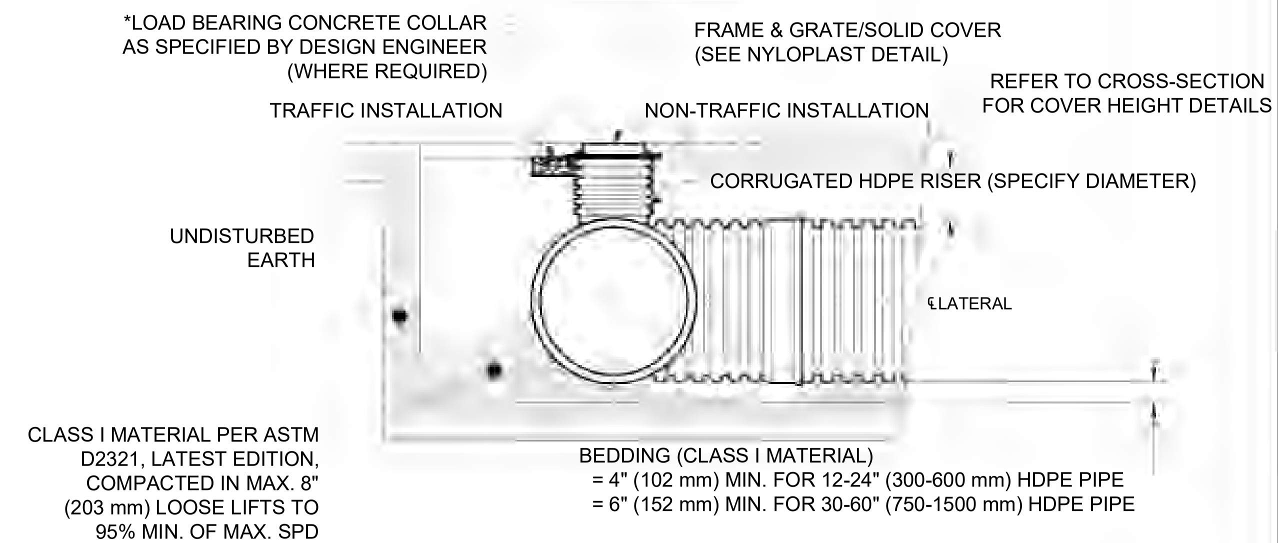


PLAN VIEW



SECTION A-A

* LOAD BEARING CONCRETE COLLAR SHALL BE CONSTRUCTED IN TRAFFIC AREAS SUCH THAT THE LIVE LOAD IS TRANSMITTED TO THE SURROUNDING SOIL AND NOT DIRECTLY TO THE RISER.

WORKFORCE REENTRY CENTER NW SYS ORANGE, CA	
DATE: 1-8-25	DRAWN: TLN
PROJECT #: S448828	CHECKED: TLN

DATE	DRWN	CHKD	DESCRIPTION

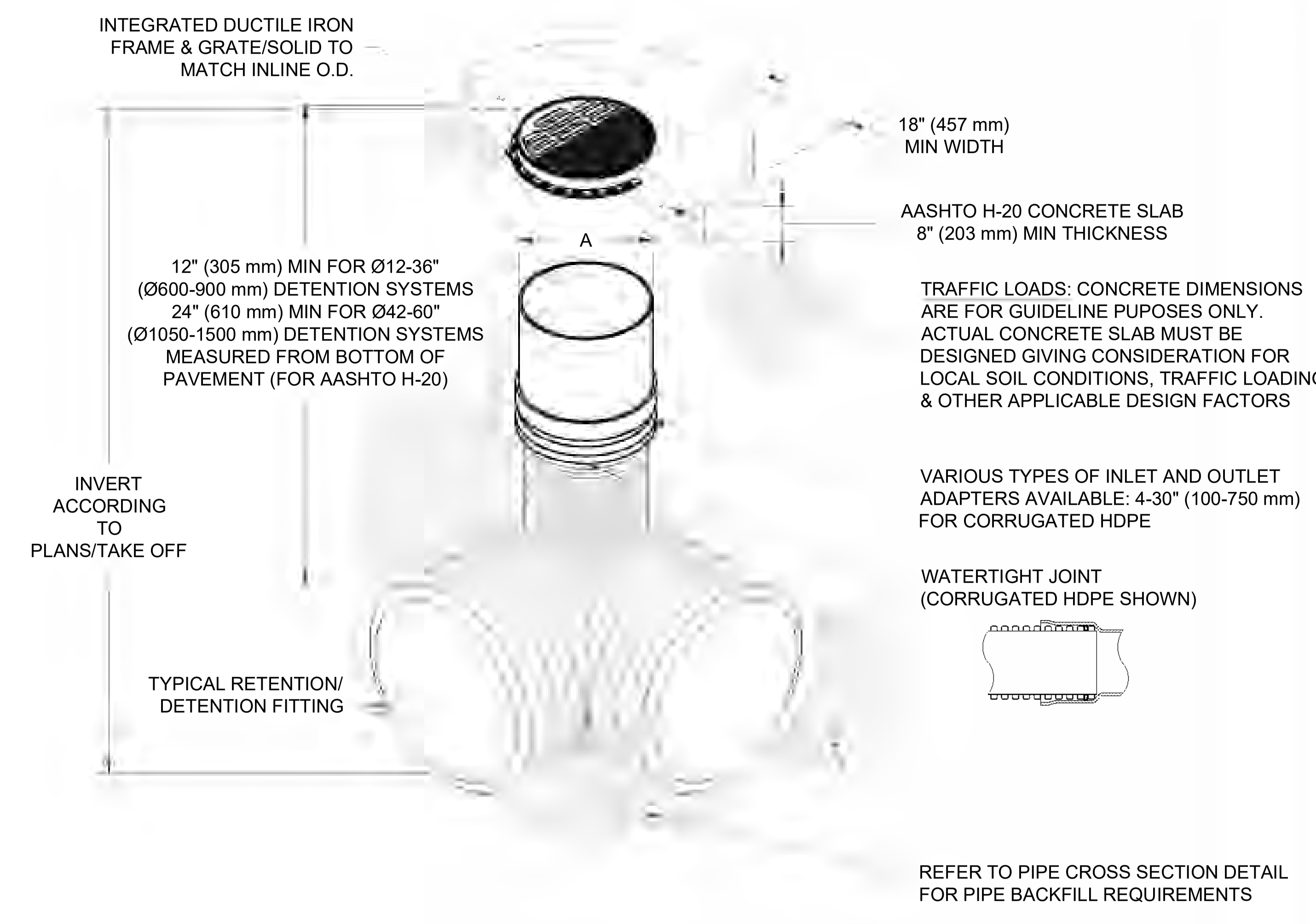
60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

SHEET 5 OF 6

NYLOPLAST INLINE DRAIN

NTS



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3. DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS
4. DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS & HANCOR DUAL WALL) & SDR 35 PVC
5. FOR COMPLETE DESIGN AND PRODUCT INFORMATION: **WWW.NYLOPLAST-US.COM**
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A	PART #	GRATE/SOLID COVER OPTIONS		
8" (200 mm)	2708AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
10" (250 mm)	2710AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
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24" (600 mm)	2724AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
30" (750 mm)	2730AG	PEDESTRIAN AASHTO H-20	STANDARD AASHTO H-20	SOLID AASHTO H-20

WORKFORCE REENTRY CENTER
NW SYS
ORANGE, CA

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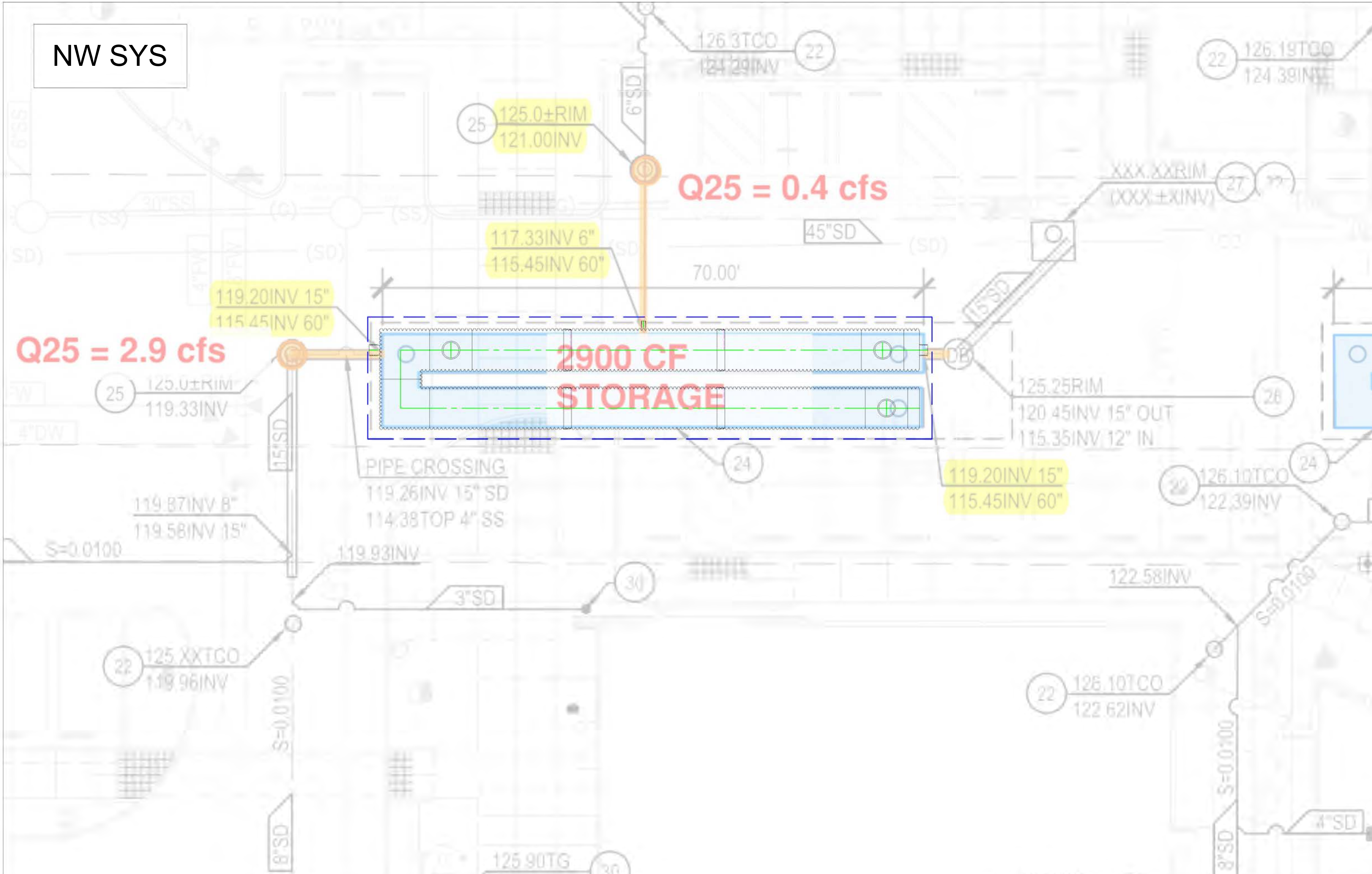
Nyloplast®

770-932-2443 | WWW.NYLOPLAST-US.COM

ADS

4640 TRUEMAN BLVD
HILLIARD, OH 43026


NW SYS
Q25 = 0.4 cfs
Q25 = 2.9 cfs
2900 CF STORAGE
125.0±RIM
121.00INV
117.33INV 6"
115.45INV 60"
119.20INV 15"
115.45INV 60"
70.00'
45"SD
125.25RIM
120.45INV 15" OUT
115.35INV 12" IN
119.20INV 15"
115.45INV 60"
PIPE CROSSING
119.26INV 15" SD
114.38TOP 4" SS
119.87INV 8"
119.58INV 15"
S=0.0100
119.93INV
3"SD
125.0±RIM
119.33INV
126.3TCO
124.29INV
126.19TCO
124.39INV
XXX.XXRIM
(XXX.±XINV)
126.10TCO
122.39INV
122.58INV
126.10TCO
122.62INV
125.XXTCO
119.96INV
125.90TG
4"SD
8"SD
6"SD
15"SD

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER:	AVERY SCOTT 971-227-0854 AVERY.SCOTT@ADSPIPE.COM
ADS SALES REP:	ROHIT CHANDER 909-203-2201 ROHIT.CHANDER@ADSPIPE.COM
PROJECT NO:	S448828

Advanced Drainage Systems, Inc.

WORKFORCE REENTRY CENTER NE SYS

ORANGE, CA

ADS RETENTION/DETENTION PIPE SYSTEM SPECIFICATION

SCOPE
THIS SPECIFICATION DESCRIBES ADS RETENTION/DETENTION PIPE SYSTEMS FOR USE IN NON-PRESSURE GRAVITY-FLOW STORM WATER COLLECTION SYSTEMS UTILIZING A CONTINUOUS OUTFALL STRUCTURE.

PIPE REQUIREMENTS
ADS RETENTION/DETENTION SYSTEMS MAY UTILIZE ANY OF THE VARIOUS PIPE PRODUCTS BELOW:

- N-12® PIPE (PER AASHTO) SHALL MEET AASHTO M 294, TYPE S OR ASTM F2306
- N-12® PIPE (PER ASTM F2648) SHALL MEET ASTM F2648
- N-12® MEGA GREEN™ SHALL MEET ASTM F2648

ALL PRODUCTS SHALL HAVE A SMOOTH INTERIOR AND ANNULAR EXTERIOR CORRUGATIONS. ALL PIPE PRODUCTS ARE AVAILABLE AS PERFORATED OR NON-PERFORATED. PRODUCT-SPECIFIC PIPE SPECIFICATIONS ARE AVAILABLE IN THE DRAINAGE HANDBOOK SECTION 1 "SPECIFICATIONS".

JOINT PERFORMANCE
INTEGRATED BELL (IB):
INTEGRATED BELL (IB) PIPE, SOIL-TIGHT OR WATER-TIGHT, SHALL BE JOINED USING A BELL AND SPIGOT JOINT. THE BELL AND SPIGOT JOINT SHALL MEET OR EXCEED THE SOIL-TIGHT REQUIREMENTS OF ASTM F2306 AND GASKETS SHALL MEET THE REQUIREMENTS OF ASTM F477.

PLAIN END:
PLAIN END PIPE AND FITTINGS CONNECTIONS SHALL BE JOINED WITH COUPLING BANDS COVERING AT LEAST TWO FULL CORRUGATIONS ON EACH END OF THE PIPE. GASKETED SOIL-TIGHT COUPLING BAND CONNECTIONS SHALL INCORPORATE A CLOSED-CELL SYNTHETIC EXPANDED RUBBER GASKET MEETING THE REQUIREMENTS OF ASTM D1056 GRADE 2A2. GASKETS, WHEN APPLICABLE, SHALL BE INSTALLED BY THE PIPE MANUFACTURER.

FITTINGS
FITTINGS SHALL CONFORM TO ASTM F2306 AND MEET JOINT PERFORMANCE INDICATED ABOVE FOR FITTINGS CONNECTIONS. CUSTOM FITTINGS ARE AVAILABLE AND MAY REQUIRE SPECIAL INSTALLATION CRITERION.

INSTALLATION
INSTALLATION SHALL BE IN ACCORDANCE WITH ASTM D2321 AND ADS RECOMMENDED INSTALLATION GUIDELINES, WITH THE EXCEPTION THAT MINIMUM COVER IN NON-TRAFFIC AREAS FOR 12-60 INCH (300-1500 mm) DIAMETERS SHALL BE 1 FT (0.3 m). MINIMUM COVER IN TRAFFICKED AREAS FOR 12-36 INCH (300-900 mm) DIAMETERS SHALL BE 1 FT (0.3 m) AND FOR 42-60 INCH (1050-1500 mm) DIAMETERS, THE MINIMUM COVER SHALL BE 2 FT (0.6 m). BACKFILL SHALL CONSIST OF CLASS I (COMPACTED) OR CLASS II (MINIMUM 95% SPD) MATERIAL, WITH THE EXCEPTION THAT 60 INCH (1500 mm) SYSTEMS SHALL USE CLASS I MATERIAL ONLY. MINIMUM COVER HEIGHTS DO NOT ACCOUNT FOR PIPE BUOYANCY. REFER TO ADS TECHNICAL NOTE 5.05 "PIPE FLOTATION" FOR BUOYANCY DESIGN CONSIDERATIONS. MAXIMUM COVER OVER SYSTEM USING STANDARD BACKFILL IS 8 FT (2.4 m); CONTACT A REPRESENTATIVE WHEN MAXIMUM FILL HEIGHT MAY BE EXCEEDED. ADDITIONAL INSTALLATION REQUIREMENTS ARE PROVIDED IN THE DRAINAGE HANDBOOK SECTION 6 "RETENTION/DETENTION".

ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES:

1) ALL ELEVATIONS, DIMENSIONS AND LOCATIONS OF RISERS, INLETS AND OUTLETS, SHALL BE VERIFIED BY THE ENGINEER PRIOR TO RELEASING FOR FABRICATION.

2) IN SITUATIONS WHERE A FINE-GRAINED BACKFILL MATERIAL IS USED ADJACENT TO THE PIPE SYSTEM, AND ESPECIALLY INVOLVING GROUND WATER CONDITIONS, CONSIDERATION SHOULD BE GIVEN TO THE USE OF GASKETED PIPE JOINTS. AT THE VERY LEAST THE PIPE JOINTS SHOULD BE WRAPPED IN A SUITABLE, NON-WOVEN GEOTEXTILE FABRIC TO PREVENT INFILTRATION OF FINES INTO THE PIPE SYSTEM.

3) CONSIDERATION FOR CONSTRUCTION EQUIPMENT LOADS MUST BE TAKEN INTO ACCOUNT.

4) ALL PIPE DIMENSIONS ARE SUBJECT TO MANUFACTURERS TOLERANCES.

5) ALL RISERS TO BE FIELD EXTENDED OR TRIMMED TO FINAL GRADE.

THE UNDERSIGNED HEREBY APPROVES THE ATTACHED PAGES.

CUSTOMER DATE

BILL OF MATERIALS

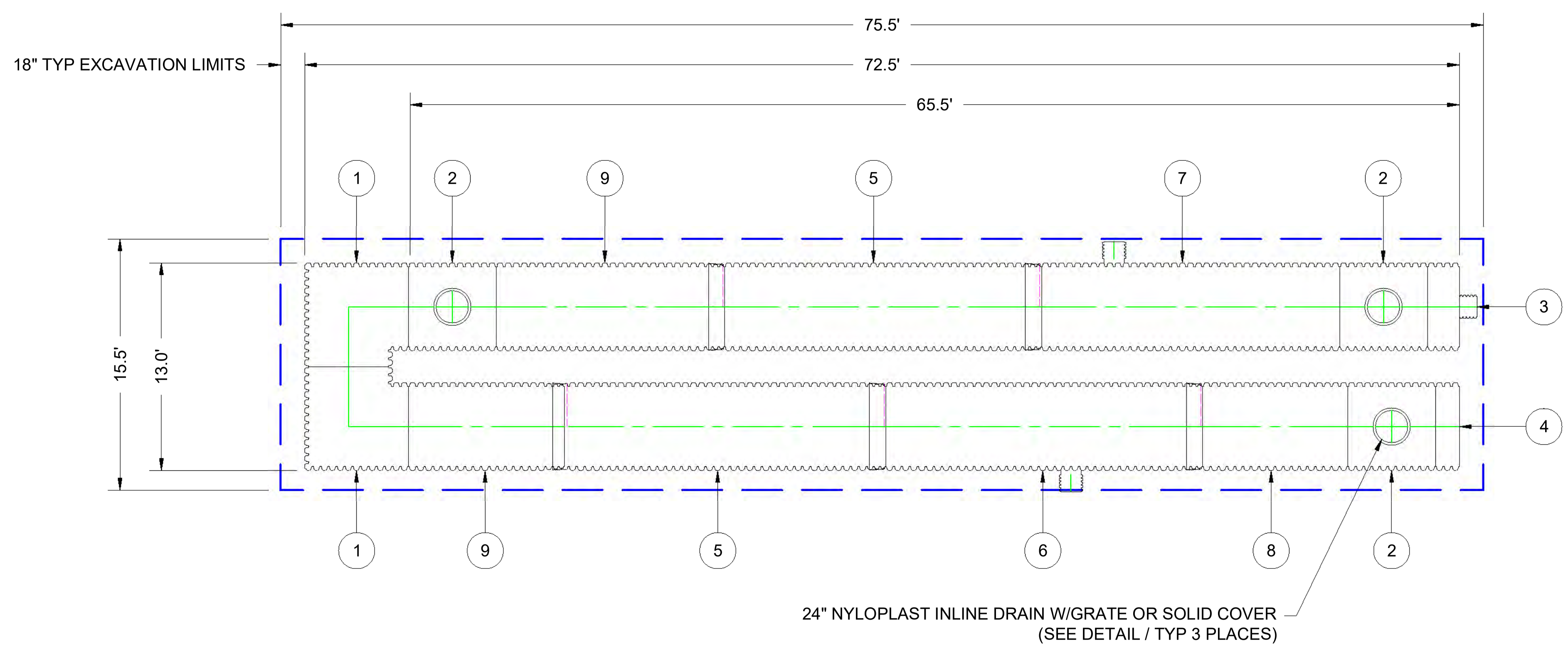
*THE COMPONENTS AND QUANTITIES LISTED HEREIN ARE NOT INTENDED TO BE A COMPREHENSIVE MATERIAL LIST. EXTRA COMPONENTS, NOT LISTED HEREIN, MAY BE NECESSARY TO COMPLETE THE CONSTRUCTION OF THE SYSTEM.

ITEM	QTY.	PART #	DESCRIPTION	MATERIAL	VENDOR	NOTE
1	2	6098AN	60" X 90° MANIFOLD BEND	HDPE	ADS	SEE DETAIL
2	3	6067AN	60" X 24" REDUCING TEE	HDPE	ADS	SEE DETAIL
3	1	REDUCER-1	60" X 15" REDUCER	HDPE	ADS	SEE DETAIL
4	1	6001AN	60" END CAP	HDPE	ADS	SEE DETAIL
5	2	6061-0020IB	60" PIPE STICK : PERF	HDPE	ADS	WTIB
6	1	STICK-1	60" PIPE STICK : PERF	HDPE	ADS	SEE DETAIL
7	1	STICK-2	60" PIPE STICK : PERF	HDPE	ADS	FIELD CUT
8	1	STICK-3	60" PIPE STICK : PERF	HDPE	ADS	FIELD CUT
9	2	STICK-4	60" PIPE STICK : PERF	HDPE	ADS	FIELD CUT
	8	6065AA	60" SPLIT COUPLER	HDPE	ADS	NOT SHOWN
	3	2724AG	24" NYLOPLAST INLINE DRAIN	AS SPECIFIED	ADS	SEE DETAIL
	1	AS SPECIFIED	ADS GEOTEXTILE FABRIC	AS SPECIFIED	ADS	AS NEEDED

NOTES

- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE PIPE COVER REQUIREMENTS ARE MET.
- STUB SIZES AND INVERTS TO BE VERIFIED BY THE SITE DESIGN ENGINEER PRIOR TO FABRICATION.
- REDUCERS CAN BE ROTATED IN THE FIELD TO MATCH CONNECTING INVERTS.

- **ATTENTION:** THIS DRAWING IS NOT INTENDED FOR USE IN BIDDING OR CONSTRUCTION WITHOUT THE PRIOR APPROVAL OF THE PROJECT'S ENGINEER OF RECORD (EOR). AS WITH ALL PROPOSED ADS LAYOUTS, THE EOR SHOULD REVIEW AND APPROVE THIS DRAWING PRIOR TO USE IN BIDDING AND/OR CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE EOR TO ENSURE THAT THE PRODUCT(S) DEPICTED AND THE ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.



ADS GEOTEXTILE FABRIC
(IF REQUIRED BY SITE DESIGN ENGINEER)

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NE SYS
ORANGE, CA

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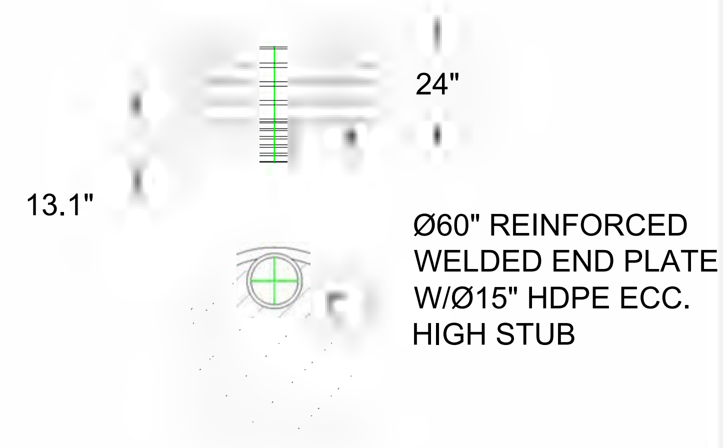
60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

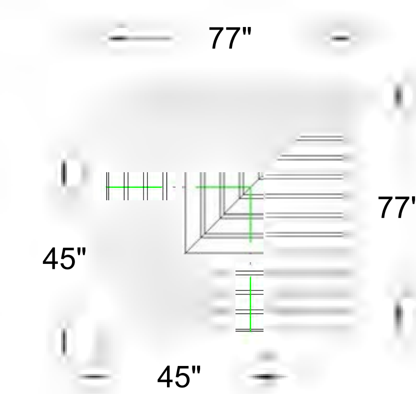
0 10' 20'

60" X 15" REDUCER



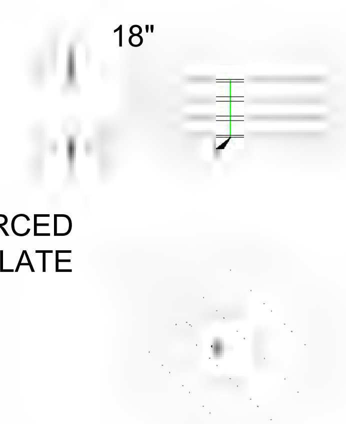
ITEM #: 3
QTY: 1
REDUCER-1

60" X 90° MANIFOLD BEND



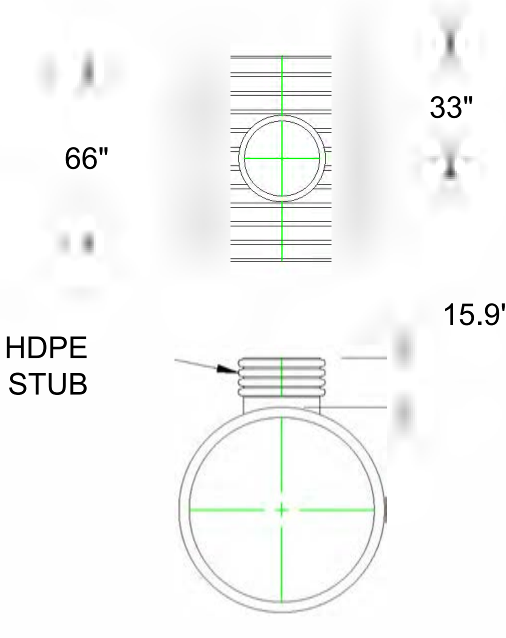
ITEM #: 1
QTY: 2
6098AN

60" END CAP



ITEM #: 4
QTY: 1
6001AN

60" X 24" REDUCING TEE (USE AS RISER)



ITEM #: 2
QTY: 3
6067AN

DATE	DRWN	CHKD	DESCRIPTION

WORKFORCE REENTRY CENTER
NE SYS
ORANGE, CA

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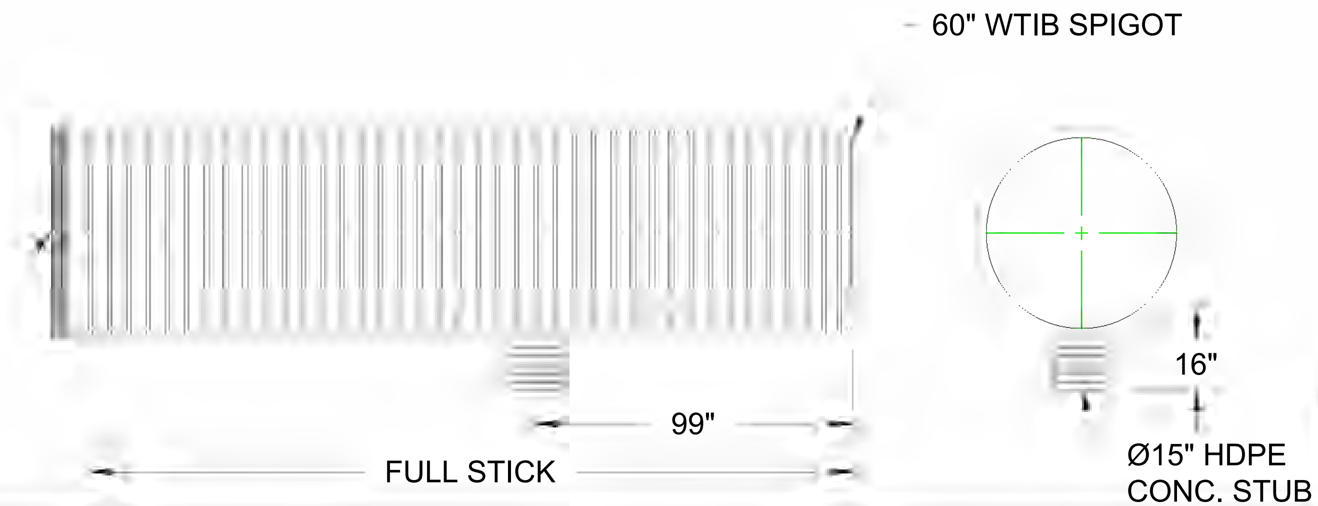
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

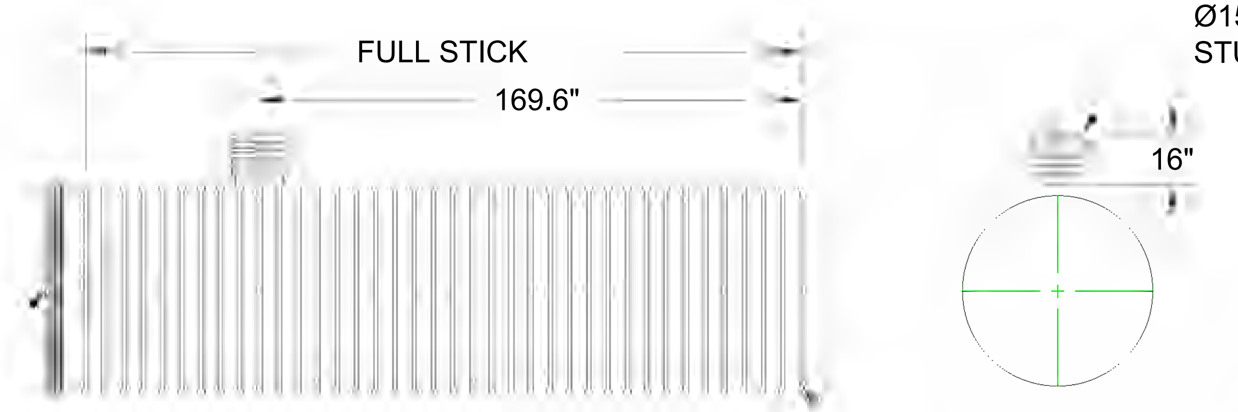
SHEET 3 OF 6

60" PIPE STICK : PERF W/15" STUB



ITEM #:	6
QTY:	1
STICK-1	

60" PIPE STICK : PERF W/15" STUB



ITEM #:	7
QTY:	1
STICK-2	

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

60" WTIB : PERF
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LandMax
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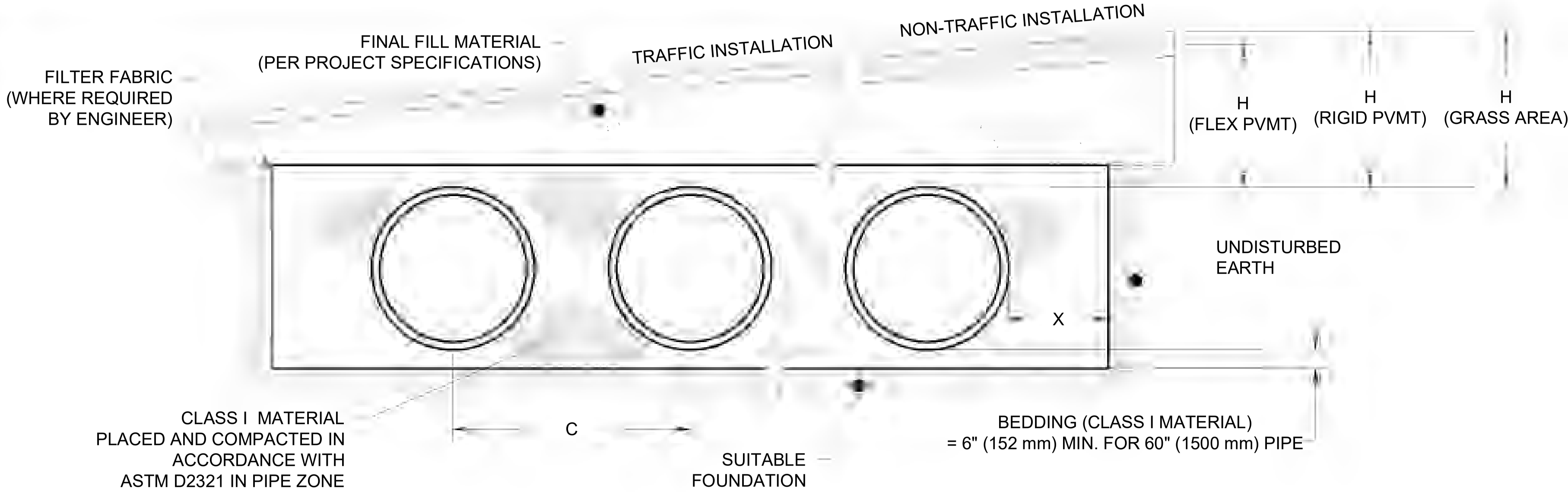

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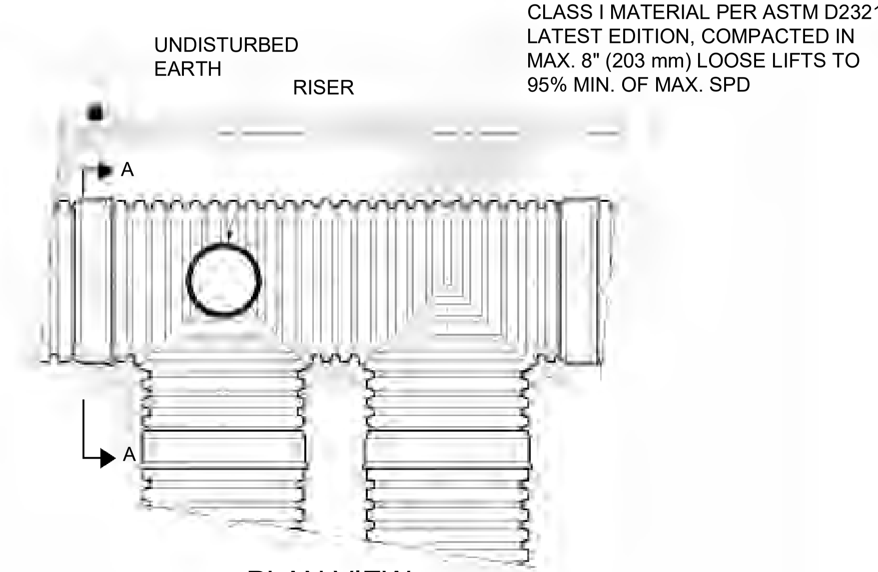
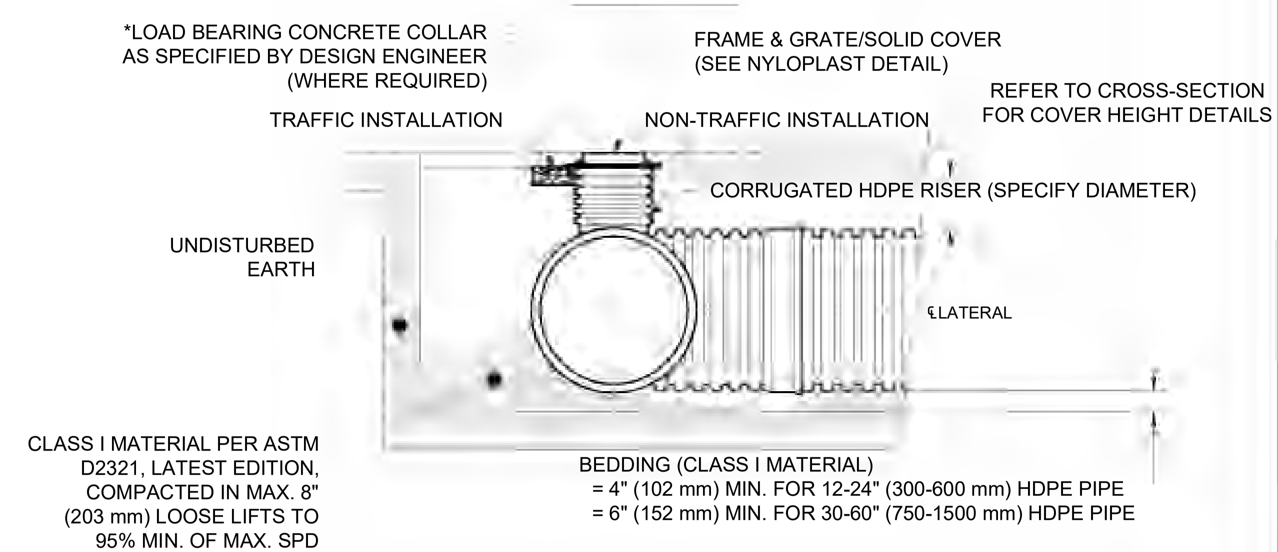


PLAN VIEW



SECTION A-A

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NE SYS
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60" WTIB : PERF
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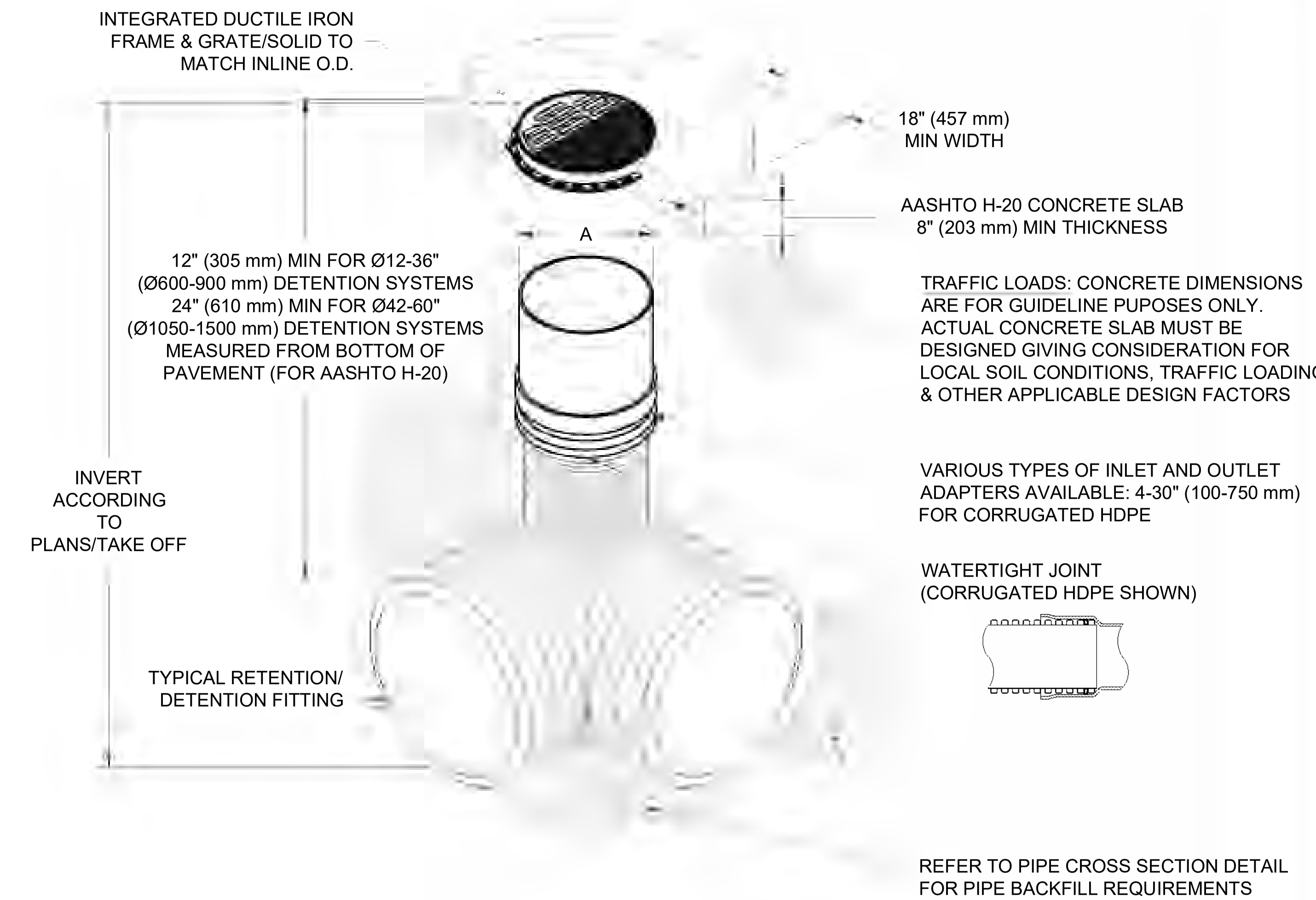
SHEET 5 OF 6

NYLOPLAST INLINE DRAIN

NTS



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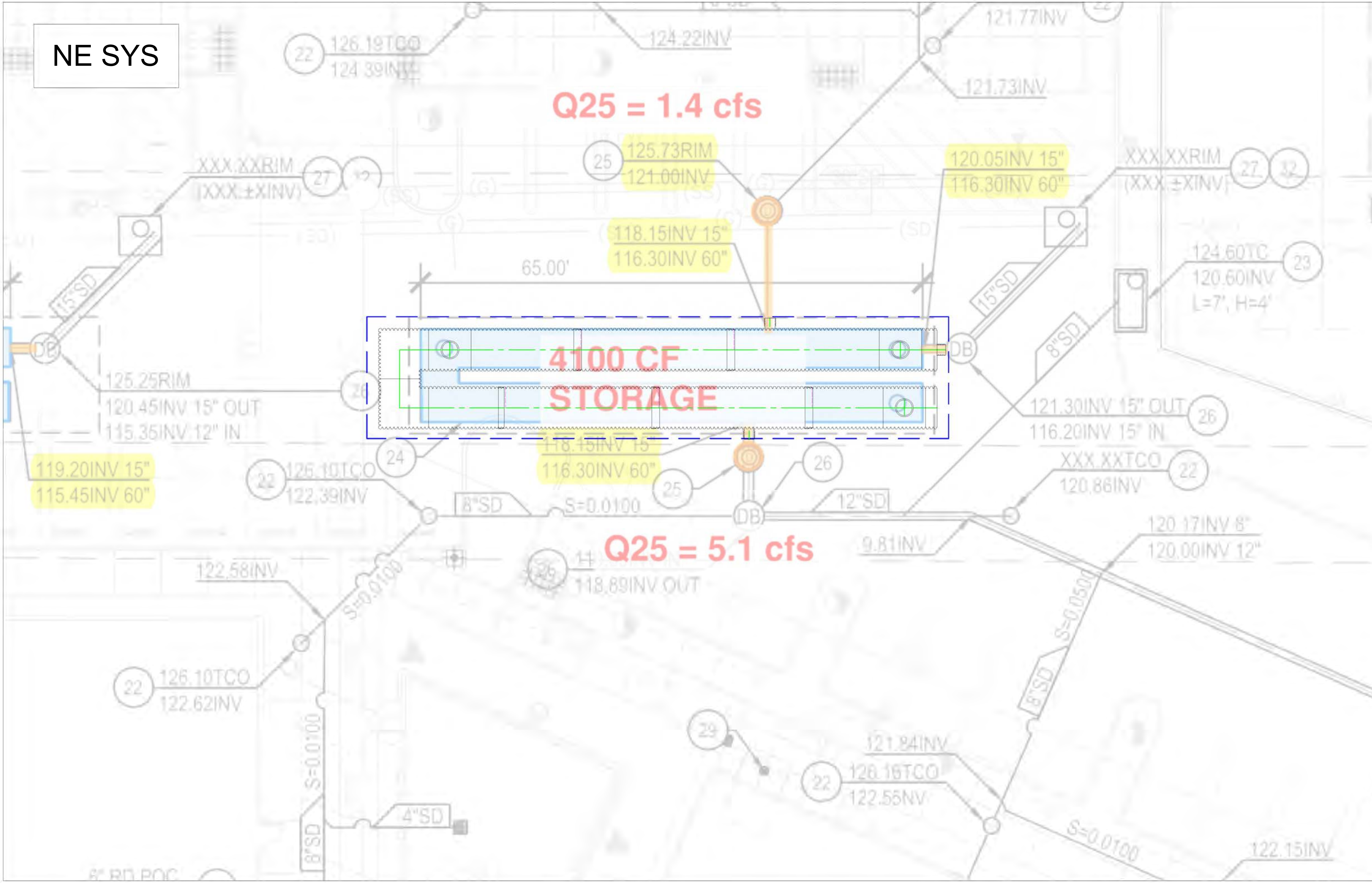
15" (375 mm)	2715AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
18" (450 mm)	2718AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
24" (600 mm)	2724AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
30" (750 mm)	2730AG	PEDESTRIAN AASHTO H-20	STANDARD AASHTO H-20	SOLID AASHTO H-20

WORKFORCE REENTRY CENTER
NE SYS
ORANGE, CA

DATE: 1-8-25 | DRAWN: TLN
PROJECT #: S448828 | CHECKED: TLN

DATE	DRWN	CHKD	DESCRIPTION

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
Nyloplast®
770-932-2443 | WWW.NYLOPLAST-US.COM


NE SYS
Q25 = 1.4 cfs
4100 CF
STORAGE
Q25 = 5.1 cfs
125.73RIM
121.00INV
120.05INV 15"
116.30INV 60"
118.15INV 15"
116.30INV 60"
65.00'
119.20INV 15"
115.45INV 60"
125.25RIM
120.45INV 15" OUT
115.35INV 12" IN
121.30INV 15" OUT
116.20INV 15" IN
126.19TCO
124.39INV
124.22INV
121.77INV
121.73INV
124.60TC
120.60INV
L=7', H=4'
126.10TCO
122.39INV
XXX.XXTCO
120.86INV
120.17INV 8"
120.00INV 12"
118.89INV OUT
122.58INV
126.10TCO
122.62INV
121.84INV
126.18TCO
122.55NV
122.15INV
S=0.0100
8"SD
12"SD
15"SD
4"SD
6" RD POC

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER:	AVERY SCOTT 971-227-0854 AVERY.SCOTT@ADSPIPE.COM
ADS SALES REP:	ROHIT CHANDER 909-203-2201 ROHIT.CHANDER@ADSPIPE.COM
PROJECT NO:	S448828

ADS™

Advanced Drainage Systems, Inc.

WORKFORCE REENTRY CENTER SOUTH SYS

ORANGE, CA

ADS RETENTION/DETENTION PIPE SYSTEM SPECIFICATION

SCOPE

THIS SPECIFICATION DESCRIBES ADS RETENTION/DETENTION PIPE SYSTEMS FOR USE IN NON-PRESSURE GRAVITY-FLOW STORM WATER COLLECTION SYSTEMS UTILIZING A CONTINUOUS OUTFALL STRUCTURE.

PIPE REQUIREMENTS

ADS RETENTION/DETENTION SYSTEMS MAY UTILIZE ANY OF THE VARIOUS PIPE PRODUCTS BELOW:

- N-12® PIPE (PER AASHTO) SHALL MEET AASHTO M 294, TYPE S OR ASTM F2306
- N-12® PIPE (PER ASTM F2648) SHALL MEET ASTM F2648
- N-12® MEGA GREEN™ SHALL MEET ASTM F2648

ALL PRODUCTS SHALL HAVE A SMOOTH INTERIOR AND ANNULAR EXTERIOR CORRUGATIONS. ALL PIPE PRODUCTS ARE AVAILABLE AS PERFORATED OR NON-PERFORATED. PRODUCT-SPECIFIC PIPE SPECIFICATIONS ARE AVAILABLE IN THE DRAINAGE HANDBOOK SECTION 1 "SPECIFICATIONS".

JOINT PERFORMANCE

INTEGRATED BELL (IB):

INTEGRATED BELL (IB) PIPE, SOIL-TIGHT OR WATER-TIGHT, SHALL BE JOINED USING A BELL AND SPIGOT JOINT. THE BELL AND SPIGOT JOINT SHALL MEET OR EXCEED THE SOIL-TIGHT REQUIREMENTS OF ASTM F2306 AND GASKETS SHALL MEET THE REQUIREMENTS OF ASTM F477.

PLAIN END:

PLAIN END PIPE AND FITTINGS CONNECTIONS SHALL BE JOINED WITH COUPLING BANDS COVERING AT LEAST TWO FULL CORRUGATIONS ON EACH END OF THE PIPE. GASKETED SOIL-TIGHT COUPLING BAND CONNECTIONS SHALL INCORPORATE A CLOSED-CELL SYNTHETIC EXPANDED RUBBER GASKET MEETING THE REQUIREMENTS OF ASTM D1056 GRADE 2A2. GASKETS, WHEN APPLICABLE, SHALL BE INSTALLED BY THE PIPE MANUFACTURER.

FITTINGS

FITTINGS SHALL CONFORM TO ASTM F2306 AND MEET JOINT PERFORMANCE INDICATED ABOVE FOR FITTINGS CONNECTIONS. CUSTOM FITTINGS ARE AVAILABLE AND MAY REQUIRE SPECIAL INSTALLATION CRITERION.

INSTALLATION

INSTALLATION SHALL BE IN ACCORDANCE WITH ASTM D2321 AND ADS RECOMMENDED INSTALLATION GUIDELINES, WITH THE EXCEPTION THAT MINIMUM COVER IN NON-TRAFFIC AREAS FOR 12-60 INCH (300-1500 mm) DIAMETERS SHALL BE 1 FT (0.3 m). MINIMUM COVER IN TRAFFICKED AREAS FOR 12-36 INCH (300-900 mm) DIAMETERS SHALL BE 1 FT (0.3 m) AND FOR 42-60 INCH (1050-1500 mm) DIAMETERS, THE MINIMUM COVER SHALL BE 2 FT (0.6 m). BACKFILL SHALL CONSIST OF CLASS I (COMPACTED) OR CLASS II (MINIMUM 95% SPD) MATERIAL, WITH THE EXCEPTION THAT 60 INCH (1500 mm) SYSTEMS SHALL USE CLASS I MATERIAL ONLY. MINIMUM COVER HEIGHTS DO NOT ACCOUNT FOR PIPE BUOYANCY. REFER TO ADS TECHNICAL NOTE 5.05 "PIPE FLOTATION" FOR BUOYANCY DESIGN CONSIDERATIONS. MAXIMUM COVER OVER SYSTEM USING STANDARD BACKFILL IS 8 FT (2.4 m); CONTACT A REPRESENTATIVE WHEN MAXIMUM FILL HEIGHT MAY BE EXCEEDED. ADDITIONAL INSTALLATION REQUIREMENTS ARE PROVIDED IN THE DRAINAGE HANDBOOK SECTION 6 "RETENTION/DETENTION".

ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES:

1) ALL ELEVATIONS, DIMENSIONS AND LOCATIONS OF RISERS, INLETS AND OUTLETS, SHALL BE VERIFIED BY THE ENGINEER PRIOR TO RELEASING FOR FABRICATION.
2) IN SITUATIONS WHERE A FINE-GRAINED BACKFILL MATERIAL IS USED ADJACENT TO THE PIPE SYSTEM, AND ESPECIALLY INVOLVING GROUND WATER CONDITIONS, CONSIDERATION SHOULD BE GIVEN TO THE USE OF GASKETED PIPE JOINTS. AT THE VERY LEAST THE PIPE JOINTS SHOULD BE WRAPPED IN A SUITABLE, NON-WOVEN GEOTEXTILE FABRIC TO PREVENT INFILTRATION OF FINES INTO THE PIPE SYSTEM.
3) CONSIDERATION FOR CONSTRUCTION EQUIPMENT LOADS MUST BE TAKEN INTO ACCOUNT.
4) ALL PIPE DIMENSIONS ARE SUBJECT TO MANUFACTURERS TOLERANCES.
5) ALL RISERS TO BE FIELD EXTENDED OR TRIMMED TO FINAL GRADE.

