Appendix I2

Priority Development Project Stormwater Quality Management Plan

PDP SWQMP

PRIORITY DEVELOPMENT PROJECT (PDP)
STORM WATER QUALITY MANAGEMENT PLAN (SWQMP)

Project Name Yards at the Bay

Assessor's Parcel Number(s) 571-330-36 Through 571-330-45

Permit Application Number City of Chula Vista TMP#_____, CDP#_____

Drawing Numbers _____



CIVIL ENGINEER NAME: Chelisa Pack; **PE #** 71026

_____
Wet Signature and Stamp

PREPARED FOR:
Applicant Name: WOHL Property Group
Address: 2251 San Diego Avenue, Suite A247
(619) 296-4113
Telephone # 858.794.2500

PREPARED BY:
Company Name: Project Design Consultants
Address: 701 B Street, Suite 800
San Diego, CA 92110
Telephone # 619-235-6471

DATE: August 1st 2023

Approved By: City of Chula Vista Date:
(print Name & Sign)

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Project Name/ Yards at the Bay

TABLE OF CONTENTS

The checklist on this page summarized the table and attachments to be included with this PDP SWQMP Submittal. Tables & attachments with boxes already checked (√) are required for all Projects

- [x] **Acronym Sheet**
- [x] **Certification Page**
- [x] **Submittal Record**
- [x] **Project Vicinity Map**
- [x] **Attach a copy of the Intake Form: Storm Water Requirements Applicability Checklist**
- [x] **HMP Exemption Exhibit (if Applicable)**
- [x] **FORM I-3B Site Information Checklist for PDPs**
- [x] **FORM I-4: Source Control BMP Checklist for All Development Projects**
- [x] **FORM I-5: Site Design BMP Checklist for All Development Projects**
- [x] **FORM I-6: Summary of PDP Structural BMPs**
- [x] **ATTACHEMNT 1: Backup for PDP Pollutant Control BMPs**

  Attachment 1A: DMA Exhibit

  Attachment 1B: Tabular Summary of DMAs and Design Capture Volume Calculations

  Attachment 1C: FORM I-7 Harvest and Use Feasibility Screening (when applicable)

  Attachment 1D: Infiltration Information Attachment 1E: Pollutant Control BMP Design Worksheets / Calculations for each DMA and Structural BMP Worksheets from Appendix B, as applicable

- [x] **ATTACHMENT 2: Backup for PDP Hydromodification Control Measures**
  - Attachment 2A: Hydromodification Management Exhibit
  - Attachment 2B: Management of Critical Coarse Sediment Yield Areas
  - Attachment 2C: Geomorphic Assessment of Receiving Channels
  - Attachment 2D: Flow Control Facility Design; Overflow Design Summary for each structural BMP
- [x] **ATTACHMENT 3: Structural BMP Maintenance Plan**
- [x] **ATTACHMENT 4: Copy of Plan Sheets Showing Permanent Storm Water BMPs**
- [x] **ATTACHMENT 5: Project's Drainage Report**
- [x] **ATTACHMENT 6: Project's Geotechnical and Groundwater Investigation Report**

ACRONYMS

APN	Assessor's Parcel Number
BMP	Best Management Practice
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NRCS	Natural Resources Conservation Service
PDP	Priority Development Project
PE	Professional Engineer
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWQMP	Storm Water Quality Management Plan

Project Name/ Yards at the Bay

Certification Page

Project Name: Yards at the Bay

Permit Application Number: _____

I hereby declare that I am the Engineer in Responsible Charge of design of storm water best management practices (BMPs) for this project, and that I have exercised responsible charge over the design of the BMPs as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the PDP requirements of the City of Chula Vista BMP Design Manual, which is based on the requirements of the San Diego Regional Water Quality Control Board Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (MS4 Permit).

I have read and understand that the City Engineer has adopted minimum requirements for managing urban runoff, including storm water, from land development activities, as described in the BMP Design Manual. I certify that this PDP SWQMP has been completed to the best of my ability and accurately reflects the project being proposed and the applicable BMPs proposed to minimize the potentially negative impacts of this project's land development activities on water quality. I understand and acknowledge that the plan check review of this PDP SWQMP by the City Engineer is confined to a review and does not relieve me, as the Engineer in Responsible Charge of design of storm water BMPs for this project, of my responsibilities for project design.

_____, _____

Engineer of Work's Signature, Date

71026, 6/30/25

PE #, Expiration Date

Chelisa Pack

Print Name

Project Design Consultants

Company



Engineer's Seal

Project Name/ Yards at the Bay

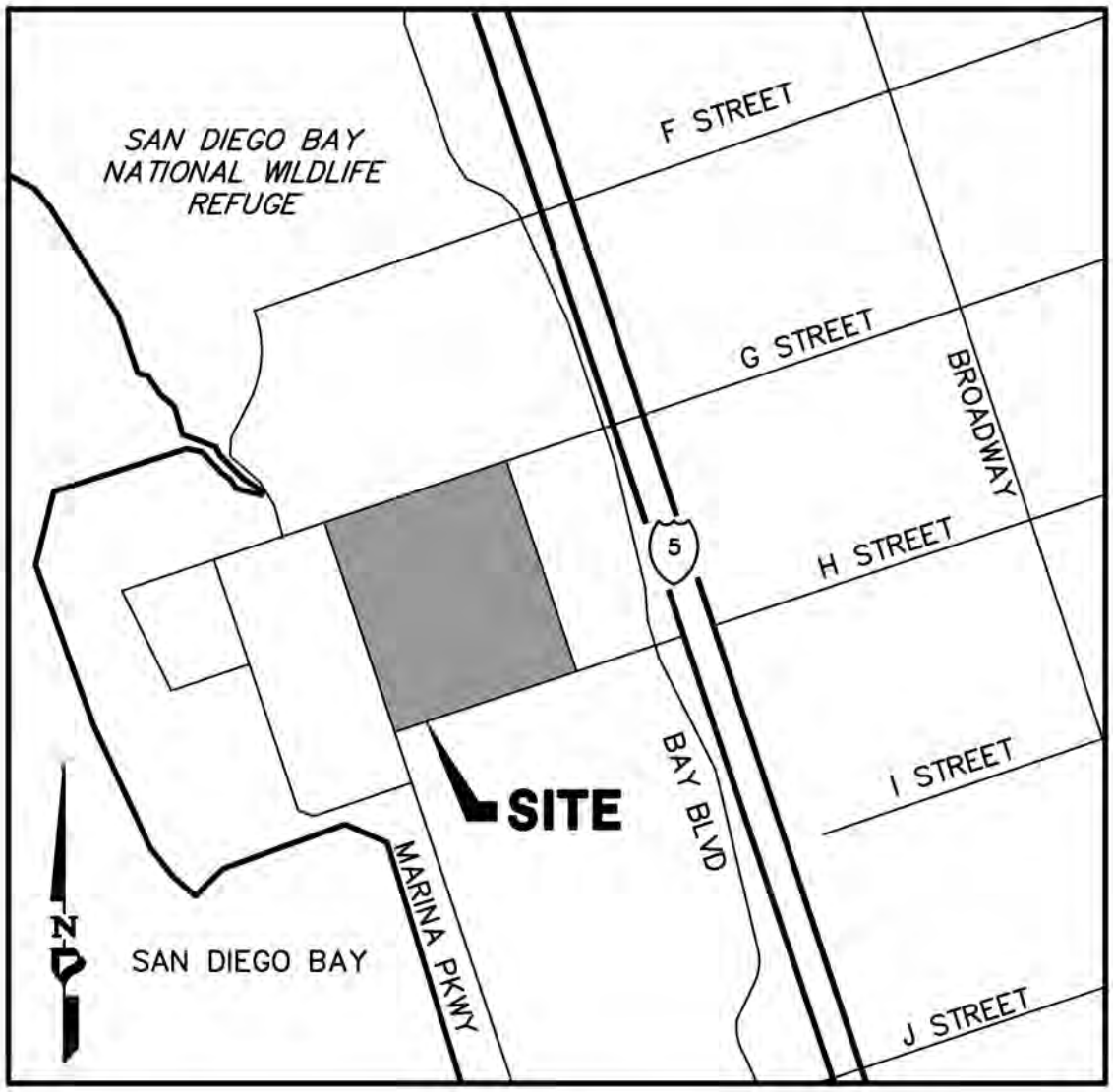
SUBMITTAL RECORD

Use this Table to keep a record of submittals of this PDP SWQMP. Each time the PDP SWQMP is re-submitted, provide the date and status of the project. In column 4 summarize the changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments behind this page.

Submittal Number	Date	Project Status	Summary of Changes
1	08/01/2023	☒ Preliminary Design / Planning/ CEQA ☐ Final Design	Initial Submittal
2		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	
3		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	
4		☐ Preliminary Design / Planning/ CEQA ☐ Final Design	

Project Name/ Yards at the Bay

Project Vicinity Map



VICINITY MAP
NOT TO SCALE

CITY OF CHULA VISTA

Storm Water Requirements Applicability Checklist for All Permit Applications

Intake Form

June 2022 Update

Project Information

Project Address: NEC H St and Marina Parkway	Project Application #
Project Name: Yards at the Bay	APN(s) 571-330-36 through 45

Brief Description of Work Proposed: Construction of four industrial warehouse buildings and drive aisles and parking lots on a previously demolished site.

The project is (select one):

☐ New Development Total Impervious Area _____ ft²
(New development is the creation of impervious surface on an undeveloped site.)

☒ Redevelopment Total new and/or replaced Impervious Area 958269 ft²
(Redevelopment is the creation and/or replacement of impervious surface on an already developed site).

☐ *Other:* _____
(Includes projects such as: Roof Mount Solar, Residential Minor Utility, Residential Interior Remodel, Commercial Interior Tenant Improvement, Cell Site Modification, etc.)

Name of Person Completing this Form: Chelisa Pack (Agent on behalf of developer)

Role: ☐ Property Owner ☐ Contractor ☐ Architect ☒ Engineer ☐ Other _____

Email: cpack@bowman.com Phone: 619-881-2575

Signature: Chelisa A. Pack Date Completed: 08/01/2023

Answer each section below, starting with Section 1 and progressing through each section. Additional information for determining the requirements is found in the Chula Vista BMP Design Manual available on the City's website at http://www.chulavistaca.gov/departments/public-works/services/storm-water-pollution-prevention/documents-and-reports.

SECTION 1: Storm Water BMP Requirements

Please answer the following two questions:

1)	Does the project involve repair or improvements to an existing building or structure that do not alter the size such as: tenant improvements, interior remodeling, electrical work, fire alarm, fire sprinkler system, HVAC work, gas, plumbing, etc.?	☐ **Yes** ☒ **No**
2)	Does the project involve routine maintenance activities such as: roof or exterior structure surface replacement; resurfacing existing roadways and parking lots including dig outs, slurry seal, overlay and restriping; repair damaged sidewalks or pedestrian ramps on existing roads without expanding the impervious footprint; routine replacement of damaged pavement, trenching and resurfacing associated with utility work (i.e. sewer, water, gas or electrical laterals, etc.), and pot holing or geotechnical investigation borings?	☐ **Yes** ☒ **No**

CHECK ONE:

☐ If you answered **YES** to **either** question 1 or 2, review and sign **"Construction Storm Water BMP Certification Statement"** on Page 2. **DO NOT** complete Sections 2, 3, or 4. The Project is **NOT** subject to Permanent Storm Water BMP requirements. It **IS** subject to Construction BMP requirements.

☒ If you answered **NO** to **both** questions 1 and 2, **Skip to Section 2, Page 3.**

Construction Storm Water BMP Certification Statement

The following storm water quality protection measures are required by City Chula Vista Municipal Code Chapter 14.20 and the City's Jurisdictional Runoff Management Program.

1) All applicable construction BMPs and non-stormwater discharge BMPs shall be installed and maintained for the duration of the project in accordance with the Appendix K "Construction BMP Standards" of the Chula Vista BMP Design Manual.
2) Erosion control BMPs shall be implemented for all portions of the project area in which no work has been done or is planned to be done over a period of 14 or more days. All onsite drainage pathways that convey concentrated flows shall be stabilized to prevent erosion.
3) Run-on from areas outside the project area shall be diverted around work areas to the extent feasible. Run-on that cannot be diverted shall be managed using appropriate erosion and sediment control BMPs.
4) Sediment control BMPs shall be implemented, including providing fiber rolls, gravel bags, or other equally effective BMPs around the perimeter of the project to prevent transport of soil and sediment offsite. Any sediment tracked onto offsite paved areas shall be removed via sweeping at least daily.
5) Trash and other construction wastes shall be placed in a designated area at least daily and shall be disposed of in accordance with applicable requirements.
6) Materials shall be stored to avoid being transported in storm water runoff and non-storm water discharges. Concrete washout shall be directed to a washout area and shall not be washed out to the ground.
7) Stockpiles and other sources of pollutants shall be covered when the chance of rain within the next 48 hours is at least 50%.

I certify that the storm water quality protection measures listed above will be implemented at the project described on Intake Form. I understand that failure to implement these measures may result in monetary penalties or other enforcement actions. This certification is signed under penalty of perjury and does not require notarization.

Name: _____ Title: _____

Signature: _____ Date: _____

SECTION 2: Determine if Project is a Standard Project or Priority Development Project

Is the project in any of the following categories, (a) through (f)?

(a)	New development that **creates 10,000 square feet** or more of impervious surfaces (collectively over the entire project site). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.	☐ **Yes** ☒ **No**
(b)	Redevelopment project that **creates and/or replaces 5,000 square feet** or more of impervious surface (collectively over the entire project site on an existing site of 10,000 square feet or more of impervious surfaces). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.	☒ **Yes** ☐ **No**
(c)	New development or redevelopment projects that **creates and/or replaces a combined total of 5,000 square feet** or more of impervious surface (collectively over the entire project site) and support one or more of the following uses: (i) **Restaurant.** This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification Code 5812). (ii) **Hillside development projects**. This category includes development on any natural slope that is twenty-five percent or greater. (iii) **Parking Lots.** This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce. (iv) **Streets, roads, highways, freeways, and driveways**. This category is defined as any paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.	☒ **Yes** ☐ **No**
(d)	New development or redevelopment project that **creates and/or replaces 2,500 square feet** or more of impervious surface (collectively over the entire project site), discharging directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands).	☐ **Yes** ☒ **No**
(e)	New development or redevelopment project that creates and/or replaces a combined total of 5,000 square feet or more of impervious surface, that support one or more of the following used: (i) **Automotive repair shops.** This category is defined as a facility that is categorized in any one of the following Standard Industrial Classification (SIC) codes: 5013, 5014, 5541, 7532-7534, or 7536-7539. (ii) **Retail gasoline outlets.** This category includes retail gasoline outlets that meet the meet one of the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.	☐ **Yes** ☒ **No**
(f)	New development or redevelopment that result in the disturbance of **one or more acres** of land and are expected to generate pollutants post construction. **NOTE:** Pollutant generating development projects are those projects that generate pollutants at levels greater than background levels. Background pollutant levels means the pollutants generated from an undeveloped sites. Projects disturbing one or more acres of land are presumed to generate pollutants post construction unless the applicant presents a design that satisfies the City Engineer that pollutants in storm water discharges will not exceed preconstruction background levels.	☒ **Yes** ☐ **No**

The project is (select one):

☐ If "No" is checked for every category in Section 2, Project is a **"Standard Development Project."** Site design and source control BMP requirements apply. **Complete and submit Standard SWQMP** (refer to Chapter 4 and Appendix E of the BMP Design Manual for guidance).

Skip to Section 4.

☒ If "Yes" is checked for ANY category in Section 2, **Project is a "Priority Development Project (PDP)."** ***Complete next part, if applicable, and continue to Section 3.***

Complete for PDP Redevelopment Projects ONLY:

The total existing (pre-project) impervious area at the project site is: 1417478 ft² (A)

The total proposed newly created or replaced impervious area is 958269 ft² (B)

Percent impervious surface created or replaced (B/A) x 100 = 68 %

The percent impervious surface created or replaced is (select one based on the above calculation):

☐ Less than or equal to fifty percent (50%) – **only new impervious areas are considered a PDP**
OR

☒ Greater than fifty percent (50%) – **the entire project site is considered a PDP**

Continue to Section 3

SECTION 3: Determine if Project is PDP Exempt

1) Does the project ONLY include new or retrofit sidewalk, bicycle lane or trails that:

- Are designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;
- Are designed and constructed to be hydraulically disconnected from paved streets or roads? Or;
- Are designed and constructed with permeable pavements or surfaces in accordance with USEPA Green Streets guidance?

☐ **Yes. Project is PDP Exempt.**

Complete and submit **Standard SWQMP** (refer to Chapter 4 of the BMP Design Manual for guidance). **Continue to Section 4.**

☒ **No. Next question**

2) Does the project ONLY include retrofitting or redevelopment of existing paved alleys, streets or roads designed and constructed in accordance with Green Streets standards?

☐ **Yes. Project is PDP Exempt.**

Complete and submit Standard SWQMP (refer to Chapter 4 of the BMP Design Manual for guidance). **Continue to Section 4.**

☒ **No. Project is a PDP.**

Site design, source control, and structural pollutant control BMPs apply. Complete and submit PDP SWQMP (refer to Chapters 4, 5 & 6 of the BMP Design Manual for guidance). **Continue to Section 4.**

SECTION 4: Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the BMP Design Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP), which is administered by the State Water Resource Control Board.

1) Does the project include Building/Grading/Construction permits proposing less than 5,000 square feet of ground disturbance and has less than 5-foot elevation change over the entire project area?

☐ Yes. Review and sign Construction Storm Water Certification Statement on Page 2, *skip questions 2-4*

☒ No; next question

2) Does the project propose construction or demolition activity, including but not limited to, clearing grading, grubbing, excavation, or other activity that results in ground disturbance of less than one acre and more than 5,000 square feet?

☐ Yes. Complete & submit Construction Storm Water Pollution Control Plan (CSWPCP), *skip questions 3-4*

☒ No; next question

3) Does the project result in the disturbance of an acre or more of total land area and is considered a regular maintenance project performed to maintain original line and grade, hydraulic capacity, or original purpose of the facility? (Projects such as sewer/storm drain/utility replacement)

☐ Yes. Complete and submit Construction Storm Water Pollution Control Plan (CSWPCP), *skip question 4*

☒ No; next question

4) Is the project proposing land disturbance greater than or equal to one acre OR the project is part of a larger common plan of development disturbing 1 acre or more?

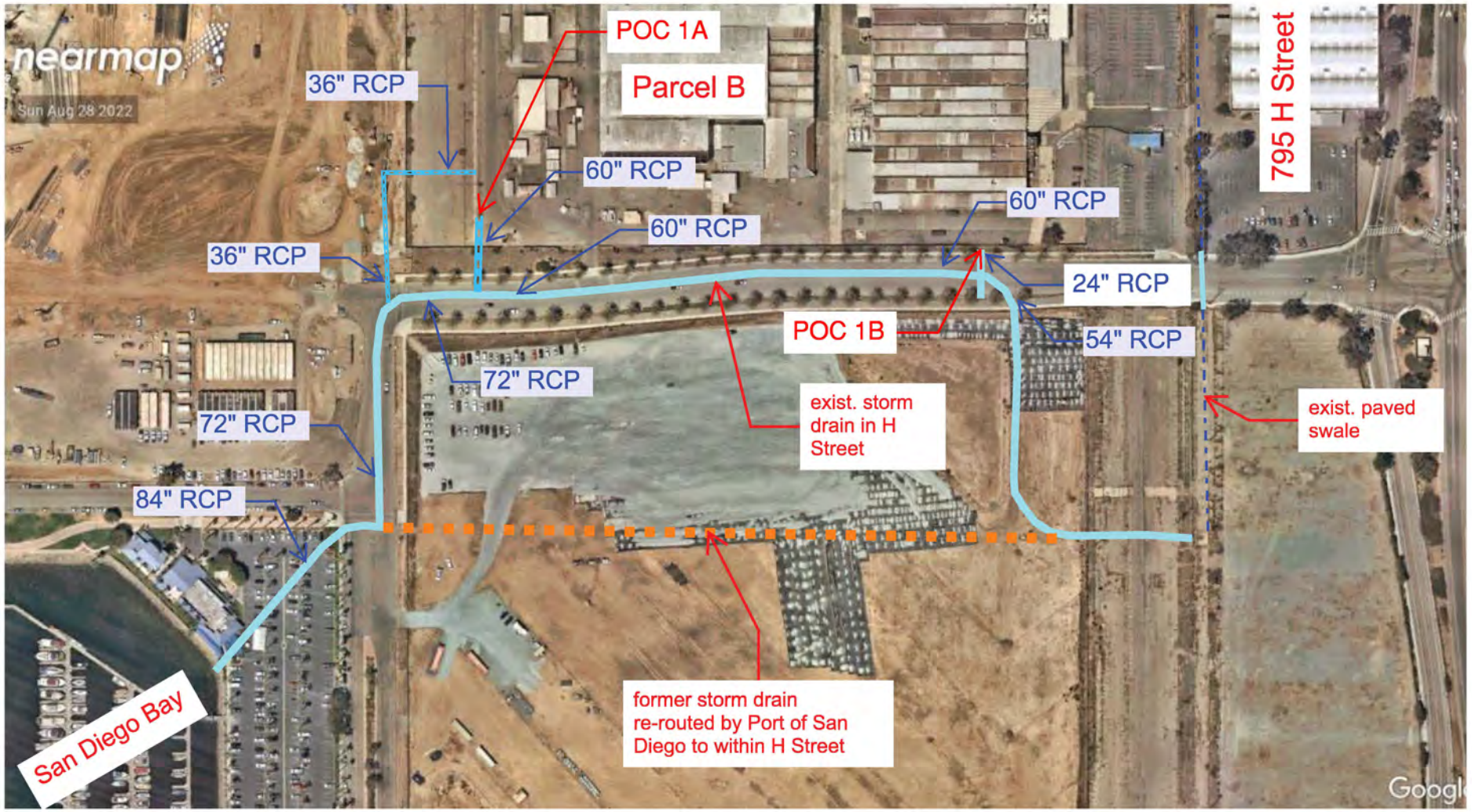
☒ Yes. Storm Water Pollution Prevention Plan (SWPPP) is required. Refer to online CASQA or Caltrans Template. Visit the SWRCB web site at: http://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.shtml.

Note: Projects that result in disturbance of one to five acres of total land area and can demonstrate that there will be no adverse water quality impacts by applying for a Construction Rainfall Erosivity Waiver, may be allowed to submit a CSWPCP in lieu of a SWPPP.

HYDRMODIFICATION EXEMPTION EXHIBIT FIGURE 1 NORTH DRAINAGE SYSTEM POC 1



HYDRMODIFICATION EXEMPTION EXHIBIT FIGURE 2 SOUTH DRAINAGE SYSTEM POC 1



Yards at the Bay

Project Name: _____

Site Information Checklist	Form I-3B
Project Summary Information	
Project Name	Yards at the Bay
Project Address	NEC H St and Marina Parkway
Assessor's Parcel Number(s) (APN(s))	571-330-36 Through 571-330-45
Permit Application Number	
Project Watershed	☒ San Diego Bay
Hydrologic Subarea name with Numeric Identifier up to two decimal places	Select One: ☐ Pueblo San Diego 908 ☒ Sweetwater 909 ☐ Otay 910
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	35.92 Acres (1,564,661 Square Feet)
Area to be Disturbed by the Project (Project Footprint)	32.54 Acres (1,417,478 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	22.00 Acres (958,269 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	10.54 Acres (459,209 Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Parcel Area.	
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition	-32 %

Project Name: Yards at the Bay

Form I-3B Page 3 of 10

Description of Existing Site Condition and Drainage Patterns

Current Status of the Site (select all that apply):

- [x] Existing development
- [ ] Previously graded but not built out
- [x] Demolition completed without new construction
- [ ] Agricultural or other non-impervious use
- [ ] Vacant, undeveloped/natural

Description / Additional Information:

Presently there are two industrial buildings on site which take up a large portion of the site. They are in the process of being demolished. The remainder of the site consists of an AC parking lot, half of G-Street, and the G Street Sewer Lift Station.

Existing Land Cover Includes (select all that apply):

- [ ] Vegetative Cover
- [ ] Non-Vegetated Pervious Areas
- [x] Impervious Areas

Description / Additional Information:

Mostly AC Parking Lots, and industrial building roofs.

Underlying Soil belongs to Hydrologic Soil Group (select all that apply):

- [ ] NRCS Type A
- [ ] NRCS Type B
- [ ] NRCS Type C
- [x] NRCS Type D

Per NRCS Site Soil Survey majority of the site consists of HuC (Huerhuero-Urban Land) which is Group D. A small westerly portion is Md (Made Land) which is unknown Hydrologic Soil Group.

Approximate Depth to Groundwater (GW):

- [ ] GW Depth < 5 feet
- [ ] 5 feet < GW Depth < 10 feet
- [ ] 10 feet < GW Depth < 20 feet
- [ ] GW Depth > 20 feet

Per Geocon report section 5, ground water depth ranges from 3' to 11' below existing grade. Fluctuating due to tidal influences.

Existing Natural Hydrologic Features (select all that apply):

- [ ] Watercourses
- [ ] Seeps
- [ ] Springs
- [ ] Wetlands
- [x] None

Description / Additional Information:

N/A

Yards at the Bay

Project Name: _____

Form I-3B Page 3 of 10

Description of Existing Site Drainage Patterns

How is storm water runoff conveyed from the site? At a minimum, this description should answer:

1. whether existing drainage conveyance is natural or urban;
2. Is runoff from offsite conveyed through the site? if yes, quantify all offsite drainage areas, design flows, and locations where offsite flows enter the project site, and summarize how such flows are conveyed through the site;
3. Provide details regarding existing project site drainage conveyance network, including any existing storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural or constructed channels; and
4. Identify all discharge locations from the existing project site along with a summary of conveyance system size and capacity for each of the discharge locations. Provide summary of the pre-project drainage areas and design flows to each of the existing runoff discharge locations.