THE UNDERSIGNED HEREBY APPROVES THE ATTACHED PAGES.

CUSTOMER DATE

BILL OF MATERIALS

*THE COMPONENTS AND QUANTITIES LISTED HEREIN ARE NOT INTENDED TO BE A COMPREHENSIVE MATERIAL LIST. EXTRA COMPONENTS, NOT LISTED HEREIN, MAY BE NECESSARY TO COMPLETE THE CONSTRUCTION OF THE SYSTEM.

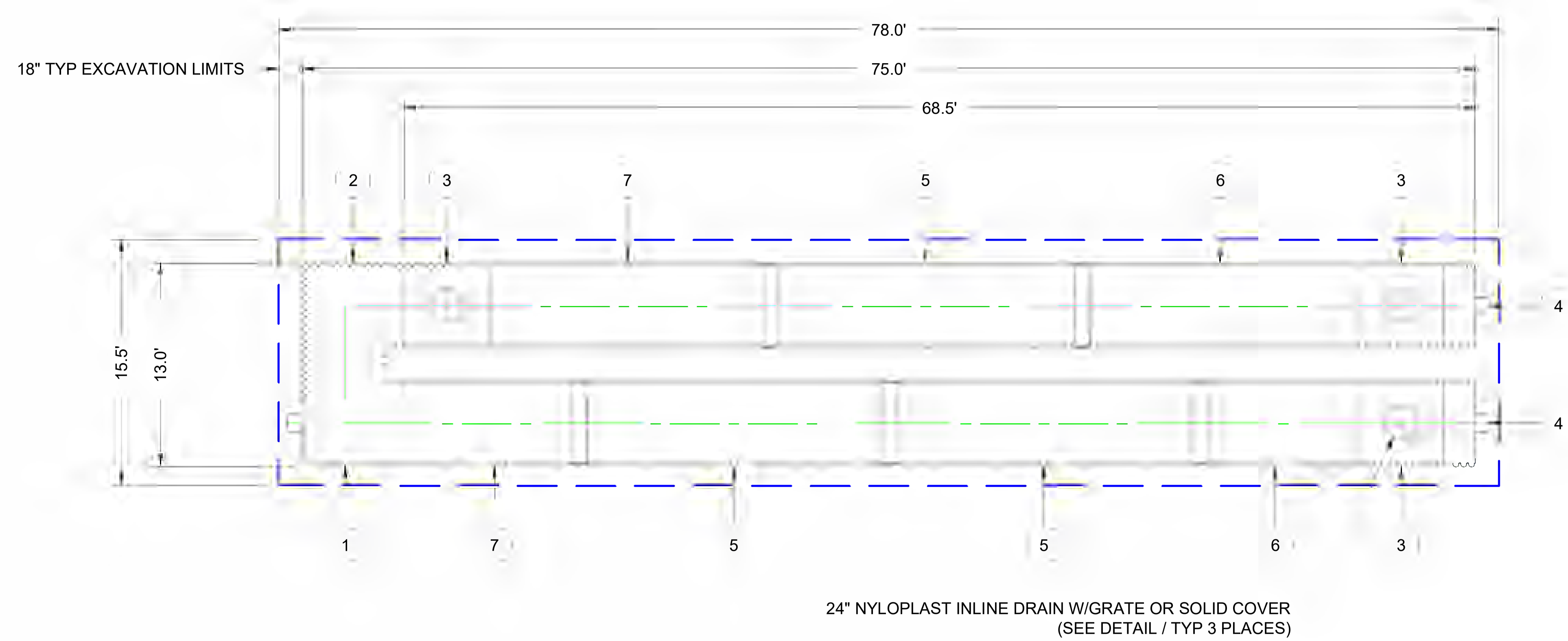
ITEM	QTY.	PART #	DESCRIPTION	MATERIAL	VENDOR	NOTE
1	1	6098ANC-1	60" X 90° MANIFOLD BEND	HDPE	ADS	SEE DETAIL
1-1	1	1206AN	12" STUB	HDPE	ADS	COMPONENT
2	1	6098AN	60" X 90° MANIFOLD BEND	HDPE	ADS	SEE DETAIL
3	3	6067AN	60" X 24" REDUCING TEE	HDPE	ADS	SEE DETAIL
4	2	REDUCER-1	60" X 12" REDUCER	HDPE	ADS	SEE DETAIL
5	3	6061-0020IB	60" PIPE STICK : PERF	HDPE	ADS	WTIB
6	2	STICK-1	60" PIPE STICK : PERF	HDPE	ADS	FIELD CUT
7	2	STICK-2	60" PIPE STICK : PERF	HDPE	ADS	FIELD CUT
	8	6065AA	60" SPLIT COUPLER	HDPE	ADS	NOT SHOWN
	3	2724AG	24" NYLOPLAST INLINE DRAIN	AS SPECIFIED	ADS	SEE DETAIL
	1	AS SPECIFIED	ADS GEOTEXTILE FABRIC	AS SPECIFIED	ADS	AS NEEDED

NOTES

- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE PIPE COVER REQUIREMENTS ARE MET.
- STUB SIZES AND INVERTS TO BE VERIFIED BY THE SITE DESIGN ENGINEER PRIOR TO FABRICATION.
- REDUCERS CAN BE ROTATED IN THE FIELD TO MATCH CONNECTING INVERTS.

- **ATTENTION:** THIS DRAWING IS NOT INTENDED FOR USE IN BIDDING OR CONSTRUCTION WITHOUT THE PRIOR APPROVAL OF THE PROJECT'S ENGINEER OF RECORD (EOR). AS WITH ALL PROPOSED ADS LAYOUTS, THE EOR SHOULD REVIEW AND APPROVE THIS DRAWING PRIOR TO USE IN BIDDING AND/OR CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE EOR TO ENSURE THAT THE PRODUCT(S) DEPICTED AND THE ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

NOT FOR CONSTRUCTION: THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.



ADS GEOTEXTILE FABRIC
(IF REQUIRED BY SITE DESIGN ENGINEER)

WORKFORCE REENTRY CENTER
SOUTH SYS
ORANGE, CA

DATE:	1-8-25	DRAWN:	TLN
PROJECT #:	S448828	CHECKED:	TLN

DATE	DRWN	CHKD	DESCRIPTION

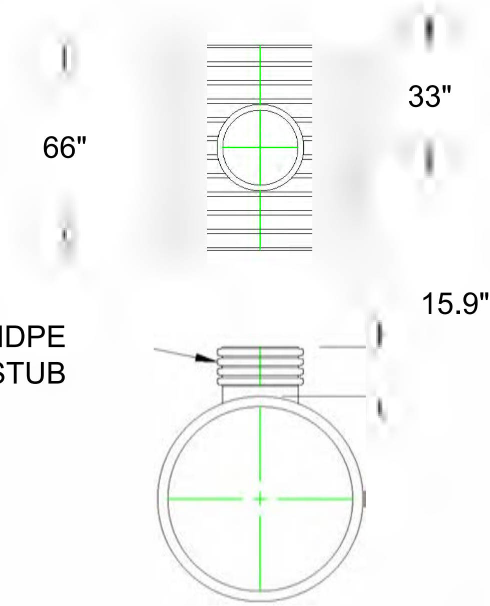
60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

0 10' 20'

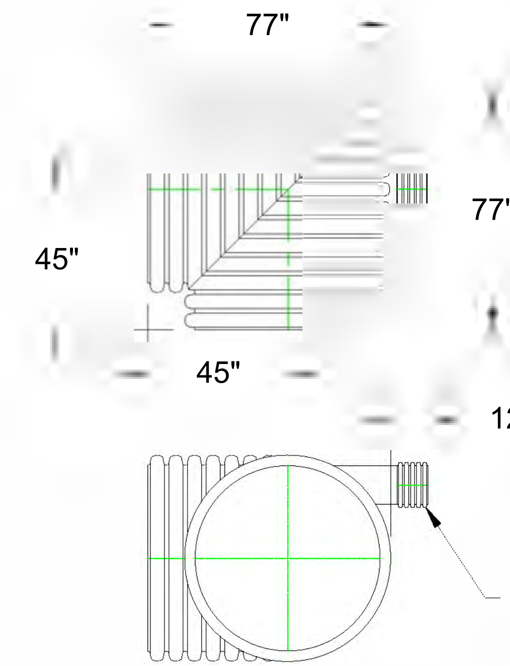
SHEET 2 OF 5

60" X 24" REDUCING TEE (USE AS RISER)



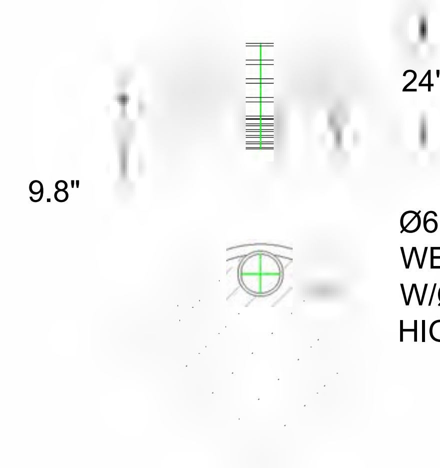
ITEM #: 3
QTY: 3
6067AN

60" X 90° MANIFOLD BEND W12" STUB



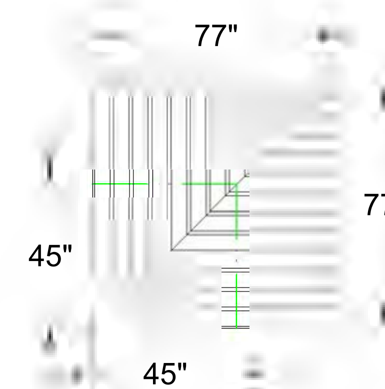
ITEM #: 1
QTY: 1
6098ANC-1

60" X 12" REDUCER



ITEM #: 4
QTY: 2
REDUCER-1

60" X 90° MANIFOLD BEND



ITEM #: 2
QTY: 1
6098AN

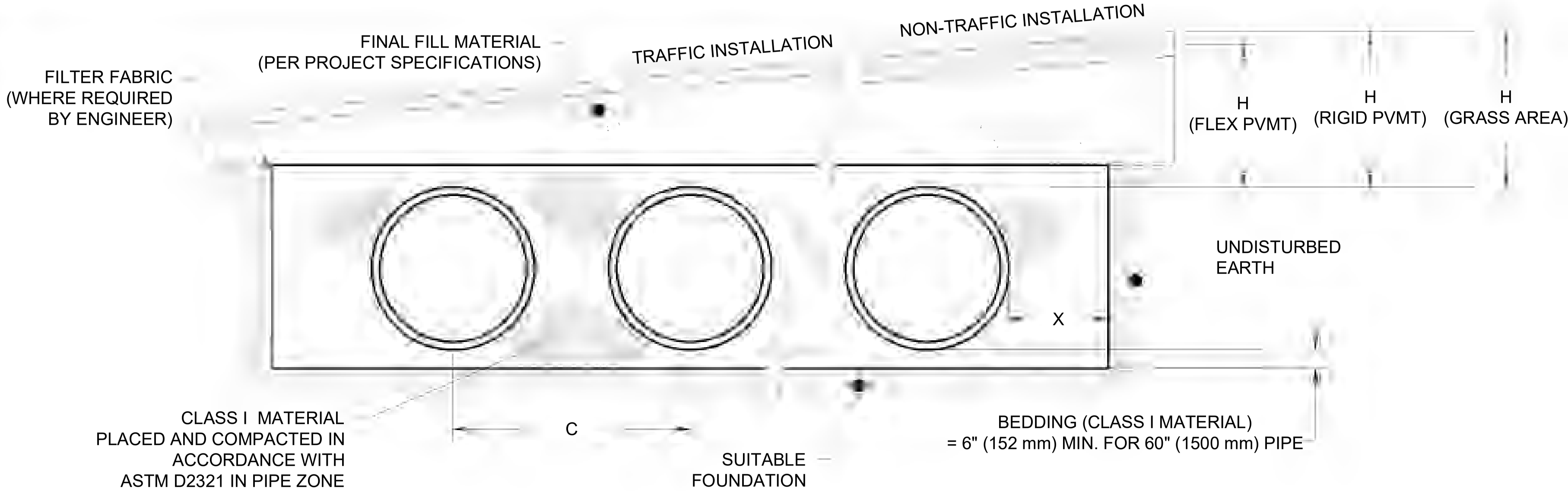
DATE	DRWN	CHKD	DESCRIPTION

WORKFORCE REENTRY CENTER
SOUTH SYS
ORANGE, CA

DATE: 1-8-25 DRAWN: TLN
PROJECT #: S448828 CHECKED: TLN

60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

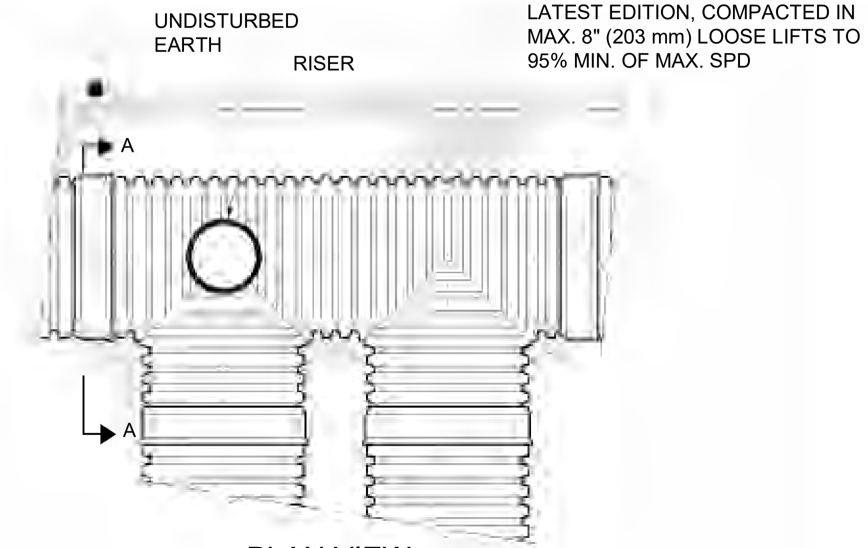


NOMINAL DIAMETER	NOMINAL O.D.	STANDARD SPACING "C"	TYPICAL SIDE WALL "X"	MIN. H (NON-TRAFFIC)	MIN. H (TRAFFIC)	MAX. H*
60" (1500 mm)	67" (1702 mm)	90" (2286 mm)	18" (457 mm)	12" (305 mm)	24" (610 mm)	8' (2.4 m)

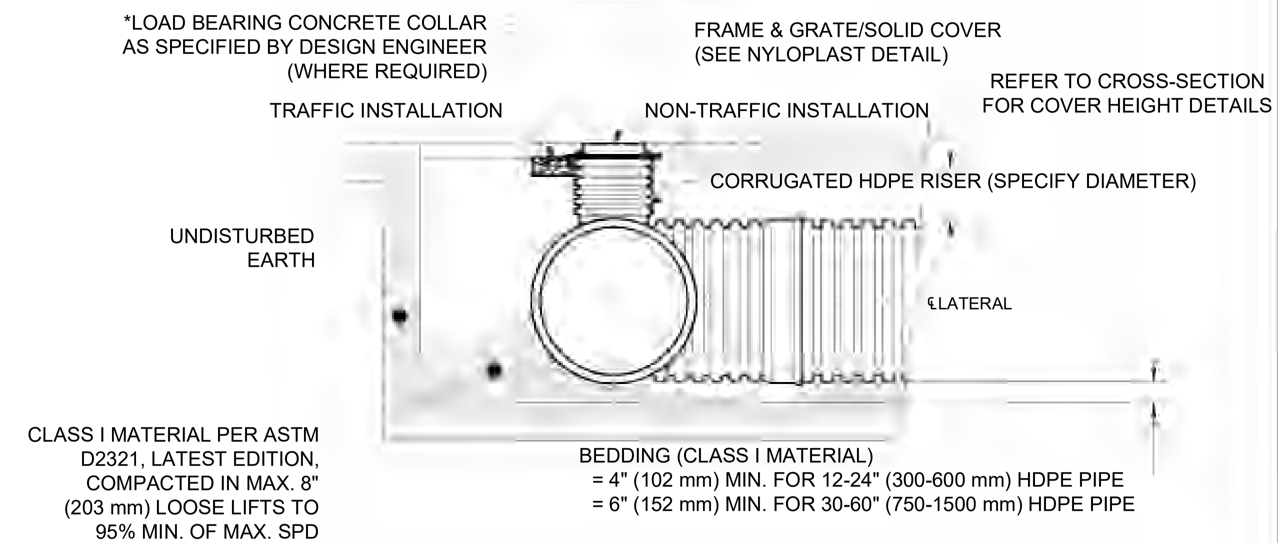
* MAXIMUM FILL HEIGHTS OVER MANIFOLD FITTINGS. CONTACT MANUFACTURER'S REPRESENTATIVE FOR INSTALLATION CONSIDERATIONS WHEN COVER EXCEEDS 8 FT (2.4 m).
**60" (1500 mm) SYSTEMS REQUIRE CLASS I BACKFILL AROUND ALL LATERALS AND FITTINGS.

NOTES:

1. ALL REFERENCES TO CLASS I MATERIAL ARE PER ASTM D2321 "STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PIPE FOR SEWERS AND OTHER GRAVITY FLOW APPLICATIONS", LATEST EDITION.
2. ALL RETENTION AND DETENTION SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321, LATEST EDITION AND THE MANUFACTURER'S PUBLISHED INSTALLATION GUIDELINES.
3. MEASURES SHOULD BE TAKEN TO PREVENT THE MIGRATION OF NATIVE FINES INTO THE BACKFILL MATERIAL, WHEN REQUIRED. SEE ASTM D2321.
4. FILTER FABRIC: A GEOTEXTILE FABRIC MAY BE USED AS SPECIFIED BY THE ENGINEER TO PREVENT THE MIGRATION OF FINES FROM THE NATIVE SOIL INTO THE SELECT BACKFILL MATERIAL.
5. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE TO A DEPTH REQUIRED BY THE ENGINEER AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE ENGINEER. AS AN ALTERNATIVE AND AT THE DISCRETION OF THE DESIGN ENGINEER, THE TRENCH BOTTOM MAY BE STABILIZED USING A GEOTEXTILE MATERIAL.
6. BEDDING: SUITABLE MATERIAL SHALL BE CLASS I. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATION TO ENGINEER. UNLESS OTHERWISE NOTED BY THE ENGINEER, MINIMUM BEDDING THICKNESS SHALL BE 4" (102 mm) FOR 4"-24" (100-600 mm); 6" (152 mm) FOR 30-60" (750-1500 mm).
7. INITIAL BACKFILL: SUITABLE MATERIAL SHALL BE CLASS I IN THE PIPE ZONE EXTENDING NOT LESS THAN 6" (152 mm) ABOVE CROWN OF PIPE. THE CONTRACTOR SHALL PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATION TO ENGINEER. MATERIAL SHALL BE INSTALLED AS REQUIRED IN ASTM D2321, LATEST EDITION.
8. COVER: MINIMUM COVER OVER ALL RETENTION/DETENTION SYSTEMS IN NON-TRAFFIC APPLICATIONS (GRASS OR LANDSCAPE AREAS) IS 12" (305 mm) FROM TOP OF PIPE TO GROUND SURFACE. ADDITIONAL COVER MAY BE REQUIRED TO PREVENT FLOATATION. FOR TRAFFIC APPLICATIONS, MINIMUM COVER IS 12" (305 mm) UP TO 36" (900 mm) DIAMETER PIPE AND 24" (610 mm) OF COVER FOR 42-60" (1050-1500 mm) DIAMETER PIPE, MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TO TOP OF RIGID PAVEMENT. MAXIMUM FILL HEIGHT LIMITED TO 8 FT (2.4 m) OVER FITTINGS FOR STANDARD INSTALLATIONS. CONTACT A SALES REPRESENTATIVE WHEN MAXIMUM FILL HEIGHTS EXCEED 8 FT (2.4 m) FOR INSTALLATION CONSIDERATIONS.



PLAN VIEW



SECTION A-A

* LOAD BEARING CONCRETE COLLAR SHALL BE CONSTRUCTED IN TRAFFIC AREAS SUCH THAT THE LIVE LOAD IS TRANSMITTED TO THE SURROUNDING SOIL AND NOT DIRECTLY TO THE RISER.

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026

60" WTIB : PERF
DETENTION
LandMax
Stormwater Management System

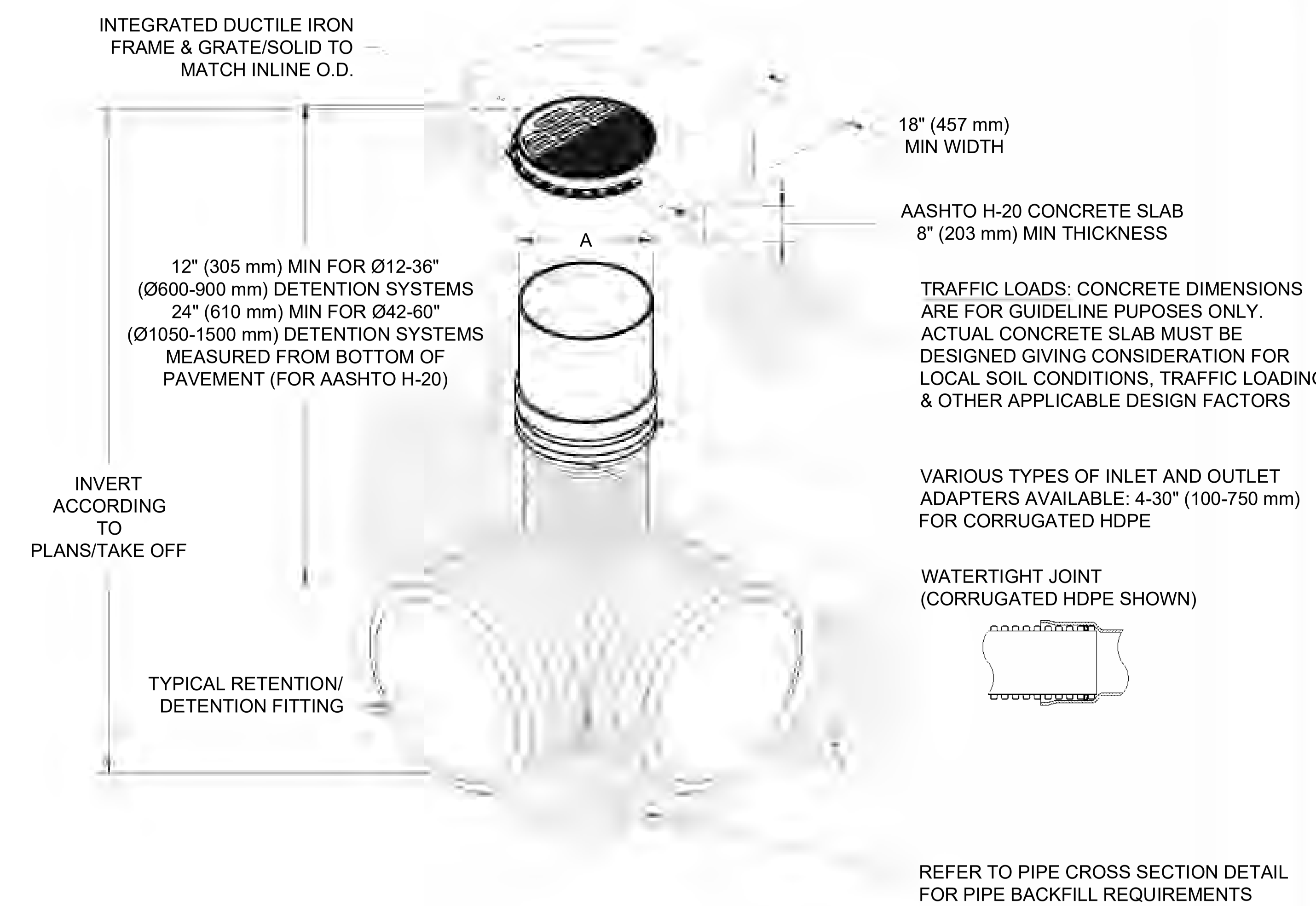
DATE	DRWN	CHKD	DESCRIPTION

WORKFORCE REENTRY CENTER
SOUTH SYS
ORANGE, CA

DATE:	1-8-25	DRAWN:	TLN
PROJECT #:	S448828	CHECKED:	TLN

NYLOPLAST INLINE DRAIN

NTS



NOTES

1. 8-30" (200-750 mm) GRATES/SOLID COVERS SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
2. 12-30" (300-750 mm) FRAMES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
3. DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS
4. DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS & HANCOR DUAL WALL) & SDR 35 PVC
5. FOR COMPLETE DESIGN AND PRODUCT INFORMATION: **WWW.NYLOPLAST-US.COM**
6. TO ORDER CALL: **800-821-6710**

A	PART #	GRATE/SOLID COVER OPTIONS		
8" (200 mm)	2708AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
10" (250 mm)	2710AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
12" (300 mm)	2712AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
15" (375 mm)	2715AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
18" (450 mm)	2718AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
24" (600 mm)	2724AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
30" (750 mm)	2730AG	PEDESTRIAN AASHTO H-20	STANDARD AASHTO H-20	SOLID AASHTO H-20

WORKFORCE REENTRY CENTER
SOUTH SYS
ORANGE, CA

DATE:	1-8-25	DRAWN:	TLN
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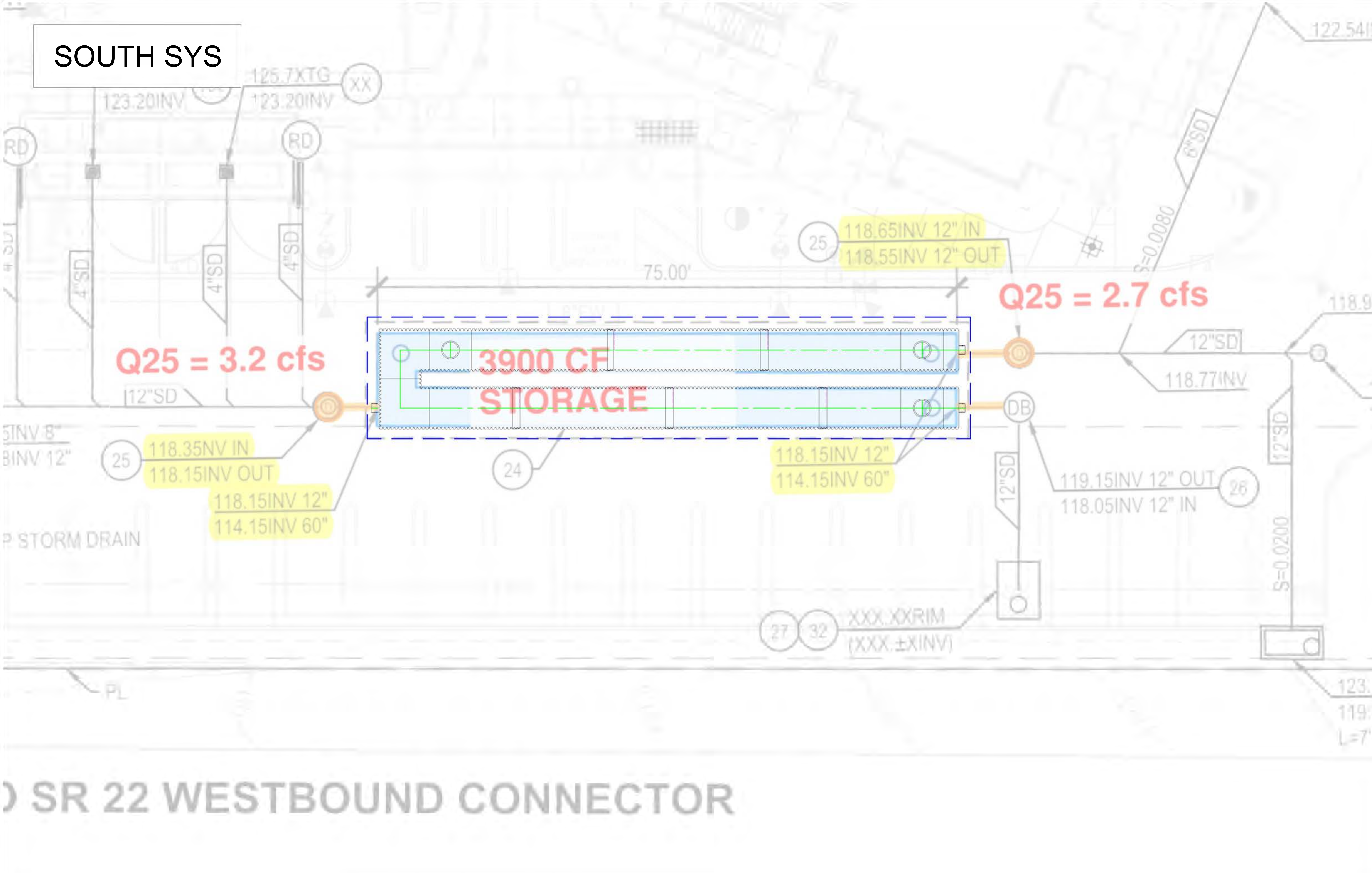
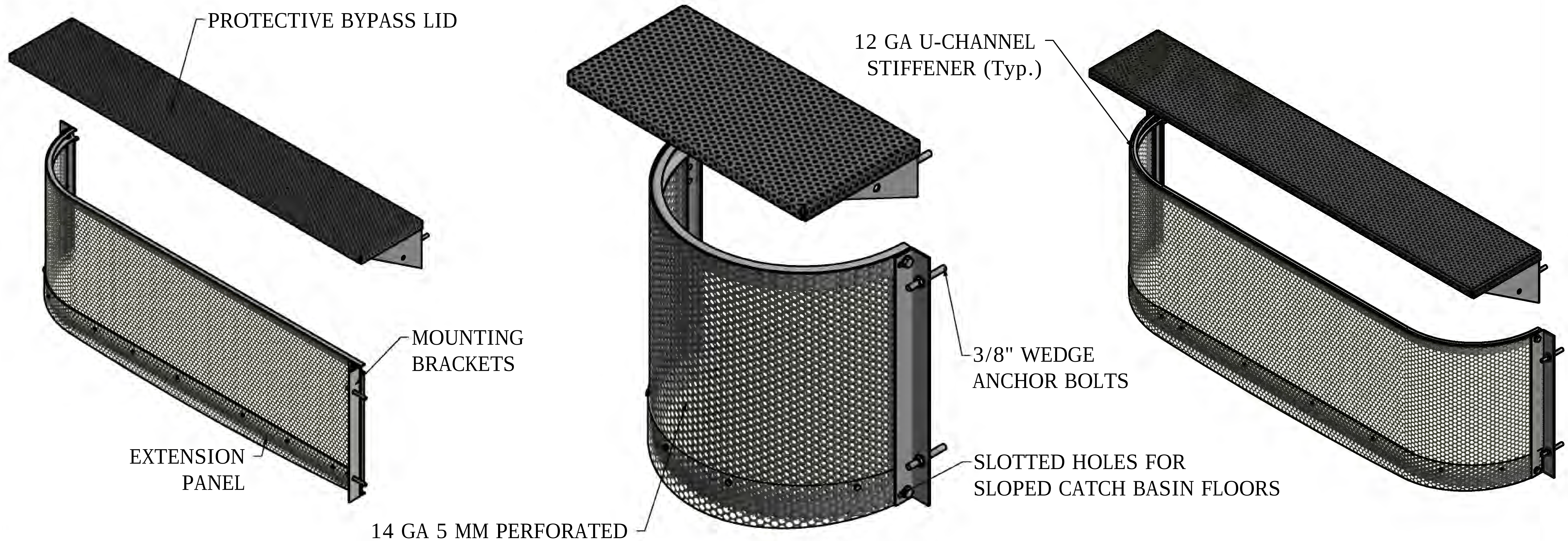
DATE	DRWN	CHKD	DESCRIPTION

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
Nyloplast®
770-932-2443 | WWW.NYLOPLAST-US.COM


SOUTH SYS
Q25 = 3.2 cfs
Q25 = 2.7 cfs
3900 CF
STORAGE
75.00'
118.65INV 12" IN
118.55INV 12" OUT
118.35NV IN
118.15INV OUT
118.15INV 12"
114.15INV 60"
118.15INV 12"
114.15INV 60"
119.15INV 12" OUT
118.05INV 12" IN
118.77INV
12"SD
125.7XTG
123.20INV
123.20INV
XXX.XXRIM
(XXX.±XINV)
S=0.0080
S=0.0200
122.54IN
118.99
STORM DRAIN
SR 22 WESTBOUND CONNECTOR

ADS FLEXSTORM: CONNECTOR PIPE SCREEN (CPS)



CPS L   CPS U   CPS U-EXT

SIZING TABLE						MINIMUM BYPASS RATINGS for lid designs with 6" Freeboard									
CPS Flow Rates by Model $Q_{screen} = cA_{screen}\sqrt{2gh}$						B (bypass height) = 4"		B (bypass height) = 6"		B (bypass height) = 8"		B (bypass height) = 10"		B (bypass height) = 12"	
Model	Screen Length	Screen Height	A_{screen} (Net open area)	Q_{screen} Flow Rate (cfs)	L_{bypass} (ft)	Q4	H_4	Q6	H_6	Q8	H_8	Q10	H_{10}	Q12	H_{12}
3L18H-Bypass-Shape	3	18	1.80	8.72	3.00	3.93	8	5.52	7	6.81	6	7.77	5	13.19	10
4L18H-Bypass-Shape	4	18	2.45	11.84	4.00	5.24	8	7.35	7	9.08	6	10.36	5	17.58	10
5L18H-Bypass-Shape	5	18	3.09	14.96	5.00	6.55	8	9.19	7	11.35	6	12.95	5	21.98	10

Determine CPS model number based on screen length and height - bypass height - and screen shape. For example Model 3L18H-8-U is 3' wide x 18" tall, has 8" bypass height, and is "U" shaped. Custom lengths and heights are available for any catch basin.

*LA County approved

*Full Capture Device as Certified by the California Regional Water Quality Control Board (CRWQCB)

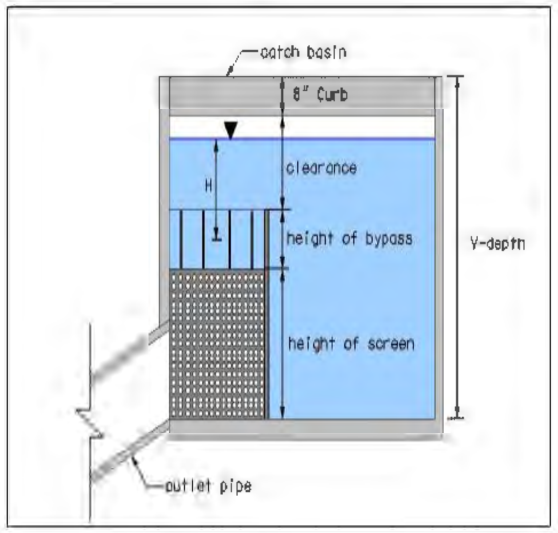
FLEXSTORM INLET FILTERS

ALL PRODUCTS MANUFACTURED BY INLET & PIPE PROTECTION, INC
A DIVISION OF ADS, INC.
WWW.INLETFILTERS.COM
(866) 287-8655 PH
(630) 355-3477 FX
INFO@INLETFILTERS.COM

SIZE	FRAME TYPE	DWG NO	REV
C	CPS	Flexstorm CPS	A

SCALE   SHEET 1 OF 1

Equation 5: $Q_{bypass} = c_{bypass} A_{bypass} \sqrt{2gH}$



STANDARD LENGTHS, VARIABLE BYPASS HEIGHTS

ADS CPS units are standardized with a pre-set Length of screen (L). The height of the bypass is the variable used to confirm that the total Q_{bypass} for the CPS with Lid design exceeds the Max Q_{10} for a certain CB width. The sizing table below shows the resultant Q_{bypass} for the various B (bypass heights).

Defininining the Orifice bypass equation for CPS with deflector lids

$$Q_{bypass} = c_{bypass} A_{bypass} \sqrt{2gH}$$

C_{bypass} = .6 (coefficient)
g= 32.2 ft/s^2
A_{bypass} = L $_{\text{(length of screen)}}$ x h $_{\text{(bypass height)}}$
H = depth of water to centroid of bypass

CPS U

SIZING TABLE						MINIMUM BYPASS RATINGS for lid designs with 6" Freeboard									
CPS Flow Rates by Model $Q_{screen} = cA_{screen}\sqrt{2gh}$						B (bypass height) = 4"		B (bypass height) = 6"		B (bypass height) = 8"		B (bypass height) = 10"		B (bypass height) = 12"	
Model	Screen Length	Screen Height	A_{screen} (Net open area)	Q_{screen} Flow Rate (cfs)	L_{bypass} (ft)	Q4	H_4	Q6	H_6	Q8	H_8	Q10	H_{10}	Q12	H_{12}
3L18H-Bypass-Shape	3	18	1.80	8.72	3.00	3.93	8	5.52	7	6.81	6	7.77	5	13.19	10
4L18H-Bypass-Shape	4	18	2.45	11.84	4.00	5.24	8	7.35	7	9.08	6	10.36	5	17.58	10
5L18H-Bypass-Shape	5	18	3.09	14.96	5.00	6.55	8	9.19	7	11.35	6	12.95	5	21.98	10

Bypass ratings in Black are for 3.5' Vb Minimum Catch Basin Depths
Bypass ratings in Red are for 4' Vb Minimum Catch Basin Depths

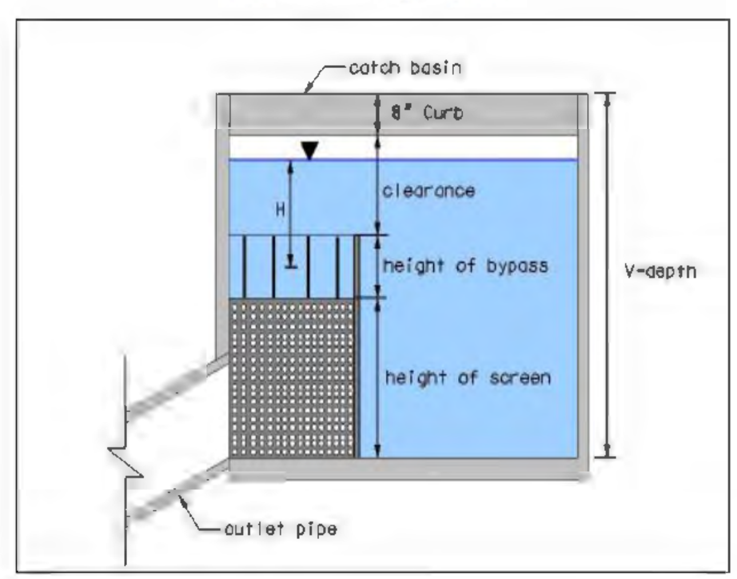
Determine CPS model number based on screen length and height - bypass height - and screen shape. For example Model 3L18H-8-U is 3' wide x 18" tall, has 8" bypass height, and is "U" shaped. Custom lengths and heights are available for any catch basin.

Example Selection and Calculation:

Assume we have a 7' wide catch basin with a depth Vb of 3.5' and 18" connector pipe. The Max Q_1 is 1.2 CFS and the Max Q_{10} is 5.3 CFS per the hydrology study table to the right. Select the appropriate screen to pass the 1 year flow then determine the minimum bypass height required to pass the 10 year flow. The 3L18H-6B screen (highlighted in green) passes 8.52 CFS far exceeding the 1.2 CFS requirement. According to the sizing table that unit will bypass 5.52 CFS with a 6" bypass height based on the Orifice Flow bypass equation which is greater than the required 5.3 CFS maximum 10 yr flow seen by the 7' wide catch basin. The bypass is calculated as follows:

$Q_{bypass} = c_{bypass} A_{bypass} \sqrt{2gH}$
C_{bypass} = .6 (orifice coefficient)
g= 32.2 ft/s^2
A_{bypass} = L $_{\text{(length of screen)}}$ x h $_{\text{(bypass height)}}$ = (3 x 6/12) = 1.5 ft^2
H = depth of water to centroid of bypass (maintaining 6" freeboard)
We need to check Clearance and determine the H
Clearance = Vdepth-Hscreen-Hbypass-curb height (must always be > 4")
Clearance = 42"-18"-6"-8"=10"
H = Hbypass/2 + Clearance - 6" freeboard (sized conservatively)
H = 6/2 + 10 - 6 = 7" or .583 ft
Finally, $Q_{bypass} = c_{bypass} A_{bypass} \sqrt{2gH}$
$\mathbf{Q_{bypass} = .6 \times 1.5 \sqrt{2 \times 32.2 \times .583} = 5.52cfs}$

Equation 5: $Q_{bypass} = c_{bypass} A_{bypass} \sqrt{2gH}$

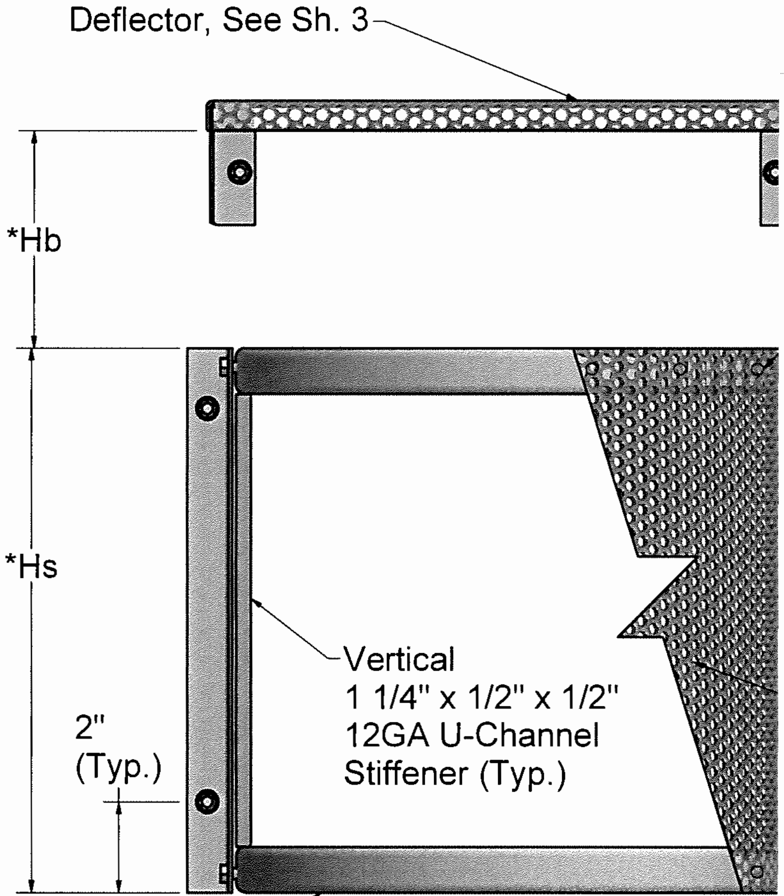


Catch Basin Ratings for one year and ten year rain events as determined by LA County hydrology studies		
CB width (ft)	Max Q_{10} (cfs)	Max $Q_{1\text{-}1}$ (cfs)
3.5	2.8	0.6
7	5.3	1.2
10	7.5	1.7
14	10	2.2
21	13.9	3.1
28	17.3	3.8

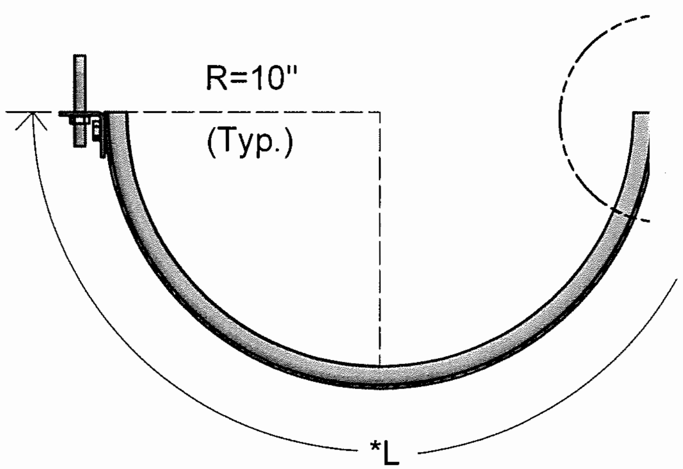
NOTES:
1. All Materials Are Type 304SS Unless Otherwise Noted

2. All Horizontal And Vertical Stiffeners Shall Be Spot
To Perforated Screen

Floor Extension Panel Detail



ELEVATION VIEW
N.T.S.

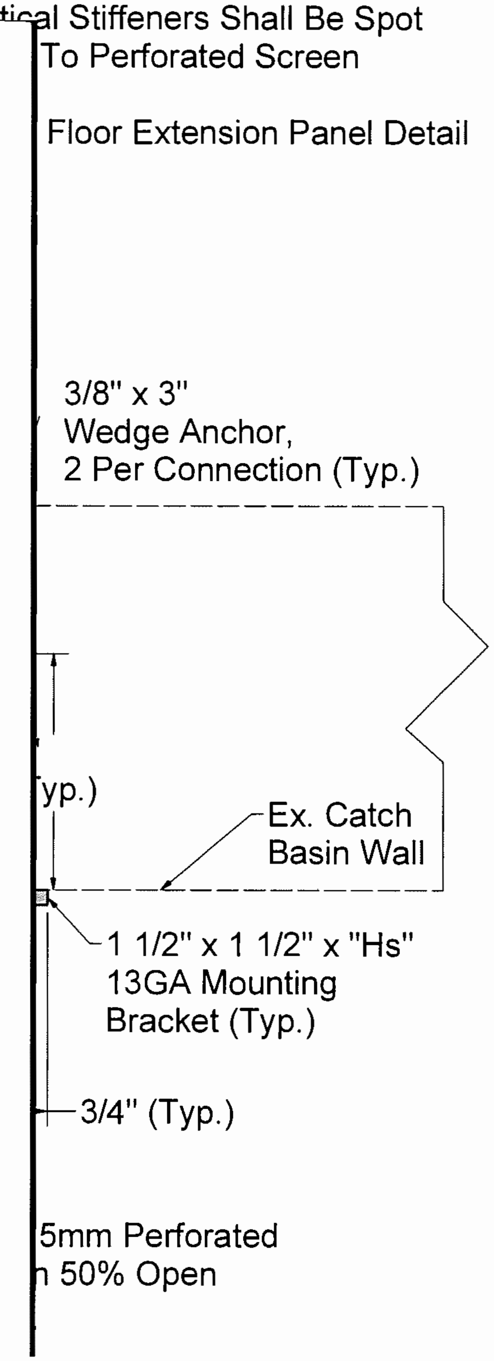


PLAN VIEW
N.T.S.

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
☒ ACCEPTED
☐ MAKE CORRECTIONS NOTED
☐ REVISE CALCULATIONS
☐ REJECTED

REVIEW IS PERFORMED BY THE DEPARTMENT TO ENSURE THE CONTRACTOR'S GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE SPECIFICATIONS. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE CORRECTNESS OF DIMENSIONS, PROPER CONSTRUCTION AND INSTALLATION METHODS, AND FOR FULFILLING ALL CONTRACTUAL REQUIREMENTS. ACCEPTANCE INDICATED HEREON DOES NOT RELIEVE THE CONTRACTOR OF THESE OBLIGATIONS.

BY Steven Dickson DATE 07-28-16



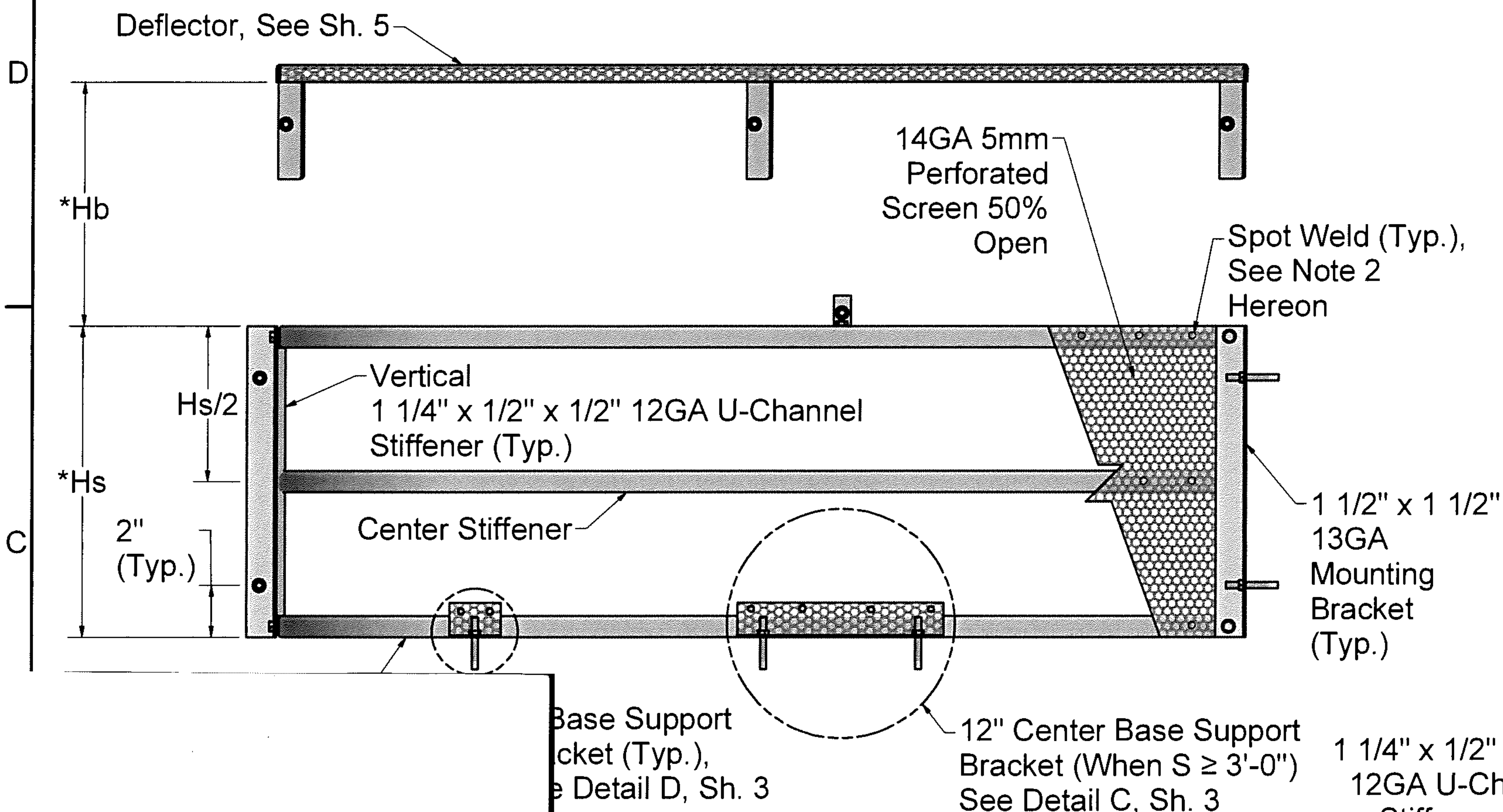
12GA U-Channel
Stiffener (Typ.)

DETAIL A
N.T.S.