Describe existing site drainage patterns:

1. The existing drainage conveyance is entirely Urban.

2. There is a very small portion of offsite run-on 0.3 acres in then north easterly corner of the site, which sheet flows onto the site and then enters storm drain to the north side of G Street.

3. The site has various grate inlets and storm drain pipes throughout the site. The existing storm drain infrastructure collects drainage from the AC parking Lots, concrete drive aisles, and building rooftops. The north half of the site is conveyed to a 36" storm drain stub to the north side of G Street. The south half of the site is conveyed to the south westerly corner of the site and thence to the existing 60" storm drain stub and then to 72" RCP in H Street.

4. The site is roughly split north and south, the North side of the site is conveyed to the 36" stub, and then westerly transitioning to 54" RCP, ultimately discharging into an existing slough north west of the site. The slough is directly connected to the San Diego Bay. The South side of the site is conveyed to the H Street 60" Storm Drain and then south westerly to the 84" RCP and then outlets directly to the San Diego Bay.

Please see Attachment 2 Hydromodification Exemption letter with exhibits and further explanation of the existing storm drain system.

Project Name: Yards at the Bay

Form I-3B Page 4 of 10

Description of Proposed Site Development and Drainage Patterns

Project Description / Proposed Land Use and/or Activities:

The intent of the project is to provide commercial/light industrial uses on the project site. There are two undeveloped graded pads with temporary sediment traps proposed for this project, to be developed by others in the future. These pads are not treated for water quality on this project. The developed portion of this project includes four buildings, parking, and drive aisles. These buildings will provide the light industrial uses. One Biofiltration Basin is proposed at the northeasterly corner of the site, and multiple Modular Wetlands for stormwater treatment for the majority of the site.

List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features):

This project proposes building roofs, driveways, sidewalks along the buildings, loading docks, and drive aisles for impervious features.

List/describe proposed pervious features of the project (e.g., landscape areas):

The pervious features of the project consist landscaping areas in medians between the buildings and parking, a large planting area on the west side of the project, and a biofiltration basin. Some of the landscape areas where impervious area drain to them, will be used as Site Design BMP's Dispersion Areas to meet volume retention requirements. Please see DMA map in attachment 1A for more information.

Does the project include grading and changes to site topography?

- ☒ Yes
- ☐ No

Description / Additional Information:

The site will be cleared of debris, and graded to create building pads. The proposed site grading generally follows the existing, as roughly half of the proposed site drains north and the other half south. Fill will be imported in to the site to elevate the proposed buildings above existing grades. Please see DMA Map in attachment 1A for more information.

Project Name: Yards at the Bay

Form I-3B Page 5 of 10

Does the project include changes to site drainage (e.g., installation of new storm water conveyance systems)?

- [x] Yes
- [ ] No

If yes, provide details regarding the proposed project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural or constructed channels, and the method for conveying offsite flows through or around the proposed project site. Identify all discharge locations from the proposed project site along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide a summary of pre- and post-project drainage areas and design flows to each of the runoff discharge locations. Reference the drainage study for detailed calculations.

Describe proposed site drainage patterns:

The proposed site drainage conveyance network includes trench drains, grate inlets, B-Inlets, ribbon gutters, earthen swales in the westerly dispersion area, and storm drain. The majority of the site drainage is collected and then directed to Modular Wetland units for water treatment. After collection in the storm drain system, the modular wetland units treat flows via pipe inflows, and also curb openings (if applicable. There is one Biofiltration Basin located at the Northeasterly Corner of the site, this is the only bBofiltration basin proposed on the project. The loading docks are depressed areas below the building finish floor and have trench drains to pick up drainage in those areas. Trench drains are also used on the east side of the site within the SDG&E Easement to pickup the AC. The project area east of the daylight line within the SDG&E Easement drains is not proposed to be disturbed by the project, only re-striping is proposed and therefore that portion of the drainage area is considered "runon".

The site is roughly split north and south, the North side of the site is conveyed to the 36" stub, and then westerly transitioning to 54" RCP, ultimately discharging into an existing slough north west of the site. The slough is directly connected to the San Diego Bay. The South side of the site is conveyed to the H Street 60" Storm Drain and then south westerly to the 84" RCP and then outlets directly to the San Diego Bay.

Project Name: Yards at the Bay

Form I-3B Page 6 of 10

Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply):

- [x] On-site storm drain inlets
- [x] Interior floor drains and elevator shaft sump pumps
- [ ] Interior parking garages
- [ ] Need for future indoor & structural pest control
- [x] Landscape/Outdoor Pesticide Use
- [ ] Pools, spas, ponds, decorative fountains, and other water features
- [ ] Food service
- [x] Refuse areas
- [ ] Industrial processes
- [ ] Outdoor storage of equipment or materials
- [ ] Vehicle and Equipment Cleaning
- [ ] Vehicle/Equipment Repair and Maintenance
- [ ] Fuel Dispensing Areas
- [x] Loading Docks
- [x] Fire Sprinkler Test Water
- [x] Miscellaneous Drain or Wash Water
- [x] Plazas, sidewalks, and parking lots

Description / Additional Information:

There are various on-site storm drain inlets for surface run-off collection. Interior floor drains will be needed for bathrooms and/or other areas in the building per plumbing routed to the sewer system. There are various trash enclosures adjacent to the buildings, which shall be enclosed. Depressed loading docks are needed for the project, and shall be graded such that water in the loading dock is collected and treated before discharging offsite. Fire sprinklers are proposed for these buildings, and test water shall drain to sanitary sewer. Any miscellaneous drains shall be directed to sewer as per the plumbing plans. There are sidewalk along the building and many parking lots, the owner shall maintain them to keep debris from entering the storm drain system.

Yards at the Bay

Project Name: _____

Form I-3B Page 7 of 10

Identification and Narrative of Receiving Water and Pollutants of Concern

Describe flow path of storm water from the project site discharge location(s), through urban storm conveyance systems as applicable, to receiving creeks, rivers, and lagoons as applicable, and ultimate discharge to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable):

Both discharge locations outlet directly to the San Diego Bay through RCP Storm drain and/or slough which extends into the San Diego Bay. Please see Attachment 2 for the Hydromodification exemption letter and full description of drainage conveyance after the runoff leaves the site.

List any 303(d) impaired water bodies within the path of storm water from the project site to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable), identify the pollutant(s)/stressor(s) causing impairment, and identify any TMDLs and/or Highest Priority Pollutants from the WQIP for the impaired water bodies:

303(d) Impaired Water Body	Pollutant(s)/Stressor(s)	TMDLs / WQIP Highest Priority Pollutant
San Diego Bay	Mercury, PAH's, PCB's	TMDL's-N/A / WQIP-Trash
San Diego Bay Shoreline, Chula Vista Marina	Copper	TMDL's-N/A / WQIP-N/A

Identification of Project Site Pollutants*

*Identification of project site pollutants is only required if flow-thru treatment BMPs are implemented onsite in lieu of retention or biofiltration BMPs (note the project must also participate in an alternative compliance program unless prior lawful approval to meet earlier PDP requirements is demonstrated)

Identify pollutants expected from the project site based on all proposed use(s) of the site (see BMP Design Manual Appendix B.6):

Pollutant	Not Applicable to the Project Site	Expected from the Project Site	Also a Receiving Water Pollutant of Concern
Sediment	☐	☐	☐
Nutrients	☐	☐	☐
Heavy Metals	☐	☐	☐
Organic Compounds	☐	☐	☐
Trash & Debris	☐	☐	☐
Oxygen Demanding Substances	☐	☐	☐
Oil & Grease	☐	☐	☐
Bacteria & Viruses	☐	☐	☐
Pesticides	☐	☐	☐

Project Name: Yards at the Bay

Form I-3B Page 8 of 10

Hydromodification Management Requirements

Do hydromodification management requirements apply (see Section 1.6)?

- ☐ Yes, hydromodification management flow control structural BMPs required.
- ☒ No, the project will discharge runoff directly to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.
- ☐ No, the project will discharge runoff directly to conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean.
- ☐ No, the project will discharge runoff directly to an area identified as appropriate for an exemption by the WMAA for the watershed in which the project resides.

Description / Additional Information (to be provided if a 'No' answer has been selected above):

The site is roughly split north and south, the North side of the site is conveyed to the 36" stub, and then westerly transitioning to 54" RCP, ultimately discharging into an existing slough north west of the site. The slough is directly connected to the San Diego Bay. The South side of the site is conveyed to the H Street 60" Storm Drain and then south westerly to the 84" RCP and then outlets directly to the San Diego Bay.
Please see attachment 2 Hydromodification Exemption letter with exhibits and further explanation of the existing storm drain system.

Note: If "No" answer has been selected the SWQMP must include an exhibit that shows the storm water conveyance system from the project site to an exempt water body. The exhibit should include details about the conveyance system and the outfall to the exempt water body.

Critical Coarse Sediment Yield Areas*

***This Section only required if hydromodification management requirements apply**

Based on Section 6.2 and Appendix H does CCSYA exist on the project footprint or in the upstream area draining through the project footprint?

- ☐ Yes
- ☒ No

Description / Additional Information:

Since this project does not require hydromodification management requirements, this section is not applicable. Furthermore, there are no CCSYA's existing on-site or in any area up-stream draining through the project.

Yards at the Bay

Project Name: _____

Form I-3B Page 9 of 10

Flow Control for Post-Project Runoff*

***This Section only required if hydromodification management requirements apply**

List and describe point(s) of compliance (POCs) for flow control for hydromodification management (see Section 6.3.1). For each POC, provide a POC identification name or number correlating to the project's HMP Exhibit and a receiving channel identification name or number correlating to the project HMP Exhibit.

As described on the previous sheet, hydromodification management requirements do not apply to this site.

Has a geomorphic assessment been performed for the receiving channel(s)?

- ☐ No, the low flow threshold is 0.1Q2 (default low flow threshold)
- ☐ Yes, the result is the low flow threshold is 0.1Q2
- ☐ Yes, the result is the low flow threshold is 0.3Q2
- ☐ Yes, the result is the low flow threshold is 0.5Q2

If a geomorphic assessment has been performed, provide title, date, and preparer:

Discussion / Additional Information: (optional)

Project Name: Yards at the Bay

Form I-3B Page 10 of 10

Other Site Requirements and Constraints

When applicable, list other site requirements or constraints that will influence storm water management design, such as zoning requirements including setbacks and open space, or local codes governing minimum street width, sidewalk construction, allowable pavement types, and drainage requirements.

There are large amounts of impervious areas proposed by the project.
The site is constrained by the low ground water (3'-8') below existing grade.
The site was formerly used for agricultural uses and later for industrial uses. There are significant contaminated soils on-site, requiring treatment of the soils where the project proposes improvements below ground. These site constraints influenced the project water quality decision to use modular wetland units to treat the majority of the site, and only one biofiltration basin in the only location feasible.

Optional Additional Information or Continuation of Previous Sections As Needed

This space provided for additional information or continuation of information from previous sections as needed.

Because the site plan includes modular wetlands for the majority of the treatment,additional site design BMP's are required to meet the volume retention requirement. The project is utilizing dispersion areas in two locations on the site. Please see the DMA map for the dispersion area locations, and Attachment 1D for the calculations showing Volume Retention requirements are met for the site.

Yards at the Bay

Project Name: _____

Source Control BMP Checklist for All Development Projects	Form I-4

All development projects must implement source control BMPs. Refer to **Chapter 4** and **Appendix E** of the BMP Design Manual for information to implement BMPs shown in this checklist.

Note: All selected BMPs must be shown on the site/construction plans.

Answer each category below pursuant to the following:

- "Yes" means the project will implement the source control BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required.
- "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided.
- "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project has no outdoor materials storage areas). Discussion / justification may be provided.

Source Control Requirement	Applied?		
4.2.1 Prevention of Illicit Discharges into the MS4	☒ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.1 not implemented: Illicit Discharges to MS4 shall be prohibited.			
4.2.2 Storm Drain Stenciling or Signage	☒ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.2 not implemented: All storm drain curb inlets or grated inlets shall be stenciled or contain signage.			
4.2.3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if 4.2.3 not implemented:			
4.2.4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☒ N/A
Discussion / justification if 4.2.4 not implemented:			
4.2.5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☒ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.5 not implemented: Trash enclosures shall be used by the project in accordance with city requirements.			

Project Name: Yards at the Bay

Source Control BMP Checklist for All Development Projects			Form I-4 (Page 2 of 2)
4.2.6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)	☒ Yes	☐ No	☐ N/A
SC-A Onsite storm drain inlets	☒ Yes	☐ No	☐ N/A
SC-B Interior floor drains and elevator shaft sump pumps	☒ Yes	☐ No	☐ N/A
SC-C Interior parking garages	☐ Yes	☐ No	☒ N/A
SC-D1 Need for future indoor & structural pest control	☐ Yes	☐ No	☒ N/A
SD-D2 Landscape/outdoor pesticide use	☒ Yes	☐ No	☐ N/A
SC-E Pools, spas, ponds, decorative fountains, and other water features	☐ Yes	☐ No	☒ N/A
SC-F Food Service	☐ Yes	☐ No	☒ N/A
SC-G Refuse areas	☒ Yes	☐ No	☐ N/A
SC-H Industrial processes	☐ Yes	☐ No	☒ N/A
SC-I Outdoor storage of equipment or materials	☐ Yes	☐ No	☒ N/A
SC-J Vehicle and equipment cleaning	☐ Yes	☐ No	☒ N/A
SC-K Vehicle/equipment repair and maintenance	☐ Yes	☐ No	☒ N/A
SC-L Fuel dispensing areas	☐ Yes	☐ No	☒ N/A
SC-M Loading docks	☒ Yes	☐ No	☐ N/A
SC-N Fire sprinkler test water	☒ Yes	☐ No	☐ N/A
SC-O Miscellaneous drain or wash water	☒ Yes	☐ No	☐ N/A
SC-P Plazas, sidewalks, and parking lots	☒ Yes	☐ No	☐ N/A
SC-Q: Large Trash Generating Facilities	☐ Yes	☐ No	☒ N/A
SC-R: Animal Facilities	☐ Yes	☐ No	☒ N/A
SC-S: Plant Nurseries and Garden Centers	☐ Yes	☐ No	☒ N/A
SC-T: Automotive Facilities	☐ Yes	☐ No	☒ N/A
Discussion / justification if 4.2.6 not implemented. Justification must be provided for all "No" answers shown above.			

Yards at the Bay

Project Name.: _____

Site Design BMP Checklist for All Development Projects	Form I-5

All development projects must implement site design BMPs where applicable and feasible. See **Chapter 4 and Appendix E** of the manual for information to implement site design BMPs shown in this checklist. **Note: All selected BMPs must be shown on the site/construction plans.**

Answer each category below pursuant to the following.

- "Yes" means the project will implement the site design BMP as described in Chapter 4 and/or Appendix E of the manual. Discussion / justification is not required.
- "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided.
- "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project site has no existing natural areas to conserve). Discussion / justification may be provided.

Site Design Requirement	Applied?		
4.3.1 Maintain Natural Drainage Pathways and Hydrologic Features	☐Yes	☐No	☒N/A
No natural drainage pathways exist on-site.			
4.3.2 Conserve Natural Areas, Soils, and Vegetation	☐Yes	☐No	☒N/A
No Natural areas, soils, or Vegetation existing on-site.			
4.3.3 Minimize Impervious Area	☒Yes	☐No	☐N/A
Site impervious areas are minimized, while meeting the proposed project needs.			
4.3.4 Minimize Soil Compaction	☒Yes	☐No	☐N/A
Landscape areas will contain amended soils to keep landscaping compacting minimal.			
4.3.5 Impervious Area Dispersion	☒Yes	☐No	☐N/A
Impervious Area Dispersion SD-E is implemented to meet site retention requirements.			

Project Name/Address/N Yards at the Bay

Site Design BMP Checklist for All Development Projects			Form I-5
Site Design Requirement	**Applied?**		
4.3.6 Runoff Collection	☐ Yes	☐ No	☒ N/A
4.3.7 Landscaping with Native or Drought Tolerant Species	☒ Yes	☐ No	☐ N/A
4.3.8 Harvesting and Using Precipitation	☐ Yes	☒ No	☐ N/A
Discussion / justification for all "No" answers shown above: Harvest and Reuse not feasible for this project, please see calculations form I-7 in the subsequent sheets.			

Yards at the Bay

Project Name: _____

Summary of PDP Structural BMPs	Form I-6

PDP Structural BMPs

All PDPs must implement structural BMPs for storm water pollutant control (see **Chapter 5 of the manual**). Selection of PDP structural BMPs for storm water pollutant control must be based on the selection process described in **Chapter 5**. PDPs subject to hydromodification management requirements must also implement structural BMPs for flow control for hydromodification management (see **Chapter 6 of the manual**). Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s).

PDP structural BMPs must be verified by City at the completion of construction. This may include requiring the project owner or project owner's representative to certify construction of the structural BMPs (see Section 1.12 of the manual). PDP structural BMPs must be maintained into perpetuity (**see Section 7 of the manual**).

Use this form to provide narrative description of the general strategy for structural BMP implementation at the project site in the box below. Then complete the PDP structural BMP summary information sheet (page **3 of this form**) for each structural BMP within the project (copy the BMP summary information page as many times as needed to provide summary information for each individual structural BMP).

Describe the general strategy for structural BMP implementation at the site. This information must describe how the steps for selecting and designing storm water pollutant control BMPs presented in Section 5.1 of the manual were followed, and the results (type of BMPs selected). For projects requiring hydromodification flow control BMPs, indicate whether pollutant control and flow control BMPs are integrated or separate.

DMA 1 includes Lined Biofiltration Basin for water treatment:
We have chosen to use a lined biofiltration basin because the project geotechnical engineer has determined the site to be no-infiltration site for storm water purposes. Please see appendix 1D for infiltration feasibility letter. The biofiltration basin includes 18-inches of engineered sandy loam growing media on top of a minimum depth of 12 inches of gravel. In addition to the two main layers for biofiltration, a barrier/filter layer underneath the soil media (and above the gravel layer) is also included. The filter layer includes a 3-inch layer of washed sand on top of 3-inch layer of #8 choking stone. For the BMP sizing calculation included in Attachment 1E, the 3-inches of washed sand and 3-inches of mulch was added to the biofiltration media depth, and the #8 choking stone was added to the gravel depth.

Yards at the Bay

Project Name: _____

Summary of PDP Structural BMPs	Form I-6

PDP Structural BMPs

General strategy for structural BMP implementation (Continued)

DMA's 2-14 includes Modular Wetland Units for the following reasons:

•The project geotechnical engineer has determined the site to be no-infiltration site for storm water purposes. Please see appendix 1D for infiltration feasibility letter.
•Due to the large amount of impervious areas proposed by the project and the high groundwater, using biofiltration basins to treat the site is not feasible.
•The site is constrained by the high ground water (3'-8') a biofiltration basin will not work in most locations of the site, since the outlet needs to be above the ground water level.
•The site was formerly used for agricultural uses and later for industrial uses thus there are significant contaminated soils on-site, requiring remediation of the soils where we are proposing improvements so shallow structural BMP's are preferred.
•The Modular Wetland units can be designed to mitigate the high-water table conditions. All Modular Wetland units are proposed to be vegetated.

Modular Wetlands are used on several projects throughout San Diego County, and have been found to be effective. The Washington State Department of Ecology has granted Modular Wetlands Units General use Level Designation (GULD), which provides further evidence of their wide use. Washington State GULD statement in Attachment 1E for reference.

Refer to Attachment 1e for the BMP calculations. The worksheets in Attachment 1e were provided to show the proposed BMPs will be compliant with the City's volume retention requirements. The project proposes to meet the volume retention requirements for the entire site on a composite basis instead of on a DMA basis. The volume retention requirements are achieved on-site through a combination of the biofiltration planter and the proposed dispersion areas. The proposed combination of BMPs retains a much larger fraction of the DCV than is required for the site, so all required retention credits are satisfied.

The project includes importing fill to raise the site above existing grades. The northerly driveways along G Street are proposed to be mitigated with a treatment swap approach, since the driveways are too large to be considered de minimis areas. The easterly portion of the site collects runon area outside of the project footprint consisting of the existing parking lot. Due to grading restrictions within this SDG&E area, this area was collected into the site's drainage system and commingled for treatment with the onsite runoff. Because the project proposes to treat an equivalent or larger amount of impervious surface due to treating the runon, the perimeter areas of the site that could not be graded to drain to onsite treatment BMPs are addressed with the proposed treatment swap. Refer to the DMA Map in Attachment 1A for further detail.

Yards at the Bay

Project Name: _____

Form I-6 Page 3 of 30 *(Copy and attach as many as needed)*	
Structural BMP ID No. 1	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Biofiltration (BF-1) ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)	
Purpose: ☒ Pollutant control only ☐ Hydromodification control only ☐ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 4 *of* 30
Structural BMP ID No. 1
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP # 1 is a lined Biofiltration basin with a bottom footprint of 3,130 SF. This basin consists of 12" of aggregate storage, 3" of ASTM No. 8 Stone, 18" Biofiltration media, 3" of ASTM 33 fine aggregate sand and 3" mulch with 6" of ponding.

Sizing worksheet B.5-1 is included in Attachment 1E.

Yards at the Bay

Project Name: _____

Form I-6 Page 5 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 2

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 6 *of* 30
Structural BMP ID No. 2
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 2 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 7 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 3

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 8 *of* 30
Structural BMP ID No. 3
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 3 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Yards at the Bay

Project Name: _____

Form I-6 Page 9 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 4

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page10 *of* 30
Structural BMP ID No. 4
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 4 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 11 **of** 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 5

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page12 *of* 30
Structural BMP ID No. 5
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 5 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 13 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 6

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Project Name: _____

Form I-6 Page 14 *of* 30
Structural BMP ID No. 6
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 6 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Yards at the Bay

Project Name: _____

Form I-6 Page 15 **of** 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 7

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page16 *of* 30
Structural BMP ID No. 7
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 7 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Yards at the Bay

Project Name: _____

Form I-6 Page 17 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 8

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 18 *of* 30
Structural BMP ID No. 8
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 8 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Yards at the Bay

Project Name: _____

Form I-6 Page 19 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 9

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 20 *of* 30
Structural BMP ID No. 9
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 9 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 21 of 30 *(Copy and attach as many as needed)*
Structural BMP ID No. 10
Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 22 *of* 30
Structural BMP ID No. 10
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 10 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 23 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 11

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 24 *of* 30
Structural BMP ID No. 11
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 11 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 25 of 30 *(Copy and attach as many as needed)*
Structural BMP ID No. 12
Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 26 *of* 30
Structural BMP ID No. 12
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 12 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 27 of 30 *(Copy and attach as many as needed)*	
Structural BMP ID No. 13	
Construction Plan Sheet No.	
Type of structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☒ Proprietary Biofiltration (BF-3) ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)	
Purpose: ☒ Pollutant control only ☐ Hydromodification control only ☐ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 28 *of* 30
Structural BMP ID No. 13
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 13 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name: Yards at the Bay

Form I-6 Page 29 of 30 *(Copy and attach as many as needed)*

Structural BMP ID No. 14

Construction Plan Sheet No.

Type of structural BMP:

- ☐ Retention by harvest and use (e.g. HU-1, cistern)
- ☐ Retention by infiltration basin (INF-1)
- ☐ Retention by bioretention (INF-2)
- ☐ Retention by permeable pavement (INF-3)
- ☐ Partial retention by biofiltration with partial retention (PR-1)
- ☒ Proprietary Biofiltration (BF-3)
- ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below)
- ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below)
- ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below)
- ☐ Detention pond or vault for hydromodification management
- ☐ Other (describe in discussion section below)

Purpose:

- ☒ Pollutant control only
- ☐ Hydromodification control only
- ☐ Combined pollutant control and hydromodification control
- ☐ Pre-treatment/forebay for another structural BMP
- ☐ Other (describe in discussion section below)

Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms if required by the City Engineer (See Section 1.12 of the manual)	Chelisa Pack, RCE 71026 Project Design Consultants (619) 235-6471
Who will be the final owner of this BMP?	Property Owner
Who will maintain this BMP into perpetuity?	Property Owner
What is the funding mechanism for maintenance?	Property Owner

Yards at the Bay

Project Name: _____

Form I-6 Page 30 *of* 30
Structural BMP ID No. 14
Construction Plan Sheet No.

Discussion (as needed, must include worksheets showing BMP sizing calculations in the SWQMP):

BMP's # 14 is an compact biofiltration BF-3 type Modular Wetland Unit from Manufacturer Contech. For sizes of each Modular Wetland Unit per DMA, please see DMA Map Attachment 1A.

Sizing calculations are included in attachment 1E.