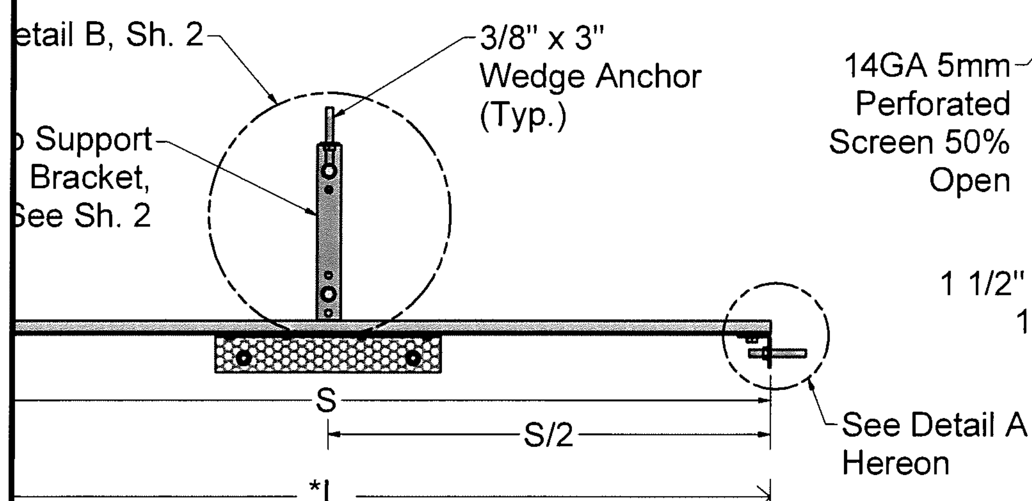
*See Appendix A-1 And CPS Sizing Table For Hb, Hs, And L Values

ADS FLEXSTORM CPS U	
TITLE: PLAN, ELEVATION, AND DETAIL	
SIZE: C	DATE: 7/25/2016
REV: A	SHEET 1 OF 3

NOTES:
1. All Materials Are Type 304SS Unless Otherwise Noted
2. All Horizontal And Vertical Stiffeners Shall Be Spot Welded @ 4"C.C. (Max) To Perforated Screen
3. Center Stiffener Required When S ≥ 3'-0"
4. Top And Center Base Support Brackets Required When S ≥ 3'-0"
5. 3" Base Support Bracket At The Inflection Point Required For All Units
6. For Catch Basin Uneven Floor Extension Panel Detail See Sh. 4

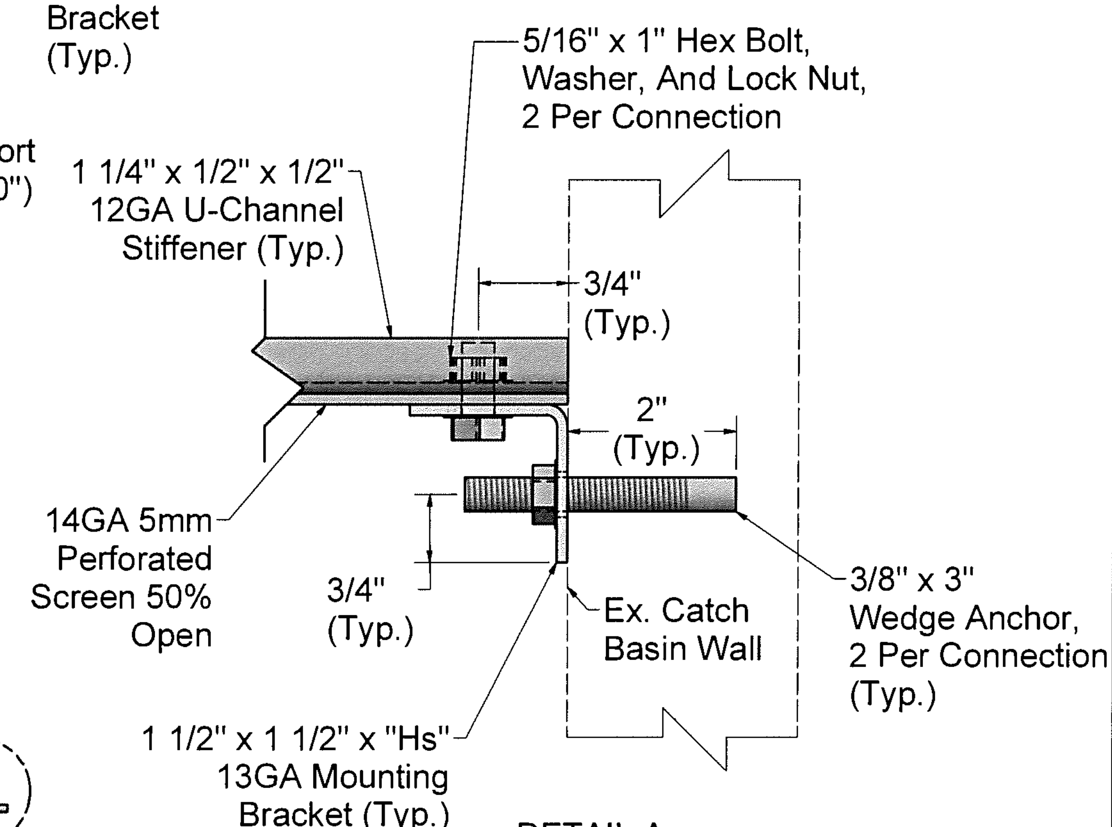


ELEVATION VIEW
N.T.S.



PLAN VIEW
N.T.S.

able For Hb, Hs, And L Values



DETAIL A
N.T.S.

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS

- [X] ACCEPTED
- [ ] MAKE CORRECTIONS NOTED
- [ ] REVISE CALCULATIONS
- [ ] REJECTED

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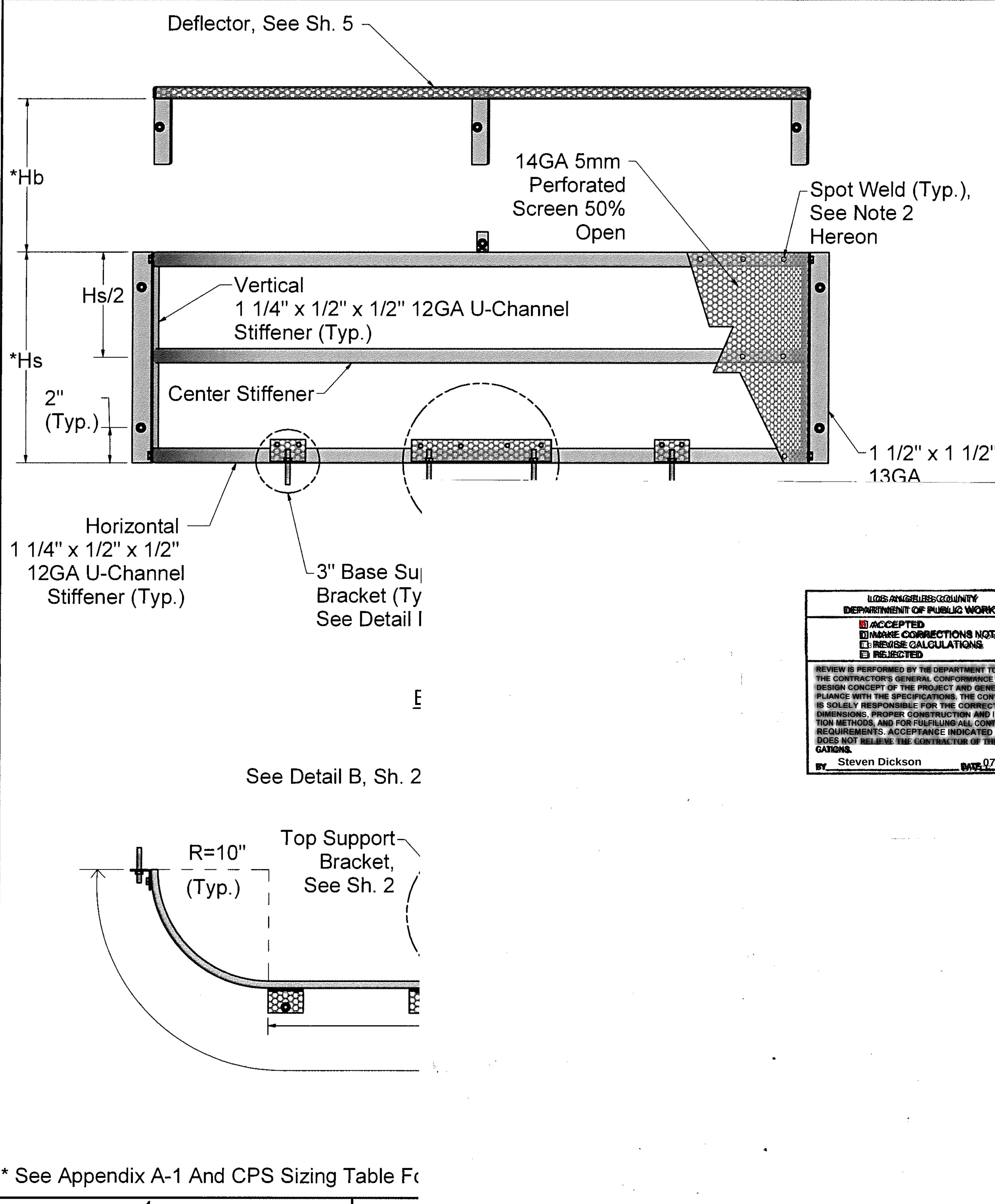
BY Steven Dickson DATE 07-28-16

ADS FLEXSTORM CPS L	
TITLE PLAN, ELEVATION, AND DETAIL	
SIZE C	DATE 7/25/2016
REV A	SHEET 1 OF 5



LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS

- [x] ACCEPTED
- [ ] MAKE CORRECTIONS NOTED
- [ ] REVISE CALCULATIONS
- [ ] REJECTED

REVIEW IS PERFORMED BY THE DEPARTMENT TO ENSURE THE CONTRACTOR'S GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE SPECIFICATIONS. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE CORRECTNESS OF DIMENSIONS, PROPER CONSTRUCTION AND INSTALLATION METHODS, AND FOR FULFILLING ALL CONTRACTUAL REQUIREMENTS. ACCEPTANCE INDICATED HEREON DOES NOT RELIEVE THE CONTRACTOR OF THESE OBLIGATIONS.

BY Steven Dickson DATE 07-28-16

NOTES:

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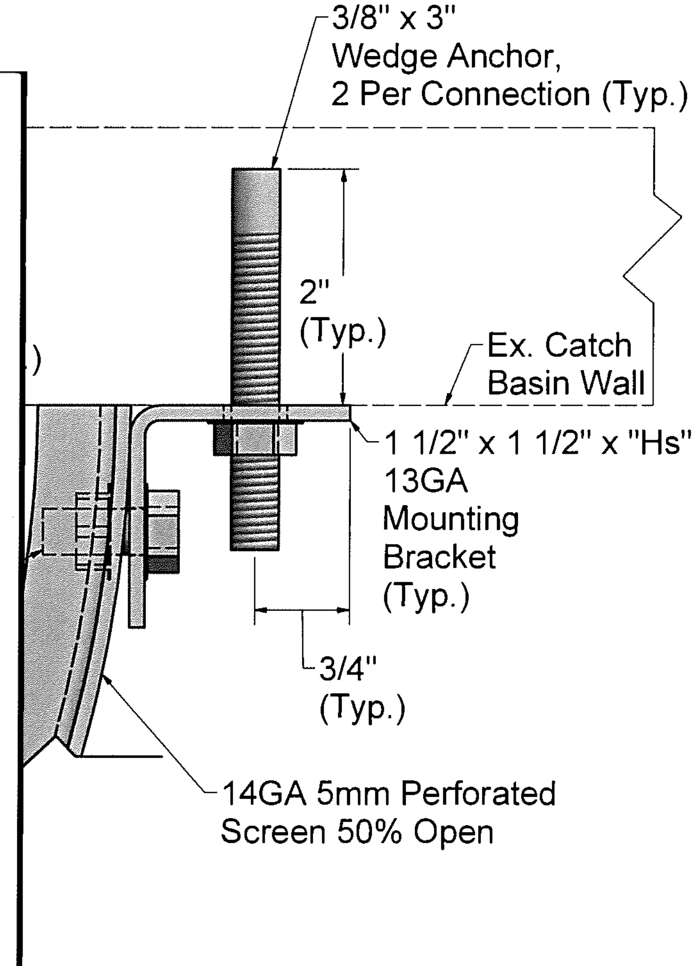
6. For Catch Basin Uneven Floor Extension Panel Detail See Sh. 4



ADS FLEXSTORM CPS U EXT	
TITLE PLAN, ELEVATION, AND DETAIL	
SIZE C	DATE 7/25/2016	REV A
SHEET 1 OF 5	

Operations and Maintenance Plan

Inspection and maintenance records shall be kept for a minimum of five years and be made available for inspection by the City staff.

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
N1. Education of Property Owners, Tenants and Occupants on Stormwater BMPs	Ongoing	The educational program and materials for the protection of stormwater shall be prepared by IMI Critical Engineering and provided to the first tenants and occupants. Education of employees/owner(s) shall be done within four weeks of startup and continue on an annual basis with each new onsite employee/owner(s) being given a water quality orientation using this WQMP as a reference within two weeks of hire date.	Owner: County of Orange
N2. Activity Restrictions	Monthly	The owner shall develop activity restrictions to minimize the threat of hazardous waste or contamination into the storm drainage system. Car washing, vehicle maintenance, and vehicle repair are not allowed on-site at any time.	
N3. Landscape Management BMPs	Yearly	Maintenance staff shall be trained annually on landscape management BMPs consistent with MS4 Permit Program and CASQA BMP #SC-41 Guidelines or City equivalent, plus pesticide usage consistent with product labels and state code.	
N4. BMP Maintenance	Weekly	Maintenance of BMPs implemented at the project site shall be performed at the frequency described in this WQMP.	
N5. Title 22 CCR Compliance	Ongoing	Owner shall comply with the applicable hazardous waste section(s) of Title 22.	
N6. Local Water Quality Ordinances	Ongoing	Ensure compliance with the City of Rialto Storm Water Ordinance through the operation and maintenance of BMPs.	

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
N7. Spill Contingency Plan	Ongoing	The Property Owner shall develop a spill contingency plan which mandates stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, and documentation.	
N8. Underground Storage Tank Compliance	Ongoing	Owner shall comply with State regulations dealing with underground storage tanks, enforced by Orange County Health Care Agency (OCHCA) on behalf of the state.	
N9. Hazardous Materials Disclosure	Ongoing	Owner shall comply with local ordinances and local fire protection agencies for the management of hazardous materials.	
N10. Uniform Fire Code Implementation	Ongoing	The project will be developed and operated in accordance with Article 80 of the Uniform Fire Code.	
N11. Litter/Debris Control Program	Weekly	Litter patrol, violations investigation, reporting and other litter control activities shall be performed in conjunction with maintenance activities.	
N12. Employee Training	Yearly for all employees and within 6 months of hire date for new employees.	The property owner shall develop an education program to train future, tenants, occupants, and employees, and provide them with educational materials about the storm water management practices outlined in this document.	
N13. Housekeeping of Loading Docks	Weekly	Owner shall maintain the loading dock as guided by CASQA BMP Handbook SC-30.	
N14. Catch Basin Inspection Program	Minimum of once a year prior to rainy season	Litter and debris removal, illicit discharge violations, investigation, and reporting shall be performed in conjunction with maintenance activities described throughout this document.	

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
N15. Vacuum Sweeping of Private Streets and Parking Lots	Monthly	Parking lots within the project shall be vacuum swept and cleaned as described in this document.	
Structural Source Control BMPs			
S1. Provide Storm Drain System Stenciling and Signage	Yearly	All proposed inlets shall be marked with the appropriate "No Dumping. Drains to Ocean." stencil with annual inspections for legibility. The stencils must be repainted when they become illegible, but at a minimum once every five years.	Owner: County of Orange
S3. Design and Construct Trash and Waste Storage Areas to Reduce Pollutant Introduction	Weekly	Sweep trash area at least once per week. Maintain area clean of trash and debris.	
S4. Use Efficient Irrigation Systems & Landscape Design, Water Conservation, Smart Controllers, and Source Control	Weekly/Monthly	Perform weekly/monthly inspections for damaged or leaking irrigation pipes and applicators and repair, as needed. Verify that landscape design continues to function properly by correctly adjusting to eliminate overspray to hardscape areas. Verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, and day or night time temperatures.	
Low Impact Development (LID) and Treatment Control BMPs			
ADS HDPE Retention System	Annually and within 48 hours following a significant storm event to verify there is no standing water in the chambers.	• Regular inspections of system to observe sediment built up and infiltration capacity. Cleaning of accumulated trash, debris, and sediment as determined by inspections. See manufacturer's recommendations for additional maintenance activities.	Maintenance Staff and Landscape Contractor

Operations and Maintenance Plan

BMP Name and BMP Implementation, Maintenance, and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Inspection / Maintenance Activities Required	Person or Entity with Operation & Maintenance Responsibility
ADS FlexStorm Connector Pipe Screen	Twice per year and after major storm events.	• Inspect and remove trash and debris from screening device twice per year. • Inspect and clean screen when over 40% full, or per manufacturer's recommendations	Maintenance Staff and Landscape Contractor
ADS Barracuda Hydrodynamic Separator	Twice per year.	• Inspect and remove trash and debris. Inspect and clean when 75% full in the isolated sump, or per manufacturer's recommendations.	Maintenance Staff and Landscape Contractor

Today's Date: ______________________________

Name of Person Performing Activity (Printed): ______________________________

Signature: ______________________________

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

BMP Implementation Tracking Table

BMP	Activity	Activity Completion Dates or Frequency
Source Control BMPs (Structural and Nonstructural)		
Low Impact Development and Treatment Control BMPs		

ADS – FLEXSTORM CONNECTOR PIPE SCREEN (CPS) MAINTENANCE GUIDELINES

FLEXSTORM suggests that its Connector Pipe Screens (CPS) be maintained per this modified set of conditions from the LA County CPS Standards. FLEXSTORM advises that catch basins be cleaned out at least 2 times per year and/or if debris has filled above a 40% level inside of the catch basin. Sites with large amounts of foliage, high sediment loads, or smaller CPS devices might need to be cleaned more frequently.

Maintenance Conditions and Maintenance Standards: The Following are deficiencies in maintenance conditions and their corresponding maintenance standards which shall apply to the Connector Pipe Screen. The cleanout of each CB shall meet the maintenance standards listed as follows:

	Description of Maintenance Actions
1	Clear trash and debris located immediately in front of curb opening or side opening of CB, and on top or between metal grates of grated CB.
2	Remove Vegetation growing across and/or blocking the basin opening.
3	Remove all Trash and debris and vegetation from inside the Catch Basin.
4	Remove Trash and debris in the connector pipe opening, upstream or downstream.
5	Knock off/Remove all Debris that covers the perforated openings of the connector pipe screen
6	Ensure there is no Standing Water inside of catch basin (indicates the device is not properly draining)

Trash and debris shall include, but is not limited to, mud, vegetation, and garbage.

Upon completion of a cleanout operation at a CB and before leaving it, the Contractor shall sweep the top surface of the CB and the area 2 feet around the CB, and shall remove any trash and debris resulting from the cleanout operations. No debris is to be left at a CB for future pick-up.

Method of Removal: All trash and debris required to be removed from the CBs shall be removed in a manner to be determined by the Contractor. This can be done by hand or with a truck mounted vacuum. If entering the catch basin ensure that local confined space entry procedures are followed. The Contractor shall not allow any trash or debris to enter the connector pipe or main line as a result of the cleanout operations.

Debris Disposal: All trash and debris removed under this Contract shall become the property of the Contractor and shall be legally disposed of away from the CB sites. The Contractor is responsible for proper disposal of the trash and debris, including obtaining approvals from all jurisdictional agencies, as applicable. The contractor shall be responsible for contacting and coordinating with local Animal Care and Control for pickup and disposal of dead animals. However, the Contractor shall be responsible for removing any dead animal from inside a CB.

Geotechnical Exploration Report
Proposed Workforce Reentry Center
591 The City Drive South
City of Orange, California

Prepared for:

Griffin Structures, Inc.
2 Technology, Suite 150
Irvine, California 92618

Prepared by:

Verdantas Inc.
2600 Michelson Drive, Suite 400
Irvine, California 92612

Project No. 20833

August 7, 2024

verdantas

August 7, 2024

Project No. 20833

Mr. Deryl Robinson, VP
Griffin Structures, Inc.
2 Technology, Suite 150
Irvine, California 92618

Subject: **Geotechnical Exploration Report**
Proposed Workforce Reentry Center
591 The City Drive South
City of Orange, California

Per your request and authorization, Verdantas Inc. (Verdantas) has prepared this geotechnical exploration report for the subject project. We understand the proposed development will consist of a one-story retail/culinary building, a two-story vocational building, a two-story housing building, and associated paved surface parking and access. A new security wall is planned along the northeastern portion of the project adjacent to the Theo Lacy Facility. Ancillary improvements likely consist of utility infrastructure, flatwork, and landscaping.

The purpose of our geotechnical exploration was to evaluate subsurface conditions at the site, identify potential geologic and seismic hazards that may impact the project, and provide geotechnical recommendations for design and construction of the proposed development as currently planned.

The project is considered feasible from a geotechnical standpoint. The results of our exploration, conclusions, and recommendations are presented in this report.

We appreciate the opportunity to be of service to you on this project. If you have any questions or if we can be of further service, please contact us at (949) 250-1421; or at the e-mail addresses listed below.

Respectfully submitted,

VERDANTAS INC.

CERTIFIED ENGINEERING GEOLOGIST
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Senior Principal Engineer
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ECB/JMP/CCK/lr

Distribution: (1) Addressee

Table of Contents

Attachments

Figures

Plates

Appendices

1.0 Introduction

1.1 Site Description and Proposed Development

The project site is located at 591 The City Drive South in the city of Orange, Orange County, California. The site location (latitude 33.7802°, longitude -117.8879) and immediate vicinity are shown on Figure 1, *Site Location Map.*

The project site is rectangular in shape and covers approximately 4.7 acres. The site is bordered by The City Drive South to the west, State Route 22 to the south, and the Theo Lacy Facility (Orange County Jail) to the east and north. The Santa Ana River channel is located immediately to the east of the Theo Lacy Facility. Access to the site is via The City Drive South on the west. The site is currently occupied by the former Orange County Animal Shelter (abandoned) consisting of several buildings and associated asphalt concrete (AC) and Portland cement concrete (PCC) paved parking and access. The southeastern portion of the project site area is located within the currently existing security walls of the Theo Lacy Facility.

The project site is relatively level with sheet flow generally directed to the south over paved surfaces to curbs and gutters. Review of the United States Geological Survey (USGS) 7.5-Minute Anaheim Quadrangle (USGS, 1965) indicates the site is between approximately Elevation (El.) +120 to +125 feet mean sea level (msl).

Based on review of historic aerial photographs (NETR, 2024), the project site appears to have been primarily undeveloped from 1953 until at least 1963, with the west central portion of the site in use as a citrus orchard and a small structure located to the northwest of the orchard. Also visible on aerial photographs during this time is evidence of the western margins of the former Santa Ana River drainage course that crossed the southeastern portion of the site prior it being channelized. This is also consistent with historic topographic maps dating back to 1898 (USGS, 1898), and later in 1950 where a topographic depression is shown in the southeastern portion of the site (USGS, 1950). Between 1963 and 1972, the orchard and the small structure was cleared, and a building was constructed in its place. At this time, the existing northern building facing The City Drive South and kennels associated with the previous animal shelter was constructed, and the southern portion of the site was paved to support surface parking. In 1980, another building was constructed in the western center of the site and additional animal kennels were constructed in the southeast portion of the site. In 1995, one of the western buildings was demolished and replaced by paved parking. By 2009, the second western building was demolished and the existing southeastern building was constructed. The site has remained in the same configuration since then.

Based on review of the *County of Orange, Workforce Reentry Center, Conceptual Pricing Set*, dated May 28, 2024, we understand that the proposed development consists of a one-story retail/culinary building, a two-story vocational building, a two-story housing building, and associated paved surface parking and access. A new security wall is planned along the northeastern portion of the project adjacent to the Theo Lacy Facility. Ancillary improvements likely consist of utility infrastructure, flatwork, and landscaping. Structural loading information was not yet available at the time this report was prepared.

1.2 Purpose and Scope

The purpose of our geotechnical exploration was to evaluate the subsurface conditions at the site relative to the proposed development concept and provide geotechnical recommendations to aid in the design and construction for the project as currently planned. The scope of this geotechnical exploration included the following tasks:

- *Background Review* – We reviewed readily available in-house geotechnical reports, literature, aerial photographs, and maps relevant to the site. We evaluated geological hazards and potential geotechnical issues that may significantly impact the site. The documents reviewed are listed in Section 5.0, *References*.

- *Pre-Field Exploration Activities* – A site visit was performed by a member of our technical staff to mark the proposed exploration locations. DigAlert (811) was notified to locate and mark existing underground utilities prior to our subsurface exploration.

- *Field Exploration* – Our subsurface exploration, performed on July 1, 2024, included drilling, logging, and sampling of five (5) hollow-stem auger borings (designated LB-1 through LB-5) to depths between approximately 31 and 51½ feet below the existing ground surface (bgs) and six (6) cone penetration test (CPT) soundings advanced to approximately 50 feet bgs. Two (2) additional borings (designated LP-1 and LP-2) were drilled to an approximate depth of 10 feet bgs for subsequent percolation testing. The approximate locations of the explorations are shown on Plate 1, *Exploration Location Map.* The boring logs and CPT logs are presented in Appendix A, *Exploration Logs.*

  Bulk and drive samples were obtained from the hollow-stem auger borings for geotechnical laboratory testing. Driven ring samples were collected from the borings using a Modified California ring-lined sampler conducted in accordance with ASTM Test Method D 3550. Standard Penetration Tests (SPTs) were also performed within the borings in accordance with ASTM Test Method D 1586. Samples were collected at 2½-foot to 5-foot intervals throughout the depth of exploration. In both test methods, the sampler is driven below the bottom of the borehole by a 140-pound weight (hammer) free-falling 30 inches. The drilling rig was equipped with an automatic hammer to provide greater consistency in the drop height and striking frequency. The number of blows to drive the sampler the final 12 inches of the 18-inch drive interval is termed the “blowcount” or SPT N-value. The N-values provide a measure of relative density in granular (non-cohesive) soils and comparative consistency in cohesive soils. The number of blows per 6 inches of penetration was recorded on the boring logs, see Appendix A.

  The borings were logged in the field by a geologist from our firm. Each soil sample collected was reviewed and described in accordance with the Unified Soil Classification System (USCS). The samples were sealed and packaged for transportation to our laboratory. After completion of drilling, the borings were backfilled to the ground surface with soils generated during the exploration and patched with cold-mix asphalt concrete to match existing surface conditions. Excess soil cuttings from the borings were spread in planter areas.

  The upper 5 feet was hand excavated at each of the CPT locations to clear potential buried utility conflict and to collect representative bulk soil samples for laboratory testing. After completion of CPT advancement, the CPTs were backfilled to the ground surface with cement grout and patched with cold-mix asphalt concrete at the surface.

- *Percolation Testing* – Borings LP-1 and LP-2 were converted to temporary percolation test wells upon completion of drilling and sampling. The test wells consisted of 2-inch slotted (0.020") PVC well casing surrounded by #3 Monterey Sand placed in the annulus of the well within the test zone. In-situ percolation testing was performed on July 3, 2024 in general accordance with the *Orange County Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Programs (WQMPs)* (OCPW, 2013). The results of the percolation testing are presented in Appendix B, *Percolation Test Data*. Refer to the discussion of infiltration rate presented in Section 2.4.1, *Infiltration*. Upon completion of the percolation testing, the well casing was removed from each boring and the borings were backfilled with soil cuttings and patched at the surface with cold-mix asphalt concrete to match existing site conditions.

- *Laboratory Testing* – Laboratory tests were performed on selected soil samples obtained from the borings during our field investigation. The laboratory testing program was designed to evaluate the physical and engineering characteristics of the onsite soil. Tests performed during this investigation include:

  - In- situ Moisture Content and Dry Density (ASTM D 2216 and ASTM D 2937);
  - Maximum Dry Density (ASTM D 1557);
  - Expansion Index (ASTM D 4829);
  - Consolidation (ASTM D 2435);
  - Direct Shear (ASTM D 3080);
  - R-value; and
  - Corrosivity Suite – pH, Sulfate, Chloride, and Resistivity (California Test Methods 417, 422, and 532/643).

  Results of the in-situ moisture content and dry density testing are presented on the boring logs in Appendix A. Other laboratory test results are presented in Appendix C, *Laboratory Test Results*

- *Engineering Analysis* – The data obtained from our background review and field exploration were evaluated and analyzed to develop recommendations for the proposed development.

- *Report Preparation* – This report presents our findings, conclusions, and recommendations for the proposed development.

1.3 Previous Study

In 2002 Ninyo & Moore, Inc. performed a previous geotechnical investigation at the site in support of the planned security wall for the Theo Leo Facility (Ninyo & Moore, 2022). As a part of their investigation, fourteen (14) hollow-stem auger borings (designated B-1 thru B-14) were drilled to approximate depths ranging from 16½ to 31½ feet bgs and geotechnical laboratory testing was performed on selected samples. The approximate locations of the previous borings by Ninyo & Moore are shown on the attached Plate 1, and copies of the previous exploration logs are included in Appendix D, *Exploration Logs (Ninyo & Moore, 2022).* Copies of the previous laboratory test results are included in Appendix E, *Laboratory Test Results (Ninyo & Moore, 2022)*.

2.0 Geotechnical Findings

2.1 Regional Geologic Setting

The site is located within the Peninsular Ranges geomorphic province of California. The Peninsular Ranges province extends approximately 900 miles southward from the Santa Monica Mountains to the tip of Baja California (Yerkes et al., 1965) and is characterized by elongated, northwest-trending mountain ridges and sediment-floored valleys. The province includes numerous northwest-trending fault zones, most of which either die out, merge with, or are terminated by faults that form the southern margin of the Transverse Ranges province. These northwest-trending fault zones include the San Jacinto, Whittier-Elsinore, Palos Verdes, and Newport-Inglewood fault zones. East of the site are the northwest-trending Santa Ana Mountains, a large range that has been uplifted on its eastern side along the Whittier-Elsinore Fault Zone, producing a tilted, irregular highland that slopes westward toward the sea.

Locally, the subject site is located in the margin between the Tustin Plain and the southern Los Angeles Basin, a large structural depression within the Peninsular Ranges geomorphic province of California. The subject site has been part of a flood plain, receiving finer-grained materials during flood and heavy storm events derived from the adjacent Santa Ana River and its tributaries. The Tustin Plain separates the Santa Ana Mountains to the north and east from the San Joaquin Hills to the south and is comprised of relatively flat-lying unconsolidated to semi-consolidated Quaternary-age clastic sediments that are up to approximately 900 feet thick beneath the site (Singer, 1973; Fuller et al., 1980). The near surface, unconsolidated sediments of Holocene to Late Pleistocene age beneath the site predominantly consist of sediments derived from the Santa Ana River and its tributaries draining from Santa Ana and San Bernardino Mountains.

2.2 Surficial Geology

The project site is located immediately to the west of the Santa Ana River channel. Geologic mapping of the project area indicates that near-surface native soils consist of Quaternary-aged (Holocene to late Pleistocene) young alluvial fan deposits derived primarily from the Santa Ana River floodplain. These sediments are generally comprised of unconsolidated to slightly consolidated, undissected to slightly dissected boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon (Bedrossian and Roffers, 2010; Morton and Miller, 2006). The surficial geologic units mapped in the vicinity of the project site are shown on Figure 2, *Regional Geology Map*.

2.3 Subsurface Soil Conditions

Based on our subsurface explorations and review of the previous explorations by Ninyo & Moore (2022), the site is underlain by a layer of undocumented artificial fill materials (Afu) overlying Quaternary-age (Holocene to late Pleistocene) young alluvial fan deposits (Qyf). The artificial fill encountered in the borings generally ranges from approximately 2 to 7½ feet bgs across the site. However, deeper fill materials were encountered in our borings and were reported to have been encountered by others (Ninyo & Moore, 2022) at depths ranging from approximately 12 to 20 feet bgs in the southeastern portion of the site. The fill soils consist primarily of locally derived silty sand and sandy silt with minor to abundant amounts of debris. The thicker accumulation of undocumented fill materials in the southeastern portion of the site is consistent with the former topographic depression that existed in the southeastern portion of the site (USGS, 1950) associated with the natural Santa Ana River drainage course that crossed the site in this area prior it being channelized. Localized thicker accumulations of undocumented fill materials may also in the unexplored portions of the site, particularly beneath the existing structures. We are not aware of any available reports documenting the placement and compaction testing of the existing artificial fill at the site; therefore, it is considered unsuitable for support of new structures in its current condition.

Below the artificial fill materials, young alluvial fan deposits (Qyf) were encountered in the borings to the maximum depth explored (51½ feet bgs). The alluvial sediments encountered generally consist of slightly moist to wet, loose to dense, poorly-graded sand and silty sand; and slightly moist to very moist, very soft to very stiff, silty clay, clayey silt, silt, clay and sandy silt.

Detailed descriptions of the subsurface soils encountered in the borings are presented on the logs included in Appendices A and D. The locations of the borings are shown on Plate 1 and the general subsurface conditions across the site are shown on Plate 2, *Geotechnical Cross-Sections A-A' and B-B'*. Some of the engineering properties of these soils are described in the following sections.

2.3.1 Expansive Soil Characteristics

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and which shrink when dried. Foundations constructed on these soils are subject to uplifting forces caused by the swelling. Without proper mitigation measures, heaving and cracking of both building foundations and slabs-on-grade could result.

One (1) near-surface soil sample obtained during our subsurface exploration was tested for expansion potential. The test results indicate an Expansion Index (EI) value of 1 ("very low" potential for expansion). The Expansion Index laboratory test results are included in Appendix C of this report.

Expansive soils will likely not impact the proposed construction. Variance in expansion potential of onsite soil is anticipated; therefore, additional testing is recommended upon completion of site grading and excavation to confirm the expansion potential presented in this report. For purposes of this report and based upon visual characterization of alluvial materials at approximate foundation depth, very low expansion potential of site materials may be considered to support design and verified upon completion of earthwork grading.

2.3.2 Soil Corrosivity

One (1) near-surface soil sample obtained during our subsurface exploration was tested for corrosivity to assess corrosion potential to buried concrete. The chemical analysis test results for the onsite soil from our geotechnical exploration are included in Appendix C of this report.

The test results indicate a soluble sulfate concentration of 107 parts per million (ppm), chloride content of 180 ppm, pH value of 8.76, and a minimum resistivity value of 5278 ohm-cm.

The results of the resistivity tests indicate the underlying soil is mildly corrosive to buried ferrous metals per ASTM STP 1013. Based on the measured water-soluble sulfate contents from the soil samples, concrete in contact with the soil is expected to have negligible exposure to sulfate attack (Exposure Class S0) per ACI 318 (ACI, 2014). The samples tested for water-soluble chloride content indicate a low potential for corrosion of steel in concrete due to the chloride content of the soil. However, an Exposure Class of C1 may be assumed for concrete in contact with soil exposed to moisture per ACI 318 (ACI, 2014), but not to external sources of chlorides.

2.3.3 Soil Compressibility

Three (3) samples of the onsite soils recovered from the borings were subjected to consolidation testing to evaluate the compressibility of these materials under assumed loads representative of anticipated structural bearing stresses. The results of testing indicate these soils exhibit a low to moderate compressibility potential. The results of testing performed as a part of this study are presented in Appendix C.

2.3.4 Shear Strength

Evaluation of the shear strength characteristics of the onsite soil and bedrock materials included laboratory direct shear testing of four (4) samples recovered from the borings as a part of this study. The results of testing are included in Appendix C.

2.3.5 Excavation Characteristics

Based on our subsurface explorations performed at the site and our experience from grading jobs in the vicinity of the site, we anticipate the onsite artificial fill and alluvial materials can generally be excavated using conventional excavation equipment in good operating condition.

2.4 Groundwater Conditions

Groundwater was encountered at the site in our subsurface investigation at depths ranging between approximately 27.8 feet and 35.9 feet bgs. Review of the *Seismic Hazard Zone Report for the Anaheim and Newport Beach Quadrangles* (CGS, 1997) indicates the historically shallowest depth to groundwater beneath the site is between approximately 25 and 30 feet bgs. Based on groundwater monitoring data available through the State Water Resources Control Board's GeoTracker website for the site associated with a former gas station, groundwater levels were measured at approximately 36 to 41 feet bgs between approximately 1992 and 2002 (TRC, 2003). For the purposes of our study, the design groundwater depth used in our analysis is 25 feet bgs.

Based on these findings, groundwater is not expected to pose a constraint during or after construction. Fluctuations of the groundwater level, localized zones of perched water, and an increase in soil moisture, should be anticipated during and following the rainy seasons or periods of locally intense rainfall or storm water runoff.

2.4.1 Infiltration

Percolation testing was performed within temporary percolation wells installed in borings LP-1 and LP-2 to evaluate the infiltration characteristics of subsurface soils. The percolation tests were conducted in general accordance with the *Orange County Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Programs (WQMPs)* (OCPW, 2013). Results of the percolation testing are presented in Appendix B. The test locations and zones tested are shown on Plate 1.

A boring percolation test is useful for field measurements of the infiltration rate of soils and is suited for testing when the design depth of the infiltration device is deeper than current existing grades, especially in areas where it is difficult to dig test pits, or where the depths of these test pits would be considerably deep. At the subject site, testing consisted of advancing the borings to general depths anticipated for the invert of typical near-surface infiltration devices.

Due to the predominately granular and permeable characteristics of the subsurface soils within the test zone at the percolation test locations, a constant-head test method was employed for testing in both LP-1 and LP-2. The constant-head method records the approximate volume of water delivered to the test zone while maintaining a relatively constant height of water in the well over the testing period. Since the subsurface materials at this location were generally favorable for percolation (sandy soils), a water source was used to deliver water to the well at a relatively constant rate while recording the water height in the well. The measured infiltration rate for the constant-head percolation test was calculated by dividing the total volume of water infiltrated by the total duration of the test and dividing by the percolation surface area.

Detailed results of the field testing data and measured infiltration rate for the test well are presented in Appendix B. The test results are summarized in the table below:

Table 1 – Measured (Unfactored) Infiltration Rate

Test Well Designation	Approximate Depth of Test Zone (feet bgs)	Measured Unfactored Infiltration Rate (inch per hour)
LP-1	5 to 10	60.4
LP-2	5 to 10	76.6

The measured (unfactored) infiltration rate for the two (2) tests performed were performed were 60.4 inch per hour (LP-1) and 76.6 inches per hour (LP-2), respectively. In accordance with the TGD (OCPW, 2013), a minimum factor of safety of 2 or more should be applied to the measured infiltration rates for design of the system.

Due to the variability of test results, the lower infiltration rate measured at test well LP-1 should be considered for design purposes. In addition, based on the variability of the results and unknown location and depth of the planned stormwater infiltration device(s), additional testing may be required.

2.5 Surface Fault Rupture

Our review of available literature indicates that no known active faults have been mapped across the site, and the site is **not** located within a currently established *Alquist-Priolo Earthquake Fault Zone* (CGS, 2018; Bryant and Hart, 2007). Therefore, a surface fault rupture hazard evaluation is not mandated for this site and the potential for surface fault rupture at the site is expected to be low.

The location of the closest active faults to the site was evaluated using the United States Geological Survey (USGS) Earthquake Hazards Program National Seismic Hazard Maps (USGS, 2008). The closest active faults to the site with the potential for surface fault rupture are the

Newport-Inglewood and Elsinore fault, located approximately 9.3 miles and 10.2 miles from the site, respectively. The San Andreas fault, which is the largest active fault in California, is approximately 41 miles northeast of the site on the north side of the San Gabriel Mountains. Major regional faults with surface expression in proximity to the site are shown on Figure 3, *Regional Fault and Historic Seismicity Map*.

2.6 Strong Ground Shaking

The principal seismic hazard to the site is ground shaking resulting from an earthquake occurring along any of several major active and potentially active faults in southern California (Figure 3). The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude, the distance from the source, and the site response characteristics.

Accordingly, design of the project should be performed in accordance with all applicable current codes and standards utilizing the appropriate seismic design parameters to reduce seismic risk as defined by California Geological Survey (CGS) Chapter 2 of Special Publication 117A (CGS, 2008). The 2022 edition of the California Building Code (CBC) is the current edition of the code. Through compliance with these regulatory requirements and the utilization of appropriate seismic design parameters selected by the design professionals, potential effects relating to seismic shaking can be reduced.

The following code-based seismic parameters should be considered for design under the 2022 CBC:

Table 2 – 2022 CBC Seismic Design Parameters (Mapped Values)

Categorization/Coefficient	Value
Site Latitude	33.7802°
Site Longitude	-117.8879°
Site Class	D
Mapped Spectral Response Acceleration at Short Period (0.2 sec), S_S	1.355 g
Mapped Spectral Response Acceleration at Long Period (1 sec), S_1	0.481 g
Short Period (0.2 sec) Site Coefficient, F_a	1
Long Period (1 sec) Site Coefficient, F_v	1.819[1]
Adjusted Spectral Response Acceleration at Short Period (0.2 sec), S_{MS}	1.355 g
Adjusted Spectral Response Acceleration at Long Period (1 sec), S_{M1}	0.875[1] g
Design Spectral Response Acceleration at Short Period (0.2 sec), S_{DS}	0.903 g
Design Spectral Response Acceleration at Long Period (1 sec), S_{D1}	0.584[1] g
Site-adjusted geometric mean Peak Ground Acceleration, PGA_M	0.629 g

[1]See Section 11.4.8 of ASCE 7-16. A site-specific ground motion hazard analysis in accordance with Section 21.2 of ASCE 7-16 is required for this site. Per Supplement 3 to ASCE 7-16, a site-specific ground motion hazard analysis is not required where the value of the parameters S_{M1} and S_{D1} in the table are increased by 50%.

2.7 Liquefaction Potential

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when three general conditions exist: 1) shallow groundwater; 2) low density, fine, clean sandy soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose and medium dense, near-surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential.

In general, adverse effects of liquefaction or cyclic softening include excessive ground settlement, loss of bearing support for structural foundations, and seismically-induced lateral ground deformations such as lateral spreading. Depending upon the relative thickness of the liquefied strata with respect to overlying non-liquefiable soils, other potentially adverse effects such as ground oscillation and ground fissuring may occur.

As shown on the *Seismic Hazard Zones* map for the Anaheim and Newport Beach Quadrangles (CGS, 1998), the project site **is** located within an area that has been identified by the State of California as being potentially susceptible to liquefaction (Figure 4, *Seismic Hazard Map*). In addition, the historically shallowest depth to groundwater at the site is between 25 and 30 feet bgs.

As a part of this geotechnical exploration, we have evaluated the liquefaction potential at the site using the data obtained from the CPT soundings with the computer program Cliq (v.3.5.2.22). Based on our evaluation using the using the Maximum Considered Earthquake (MCE) and a design groundwater level of 25 feet bgs for the CPTs performed at the site, the potential for liquefaction to occur at the site is low with little to no expression at the surface. The results of our analysis are presented in Appendix F, *Liquefaction Analysis*.

2.8 Seismically-Induced Settlement

Seismically-induced settlement consists of dynamic settlement of unsaturated soil (above groundwater) and liquefaction-induced settlement (below groundwater). These settlements occur primarily within low density sandy soil due to reduction in volume during and shortly after an earthquake event.

As a part of the liquefaction analysis, we estimated the corresponding seismically-induced ground deformations using the computer program Cliq (v.3.5.2.22). Under existing conditions, the total seismically-induced settlement is estimated to be on the order of 1 inch or less. Differential settlement is expected to be on the order of ¼ inch or less over a horizontal distance of 30 feet. The results of our analysis are presented in Appendix F.

2.9 Seismically-Induced Lateral Ground Displacements

Liquefaction may also cause lateral spreading. For lateral spreading to occur, the liquefiable zone must be continuous, unconstrained laterally, and free to move along gently sloping ground toward an unconfined area. The Santa Ana River channel is located about 160 feet away from the southeastern property boundary. The channel embankment is approximately 10 feet high. We performed a lateral deformation analysis for all CPTs assuming that they are all located within 160 feet of the channel. Based on the results, seismically-induced lateral displacement is anticipated to be negligible (Appendix F).

2.10 Earthquake-Induced Landsliding

As shown on Figure 4, the site is **not** mapped within a seismically-induced landslide hazard zone identified by the State of California (CGS, 1998). In addition, due to project site being relatively flat, it is our opinion that the potential for seismically-induced landslide hazard at the site is negligible.

2.11 Flooding

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 2009), the project site is located within a flood hazard area identified as "Zone X", which is defined as an area of reduced flood risk due to levee. Accordingly, and as shown on Figure 5, *Flood Hazard Zone Map*, the site **is** located within a 500-year flood hazard zone. Regionally, storm runoff flow is generally directed to the southwest.

Earthquake-induced flooding can be caused by failure of dams or other water-retaining structures as a result of earthquakes. The project site **is** located within a flood impact zone from Prado Dam and Santiago Creek Dam as indicated on Figure 6, *Dam Inundation Map*. However, due to the location and distance of the site from these dams, the potential for earthquake-induced flooding to occur due to a failure of this dam is considered low. Catastrophic failure of this dam is expected to be a very unlikely event in that dam safety regulations exist and are enforced by the DOSD, Army Corps of Engineers and Department of Water Resources. Inspectors may require dam owners to perform work, maintenance or implement controls if issues are found with the safety of the dam.

2.12 Seiches and Tsunamis

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. Tsunamis are waves generated in large bodies of water by fault displacement or major ground movement. Based on the absence of an enclosed water body near the site and the inland location of the site, seiche and tsunami risks at the site are considered negligible.

2.13 Methane

Based on review of State of California Geologic Energy Management Division (CalGEM) records, the project site is **not** located within an oil field boundary (CalGEM, 2024). The nearest documented oil well to the site (Chevron U.S.A. Well No. 1) is located approximately 0.6 mile west of the site and is reported as plugged (CalGEM, 2024). Based on these findings, the potential for methane hazard at the site is considered low.

3.0 Geotechnical Design Recommendations

Based upon this study, we conclude that the proposed development for the subject site is feasible from a geotechnical standpoint, provided that the recommendations presented in this report are properly incorporated in design and construction.

Based on our review of available site-specific geotechnical data and our professional experience, the earth materials on the site are suitable for support of the proposed development, provided they are subjected to a phase of remedial rough grading. The purpose of the grading would be to establish conditions suitable for the use of conventional shallow foundations (spread footings).

The proposed structures may be supported on shallow spread-type foundations established over engineered fill. We estimate removals of existing undocumented fill will generally be on the order of approximately 3 to 7½ feet, with areas in the southeastern portion of the site where removals are expected to be up to approximately 20 feet below existing grades or more. The floor slab may be supported directly on grade. Unexplored portions of the site and areas disturbed during demolition of existing buildings and improvements may require deeper removals. Removals should be performed such that all undocumented fill and unsuitable materials are removed to expose suitable native alluvial soils and replaced as engineered fill. There may be existing underground utilities that will also be impacted. Information on these utilities should be provided to Verdantas for evaluation. All existing undocumented fill is recommended to be removed from the proposed building/structure footprint areas prior to placement of engineered fill.

Alternatively, due to the depth of undocumented fill soils beneath the planned building footprints and site boundary constraints, implementation of ground improvement in lieu of remedial rough grading in these areas of deep existing undocumented fill soils may be considered within the planned building footprint areas if reviewed and accepted by the local reviewing agency. Feasible alternatives for ground improvement at this site that may be considered are Geopiers® or rammed aggregate piers, drilled displacement columns, and stone columns. Ground improvement should densify the subsurface below the proposed building footprint(s) down to a depth of 15 feet. In addition, perimeter site walls may be supported on deep foundations with a grade beam in areas where complete removals are not feasible.

The recommendations below are based upon the exhibited geotechnical engineering properties of the soils and their anticipated response both during and after construction. The recommendations are also based upon proper field observation and testing during construction. The project geotechnical engineer should be notified of suspected variances in field conditions to determine the effect upon the recommendations subsequently presented. These recommendations are considered minimal and may be superseded by more restrictive requirements of the civil and structural engineers, the City of Orange, the County of Orange, and other governing agencies.

Verdantas should review the grading and foundation plans and project specifications as they become available to verify that the recommendations presented in this report have been incorporated into the plans for this project.

3.1 Site Grading

Earthwork for the project is expected to consist of removal of unsuitable soil materials, overexcavation, and placement of compacted fill. We recommend all earthwork on the site be performed in accordance with the recommendations presented in this report and the project specifications as prepared by others. The *Earthwork and Grading Guide Specifications* included in Appendix G may be used for guidance in developing the project specifications. If conflict arises, the recommendations in Appendix E shall be superseded by the project specifications, recommendations contained in this report and/or the County of Orange Grading Guidelines, whichever is more stringent. All site grading should be performed in accordance with the applicable local codes and in accordance with the project specifications that are prepared by the appropriate design professional.

3.1.1 Site Preparation

Prior to construction, the site should be cleared of any vegetation, trash, and/or debris within the area of proposed grading. These materials should be removed from the site. Any underground obstructions onsite should be removed. Efforts should be made to locate any existing utility lines to be removed or rerouted where interfering with the proposed construction. Any resulting cavities should be properly backfilled and compacted. After the site is cleared, the soils should be carefully observed for the removal of all unsuitable deposits. All undocumented fill or man-made debris, unsuitable native soils and former foundation remnants should be excavated and removed from the proposed building/structure footprint areas prior to placement of engineered fill.

3.1.2 Removals and Overexcavations

To provide uniform foundation support and reduce the potential for excessive static settlement, all existing undocumented fill and any unsuitable soil, as deemed by the geotechnical engineer, should be removed to expose suitable native alluvial soils and replaced as engineered fill below the proposed buildings and other structural improvements. Based on our field explorations and the previous explorations performed at the site by others (Ninyo & Moore, 2022), we estimate removals of existing undocumented fill at the site will generally be on the order of approximately 3 to 7½ feet. However, fill materials were encountered in our borings or reported to have been encountered (Ninyo & Moore, 2022) at depths ranging from approximately 12 to 20 feet bgs in the southeastern portion of the site. Localized areas may also require deeper removals as determined during grading by a representative of the geotechnical engineer depending on observed subsurface conditions. Unexplored portions of the site including areas beneath existing buildings and in areas of existing utilities, and areas disturbed during demolition of existing buildings and improvements may also require deeper removals.

In addition, we recommend overexcavations be performed to allow placement of least 3 feet of engineered fill below the proposed building foundation elements. The lateral extent of removals and overexcavations beyond foundations should be equal to the depth of excavation below the proposed foundation elements.

The depth of overexcavation in non-structural areas planned for new pavement construction is recommended to be 2 feet below the current grade or planned subgrade elevation to develop a suitable bearing subgrade for pavement support. Deeper overexcavations in localized areas may be recommended during grading by a representative of the geotechnical engineer depending on observed subsurface conditions. Preparation limited to 2 feet of overexcavation below subgrade may result in the need for increased pavement maintenance and periodic repairs where existing undocumented fill is left in place below the recommended overexcavation depth of 2 feet. Alternatively, removals can be performed such that all undocumented fill is removed to expose suitable natural soils (alluvium) and replaced as engineered fill.

3.1.3 Excavation Bottom Preparation

All excavation or removal bottoms should be observed by a representative of the geotechnical engineer prior to placement of fill or other improvements to determine that geotechnically suitable soil is exposed. Excavation bottoms observed to be suitable for fill placement or other improvements should be scarified to a depth of at least 8 inches, moisture-conditioned as necessary to achieve a moisture content within 2 percentage points of the optimum moisture content, and then compacted to a minimum of 90 percent of the laboratory derived maximum density as determined by ASTM Test Method D 1557 (Modified Proctor).

3.1.4 Fill Materials

On-site soil that is free of construction debris, organics, cobbles, boulders, rubble, or rock larger than 4 inches in largest dimension is suitable to be used as fill for support of structures. If required, any imported fill soil should be approved by the geotechnical engineer prior to import or use onsite.

3.1.5 Fill Placement and Compaction

Fill soils should be placed in thin lifts, moisture-conditioned to within 2 percent of optimum moisture content and compacted using appropriate equipment and methods to achieve a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method D 1557. Aggregate base should be compacted to a minimum of 95 percent relative compaction.

3.1.6 Shrinkage

The change in volume of excavated and recompacted soil varies according to soil type and location. This volume change is represented as a percentage increase (bulking) or decrease (shrinkage) in volume of fill after removal and recompaction. Field and laboratory data used in our calculations included laboratory-measured maximum dry density for the general soil type encountered at the subject site, the measured in-place densities of near surface soils encountered and our experience.

Based upon the results of the in-place density and the moisture-density relationship exhibited by representative bulk samples of the near surface soils, recompaction of the soils is anticipated to result in volume shrinkage in the range of 10 to 15 percent. The estimated shrinkage does not include material losses due to removal of organic material or other unsuitable bearing materials (debris, rubble, oversize material greater than 6-inches) and the actual shrinkage that occurs during grading may vary throughout the site.

3.1.7 Reuse of Concrete and Asphalt Rubble

If encountered during site clearing and/or during preparation activities, construction rubble (i.e., Portland cement concrete and asphalt concrete) may be incorporated in the proposed development. For use as structural fill, the processed material should be crushed to develop a relatively well-graded mixture with a maximum particle size of 3-inch nominal diameter. Concrete rubble should be free of rebar and processed asphalt pavement rubble may be used if mixed with the existing base course (where present). Processed material may be used as structural fill if uniformly mixed with onsite soils in proportion of 1 part processed material to 3 parts soil. For use as pavement base course, crushed material should satisfy gradation requirements of Section 200-2.4 of the *Standard Specifications for Public Works Construction* (Greenbook), current edition. Such materials must be free of and segregated from any hazardous materials and/or organic material of any kind.

3.2 Ground Improvement

Due to the depth of undocumented fill soils beneath the planned building footprints and site boundary constraints, implementation of ground improvement in lieu of remedial rough grading in these areas of deep existing undocumented fill soils may be considered within the planned building footprint areas if reviewed and accepted by the local reviewing agency. Feasible alternatives for ground improvement at this site that may be considered are Geopiers® or rammed aggregate piers, drilled displacement columns, and stone columns. Ground improvement should densify the subsurface below the proposed building footprint(s) down to a depth of 15 feet..

3.3 Foundation Design

Conventional spread footings established on engineered fill soils may be used to support the proposed building and other structural elements. Footings should be embedded a minimum of 12 inches below the lowest adjacent grade. An allowable soil bearing pressure of 3,000 pounds per square foot (psf) may be used for footings with a minimum width of 12 inches for continuous footings and 18 inches for isolated footings. Footings should have a minimum embedment of 12 inches below the lowest adjacent grade. Higher bearing capacities may be feasible depending on the design of the ground improvement system, if applicable.

The ultimate bearing capacity can be taken as 9,000 psf, which does not incorporate a factor of safety. A resistance factor of 0.45 should be used for initial bearing capacity evaluation with factored loads.

A one-third increase in the bearing value for short duration loading, such as wind or seismic forces may be used. The recommended bearing values are net values, and the weight of concrete in the footings can be taken as 50 pounds per cubic foot (pcf); the weight of soil backfill can be neglected when determining the downward loads.

The allowable bearing capacity for shallow footings is based on a total static settlement of ¾ inch. Differential settlement can be taken as half the total settlement over a horizontal distance of 40 feet.

For static loading, 50 pounds per cubic inch (pci) may be assumed as the modulus of subgrade reaction (*k*). For seismic loading, a *k* value of 150 pci may be assumed.

Since settlement is a function of footing size and contact bearing pressure, differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists. Once developed by the structural engineer, we should review total dead and sustained live loads for each column including plan location and span distance, to evaluate if differential settlements between dissimilarly loaded columns will be tolerable. Excessive differential settlement can be mitigated with the use of reduced bearing pressures, deeper footing embedment, possibly changing overexcavation schemes and using imported base material under spread footings, or possibly other methods.

Resistance to lateral loads will be provided by a combination of friction between the soil and structure interface and passive pressure acting against the vertical portion of the footings. For calculating lateral resistance, a passive pressure of 300 psf per foot of depth to a maximum of 3,000 psf and a frictional coefficient of 0.3 may be used. Note that the passive and frictional coefficients do not include a factor of safety. The frictional resistance and the passive resistance of the soils can be combined without reduction in determining the total lateral resistance.

3.4 Flagpole Footings

Flagpole type footings (short caissons) established either in undisturbed natural soils or engineered fill may be used to support ancillary structures such as perimeter walls, flagpoles, light poles, and canopies.

Short caissons should extend through any existing undocumented fill and derive support from the underlying undisturbed natural soils. Caisson segments through undocumented fill should be isolated from contacting those materials by using Sonotubes or equivalents.

Flagpole type footings established directly on undisturbed natural soils or on engineered fill underlain by natural soils may be designed to impose an allowable bearing pressure due to dead-plus-live (static) loads of 3,000 psf.

A one-third increase can be used for wind or seismic loads. The recommended bearing value is net value, and the weight of concrete in the footings can be taken as 50 pcf.

The estimated total settlement of the structures supported on spread footings not established over refuse is on the order of ½ inch or less. Differential settlement is anticipated to be on the order of ¼ inch over 30 feet. Most of the settlement is anticipated to occur within a few months of the application of dead loads.

Lateral loads can be resisted by the passive resistance of the soils. The passive resistance of natural soils or engineered fill against flagpole type footings, with on-center spacing of at least 3 diameters, may be assumed to be equal to the pressure developed by a fluid with a density of 600 pcf. The passive resistance of undocumented fill against flagpole type footings, with on-center spacing of at least 3 diameters, may be assumed to be equal to the pressure developed by a fluid with a density of 300 pcf.

A one-third increase in the passive value can be used for wind or seismic loads. The frictional resistance and the passive resistance of the soils can be combined without reduction in determining the total lateral resistance.

A friction coefficient of 0.3 may be used at the soil-concrete interface for calculating uplift resistance. The coefficient of horizontal earth pressure (ratio of horizontal vs vertical earth pressure) may be assumed to be 0.5.

3.5 Slabs-on-Grade

Unloaded concrete slabs may be designed using a modulus of subgrade reaction of 100 pci provided the subgrade is prepared as described in Section 3.1. From a geotechnical standpoint, we recommend slab-on-grade be a minimum 5 inches thick with No. 3 rebar placed at the center of the slab at 24 inches on center in each direction. The structural engineer should design the actual thickness and reinforcement based on anticipated loading conditions. Where moisture-sensitive floor coverings or equipment is planned, the slabs should be protected by a minimum 10-mil-thick vapor barrier between the slab and subgrade. A coefficient of friction of 0.35 can be used between the floor slab and the vapor barrier.

Minor cracking of concrete after curing due to drying and shrinkage is normal and should be expected; however, concrete is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. The use of low-slump concrete or low water/cement ratios can reduce the potential for shrinkage cracking. Additionally, our experience indicates that the use of reinforcement in slabs and foundations can generally reduce the potential but not eliminate for concrete cracking.

To reduce the potential for excessive cracking, concrete slabs-on-grade should be provided with construction or weakened plane joints at frequent intervals. Joints should be laid out to form approximately square panels.

3.6 Cement Type and Corrosion Protection

Based on the results of laboratory testing, concrete structures in contact with the onsite soil are expected to have negligible exposure to water-soluble sulfates in the soil (Exposure Class S0). Based on ACI 318, concrete exposed to moisture but not to external sources of chlorides is classified as having <u>low exposure</u> (Exposure Class C1). Common Type II cement may be used for concrete construction onsite and the concrete should be designed in accordance with CBC 2022 requirements. However, concrete exposed to recycled water should be designed using Type V cement.

Based on our laboratory testing, the onsite soil is considered mildly corrosive to ferrous metals. Ferrous pipe should be avoided by using high-density polyethylene (HDPE) or other non-ferrous pipe when possible. Ferrous pipe, if used, should be protected by polyethylene bags, tap or coatings, di-electric fittings or other means to separate the pipe from onsite soils.

3.7 Retaining Walls

Recommended lateral earth pressures are provided as equivalent fluid unit weights, in psf/ft. or pcf. These values do not contain an appreciable factor of safety, so the structural engineer should apply the applicable factors of safety and/or load factors during design.

Onsite soils may be suitable to be used as retaining wall backfill due to its very low expansion potential. However, field and laboratory verification are recommended before use. Site soils can be variable in composition, clast size and expansive characteristics. Should onsite soil be considered for reuse behind retaining walls, it should be tested to ensure the expansion potential is less than 20 (EI<20). Recommended lateral earth pressures for retaining walls backfilled with sandy soils with drained conditions as shown on Figure 7, *Retaining Wall Backfill and Subdrain Detail* are as follows:

Table 3 – Retaining Wall Design Earth Pressures

Retaining Wall Condition (Level Backfill)	Equivalent Fluid Pressure (pounds-per-cubic-foot)*
Active (cantilever)	40
At-Rest (braced)	60
Passive Resistance (compacted fill)	300
Seismic Increment	25

*Only for level and drained properly compacted backfill

Walls that are free to rotate or deflect may be designed using active earth pressure. For basement walls or walls that are fixed against rotation, the at-rest pressure should be used. For the seismic condition, the pressure should be distributed as an inverted triangular distribution and the dynamic thrust should be applied at a height of 0.6H above the base of the wall.

3.7.1 Sliding and Overturning

Total depth of retained earth for design of walls and for uplift resistance, should be measured as the vertical height of the stem below the ground surface at the wall face for stem design, or measured at the heel of the footing for overturning and sliding. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing, if drained, or 60 pcf if submerged, for properly compacted backfill.

3.7.2 Drainage

Adequate drainage may be provided by a subdrain system positioned behind the walls (Figure 7). Typically, this system consists of a 4-inch minimum diameter perforated pipe placed near the base of the wall (perforations placed downward). The pipe should be bedded and backfilled with pervious backfill material described in Section 300-3.6 of the *Standard Specifications for Public Works Construction* (Greenbook), current edition. This pervious backfill should extend at least 2 feet out from the wall and to within 2 feet of the outside finished grade. This pervious backfill and pipe should be wrapped in filter fabric, such as Mirafi 140N or equivalent, placed as described in Section 300-8.1 of the *Standard Specifications for Public Works Construction* (Greenbook), current edition. The subdrain outlet should be connected to a free-draining outlet or sump.

Miradrain, Geotech Drainage Panels, or Enkadrain drainage geocomposites, or similar, may be used for wall drainage as an alternative to the Class 2 Permeable Material or drain rock backfill, particularly where horizontal space is limited adjacent to shoring (where walls are cast against shoring). These drainage panels should be connected to the perforated drainpipe at the base of the wall.

3.8 Paving

To provide support for paving, the subgrade soils should be prepared as recommended in the Section 3.1. Compaction of the subgrade, including trench backfills, to at least 90 percent of the maximum dry density as determined by ASTM Test Method D 1557, and achieving a firm, hard, and unyielding surface will be important for paving support. The preparation of the paving area subgrade should be performed immediately prior to placement of the base course.

Proper drainage of the paved areas should be provided since this will reduce moisture infiltration into the subgrade and increase the life of the paving.

3.8.1 Asphalt Concrete

The required paving and base thicknesses will depend on the expected wheel loads and volume of traffic (Traffic Index or TI). Assuming that the paving subgrade will consist of engineered fill with an R-value greater than 40, compacted to at least 90 percent as recommended, the minimum recommended paving thicknesses are presented in the following table. Results of R-value testing on near surface samples of existing onsite soils indicate a value of 72.

Table 4 – Asphalt Concrete Pavement Sections

Area	Traffic Index	Asphalt Concrete (inches)	Base Course (inches)
Parking Areas	4	3	4
Light Truck	5	3	4
Heavy Truck	6	3	6½
Main Drives	7	4	7

The asphalt paving sections were determined using the Caltrans design method. We can determine the recommended paving and base course thicknesses for other Traffic Indices if required. Careful inspection is recommended to verify that the recommended thicknesses or greater are achieved, and that proper construction procedures are followed.

3.8.2 Portland Cement Concrete Paving

We have assumed that such a subgrade will have an R-value of at least 40, which will need to be verified after the completion of site grading. Portland cement concrete (PCC) paving sections were determined in accordance with procedures developed by the Portland Cement Association. Concrete paving sections for a range of Traffic Indices are presented in the following table. We have assumed that the Portland cement concrete will have a compressive strength of at least 4,000 pounds per square inch.

Table 5 – PCC Pavement Sections

Area	Traffic Index	Portland Cement Concrete (inches)	Base Course (inches)
Parking Areas	4	5	4
Light Truck	5	5½	4
Heavy Truck	6	6	4
Main Drives	7	6½	4

The paving should be provided with control joints or expansion joints at regular intervals no more than 15 feet in each direction. Load transfer devices, such as dowels or keys, are recommended at joints in the paving to reduce possible offsets. The paving sections in the above table have been developed based on the strength of unreinforced concrete. Steel reinforcing may be added to the paving to reduce cracking and to prolong the life of the paving.

3.8.3 Base Course

The base course for both asphalt concrete and Portland cement concrete paving should meet the specifications for Class 2 Aggregate Base as defined in Section 26 of the latest edition of the State of California, Department of Transportation, Standard Specifications. Alternatively, the base course could meet the specifications for untreated base as defined in Section 200-2 of the latest edition of the *Standard Specifications for Public Works Construction* (Greenbook), current edition. The base course should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D 1557.

3.9 Infiltration BMP Design Considerations

It should be noted that the measured infiltration rates presented herein may degrade over time due to complete saturation of underlying soils, and fines build-up and plugging if pretreatment of the storm water is not performed. As such, a reduction of the measured infiltration rates using a factor of safety of at least 2 or more should be considered to establish a conservative infiltration rate for the service life of the system. This factor should not be less than 2, but may be higher at the discretion of the design engineer.

In general, a vast majority of geotechnical distress issues are related to improper drainage. Distress in the form of foundation movement could occur. Direct infiltration to the subsurface is not recommended adjacent to curb and gutter, public pavements or within 10 feet away from the design saturation zone as soil saturation could lead to a loss of soil support, settlement or collapse, and internal erosion (piping). The design saturation zone may be assumed as a 1:1 plane projected downward from the top of an infiltration device's discharge zone. Additionally, infiltration water will migrate along pipe backfill (typically sand or gravel bedding) affecting improvements far from the point of infiltration. Proposed direct open bottom infiltration systems, should be located as far away from existing or proposed foundations, rigid improvements and utilities as is practical in order to reduce the geotechnical distress issues related to water. Where sufficient distance from improvements cannot be achieved, additional recommendations may be warranted and can be provided during plan review.

Prior to construction of any infiltration device intended for the site, the plans should be reviewed by the geotechnical consultant to verify that our geotechnical recommendations have been appropriately incorporated into the plans and not compromised by the addition of an infiltration system to the site. The designer of any infiltration system should contact the geotechnical consultant for geotechnical input during the design process as they feel necessary.

3.10 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations, and foundation excavations should be performed in accordance with project plans, specifications, and all OSHA requirements. Excavations 4 feet or deeper should be laid back or shored in accordance with OSHA requirements before personnel are allowed to enter.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the cut, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundation should be properly shored to maintain support of the adjacent structure.

Temporary excavations should be treated in accordance with the State of California version of OSHA excavation regulations, Construction Safety Orders for Excavation General Requirements, Article 6, Section 1541, effective October 1, 1995. The sides of excavations should be shored or sloped in accordance with OSHA regulations. OSHA allows the sides of unbraced excavations, up to a maximum height of 20 feet, to be cut to a ¾H:1V (horizontal:vertical) slope for Type A soils, 1H:1V for Type B soils, and 1½H:1V for Type C soils. Near-surface onsite soils are to be considered Type C soils.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor shall be responsible for providing the “competent person” required by OSHA standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

3.11 Trench Backfill

Utility trenches should be backfilled with compacted fill in accordance with Sections 306-1 and 306-6 of the *Standard Specifications for Public Works Construction* (Greenbook), current edition. Utility trenches can be backfilled with onsite sandy material free of rubble, debris, organic and oversized material up to (≤) 3-inches in largest dimension. Prior to backfilling trenches, pipes should be bedded in and covered with either:

(1) **Sand:** A uniform, sand material that has a Sand Equivalent (SE) greater-than-or-equal-to (≥) 30, passing the No. 4 U.S. Standard Sieve (or as specified by the pipe manufacturer), water densified in place, or

(2) **CLSM:** Controlled Low Strength Material (CLSM) conforming to Section 201-6 of the *Standard Specifications for Public Works Construction,* (Greenbook), current edition. CLSM should not be jetted.

Pipe bedding should extend at least 4 inches below the pipeline invert and at least 12 inches over the top of the pipeline. Native and clean fill soils can be used as backfill over the pipe bedding zone, and should be placed in thin lifts, moisture conditioned above optimum, and mechanically compacted to at least 90 percent relative compaction, relative to the ASTM D 1557 laboratory maximum density.

3.12 Drainage and Landscaping

Building walls below grade should be waterproofed or at least damp proofed, depending upon the degree of moisture protection desired. Surface drainage should be designed to direct water away from foundations and toward approved drainage devices. Irrigation of landscaping should be controlled to maintain, as much as possible, consistent moisture content sufficient to provide healthy plant growth without overwatering.

3.13 Additional Geotechnical Services

Verdantas should review the grading plans, foundation plans, and specifications when they are available to verify that the recommendations presented in this report have been properly interpreted and incorporated.

Geotechnical observation and testing should be provided during the following activities:

- Grading and excavation of the site;
- Installation of ground improvement;
- Subgrade preparation;
- Compaction of all fill materials;
- Utility trench backfilling and compaction;
- Footing excavation and slab-on-grade preparation;
- Pavement subgrade and base preparation;
- Placement of asphalt concrete and/or concrete; and
- When any unusual conditions are encountered.

4.0 Limitations

This geotechnical exploration does not address the potential for encountering hazardous soil at this site. In addition, this report was necessarily based in part upon data obtained from a limited number of observances, site visits, soil samples, tests, analyses, histories of occurrences, spaced subsurface explorations and limited information on historical events and observations. Such information is, by necessity, incomplete. Please also refer GBA's *Important Information About Your Geotechnical Report* (included at the rear of the text), presenting additional information and limitations regarding geotechnical engineering studies and reports. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, the findings, conclusions, and recommendations presented in this report are only valid if Verdantas, Inc. has the opportunity to observe subsurface conditions during grading and construction, to confirm that our data are representative for the site. Verdantas, Inc. should also review the construction plans and project specifications, when available, to comment on the geotechnical aspects.

This report was prepared using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing at this time in Orange County. We do not make any warranty, either expressed or implied.

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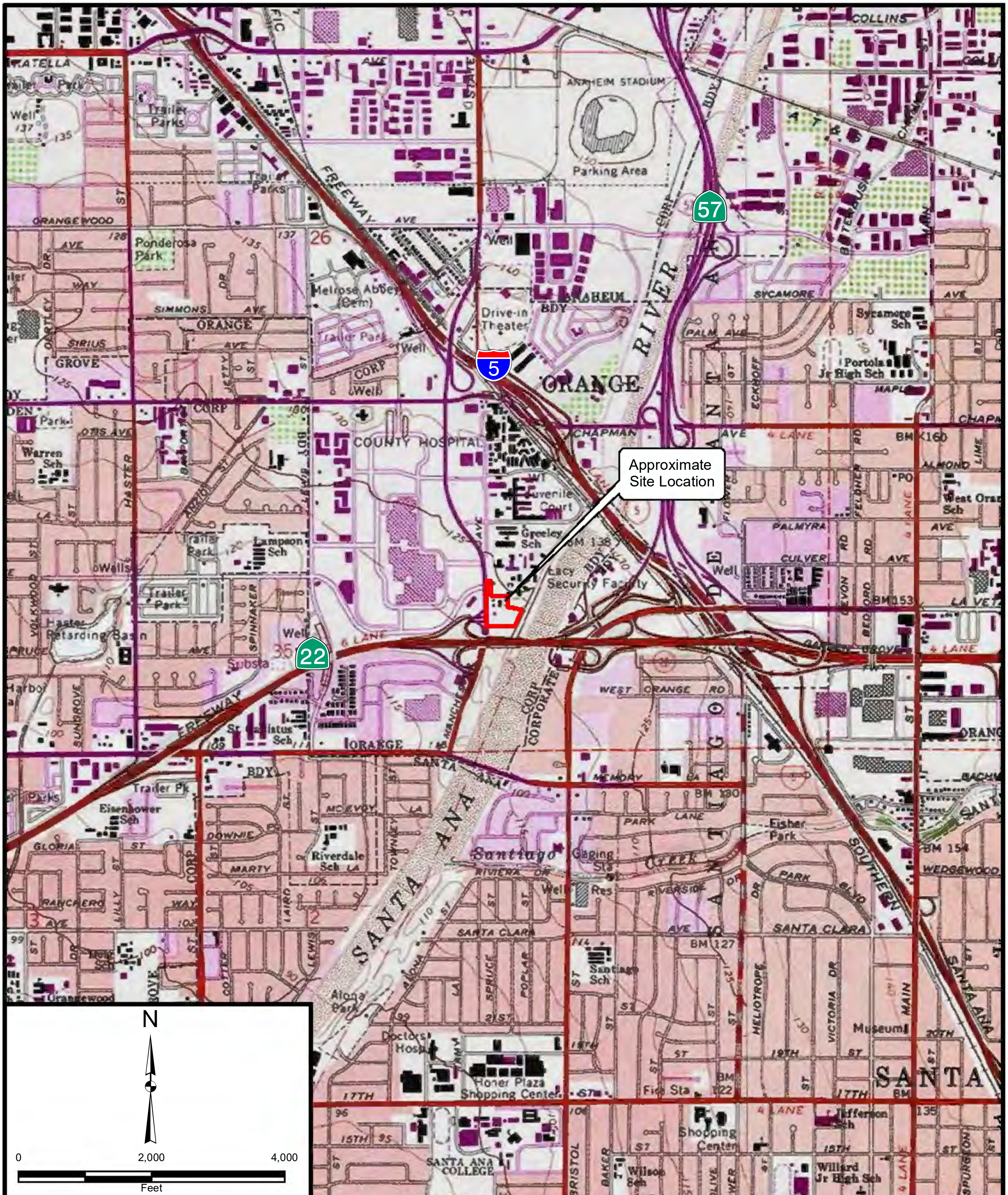
Figures and Plates



Project: 20833	Eng/Geol: CCK/JMP
Scale: 1 " = 2,000 '	Date: August 2024

Reference: Copyright:© 2013 National Geographic Society, i-cubed

SITE LOCATION MAP

Proposed Workforce Reentry Project
591 The City Drive South
City of Orange, California

FIGURE 1

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Map Saved as Z:\Project Files\GA-HZ\Griffin\20833 - Griffin OC Workforce Reentry Geo\GIS\Maps\20833_F01_SLM_2024-07-19.mxd on 7/24/2024 1:24:17 PM Author: KVM (btran)

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Scale: 1 " = 2,000 '	Date: August 2024

Reference: Geologic Map of the Santa Ana and San Bernardino Quads (30'x60') by Morton & Miller, 2006.

REGIONAL GEOLOGY MAP

Proposed Workforce Reentry Project
591 The City Drive South
City of Orange, California

FIGURE 2

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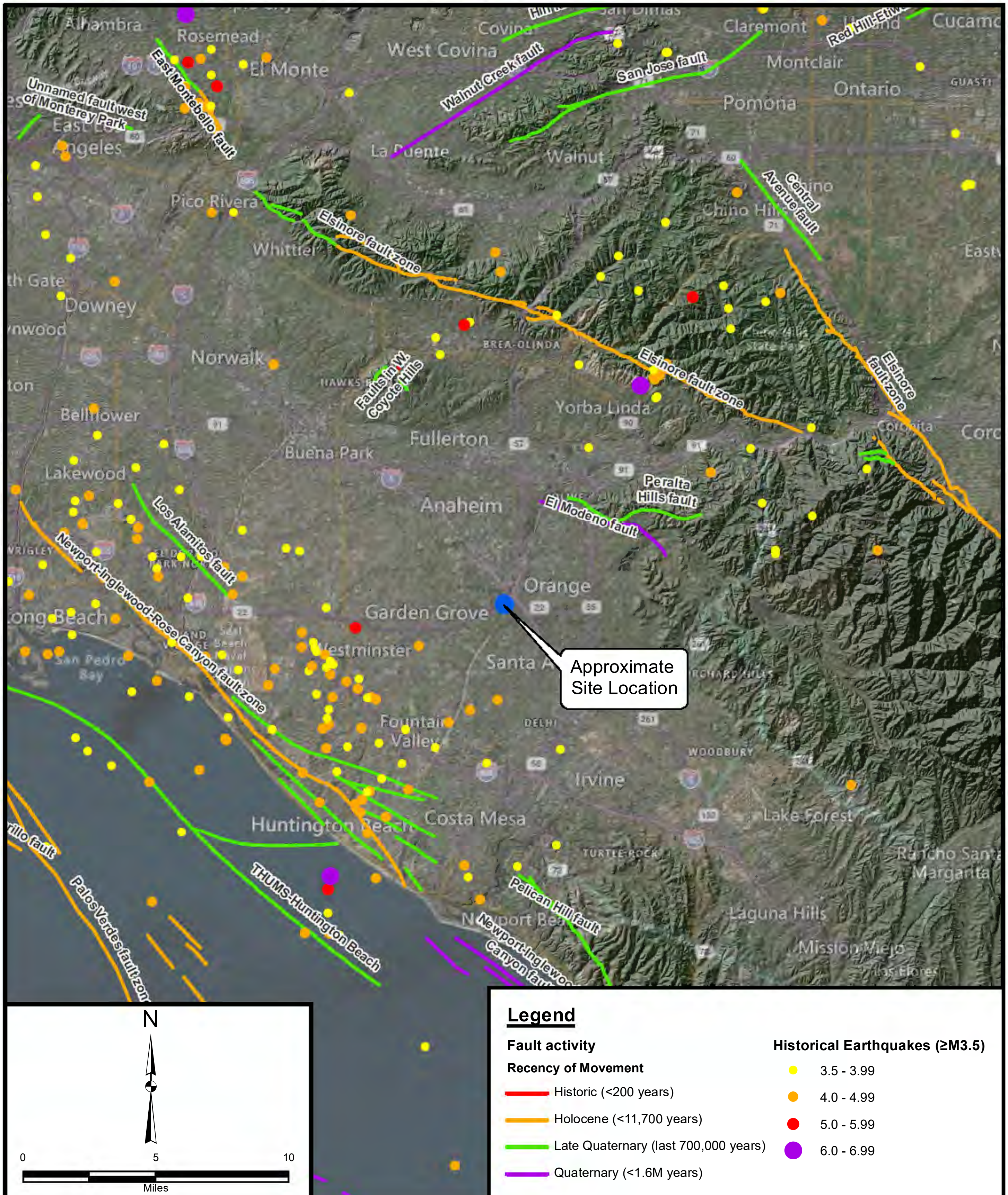
Map Saved as Z:\Project Files\GA-HZ\Griffin\20833 - Griffin OC Workforce Reentry Geo\GIS\Maps\20833_F02_RGM_2024-08-06.mxd on 7/24/2024 2:43:26 PM Author: KVM (btran)



Project: 20833	Eng/Geol: CCK/JMP
Scale: 1 " = 5 miles	Date: August 2024

Basemap Reference: © 2024 Microsoft Corporation Earthstar Geographics SIO © 2024 TomTom
Seismicity Data Reference: maps.conservation.ca.gov

REGIONAL FAULT AND HISTORIC SEISMICITIY MAP

Proposed Workforce Reentry Project
591 The City Drive South
City of Orange, California

FIGURE 3

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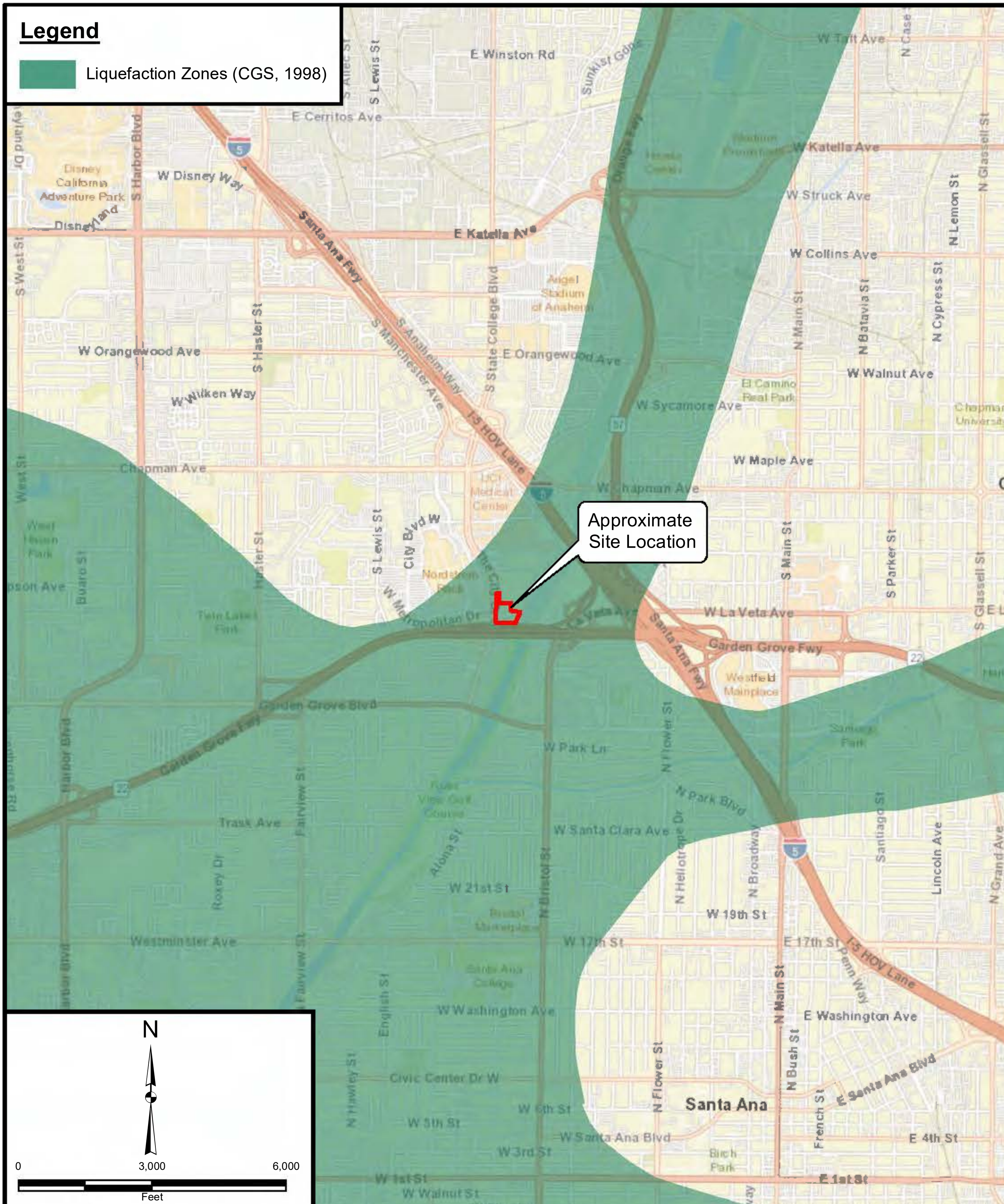
Map Saved as Z:\Project Files\GA-HZ\Griffin\20833 - Griffin OC Workforce Reentry Geo\GIS\Maps\20833_F03_RFHSM_2024-08-06.mxd on 7/24/2024 2:30:53 PM Author: KVM (btran)



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Scale: 1 " = 3,000 '	Date: August 2024

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Seismic Hazards Program, California Geological Survey, California Department of Conservation

SEISMIC HAZARD MAP

Proposed Workforce Reentry Project
591 The City Drive South
City of Orange, California

FIGURE 4

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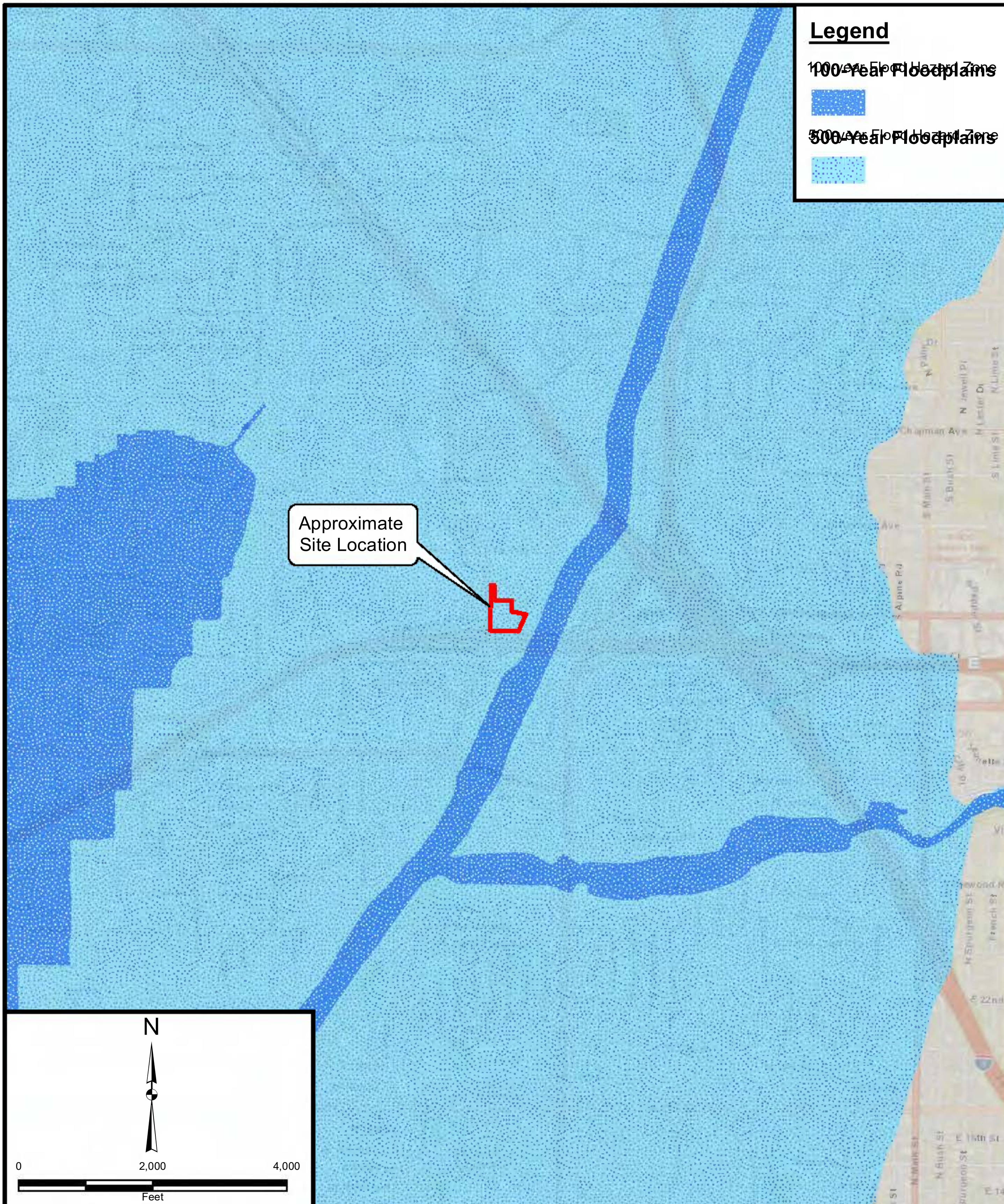
Map Saved as Z:\Project Files\GA-HZ\Griffin\20833 - Griffin OC Workforce Reentry Geo\GIS\Maps\20833_F04_SHM_2024-08-06.mxd on 7/24/2024 2:31:06 PM Author: KVM (btran)



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Reference: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
FEMA (http://www.fema.gov/index.shtm), DWR (http://www.dwr.ca.gov)

FLOOD HAZARD ZONE MAP

Proposed Workforce Reentry Project
591 The City Drive South
City of Orange, California

FIGURE 5

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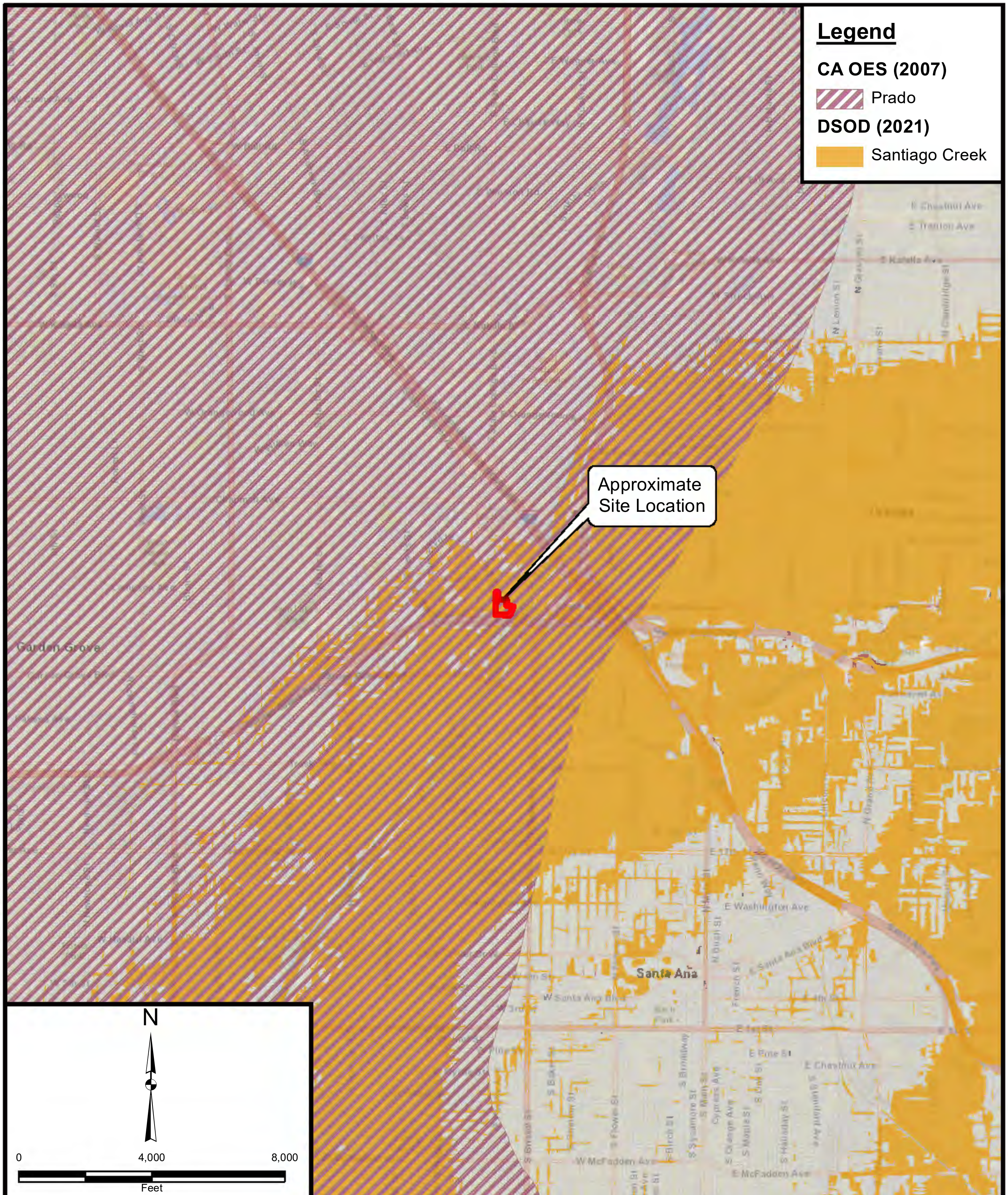
Map Saved as Z:\Project Files\GA-HZ\Griffin\20833 - Griffin OC Workforce Reentry Geo\GIS\Maps\20833_F05_FHM_2024-08-06.mxd on 8/6/2024 1:39:16 PM Author: KVM (btran)



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Scale: 1 " = 4,000 '	Date: August 2024

Basemap Reference: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China
Reference: Office of Emergency Services (2007),
Dept of Safety of Dams (2021)
National Inventory of Dams, Army Corps of Engrs (2021)

DAM INUNDATION MAP

Proposed Workforce Reentry Project
591 The City Drive South
City of Orange, California

FIGURE 6

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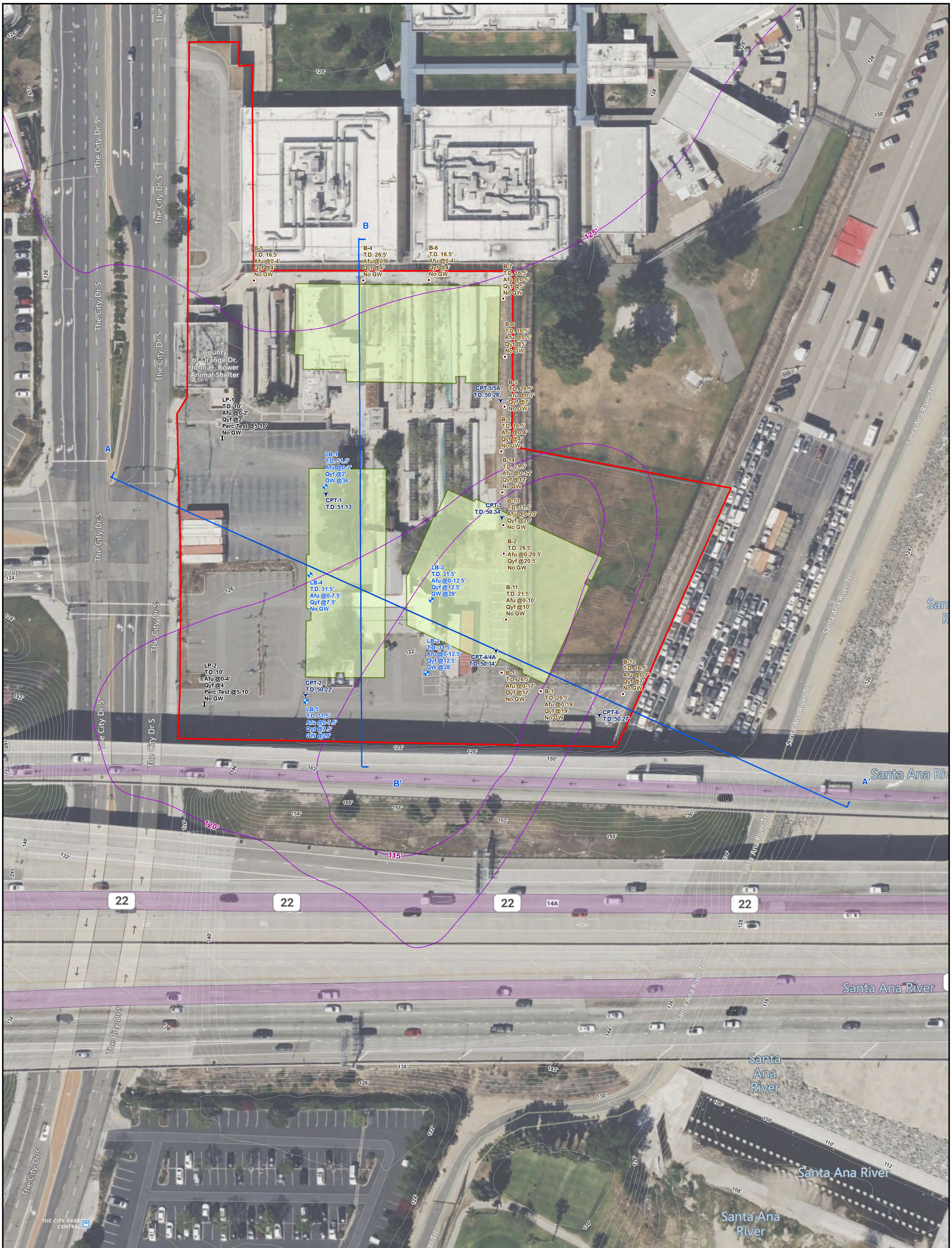
Map Saved as Z:\Project Files\GA-HZ\Griffin\20833 - Griffin OC Workforce Reentry Geo\GIS\Maps\20833_F06_DIM_2024-08-06.mxd on 7/24/2024 2:37:19 PM Author: KVM (btran)



Legend

LB-4 T.D. 31.5' Afu @0-7.5' Qyf @7.5' No GW	Approximate location of hollow-stem auger boring showing total depth (T.D.), groundwater conditions and depth to earth units in feet below existing grade. (Current investigation)
CPT-5/5A T.D. 50.28'	Approximate of cone penetration test showing total depth (T.D.) in feet below existing grade. (current investigation)
LP-2 T.D. 10' Afu @0-4' Qyf @4' Perc Test @5-10' No GW	Approximate location of percolation test boring showing total depth (T.D.), groundwater conditions, depth to earth units, and depth to percolation test zone in feet below existing grade. (Current investigation)
B-12 T.D. 16.5' Afu @0-7' Qyf @7' No GW	Approximate Location of hollow stem auger boring showing total depth (T.D.), groundwater conditions and depth to earth units in feet below existing grade (Ninyo and Moore, 2022).
B B'	Cross-Section Line
125'	Predevelopment topographic contour line (USGS, 1950)
142'	Existing ground surface elevation in feet (white contour line)
	Proposed Building Footprint
	Approximate Site Boundary
Afu	Artificial fill, undocumented
Qyf	Quaternary Age Young Alluvial Fan Deposits

N

0 40 80

EXPLORATION LOCATION MAP

Proposed Workforce Reentry Project
591 The City Drive South
City of Orange, California

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Base Map:

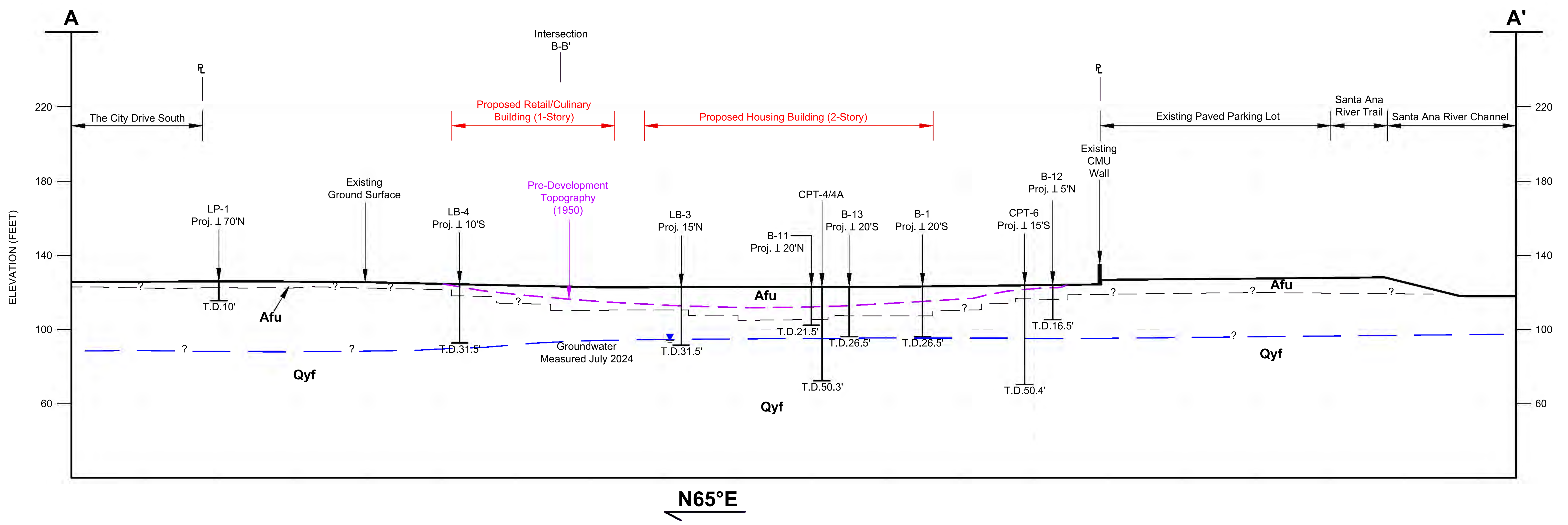
Plate 1

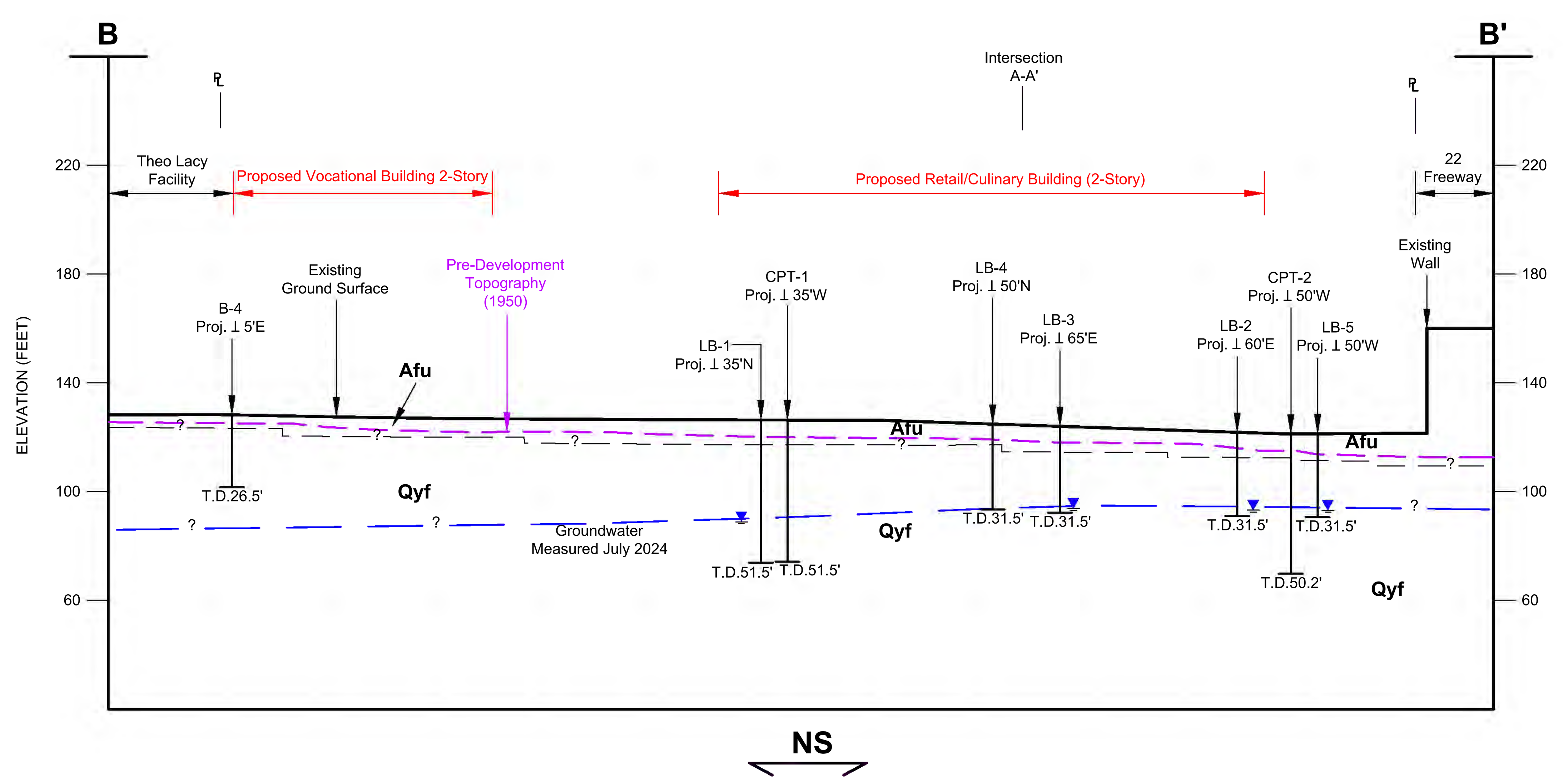
Scale: 1" = 40 feet

Date: August 2024

Project: 20833

Eng/Geol: CCK/JMP





GEOLOGIC CROSS SECTIONS A-A' AND B-B' Proposed Workforce Reentry Center 591 The City Drive South City of Orange, California	PLATE 2
	Scale: 1"=40'
	Date: August 2024
verdantas	Proj: 20833
	Eng/Geol: CCK/JMP

Appendix A

Exploration Logs

GEOTECHNICAL BORING LOG LB-1

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	126'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0			B-1				SM	@Surface: 3-inch Asphalt over subgrade (no base) **Artificial fill, undocumented (Afu)** @0.25': Silty SAND with gravel, light to medium brown, slightly moist, fine to medium sand, fine gravel	MD,EI, DS,CN, RV,CR
125								SP-SM	**Quaternary Young Alluvial Fan Deposits (Qyf)** @2': Poorly-graded SAND to Silty SAND, light brown, uniform, fine grained	
120	5			S-1	2 3 4		4	SP	@5': Poorly-graded SAND, light brown, slightly moist, medium dense, fine sand	
				R-1	4 5 7				@7.5': Poorly-graded SAND, light brow, slihglty moist, medium dense, fine to medium sand	DS
115	10			S-2	2 5 4		4		@10': medium dense	
								ML	@11': SILT (in shoe of sampler), medium brown, slightly moist to moist, meidum stiff, micaceous	
				R-2	4 6 6				@12.5': SILT, medium brown, slighlty moist, stiff, micaceous	DS,CN
110	15			S-3	1 2 3		19	CL-ML	@15': Silty CLAY, brown to orange brown (oxidation), moist, medium stiff, low plasticity	
105	20			R-3	4 5 8	96	16	ML	@20': SILT, medium gray brown with orange oxidiation, slighlty moist, stiff, few CaCO3 nodules, slight visible porosity	
100	25			S-4	3 4 5		20	ML\CL	@25': SILT to CLAY, medium brown, moist, stiff	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-1

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	126'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
95	30			R-4	2 5 7	110	17	CL-ML	@30': Silty CLAY, brown, moist, stiff, trace fine sand	
90	35			S-5	3 7 12		21	SP	@35': Poorly-graded SAND, gray brown, wet, medium dense, fine to medium sand @35.9': Final groundwater reading at 1030 @36.4': Initial groundwater reading	
85	40			R-5	9 29 21	107	22		@40': dense	
80	45			S-6	4 17 13		22	SM	@45': Silty fine SAND, gray brown, wet, meidum dense to dense, fine sand	
75	50			R-6	4 5 6	94	30	CL	@50': CLAY, brown to orange brown, very moist, stiff, oxidized	
70	55									
	60									

Total Depth 51.5 feet bgs
Groundwater initially encountered at during drilling at 36.4 feet bgs, settled at 35.9 feet bgs.
Boring backfilled to surface with spoils and surface cold-patched asphalt.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-2