Project Name/_____

ATTACHMENT 1

Backup for PDP Pollutant Control BMPs

Project Name/ Yards at the Bay

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 1A	**DMA Exhibit (Required)** See DMA Exhibit Checklist.	☒ Included
Attachment 1B	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☒ Included on DMA Exhibit in Attachment 1A ☐ Included as Attachment 1B, separate from DMA Exhibit
Attachment 1C	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	☒ Included ☐ Not included because the entire project will use infiltration BMPs
Attachment 1D	Infiltration Feasibility Information. Contents of Attachment 1D depend on the infiltration condition: ☒ **No Infiltration Condition**: ☐ Infiltration Feasibility Condition ☐ Letter (***Note: must be stamped & signed by licensed geotechnical engineer***) ☐ Form I-8A (optional) ☐ Form I-8B (optional) ☐ **Partial Infiltration Condition**: ☐ Infiltration Feasibility Condition ☐ Letter (***Note: must be stamped & signed by licensed geotechnical engineer***) ☐ Form I-8A ☐ Form I-8B ☐ **Full Infiltration Condition:** ☐ Form I-8A ☐ Form I-8B ☐ Worksheet C.4-3 ☐ Form I-9 Refer to Appendices C and D of the BMP Design Manual for guidance.	☒ Included ☐ Not included because the entire project will use harvest and use BMPs
Attachment 1E	**Pollutant Control BMP Design Worksheets/ Calculations (Required)** Refer to Appendices B and E of the BMP Design Manual for structural pollutant control BMP design guidelines	☒ Included

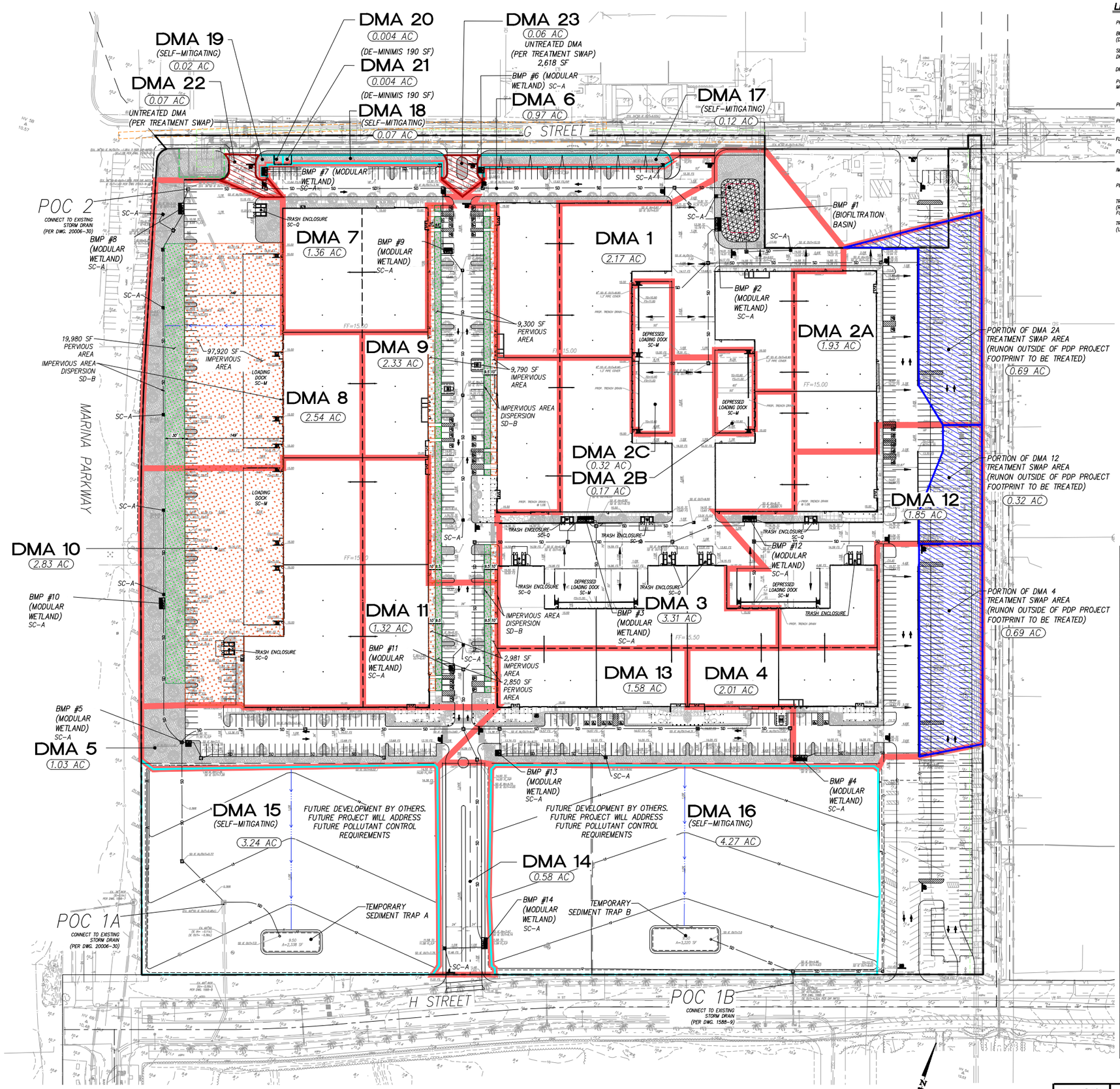
Project Name/ Yards at the Bay

Use this checklist to ensure the required information has been included on the DMA Exhibit:

The DMA Exhibit must identify all the following:

- ☒ Underlying hydrologic soil group
- ☒ Approximate depth to groundwater
- ☒ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- ☒ Critical coarse sediment yield areas to be protected
- ☒ Existing topography and impervious areas
- ☒ Existing and proposed site drainage network and connections to drainage offsite
- ☒ Proposed grading
- ☒ Proposed impervious features
- ☒ Proposed design features and surface treatments used to minimize imperviousness
- ☒ Drainage management area (DMA) boundaries, DMA ID numbers, and DMA areas (square footage or acreage), and DMA type (i.e., drains to BMP, self-retaining, or self-mitigating)
- ☒ Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
- ☒ Structural BMPs (identify location, type of BMP, and size/detail, and include cross-sections)

ATTACHMENT 1A,1B – DMA MAP



LEGEND

- PROPERTY BOUNDARY
- BMP DRAINAGE SUBAREA (DMA BOUNDARY)
- SELF-MITIGATING OR DE-MINIMIS DRAINAGE SUBAREA (DMA BOUNDARY)
- DMA DRAINAGE AREA — X.XX AC
- POLLUTANT CONTROL BMP: MODULAR WETLAND UNIT — XXX
- PROPOSED STORM DRAIN — SD
- PROPOSED TRENCH DRAIN
- FLOW PATH
- FLOW DIRECTION
- IMPERVIOUS AREA DISPERSION
- PERVIOUS AREA DISPERSION
- TREATMENT SWAP (RUNON OUTSIDE OF PDP PROJECT FOOTPRINT TO BE TREATED)
- TREATMENT SWAP (UNTREATED DMA)

TREATMENT SWAP AREA TABLE	
UN-TREATED DMA'S	
DMA	AREA (AC)
22	0.07
23	0.06
TOTAL:	0.13
TREATED DMA	
DMA	AREA (AC)
PORTION OF DMA 2A	0.69
PORTION OF DMA 4	0.69
PORTION OF DMA 12	0.32
TOTAL:	1.71

BECAUSE THE TOTAL TREATED RUNON AREAS (PORTIONS OF DMA'S 2A, 4, AND 12) IS GREATER THAN UN-TREATED BYPASS AREAS (DMA'S 22 AND 23) TREATMENT SWAP IS ACCEPTABLE.

BMP NOTES:

1. SITE DESIGN BMPS INCLUDE:
   - MINIMIZATION OF IMPERVIOUS FOOTPRINT
   - CONSERVATION OF NATURAL AREAS
   - SD-B IMPERVIOUS AREA DISPERSION
   - SD-F AMENDED SOILS
2. SOURCE CONTROL BMPs FOR PROJECT INCLUDE:
   - PREVENTION OF ILLICIT DISCHARGES
   - SC-A STORM DRAIN STENCILING
   - SC-B INTERIOR FLOOR DRAINS
   - SD-D2 LANDSCAPE / OUTDOOR PESTICIDE USE
   - SC-G PROTECTION OF TRASH STORAGE AREAS
   - SC-M LOADING DOCKS
   - SC-N FIRE SPRINKLER TEST WATER TO DRAIN TO SEWER
   - SC-O LARGE TRASH GENERATING FACILITIES
   - EFFICIENT LANDSCAPE AND IRRIGATION DESIGN
   - STORMWATER EDUCATION
   - BUILDING MANAGEMENT PRACTICES (MANAGEMENT OF FIRE SPRINKLER SYSTEM DISCHARGES, AIR CONDITIONING CONDENSATE DISCHARGES, AND THE USE OF NON-TOXIC ROOFING MATERIALS.
3. THE TREATMENT BMPS SELECTED FOR THIS PROJECT ARE ONE LINED BIOFILTRATION BASIN AND MULTIPLE COMPACT BIOFILTRATION UNIT (MODULAR WETLAND UNIT). SEE ATTACHMENT 4 FOR BMP DETAILS/PLANS.
4. PROJECT WILL DIRECTLY DISCHARGE TO SAN DIEGO BAY AND IS EXEMPT FROM HYDROMODIFICATION REQUIREMENTS.
5. THE NRCS SOIL SURVEY CLASSIFIES THE SITE AS HAVING SOILS OF THE HYDROLOGIC SOIL GROUP 'D'.
6. GROUNDWATER DEPTHS RANGE FROM ABOUT 3' TO 11' BELOW GRADE AS PER THE GEOTECHNICAL REPORT TITLED: COLLINS AEROSPACE REDEVELOPMENT SITE – PARCEL B NORTHEAST CORNER OF H STREET AND MARINA PARKWAY CHULA VISTA, CALIFORNIA, DATED DECEMBER 17 2021. SEE GEOTECHNICAL REPORT FOR MORE INFORMATION.
7. THERE ARE NO CCSYA'S ON-SITE.

DMA/BMP TABLE

DMA#	DMA TYPE	BMP#	POC	BMP TYPE	DMA TRIBUTARY DRAINAGE AREA (AC)	BMP BOTTOM AREA (SQFT)
1	DRAINS TO BMP 1	1	DRAINS TO POC 2	BIOFILTRATION (BF-1) LINED BIOFILTRATION	2.17	3120
2A	DRAINS TO BMP 2	2	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-20	1.93	N/A
2B	DRAINS TO BMP 2	2	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-20	0.17	N/A
2C	DRAINS TO BMP 2	2	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-20	0.32	N/A
3	DRAINS TO BMP 3	3	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-24	3.31	N/A
4	DRAINS TO BMP 4	4	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-20	2.01	N/A
5	DRAINS TO BMP 5	5	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-8	1.03	N/A
6	DRAINS TO BMP 6	6	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-8	0.97	N/A
7	DRAINS TO BMP 7	7	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-12	1.36	N/A
8	DRAINS TO BMP 8	8	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-16	2.54	N/A
9	DRAINS TO BMP 9	9	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-12	2.33	N/A
10	DRAINS TO BMP 10	10	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-16	2.83	N/A
11	DRAINS TO BMP 11	11	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-8	1.32	N/A
12	DRAINS TO BMP 12	12	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-20	1.85	N/A
13	DRAINS TO BMP 13	13	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-8	1.58	N/A
14	DRAINS TO BMP 14	14	DRAINS TO POC 1A	PROPRIETARY BIOFILTRATION SYSTEMS (BF-3) MWS-L-8-16	0.58	N/A
15	SELF-MITIGATING	N/A	DRAINS TO POC 1A	N/A	3.24	N/A
16	SELF-MITIGATING	N/A	DRAINS TO POC 1B	N/A	4.27	N/A
17	SELF-MITIGATING	N/A	DRAINS TO POC 2	N/A	0.12	N/A
18	SELF-MITIGATING	N/A	DRAINS TO POC 2	N/A	0.07	N/A
19	SELF-MITIGATING	N/A	DRAINS TO POC 2	N/A	0.02	N/A
20	DE-MINIMUS	N/A	DRAINS TO POC 2	N/A	0.004	N/A
21	DE-MINIMUS	N/A	DRAINS TO POC 2	N/A	0.004	N/A
22	TREATMENT SWAP	N/A	DRAINS TO POC 2	N/A	0.07	N/A
23	TREATMENT SWAP	N/A	DRAINS TO POC 2	N/A	0.06	N/A
SUM					34.15	3120

SCALE: 1"=50'
JOB #: 4508
CREATED: 7/12/23

PREPARED BY:
PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey
701 B Street, Suite 800
San Diego, CA 92101
619.235.6471 Tel
619.234.0349 Fax

CITY OF CHULA VISTA
YARDS AT THE BAY - PARCEL B
DMA EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A-1

File Name: P:\4508\Engr\Reports\SWQMP-Prelim\ATTACHMENTS\A1-Pollutant Control BMPs\4508-DMA-MAP.dwg, 8/1/2023 3:22:38 PM

Project Name: Yards at the Bay

Tabular Summary of DMAs							Worksheet B-1		
DMA Unique Identifier	Area (acres)	Impervious Area (acres)	% Imp	HSG	Area Weighted Runoff Coefficient	DCV (Cubic feet)	Treated by (BMP ID)	Pollutant Control Type	Drains to (POC ID)
Summary of DMA Information (Must match Project description and SWQMP narrative)									
No. of DMAs	Total DMA Area (acres)	Total Impervious Area (acres)	% Impervious		Area Weighted Runoff Coefficient	DCV (Cubic feet)	Total Area Treated (acres)		No. of POCs

Where: DMA = Drainage Management Area; HSG = Hydrologic Soil Group; BMP = Best Management Practice; Imp = Imperviousness; DCV= Design Capture Volume; POC = Point of Compliance; ID = identifier; No. = Number

PLEASE SEE WORKSHEET B.2-1 FOR ENTIRE SITE DCV.

*Volume Retention for the site as a whole will be met with Biofiltration Basins and Impervious Dispersion.

ATTACHMENT 1C – HARVEST & USE FEASIBILITY CHECKLIST

Yards at the Bay

Project Name: _____

Harvest and Use Feasibility Screening	FORM I-7 (Worksheet B.3-1)

1. Is there a demand for harvested water (check all that apply) at the project site that is reliably present during the wet season?

- ☐ Toilet and urinal flushing
- ☒ Landscape irrigation
- ☐ Other:_____

2. If there is a demand; estimate the anticipated average wet season demand over a period of 36 hours. Guidance for planning level demand calculations for toilet/urinal flushing and landscape irrigation is provided in Section B.3.2.

[Provide a summary of calculations here]

Landscape Irrigation:
Landscape area=2.87 Ac. Assumed Water Use:
1470 g/ac/36 hours x 2.87 Ac=4219 Gallons 1CF=7.48 gallons,
water use=564 CF /36 hours

3. Calculate the DCV using worksheet B-2.1.

[Provide a result here]

45,536 CF see site DCV B-2.1.

3a. Is the 36-hour demand greater than or equal to the DCV?	3b. Is the 36-hour demand greater than 0.25DCV but less than the full DCV?	3c. Is the 36-hour demand less than 0.25DCV?
Yes ⇩ / **No** ⇨	**Yes** ⇩ / **No** ⇨	**Yes** ⇩
	45,536*0.25=11,384>564	
Harvest and use appears to be feasible. Conduct more detailed evaluation and sizing calculations to confirm that DCV can be used at an adequate rate to meet drawdown criteria.	Harvest and use may be feasible. Conduct more detailed evaluation and sizing calculations to determine feasibility. Harvest and use may only be able to be used for a portion of the site, or (optionally) the storage may need to be upsized to meet long term capture targets while draining in longer than 36 hours.	Harvest and use is considered to be infeasible.

Note: 36-hour demand calculations are for feasibility analysis only, once the feasibility analysis is complete the applicant may be allowed to use a different drawdown time provided they meet the 80 percent of average annual (long term) runoff volume performance standard.

ATTACHMENT 1D – INFILTRATION FEASIBILITY LETTER

Project No. G2560-52-01
August 1, 2023

Wohl Property Group
1081 Camino Del Rio South, Suite 115
San Diego, California 92108

Attention: Mr. Emil Wohl

Subject: STORM WATER INFILTRATION FEASIBILITY EVALUATION
COLLINS AEROSPACE REDEVELOPMENT SITE – PARCEL B
NORTHWEST CORNER OF H STREET AND MARINA PARKWAY
CHULA VISTA, CALIFORNIA

References:
1. *Updated Limited Geotechnical Investigation, Collins Aerospace Redevelopment Site – Parcel B, Northeast Corner of H Street and Marina Parkway, Chula Vista, California*, prepared by Geocon Incorporated, dated December 17, 2021 (Project No. G2560-52-01).
2. *DMA Exhibit Proposed Conditions, Exhibit 1-A, Yards at the Bay – Parcel B, Chula Vista, CA 91910,* prepared by Project Design Consultants, dated August 1, 2023.

Dear Mr. Wohl:

In accordance with the request of Ms. Chelisa Pack with Project Design Consultants, we prepared this letter to describe the infiltration feasibility characteristics of the subject site for the proposed project. We reviewed the referenced update geotechnical investigation report to evaluate the current geologic conditions on the property in accordance with the *City of Chula Vista Best Management Practices (BMP) Design Manual (dated August 2021).*

As noted in the referenced project geotechnical report, the site is underlain at relatively shallow depths by clayey soils that are considered to be "expansive" as defined by the California Building Code. Infiltration of storm water into these expansive soils could cause distress to existing and proposed surfaces and structures. Additionally, the NRCS Web Soil Survey indicates that the site is mapped as being underlain by Soil Type D. The observed and mapped soil characteristics of the near-surface onsite clayey soils indicate that they are considered to have poor infiltration characteristics (poor to no permeability). In addition, the site is underlain by a shallow-static ground water table that varies from 3 to 12 feet below the existing site surface and is tidally influenced. As such, we opine that infiltration of storm water in any amount should not be allowed at the subject site. Any BMPs should be lined with

impermeable liners and piped to a suitable discharge facility. We have completed a City of Chula Vista Form I-8A (Worksheet C.4-1) for this evaluation and it is attached.

If you have any questions regarding this response, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Adam W. Hespeler
PG 10001

Matt Love
RCE 84154

AWH:ML:arm

Attachments:
City of Chula Vista Form I-8A (Worksheet C.4-1)

(e-mail) Addressee

Project Name: Yards at the Bay - Parcel B (Geocon, Inc. Project No. G2560-52-01)

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
DMA exhibit prepared by Project Design Consultants dated 8-1-2023	

Criteria 1: Infiltration Rate Screening	
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[2]? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ☐ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ☒ No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ☐ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ☐ Yes; Continue to Step 1C. ☐ No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ☐ No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ☐ Yes; continue to Step 1E. ☐ No; select an appropriate infiltration testing method.
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ☐ Yes; continue to Step 1F. ☐ No; conduct appropriate number of tests.

[1] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.
[2] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Project Name: Yards at the Bay - Parcel B (Geocon, Inc. Project No. G2560-52-01)

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ☐ Yes; continue to Step 1G. ☐ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ☐ Yes; answer "Yes" to Criteria 1 Result. ☐ No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ☐ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ☐ No; full infiltration is not required. Skip to Part 1 Result.

Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.

As noted in the referenced project geotechnical report (Updated Limited Geotechnical Investigation, Collins Aerospace Redevelopment Site – Parcel B, Northeast Corner of H Street and Marina Parkway, Chula Vista, California, prepared by Geocon Incorporated, dated December 17, 2021 (Project No. G2560-52-01)), the site is underlain at relatively shallow depths by clayey soils that are expansive. Infiltration of storm water into these expansive soils could cause distress to existing and proposed surfaces and structures. Also, the NRCS Web Soil Survey indicates that the site is mapped as being underlain by Soil Type D. The near surface onsite clayey soils are considered to have poor permeability. In addition, the site is underlain by a shallow-static ground water table that varies from 3 to 12 feet below the existing site surface. As such, we opine that infiltration of storm water in any amount should not be allowed at the subject site. Any BMPs should be lined with impermeable liners and piped to a suitable discharge facility.

Criteria 2: Geologic/Geotechnical Screening	
2A	**If all questions in Step 2A are answered "Yes," continue to Step 2B.** For any "No" answer in Step 2A answer "No" to Criteria 2 and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.

Project Name: Yards at the Bay - Parcel B (Geocon, Inc. Project No. G2560-52-01)

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Form I-8A[1] (Worksheet C.4-1)	
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	☐ Yes	☐ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	☐ Yes	☐ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	☐ Yes	☐ No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	☐ Yes	☐ No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	☐ Yes	☒ No
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐ Yes	☐ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐ Yes	☐ No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐ Yes	☒ No

Project Name: Yards at the Bay - Parcel B (Geocon, Inc. Project No. G2560-52-01)

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Form I-8A[1] (Worksheet C.4-1)	
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	☐ Yes	☐ No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐ Yes	☒ No

Summarize findings and basis; provide references to related reports or exhibits.

As noted in the referenced project geotechnical report, the site is underlain at relatively shallow depths by clayey soils that are expansive. Infiltration of storm water into these expansive soils could cause distress to existing and proposed surfaces and structures. Also, the NRCS Web Soil Survey indicates that the site is mapped as being underlain by Soil Type D. The near surface onsite clayey soils are considered to have poor permeability. In addition, the site is underlain by a shallow-static ground water table that varies from 3 to 12 feet below the existing site surface. As such, we opine that infiltration of storm water in any amount should not be allowed at the subject site. Any BMPs should be lined with impermeable liners and piped to a suitable discharge facility.

Part 1 Result – Full Infiltration Geotechnical Screening [3]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	☐ **Full infiltration Condition** ☒ **Complete Part 2**

[3] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Project Name: Yards at the Bay - Parcel B (Geocon, Inc. Project No. G2560-52-01)

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**

Criteria 3 : Infiltration Rate Screening	
3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ☐ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☐ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☐ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ☐ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ☐ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ☐ Yes; Continue to Criteria 4. ☐ No: Skip to Part 2 Result.

Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).

As noted in the referenced project geotechnical report, the site is underlain at relatively shallow depths by clayey soils that are expansive. Infiltration of storm water into these expansive soils could cause distress to existing and proposed surfaces and structures. Also, the NRCS Web Soil Survey indicates that the site is mapped as being underlain by Soil Type D. The near surface onsite clayey soils are considered to have poor permeability. In addition, the site is underlain by a shallow-static ground water table that varies from 3 to 12 feet below the existing site surface. As such, we opine that infiltration of storm water in any amount should not be allowed at the subject site. Any BMPs should be lined with impermeable liners and piped to a suitable discharge facility.

Project Name: Yards at the Bay - Parcel B (Geocon, Inc. Project No. G2560-52-01)

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Form I-8A[1] (Worksheet C.4-1)	
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	☐ Yes	☐ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	☐ Yes	☐ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	☐ Yes	☐ No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	☐ Yes	☐ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	☐ Yes	☒ No
4B-3	**Liquefaction.** If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐ Yes	☐ No

Project Name: _____

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Form I-8A[1] (Worksheet C.4-1)	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐ Yes	☐ No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐ Yes	☐ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	☐ Yes	☐ No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐ Yes	☒ No

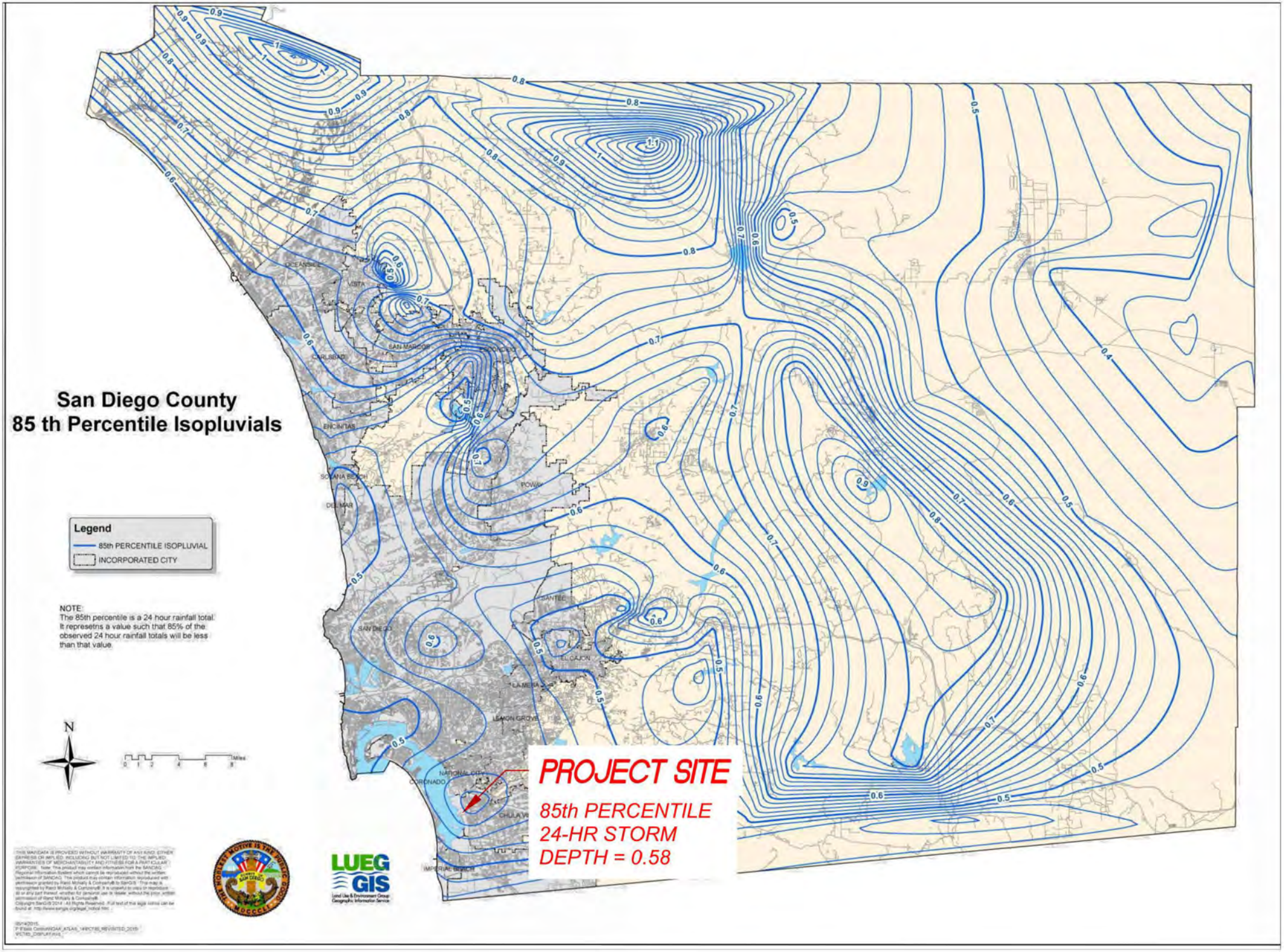
Project Name: Yards at the Bay - Parcel B (Geocon, Inc. Project No. G2560-52-01)

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Form I-8A[1] (Worksheet C.4-1)
Summarize findings and basis; provide references to related reports or exhibits. As noted in the referenced project geotechnical report, the site is underlain at relatively shallow depths by clayey soils that are expansive. Infiltration of storm water into these expansive soils could cause distress to existing and proposed surfaces and structures. Also, the NRCS Web Soil Survey indicates that the site is mapped as being underlain by Soil Type D. The near surface onsite clayey soils are considered to have poor permeability. In addition, the site is underlain by a shallow-static ground water table that varies from 3 to 12 feet below the existing site surface. As such, we opine that infiltration of storm water in any amount should not be allowed at the subject site. Any BMPs should be lined with impermeable liners and piped to a suitable discharge facility.	

Part 2 – Partial Infiltration Geotechnical Screening Result[4]	**Result**
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	☐ **Partial Infiltration Condition** ☒ **No Infiltration Condition**

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

ATTACHMENT 1E – POLLUTANT CONTROL BMP DESIGN WORKSHEETS/CALCULATIONS


San Diego County
85 th Percentile Isopluvials
Legend
85th PERCENTILE ISOPLUVIAL
INCORPORATED CITY
NOTE:
The 85th percentile is a 24 hour rainfall total. It represetns a value such that 85% of the observed 24 hour rainfall totals will be less than that value.
N
0 1 2 4 6 8 Miles
PROJECT SITE
85th PERCENTILE
24-HR STORM
DEPTH = 0.58
OCEANSIDE
VISTA
SAN MARCOS
CARLSBAD
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
NATIONAL CITY
CORONADO
IMPERIAL BEACH
LUEG GIS

ATTACHMENT 1B: Worksheet B.2-1: DCV

85th percentile 24-hr storm depth from Figure B.1.= 0.58 in

DMA ID	BMP ID	BMP Drainage Area (ac)	BMP Drainage Area (SF)	Impervious Area (ac)	Amended Soils (ac) (C=0.1)	Natural A Soils (ac) (C=0.1)	Natural B Soils (ac) (C=0.14)	Natural C Soils (ac) (C=0.23)	Natural D Soils (ac) (C=0.3)	% Impervious	Composite C[1]	Tree Credit Volume (cf)	Rain Barrels Credit Volume (cf)	Design Capture Volume (DCV) (CF)
Project Site	1 THRU 14	26.30	1145628	23.27	3.03					88%	0.808			44727

Notes:

1) Equation for composite C factor = (0.9*Impervious Area +C*Pervious Area)/Total Area per BMP Design Manual.
C factors are from Table B.1-1 of August 2021 City BMP Design Manual.

2) Volume Retention will be met with Biofiltration Basins and Impervious Dispersion

CITY OF CHULA VISTA	**Project Name**	Yards at the bay					
	BMP ID	Site					
Volume Retention for No Infiltration Condition					**Worksheet B.5-6**		
1	Area draining to the biofiltration BMP					1145628	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)					0.807746	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]					925376	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]					27761	sq. ft.
5	Biofiltration BMP Footprint					3120	sq. ft.
Landscape Area (must be identified on DS-3247)							
		Identification	**1**	**2**	**3**	**4**	**5**
6	Landscape area that meet the requirements in SD-B and SD-F Fact Sheet (sq. ft.)		19980	3009	9771		
7	Impervious area draining to the landscape area (sq. ft.)		97921	3144	9342		
8	Impervious to Pervious Area ratio [Line 7/Line 6]		4.90	1.04	0.96	0.00	0.00
9	Effective Credit Area If (Line 8 >1.5, Line 6, Line 7/1.5]		19980	2096	6228	0	0
10	Sum of Landscape area [sum of Line 9 Id's 1 to 5]					28304	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]					31424	sq. ft.
Volume Retention Performance Standard							
12	Is Line 11 ≥ Line 4?		Volume Retention Performance Standard is Met				
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]					1.13	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]					1029	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]					-133.7323127	cu. ft.
Site Design BMP							
	Identification	**Site Design Type**				**Credit**	
16	1						cu. ft.
	2						cu. ft.
	3						cu. ft.
	4						cu. ft.
	5						cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Line 16 Credits for Id's 1 to 5] Provide documentation of how the site design credit is calculated in the PDP SWQMP.					0	cu. ft.
17	Is Line 16 ≥ Line 15?		Volume Retention Performance Standard is Met				

ATTACHMENT 1B: Worksheet B.2-1: DCV

85th percentile 24-hr storm depth from Figure B.1.= 0.58 in

DMA ID	BMP ID	BMP Drainage Area (ac)	BMP Drainage Area (SF)	Impervious Area (ac)	Amended Soils (ac) (C=0.1)	Natural A Soils (ac) (C=0.1)	Natural B Soils (ac) (C=0.14)	Natural C Soils (ac) (C=0.23)	Natural D Soils (ac) (C=0.3)	% Impervious	Composite C[1]	Tree Credit Volume (cf)	Rain Barrels Credit Volume (cf)	Design Capture Volume (DCV) (CF)
1	1	2.17	94382	1.91	0.26					88%	0.805			3673

Notes:

1) Equation for composite C factor = (0.9*Impervious Area +C*Pervious Area)/Total Area per BMP Design Manual.
C factors are from Table B.1-1 of August 2021 City BMP Design Manual.

2) Volume Retention will be met with Biofiltration Basins and Impervious Dispersion

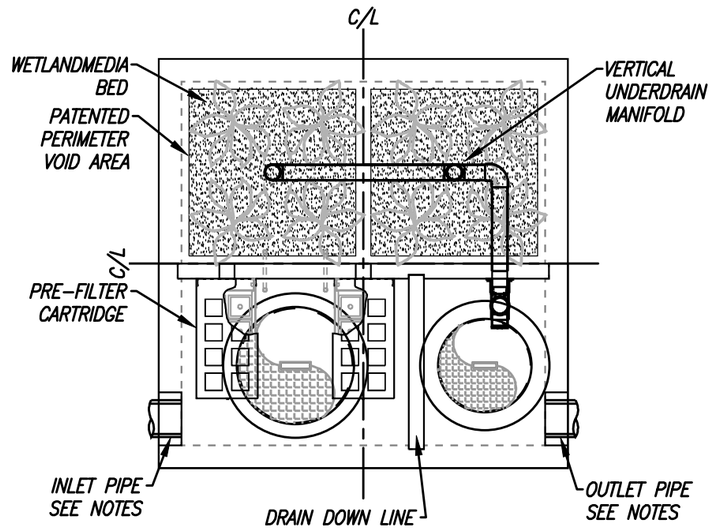
CITY OF CHULA VISTA		**Project Name**	Yards at the bay	
		BMP ID	1	
Sizing Method for Pollutant Removal Criter			**Worksheet B.5-1**	
1	Area draining to the BMP		94382	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)		0.805176764	
3	85th percentile 24-hour rainfall depth		0.58	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]		3673	cu. ft.
BMP Parameters				
5	Surface ponding [6 inch minimum, 12 inch maximum]		6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations		24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area		12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area		3	inches
9	Freely drained pore storage of the media		0.2	in/in
10	Porosity of aggregate storage		0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)		5	in/hr.
Baseline Calculations				
12	Allowable routing time for sizing		6	hours
13	Depth filtered during storm [Line 11 x Line 12]		30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]		16.8	inches
15	Total Depth Treated [Line 13 + Line 14]		46.8	inches
Option 1 – Biofilter 1.5 times the DCV				
16	Required biofiltered volume [1.5 x Line 4]		5510	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12		1413	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding				
18	Required Storage (surface + pores) Volume [0.75 x Line 4]		2755	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12		1968	sq. ft.
Footprint of the BMP				
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)		0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]		2280	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)		2280	sq. ft.
23	Provided BMP Footprint		3120	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**		

Modular Wetland Sizing Calculations							
BMP-ID	A (sf)	Impervious Area (sf)	%IMP	C	1.5 x Q (cfs)	Q100 (cfs)	✳BMP Size
2	105534	104725	99%	0.89	0.650	15.0	MWS-L-8-20
3	143976	142175	99%	0.89	0.882	20.1	MWS-L-8-24
4	87959.8	80174.8	91%	0.83	0.502	12.2	MWS-L-8-20
5	45054	32738	73%	0.68	0.211	5.1	MWS-L-8-8
6	42135	40277	96%	0.86	0.251	5.8	MWS-L-8-8
7	59002	56022	95%	0.86	0.349	7.0	MWS-L-8-12
8	110578	83719	76%	0.71	0.537	14.2	MWS-L-8-16
9	101425	90190	89%	0.81	0.567	12.7	MWS-L-8-12
10	123084	98265	80%	0.74	0.626	15.9	MWS-L-8-16
11	57360	53772	94%	0.85	0.336	7.4	MWS-L-8-8
12	80456	78622	98%	0.88	0.489	11.1	MWS-L-8-20
13	54752	47467	87%	0.79	0.299	8.8	MWS-L-8-8
14	101899	96224	94%	0.86	0.600	3.4	MWS-L-8-16

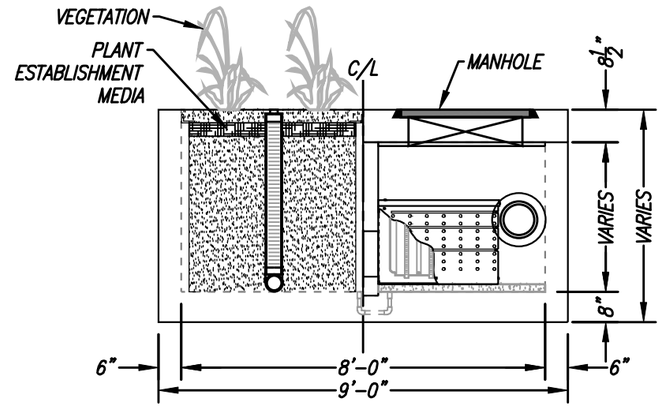
(✳) Please note BMP sizes are based on specific vertical constraints per DMA.

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
FLOW BASED (CFS)			
0.231			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
NOTES:			

* PRELIMINARY NOT FOR CONSTRUCTION



PLAN VIEW



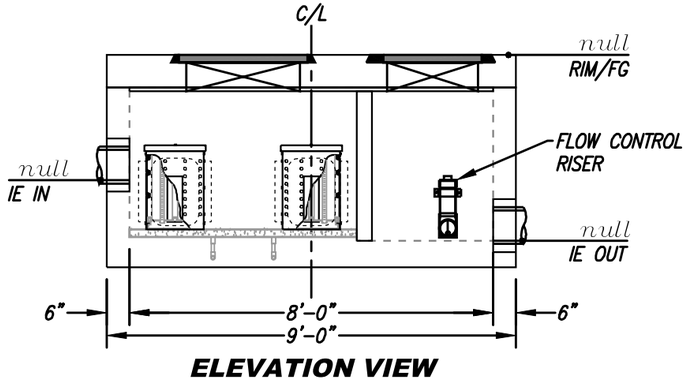
LEFT END VIEW

INSTALLATION NOTES

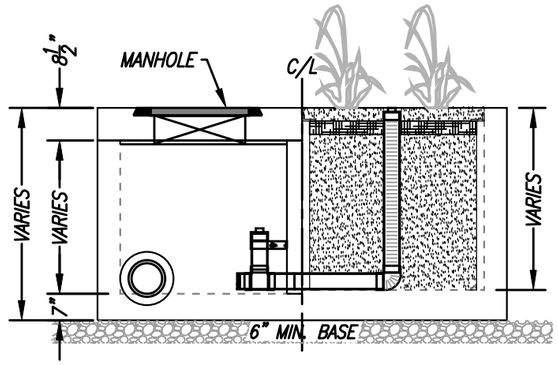
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ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	8.5
PRETREATMENT LOADING RATE (GPM/SF)	5.1
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

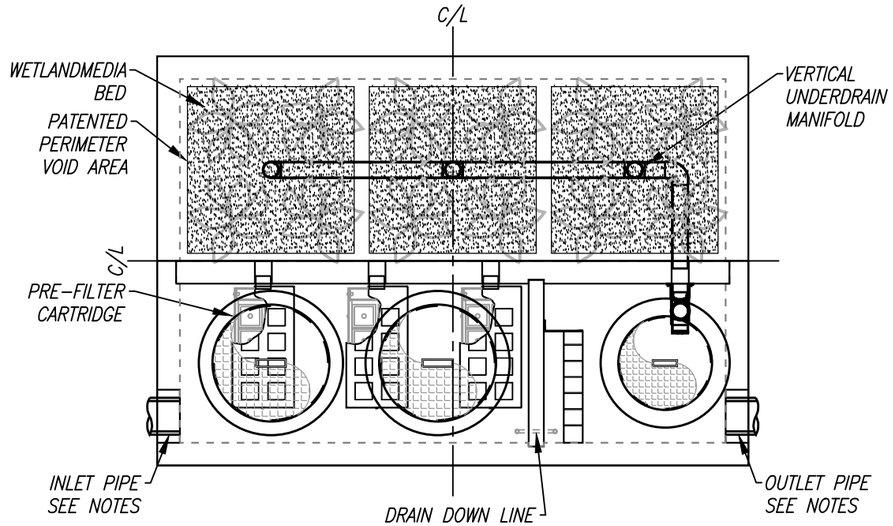
MODULAR WETLANDS
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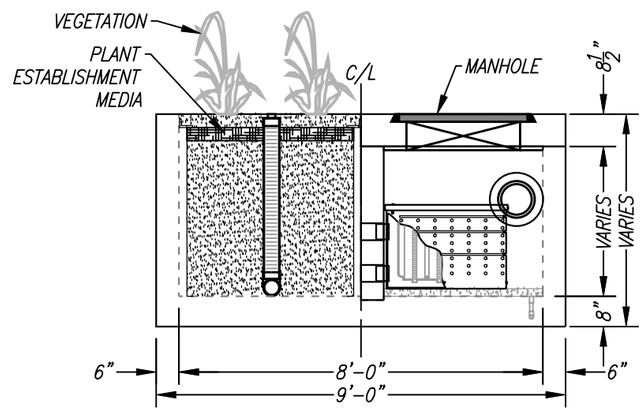
MWS-L-8-8-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.346	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
FRAME & COVER	2EA ø30"	OPEN PLANTER	ø24"
NOTES:			

* PRELIMINARY NOT FOR CONSTRUCTION



PLAN VIEW



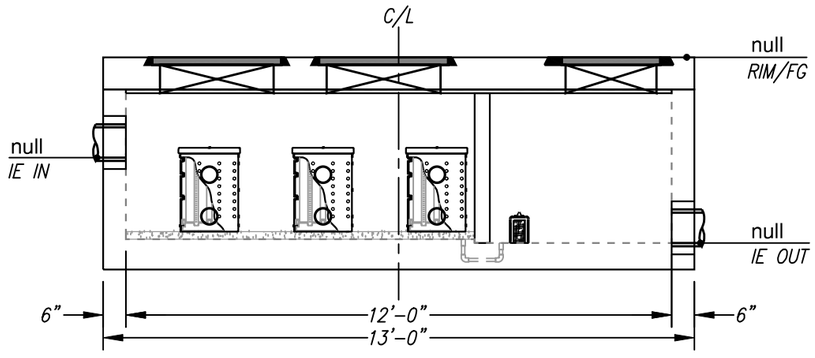
LEFT END VIEW

INSTALLATION NOTES

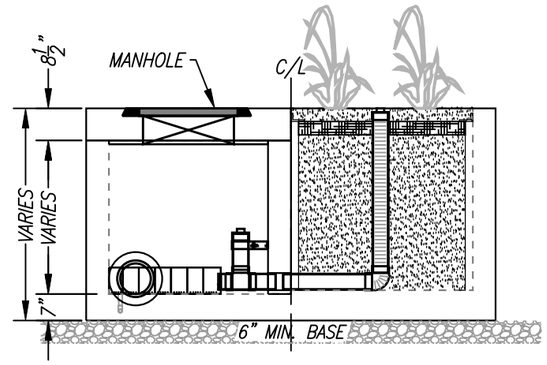
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ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	5.7
PRETREATMENT LOADING RATE (GPM/SF)	3.4
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

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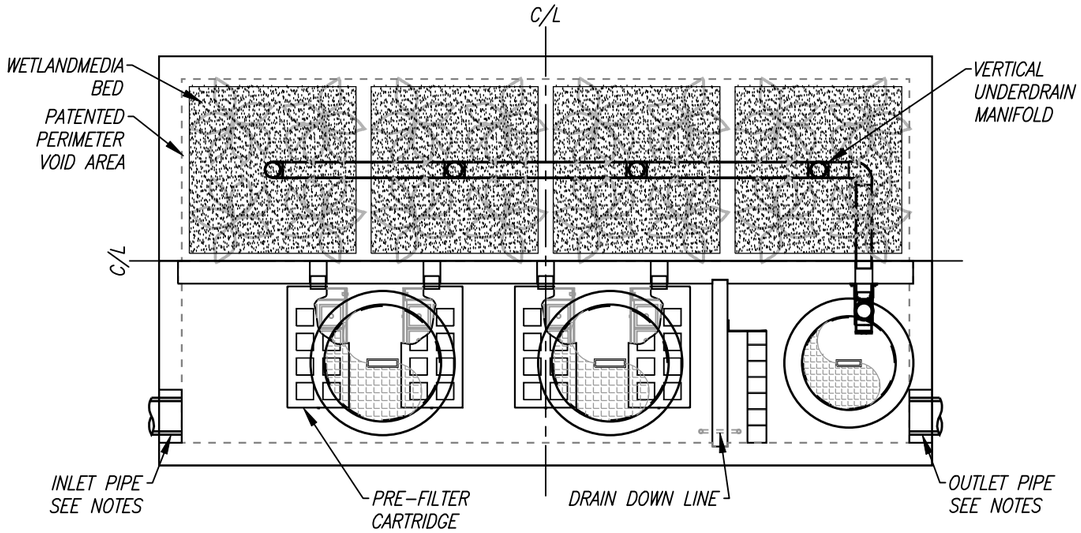
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MWS-L-8-12-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

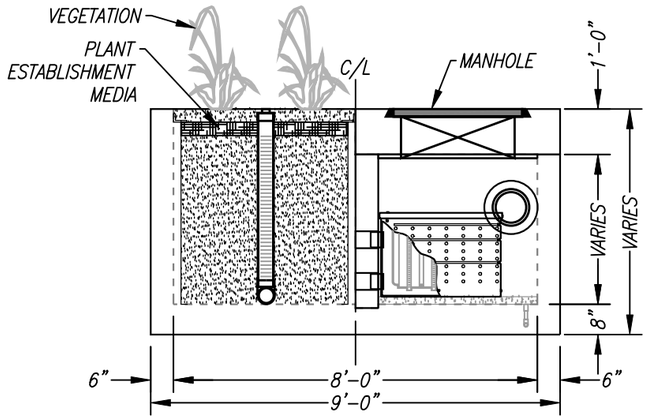
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SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.462	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
FRAME & COVER	2EA ø30"	OPEN PLANTER	ø24"
NOTES:			

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PLAN VIEW



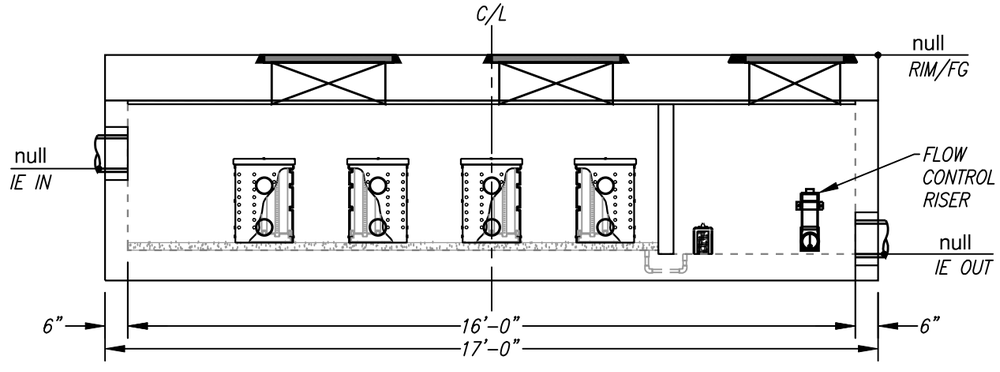
LEFT END VIEW

INSTALLATION NOTES

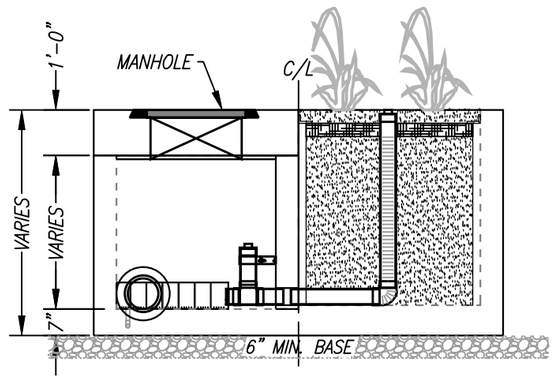
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ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	4.2
PRETREATMENT LOADING RATE (GPM/SF)	2.5
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

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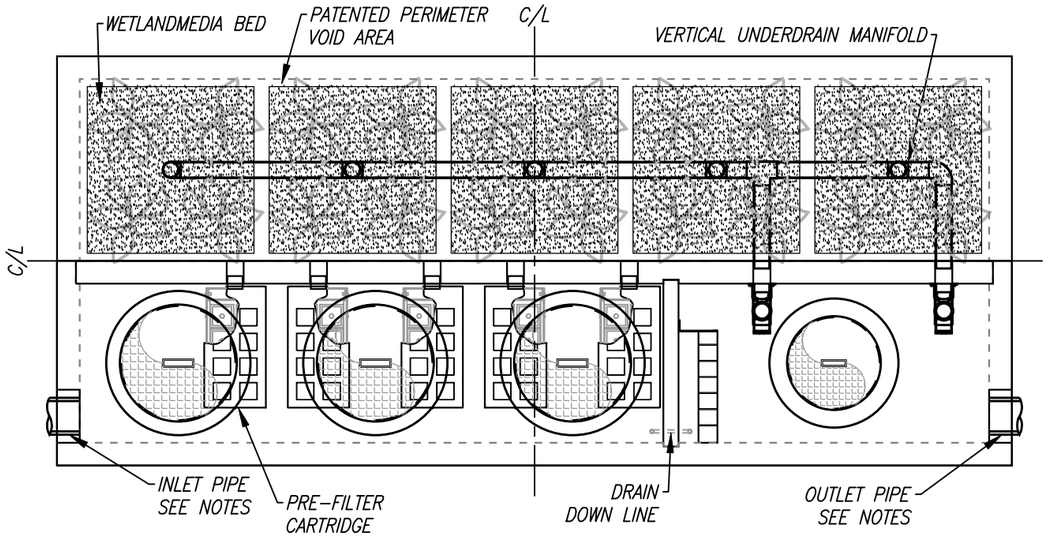
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STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

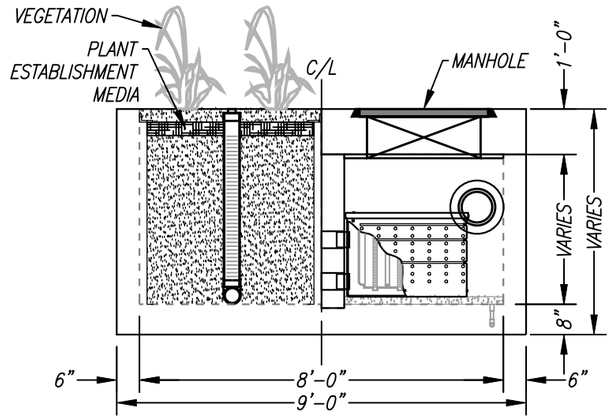
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SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.577	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN		
FRAME & COVER	3EA ø30"	OPEN PLANTER	ø24"
NOTES:			

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PLAN VIEW



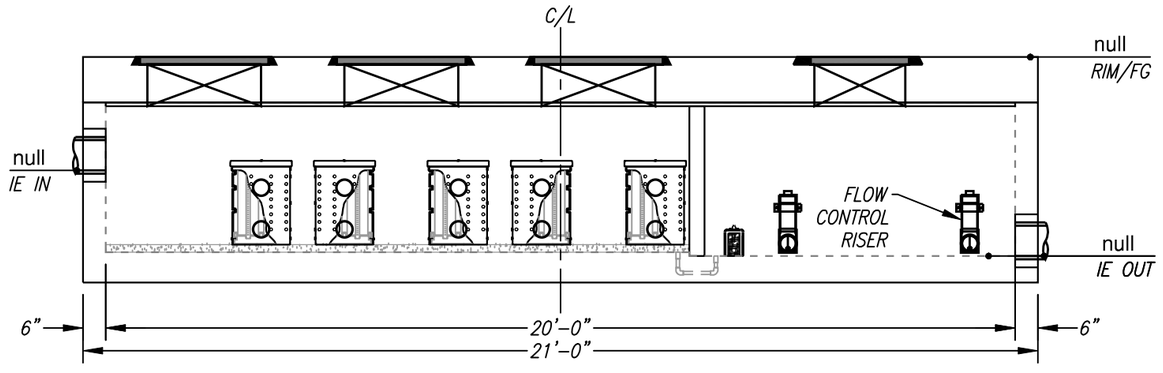
LEFT END VIEW

INSTALLATION NOTES

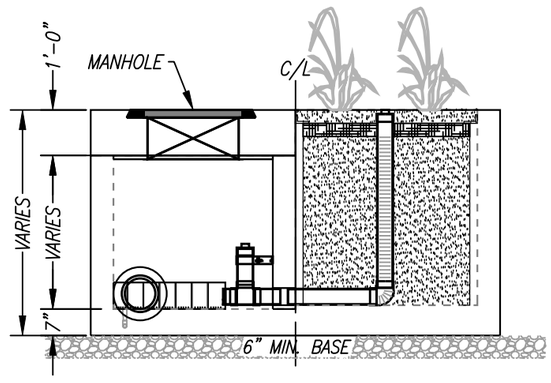
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ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.577
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