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	122'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								@Surface: 4-inch Asphalt over 4-inch Base	
120				B-1				SM	**Artificial fill, undocumented (Afu)** @0.6': Silty SAND with gravel, brown to gray, moist, some asphalt and debris	
	5			S-1	5 26 5		9		@5': Silty SAND with AC and Concrete debris, slightly moist, dense	
115				R-1	50/5"	109	8		@7.5': very dense	
110	10			S-2	10 42 11		4		@10': Apshalt and Concrete Debris, little/no soil	
				R-2	5 5 7	98	22	ML	**Quaternary Young Alluvial Fan Deposits (Qyf)** @12.5': SILT, brown to orange brown with oxidation, moist, stiff, micaceous	
	15			S-3	1 1 2		28	CL	@15': CLAY, brown to orange brown, oxidation, moist, soft, $CaCO_3$ nodules	
105										
	20			R-3	4 4 4	94	26	ML	@20': SILT, gray brown, very moist, medium stiff, micacous, trace fine sand	
100										
	25			S-4	push push 2		22	CL	@25': CLAY, brown to gray brown, very moist, soft, micaceous, trace fine sand	
95										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

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GEOTECHNICAL BORING LOG LB-2

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	122'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	30			R-4	5 10 31	100	24	SP/ML	@30': Interlayered SAND and SILT, medium brown, very moist, dense/very stiff, fine to medium sand	
90									**Total Depth 31.5 feet bgs** **Groundwater encountered during drilling at 27.8 feet bgs** **Boring backfilled to surface with spoils and surface cold-patched asphalt.**	
	35									
85										
	40									
80										
	45									
75										
	50									
70										
	55									
65										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-3

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	123'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								@Surface: 6-inch PPC over 4-inch Base	
								SM	**Artificial fill, undocumented (Afu)** @0.8': Silty SAND, brown to dark gray, slightly moist, fine to coarse sand, some gravels and peices of asphalt and debris	
120										
	5			R-1	14 14 10	113	4		@5': Asphalt debris with gray Silty SAND, slightly moist, dense, fine to coarse grained	
115				S-1	push push 1		18		@7.5': Silty SAND, gray, moist, very loose	
	10			R-2	16 24 17	109	6		@10': Asphalt Debris, primarily asphalt, little/no soil, dark gray to black	
110				S-2	2 2 4		22	CL	**Quaternary Young Alluvial Fan Deposits (Qyf)** @12.5': CLAY to Silty CLAY, brown to orange brown with oxidation, moist, medium stiff to stiff	
	15			R-3	3 5 7	100	23		@15': stiff	
105										
	20			S-3	2 2 3		24	SM/ML	@20': Silty fine SAND to Sandy SILT, brown to gray brown with orange oxidation, very moist, loose to meidum stiff, fine sand	
100										
	25			R-4	2 3 5	103	22	CL	@25': CLAY, gray brown to orange brown, very moist, medium stiff	
95										
									@29': Groundwater encountered	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

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GEOTECHNICAL BORING LOG LB-3

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	123'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-4	2 3 7		27	SM	@30': Silty SAND, gray brown, wet, medium dense, fine sand	
90									**Total Depth 31.5 feet bgs** **Groundwater encountered during drilling at 29 feet bgs** **Boring backfilled to surface with spoils and surface cold-patched asphalt.**	
	35									
85										
	40									
80										
	45									
75										
	50									
70										
	55									
65										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-4

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	126'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								@Surface: 4-inch Asphalt over 4-inch Base	
125				B-1				SM	**Artificial fill, undocumented (Afu)** @0.66': Silty SAND, moist, medium brown, fine sand, few peices of aspalt and metal (rusty)	
120	5			R-1	8 6 10	118	13	ML/SM	@5': Sandy SILT to Silty SAND, reddish brown to black, moist, stiff/medium dense, pieces of asphalt and debris	
				S-1	3 5 6		5	SP	**Quaternary Young Alluvial Fan Deposits (Qyf)** @7.5': Poorly-graded SAND, light brown, slightly moist, medium dense, fine sand, uniform	
115	10			R-2	3 4 3	105	10	SP/ML	@10': Interlayered Poorly-graded SAND (same as above) and Sandy SILT, medium to dark brown, moist, medium stiff, fine sand	
				S-2	push 1 1		26	CL	@12.5': CLAY, dark brown, very moist, very soft, trace silt, some orange oxidation	
110	15			R-3	2 3 7	102	22		@15': medum stiff	
105	20			S-3	push 2 2		28		@20': soft	
100	25			R-4	3 3 5	91	28	CL/ML	@25': Interlayered CLAY (same as above) and Sandy SILT, moist, medium stiff, fine sand	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-4

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	126'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30			S-4	1 3 4		18	ML	@20': Sandy SILT, brown, moist, stiff, fine sand, micaceous	
95										
									Total Depth 31.5 feet bgs **No groundwater encoutered during drilling.** **Boring backfilled to surface with spoils and surface cold-patched asphalt.**	
	35									
90										
	40									
85										
	45									
80										
	50									
75										
	55									
70										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-5

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	123'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-1				SM	@Surface: 3-inch Asphalt over 4-inch Base **Artificial fill, undocumented (Afu)** @0.6': Silty SAND, brown, moist, fine to coarse sand, some gravel and asphalt/concrete debris	
120	5			R-1	8 11 15	119	11		@5': Silty SAND, brown, moist, medium dense, fine to caorse sand, large asphalt chunk in sampler shoe	
115				S-1	1 1 2		21	ML	**Quaternary Young Alluvial Fan Deposits (Qyf)** @7.5': SILT, brown, moist, soft to medium stiff, micaceous	
	10			R-2	2 3 4			CL	@10': CLAY to Silty CLAY, brown to orange brown with oxidation, moist to very moist, medium stiff	DS,CN
110				S-2	push 1 1		24		@12.5': soft, few CaCO3 nodules	
	15			R-3	2 4 6	96	27		@15': CLAY, brown to orange brown with oxidation, moist to very moist, stiff, few CaCO3 nodules	
105										
	20			S-3	3 5 4		20	SM	@20': Silty fine SAND, brown to orange brown with oxidation, very moist, medium dense, fine sand	
100										
	25			R-4	3 4 6	100	24	CL	@25': CLAY, brown to orange brown with oxidation, very moist, stiff	
95									@28.8': Groundwater encountered	
	30									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-5

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	123'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30			S-4	3 7 8		23	SP	@30': Poorly-graded SAND, gray brown, wet, medium dense, fine to medium sand	
90									**Total Depth 31.5 feet bgs** **Groundwater encountered during drilling at 28.8 feet bgs.** **Boring backfilled to surface with spoils and surface cold-patched asphalt.**	
	35									
85										
	40									
80										
	45									
75										
	50									
70										
	55									
65										
	60									

SAMPLE TYPES:
B BULK SAMPLE
C CORE SAMPLE
G GRAB SAMPLE
R RING SAMPLE
S SPLIT SPOON SAMPLE
T TUBE SAMPLE

TYPE OF TESTS:
-200 % FINES PASSING
AL ATTERBERG LIMITS
CN CONSOLIDATION
CO COLLAPSE
CR CORROSION
CU UNDRAINED TRIAXIAL
DS DIRECT SHEAR
EI EXPANSION INDEX
H HYDROMETER
MD MAXIMUM DENSITY
PP POCKET PENETROMETER
RV R VALUE
SA SIEVE ANALYSIS
SE SAND EQUIVALENT
SG SPECIFIC GRAVITY
UC UNCONFINED COMPRESSIVE STRENGTH

verdantas

GEOTECHNICAL BORING LOG LP-1

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	126'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0							ML/SM	@Surface: 2-inch Ashpalt over subgrade (no base) **Artificial fill, undocumented (Afu)** @0.2': SILT to Silty SAND, brown moist, fine sand, mottled	
125									**Quaternary Young Alluvial Fan Deposits (Qyf)** @2': Silty SAND, light to meidum brwon, moist, uniform	
	5			S-1	1 2 2		4	SP	@5': Poorly-graded SAND, light brown, moist, loose, poorly graded, fine sand	
120				S-2	push push 1		16	SM	@7': Silty SAND, light to medium brown, moist, very loose, fine grained	
				S-3	2 2 3		6	SP	@8.5': Poorly-graded SAND, light brown, moist, loose, fine to medium sand	
115	10								**Total Depth 10 feet bgs** **No groundwater encountered during drilling.** **Temporary percolation test well installed using 2-inch diameter PVC pipe. Solid pipe from 0-5 feet and 0.020-inch slotted pipe from 5-10 feet. Industrial SAND placed in annulus from 4-10 feet. Upon completion of testing, pipe was removed and boring was backfilled with soil cuttings. Surface patched with cold-mix asphalt.**	
110	15									
105	20									
100	25									
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LP-2

Project No.	20833	**Date Drilled**	7-1-24
Project	Griffin OC Workforce Reentry Center	**Logged By**	JMP
Drilling Co.	Martini Drilling Inc.	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	124'
Location	See Plate 1 - Exploration Location Map	**Sampled By**	JMP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								@Surface: 3-inch Ashpalt over 4-inch Base	
								SW	**Artificial fill, undocumented (Afu)** @0.6': Gravelly SAND, brown	
								ML/SM	@1.6': Asphalt Debris layer overtopSilty SAND to Sandy SILT, mottled brown, moist, fine to coarse sand, some gravels	
120								SP	**Quaternary Young Alluvial Fan Deposits (Qyf)** @4': Poorly-graded SAND, light to meidum brown, slightly moist, fine sand, uniform	
	5			S-1	5 6 6		3		@5': medium dense	
				S-2	4 6 7		2	SW	@7': Well-graded SAND, light brown, slightly moist, medium dense, fine to coarse sand	
115				S-3	1 1 2		17	ML	@8.5': SILT to Sandy SILT, gray brown, moist, soft, fine sand	
	10									
110	15									
105	20									
100	25									
95	30									

Total Depth 10 feet bgs
No groundwater encountered during drilling.
Temporary percolation test well installed using 2-inch diameter PVC pipe. Solid pipe from 0-5 feet and 0.020-inch slotted pipe from 5-10 feet. Industrial SAND placed in annulus from 4-10 feet. Upon completion of testing, pipe was removed and boring was backfilled with soil cuttings. Surface patched with cold-mix asphalt.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

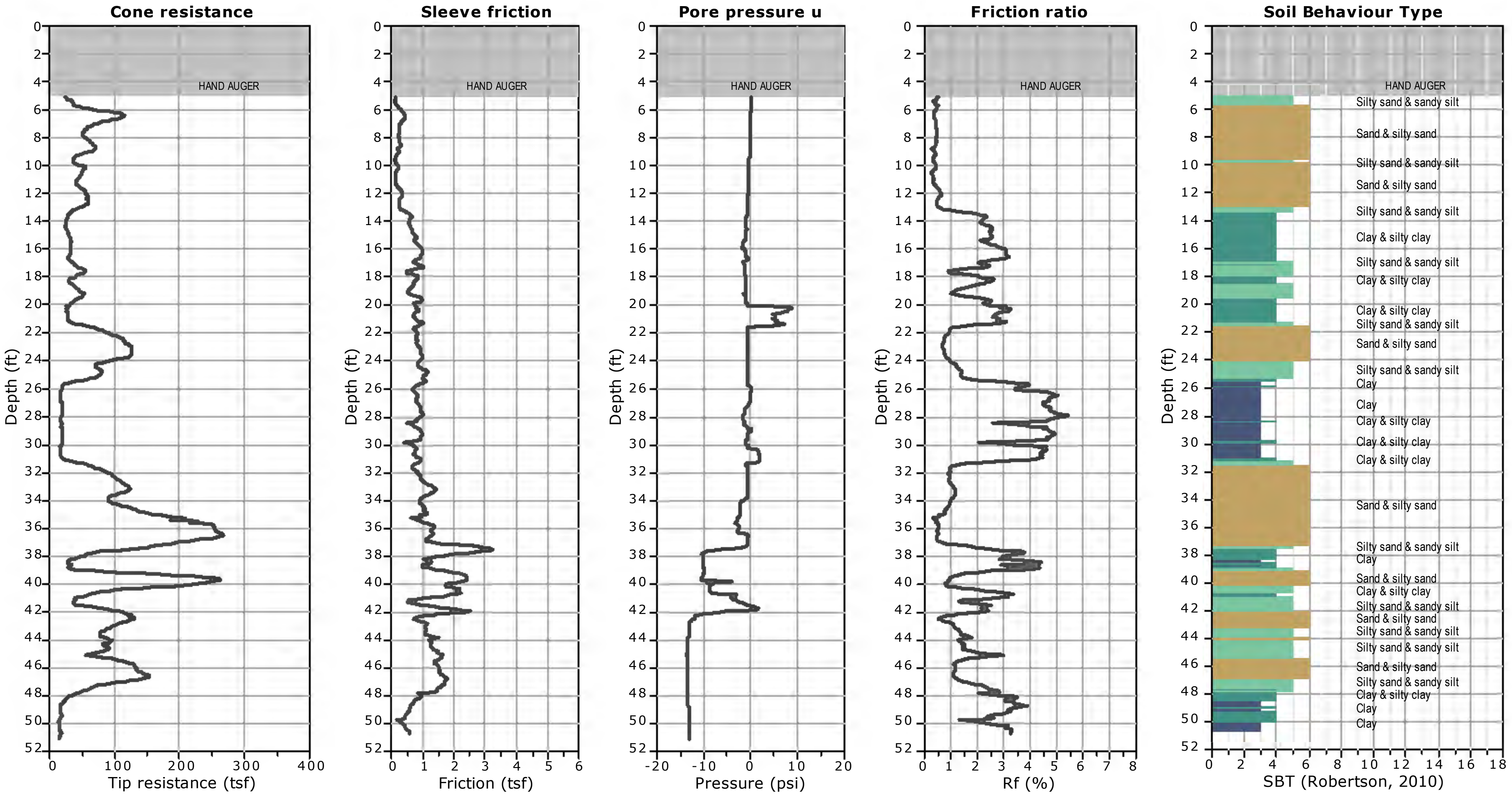
verdantas

* * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * *

Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **Verdantas / Griffin OC Workforce Reentry**
Location: **591 The City Drive South, Orange, CA**

CPT-1
Total depth: 51.13 ft, Date: 7/1/2024



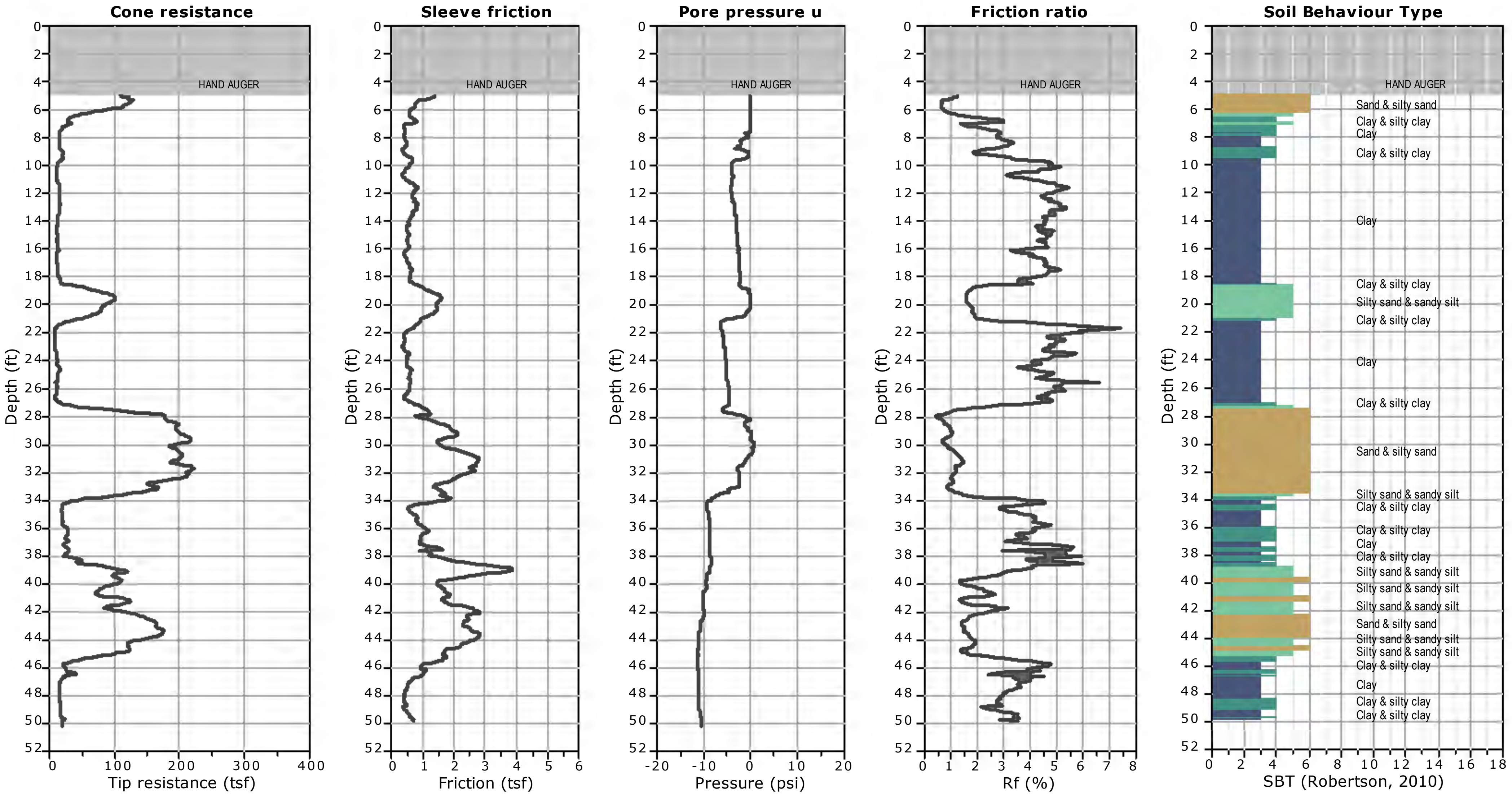
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Verdantas / Griffin OC Workforce Reentry

Location: 591 The City Drive South, Orange, CA

CPT-2

Total depth: 50.22 ft, Date: 7/1/2024



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714-901-7270
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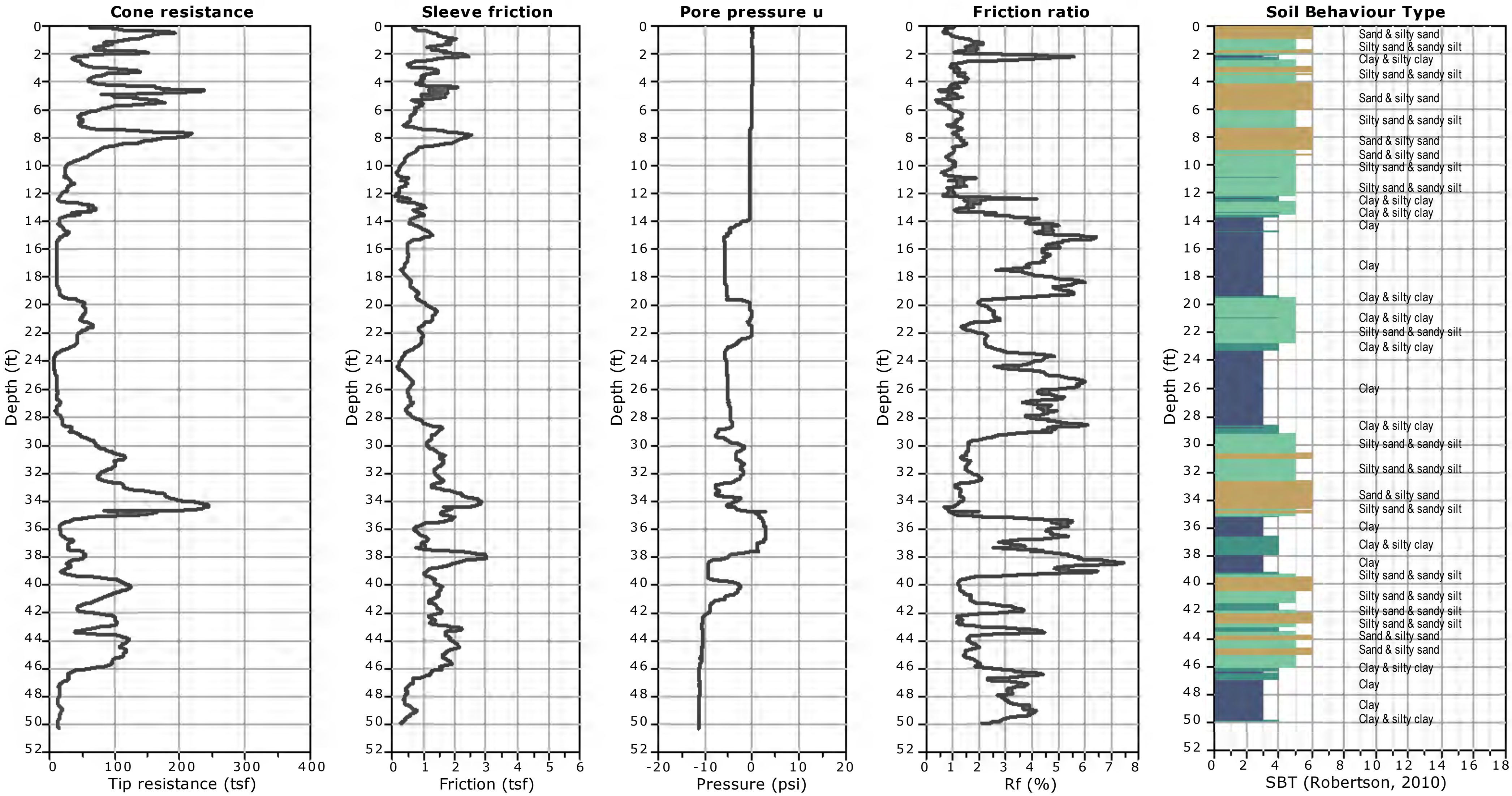
Project: Verdantas / Griffin OC Workforce Reentry
Location: 591 The City Drive South, Orange, CA

CPT-3
Total depth: 50.34 ft, Date: 7/1/2024



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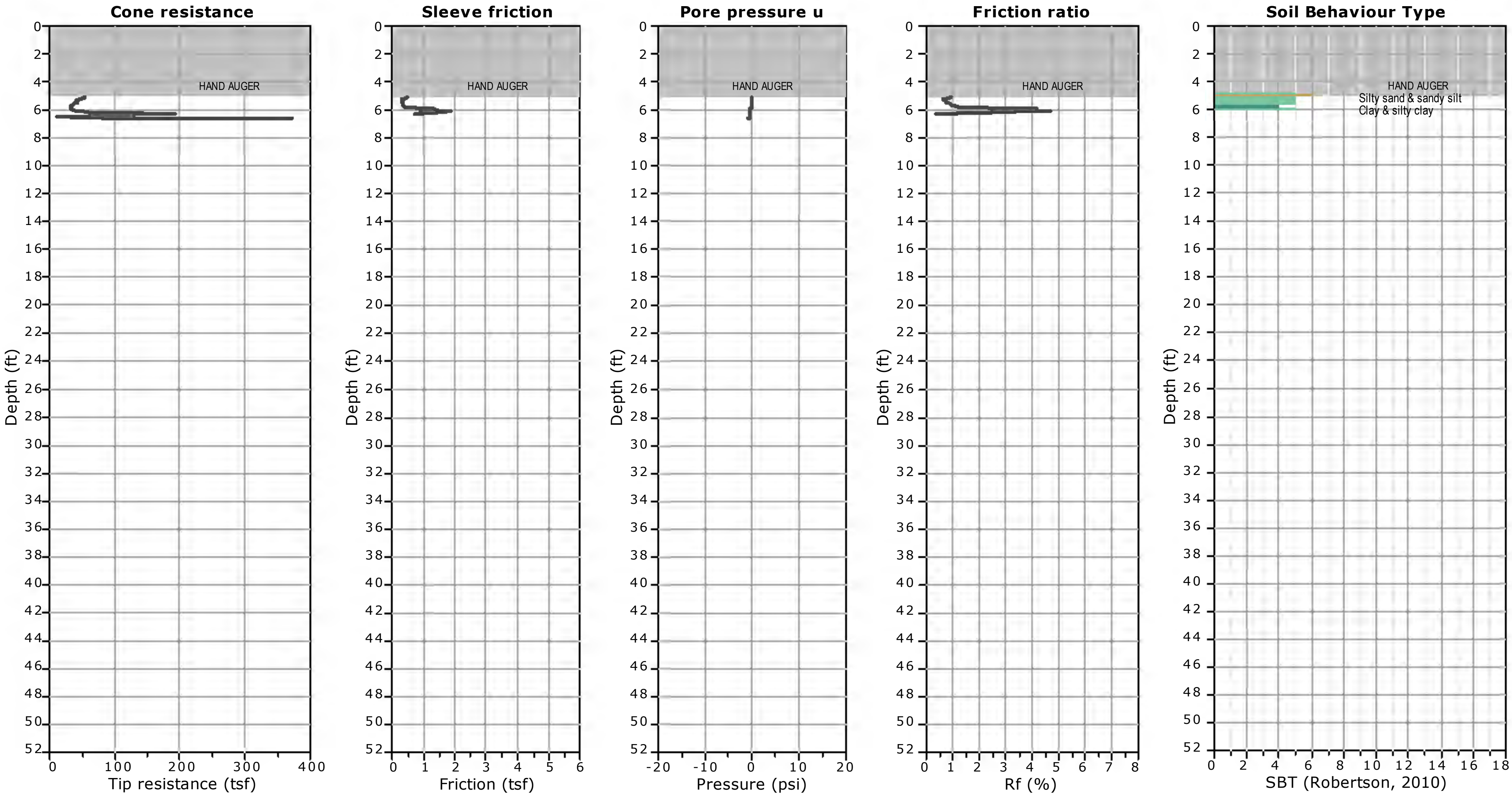
Project: **Verdantas / Griffin OC Workforce Reentry**

Location: **591 The City Drive South, Orange, CA**

CPT-4

Total depth: 6.64 ft, Date: 7/1/2024



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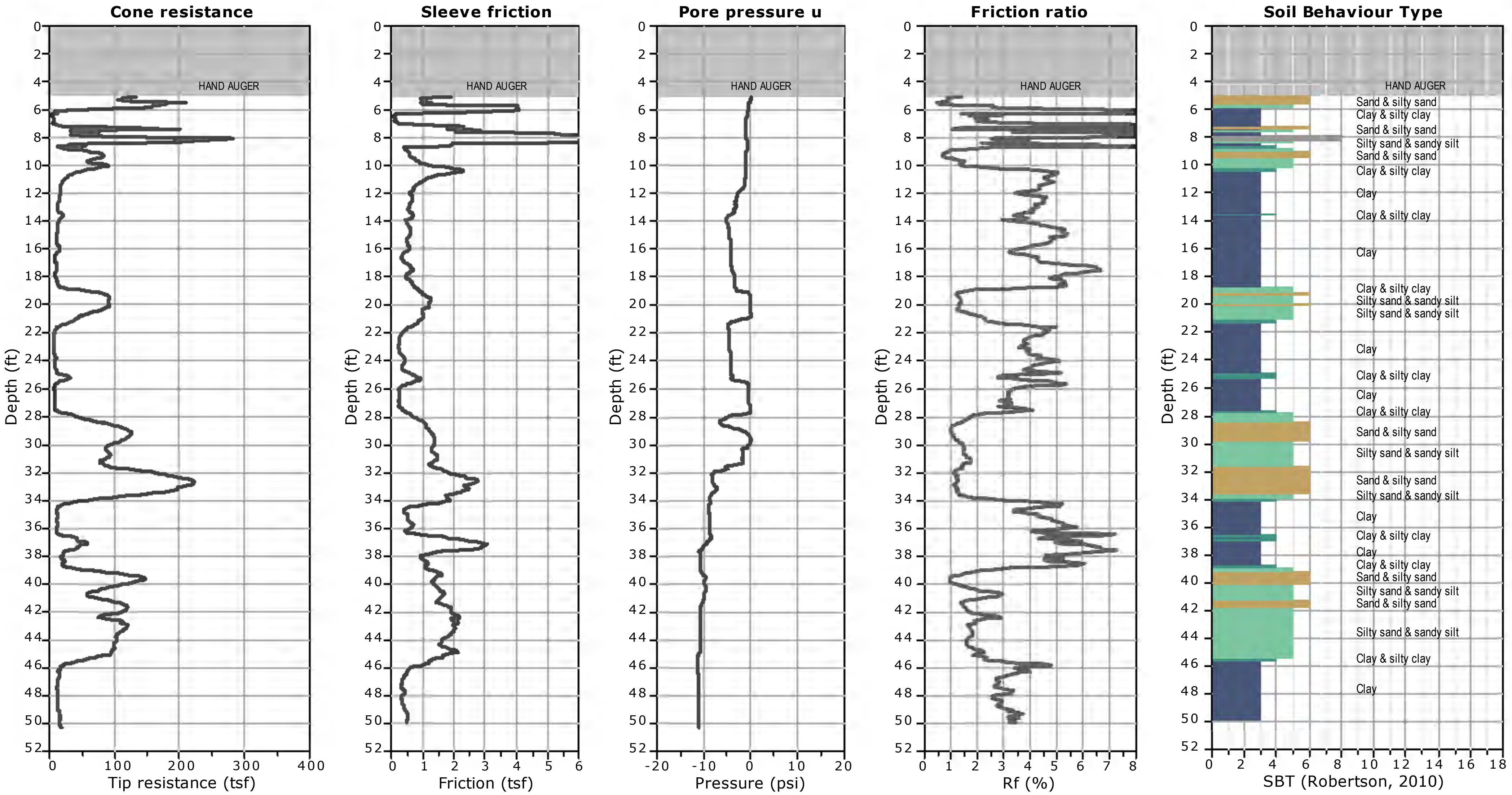
Project: Verdantas / Griffin OC Workforce Reentry

Location: 591 The City Drive South, Orange, CA

CPT-4A

Total depth: 50.34 ft, Date: 7/1/2024



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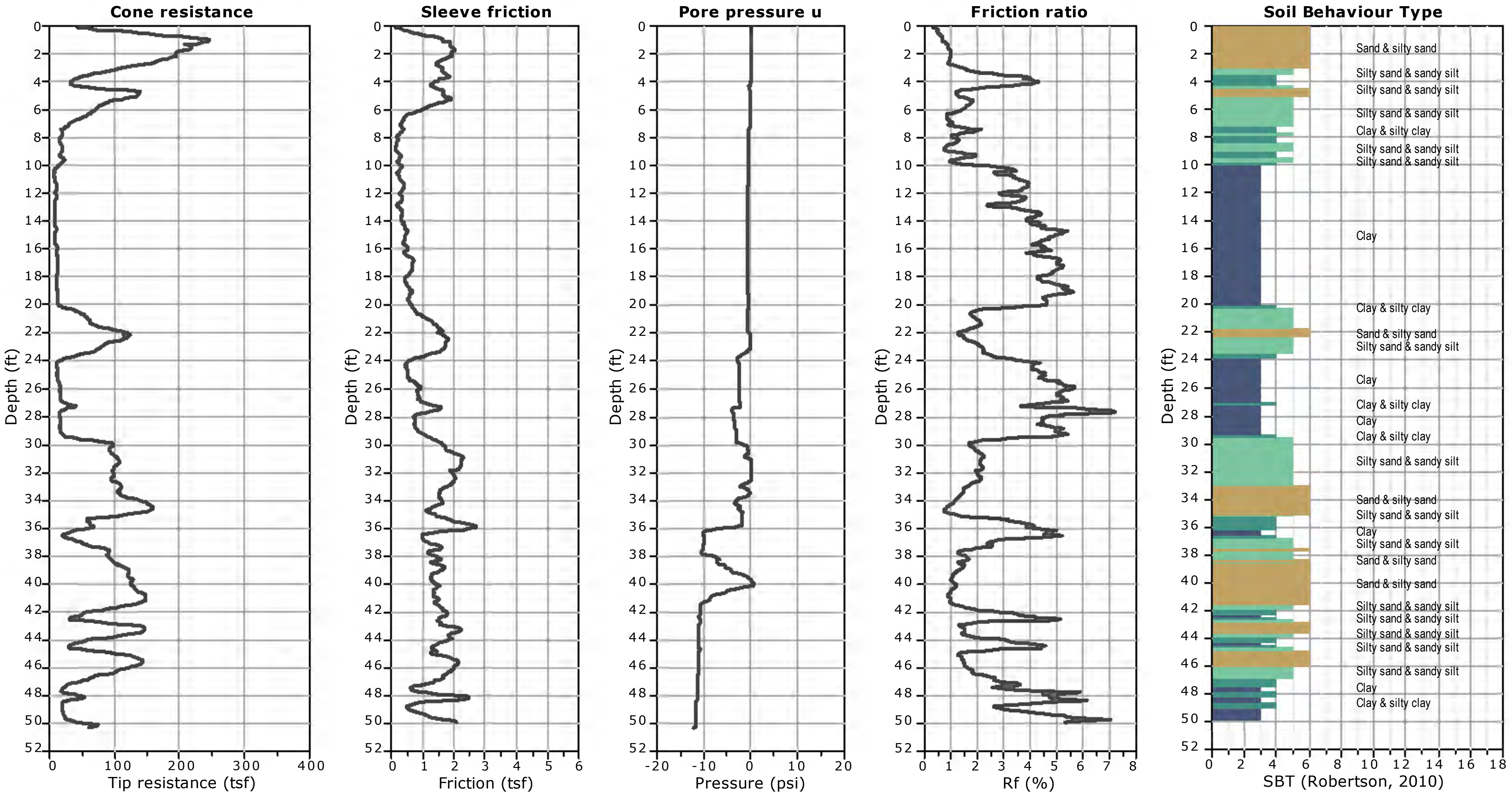
www.kehoetesting.com

Project: Verdantas / Griffin OC Workforce Reentry

Location: 591 The City Drive South, Orange, CA

CPT-5

Total depth: 50.28 ft, Date: 7/1/2024



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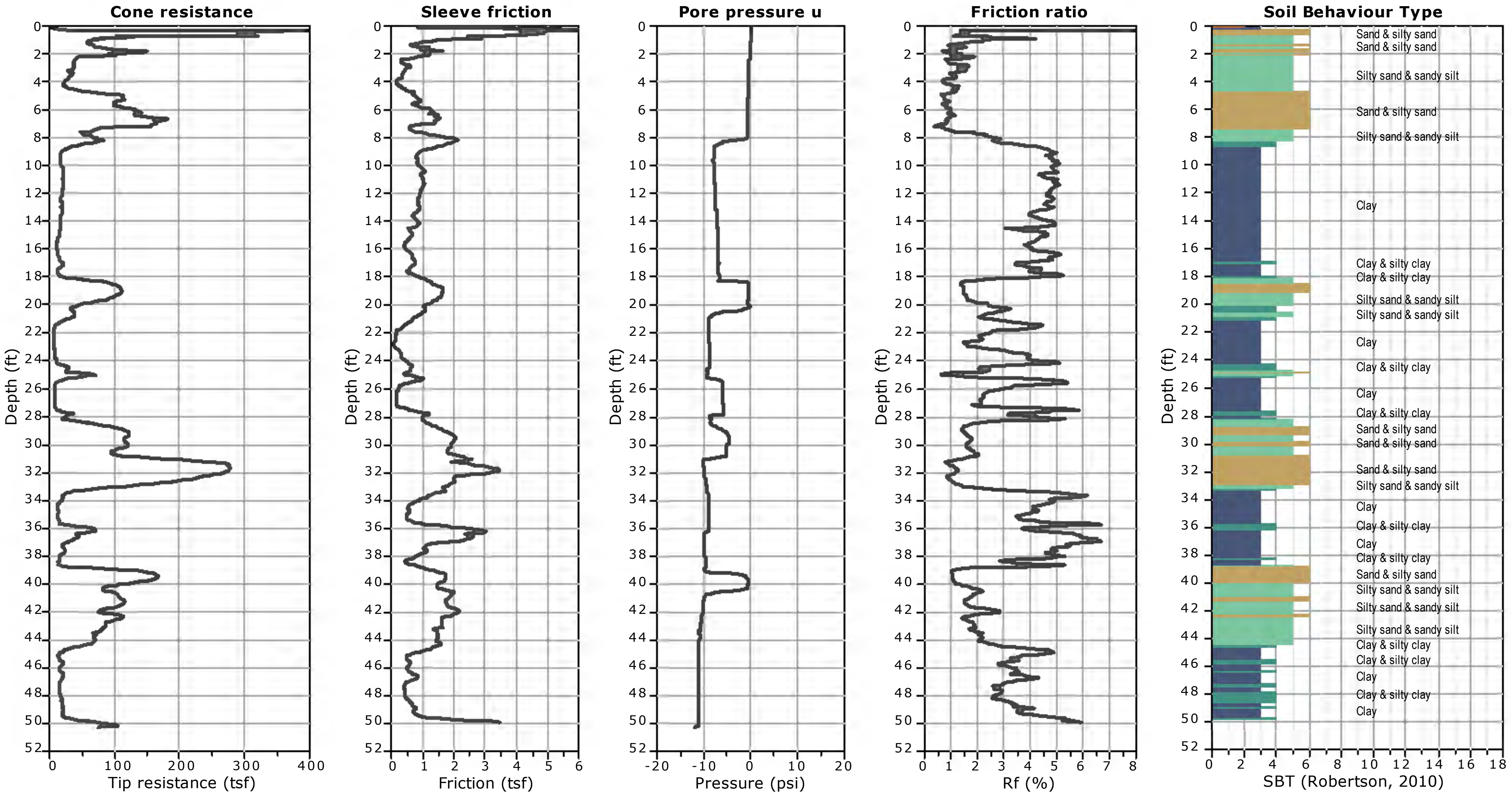
www.kehoetesting.com

Project: Verdantas / Griffin OC Workforce Reentry

Location: 591 The City Drive South, Orange, CA

CPT-6

Total depth: 50.27 ft, Date: 7/1/2024



Appendix B

Percolation Test Data

Boring Percolation Test Data Sheet

Project Number:	20833	**Test Hole Number:**	LP-1
Project Name:	OC Workforce Reentry	**Date Excavated:**	7/1/2024
Earth Description:	Alluvium	**Date Tested:**	7/3/2024
Liquid Description:	Tap water	**Depth of boring (ft):**	10
Tested By:	JMP	**Radius of boring, r (in):**	4
		Radius of casing (in):	1
		Length of slotted of casing (ft):	5
		Porosity of Annulus Material, *n* :	0.37
		Bentonite Plug at Bottom:	No

Field Percolation Data - High Flow Constant Head Test

Reading	Time	Time Interval, Δt (minutes)	Depth to Water (feet bgs)	Water Height, H (inches)	Cumulative Water Volume Delivered (gallons)
1	8:20	-	-	-	-
2	8:25	5	4.90	61.2	40.4
3	8:30	5	4.80	62.4	80.7
4	8:35	5	4.65	64.2	121.1
5	8:40	5	4.40	67.2	161.4
6	8:45	5	4.95	60.6	196.4
7	8:50	5	4.94	60.7	231.4
8	8:55	5	4.87	61.6	266.4
9	9:00	5	4.84	61.9	301.4
10	9:05	5	4.83	62.0	336.4
11	9:10	5	4.78	62.6	371.4
12	9:15	5	4.77	62.8	406.4
13	9:20	5	4.74	63.1	441.4
14	9:25	5	4.70	63.6	476.4
15	9:30	5	4.72	63.4	511.4
16	9:35	5	4.68	63.8	546.4
17	9:40	5	4.67	64.0	581.4
18	9:45	5	4.65	64.2	616.4
19	9:50	5	4.63	64.4	651.4
20	9:55	5	4.61	64.7	686.4
21	10:00	5	4.60	64.8	721.4
22	10:05	5	4.59	64.9	756.4
23	10:10	5	4.58	65.0	791.4
24	10:15	5	4.55	65.4	826.4
25	10:20	5	4.55	65.4	861.4

High Flowrate Percolation Test Calculation

Total Volume of Water Delivered (gallons)	861.4
Total Volume of Water Delivered (cubic inches)	198983.4
Average Water Height (inches)	63.5
Average Percolation Surface Area (cubic Inches)	1646.2
Duration of Test (minutes)	120
Duration of Test (hours)	2.00

$$\text{Measured Infiltration Rate} = (\text{Total Volume})/(\text{Test Duration})/(\text{Surface Area})$$

Measured Infiltration Rate = 60.4 in./hr.

Boring Percolation Test Data Sheet

Project Number:	20833	**Test Hole Number:**	LP-2
Project Name:	OC Workforce Reentry	**Date Excavated:**	7/1/2024
Earth Description:	Alluvium	**Date Tested:**	7/3/2024
Liquid Description:	Tap water	**Depth of boring (ft):**	10
Tested By:	JMP	**Radius of boring, r (in):**	4
		Radius of casing (in):	1
		Length of slotted of casing (ft):	5
		Porosity of Annulus Material, *n* :	0.37
		Bentonite Plug at Bottom:	No

Field Percolation Data - High Flow Constant Head Test

Reading	Time	Time Interval, Δt (minutes)	Depth to Water (feet bgs)	Water Height, H (inches)	Cumulative Water Volume Delivered (gallons)
1	10:35	-	-	-	-
2	10:40	5	5.90	49.2	45.7
3	10:45	5	5.60	52.8	91.3
4	10:50	5	5.34	55.9	137.0
5	10:55	5	5.07	59.2	182.6
6	11:00	5	4.90	61.2	228.3
7	11:05	5	4.84	61.9	273.9
8	11:10	5	4.78	62.6	319.6
9	11:15	5	4.73	63.2	365.2
10	11:20	5	4.69	63.7	410.9
11	11:25	5	4.64	64.3	456.5
12	11:30	5	4.61	64.7	502.2
13	11:35	5	4.58	65.0	547.8
14	11:40	5	4.55	65.4	593.5
15	11:45	5	4.52	65.8	639.1
16	11:50	5	4.48	66.2	684.8
17	11:55	5	4.46	66.5	730.4
18	12:00	5	4.44	66.7	776.1
19	12:05	5	4.42	67.0	821.7
20	12:10	5	4.40	67.2	867.4
21	12:15	5	4.36	67.7	913.0
22	12:20	5	4.33	68.0	958.7
23	12:25	5	4.30	68.4	1004.3
24	12:30	5	4.28	68.6	1050.0
25	12:35	5	4.27	68.8	1095.6

High Flowrate Percolation Test Calculation

Total Volume of Water Delivered (gallons)	1095.6
Total Volume of Water Delivered (cubic inches)	253083.6
Average Water Height (inches)	63.8
Average Percolation Surface Area (cubic Inches)	1652.6
Duration of Test (minutes)	120
Duration of Test (hours)	2.00

$$\text{Measured Infiltration Rate} = (\text{Total Volume})/(\text{Test Duration})/(\text{Surface Area})$$

Measured Infiltration Rate = $\boxed{76.6}$ **in./hr.**

Appendix C

Laboratory Test Results

MODIFIED PROCTOR COMPACTION TEST
ASTM D 1557

Leighton

Project Name:	Griffin OC Workforce Reentry	Tested By:	P. Martin	Date:	07/08/24
Project No.:	036.0000020833	Checked By:	A. Santos	Date:	07/09/24
Boring No.:	LB-1	Depth (ft.):	0-5		
Sample No.:	B-1				
Soil Identification:	Olive brown sandy silt s(ML)				

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture content of 1.0% for oversize particles

			Scalp Fraction (%)	
Preparation Method:	X	Moist	#3/4	
		Dry	#3/8	
Compaction Method	X	Mechanical Ram	#4	9.6
		Manual Ram		

Rammer Weight (lb.) = 10.0
Height of Drop (in.) = 18.0
Mold Volume (ft³) 0.03320

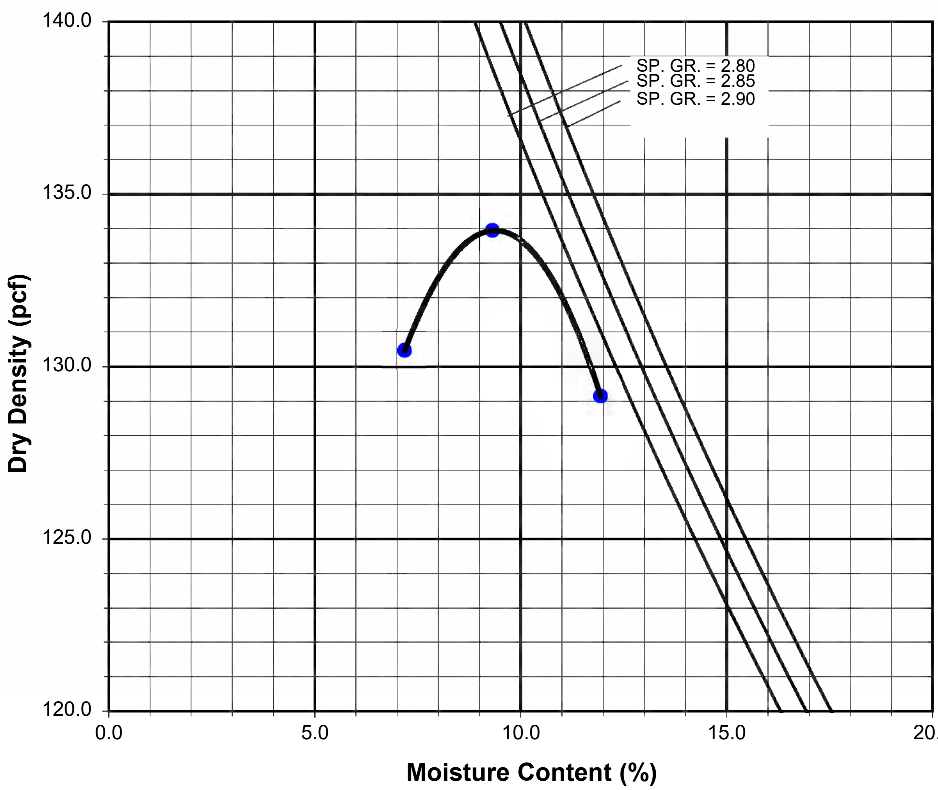
TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	3886	3985	3957			
Weight of Mold	(g)	1780	1780	1780			
Net Weight of Soil	(g)	2106	2205	2177			
Wet Weight of Soil + Cont.	(g)	539.0	575.7	561.3			
Dry Weight of Soil + Cont.	(g)	508.8	533.2	509.5			
Weight of Container	(g)	88.7	77.0	75.8			
Moisture Content	(%)	7.19	9.32	11.94			
Wet Density	(pcf)	139.8	146.4	144.6			
Dry Density	(pcf)	130.5	133.9	129.1			

Maximum Dry Density (pcf)	134.0	Optimum Moisture Content (%)	9.4
Corrected Dry Density (pcf)	136.7	Corrected Moisture Content (%)	8.6

X Procedure A
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ Procedure B
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

☐ Procedure C
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%



Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI

EXPANSION INDEX of SOILS
ASTM D 4829

Project Name:	Griffin OC Workforce Reentry	Tested By:	G. Bathala	Date:	07/11/24
Project No.:	036.0000020833	Checked By:	A. Santos	Date:	08/01/24
Boring No.:	LB-1	Depth (ft.):	0-5		
Sample No.:	B-1				
Soil Identification:	Olive brown sandy silt s(ML)				

Dry Wt. of Soil + Cont.	(g)	1000.00
Wt. of Container No.	(g)	0.00
Dry Wt. of Soil	(g)	1000.00
Weight Soil Retained on #4 Sieve		0.00
Percent Passing # 4		100.00

MOLDED SPECIMEN		Before Test	After Test
Specimen Diameter	(in.)	4.01	4.01
Specimen Height	(in.)	1.0000	1.0000
Wt. Comp. Soil + Mold	(g)	613.62	441.52
Wt. of Mold	(g)	187.65	0.00
Specific Gravity (Assumed)		2.70	2.70
Container No.		O	O
Wet Wt. of Soil + Cont.	(g)	847.50	629.17
Dry Wt. of Soil + Cont.	(g)	786.20	582.81
Wt. of Container	(g)	0.00	187.65
Moisture Content	(%)	7.80	11.73
Wet Density	(pcf)	128.5	133.2
Dry Density	(pcf)	119.2	119.2
Void Ratio		0.414	0.414
Total Porosity		0.293	0.293
Pore Volume	(cc)	60.6	60.6
Degree of Saturation (%) [S_{meas}]		50.8	76.5

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
07/11/24	15:29	1.0	0	0.4160
07/11/24	15:39	1.0	10	0.4150
		Add Distilled Water to the Specimen		
07/11/24	16:07	1.0	28	0.4155
07/12/24	10:12	1.0	1113	0.4155
07/12/24	11:17	1.0	1178	0.4160

Expansion Index (EI_{meas}) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	1

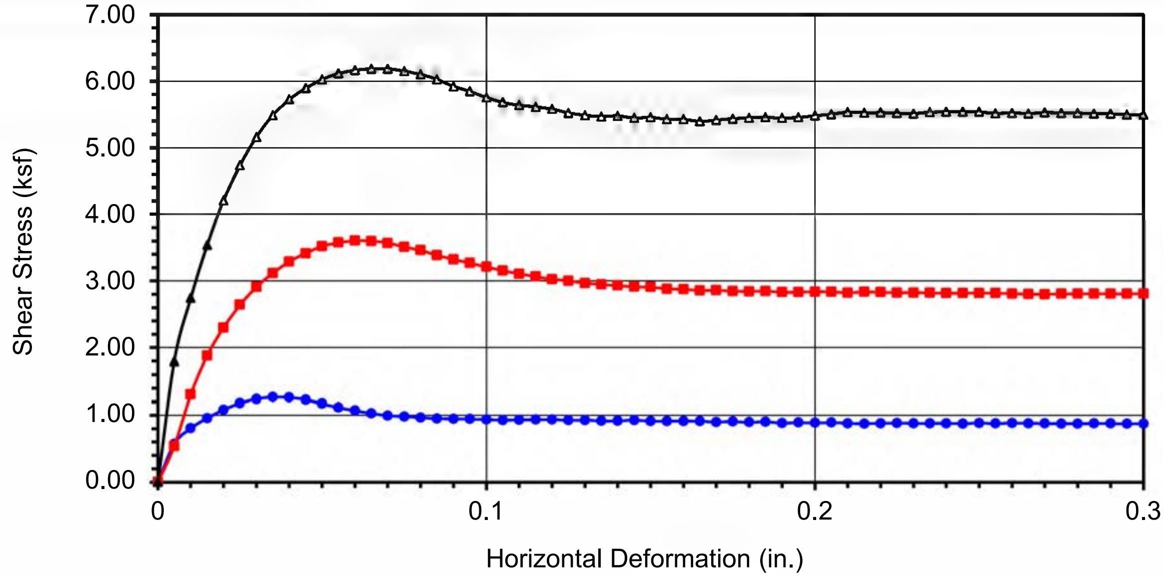
Leighton

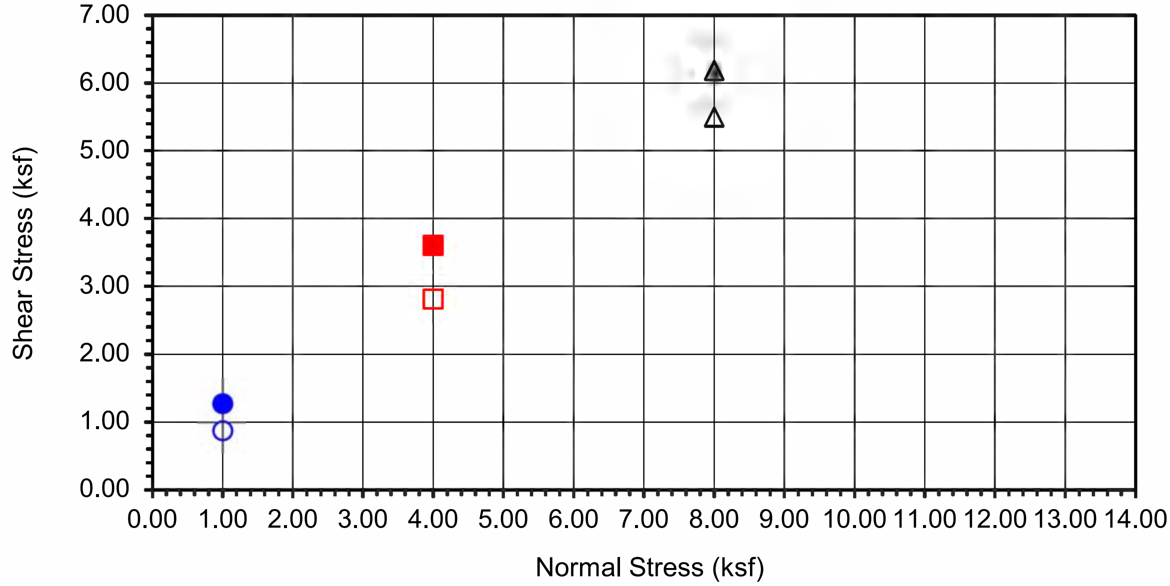
DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name:	Griffin OC Workforce Reentry	Tested By:	G. Bathala	Date:	07/09/24
Project No.:	036.0000020833	Checked By:	A. Santos	Date:	08/01/24
Boring No.:	LB-1	Sample Type:	Bulk		
Sample No.:	B-1	Depth (ft.):	0-5		
Soil Identification:	Olive brown sandy silt s(ML)				