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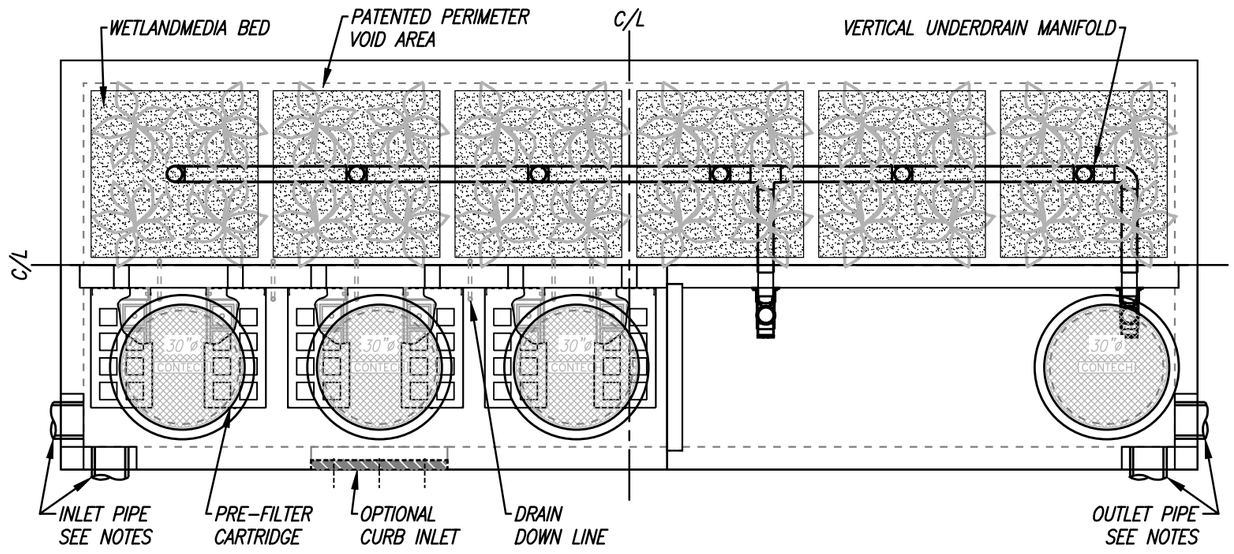
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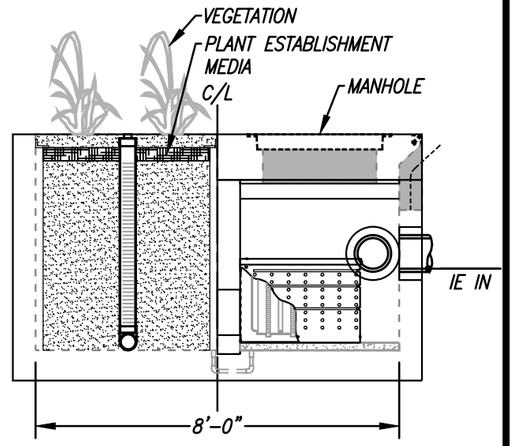
MWS-L-8-20-V
STORMWATER BIOFILTRATION SYSTEM STANDARD DETAIL

5/23/19 10:LEE

SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
TREATMENT FLOW (CFS)			
OPERATING HEAD (FT)			
PRETREATMENT LOADING RATE (GPM/SF)			
WETLAND MEDIA LOADING RATE (GPM/SF)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD			
NOTES:			



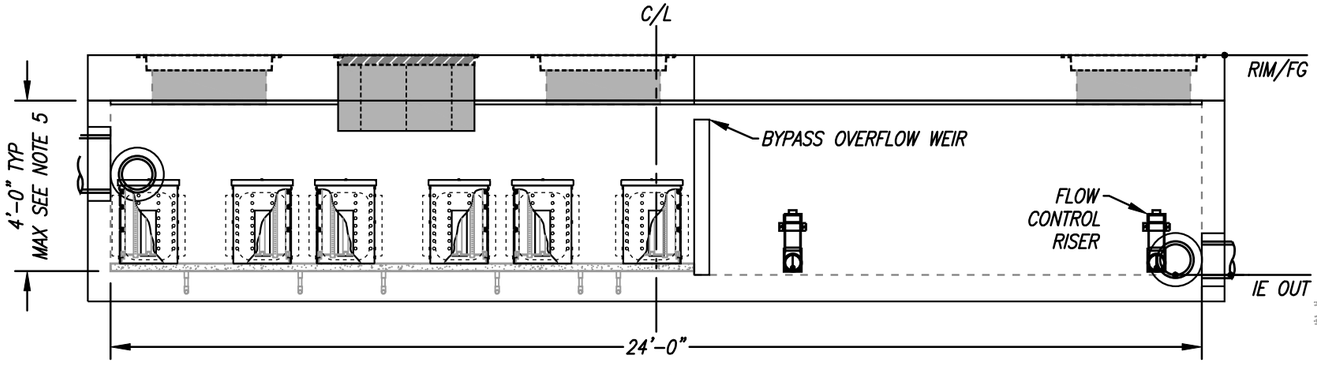
PLAN VIEW



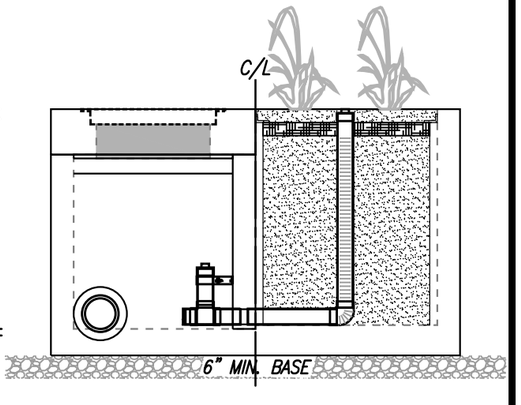
LEFT END VIEW

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURER'S SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
3. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
4. CONTRACTOR RESPONSIBLE FOR CONTACTING CONTECH FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A CONTECH REPRESENTATIVE.
5. VERTICAL HEIGHT VARIES BASED ON SITE SPECIFIC REQUIREMENTS.



ELEVATION VIEW



RIGHT END VIEW

MODULAR WETLANDS
FOR PATENT INFORMATION, GO TO www.ContechES.com/IP

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MWS-L-8-24-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

5/31/23TIM.GIRARD

WASHINGTON STATE DEPARTMENT OF ECOLOGY

July 2017

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

    - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
    - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
    - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. The applicant tested the MWS – Linear Modular Wetland Stormwater Treatment System with an external bypass weir. This weir limited the depth of water flowing through the media, and therefore the active treatment area, to below the root zone of the plants. This GULD applies to MWS – Linear Modular Wetland Stormwater Treatment Systems whether plants are included in the final product or not.
5. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.

    - Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
    - Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
    - Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific

maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).
- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

Applicant: Zach Kent
BioClean A Forterra Company.
398 Vi9a El Centro
Oceanside, CA 92058
zach.kent@forterrabp.com

Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	**Revision**
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment
December 2015	Updated GULD to document the acceptance of MWS-Linear Modular Wetland installations with or without the inclusion of plants
July 2017	Revised Manufacturer Contact Information (name, address, and email)

E.20 BF-3 Proprietary Biofiltration Systems

The purpose of this fact sheet is to help explain the potential role of proprietary BMPs in meeting biofiltration requirements, when full retention of the DCV is not feasible. The fact sheet does not describe design criteria like the other fact sheets in this appendix because this information varies by BMP product model.

Criteria for Use of a Proprietary BMP as a Biofiltration BMP

A proprietary BMP may be acceptable as a "biofiltration BMP" under the following conditions:

1. The BMP meets the minimum design criteria listed in **Appendix F**, including the pollutant treatment performance standard in **Appendix F.1**;
2. The BMP meets the performance standard for compact BMPs in **Table B.5-1** in **Appendix B.5;**
3. The BMP is designed and maintained in a manner consistent with its performance certifications (See explanation in **Appendix F.2**); and
4. The BMP is acceptable at the discretion of the City Engineer. In determining the acceptability of a BMP, the City Engineer should consider, as applicable, (a) the data submitted; (b) representativeness of the data submitted; (c) consistency of the BMP performance claims with pollutant control objectives; certainty of the BMP performance claims; (d) for projects within the public right of way and/or public projects: maintenance requirements, cost of maintenance activities, relevant previous local experience with operation and maintenance of the BMP type, ability to continue to operate the system in event that the vending company is no longer operating as a business; and (e) other relevant factors. If a proposed BMP is not accepted by the City Engineer, a written explanation/reason will be provided to the applicant.

Guidance for Sizing a Proprietary BMP as a Biofiltration BMP

Proprietary biofiltration BMPs must meet the same sizing guidance as non-proprietary BMPs. Sizing is typically based on capturing and treating 1.50 times the DCV not reliably retained. Guidance for sizing biofiltration BMPs to comply with requirements of this manual is provided in **Appendix B.5** and **Appendix F.2.**

Maintenance Overview

Refer to manufacturer for maintenance information.

E.18 BF-1 Biofiltration



Location: 43rd Street and Logan Avenue, San Diego, California

MS4 Permit Category
Biofiltration

Manual Category
Biofiltration

Applicable Performance Standard
Pollutant Control
Flow Control

Primary Benefits
Treatment
Volume Reduction (Incidental)
Peak Flow Attenuation (Optional)

Description

Biofiltration (Bioretention with underdrain) facilities are vegetated surface water systems that filter water through vegetation, and soil or engineered media prior to discharge via underdrain or overflow to the downstream conveyance system. Bioretention with underdrain facilities are commonly incorporated into the site within parking lot landscaping, along roadsides, and in open spaces. Because these types of facilities have limited or no infiltration, they are typically designed to provide enough hydraulic head to move flows through the underdrain connection to the storm drain system. Treatment is achieved through filtration, sedimentation, sorption, biochemical processes and plant uptake.

Typical bioretention with underdrain components include:

- Inflow distribution mechanisms (e.g, perimeter flow spreader or filter strips)
- Energy dissipation mechanism for concentrated inflows (e.g., splash blocks or riprap)
- Shallow surface ponding for captured flows
- Side slope and basin bottom vegetation selected based on expected climate and ponding depth
- Non-floating mulch layer (Optional)
- Media layer (planting mix or engineered media) capable of supporting vegetation growth
- Filter course layer consisting of aggregate to prevent the migration of fines into uncompacted native soils or the aggregate storage layer
- Aggregate storage layer with underdrain(s)
- Impermeable liner or uncompacted native soils at the bottom of the facility
- Overflow structure

Design Adaptations for Project Goals

Biofiltration Treatment BMP for storm water pollutant control. The system is lined or un-lined to provide incidental infiltration, and an underdrain is provided at the bottom to carry away filtered runoff. This configuration is considered to provide biofiltration treatment via flow through the media layer. Storage provided above the underdrain within surface ponding, media, and aggregate storage is considered included in the biofiltration treatment volume. Saturated storage within the aggregate storage layer can be added to this design by raising the underdrain above the bottom of the aggregate storage layer or via an internal weir structure designed to maintain a specific water level elevation.

Integrated storm water flow control and pollutant control configuration. The system can be designed to provide flow rate and duration control by primarily providing increased surface ponding and/or having a deeper aggregate storage layer above the underdrain. This will allow for significant detention storage, which can be controlled via inclusion of an outlet structure at the downstream end of the underdrain.

Recommended Siting Criteria

	Siting Criteria	*Intent/Rationale*
□	Placement observes geotechnical recommendations regarding potential hazards (e.g., slope stability, landslides, liquefaction zones) and setbacks (e.g., slopes, foundations, utilities).	Must not negatively impact existing site geotechnical concerns.
□	An impermeable liner or other hydraulic restriction layer is included if site constraints indicate that infiltration or lateral flows should not be allowed.	Lining prevents storm water from impacting groundwater and/or sensitive environmental or geotechnical features. Incidental infiltration, when allowable, can aid in pollutant removal and groundwater recharge.
□	Contributing tributary area shall be ≤ 5 acres (≤ 1 acre preferred).	Bigger BMPs require additional design features for proper performance. Contributing tributary area greater than 5 acres may be allowed at the discretion of the City Engineer if the following conditions are met: 1) incorporate design features (e.g. flow spreaders) to minimizing short circuiting of flows in the BMP and 2) incorporate additional design features requested by the City Engineer for proper performance of the regional BMP.
□	Finish grade of the facility is ≤ 2%.	Flatter surfaces reduce erosion and channelization within the facility.

Example Schematic Design – Plan and Section View

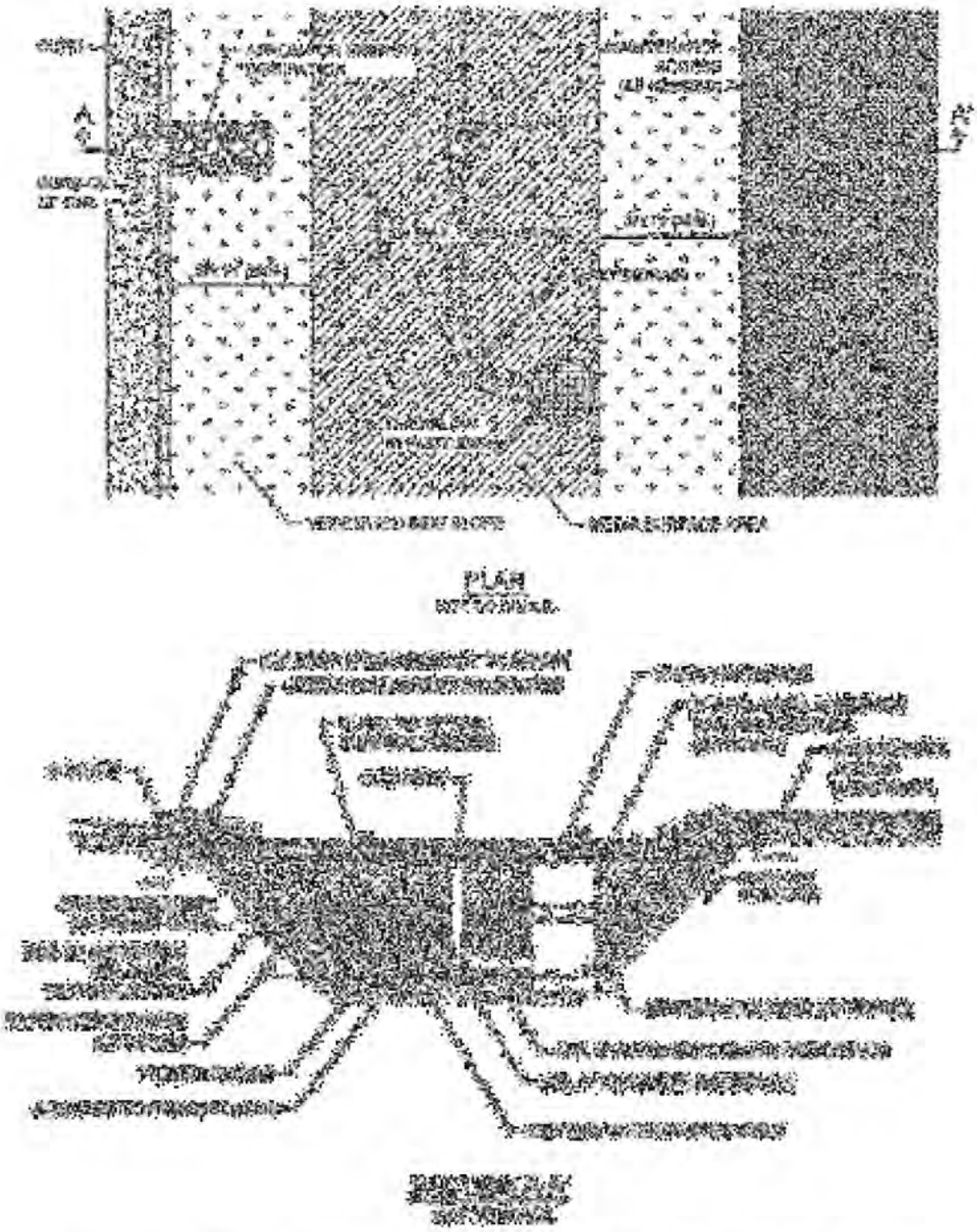


Figure E.18-1: Typical plan and Section view of a Biofiltration BMP

Recommended BMP Component Dimensions

BMP Component	*Dimension*	*Intent/Rationale*
Freeboard	≥ 2 inches	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge.
Surface Ponding	≥ 6 and ≤ 12 inches	Surface ponding capacity lowers subsurface storage requirements. Deep surface ponding raises safety concerns. Surface ponding depth greater than 12 inches (for additional pollutant control or surface outlet structures or flow-control orifices) may be allowed at the discretion of the City Engineer if the following conditions are met: 1) surface ponding depth drawdown time is less than 24 hours; and 2) safety issues and fencing requirements are considered (typically ponding greater than 18" will require a fence and/or flatter side slopes) and 3) potential for elevated clogging risk is considered.
Ponding Area Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Mulch	≥ 3 inches	Mulch will suppress weeds and maintain moisture for plant growth. Aging mulch kills pathogens and weed seeds and allows the beneficial microbes to multiply.
Media Layer	≥ 18 inches	A deep media layer provides additional filtration and supports plants with deeper roots. Standard specifications shall be followed. For non-standard or proprietary designs, compliance with F.1 ensures that adequate treatment performance will be provided.
Underdrain Diameter	≥ 6 inches	Smaller diameter underdrains are prone to clogging.
Cleanout Diameter	≥ 6 inches	Properly spaced cleanouts will facilitate underdrain maintenance.

Design Criteria and Considerations

Bioretention with underdrain must meet the following design criteria. Deviations from the below criteria may be approved at the discretion of the City Engineer if it is determined to be appropriate:

Siting Design Criteria		*Intent/Rationale*
Surface Ponding		
☐	Surface ponding is limited to a 24-hour drawdown time.	Surface ponding limited to 24 hours for plant health. Surface ponding drawdown time greater than 24-hours but less than 96 hours may be allowed at the discretion of the [City Engineer] if certified by a landscape architect or agronomist.
Vegetation		
☐	Plantings are suitable for the climate and expected ponding depth. A plant list to aid in selection can be found in Appendix E.26.	Plants suited to the climate and ponding depth are more likely to survive.
☐	An irrigation system with a connection to water supply should be provided as needed.	Seasonal irrigation might be needed to keep plants healthy.
Mulch		
☐	A minimum of 3 inches of well-aged, shredded hardwood mulch that has been stockpiled or stored for at least 12 months is provided.	Mulch will suppress weeds and maintain moisture for plant growth. Aging mulch kills pathogens and weed seeds and allows the beneficial microbes to multiply.
Media Layer		
☐	Media maintains a minimum filtration rate of 5 in/hr over lifetime of facility. An initial filtration rate of 8 to 12 in/hr is recommended to allow for clogging over time; the initial filtration rate should not exceed 12 inches per hour.	A filtration rate of at least 5 inches per hour allows soil to drain between events. The initial rate should be higher than long term target rate to account for clogging over time. However an excessively high initial rate can have a negative impact on treatment performance, therefore an upper limit is needed.
☐	Media is a minimum 18 inches deep, meeting either of these two media specifications: Section F.3 Bioretention Soil Media (BSM) or specific jurisdictional guidance. Alternatively, for proprietary designs and	A deep media layer provides additional filtration and supports plants with deeper roots. Standard specifications shall be followed.

Siting Design Criteria		*Intent/Rationale*
	custom media mixes not meeting the media specifications contained in the 2016 City Storm Water Standards or County LID Manual, the media meets the pollutant treatment performance criteria in Section F.1.	For non-standard or proprietary designs, compliance with F.1 ensures that adequate treatment performance will be provided.
☐	Media surface area is 3% of contributing area times adjusted runoff factor or greater. Unless demonstrated that the BMP surface area can be smaller than 3%.	Greater surface area to tributary area ratios: a) maximizes volume retention as required by the MS4 Permit and b) decrease loading rates per square foot and therefore increase longevity. Adjusted runoff factor is to account for site design BMPs implemented upstream of the BMP (such as rain barrels, impervious area dispersion, etc.). Refer to Appendix B.2 guidance. Use Worksheet B.5-1 Line 26 to estimate the minimum surface area required per this criteria.
☐	Where receiving waters are impaired or have a TMDL for nutrients, the system is designed with nutrient sensitive media design (see fact sheet BF-2).	Potential for pollutant export is partly a function of media composition; media design must minimize potential for export of nutrients, particularly where receiving waters are impaired for nutrients.
Filter Course Layer		
☐	A filter course is used to prevent migration of fines through layers of the facility. Filter fabric is not used.	Migration of media can cause clogging of the aggregate storage layer void spaces or subgrade. Filter fabric is more likely to clog.
☐	Filter course is washed and free of fines.	Washing aggregate will help eliminate fines that could clog the facility and impede infiltration.
☐	Filter course calculations assessing suitability for particle migration prevention have been completed.	Gradation relationship between layers can evaluate factors (e.g., bridging, permeability, and uniformity) to determine if particle sizing is appropriate or if an intermediate layer is needed.

	Siting Design Criteria	*Intent/Rationale*
	Aggregate Storage Layer	
☐	Class 2 Permeable per Caltrans specification 68-1.025 is recommended for the storage layer. Washed, open-graded crushed rock may be used, however a 4-6 inch washed pea gravel filter course layer at the top of the crushed rock is required.	Washing aggregate will help eliminate fines that could clog the aggregate storage layer void spaces or subgrade.
☐	The depth of aggregate provided (12-inch typical) and storage layer configuration is adequate for providing conveyance for underdrain flows to the outlet structure.	Proper storage layer configuration and underdrain placement will minimize facility drawdown time.
	Inflow, Underdrain, and Outflow Structures	
☐	Inflow, underdrains and outflow structures are accessible for inspection and maintenance.	Maintenance will prevent clogging and ensure proper operation of the flow control structures.
☐	Inflow velocities are limited to 3 ft/s or less or use energy dissipation methods. (e.g., riprap, level spreader) for concentrated inflows.	High inflow velocities can cause erosion, scour and/or channeling.
☐	Curb cut inlets are at least 12 inches wide, have a 4-6 inch reveal (drop) and an apron and energy dissipation as needed.	Inlets must not restrict flow and apron prevents blockage from vegetation as it grows in. Energy dissipation prevents erosion.
☐	Underdrain outlet elevation should be a minimum of 3 inches above the bottom elevation of the aggregate storage layer.	A minimal separation from subgrade or the liner lessens the risk of fines entering the underdrain and can improve hydraulic performance by allowing perforations to remain unblocked.
☐	Minimum underdrain diameter is 6 inches.	Smaller diameter underdrains are prone to clogging.
☐	Underdrains are made of slotted, PVC pipe conforming to ASTM D 3034 or equivalent or corrugated, HDPE pipe conforming to AASHTO 252M or equivalent.	Slotted underdrains provide greater intake capacity, clog resistant drainage, and reduced entrance velocity into the pipe, thereby reducing the chances of solids migration.
☐	An underdrain cleanout with a minimum 6-inch diameter and lockable cap is placed every 250 to 300 feet as required based on underdrain length.	Properly spaced cleanouts will facilitate underdrain maintenance.

Siting Design Criteria		*Intent/Rationale*
☐	Overflow is safely conveyed to a downstream storm drain system or discharge point Size overflow structure to pass 100-year peak flow for on-line infiltration basins and water quality peak flow for off-line basins.	Planning for overflow lessens the risk of property damage due to flooding.

Conceptual Design and Sizing Approach for Storm Water Pollutant Control Only

To design bioretention with underdrain for storm water pollutant control only (no flow control required), the following steps should be taken:

1. Verify that siting and design criteria have been met, including placement requirements, contributing tributary area, maximum side and finish grade slopes, and the recommended media surface area tributary ratio.
2. Calculate the DCV per **Appendix B** based on expected site design runoff for tributary areas.
3. Use the sizing worksheet presented in **Appendix B.5** to size biofiltration BMPs.

Conceptual Design and Sizing Approach when Storm Water Flow Control is Applicable

Control of flow rates and/or durations will typically require significant surface ponding and/or aggregate storage volumes, and therefore the following steps should be taken prior to determination of storm water pollutant control design. Pre-development and allowable post-project flow rates and durations should be determined as discussed in **Chapter 6** of the manual.

1. Verify that siting and design criteria have been met, including placement requirements, contributing tributary area, maximum side and finish grade slopes, and the recommended media surface area tributary ratio.
2. Iteratively determine the facility footprint area, surface ponding and/or aggregate storage layer depth required to provide detention storage to reduce flow rates and durations to allowable limits. Flow rates and durations can be controlled from detention storage by altering outlet structure orifice size(s) and/or water control levels. Multi-level orifices can be used within an outlet structure to control the full range of flows.
3. If bioretention with underdrain cannot fully provide the flow rate and duration control required by this manual, an upstream or downstream structure with significant storage volume such as an underground vault can be used to provide remaining controls.
4. After bioretention with underdrain has been designed to meet flow control requirements, calculations must be completed to verify if storm water pollutant control requirements to treat the DCV have been met.

Maintenance Overview

Normal Expected Maintenance. Biofiltration requires routine maintenance to: remove accumulated materials such as sediment, trash or debris; maintain vegetation health; maintain infiltration capacity of the media layer; replenish mulch; and maintain integrity of side slopes, inlets, energy dissipators, and outlets. A summary table of standard inspection and maintenance indicators is provided within this Fact Sheet.

Non-Standard Maintenance or BMP Failure. If any of the following scenarios are observed, the BMP is not performing as intended to protect downstream waterways from pollution and/or erosion. Corrective maintenance, increased inspection and maintenance, BMP replacement, or a different BMP type will be required.

- The BMP is not drained between storm events. Surface ponding longer than approximately 24 hours following a storm event may be detrimental to vegetation health, and surface ponding longer than approximately 96 hours following a storm event poses a risk of vector (mosquito) breeding. Poor drainage can result from clogging of the media layer, filter course, aggregate storage layer, underdrain, or outlet structure. The specific cause of the drainage issue must be determined and corrected.
- Sediment, trash, or debris accumulation greater than 25% of the surface ponding volume within one month. This means the load from the tributary drainage area is too high, reducing BMP function or clogging the BMP. This would require pretreatment measures within the tributary area draining to the BMP to intercept the materials. Pretreatment components, especially for sediment, will extend the life of components that are more expensive to replace such as media, filter course, and aggregate layers.
- Erosion due to concentrated storm water runoff flow that is not readily corrected by adding erosion control blankets, adding stone at flow entry points, or minor re-grading to restore proper drainage according to the original plan. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.