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	204.16	203.46	201.69
Weight of Ring(gm):	45.13	44.33	42.41
Before Shearing			
Weight of Wet Sample+Cont.(gm):	192.07	192.07	192.07
Weight of Dry Sample+Cont.(gm):	181.20	181.20	181.20
Weight of Container(gm):	68.52	68.52	68.52
Vertical Rdg.(in): Initial	0.2431	0.2501	0.0000
Vertical Rdg.(in): Final	0.2530	0.2695	-0.0236
After Shearing			
Weight of Wet Sample+Cont.(gm):	224.25	221.80	199.18
Weight of Dry Sample+Cont.(gm):	205.82	203.56	181.13
Weight of Container(gm):	62.60	60.27	37.00
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	LB-1
Sample No.	B-1
Depth (ft)	0-5

Sample Type:

Bulk

Soil Identification:

Olive brown sandy silt s(ML)

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.270	■ 3.606	▲ 6.187
Shear Stress @ End of Test (ksf)	○ 0.877	□ 2.811	△ 5.498
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	9.65	9.65	9.65
Dry Density (pcf)	120.6	120.7	120.8
Saturation (%)	65.5	65.7	65.9
Soil Height Before Shearing (in.)	0.9901	0.9806	0.9764
Final Moisture Content (%)	12.9	12.7	12.5

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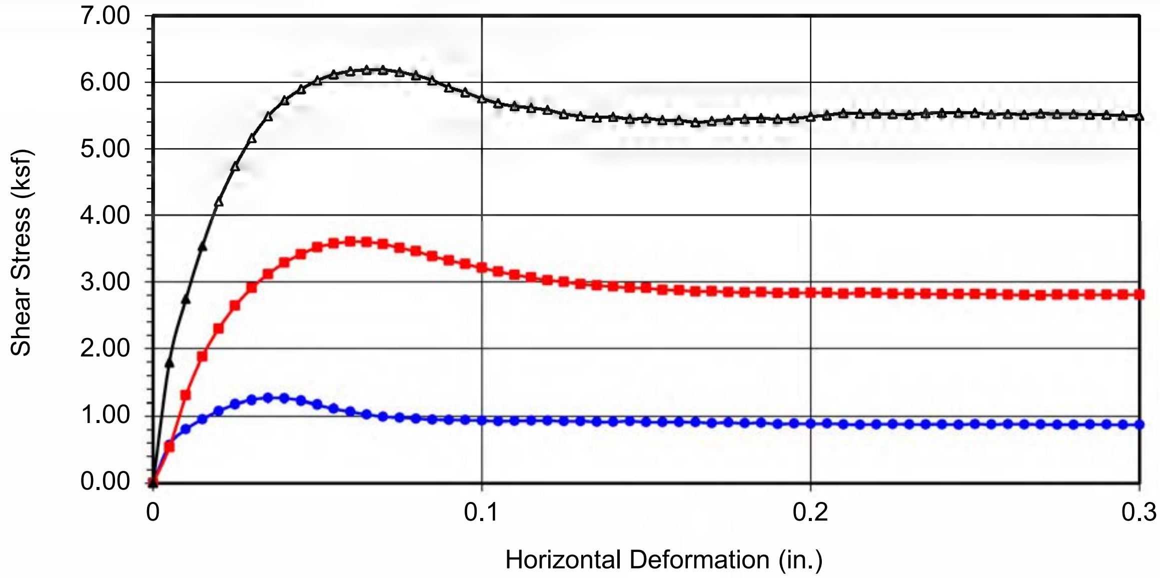
DIRECT SHEAR TEST RESULTS

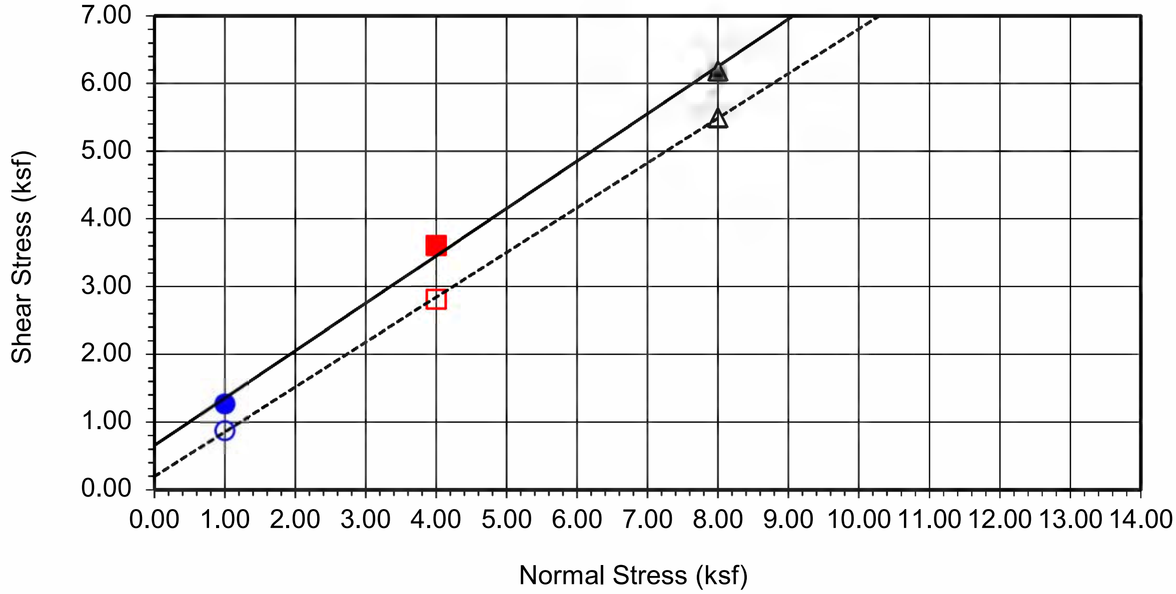
Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24





Boring No.	LB-1
Sample No.	B-1
Depth (ft)	0-5
Sample Type:	Bulk

Soil Identification:
Olive brown sandy silt s(ML)

Strength Parameters

	C (psf)	ϕ (°)
Peak	657	35
Ultimate	199	33

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.270	■ 3.606	▲ 6.187
Shear Stress @ End of Test (ksf)	○ 0.877	□ 2.811	△ 5.498
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	9.65	9.65	9.65
Dry Density (pcf)	120.6	120.7	120.8
Saturation (%)	65.5	65.7	65.9
Soil Height Before Shearing (in.)	0.9901	0.9806	0.9764
Final Moisture Content (%)	12.9	12.7	12.5

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DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24

DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name: Griffin OC Workforce Reentry
Tested By: G. Bathala
Date: 07/10/24

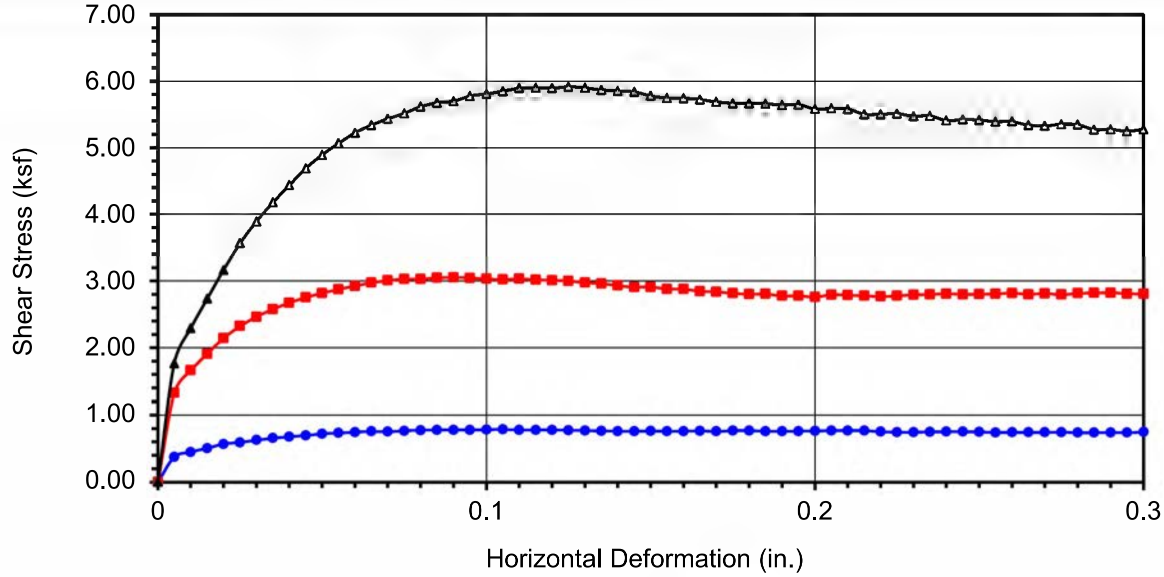
Project No.: 036.0000020833
Checked By: A. Santos
Date: 07/31/24

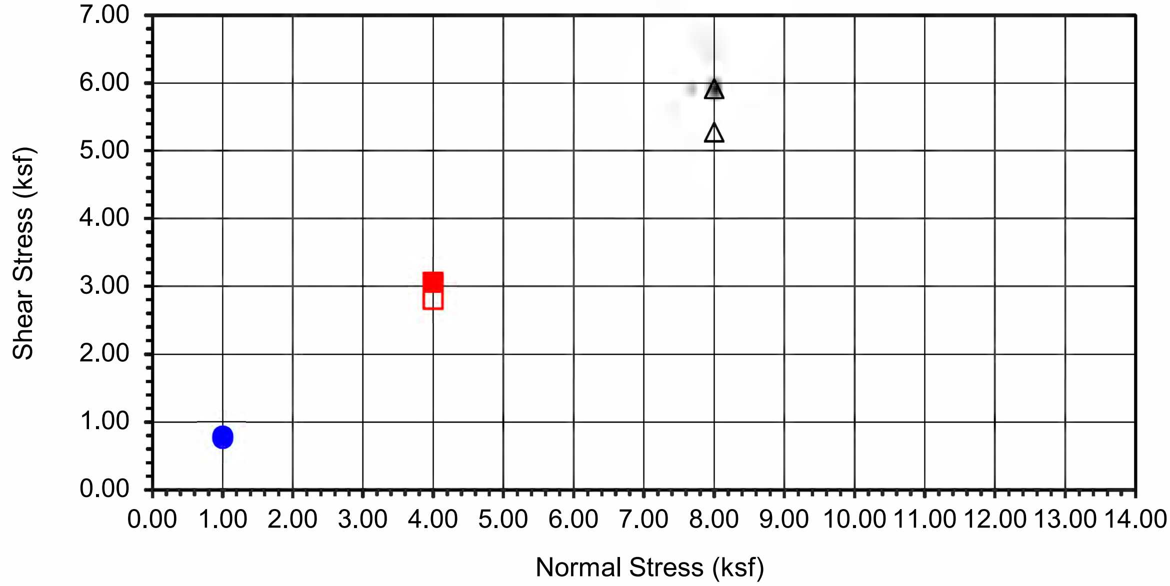
Boring No.: LB-1
Sample Type: Ring

Sample No.: R-1
Depth (ft.): 7.5

Soil Identification: Light brown poorly-graded sand (SP)

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	164.37	165.43	173.12
Weight of Ring(gm):	45.07	41.27	45.50
Before Shearing			
Weight of Wet Sample+Cont.(gm):	178.52	178.52	178.52
Weight of Dry Sample+Cont.(gm):	176.08	176.08	176.08
Weight of Container(gm):	52.93	52.93	52.93
Vertical Rdg.(in): Initial	0.0000	0.2557	0.2588
Vertical Rdg.(in): Final	-0.0116	0.2857	0.2899
After Shearing			
Weight of Wet Sample+Cont.(gm):	198.84	174.04	177.70
Weight of Dry Sample+Cont.(gm):	177.52	153.54	158.51
Weight of Container(gm):	64.77	36.53	38.48
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	LB-1
Sample No.	R-1
Depth (ft)	7.5

Sample Type:

Ring

Soil Identification:

Light brown poorly-graded sand (SP)

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.789	■ 3.056	▲ 5.917
Shear Stress @ End of Test (ksf)	○ 0.751	□ 2.807	△ 5.278
Deformation Rate (in./min.)	0.0050	0.0050	0.0050
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	1.98	1.98	1.98
Dry Density (pcf)	97.3	101.3	104.1
Saturation (%)	7.3	8.0	8.6
Soil Height Before Shearing (in.)	0.9884	0.9700	0.9689
Final Moisture Content (%)	18.9	17.5	16.0

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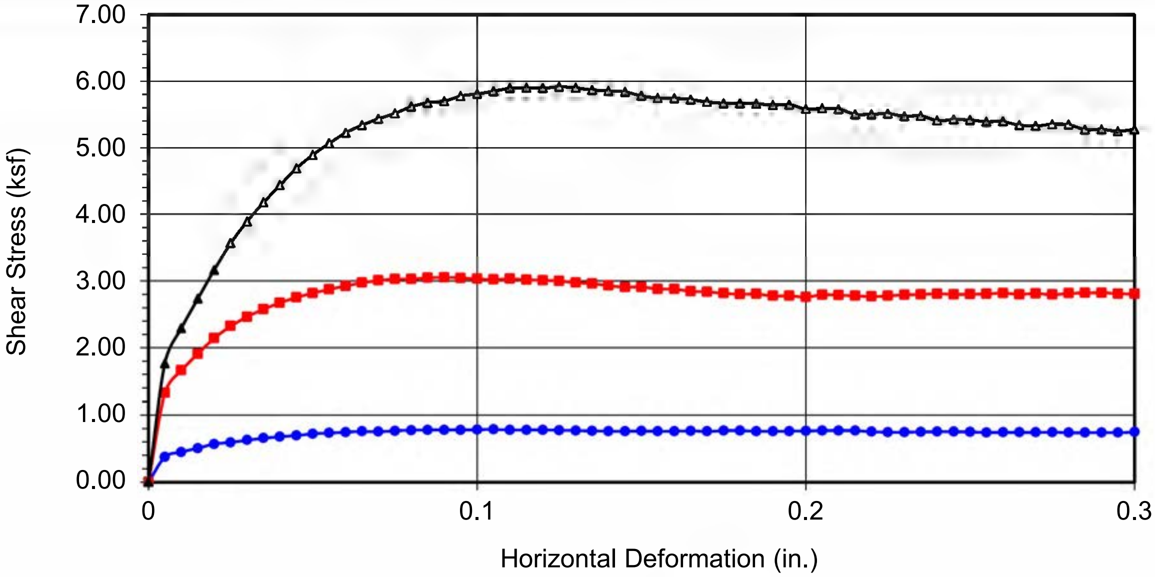
DIRECT SHEAR TEST RESULTS

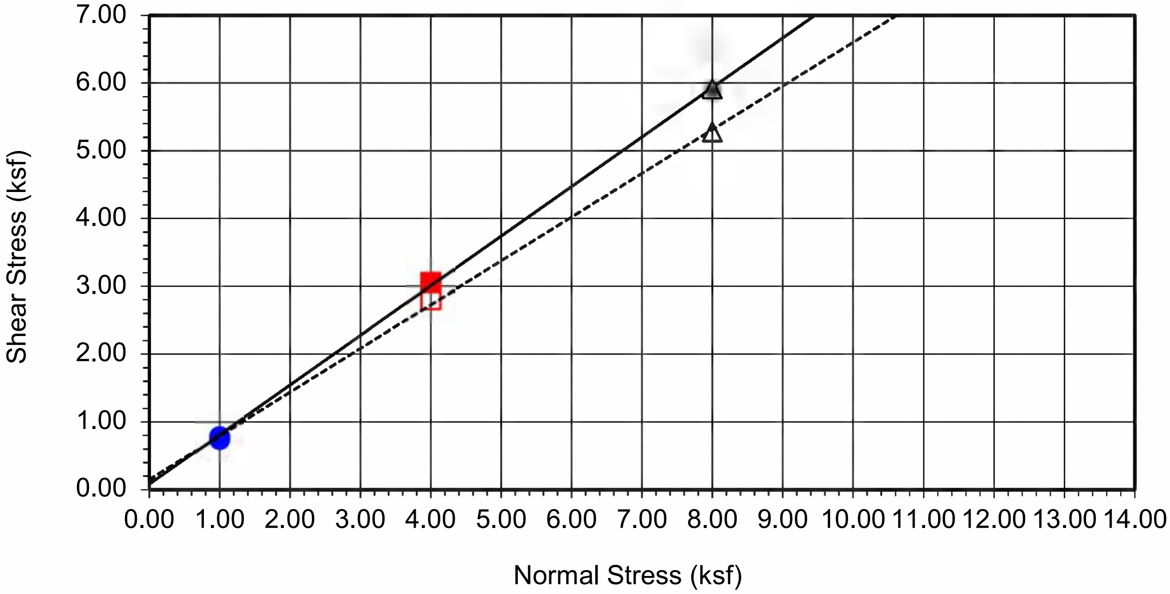
Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24





Boring No.	LB-1
Sample No.	R-1
Depth (ft)	7.5
Sample Type:	Ring
Soil Identification: Light brown poorly-graded sand (SP)	

Strength Parameters

	C (psf)	ϕ (°)
Peak	84	36
Ultimate	150	33

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.789	■ 3.056	▲ 5.917
Shear Stress @ End of Test (ksf)	○ 0.751	□ 2.807	△ 5.278
Deformation Rate (in./min.)	0.0050	0.0050	0.0050
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	1.98	1.98	1.98
Dry Density (pcf)	97.3	101.3	104.1
Saturation (%)	7.3	8.0	8.6
Soil Height Before Shearing (in.)	0.9884	0.9700	0.9689
Final Moisture Content (%)	18.9	17.5	16.0

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DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24

DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name: Griffin OC Workforce Reentry
Tested By: G. Bathala
Date: 07/17/24

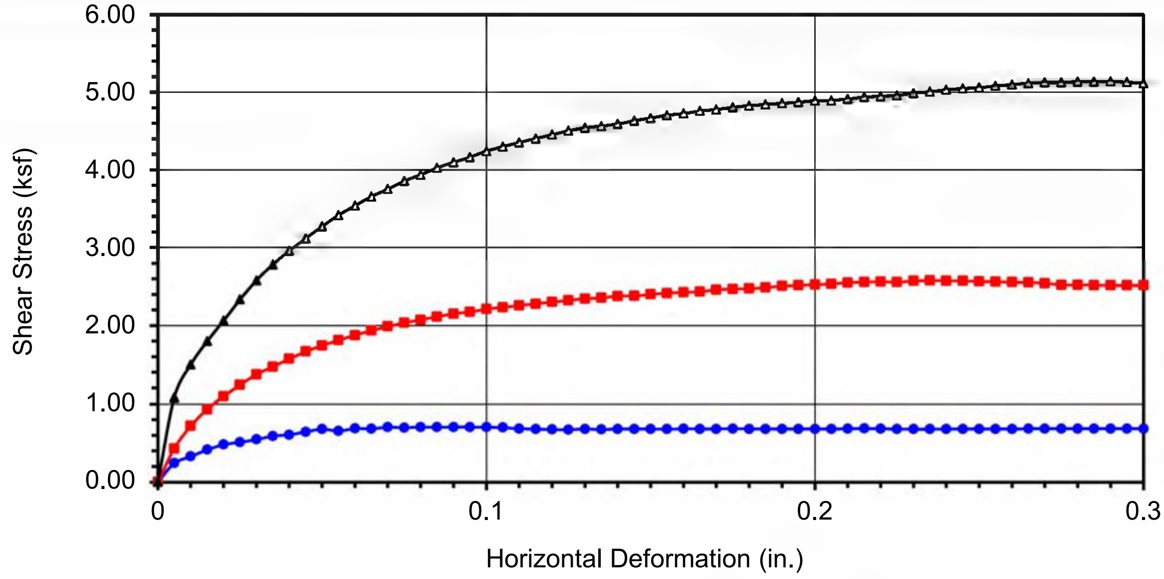
Project No.: 036.0000020833
Checked By: A. Santos
Date: 07/31/24

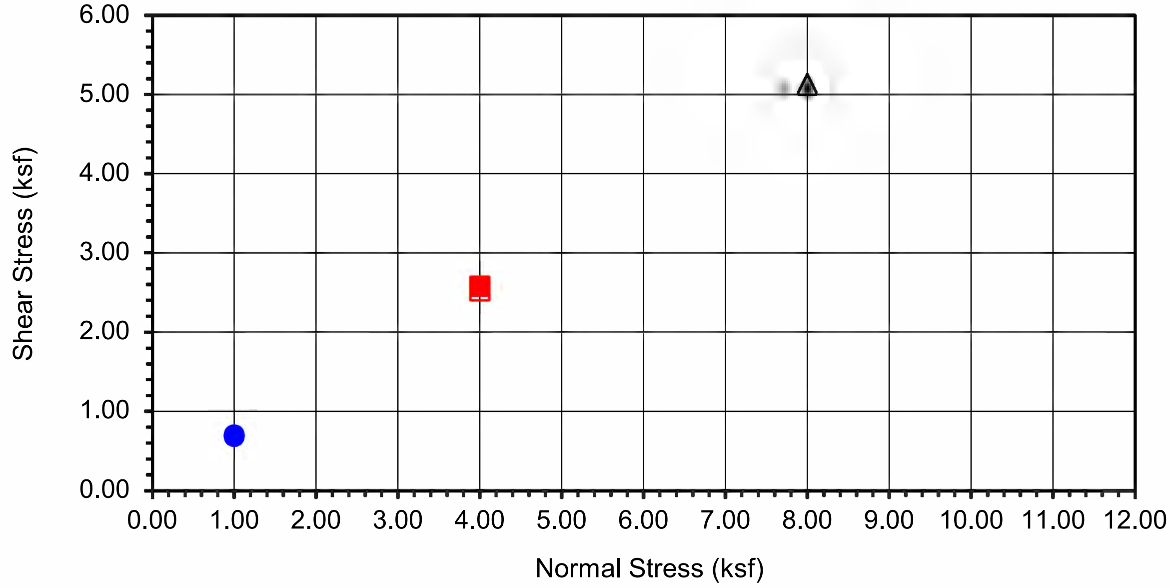
Boring No.: LB-1
Sample Type: Ring

Sample No.: R-2
Depth (ft.): 12.5

Soil Identification: Olive gray silty clay (CL-ML)

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	172.40	168.84	176.65
Weight of Ring(gm):	44.31	37.44	43.48
Before Shearing			
Weight of Wet Sample+Cont.(gm):	174.35	174.35	174.35
Weight of Dry Sample+Cont.(gm):	165.33	165.33	165.33
Weight of Container(gm):	59.16	59.16	59.16
Vertical Rdg.(in): Initial	0.2506	0.2615	0.0000
Vertical Rdg.(in): Final	0.2694	0.3096	-0.0650
After Shearing			
Weight of Wet Sample+Cont.(gm):	198.11	201.98	196.97
Weight of Dry Sample+Cont.(gm):	172.19	178.48	175.15
Weight of Container(gm):	57.12	60.26	55.13
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	LB-1
Sample No.	R-2
Depth (ft)	12.5
Sample Type: Ring	
Soil Identification: Olive gray silty clay (CL-ML)	

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.707	■ 2.581	▲ 5.140
Shear Stress @ End of Test (ksf)	○ 0.685	□ 2.518	△ 5.118
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	8.50	8.50	8.50
Dry Density (pcf)	98.2	100.7	102.1
Saturation (%)	32.0	34.1	35.2
Soil Height Before Shearing (in.)	0.9812	0.9519	0.9350
Final Moisture Content (%)	22.5	19.9	18.2

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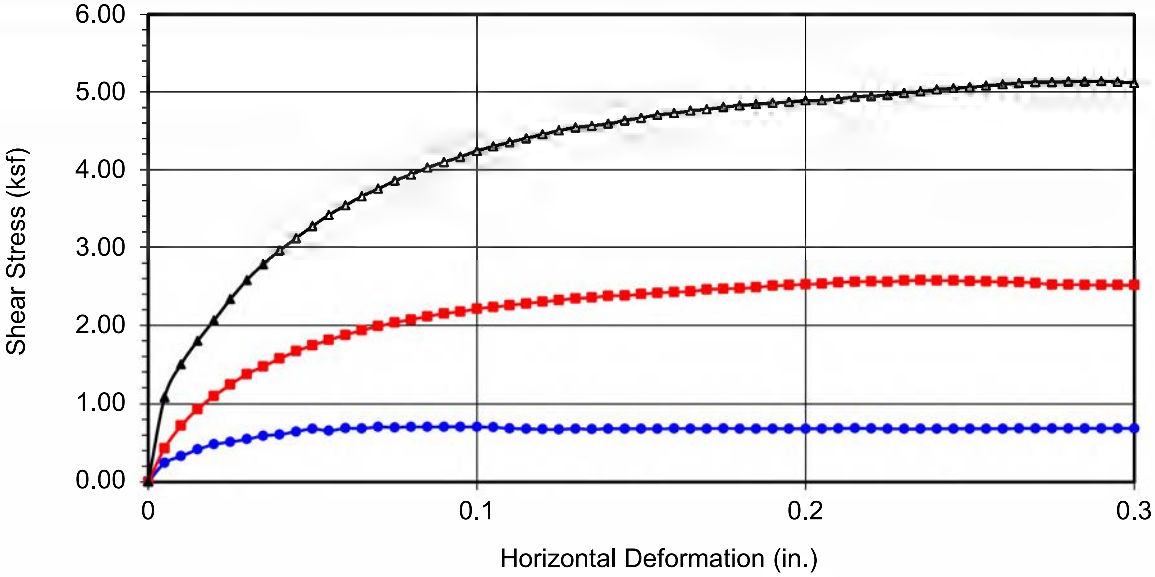
DIRECT SHEAR TEST RESULTS

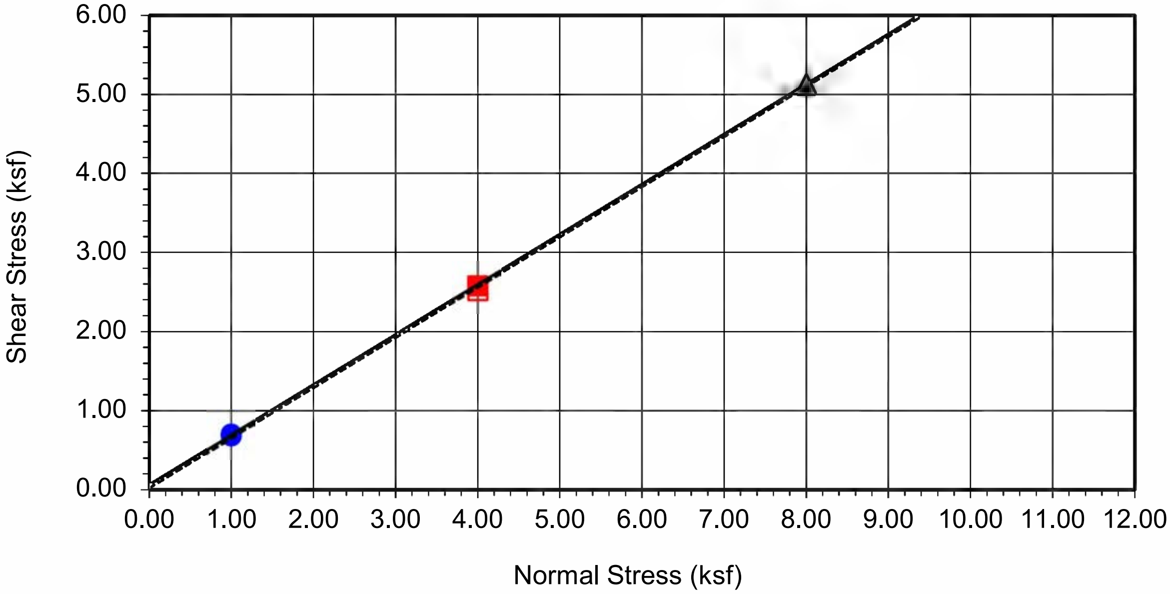
Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24





Boring No.	LB-1
Sample No.	R-2
Depth (ft)	12.5
Sample Type:	Ring

Soil Identification:
Olive gray silty clay (CL-ML)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	64	32
Ultimate	26	32

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.707	■ 2.581	▲ 5.140
Shear Stress @ End of Test (ksf)	○ 0.685	□ 2.518	△ 5.118
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	8.50	8.50	8.50
Dry Density (pcf)	98.2	100.7	102.1
Saturation (%)	32.0	34.1	35.2
Soil Height Before Shearing (in.)	0.9812	0.9519	0.9350
Final Moisture Content (%)	22.5	19.9	18.2

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DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24

DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Leighton

Project Name: Griffin OC Workforce Reentry
Tested By: G. Bathala
Date: 07/17/24

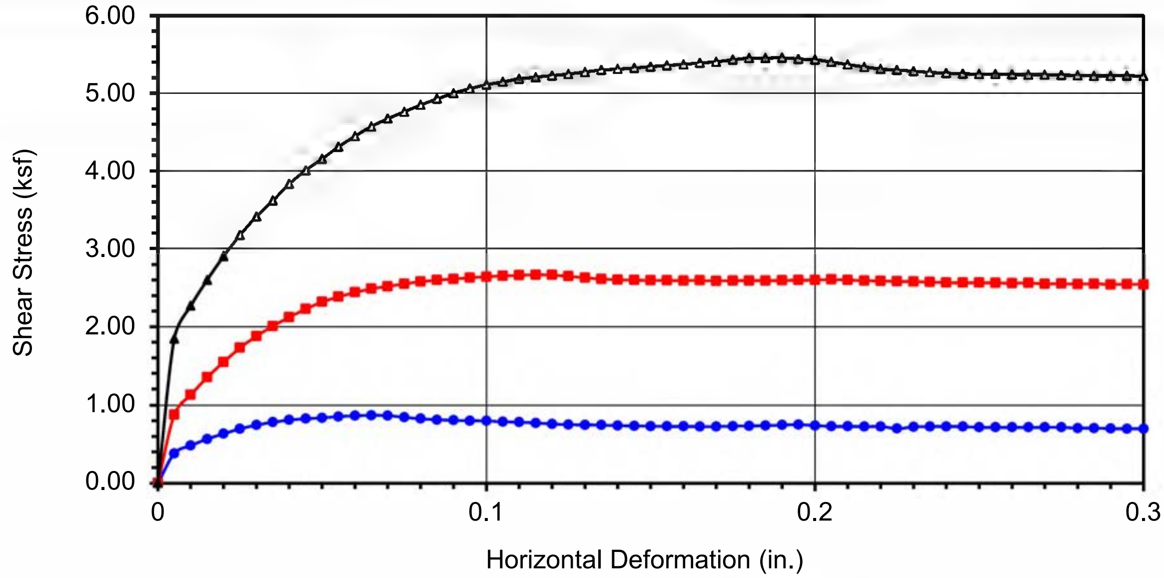
Project No.: 036.0000020833
Checked By: A. Santos
Date: 07/31/24

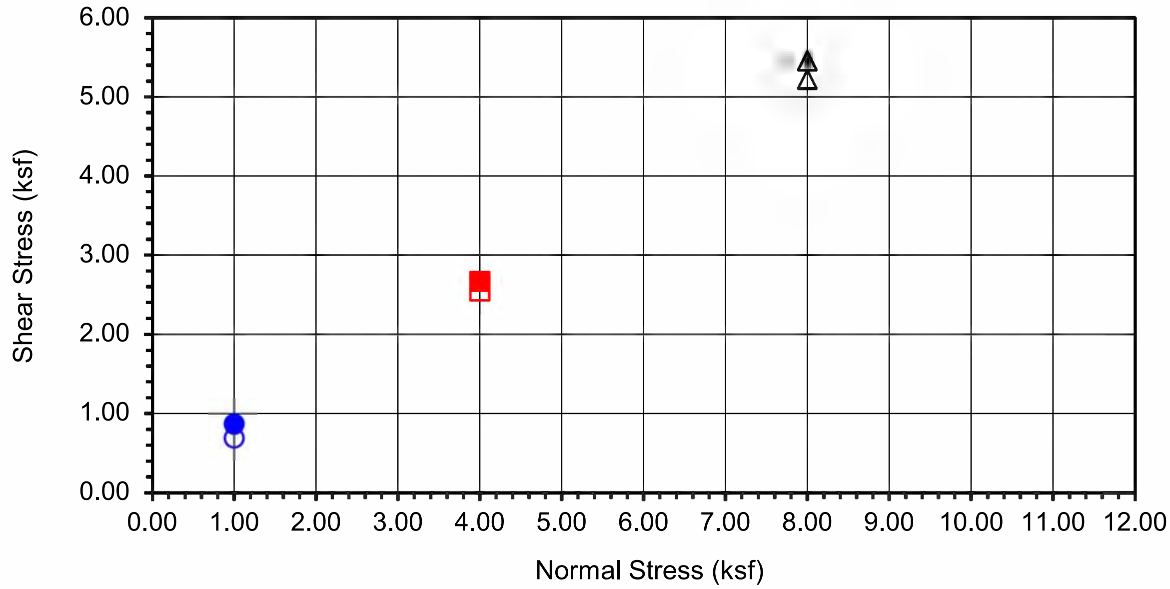
Boring No.: LB-5
Sample Type: Ring

Sample No.: R-2
Depth (ft.): 10.0

Soil Identification: Olive gray silty clay (CL-ML)

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	188.40	188.78	189.67
Weight of Ring(gm):	41.76	41.32	40.87
Before Shearing			
Weight of Wet Sample+Cont.(gm):	217.95	217.95	217.95
Weight of Dry Sample+Cont.(gm):	188.87	188.87	188.87
Weight of Container(gm):	60.36	60.36	60.36
Vertical Rdg.(in): Initial	0.2622	0.2852	0.0000
Vertical Rdg.(in): Final	0.2733	0.3483	-0.0551
After Shearing			
Weight of Wet Sample+Cont.(gm):	201.55	205.63	215.96
Weight of Dry Sample+Cont.(gm):	169.93	178.22	191.48
Weight of Container(gm):	55.45	61.80	72.04
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	LB-5
Sample No.	R-2
Depth (ft)	10
Sample Type: Ring	
Soil Identification: Olive gray silty clay (CL-ML)	

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.871	■ 2.669	▲ 5.458
Shear Stress @ End of Test (ksf)	○ 0.698	□ 2.546	△ 5.222
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	22.63	22.63	22.63
Dry Density (pcf)	99.5	100.0	100.9
Saturation (%)	87.9	89.1	91.1
Soil Height Before Shearing (in.)	0.9889	0.9369	0.9449
Final Moisture Content (%)	27.6	23.5	20.5

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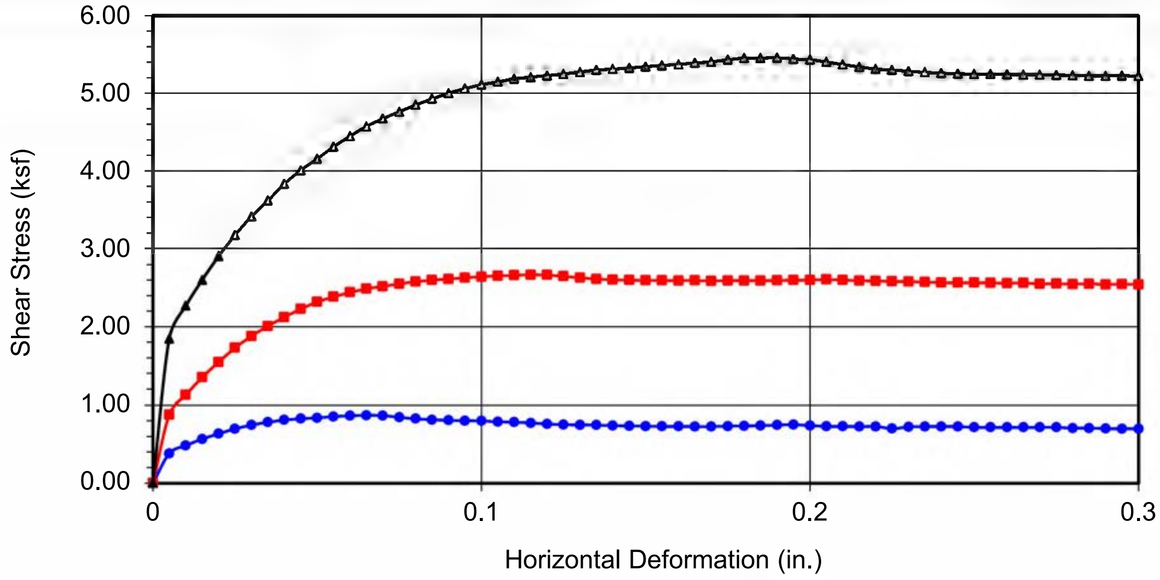
DIRECT SHEAR TEST RESULTS

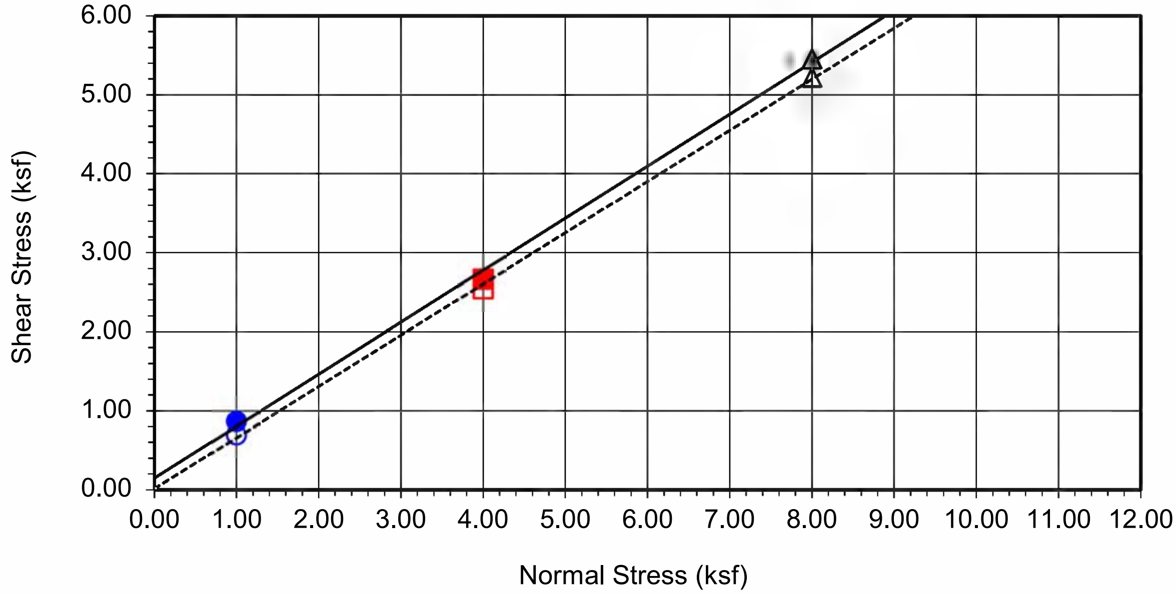
Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24





Boring No.	LB-5
Sample No.	R-2
Depth (ft)	10
Sample Type:	Ring

Soil Identification:
Olive gray silty clay (CL-ML)

Strength Parameters

	C (psf)	ϕ (°)
Peak	150	33
Ultimate	16	33

Normal Stress (kip/ft²)	1.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 0.871	■ 2.669	▲ 5.458
Shear Stress @ End of Test (ksf)	○ 0.698	□ 2.546	△ 5.222
Deformation Rate (in./min.)	0.0017	0.0017	0.0017
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	22.63	22.63	22.63
Dry Density (pcf)	99.5	100.0	100.9
Saturation (%)	87.9	89.1	91.1
Soil Height Before Shearing (in.)	0.9889	0.9369	0.9449
Final Moisture Content (%)	27.6	23.5	20.5

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DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 036.0000020833

Griffin OC Workforce Reentry

07-24

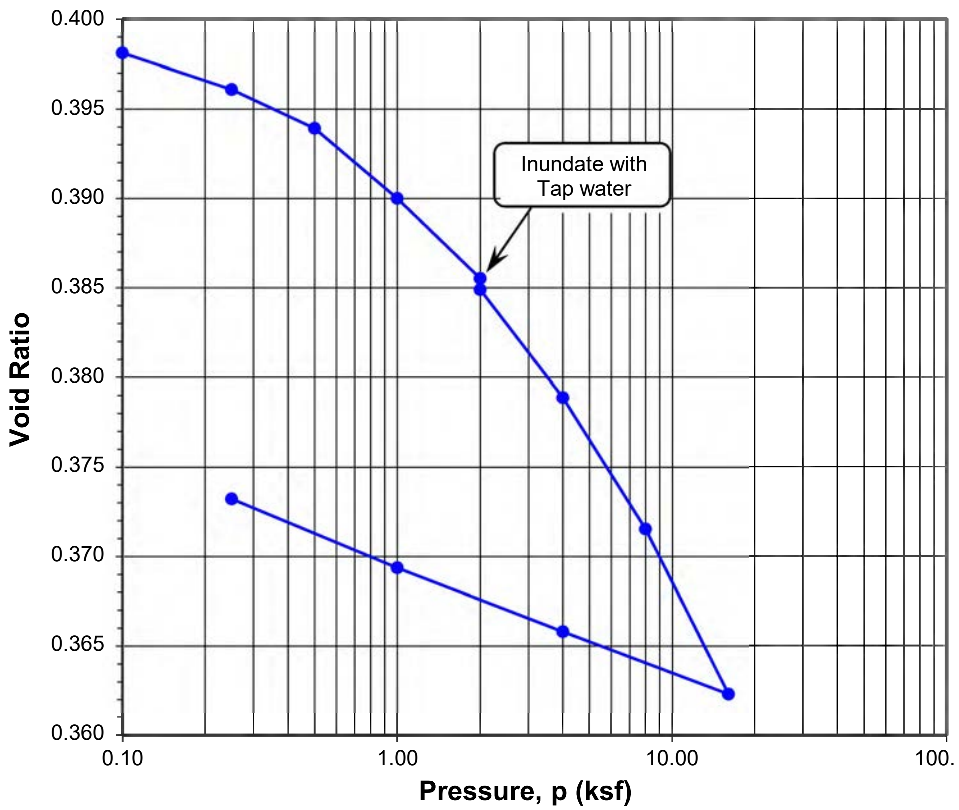
Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name:	Griffin OC Workforce Reentry	Tested By: GB/JD	Date: 07/09/24
Project No.:	036.0000020833	Checked By: A. Santos	Date: 07/31/24
Boring No.:	LB-1	Depth (ft.): 0-5	
Sample No.:	B-1	Sample Type:	Bulk
Soil Identification:	Olive brown sandy silt s(ML)		

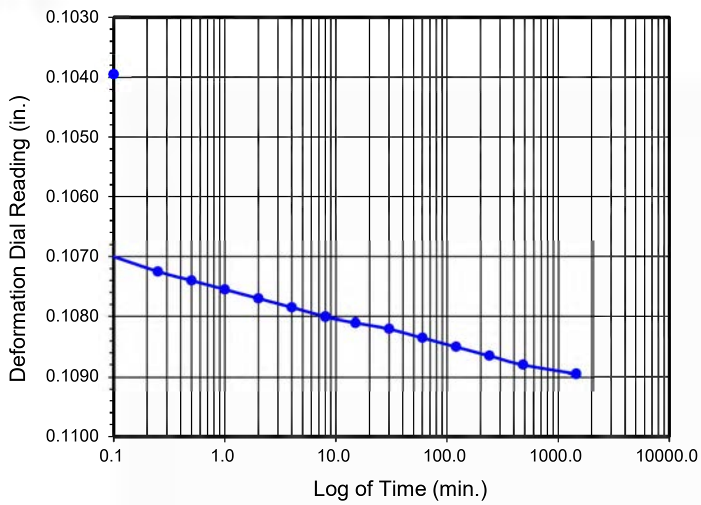
Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	204.68
Weight of Ring (g):	45.76
Height after consol. (in.):	0.9820
Before Test	
Wt. of Wet Sample+Cont. (g):	192.07
Wt. of Dry Sample+Cont. (g):	181.20
Weight of Container (g):	68.52
Initial Moisture Content (%)	9.6
Initial Dry Density (pcf)	120.5
Initial Saturation (%):	65
Initial Vertical Reading (in.)	0.0921
After Test	
Wt. of Wet Sample+Cont. (g):	261.71
Wt. of Dry Sample+Cont. (g):	243.75
Weight of Container (g):	52.94
Final Moisture Content (%)	12.38
Final Dry Density (pcf):	122.8
Final Saturation (%):	90
Final Vertical Reading (in.)	0.1118
Specific Gravity (assumed):	2.70
Water Density (pcf):	62.43

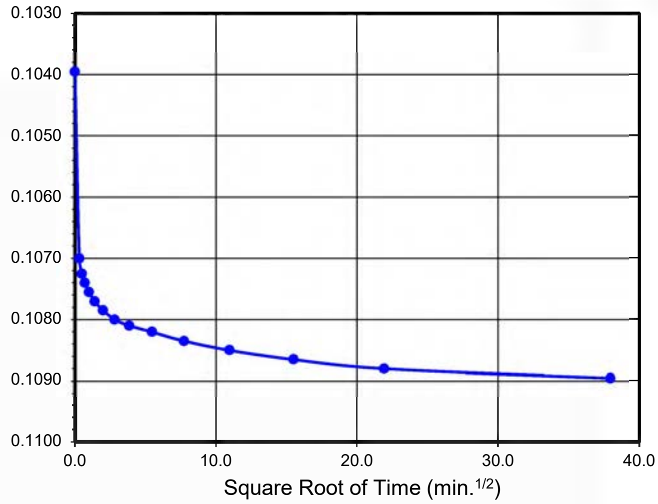


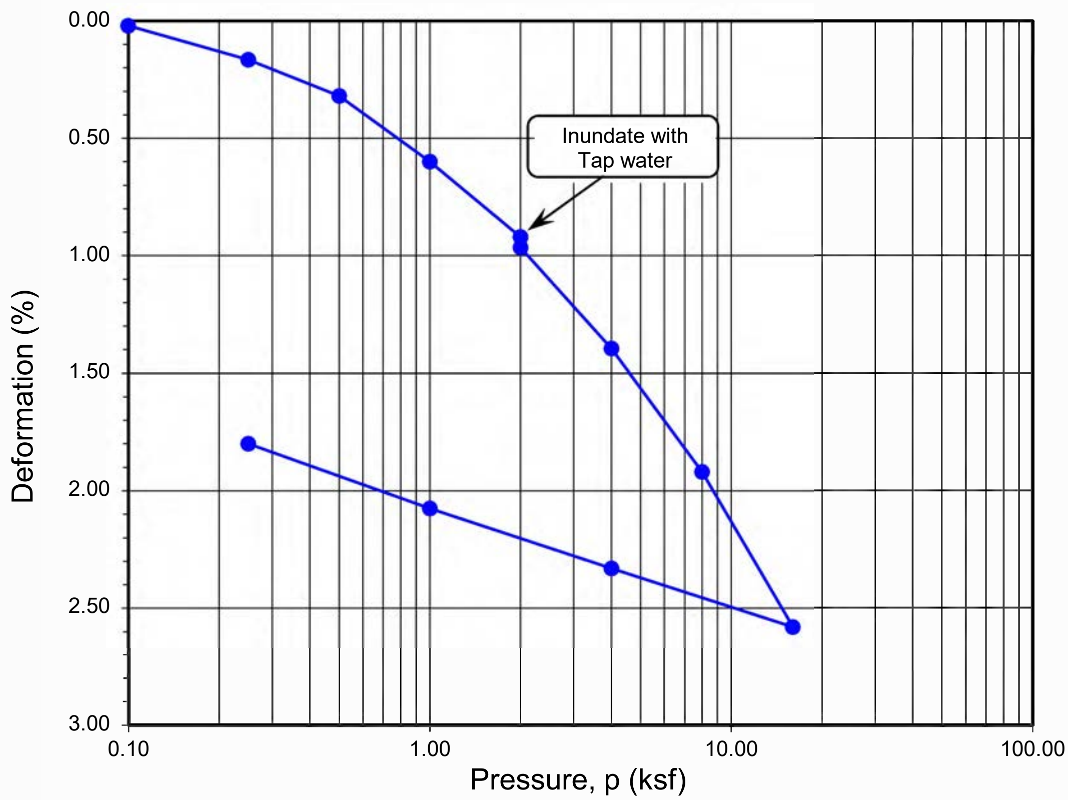
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.0923	0.9998	0.00	0.02	0.398	0.02
0.25	0.0942	0.9980	0.04	0.21	0.396	0.17
0.50	0.0962	0.9959	0.09	0.41	0.394	0.32
1.00	0.0996	0.9925	0.15	0.75	0.390	0.60
2.00	0.1035	0.9886	0.22	1.14	0.386	0.92
2.00	0.1040	0.9882	0.22	1.19	0.385	0.97
4.00	0.1090	0.9832	0.29	1.69	0.379	1.40
8.00	0.1150	0.9771	0.37	2.29	0.372	1.92
16.00	0.1227	0.9694	0.48	3.06	0.362	2.58
4.00	0.1190	0.9731	0.36	2.69	0.366	2.33
1.00	0.1154	0.9768	0.25	2.33	0.369	2.08
0.25	0.1118	0.9803	0.17	1.97	0.373	1.80

Time Readings @ 4.0 ksf				
Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
7/12/24	7:40:00	0.0	0.0	0.1040
7/12/24	7:40:06	0.1	0.3	0.1070
7/12/24	7:40:15	0.2	0.5	0.1073
7/12/24	7:40:30	0.5	0.7	0.1074
7/12/24	7:41:00	1.0	1.0	0.1076
7/12/24	7:42:00	2.0	1.4	0.1077
7/12/24	7:44:00	4.0	2.0	0.1079
7/12/24	7:48:00	8.0	2.8	0.1080
7/12/24	7:55:00	15.0	3.9	0.1081
7/12/24	8:10:00	30.0	5.5	0.1082
7/12/24	8:40:00	60.0	7.7	0.1084
7/12/24	9:40:00	120.0	11.0	0.1085
7/12/24	11:40:00	240.0	15.5	0.1087
7/12/24	15:40:00	480.0	21.9	0.1088
7/13/24	7:40:00	1440.0	37.9	0.1090

Time Readings @ 4.0 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-1	B-1	0-5	9.6	12.4	120.5	122.8	0.398	0.373	65	90

Soil Identification: Olive brown sandy silt s(ML)

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 036.0000020833

Griffin OC Workforce Reentry

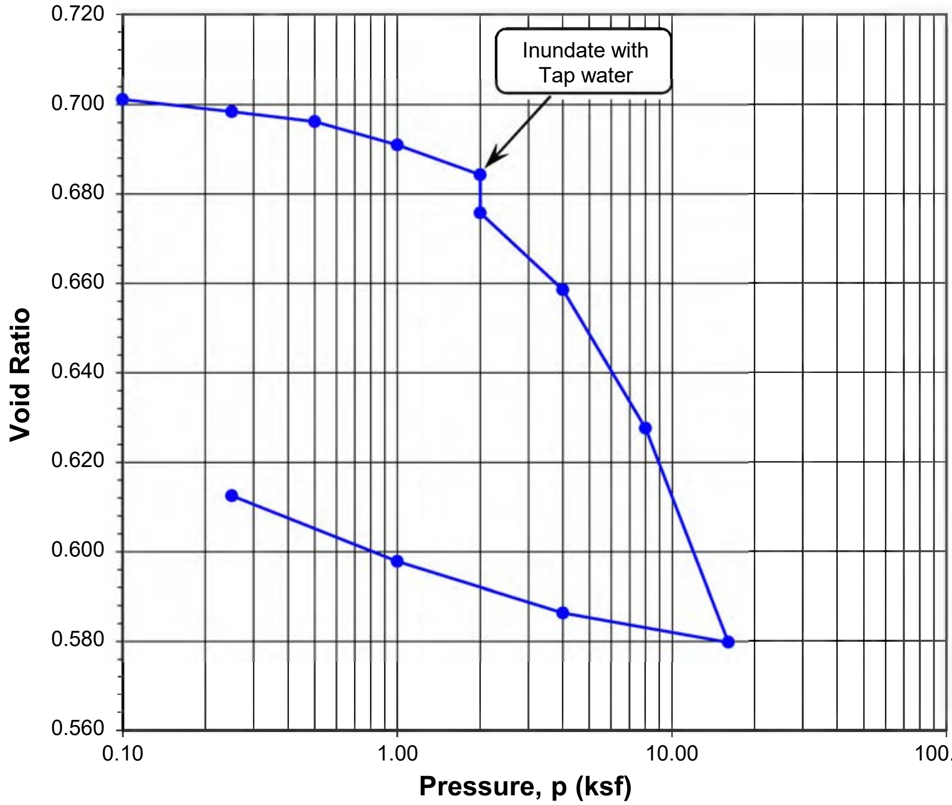
08-24

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name:	Griffin OC Workforce Reentry	Tested By:	GB/JD	Date:	07/09/24
Project No.:	036.0000020833	Checked By:	A. Santos	Date:	07/31/24
Boring No.:	LB-1	Depth (ft.):	12.5		
Sample No.:	R-2	Sample Type:	Ring		
Soil Identification:	Olive gray silty clay (CL-ML)				

Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	174.16
Weight of Ring (g):	44.92
Height after consol. (in.):	0.9477
Before Test	
Wt. of Wet Sample+Cont. (g):	174.35
Wt. of Dry Sample+Cont. (g):	165.33
Weight of Container (g):	59.16
Initial Moisture Content (%)	8.5
Initial Dry Density (pcf)	99.1
Initial Saturation (%):	33
Initial Vertical Reading (in.)	0.1303
After Test	
Wt. of Wet Sample+Cont. (g):	264.49
Wt. of Dry Sample+Cont. (g):	238.92
Weight of Container (g):	76.75
Final Moisture Content (%)	21.81
Final Dry Density (pcf):	102.9
Final Saturation (%):	92
Final Vertical Reading (in.)	0.1905
Specific Gravity (assumed):	2.70
Water Density (pcf):	62.43

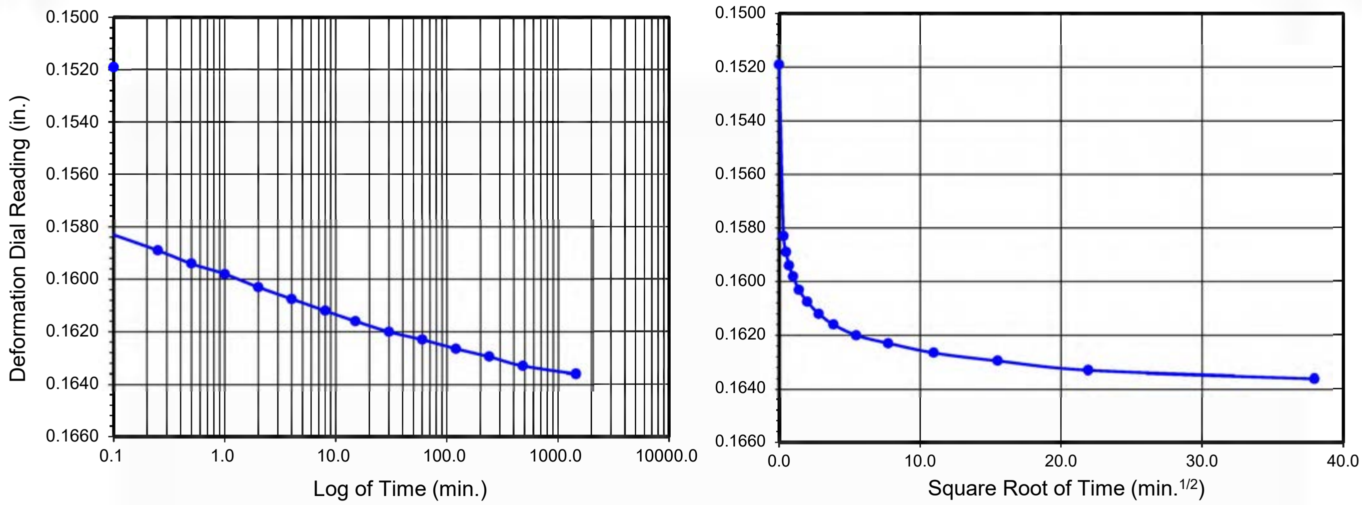


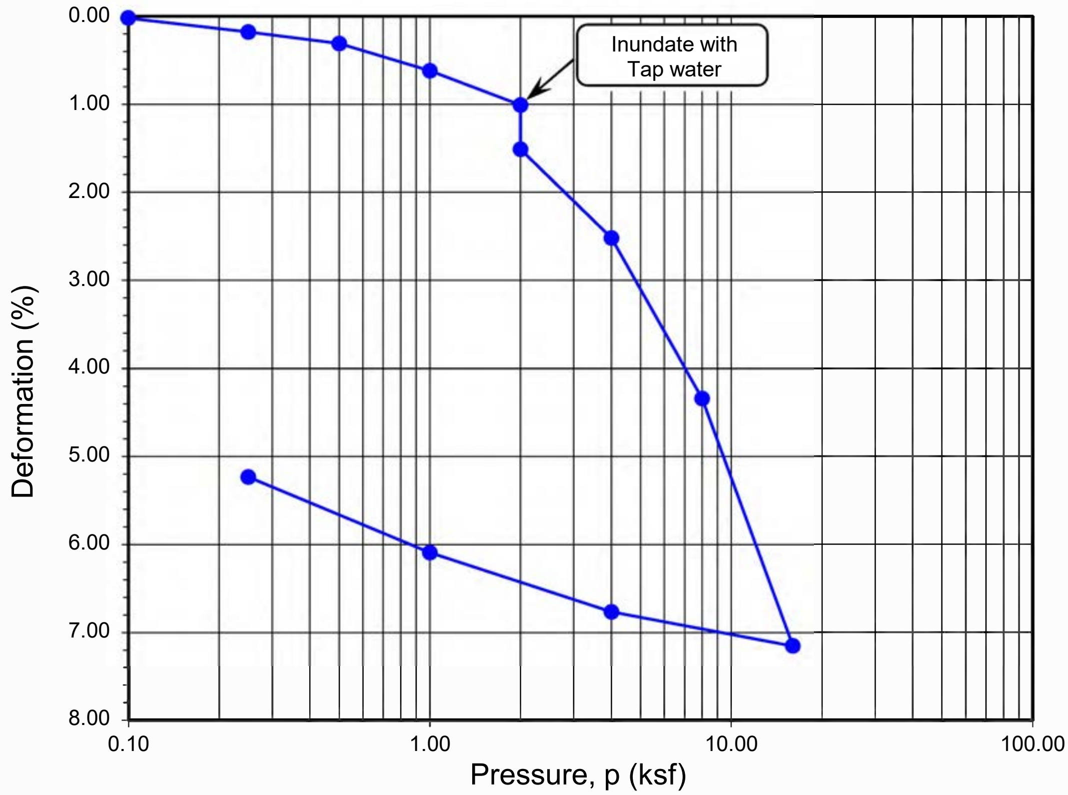
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.1305	0.9998	0.00	0.02	0.701	0.02
0.25	0.1335	0.9968	0.14	0.32	0.698	0.18
0.50	0.1364	0.9939	0.30	0.61	0.696	0.31
1.00	0.1414	0.9889	0.49	1.11	0.691	0.62
2.00	0.1469	0.9834	0.65	1.66	0.684	1.01
2.00	0.1519	0.9784	0.65	2.16	0.676	1.51
4.00	0.1636	0.9667	0.81	3.33	0.659	2.52
8.00	0.1832	0.9471	0.95	5.29	0.628	4.34
16.00	0.2127	0.9176	1.09	8.24	0.580	7.15
4.00	0.2079	0.9225	0.99	7.76	0.586	6.77
1.00	0.2001	0.9302	0.89	6.98	0.598	6.09
0.25	0.1905	0.9398	0.79	6.02	0.612	5.23

Time Readings @ 4.0 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
7/12/24	7:30:00	0.0	0.0	0.1519
7/12/24	7:30:06	0.1	0.3	0.1583
7/12/24	7:30:15	0.2	0.5	0.1589
7/12/24	7:30:30	0.5	0.7	0.1594
7/12/24	7:31:00	1.0	1.0	0.1598
7/12/24	7:32:00	2.0	1.4	0.1603
7/12/24	7:34:00	4.0	2.0	0.1608
7/12/24	7:38:00	8.0	2.8	0.1612
7/12/24	7:45:00	15.0	3.9	0.1616
7/12/24	8:00:00	30.0	5.5	0.1620
7/12/24	8:30:00	60.0	7.7	0.1623
7/12/24	9:30:00	120.0	11.0	0.1627
7/12/24	11:30:00	240.0	15.5	0.1630
7/12/24	15:30:00	480.0	21.9	0.1633
7/13/24	7:30:00	1440.0	37.9	0.1636

Time Readings @ 4.0 ksf





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-1	R-2	12.5	8.5	21.8	99.1	102.9	0.701	0.612	33	92

Soil Identification: Olive gray silty clay (CL-ML)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 036.0000020833

Griffin OC Workforce Reentry

08-24

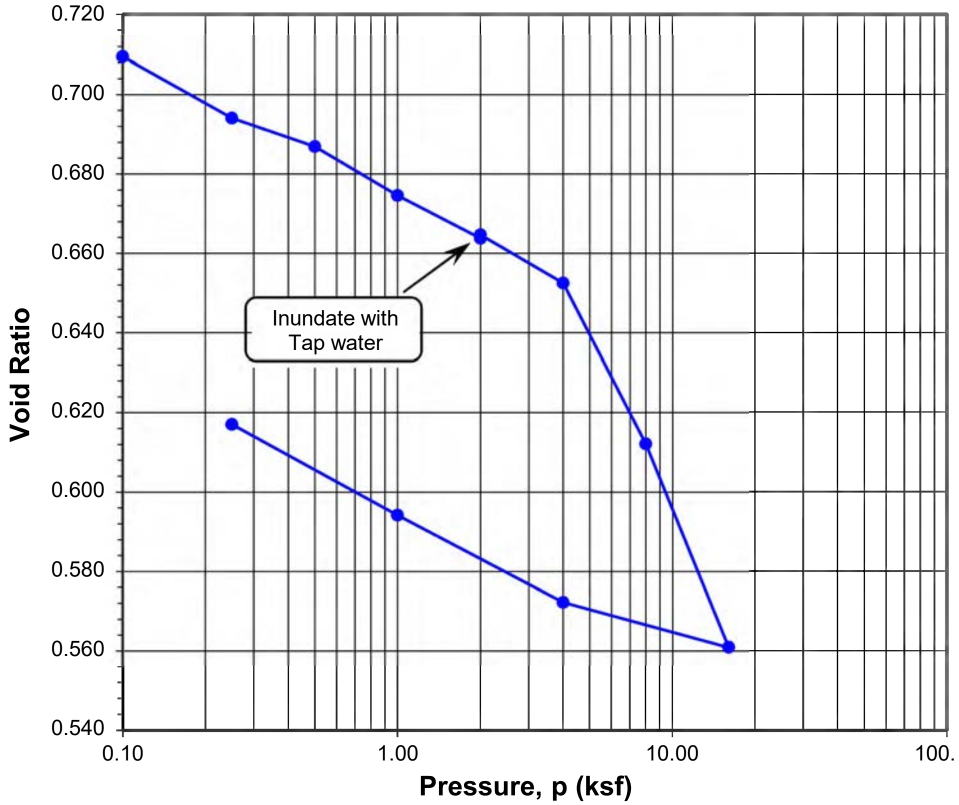
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Leighton

Project Name:	Griffin OC Workforce Reentry	Tested By: GB/JD	Date: 07/09/24
Project No.:	036.0000020833	Checked By: A. Santos	Date: 07/31/24
Boring No.:	LB-5	Depth (ft.): 10.0	
Sample No.:	R-2	Sample Type: Ring	
Soil Identification:	Olive gray silty clay (CL-ML)		

Sample Diameter (in.):	2.415
Sample Thickness (in.):	1.000
Weight of Sample + ring (g):	190.97
Weight of Ring (g):	44.68
Height after consol. (in.):	0.9448
Before Test	
Wt. of Wet Sample+Cont. (g):	217.95
Wt. of Dry Sample+Cont. (g):	188.87
Weight of Container (g):	60.36
Initial Moisture Content (%)	22.6
Initial Dry Density (pcf)	99.2
Initial Saturation (%):	86
Initial Vertical Reading (in.)	0.1354
After Test	
Wt. of Wet Sample+Cont. (g):	249.86
Wt. of Dry Sample+Cont. (g):	220.92
Weight of Container (g):	62.03
Final Moisture Content (%)	25.34
Final Dry Density (pcf):	100.5
Final Saturation (%):	100
Final Vertical Reading (in.)	0.1926
Specific Gravity (assumed):	2.72
Water Density (pcf):	62.43

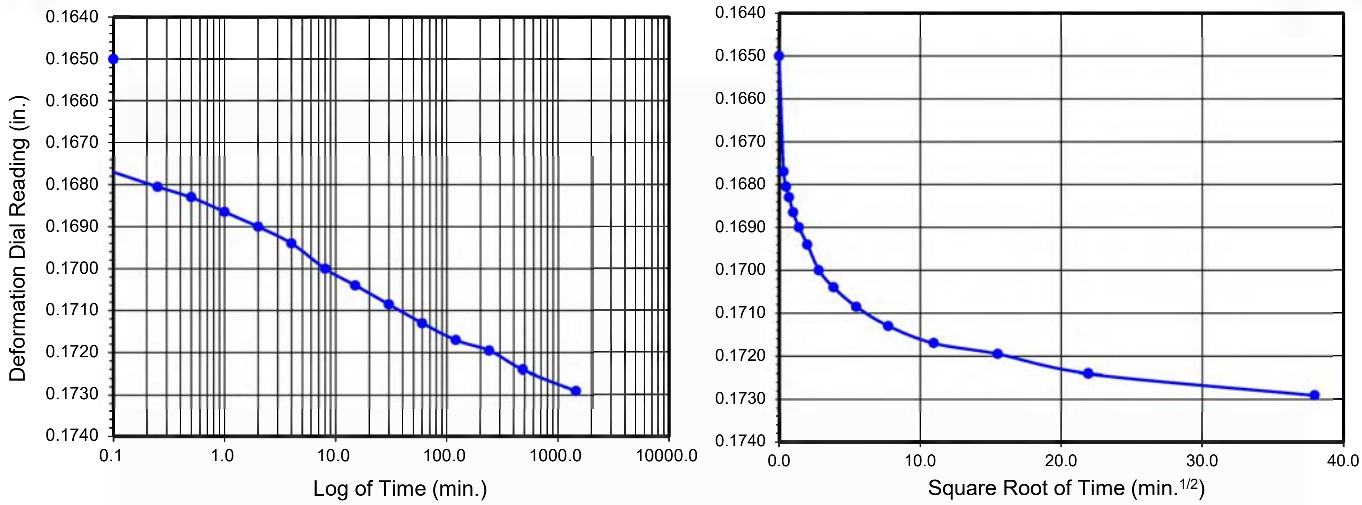


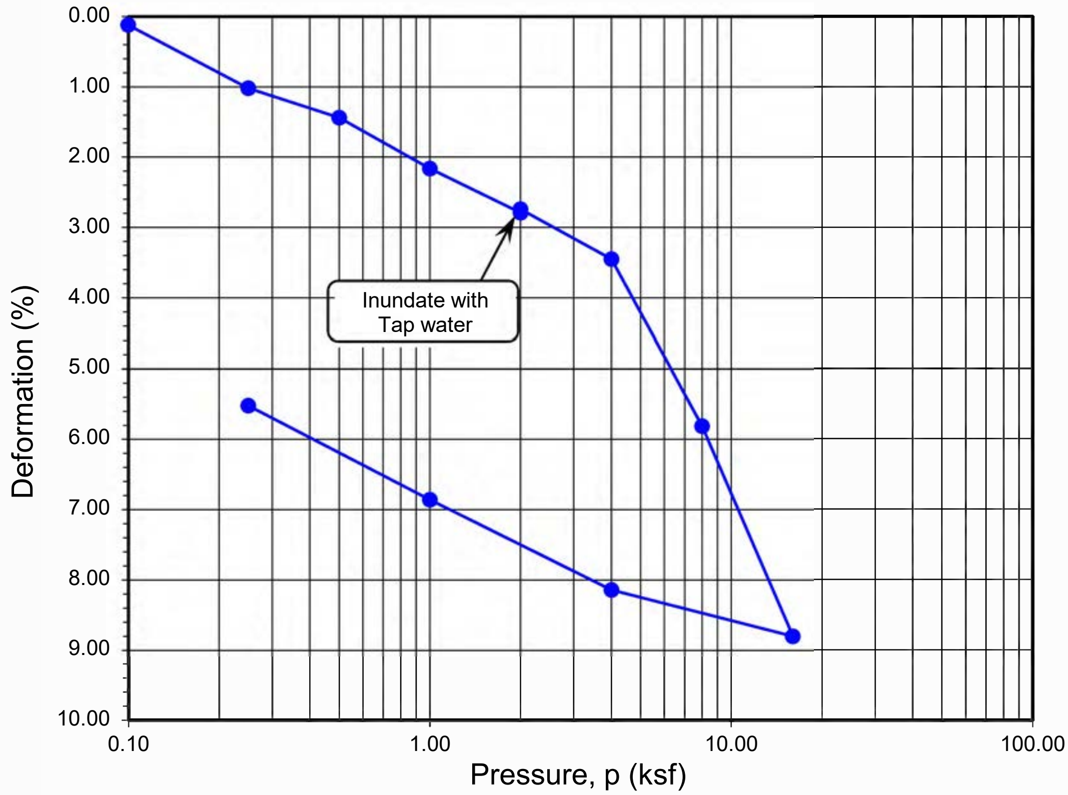
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deforma-tion (%)
0.10	0.1366	0.9988	0.00	0.12	0.710	0.12
0.25	0.1460	0.9894	0.04	1.06	0.694	1.02
0.50	0.1507	0.9847	0.09	1.53	0.687	1.44
1.00	0.1585	0.9769	0.15	2.31	0.675	2.16
2.00	0.1655	0.9699	0.22	3.01	0.664	2.79
2.00	0.1650	0.9704	0.22	2.96	0.665	2.74
4.00	0.1729	0.9625	0.30	3.75	0.653	3.45
8.00	0.1975	0.9379	0.40	6.21	0.612	5.81
16.00	0.2287	0.9067	0.53	9.33	0.561	8.80
4.00	0.2209	0.9145	0.41	8.55	0.572	8.14
1.00	0.2070	0.9284	0.30	7.16	0.594	6.86
0.25	0.1926	0.9428	0.20	5.72	0.617	5.52

Time Readings @ 4.0 ksf

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
7/12/24	7:35:00	0.0	0.0	0.1650
7/12/24	7:35:06	0.1	0.3	0.1677
7/12/24	7:35:15	0.2	0.5	0.1681
7/12/24	7:35:30	0.5	0.7	0.1683
7/12/24	7:36:00	1.0	1.0	0.1687
7/12/24	7:37:00	2.0	1.4	0.1690
7/12/24	7:39:00	4.0	2.0	0.1694
7/12/24	7:43:00	8.0	2.8	0.1700
7/12/24	7:50:00	15.0	3.9	0.1704
7/12/24	8:05:00	30.0	5.5	0.1709
7/12/24	8:35:00	60.0	7.7	0.1713
7/12/24	9:35:00	120.0	11.0	0.1717
7/12/24	11:35:00	240.0	15.5	0.1720
7/12/24	15:35:00	480.0	21.9	0.1724
7/13/24	7:35:00	1440.0	37.9	0.1729

Time Readings @ 4.0 ksf





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-5	R-2	10	22.6	25.3	99.2	100.5	0.712	0.617	86	100

Soil Identification: Olive gray silty clay (CL-ML)

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 036.0000020833

Griffin OC Workforce Reentry

08-24

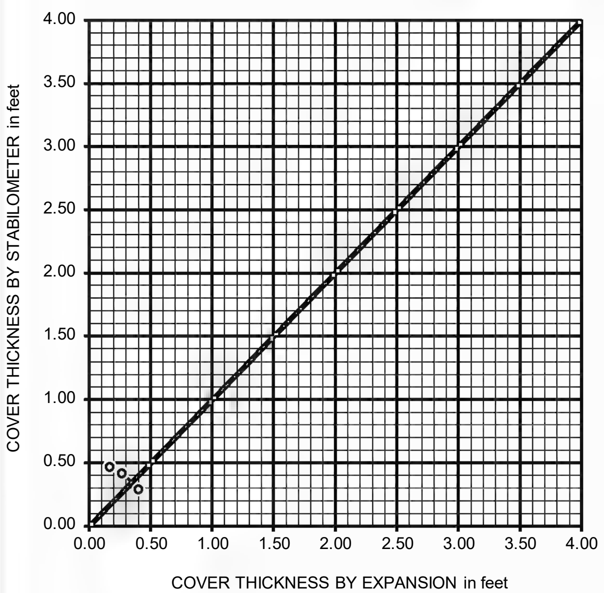
R-VALUE TEST RESULTS
DOT CA Test 301

PROJECT NAME:	Griffin OC Workforce Reentry	PROJECT NUMBER:	036.0000020833
BORING NUMBER:	LB-1	DEPTH (FT.):	0-5
SAMPLE NUMBER:	B-1	TECHNICIAN:	O. Figueroa
SAMPLE DESCRIPTION:	Olive brown sandy silt s(ML)	DATE COMPLETED:	7/16/2024

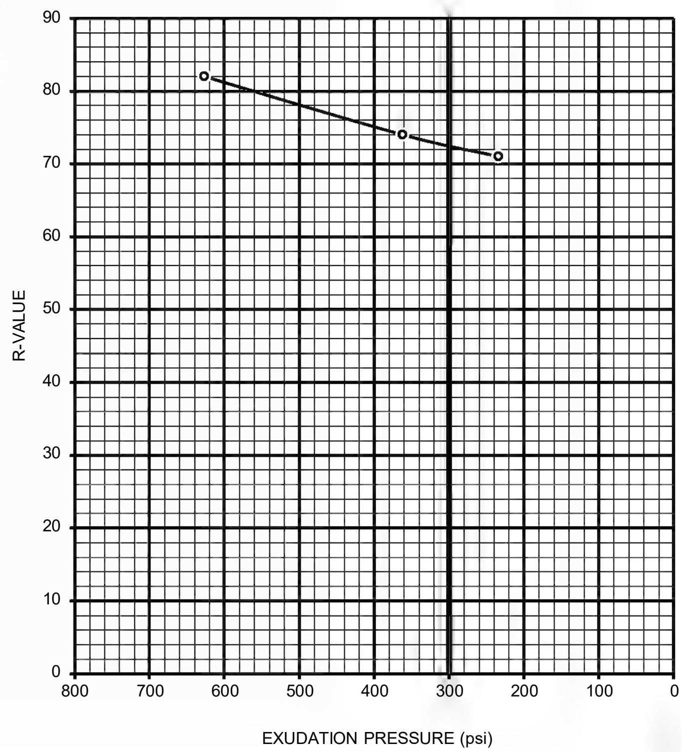
TEST SPECIMEN	**a**	**b**	**c**
MOISTURE AT COMPACTION %	8.6	9.1	9.6
HEIGHT OF SAMPLE, Inches	2.49	2.50	2.53
DRY DENSITY, pcf	125.5	125.4	125.0
COMPACTOR PRESSURE, psi	350	300	260
EXUDATION PRESSURE, psi	628	363	235
EXPANSION, Inches x 10exp-4	12	8	5
STABILITY Ph 2,000 lbs (160 psi)	19	24	27
TURNS DISPLACEMENT	4.65	4.85	5.05
R-VALUE UNCORRECTED	80	74	71
R-VALUE CORRECTED	82	74	71

DESIGN CALCULATION DATA	**a**	**b**	**c**
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.29	0.42	0.46
EXPANSION PRESSURE THICKNESS, ft.	0.40	0.27	0.17

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	78
R-VALUE BY EXUDATION:	72
EQUILIBRIUM R-VALUE:	72

Leighton

TESTS for SULFATE CONTENT CHLORIDE CONTENT and pH of SOILS

Project Name: Griffin OC Workforce Reentry | Tested By : KJ/GEB | Date: 07/11/24

Project No. : 036.0000020833 | Checked By: A. Santos | Date: 07/31/24

Boring No.	LB-1			
Sample No.	B-1			
Sample Depth (ft)	0-5			
Soil Identification:	Olive brown s(ML)			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.60			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	7			
Crucible No.	301			
Furnace Temperature (°C)	860			
Time In / Time Out	8:15/9:00			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	61.9101			
Wt. of Crucible (g)	61.9075			
Wt. of Residue (g) (A)	0.0026			
PPM of Sulfate (A) x 41150	106.99			
PPM of Sulfate, Dry Weight Basis	107			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15			
ml of AgNO3 Soln. Used in Titration (C)	1.1			
PPM of Chloride (C -0.2) * 100 * 30 / B	180			
PPM of Chloride, Dry Wt. Basis	180			

pH TEST, DOT California Test 643

pH Value	8.76			
Temperature °C	22.0			

SOIL RESISTIVITY TEST

DOT CA TEST 643

Project Name:	Griffin OC Workforce Reentry	Tested By :	G. Berdy Date: 07/17/24
Project No. :	036.0000020833	Checked By:	A. Santos Date: 07/31/24
Boring No.:	LB-1	Depth (ft.) :	0-5
Sample No. :	B-1		

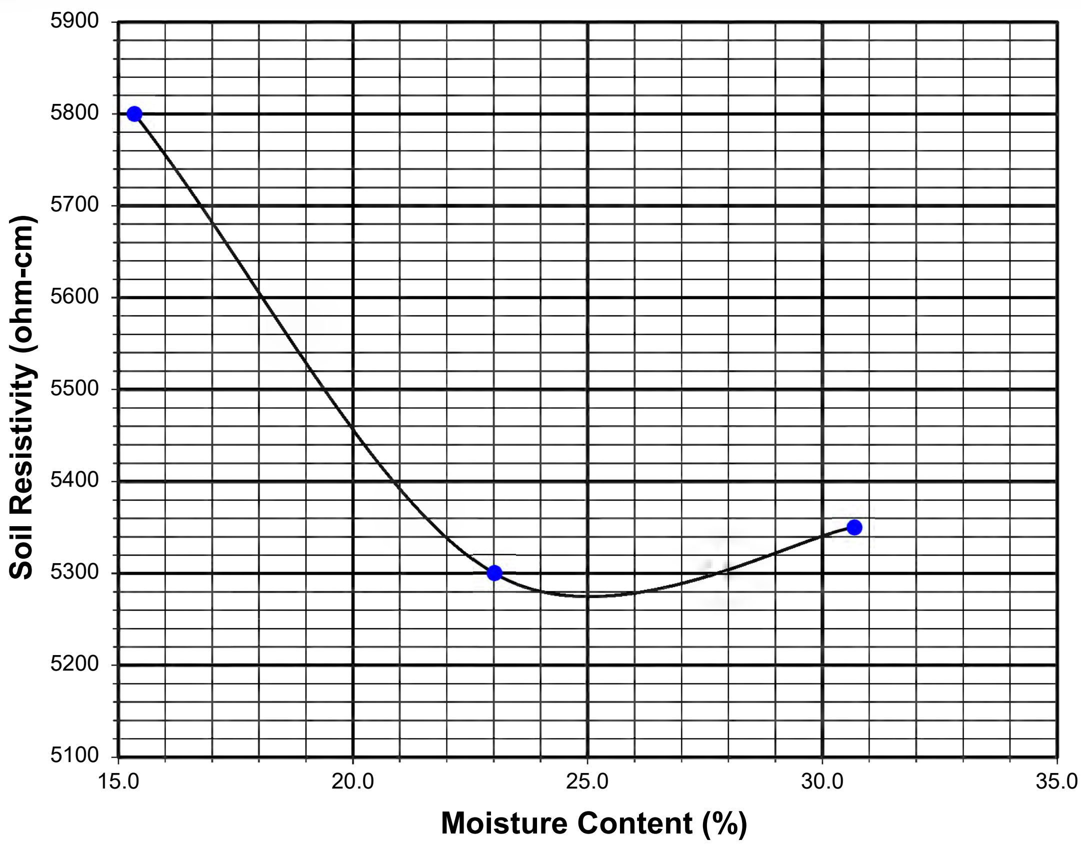
Soil Identification:* Olive brown s(ML)

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	20	15.34	5800	5800
2	30	23.01	5300	5300
3	40	30.69	5350	5350
4				
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	130.35
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
5278	25.0	107	180	8.76	22.0



Appendix D

Exploration Logs
(Ninyo & Moore, 2022)

DATE DRILLED 5/18/22 BORING NO. B-1

GROUND ELEVATION 117' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 4 inches thick.
							GM	AGGREGATE BASE: Gray, moist, medium dense, silty GRAVEL with sand; approximately 2 inches thick.
							SM	FILL: Grayish brown, moist, medium dense, silty SAND with gravel and gravel-sized asphalt concrete and Portland cement concrete fragments.
			8					@ 5': Loose.
							CL	Reddish brown, dark grayish brown, mottled, moist, stiff, lean CLAY with sand; trace gravel; trace sand pockets; trace asphalt concrete fragments.
10			14	23.9	98.9			Very stiff.
			12					Olive brown; stiff.
20							SP	ALLUVIUM: Yellowish brown, moist, medium dense, poorly graded SAND.
			15					
							SM	Dark yellowish brown, moist, medium dense, silty SAND.
			11				CL	Yellowish brown, moist, stiff, lean CLAY.
								Total Depth = 26.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil and patched with rapid-set concrete dyed black on 5/18/22.
30								
40								

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DATE DRILLED 5/18/22	BORING NO. B-2
GROUND ELEVATION 119' ± (MSL)	SHEET 1 OF 1
METHOD OF DRILLING 8" Hollow-Stem Auger (Baja Exploration)	
DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer)	DROP 30"
SAMPLED BY GM LOGGED BY GM	REVIEWED BY MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	FILL: Grayish brown, moist, medium dense, silty SAND with angular to sub-angular gravel; few gravel-sized asphalt concrete and Portland cement concrete fragments.
		X	23	2.4	108.8			
								Difficult drilling conditions; possible cobbles and/or cobble-size construction debris.
10		X	20					Few small gravel-sized asphalt concrete fragments.
		X	26					Portland cement concrete fragment in sampler tip.
20		X	27				SP	ALLUVIUM: Yellowish brown, moist, medium dense, poorly graded SAND.
							CL	Yellowish brown, moist, very stiff, lean CLAY.
		X	19				SC	Yellowish brown, moist, medium dense, clayey SAND.
								Total Depth = 26.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil on 5/18/22.
30								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED	5/18/22	BORING NO. B-3
GROUND ELEVATION	120' ± (MSL)	SHEET 1 OF 1
METHOD OF DRILLING	8" Hollow-Stem Auger (Baja Exploration)	
DRIVE WEIGHT	140 lbs. (Auto. Trip Hammer)	DROP 30"
SAMPLED BY GM	LOGGED BY GM	REVIEWED BY MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	X						SM	FILL: Grayish brown, moist, medium dense, silty SAND; trace gravel and gravel-sized asphalt concrete fragments. Some fill lifts contain clayey zones.
		X	25	9.9	117.0			
							SP	ALLUVIUM: Grayish brown, moist, loose, poorly graded SAND.
10		X	9	3.7	97.9			
							CL	Yellowish brown, moist, stiff, sandy lean CLAY.
							SC	Yellowish brown, moist, loose, clayey SAND.
		X	12					
20		X	40				SM	Grayish brown, moist, medium dense, silty SAND.
							CL	Yellowish brown, moist, very stiff, lean CLAY.
		X	26					
							SM	Grayish brown, moist, medium dense, silty SAND.
								Total Depth = 26.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil on 5/18/22.
30								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED	5/18/22	BORING NO.	B-4
GROUND ELEVATION	120' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	8" Hollow-Stem Auger (Baja Exploration)		
DRIVE WEIGHT	140 lbs. (Auto. Trip Hammer)	DROP	30"
SAMPLED BY	GM	LOGGED BY GM	REVIEWED BY MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							PORTLAND CEMENT CONCRETE: Approximately 5 inches thick; no base.
	X					SP	FILL: Yellowish brown, moist, medium dense, poorly graded SAND; trace angular to sub-angular gravel.
		X	24			SP	ALLUVIUM: Light yellowish brown, moist, medium dense, poorly graded SAND.
10		X	12	25.4	95.9	CL	Yellowish brown, moist, stiff, lean CLAY with sand.
						ML	Yellowish brown, moist, medium dense, sandy SILT.
		X	27			CL	Yellowish brown, moist, hard, sandy CLAY.
20		X	29			SM	Grayish brown, moist, medium dense, silty SAND.
						CL	Yellowish brown, moist, hard, sandy lean CLAY.
		X	28			SM	Grayish brown, moist, medium dense, silty SAND.
30							
40							

Total Depth = 26.5 feet.
Groundwater was not encountered during drilling.
Backfilled with on-site soil and patched with rapid-set concrete on 5/18/22.

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA
211948002 | 11/22

DATE DRILLED	9/21/22	BORING NO.	B-5
GROUND ELEVATION	120' ± (MSL)	SHEET	1 OF 1
METHOD OF DRILLING	8" Hollow-Stem Auger (MR Drilling)		
DRIVE WEIGHT	140 lbs. (Auto. Trip Hammer)	DROP	30"
SAMPLED BY	GM	LOGGED BY	GM
REVIEWED BY	MLP		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	PORTLAND CEMENT CONCRETE: Approximately 5 inches thick; no base.
							SP	FILL: Reddish brown, moist, medium dense, silty SAND with gravel; gravel angular to sub-angular.
								Yellowish brown, moist, medium dense, poorly graded SAND; trace angular to sub-angular gravel.
			28	6.9	104.2		SP	ALLUVIUM: Yellowish brown, moist, medium dense, poorly graded SAND; trace gravel rounded to sub-rounded.
							ML	Gray, moist, hard, SILT.
10			22					
							CL	Olive brown, moist, very stiff, lean CLAY.
			18					
								Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil and patched with rapid-set concrete on 9/21/22.
20								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED	9/21/22	BORING NO.	B-6
GROUND ELEVATION	120' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	8" Hollow-Stem Auger (MR Drilling)		
DRIVE WEIGHT	140 lbs. (Auto. Trip Hammer)	DROP	30"
SAMPLED BY GM	LOGGED BY GM	REVIEWED BY	MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	PORTLAND CEMENT CONCRETE: Approximately 5 inches thick; no base.
							SP	FILL: Reddish brown, moist, medium dense, silty SAND with gravel; cobble-sized Portland cement concrete fragments at 1 foot deep; few rootlets. Yellowish brown, moist, medium dense, poorly graded SAND; trace angular to sub-angular gravel.
							SP	ALLUVIUM: Yellowish brown, moist, medium dense, poorly graded SAND; trace rounded to sub-rounded gravel.
		■	24	3.4	94.6			
							CL	Dark yellowish brown, moist, very stiff, sandy lean CLAY.
10		◩	12					
							ML	Olive brown, moist, hard, SILT.
		◩	25					
								Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil and patched with rapid-set concrete on 9/21/22.
20								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
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DATE DRILLED	9/21/22	BORING NO.	B-7
GROUND ELEVATION	120' ± (MSL)	SHEET	1 OF 1
METHOD OF DRILLING	8" Hollow-Stem Auger (MR Drilling)		
DRIVE WEIGHT	140 lbs. (Auto. Trip Hammer)	DROP	30"
SAMPLED BY	GM	LOGGED BY	GM
REVIEWED BY	MLP		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Gray, dry, medium dense, silty SAND with gravel; few tree roots.
							SP	Yellowish brown, moist, medium dense, poorly graded SAND; few gravel; trace clay pockets. @ 3': Few clay pockets.
							CL	Gray, moist, stiff, sandy CLAY; trace angular fine gravel.
			31	5.0	95.9		SP	ALLUVIUM: Light yellowish brown, moist, medium dense, poorly graded SAND; trace rounded to sub-rounded gravel.
10			18				CL	Dark yellowish brown, moist, very stiff, sandy lean CLAY.
			21					Hard; decrease in sand.
20								Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil on 9/21/22.
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Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Grayish brown, moist, medium dense, silty SAND; trace gravel and gravel-sized asphalt concrete fragments. Some fill lifts contain clayey zones. @ 3': Few clay pockets.
			39	12.6	92.7		SP	ALLUVIUM: Light yellowish brown, moist, medium dense, poorly graded SAND; trace rounded to sub-rounded gravel.
10			17				CL	Reddish brown, moist, very stiff, sandy lean CLAY.
			21					Hard.
								Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil on 9/21/22. Notes: The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								
30								
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DATE DRILLED 9/21/22 BORING NO. B-8

GROUND ELEVATION 120' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (MR Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	■						SM	FILL: Grayish brown, moist, medium dense, silty SAND with angular to sub-angular gravel; few gravel-sized asphalt concrete and Portland cement concrete fragments. Difficult hand auguring conditions.
		■	35	1.3	101.4		SP	ALLUVIUM: Light yellowish brown, moist, medium dense, poorly graded SAND; trace rounded to sub-rounded gravel.
10		■	19				CL	Reddish brown, moist, very stiff, sandy lean CLAY.
		■	25					Hard.
								Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil on 9/21/22. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								
30								
40								

DATE DRILLED 9/21/22 BORING NO. B-9

GROUND ELEVATION 120' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (MR Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP

DATE DRILLED 9/21/22 BORING NO. B-10

GROUND ELEVATION 120' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (MR Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Grayish brown, moist, medium dense, silty SAND with angular to sub-angular gravel; few gravel-sized asphalt concrete and Portland cement concrete fragments.
			48					Few cobble-sized asphalt concrete fragments.
			33	6.5	109.8			Medium dense.
10			51					Black with asphalt concrete fragments; dense.
							CL	Olive brown, moist, hard, sandy CLAY; trace gravel.
			58	22.5	101.6			
20			60				SM	ALLUVIUM: Yellowish brown, moist, dense, silty SAND; trace iron oxide staining.
							CL	Yellowish brown, moist, hard, lean CLAY.
			28					
							SM	Gray, moist, very dense, silty SAND.
30			42					
								Total Depth = 31.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil on 9/21/22.
40								

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

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FIGURE A- 10

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							GM	ASPHALT CONCRETE: Approximately 2 inches thick.
							SM	AGGREGATE BASE: Gray, moist, medium dense, silty GRAVEL with sand; approximately 5 inches thick.
								FILL: Gray, moist, medium dense, silty SAND with gravel and gravel-sized asphalt concrete and Portland cement concrete fragments.
								@ 5': Very dense.
		■	50/5"					
		■	40					Few asphalt chunks; medium dense.
10		■	48	2.5	102.9		SP	ALLUVIUM: Light gray, moist, dense, poorly graded SAND; few gravel.
							CL	Olive brown, moist, hard, sandy CLAY.
		■	52					
							SM	Gray to olive brown, moist, dense, silty SAND.
20		■	28					
								Total Depth = 21.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil and patched with rapid-set concrete dyed black on 9/27/22.
30								
40								

DATE DRILLED 9/27/22 BORING NO. B-11

GROUND ELEVATION 120' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (MR Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP

Notes:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.

DEPTH (feet)	SAMPLES: Bulk	SAMPLES: Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							GM	ASPHALT CONCRETE: Approximately 3 inches thick.
							SM	AGGREGATE BASE: Gray, moist, medium dense, silty GRAVEL with sand; approximately 5 inches thick.
								FILL: Grayish brown and dark yellowish brown, moist, medium dense, silty SAND with gravel and gravel-sized asphalt concrete fragments and Portland cement concrete fragments.
			49					Dense.
							SP	ALLUVIUM: Yellowish brown, moist, medium dense, poorly graded SAND; few gravel.
			30	24.5	97.2		CL	Olive brown, moist, hard, sandy CLAY.
10								
			28					Trace oxidation staining.
								Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil and patched with rapid-set concrete dyed black on 9/27/22.
20								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
30								
40								

DATE DRILLED 9/27/22 BORING NO. B-12

GROUND ELEVATION 120' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Hollow-Stem Auger (MR Drilling)

DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"

SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 9/27/22 BORING NO. B-13 GROUND ELEVATION 120' ± (MSL) SHEET 1 OF 1 METHOD OF DRILLING 8" Hollow-Stem Auger (MR Drilling) DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30" SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP DESCRIPTION/INTERPRETATION
0							GM	ASPHALT CONCRETE: Approximately 2 inches thick.
							SM	AGGREGATE BASE: Gray, moist, medium dense, silty GRAVEL with sand; approximately 7 inches thick.
								FILL: Grayish brown and dark yellowish brown, moist, medium dense, silty SAND with gravel and gravel-sized asphalt concrete and Portland cement concrete fragments.
			41	9.3	108.9		SC	Grayish brown and dark yellowish brown, moist, medium dense, clayey SAND with gravel and gravel-sized asphalt concrete and Portland cement concrete fragments.
			50/4"					Very dense.
10			44	20.8	104.4		CL	Dark olive brown to dark yellowish brown, moist, hard, sandy CLAY; trace gravel-sized Portland cement concrete fragments.
			39					
							SM	ALLUVIUM: Yellowish brown, moist, medium dense, silty SAND; oxidation staining.
20			33					@ 20': Seepage encountered during drilling; wet.
			24				CL	Dark yellowish brown, moist, hard, sandy CLAY; trace caliche.
30								Total Depth = 26.5 feet. Groundwater was not encountered during drilling. Seepage was encountered at approximately 20 feet during drilling. Backfilled with on-site soil and patched with rapid-set concrete dyed black on 9/27/22. Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
40								

DEPTH (feet)	SAMPLES: Bulk	SAMPLES: Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
								DATE DRILLED 9/27/22 BORING NO. B-14
								GROUND ELEVATION 120' ± (MSL) SHEET 1 OF 1
								METHOD OF DRILLING 8" Hollow-Stem Auger (MR Drilling)
								DRIVE WEIGHT 140 lbs. (Auto. Trip Hammer) DROP 30"
								SAMPLED BY GM LOGGED BY GM REVIEWED BY MLP
0							SM	FILL: Grayish brown, moist, medium dense, silty SAND with angular and sub-rounded gravel; few gravel-sized asphalt concrete and Portland cement concrete fragments.
			50/5"					* Possible cobble/cobble-sized debris at 5 feet; sample taken at 5.5 feet. * Very dense.
			51					Dense.
10			50/4"	13.9	93.1		CL	Dark olive brown, moist, hard, sandy CLAY with gravel-sized asphalt concrete and Portland cement concrete fragments.
			43				SP	ALLUVIUM: Light gray, moist, dense, poorly graded SAND.
			61					Few gravel.
							CL	Olive brown, moist, hard, CLAY with sand; trace gravel.
20			41				ML	Olive brown, moist, very dense, sandy SILT.
								Total Depth = 21.5 feet. Groundwater was not encountered during drilling. Backfilled with on-site soil on 9/27/22.
								Notes: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
30								
40								

Appendix E

Laboratory Test Results
(Ninyo & Moore, 2022)

SAMPLE LOCATION	SAMPLE DEPTH (ft)	DESCRIPTION	PERCENT PASSING NO. 4	PERCENT PASSING NO. 200	USCS (TOTAL SAMPLE)
B-1	10.0-11.5	LEAN CLAY WITH SAND	100	78	CL
B-3	0.0-5.0	SILTY SAND	97	16	SM
B-4	10.0-11.5	LEAN CLAY WITH SAND	100	75	CL
B-4	20.0-21.5	SILTY SAND	100	32	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 1140

FIGURE B-1

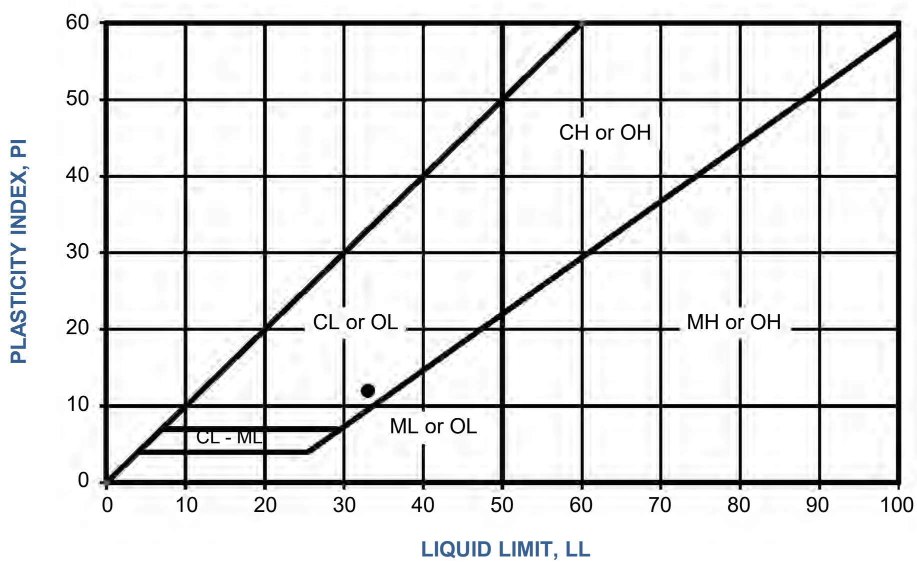
NO. 200 SIEVE ANALYSIS TEST RESULTS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

211948002 | 11/22

SYMBOL	LOCATION	DEPTH (ft)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS
●	B-4	10.0-11.5	33	21	12	CL	CL



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

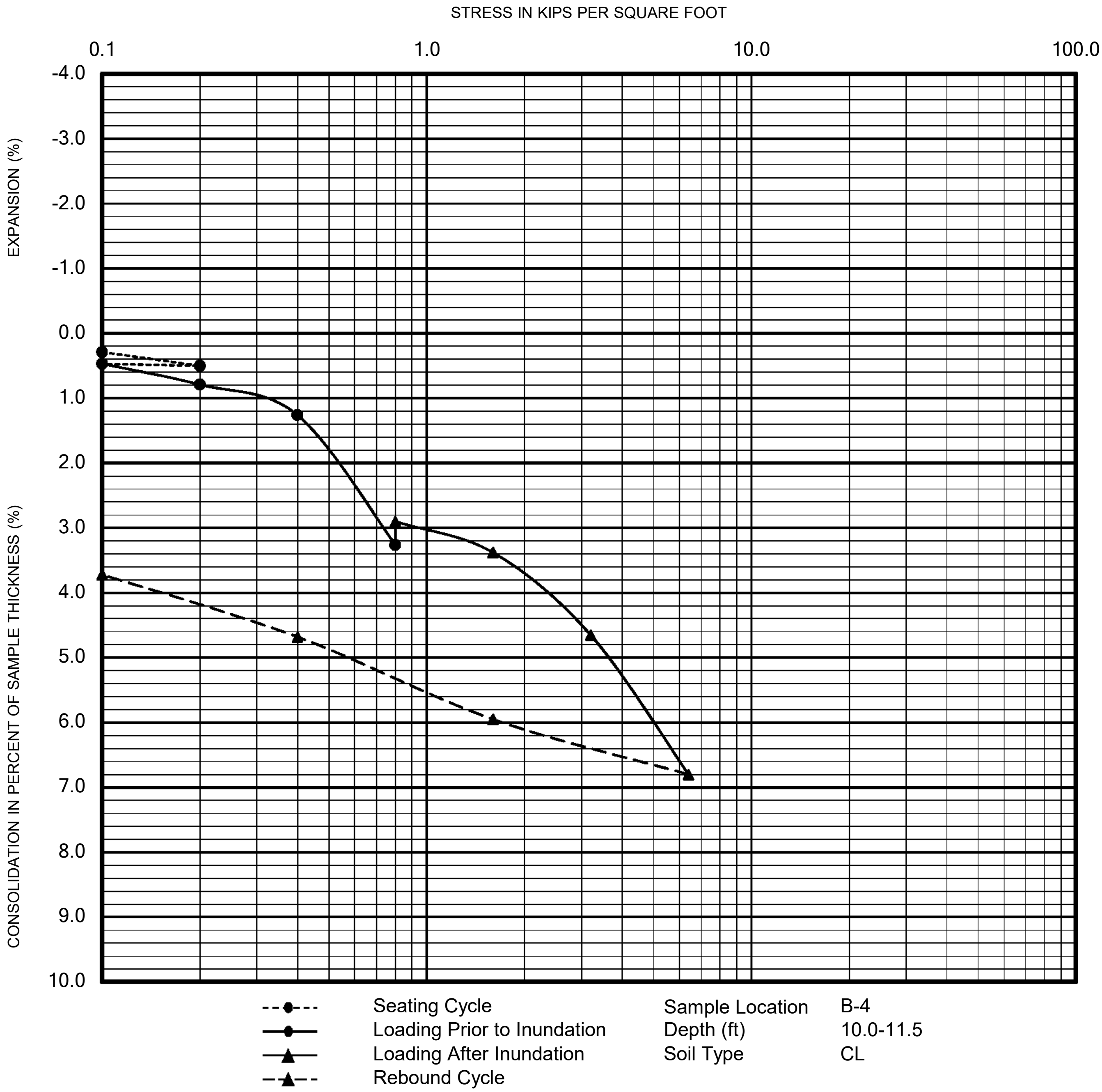
FIGURE B-2

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

ATTERBERG LIMITS TEST RESULTS

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

211948002 | 11/22



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435

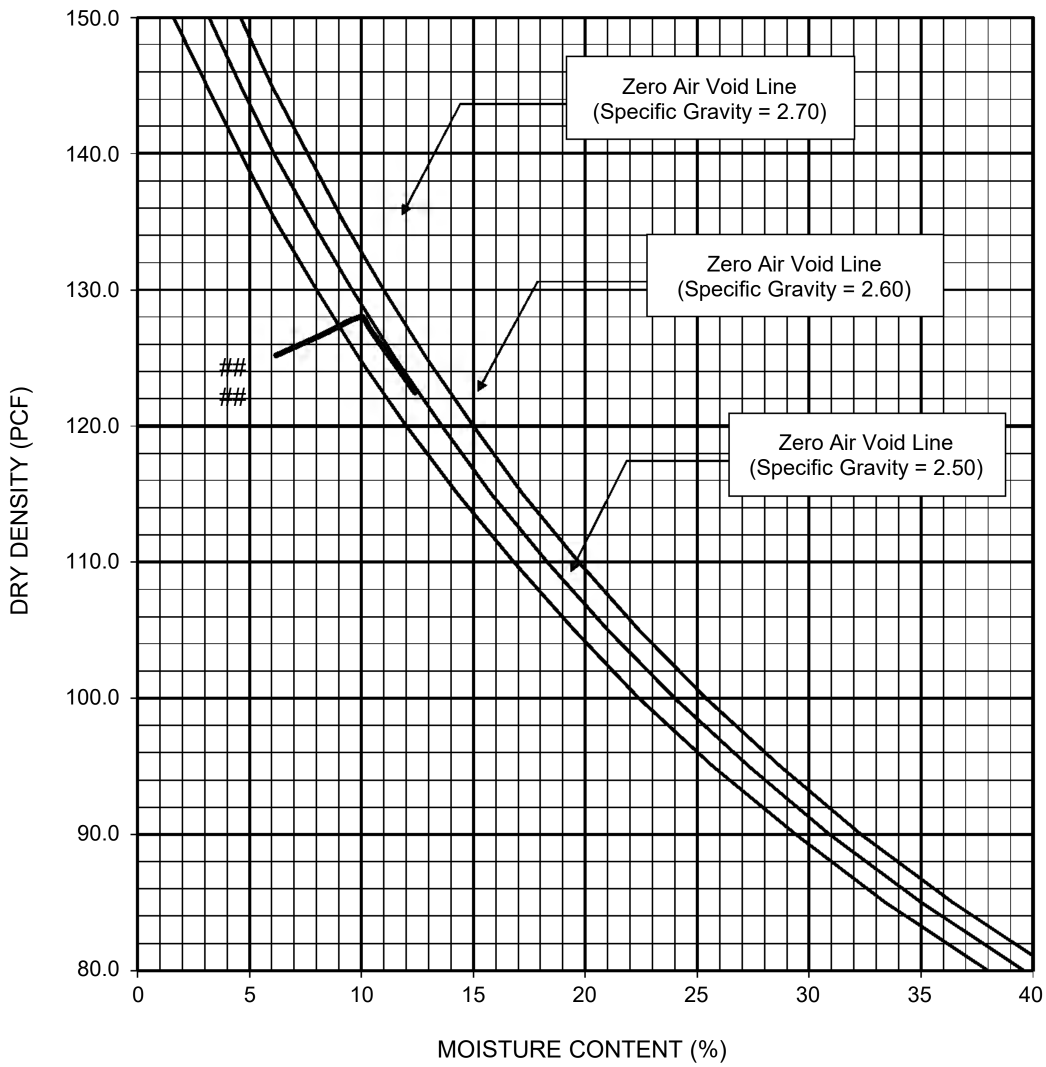
FIGURE B-3

CONSOLIDATION TEST RESULTS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

211948002 | 11/22



Sample Location	Depth (ft)	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture Content (percent)
B-3	0.0-5.0	Grayish Brown Silty Sand	128.0	10.0
Dry Density and Moisture Content Values Corrected for Oversize (ASTM D 4718)			N/A	N/A