Other Special Considerations. Biofiltration is a vegetated structural BMP. Vegetated structural BMPs that are constructed in the vicinity of, or connected to, an existing jurisdictional water or wetland could inadvertently result in creation of expanded waters or wetlands. As such, vegetated structural BMPs have the potential to come under the jurisdiction of the United States Army Corps of Engineers, SDRWQCB, California Department of Fish and Wildlife, or the United States Fish and Wildlife Service. This could result in the need for specific resource agency permits and costly mitigation to perform maintenance of the structural BMP. Along with proper placement of a structural BMP, routine maintenance is key to preventing this scenario.

Summary of Standard Inspection and Maintenance

The property owner is responsible to ensure inspection, operation and maintenance of permanent BMPs on their property unless responsibility has been formally transferred to an agency, community facilities district, homeowners association, property owners association, or other special district.

Maintenance frequencies listed in this table are average/typical frequencies. Actual maintenance needs

are site-specific, and maintenance may be required more frequently. Maintenance must be performed whenever needed, based on maintenance indicators presented in this table. The BMP owner is responsible for conducting regular inspections to see when maintenance is needed based on the maintenance indicators. During the first year of operation of a structural BMP, inspection is recommended at least once prior to August 31 and then monthly from September through May. Inspection during a storm event is also recommended. After the initial period of frequent inspections, the minimum inspection and maintenance frequency can be determined based on the results of the first year inspections.

Threshold/Indicator	Maintenance Action	Typical Maintenance Frequency
Accumulation of sediment, litter, or debris	Remove and properly dispose of accumulated materials, without damage to the vegetation or compaction of the media layer.	• Inspect monthly. If the BMP is 25% full* or more in one month, increase inspection frequency to monthly plus after every 0.1-inch or larger storm event. • Remove any accumulated materials found at each inspection.
Obstructed inlet or outlet structure	Clear blockage.	• Inspect monthly and after every 0.5-inch or larger storm event. • Remove any accumulated materials found at each inspection.
Damage to structural components such as weirs, inlet or outlet structures	Repair or replace as applicable	• Inspect annually. • Maintain when needed.
Poor vegetation establishment	Re-seed, re-plant, or re-establish vegetation per original plans.	• Inspect monthly. • Maintain when needed.
Dead or diseased vegetation	Remove dead or diseased vegetation, re-seed, re-plant, or re-establish vegetation per original plans.	• Inspect monthly. • Maintain when needed.
Overgrown vegetation	Mow or trim as appropriate.	• Inspect monthly. • Maintain when needed.
2/3 of mulch has decomposed, or mulch has been removed	Remove decomposed fraction and top off with fresh mulch to a total depth of 3 inches.	• Inspect monthly.

Threshold/Indicator	Maintenance Action	Typical Maintenance Frequency
		• Replenish mulch annually, or more frequently when needed based on inspection.
Erosion due to concentrated irrigation flow	Repair/re-seed/re-plant eroded areas and adjust the irrigation system.	• Inspect monthly. • Maintain when needed.
Erosion due to concentrated storm water runoff flow	Repair/re-seed/re-plant eroded areas, and make appropriate corrective measures such as adding erosion control blankets, adding stone at flow entry points, or minor re-grading to restore proper drainage according to the original plan. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.	• Inspect after every 0.5-inch or larger storm event. If erosion due to storm water flow has been observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintain when needed. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.
Standing water in BMP for longer than 24 hours following a storm event Surface ponding longer than approximately 24 hours following a storm event may be detrimental to vegetation health	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, clearing underdrains, or repairing/replacing clogged or compacted soils.	• Inspect monthly and after every 0.5-inch or larger storm event. If standing water is observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintain when needed.
Presence of mosquitos/larvae For images of egg rafts, larva, pupa, and adult mosquitos, see http://www.mosquito.org/biology	If mosquitos/larvae are observed: first, immediately remove any standing water by dispersing to nearby landscaping; second, make corrective measures as applicable to restore BMP drainage to prevent standing water. If mosquitos persist following corrective measures to remove standing water, or if the BMP design does not meet the 96-	• Inspect monthly and after every 0.5-inch or larger storm event. If mosquitos are observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintain when needed.

Threshold/Indicator	Maintenance Action	Typical Maintenance Frequency
	hour drawdown criteria due to release rates controlled by an orifice installed on the underdrain, the City Engineer shall be contacted to determine a solution. A different BMP type, or a Vector Management Plan prepared with concurrence from the County of San Diego Department of Environmental Health, may be required.	
Underdrain clogged	Clear blockage.	• Inspect if standing water is observed for longer than 24-96 hours following a storm event. • Maintain when needed.

E.2 SC-Q: Large Trash Generating Facilities



MS4 Permit Category
Source Control

BMP Manual Category
Source Control

Applicable Performance Standard
Source Control

Primary Benefits
Source Control

Description

Storm water 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 to nearby storm drain inlets, channels, and/or creeks. Trash generating facilities that generate large amounts of trash require special attention to protect trash storage areas from rainfall, run-on, runoff, and wind dispersal. Large trash generating, or trash build-up areas, include but are not limited to restaurants, supermarkets, "big box" retail stores serving food, and pet stores. The City Engineer may designate additional facilities if they are likely to generate or accumulate large quantities of trash.

Design Adaptations for Project Goals

Source control BMPs reduce the amount of pollutants that are generated. This fact sheet contains details on the additional measures required to prevent or reduce pollutants in storm water runoff associated with trash storage and handling for large trash generating facilities. The requirements presented here are in addition to the requirements of **SC-5** which requires all development projects to protect trash storage areas from rainfall, run-on, runoff, and wind dispersal:

- **Areas where trash containers are stored must be enclosed on four sides to prevent off-site transport of trash**. Four-sided trash enclosures typically consist of three walled sides and one gated side. Trash enclosures limit the potential for trash to pollute storm water runoff by limiting mobilization mechanisms (runoff, run-on, and wind dispersal).
- **Trash enclosures must be covered to minimize direct precipitation and prevent rainfall from entering enclosures**. Structural overhead covers are required as container lids are often left open.
- **Enclosures must be hydraulically isolated from surrounding areas**. Slabs shall be sloped such that any leaked materials will be contained within the enclosure. Drains must be provided

that capture and direct potential leaks to the sanitary sewer or appropriate BMPs. Divert runoff from surrounding areas away from the enclosure to prevent contamination and dispersion of collected materials.

- **Owner must provide BMP storm water training to employees**. Employee participation is required to ensure that enclosures are properly maintained and kept clean.

Design Guidelines

All trash shall be stored in weather-protected receptacles/bins and recyclable materials shall be protected against adverse weather conditions, which might render the collected materials unmarketable. Trash enclosure dimensions will vary based on projected usage and the following information is offered as an aid in planning new projects. Businesses that use dumpsters must design the enclosure to accommodate three-yard containers at a minimum. The tenants may use any dumpster size that is appropriate for their needs, but the enclosure must be able to accommodate different tenants with varying waste production, including any recycling requirements. The design of the enclosure must be signed and sealed by a California licensed engineer. Substantiating structural calculations may be required. The location and design of the enclosure will require review and approval by the City Engineer. Building permits may be required.

The following recommendations for typical bin sizes are adopted from the City of Escondido trash enclosure guidelines. The following bin/container measurements are approximate (add 8" to width for side pockets):

Typical Trash Bin Sizes

Size	Width	Depth	Height(front)	Height (back)
3 cubic yard	72" bin, 81" plus lid	43"	42"	70"
4 cubic yard	72" bin, 81" plus lid	56"	72"	72"

Filled weight should not exceed 1,000 pounds.

Design Criteria

1. Enclosures shall be structurally strong and constructed of reinforced masonry block or wood panels/boards. Structural requirements for enclosures are detailed in the City of San Diego specification for Woods and masonary Fences.

   http://www.sandiego.gov/development-services/pdf/industry/infobulletin/ib223.pdf

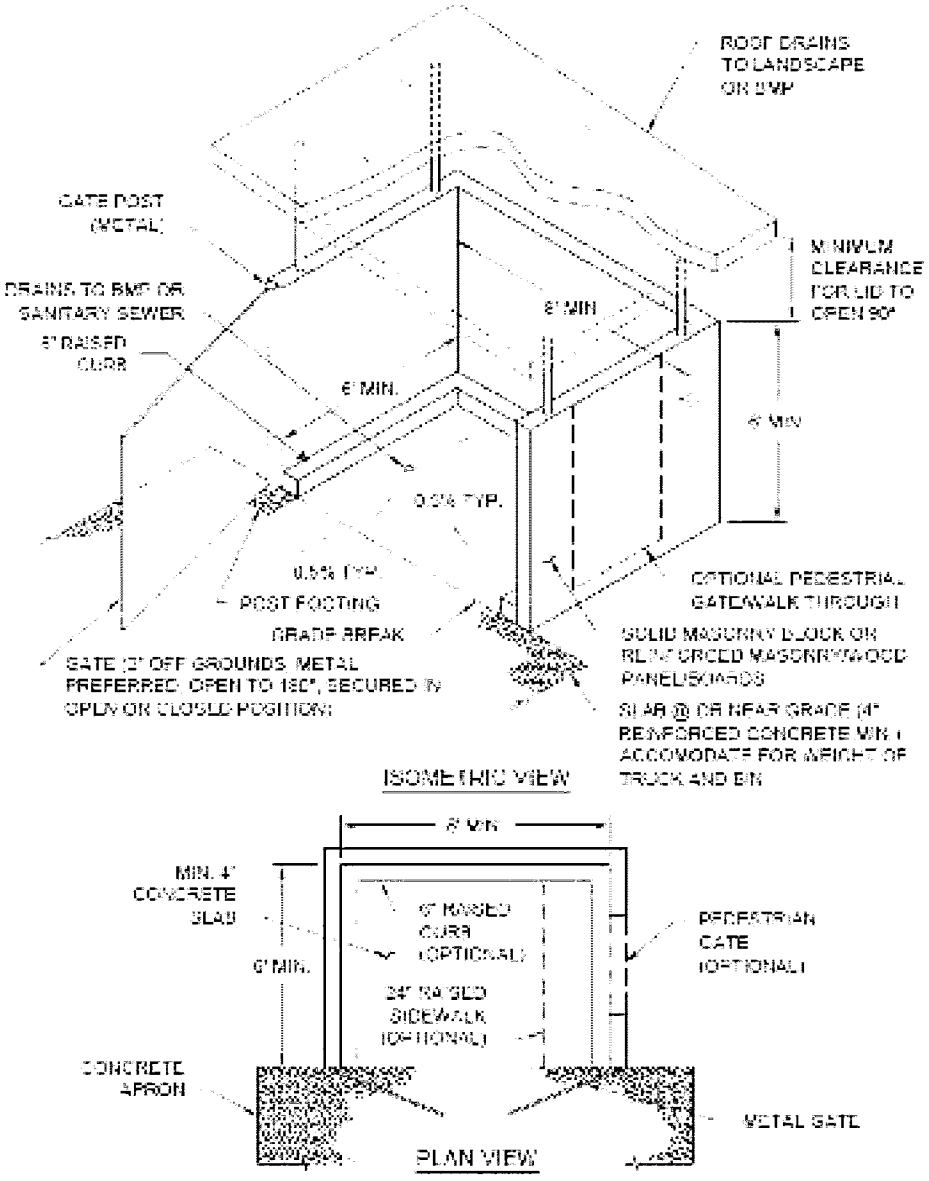
2. The enclosure should be constructed to the following minimum inside dimensions to accommodate three cubic-yard dumpsters (larger enclosures may be necessary to accommodate additional trash bins, recycling bins, and accessibility):

No. of Bins	Loading	Width	Depth	Height
One	Front	8'	6'	6'
One	Side	7.5'	8'	6'
Two	Front	16'	6'	6'
Two	Side	8'	16'	6'

3. The enclosure slab should be designed to keep storm water drainage out of the enclosure area, typically sloped at 0.5%. Slab construction specifications will vary according to methods of construction, but should be at least 4 inches of reinforced concrete.
4. Sturdy gates/doors shall be installed on all enclosures. Gates should not be mounted directly onto the block wall or inside of enclosure. The enclosure should include hardware to secure the gate's doors both open and closed (i.e., cane bolt w/sleeve and latch between doors and sleeve in pavement).
5. To prevent trash enclosures from contributing to storm water runoff pollution, all enclosures must be fitted with a roof deigned to drain into on-site landscape areas (where necessary) and/or to appropriate BMPs. The roof must provide sufficient clearance to allow the dumpster lid to open to the 90 degree position.
6. Enclosure roofs not conforming to City specifications for Patio Covers may require a building permit. Generally roofs not more than 12 feet in height above grade and constructed with conventional light-frame wood construction are considered acceptable. The use of metal roofs is not recommended as they can act as a source of pollutants.

   http://www.sandiego.gov/development-services/pdf/industry/infobulletin/ib206.pdf
7. Dumpsters associated with food establishments shall be sized per County Health Department requirements for wash down. Drains shall be connected to the business grease interceptor.

Example isometric view and plan view of an allowable trash enclosure facility is presented below. The project applicant may be allowed to use an alternative trash enclosure design that might be more appropriate for a project site if the alternative design is approved by the City Engineer.



Typical Isometric and Plan View of a Trash Enclosure BMP

E.7 SD-B Impervious Area Dispersion



Photo Credit: Orange County Technical Guidance Document

MS4 Permit Category
Site Design
Manual Category
Site Design
Applicable Performance Criteria
Site Design
Primary Benefits
Volume Reduction Peak Flow Attenuation

Description

Impervious area dispersion (dispersion) refers to the practice of effectively disconnecting impervious areas from directly draining to the storm drain system by routing runoff from impervious areas such as rooftops (through downspout disconnection), walkways, and driveways onto the surface of adjacent pervious areas. The intent is to slow runoff discharges, and reduce volumes. Dispersion with partial or full infiltration results in significant volume reduction by means of infiltration and evapotranspiration.

Typical dispersion components include:

- An impervious surface from which runoff flows will be routed with minimal piping to limit concentrated inflows
- Splash blocks, flow spreaders, or other means of dispersing concentrated flows and providing energy dissipation as needed
- Dedicated pervious area, typically vegetated, with in-situ soil infiltration capacity for partial or full infiltration
- Optional soil amendments to improve vegetation support, maintain infiltration rates and enhance treatment of routed flows
- Overflow route for excess flows to be conveyed from dispersion area to the storm drain system or discharge point

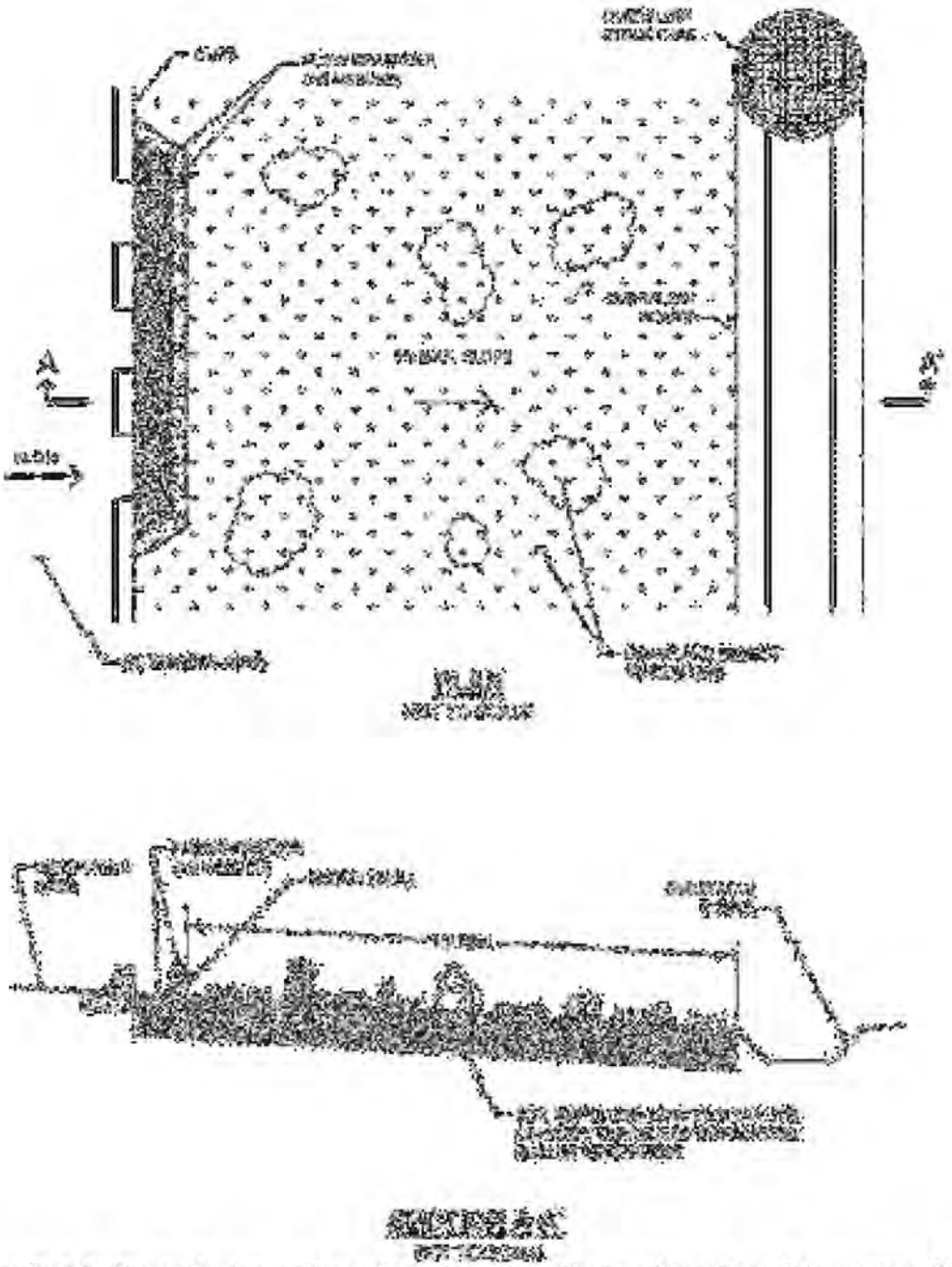


Figure E.7-1: Typical plan and section view of an Impervious Area Dispersion BMP

Design Adaptations for Project Goals

Site design BMP to reduce impervious area and DCV. Impervious area dispersion primarily functions as a site design BMP for reducing the effective imperviousness of a site by providing partial or full infiltration of the flows that are routed to pervious dispersion areas and otherwise slowing down excess flows that eventually reach the storm drain system. This can significantly reduce the DCV for the site.

Design Criteria and Considerations

Dispersion must meet the following design criteria. Deviations from the below criteria may be approved at the discretion of the City Engineer if it is determined to be appropriate:

Siting and Design	Intent/Rationale
☐ Dispersion is over areas with soil types capable of supporting or being amended (e.g., with sand or compost) to support vegetation. Media amendments must be tested to verify that they are not a source of pollutants.	Soil must have long-term infiltration capacity for partial or full infiltration and be able to support vegetation to provide runoff treatment. Amendments to improve plant growth must not have negative impact on water quality.
☐ Dispersion has vegetated sheet flow over a relatively large distance (minimum 10 feet) from inflow to overflow route.	Full or partial infiltration requires relatively large areas to be effective depending on the permeability of the underlying soils.
☐ Pervious areas should be flat (with less than 5% slopes) and vegetated.	Flat slopes facilitate sheet flows and minimize velocities, thereby improving treatment and reducing the likelihood of erosion.
Inflow velocities	
☐ Inflow velocities are limited to 3 ft/s or less or use energy dissipation methods (e.g., riprap, level spreader) for concentrated inflows.	High inflow velocities can cause erosion, scour and/or channeling.
Dedication	
☐ Dispersion areas must be owned by the project owner and be dedicated for the purposes of dispersion to the exclusion of other future uses that might reduce the effectiveness of the dispersion area.	Dedicated dispersion areas prevent future conversion to alternate uses and facilitate continued full and partial infiltration benefits.
Vegetation	
☐ Dispersion typically requires dense and robust vegetation for proper function. Drought tolerant species should be selected to minimize irrigation needs. A plant list to aid in selection can be found in Appendix E.26.	Vegetation improves resistance to erosion and aids in runoff treatment.

Conceptual Design and Sizing Approach for Site Design

1. Determine the areas where dispersion can be used in the site design to reduce the DCV for pollutant control sizing.
2. Calculate the DCV for storm water pollutant control per Appendix B.2, taking into account reduced runoff from dispersion.

3. Determine if a DMA is considered "Self-retaining" if the impervious to pervious ratio is:
    a. 2:1 when the pervious area is composed of Hydrologic Soil Group A
    b. 1:1 when the pervious area is composed of Hydrologic Soil Group B
4. If the top 12 inches uses amended soils in accordance with SD-F, the runoff coefficient (c-factor) for the amended area is 0.1

Conceptional Design and Sizing Approach for Storm Water Pollutant Treatment and Flow Control

DMAs using impervious area dispersion are considered to meet both pollutant control and hydromodification flow control requirements if ALL of the following criteria are met:

1. All impervious area within the DMA discharges to the pervious area before the runoff discharges from the DMA.
2. As a minimum, the top 11 inches of the pervious area uses amended soils in accordance with the SD-F fact sheet and the pervious area also meets the requirements for dispersion (e.g. slope, inflow velocities, etc.) in the SD-B fact sheet.
3. The impervious to pervious area ratio is 1:1 or less.

Maintenance Overview

Normal Expected Maintenance. Vegetated area shall be maintained as part of normal landscape maintenance. Additionally, ensure that storm water runoff can be conveyed into the vegetated area as designed. That is, the mechanism that allows storm water runoff from impervious area to flow into the pervious area (e.g., a curb cut allows runoff from a parking lot to drain onto adjacent landscaping area, or a roof drain outlet is directed to a lawn) shall not be removed, blocked, filled, or otherwise changed in a manner that prevents storm water from draining into the pervious area. A summary table of standard inspection and maintenance indicators is provided within this Fact Sheet.

Non-Standard Maintenance or BMP Failure. Impervious area dispersion is a site design BMP that normally does not require maintenance actions beyond routine landscape maintenance. If changes have been made to the area, such as the vegetated area has been replaced with impervious area, or the mechanism that allows storm water runoff from impervious area to flow into the pervious area has been removed (e.g., roof drains previously directed to vegetated area have been directly connected to the street or storm drain system), the BMP is not performing as intended to protect downstream waterways from pollution and/or erosion. Corrective maintenance will be required to restore drainage into the pervious area as designed. If the pervious area has been removed, contact the City Engineer to determine a solution.

Runoff directed into vegetated areas is expected to be drained within 24-96 hours following a storm event. Surface ponding longer than approximately 24 hours following a storm event may be detrimental to vegetation health, and surface ponding longer than approximately 96 hours following a storm event poses a risk of vector (mosquito) breeding. Poor drainage can result from clogging or compaction of the soils. Loosen or replace the soils to restore drainage.

Other Special Considerations. Site design BMPs, such as impervious area dispersion, installed within a new development or redevelopment project are components of an overall storm water management strategy for the project. The presence of site design BMPs within a project is usually a factor in the

determination of the amount of runoff to be managed with structural BMPs (i.e., the amount of runoff expected to reach downstream retention or biofiltration basins that process storm water runoff from the project as a whole). When site design BMPs are not maintained or are removed, this can lead to clogging or failure of downstream structural BMPs due to greater delivery of runoff and pollutants than intended for the structural BMP. Therefore, the City Engineer may require confirmation of maintenance of site design BMPs as part of their structural BMP maintenance documentation requirements. Site design BMPs that have been installed as part of the project should not be removed, nor should they be bypassed by re-routing roof drains or re-grading surfaces within the project. If changes are necessary, consult the City Engineer to determine requirements.

Summary of Standard Inspection and Maintenance

The property owner is responsible to ensure inspection, operation and maintenance of permanent BMPs on their property unless responsibility has been formally transferred to an agency, community facilities district, homeowners association, property owners association, or other special district.

Maintenance frequencies listed in this table are average/typical frequencies. Actual maintenance needs are site-specific, and maintenance may be required more frequently. Maintenance must be performed whenever needed, based on maintenance indicators presented in this table. The BMP owner is responsible for conducting regular inspections to see when maintenance is needed based on the maintenance indicators. During the first year of operation of a structural BMP, inspection is recommended at least once prior to August 31 and then monthly from September through May. Inspection during a storm event is also recommended. After the initial period of frequent inspections, the minimum inspection and maintenance frequency can be determined based on the results of the first year inspections.

Threshold/Indicator	Maintenance Action	Typical Maintenance Frequency
Poor vegetation establishment	Re-seed, re-plant, or re-establish vegetation per original plans.	• Inspect monthly. • Maintain when needed.
Dead or diseased vegetation	Remove dead or diseased vegetation, re-seed, re-plant, or re-establish vegetation per original plans.	• Inspect monthly. • Maintain when needed.
Overgrown vegetation	Mow or trim as appropriate.	• Inspect monthly. • Maintain when needed.
Standing water in vegetated pervious area for longer than 24 hours following a storm event Surface ponding longer than approximately 24 hours following a storm event may be detrimental to vegetation health	Disperse any areas of standing water to nearby landscaping (i.e., spread it out to another portion of the pervious area so it drains into the soil). Make appropriate corrective measures such as adjusting irrigation system, or	• Inspect monthly and after every 0.5-inch or larger storm event. If standing water is observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintain when needed.

Threshold/Indicator	Maintenance Action	Typical Maintenance Frequency
	repairing/replacing clogged or compacted soils.	
Presence of mosquitos/larvae For images of egg rafts, larva, pupa, and adult mosquitos, see http://www.mosquito.org/biology	Disperse any areas of standing water to nearby landscaping (i.e., spread it out to another portion of the pervious area so it drains into the soil). Loosen or replace soils to restore drainage (and prevent standing water)	• Inspect monthly and after every 0.5-inch or larger storm event. If mosquitos are observed, increase inspection frequency to after every 0.1-inch or larger storm event. • Maintain when needed
Entrance / opening to the vegetated pervious area is blocked such that storm water from impervious area will not drain into the pervious area (e.g., a curb cut opening is blocked by debris or a roof drain outlet has been directly connected to the storm drain system)	Make repairs as appropriate to restore drainage into the vegetated pervious area.	• Inspect monthly. • Maintain when needed.

E.11 SD-F Amended Soils



Photo Credit: Orange County Technical Guidance Document

MS4 Permit Category
Site Design
Manual Category
Site Design
Applicable Performance Standard
Site Design
Primary Benefits
Volume Reduction Peak Flow Attenuation

Description

Amended soils are soils whose physical, chemical, and biological characteristics have been altered from the natural condition to promote beneficial storm water characteristics. Amended soils shall be used as part of SD-B Impervious Area Dispersion, where applicable. Typical storm water management benefits associated with amended soils include:

- **Improved hydrologic characteristics**—amended soils can promote infiltration, decrease runoff rates and volumes, and more effectively filter pollutants from storm water runoff
- **Improved vegetation health**—amended soils provide greater moisture retention, and altered chemical and biological characteristics that can result in healthier plant growth, reduced irrigation demands, and reduced need for fertilization and maintenance
- **Reduced erosion**—amended soils produce healthier plant growth and reduced runoff which results in reduced soil erosion

Not all amended soils have the same storm water benefits, the soil amendment used should be suited for the design purpose and design period of the amended area.

Design Adaptations for Project Goals

Varying categories of soil amendments have different benefits and applications. Mulch is a soil amendment that is added at grade, rather than mixed into the soil. Mulch reduces evaporation and improves retention. Shavings and compost are common soil amendments that improve biological and chemical properties of the soil. Sand can be used as an amendment to improve the drainage rates of amended soils. Native soil samples may need to be analyzed by a lab to determine the specific soil amendments needed to achieve the desired infiltration, retention, and/or filtration rates, as well as, to provide a growing medium for healthy plant growth.

Important Considerations

Maintenance: Annual maintenance may be required to determine reapplication requirements of amended soils. Amended soils should be regularly inspected for signs of compaction, waterlogging, and unhealthy vegetation.

Limitations: Not all amended soils have the same storm water benefits, the soil amendment used should be suited for the design purpose and design period of the amended area.

Design Criteria and Considerations

Soil amendments must meet the following design criteria and considerations. Deviations from the below criteria may be approved at the discretion of the City Engineer if appropriate:

	Siting and Design	*Intent/Rationale*
☐	When mulch is used as an amendment, it is applied at grade over all planting areas to a depth of 3".	Mulch should be applied on top and not mixed into underlying soils
☐	When shavings or compost is used as an amendment, it is rototilled into the native soil to a minimum depth of 6" (12 inches preferred).	If soil is not completely mixed the overall benefit will be reduced.
☐	Compost meets the criteria in Appendix F.3.1.2	If poor quality compost is used, it will have negative impact to water quality.
☐	Soil amendments are free of stones, stumps, roots, glass, plastic, metal, and other deleterious materials.	Large debris in amended soils can cause localized erosion. Trash/harmful materials can result in personal injury or contamination.
☐	Mixing of soils are done prior to planting	Soil mixing before planting results in a more homogeneous mixing and will reduce the stress on plants.
☐	Care is taken around existing trees and shrubs to prevent root damage during construction and soil amendment application.	Preservation of existing established vegetation is an important part of site design and erosion control.
☐	Soil amendments are applied at the end of construction	Soil amendments applied too soon in the construction process may become over compacted reducing effectiveness.
☐	Soil amendments are compatible with planned vegetation	The soil amendments impact the pH and salinity of the soil. Some plants have sensitive pH and/or salinity tolerance ranges.

Conceptual Design and Sizing Approach for Site Design

- When soil amendments are used a runoff factor of 0.1 can be used for DCV calculation for the amended area.
- Amended soils should be used as part of SD-B Impervious Area Dispersion, and to increase the retention volume in other BMPs.

Maintenance

Annual maintenance may be required to determine reapplication requirements of amended soils. Amended soils should be regularly inspected for signs of compaction, waterlogging, and unhealthy vegetation.

ATTACHMENT 2

Backup for PDP Hydromodification Control Measures

☒ Mark this box if this attachment is empty because the project is exempt from PDP hydromodification management requirements.

Project Name/ Yards at the Bay

Indicate which Items are Included

Letter indicating Hydromodification exemption is provided after this sheet.

Attachment Sequence	Contents	Checklist
Attachment 2A	Hydromodification Management Exhibit (Required)	☒ Included See Hydromodification Management Exhibit Checklist.
Attachment 2B	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual. CCSYA requirements are not applicable since the project is Hydromodification Exempt.	☐ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map **(Required)** Optional analyses for Critical Coarse Sediment Yield Area Determination ☐ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2C	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	☐ Not performed ☐ Included ☐ Submitted as separate stand-alone document
Attachment 2D	Flow Control Facility Design and Structural BMP Drawdown Calculations (Required) Overflow Design Summary for each Structural BMP See Chapter 6 and Appendix G of the BMP Design Manual	☐ Included ☐ Submitted as separate stand-alone document

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May 2, 2023

Mike Knapton
PSIP Wohl Bay Boulevard LLC
2251 San Diego Avenue, Suite A-247
San Diego, CA 92110

Subject: Parcel B Hydromodification Exemption

Dear Mike:

I have performed a hydromodification assessment of the Parcel B redevelopment project and determined that the project meets the hydromodification exemption criteria. The site is located on the north side of H Street east of Marina Parkway in the city of Chula Vista (see Figure 1). The redevelopment will occur over a currently impervious site comprising approximately 35.5 acres. The future site plan is undetermined, but the Specific Plan will re-zone the property around two distinct Planning Areas, B-1 and B-2. The project will install stormwater quality best management practices in accordance with the City of Chula Vista's *BMP Design Manual*.

The project's treated storm runoff will be conveyed by separate storm drain systems in two directions (north and south) towards San Diego Bay west of the site. The north system outlets at a 54-inch RCP into a slough just northwest of the site (see Figure 1). The slough is directly connected to San Diego Bay. This storm drain system extends along the northerly edge of the site, so will collect the project's northerly storm runoff.

The south system outlet is from an 84-inch RCP that discharges into San Diego Bay at the Chula Vista Marina (see Figure 2). This storm drain system extends along H Street adjacent to Parcel B. Storm runoff from the southerly project area will be collected by this system. The 84-inch RCP outlet into San Diego Bay is the same one that is below your 795 H Street project. Chang Consultants prepared a March 13, 2023, hydromodification exemption letter for the 795 H Street project that was approved by the City of Chula Vista. Since both project's have the same outlet into San Diego Bay, the portion of Parcel B that drains to the south system is hydromodification exempt.

The north storm drain system to San Diego Bay is an uninterrupted, hardened conveyance, so potentially qualifies for a hydromodification exemption. The *BMP Design Manual* outlines criteria for a hydromodification exemption. Attached Figure 1-2 is a flow chart to determine if an exemption applies. The project is a priority development project under Step 1. The north system does not discharge to the Pacific Ocean per Step 2, but does have a direct discharge to a non-protected enclosed embayment per Step 3. San Diego Bay is identified as an enclosed embayment

in the *BMP Design Manual*. Step 3 states that an outfall must not be located within a wildlife refuge. The US Fish & Wildlife Service maps wildlife refuges along San Diego Bay (see Figure 3). Figure 3 shows that the only refuge in the area is the San Diego Bay National Wildlife Refuge. The north system's outfall is south of and not within this refuge. The Step 3 hydromodification exemption criteria requires proper energy dissipation at the drainage outlet and the outlet invert elevation be equal to or below the mean high tide elevation. Figure 4 shows that the storm drain outfall discharges below the San Diego Bay water surface. The water will effectively dissipate outflow. The plans for the 54-inch outlet are attached and show that the flow line elevation is 2.04 feet MLLW datum. The attached NOAA Tides & Currents web-site information indicates that mean high tide is 4.99 feet MLLW. Therefore, the outlet is below the mean tide level and all of the Step 3 criteria are met.

This information indicates that the Parcel B redevelopment project meets the City of Chula Vista's criteria for a hydromodification exemption. Storm runoff from the southerly portion of the project will be conveyed to a storm drain outlet into the Chula Vista Marina that was determined to be exempt by a March 13, 2023, Chang Consultants letter approved by the City. Furthermore, this letter shows that the project's northerly storm runoff will be conveyed directly in a non-erodible storm drain system to the hydromodification exempt San Diego Bay.

Sincerely,

Wayne W. Chang, M.S., P.E.

Attachments




FIGURE 1 - NORTH DRAINAGE SYSTEM
POC 2
Existing 54" RCP storm drain discharges into slough which extends from San Diego Bay
54" RCP
42" RCP
36" RCP
48" RCP
42" RCP
POC 2
PRIVATE STREET
G STREET
FORMERLY MARINA PARKWAY
Existing 72" RCP storm drain discharges into San Diego Bay (see Figure 2)
H STREET
Legend
Parcel B
Google Earth
700 ft
N

Figure 2: South Storm Drain System POC 1A AND 1B

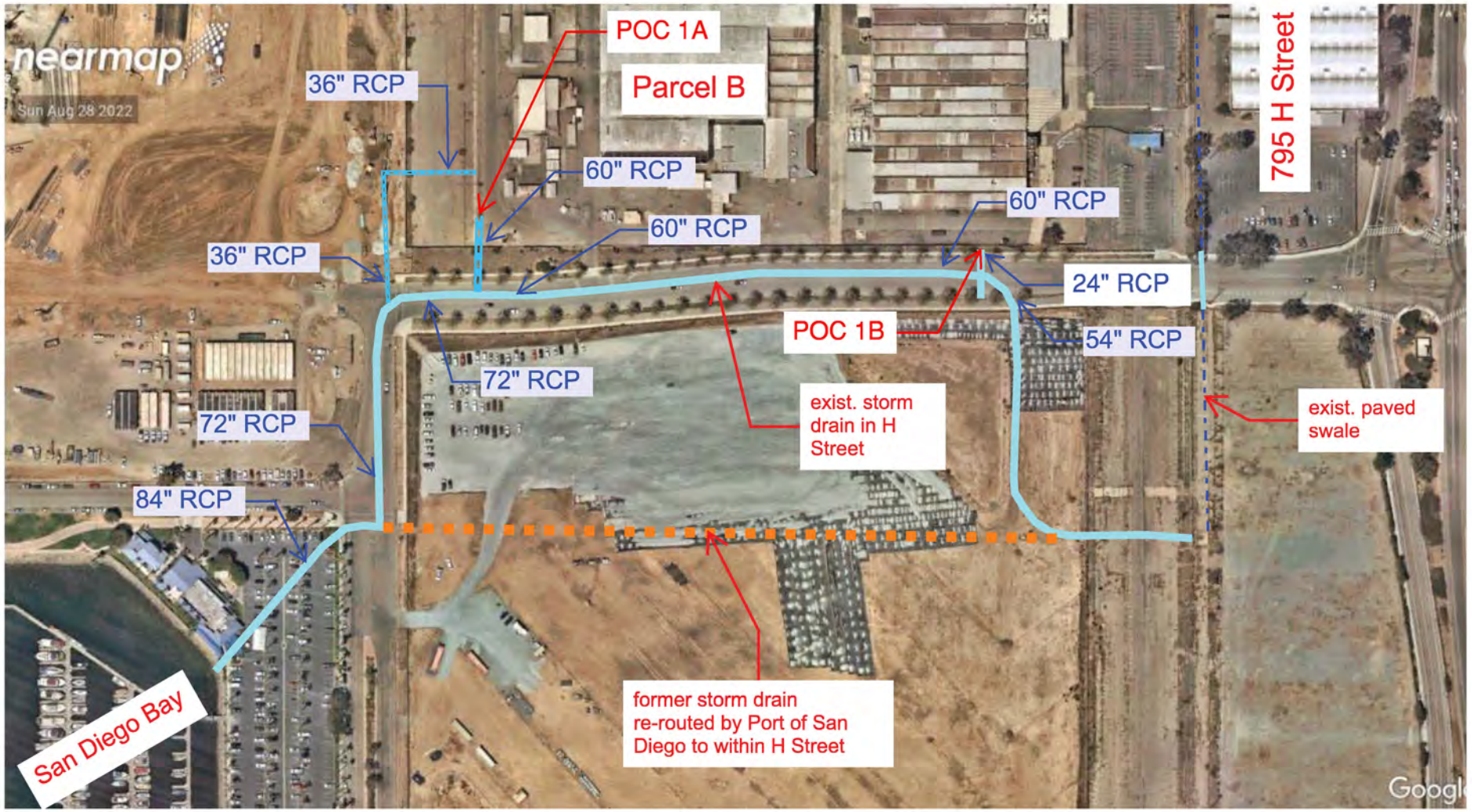




Figure 3. USFWS Refuge Mapping

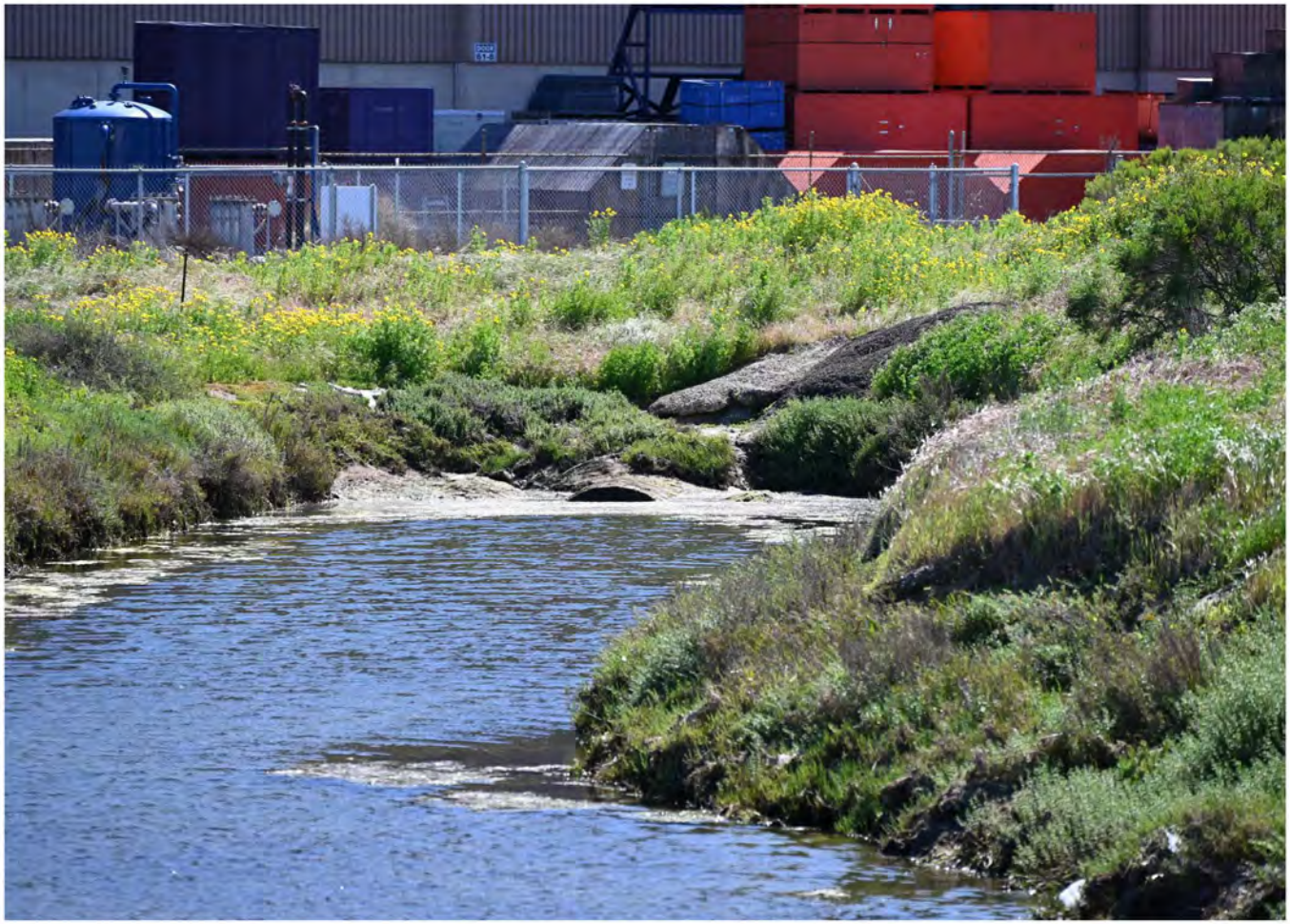
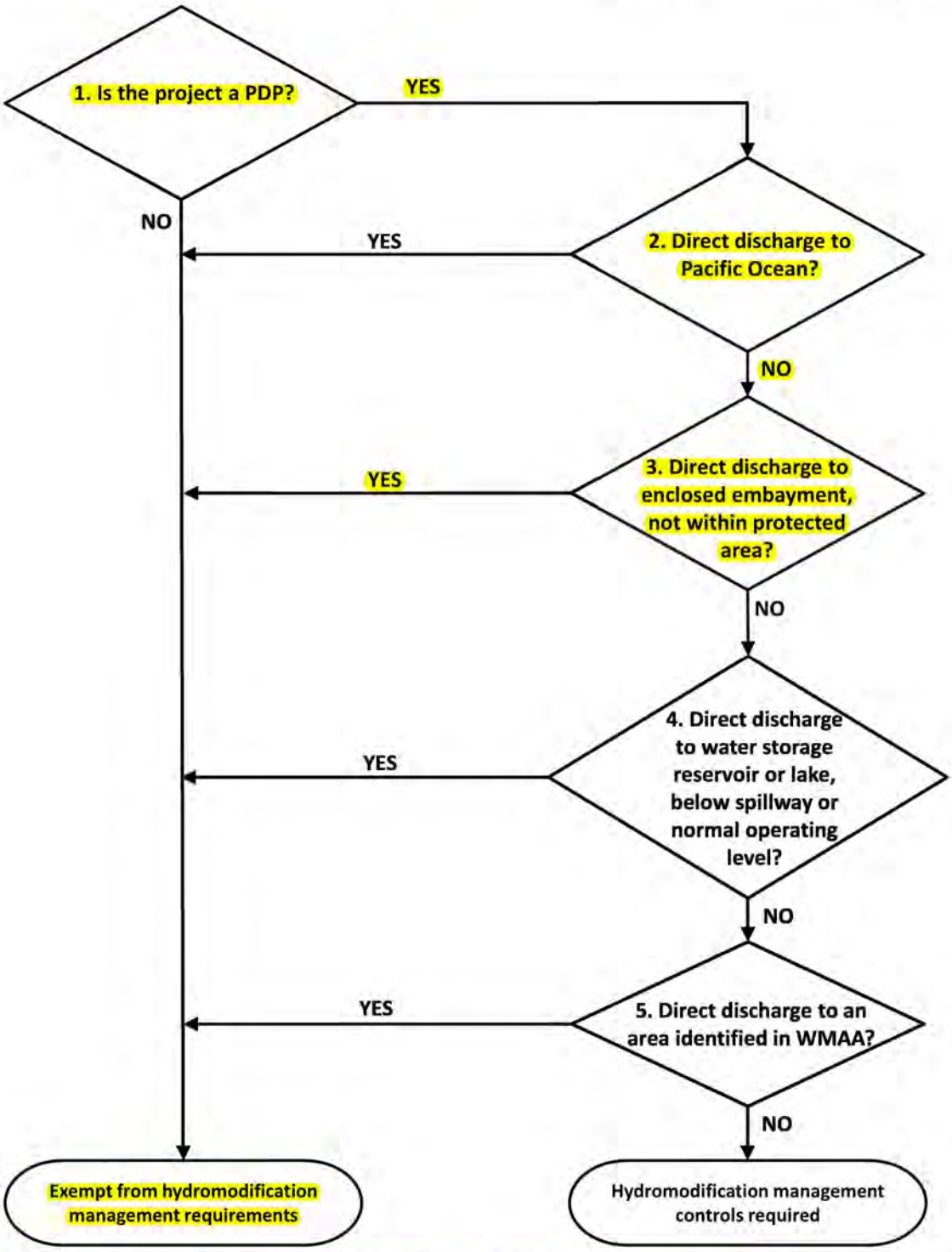
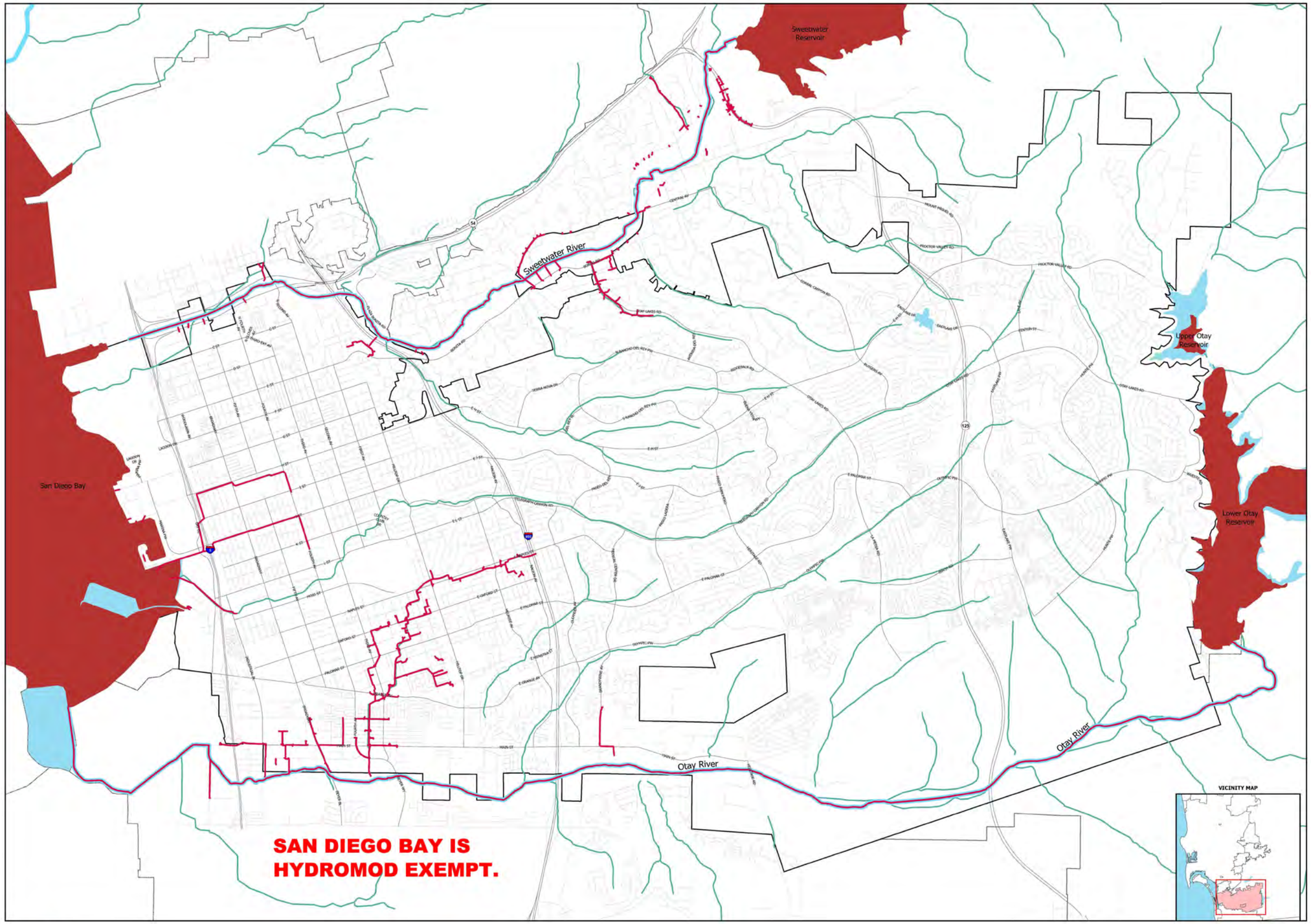


Figure 4. Submerged 54" RCP Outlet



*Direct discharge refers to an uninterrupted hardened conveyance system; Note to be used in conjunction with Node Descriptions.

Figure 1-2: Applicability of Hydromodification Management BMP Requirements



CITY OF CHULA VISTA

MAP NOTE:
This map is intended for study only and should not be used for any other purpose. Information on this map is also subject to change (or revision) periodically. The City of Chula Vista does not guarantee the accuracy of information contained on this map and cautions against the use of this data in making land use decisions.