PERFORMED IN GENERAL ACCORDANCE WITH ☑ ASTM D 1557 ☐ ASTM D 698 METHOD ☐ A ☑ B ☐ C

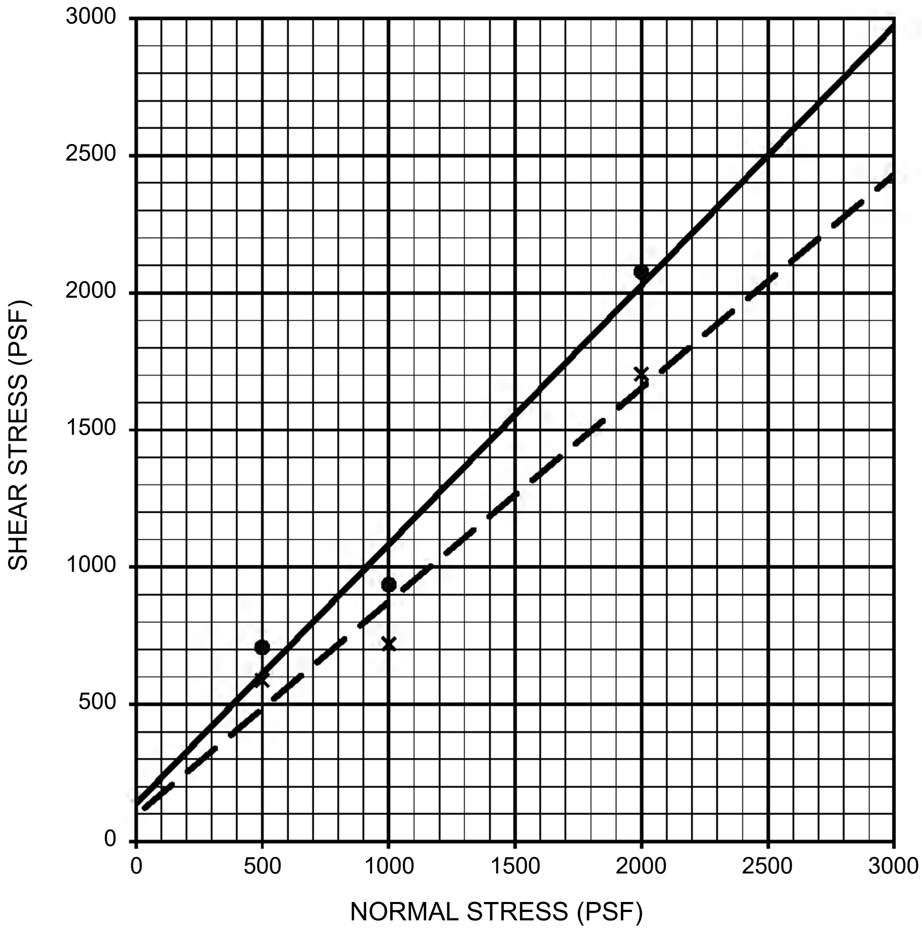
FIGURE B-4

PROCTOR DENSITY TEST RESULTS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

211948002 | 11/22



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
SILTY SAND	——●——	B-3	0.0-5.0	Peak	138	43	SM
SILTY SAND	– – X – –	B-3	0.0-5.0	Ultimate	96	38	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080 ON A SAMPLE REMOLDED TO 90% RELATIVE COMPACTION

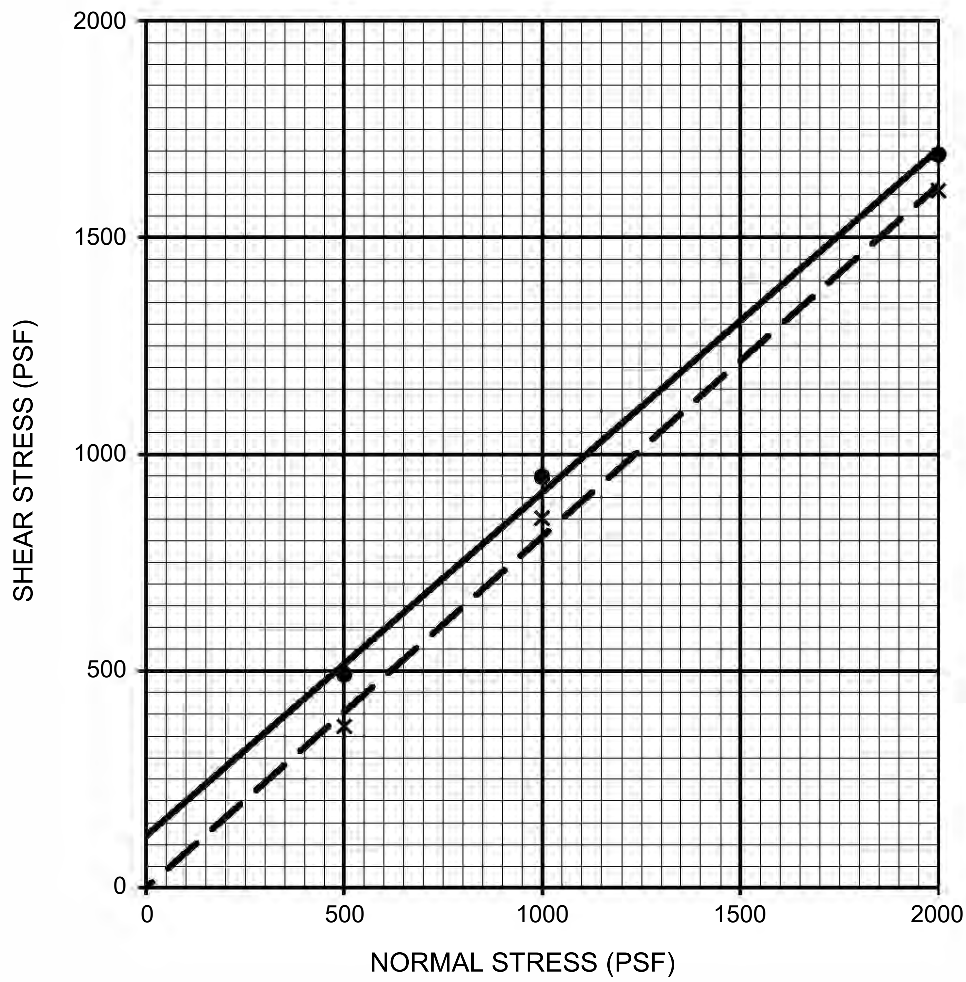
FIGURE B-5

DIRECT SHEAR TEST RESULTS

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

211948002 | 11/22

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion (psf)	Friction Angle (degrees)	Soil Type
SILTY SAND	——●——	B-10	7.5-9.0	Peak	120	38	SM
SILTY SAND	– – X – –	B-10	7.5-9.0	Ultimate	0	39	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

FIGURE B-6

DIRECT SHEAR TEST RESULTS

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

211948002 | 11/22

SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH [1]	RESISTIVITY [1] (ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-3	0.0-5.0	7.5	5,963	10	0.001	10

[1] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643
[2] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417
[3] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422

FIGURE B-7

CORROSIVITY TEST RESULTS

THEO LACY FACILITY SECURITY WALL
ORANGE, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

211948002 | 11/22

Appendix F

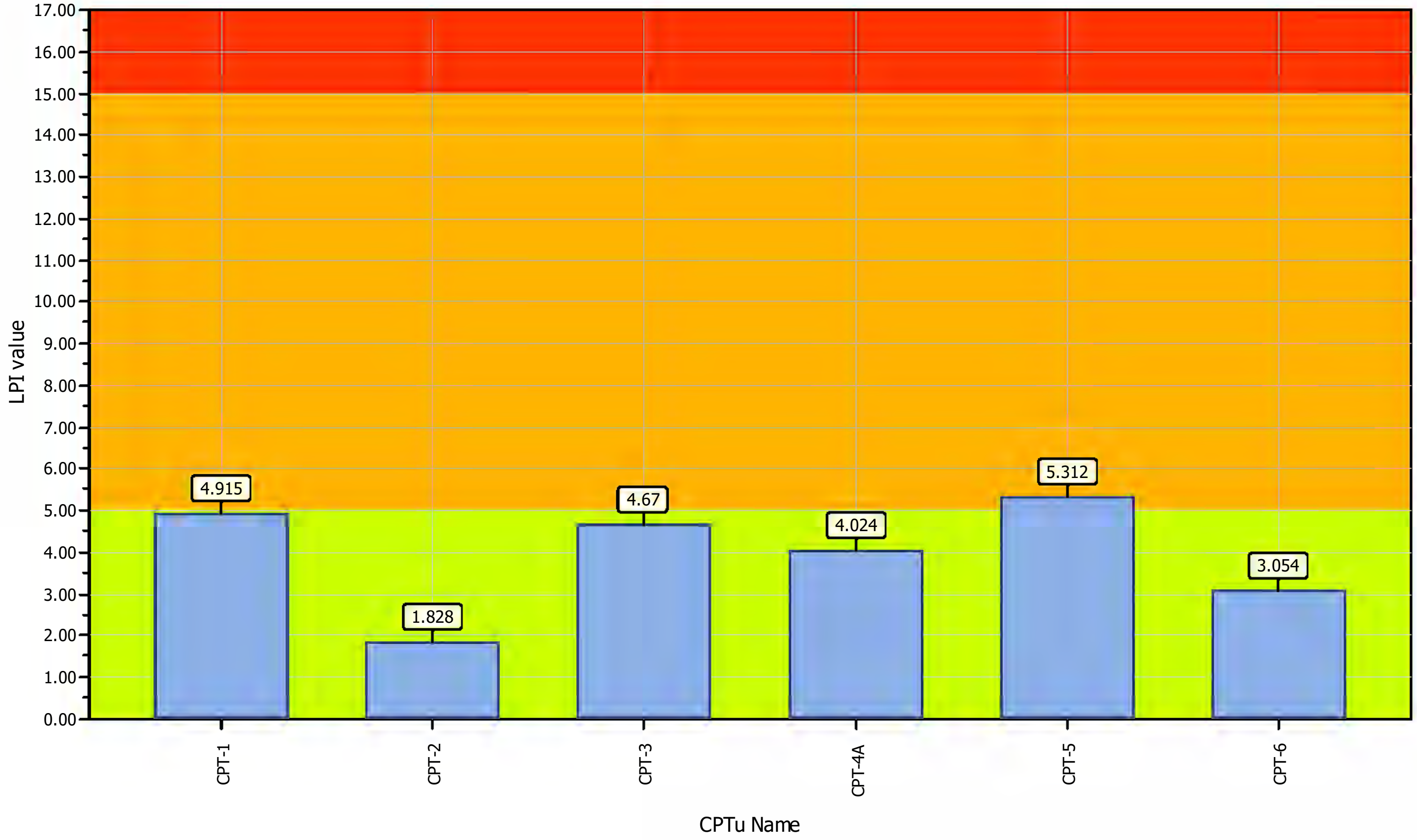
Liquefaction Analysis

Verdantas
2600 Michelson Drive, Suite 400
Irvine, CA 92612

Project title : Verdantas / Griffin OC Workforce Reentry

Location : 591 The City Drive South, Orange, CA

Overall Liquefaction Potential Index report



LPI color scheme

- Very high risk
- High risk
- Low risk

Basic statistics

Total CPT number: 6

83% low risk

17% high risk

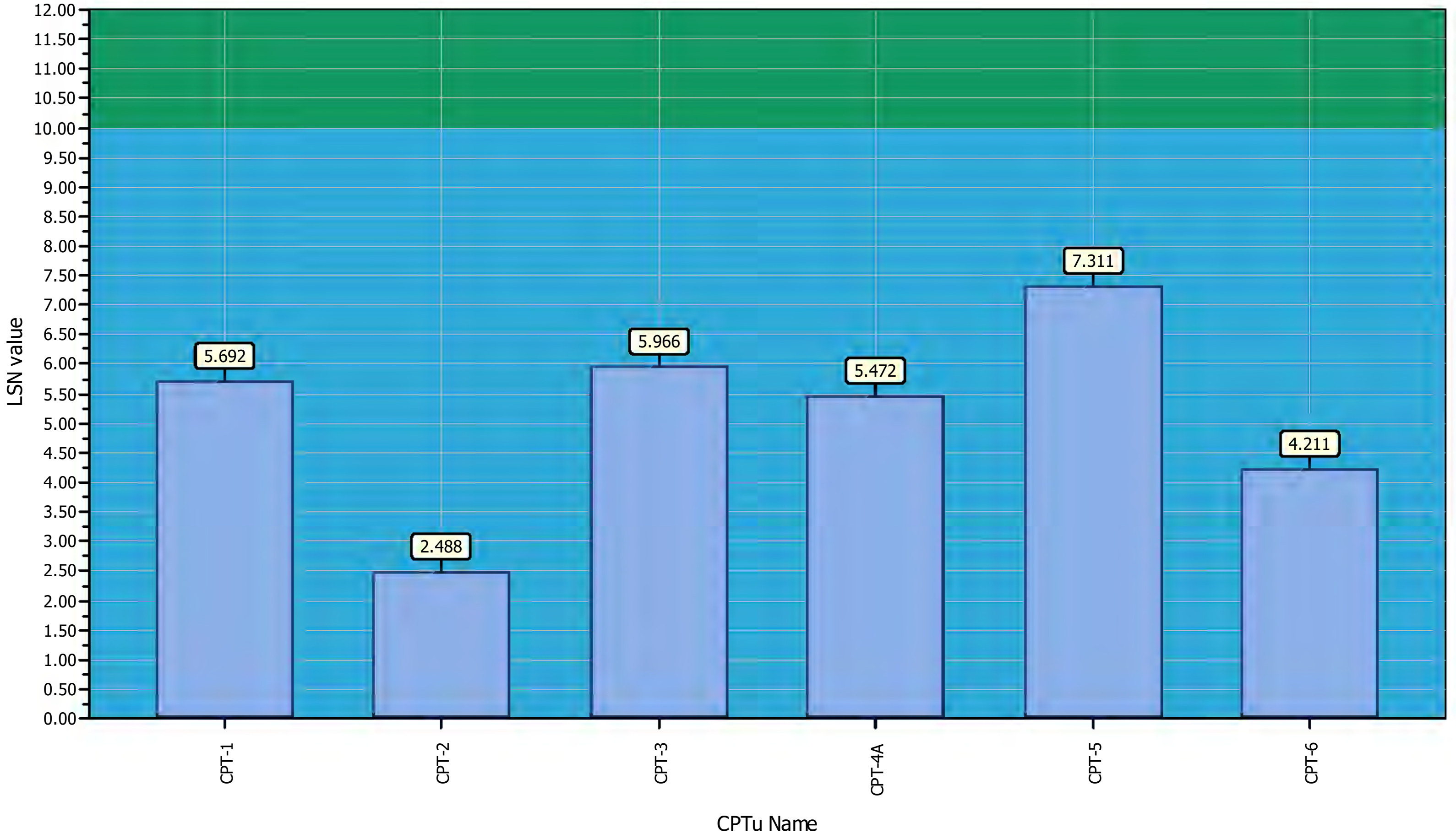
0% very high risk

Verdantas
2600 Michelson Drive, Suite 400
Irvine, CA 92612

Project title : Verdantas / Griffin OC Workforce Reentry

Location : 591 The City Drive South, Orange, CA

Overall Liquefaction Severity Number report



LSN color scheme
- Severe damage
- Major expression of liquefaction
- Moderate to severe exp. of liquefaction
- Moderate expression of liquefaction
- Minor expression of liquefaction
- Little to no expression of liquefaction

Basic statistics

Total CPT number: 6

100% little liquefaction

0% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

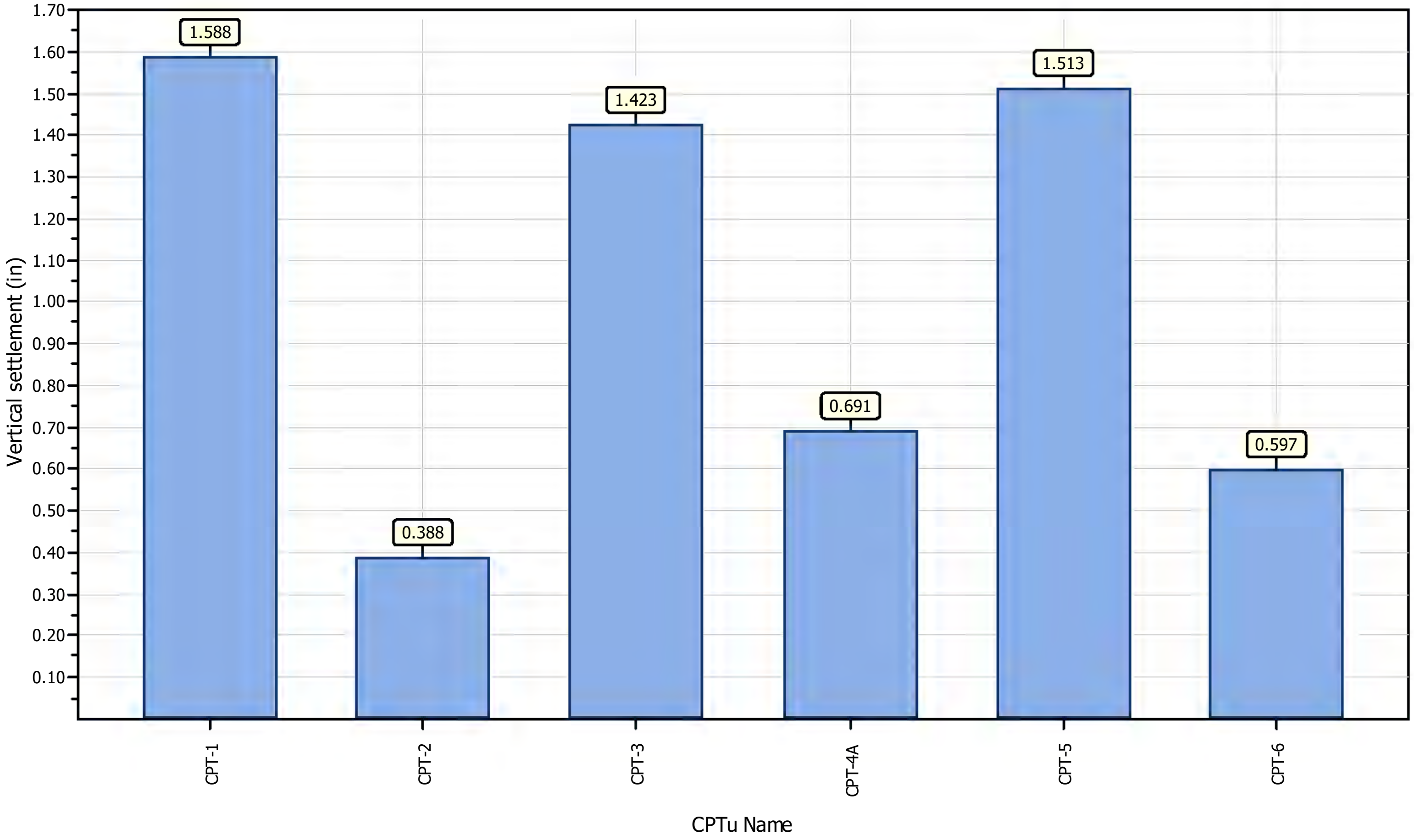
0% severe liquefaction

Verdantas
2600 Michelson Drive, Suite 400
Irvine, CA 92612

Project title : Verdantas / Griffin OC Workforce Reentry

Location : 591 The City Drive South, Orange, CA

Overall vertical settlements report

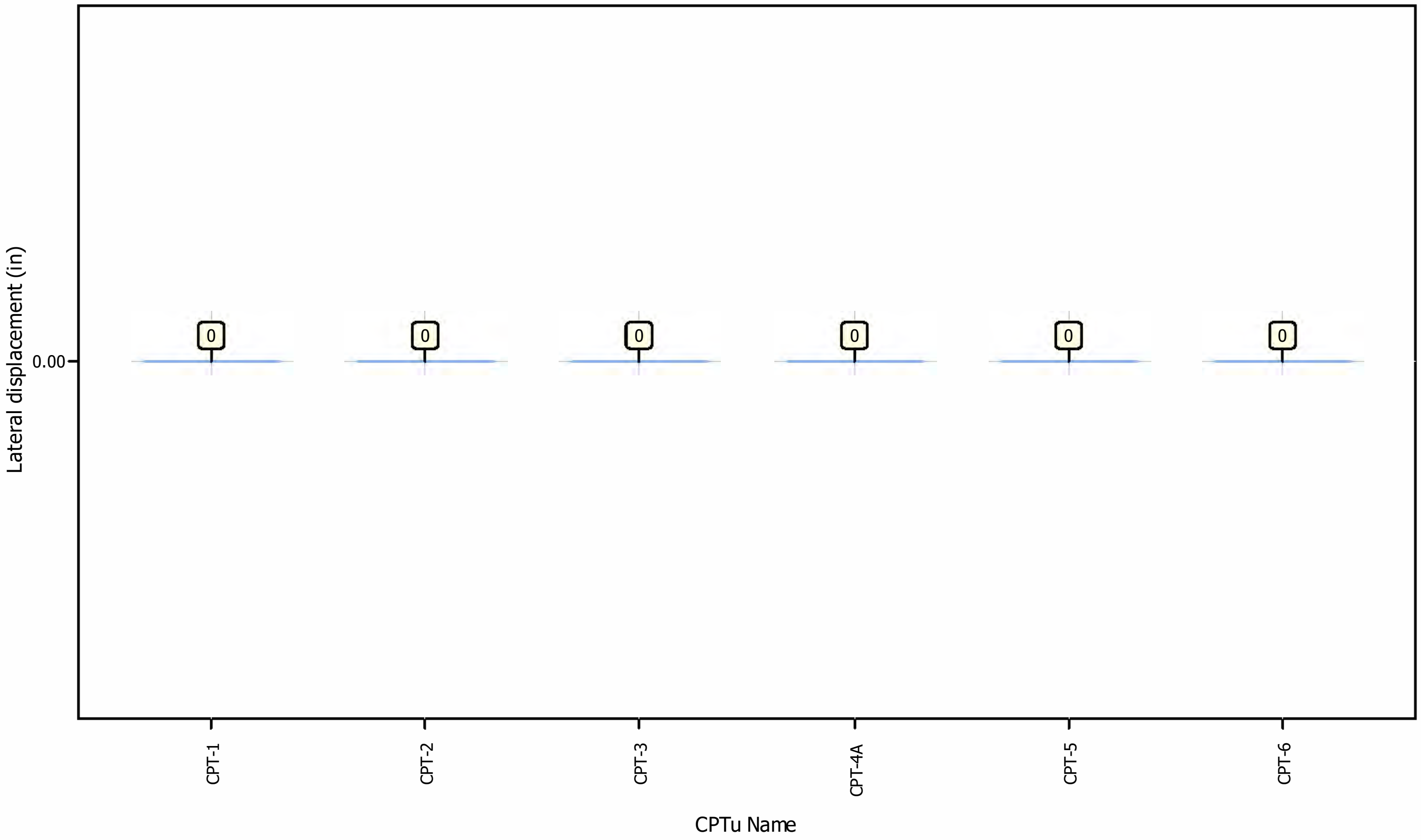


Verdantas
2600 Michelson Drive, Suite 400
Irvine, CA 92612

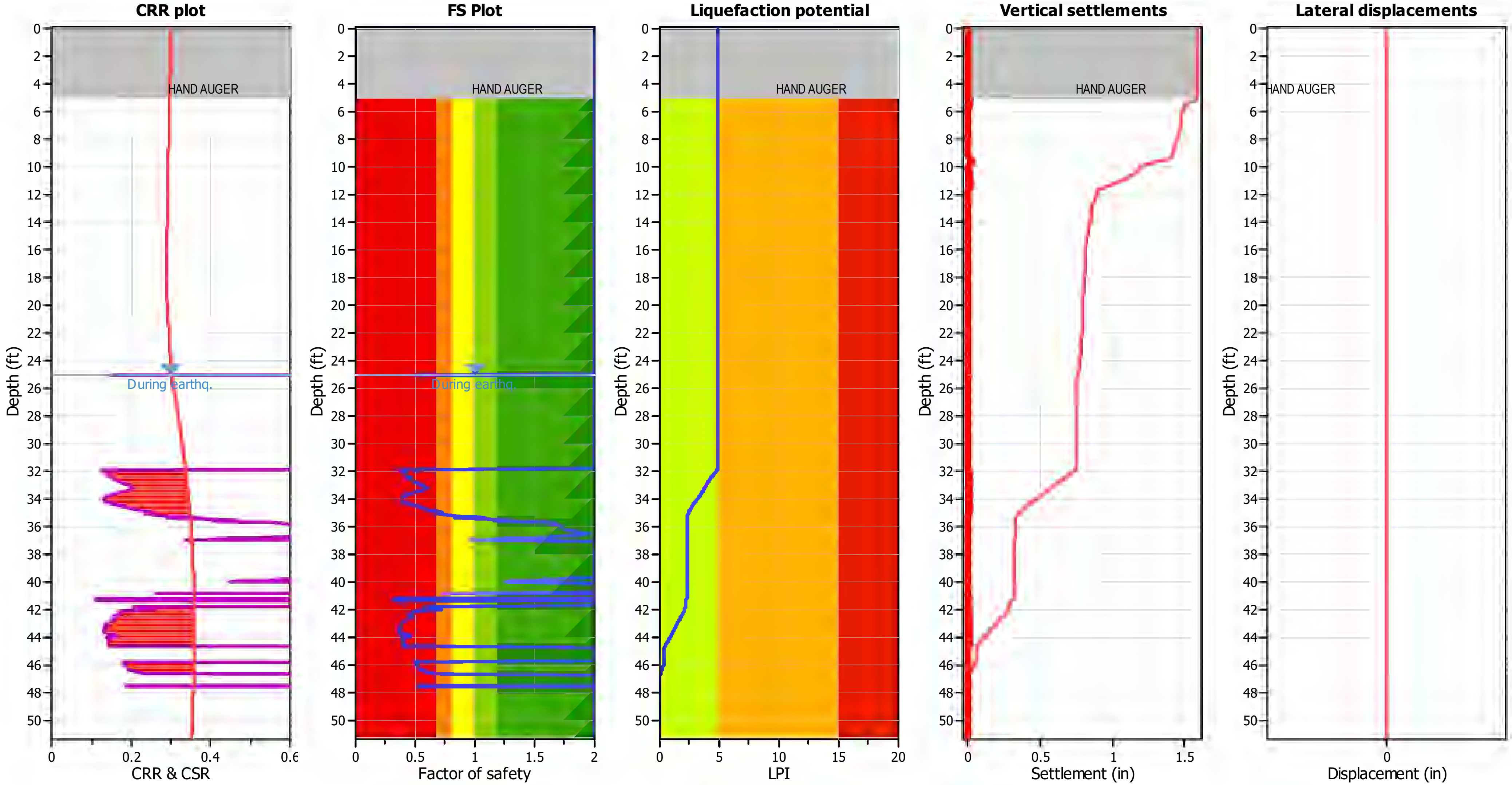
Project title : Verdantas / Griffin OC Workforce Reentry

Location : 591 The City Drive South, Orange, CA

Overall lateral displacements report



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	25.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.64	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	29.00 ft	Fill height:	N/A	Limit depth:	N/A

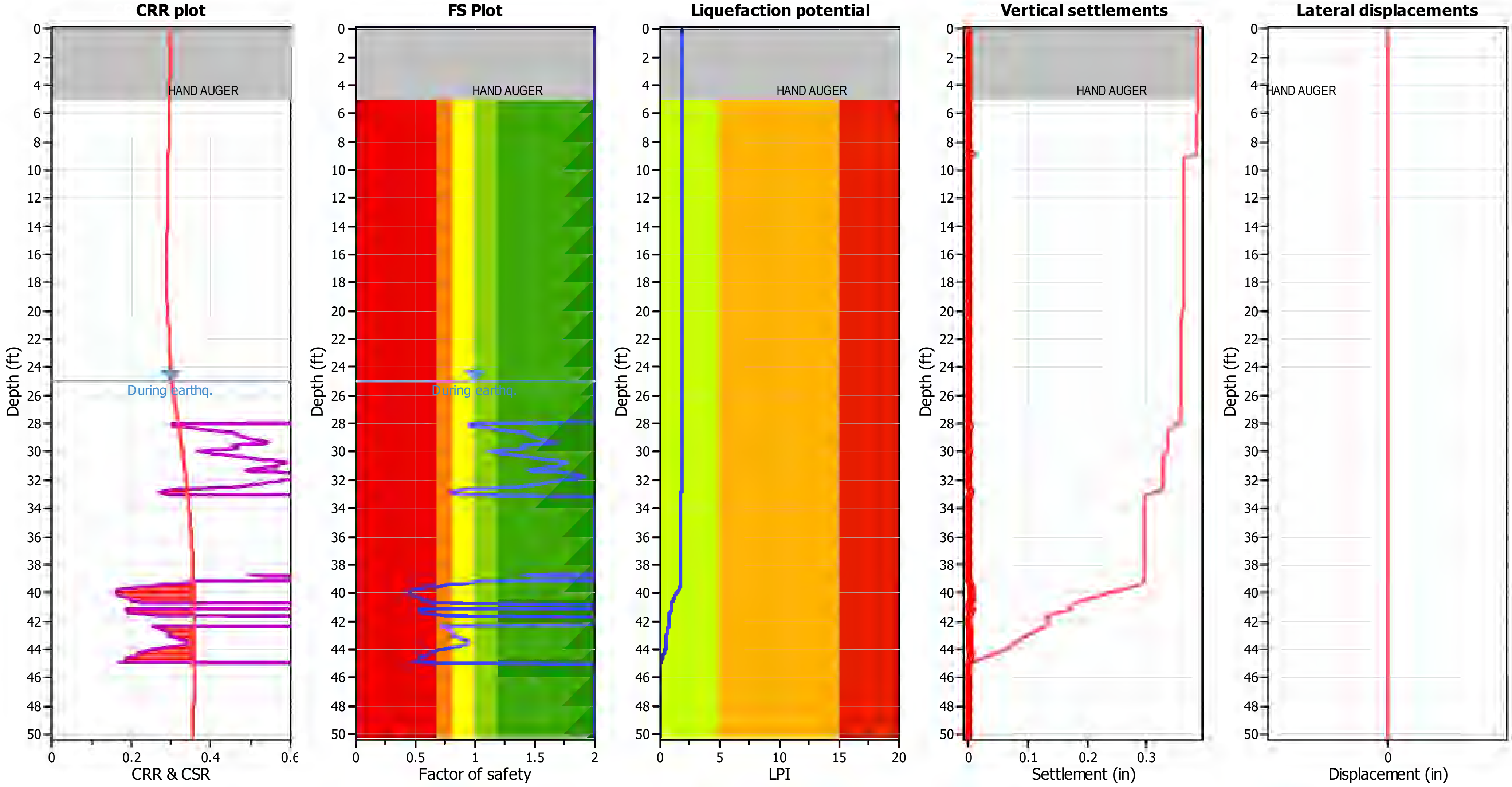
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	25.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.64	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	29.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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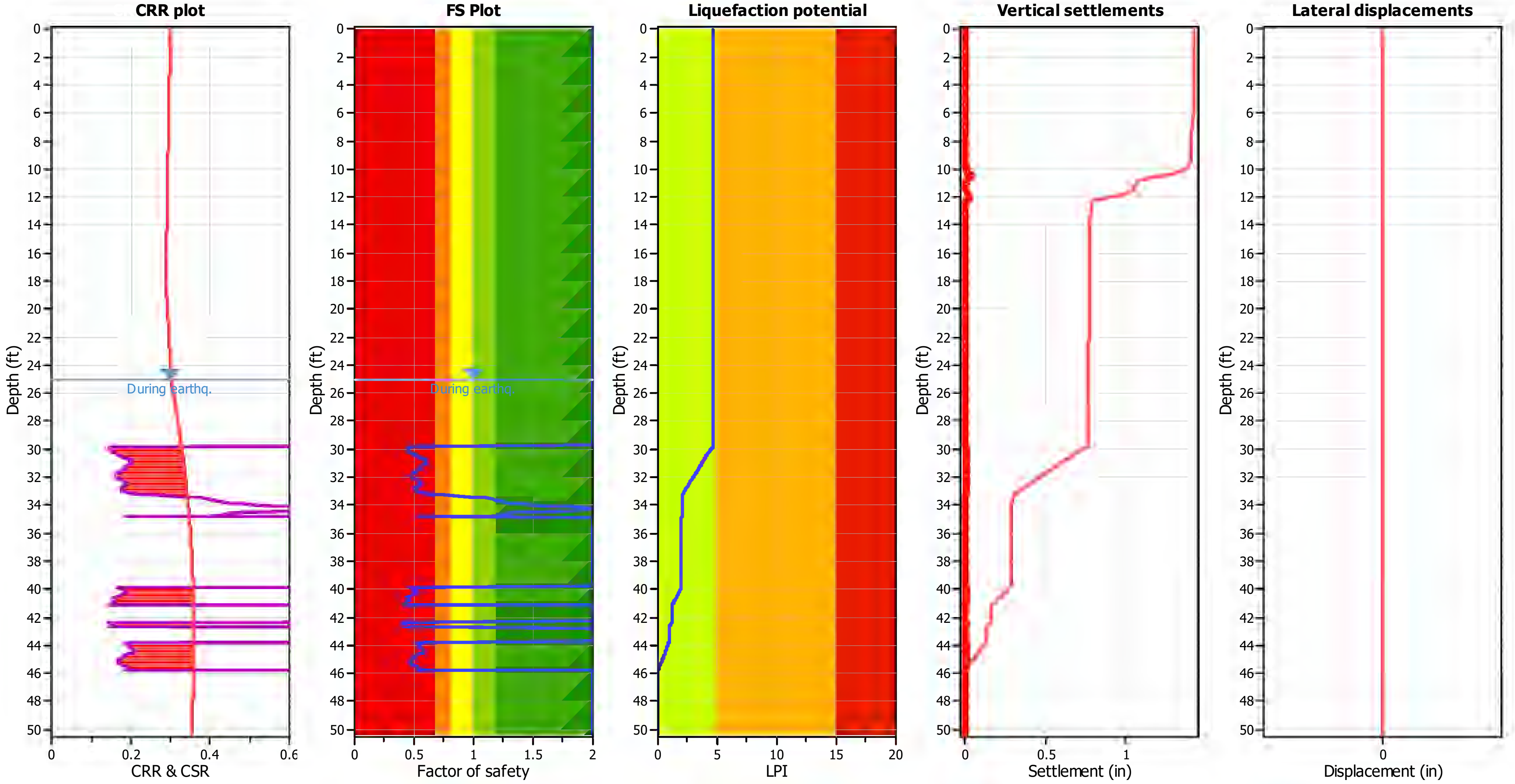
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	25.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.64	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	29.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
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- Liquefaction and no liq. are equally likely
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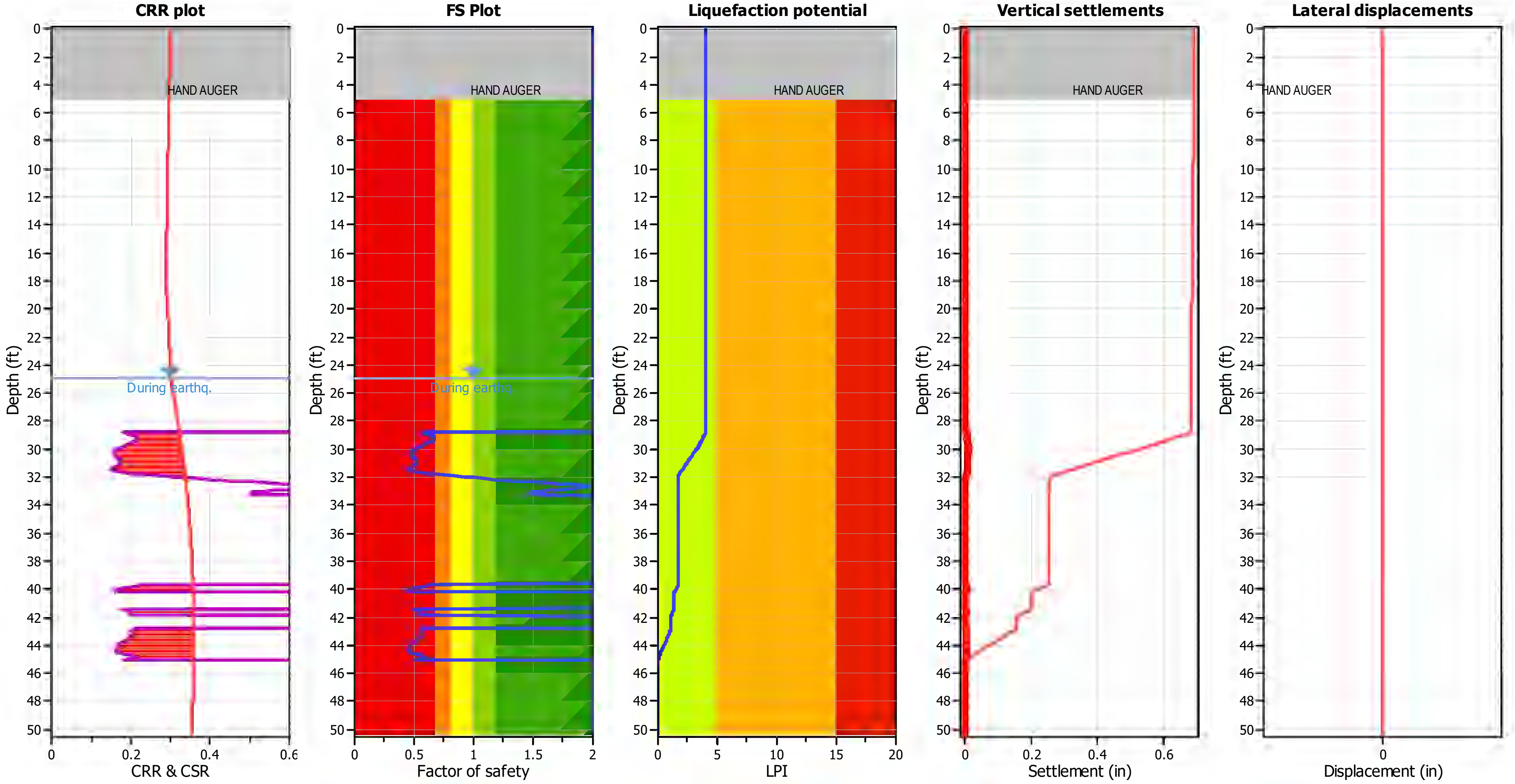
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	25.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.64	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	29.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
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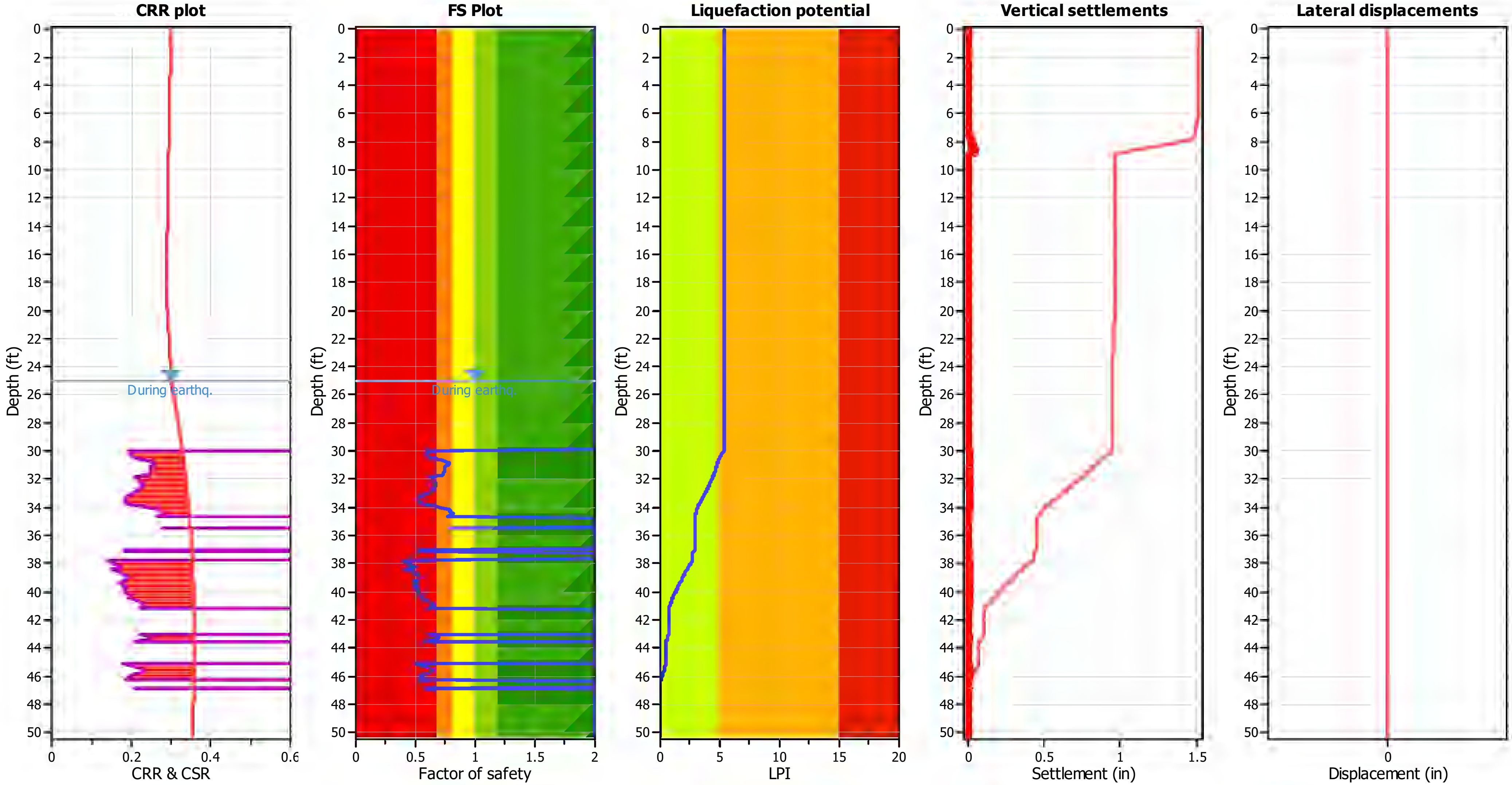
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	25.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.64	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	29.00 ft	Fill height:	N/A	Limit depth:	N/A

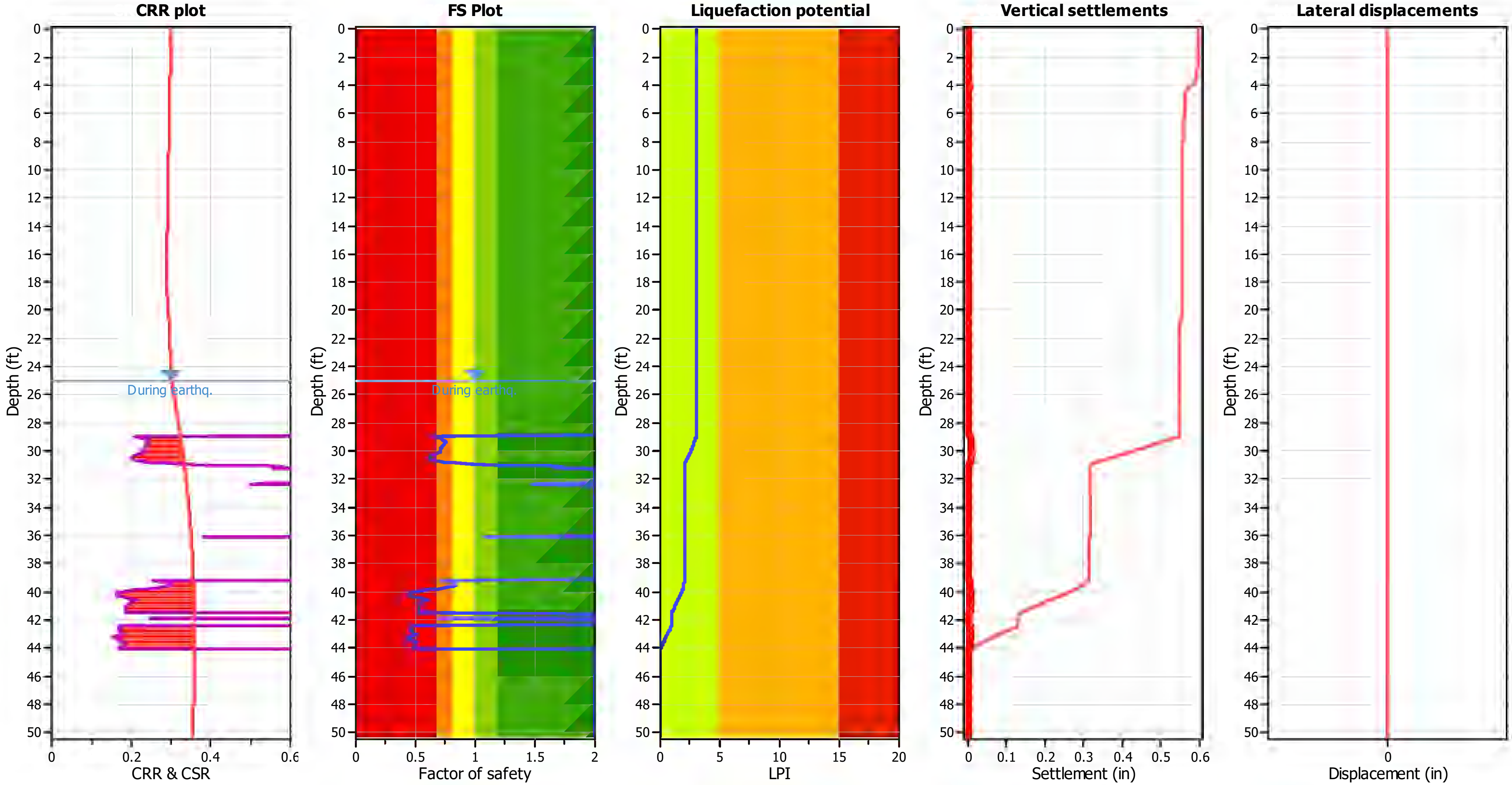
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	25.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	1	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.64	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	29.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Appendix G

Earthwork and Grading Guide Specifications

APPENDIX G

EARTHWORK AND GRADING GUIDE SPECIFICATIONS

Table of Contents

1.0 General

1.1 Intent

These Earthwork and Grading Guide Specifications are for grading and earthwork shown on the current, approved grading plan(s) and/or indicated in the Verdantas Inc. geotechnical report(s). These Guide Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the project-specific recommendations in the geotechnical report shall supersede these Guide Specifications. Verdantas Inc. shall provide geotechnical observation and testing during earthwork and grading. Based on these observations and tests, Verdantas Inc. may provide new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 Role of Verdantas Inc.

Prior to commencement of earthwork and grading, Verdantas Inc. shall meet with the earthwork contractor to review the earthwork contractor's work plan, to schedule sufficient personnel to perform the appropriate level of observation, mapping and compaction testing. During earthwork and grading, Verdantas Inc. shall observe, map, and document subsurface exposures to verify geotechnical design assumptions. If observed conditions are found to be significantly different than the interpreted assumptions during the design phase, Verdantas Inc. shall inform the owner, recommend appropriate changes in design to accommodate these observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include (1) natural ground after clearing to receiving fill but before fill is placed, (2) bottoms of all "remedial removal" areas, (3) all key bottoms, and (4) benches made on sloping ground to receive fill.

Verdantas Inc. shall observe moisture-conditioning and processing of the subgrade and fill materials, and perform relative compaction testing of fill to determine the attained relative compaction. Verdantas Inc. shall provide *Daily Field Reports* to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The earthwork contractor (Contractor) shall be qualified, experienced and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Guide Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing grading and backfilling in accordance with the current, approved plans and specifications.

The Contractor shall inform the owner and Verdantas Inc. of changes in work schedules at least one working day in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that Verdantas Inc. is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish earthwork and grading in accordance with the applicable grading codes and agency ordinances, these Guide Specifications, and recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of Verdantas Inc., unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, Verdantas Inc. shall reject the work and may recommend to the owner that earthwork and grading be stopped until unsatisfactory condition(s) are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies and Verdantas Inc.. Care should be taken not to encroach upon or otherwise damage native and/or historic trees designated by the Owner or appropriate agencies to remain. Pavements, flatwork or other construction should not extend under the “drip line” of designated trees to remain.

Verdantas Inc. shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 3 percent of organic materials (by dry weight: ASTM D 2974). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill, by Verdantas Inc., shall be scarified to a minimum depth of 6 inches (15 cm). Existing ground that is not satisfactory shall be over-excavated as specified in the following Section A-2.3. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation

In addition to removals and over-excavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by Verdantas Inc. during grading. All undocumented fill soils under proposed structure footprints should be excavated

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), (>20 percent grade) the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet (4.5 m) wide and at least 2 feet (0.6 m) deep, into competent material as evaluated by Verdantas Inc.. Other benches shall be excavated a minimum height of 4 feet (1.2 m) into competent material or as otherwise recommended by Verdantas Inc.. Fill placed on ground sloping flatter than 5:1 (horizontal to vertical units), (<20 percent grade) shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by Verdantas Inc. as suitable to receive fill. The Contractor shall obtain a written acceptance (*Daily Field Report*) from Verdantas Inc. prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys and benches.

3.0 Fill Material

3.1 Fill Quality

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by Verdantas Inc. prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to Verdantas Inc. or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 6 inches (15 cm), shall not be buried or placed in fill unless location, materials and placement methods are specifically accepted by Verdantas Inc.. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet (3 m) measured vertically from finish grade, or within 2 feet (0.61 m) of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section A-3.1, and be free of hazardous materials (“contaminants”) and rock larger than 3-inches (8 cm) in largest dimension. All import soils shall have an Expansion Index (EI) of 20 or less and a sulfate content no greater than (≤) 500 parts-per-million (ppm). A representative sample of a potential import source shall be given to Verdantas Inc. at least four full working days before importing begins, so that suitability of this import material can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill, as described in Section A-2.0, above, in near-horizontal layers not exceeding 8 inches (20 cm) in loose thickness. Verdantas Inc. may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers, and only if the building officials with the appropriate jurisdiction approve. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM) Test Method D 1557.

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, each layer shall be uniformly compacted to not-less-than (≥) 90 percent of the maximum dry density as determined by ASTM Test Method D 1557. In some cases, structural fill may be specified (see project-specific geotechnical report) to be uniformly compacted to at-least (≥) 95 percent of the ASTM D 1557 modified Proctor laboratory maximum dry density. For fills thicker than (>) 15 feet (4.5 m), the portion of fill deeper than 15 feet below proposed finish grade shall be compacted to 95 percent of the ASTM D 1557 laboratory maximum density. Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by back rolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet (1 to 1.2 m) in fill elevation, or by other methods producing satisfactory results acceptable to Verdantas Inc.. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of the ASTM D 1557 laboratory maximum density.

4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by Verdantas Inc.. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Compaction Test Locations

Verdantas Inc. shall document the approximate elevation and horizontal coordinates of each density test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that Verdantas Inc. can determine the test locations with sufficient accuracy. Adequate grade stakes shall be provided.

5.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by Verdantas Inc. during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by Verdantas Inc. based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, then observed and reviewed by Verdantas Inc. prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by Verdantas Inc..

6.0 Trench Backfills

6.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations. Work should be performed in accordance with Article 6 of the *California Construction Safety Orders*, 2009 Edition or more current (see also: http://www.dir.ca.gov/title8/sb4a6.html).

6.2 Bedding and Backfill

All utility trench bedding and backfill shall be performed in accordance with applicable provisions of the 2018 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Bedding material shall have a Sand Equivalent greater than 30 (SE>30). Bedding shall be placed to 1-foot (0.3 m) over the top of the conduit, and densified by jetting in areas of granular soils, if allowed by the permitting agency. Otherwise, the pipe-bedding zone should be backfilled with Controlled Low Strength Material (CLSM) consisting of at least one sack of Portland cement per cubic-yard of sand, and conforming to Section 201-6 of the 2018 Edition of the *Standard Specifications for Public Works Construction* (Green Book). Backfill over the bedding zone shall be placed and densified mechanically to a minimum of 90 percent of relative compaction (ASTM D 1557) from 1 foot (0.3 m) above the top of the conduit to the surface. Backfill above the pipe zone shall **not** be jetted. Jetting of the bedding around the conduits shall be observed by Verdantas Inc. and backfill above the pipe zone (bedding) shall be observed and tested by Verdantas Inc..

6.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to Verdantas Inc. that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method, and only if the building officials with the appropriate jurisdiction approve.