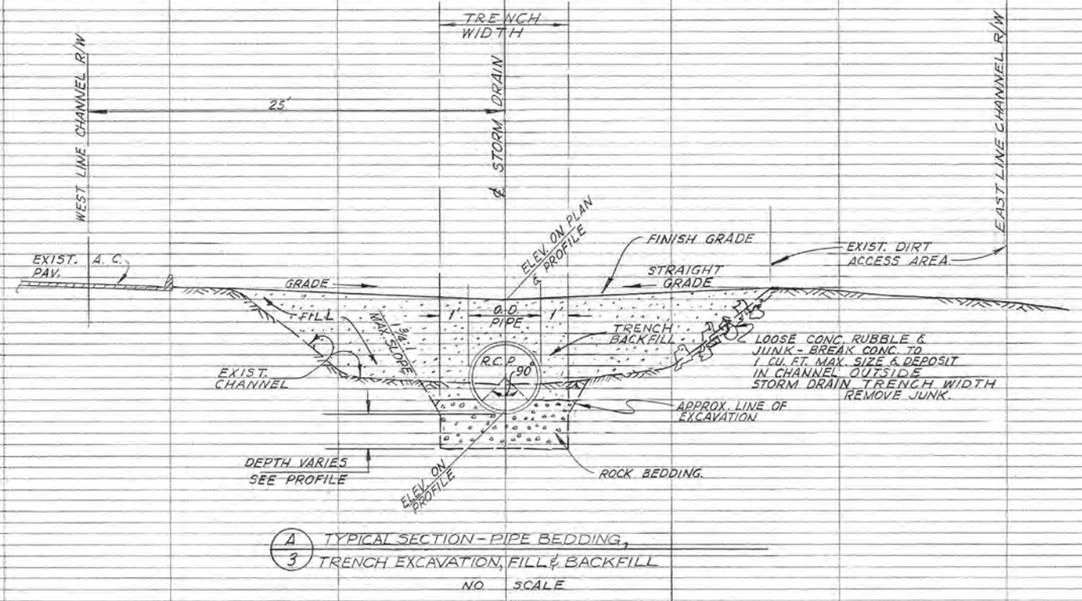
LEGEND

- City of Chula Vista
- Major Roads
- Minor Roads
- Water Body
- Exempt Systems
- Exempt Water Bodies
- Rivers
- Streams

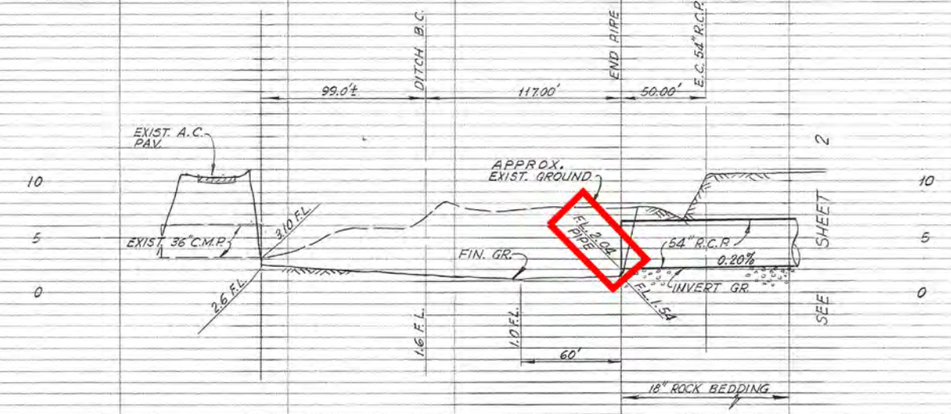
0 1800 3600 Feet

RECEIVING WATERS & CONVEYANCE SYSTEMS EXEMPT FROM HYDROMODIFICATION MANAGEMENT REQUIREMENTS

Folder: C:\Users\kvalenzuela\Documents\ArcGIS\Projects\Hydromod Exemptions 2022\ Date: 4/20/2022 10:42 AM



A/3 TYPICAL SECTION - PIPE BEDDING, TRENCH EXCAVATION, FILL & BACKFILL
NO SCALE

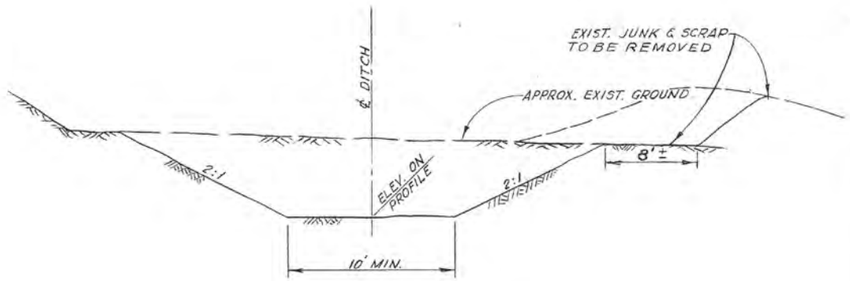


B/3 PROFILE
CHANNEL EXCAVATION
SCALES: HORIZ. 1"=40'
VERT. 1"=6'

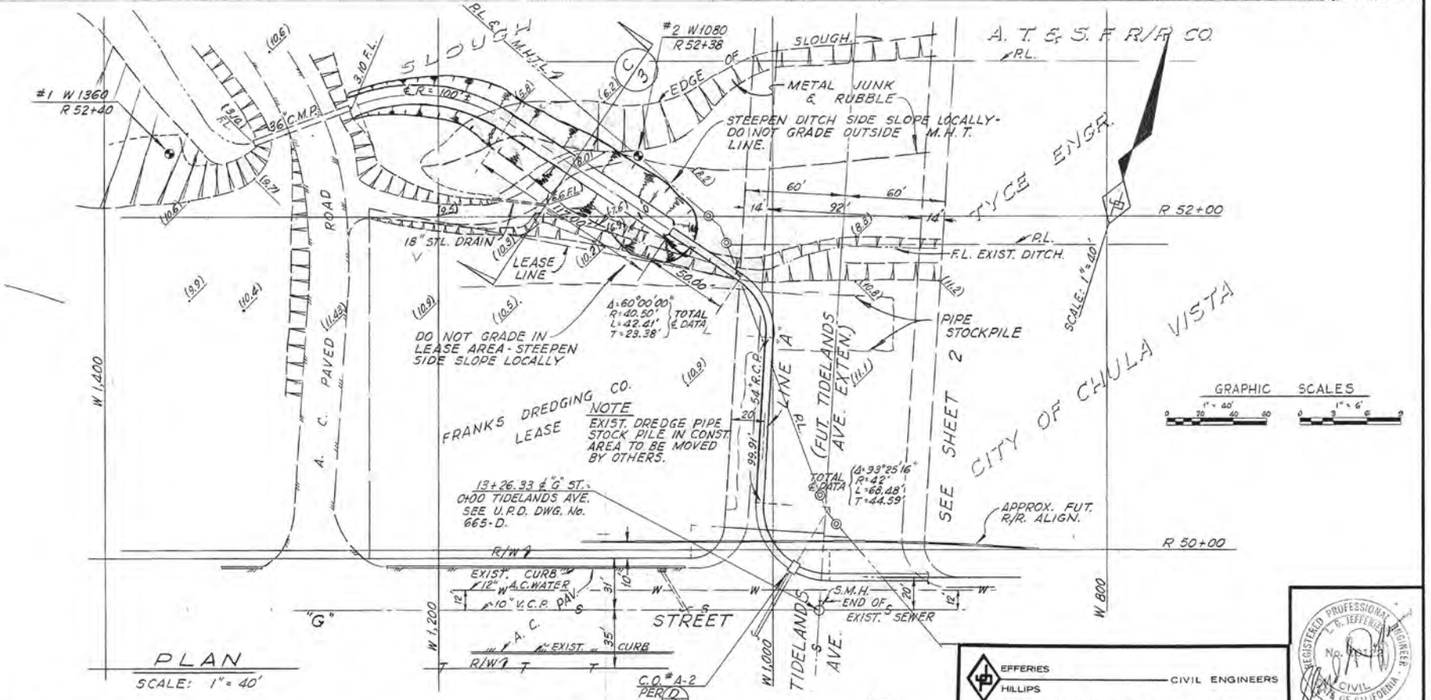
BENCH MARK

CONCRETE MON. AT R 32+65.47, W 1,000. ELEV. 10.917 M.L.L.W. DATUM.

CONC. MON. 20' LEFT OF STA. 11+73.82 "G" ST. EL.=8.494 M.L.W.



C/3 TYPICAL SECTION
CHANNEL EXCAVATION
NO SCALE.



PLAN
SCALE: 1"=40'

EFFERIES HILLIPS — CIVIL ENGINEERS
SUITE J · 8383 CENTER DR. · LA MESA, CALIF. · 465-6755

6703-1

REGISTERED PROFESSIONAL ENGINEER — C. JEFFERIES — No. 6703 — CIVIL — STATE OF CALIFORNIA

SPEC. NO: 67-5	W.O. NO: 64030		
REFERENCES			
CONTRACTOR			
CONSTRUCTION STARTED			
CONSTRUCTION COMPLETED			
COST	INSPECTOR		

REVISIONS	DATE	APPROVED

San Diego Unified Port District

San Diego • California

DESIGNED	PHILLIPS
DRAWN	J.A.L./C.
CHECKED	JEFFERIES

APPROVAL RECOMMENDED ——— ASST. CHIEF ENGINEER

APPROVED ——— CHIEF ENGINEER

Storm Drains In & Adjacent to Tidelands Ave. & "G" St.

CHULA VISTA, CALIF.

OUTFALL - PLAN & PROFILE NORTH OF "G" ST. & DETAILS.

· DATUM · MEAN LOWER LOW WATER

SHEET 3 OF 16

943

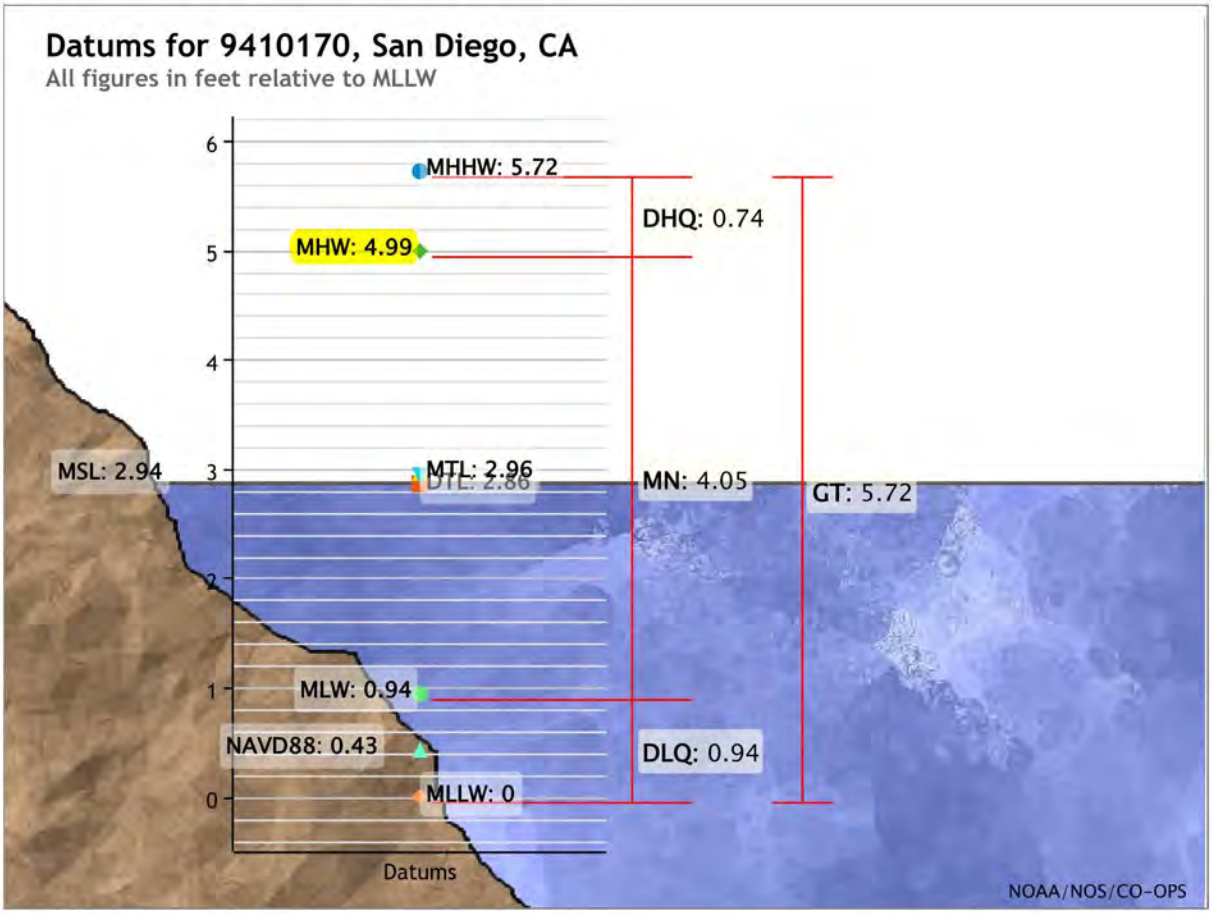
Datums for 9410170, San Diego CA

NOTICE: All data values are relative to the MLLW.

Elevations on Mean Lower Low Water

Station: 9410170, San Diego, CA
Status: Accepted (Sep 20 2017)
Units: Feet
Control Station:
T.M.: 0
Epoch: (/datum_options.html#NTDE) 1983-2001
Datum: MLLW

Datum	Value	Description
MHHW (/datum_options.html#MHHW)	5.72	Mean Higher-High Water
MHW (/datum_options.html#MHW)	4.99	Mean High Water
MTL (/datum_options.html#MTL)	2.96	Mean Tide Level
MSL (/datum_options.html#MSL)	2.94	Mean Sea Level
DTL (/datum_options.html#DTL)	2.86	Mean Diurnal Tide Level
MLW (/datum_options.html#MLW)	0.94	Mean Low Water
MLLW (/datum_options.html#MLLW)	0.00	Mean Lower-Low Water
NAVD88 (/datum_options.html)	0.43	North American Vertical Datum of 1988
STND (/datum_options.html#STND)	-3.79	Station Datum
GT (/datum_options.html#GT)	5.72	Great Diurnal Range
MN (/datum_options.html#MN)	4.05	Mean Range of Tide



Showing datums for

9410170 San Diego, San Die…

Datum

MLLW

Data Units
- (•) Feet
- ( ) Meters

Epoch
- (•) Present (1983-2001)
- ( ) Superseded (1960-1978)

Submit

Show nearby stations

Project Name/_____

ATTACHMENT 3

Structural BMP Maintenance Information
Hydromodification Control Measures

Yards at the Bay

Project Name/_____

Use this checklist to ensure the required information has been included in the Structural BMP Maintenance Information Attachment:

Attachment 3: For private entity operation and maintenance, Attachment 3 must include a Storm Water Management Facilities Maintenance Agreement with Grant of Access and Covenant's ("Maintenance Agreement") Template can be found at the following link (also refer to Chapter 8.2.1 for more information's):

The following information must be included in the exhibits attached to the Maintenance Agreement:

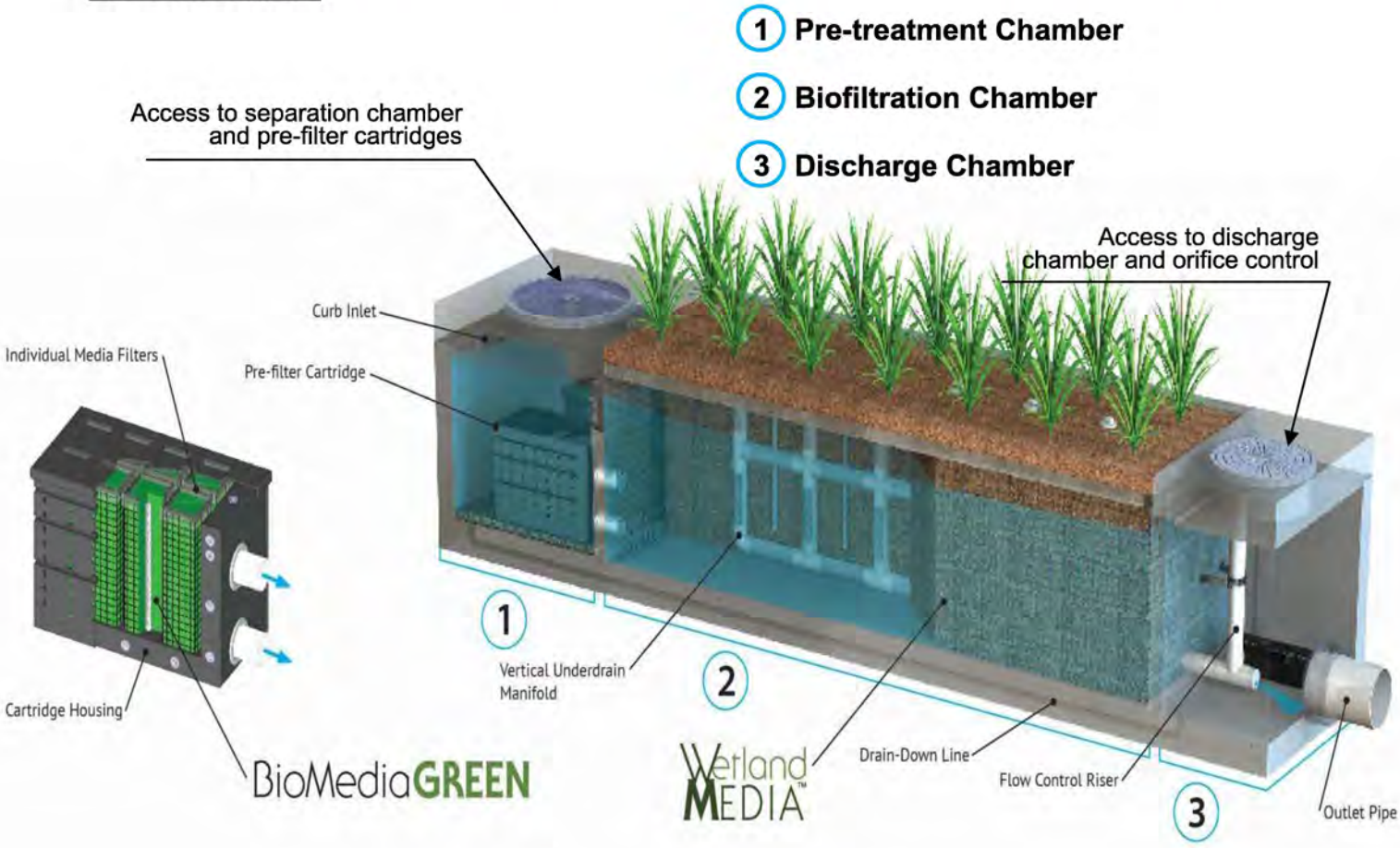
- ☒ Vicinity map (Depiction of Project Site)
- ☒ Legal Description for Project Site
- ☒ Site design BMPs for which DCV reduction is claimed for meeting the pollutant
- ☒ control obligations.
- ☒ BMP and HMP type, location, type, manufacture model, and dimensions, specifications, cross section
- ☒ LID features such as (permeable paver and LS location, dim, SF).
- ☒ Maintenance recommendations and frequency

Inspection Guidelines for Modular Wetland System - Linear

Inspection Summary

- Inspect Pre-Treatment, Biofiltration and Discharge Chambers – average inspection interval is 6 to 12 months.
  - (1*5 minute average inspection time*).
- NOTE: Pollutant loading varies greatly from site to site and no two sites are the same. Therefore, the first year requires inspection monthly during the wet season and every other month during the dry season in order to observe and record the amount of pollutant loading the system is receiving.

System Diagram



Inspection Overview

As with all stormwater BMPs inspection and maintenance on the MWS Linear is necessary. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess the site specific loading conditions. This is recommended because pollutant loading and pollutant characteristics can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding on roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years to ensure appropriate maintenance is provided. Without appropriate maintenance a BMP will exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the MWS Linear:

- Modular Wetland Inspection Form
- Flashlight
- Manhole hook or appropriate tools to remove access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure.
- Protective clothing and eye protection.
- 7/16" open or closed ended wrench.
- Large permanent black marker (initial inspections only – first year)
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system.



Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the MWS Linear are quick and easy. As mentioned above the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long term inspection and maintenance interval requirements.

The MWS Linear can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and near-by pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

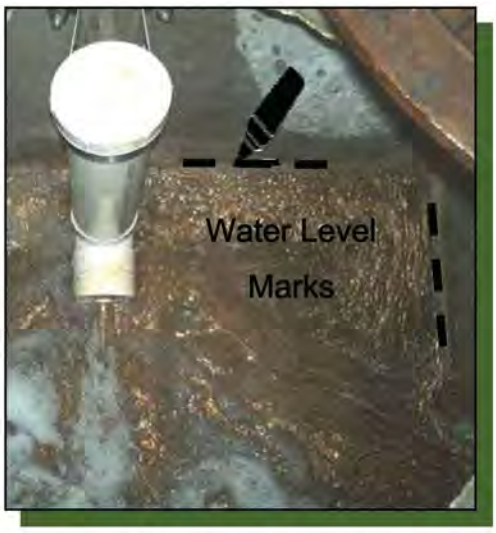
- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the inside of the system through the access hatches. If minimal light is available and vision into the unit is impaired utilize a flashlight to see inside the system and all of its chambers.
- Look for any out of the ordinary obstructions in the inflow pipe, pre-treatment chamber, biofiltration chamber, discharge chamber or outflow pipe. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of trash, debris and sediment accumulated in the pre-treatment chamber. Utilizing a tape measure or measuring stick estimate the amount of trash, debris and sediment in this chamber. Record this depth on the inspection form.

- Through visual observation inspect the condition of the pre-filter cartridges. Look for excessive build-up of sediments on the cartridges, any build-up on the top of the cartridges, or clogging of the holes. Record this information on the inspection form. The pre-filter cartridges can further be inspected by removing the cartridge tops and assessing the color of the BioMediaGREEN filter cubes (requires entry into pre-treatment chamber – see notes above regarding confined space entry). Record the color of the material. New material is a light green in color. As the media becomes clogged it will turn darker in color, eventually becoming dark brown or black. Using the below color indicator record the percentage of media exhausted.



- The biofiltration chamber is generally maintenance free due to the system's advanced pre-treatment chamber. For units which have open planters with vegetation it is recommended that the vegetation be inspected. Look for any plants that are dead or showing signs of disease or other negative stressors. Record the general health of the plants on the inspection and indicate through visual observation or digital photographs if trimming of the vegetation is needed.
- The discharge chamber houses the orifice control structure and is connected to the outflow pipe. It is important to check to ensure the orifice is in proper operating conditions and free of any obstructions. Generally, the discharge chamber will be clean and free of debris. Inspect the water marks on the side walls. If possible, inspect the discharge chamber during a rain event to assess the amount of flow leaving the system while it is at 100% capacity (pre-treatment chamber water level at peak HGL). The water level of the flowing water should be compared to the watermark level on the side walls which is an indicator of the highest discharge rate the system achieved when initially installed. Record on the form is there is any difference in level from watermark in inches.

- NOTE: During the first few storms the water level in the outflow chamber should be observed and a 6" long horizontal watermark line drawn (using a large permanent marker) at the water level in the discharge chamber while the system is operating at 100% capacity. The diagram below illustrates where a line should be drawn. This line is a reference point for future inspections of the system:







Using a permanent marker draw a 6 inch long horizontal line, as shown, at the higher water level in the MWS Linear discharge chamber.

- Water level in the discharge chamber is a function of flow rate and pipe size. Observation of water level during the first few months of operation can be used as a benchmark level for future inspections. The initial mark and all future observations shall be made when system is at 100% capacity (water level at maximum level in pre-treatment chamber). If future water levels are below this mark when system is at 100% capacity this is an indicator that maintenance to the pre-filter cartridges may be needed.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

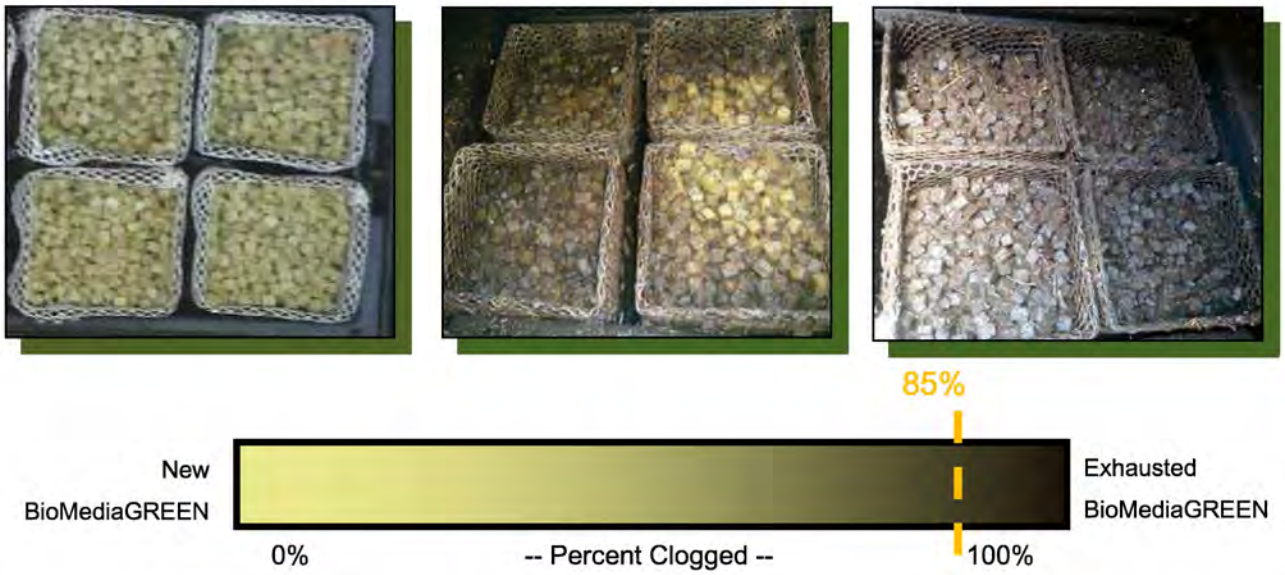
- Missing or damaged internal components or cartridges.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatables in the pre-treatment chamber in which the length and width of the chamber is fully impacted more than 18".



- Excessive accumulation of sediment in the pre-treatment chamber of more than 6" in depth.



- Excessive accumulation of sediment on the BioMediaGREEN media housed within the pre-filter cartridges. The following chart shows photos of the condition of the BioMediaGREEN contained within the pre-filter cartridges. When media is more than 85% clogged replacement is required.



- Overgrown vegetation.



- Water level in discharge chamber during 100% operating capacity (pre-treatment chamber water level at max height) is lower than the watermark by 20%.

Inspection Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

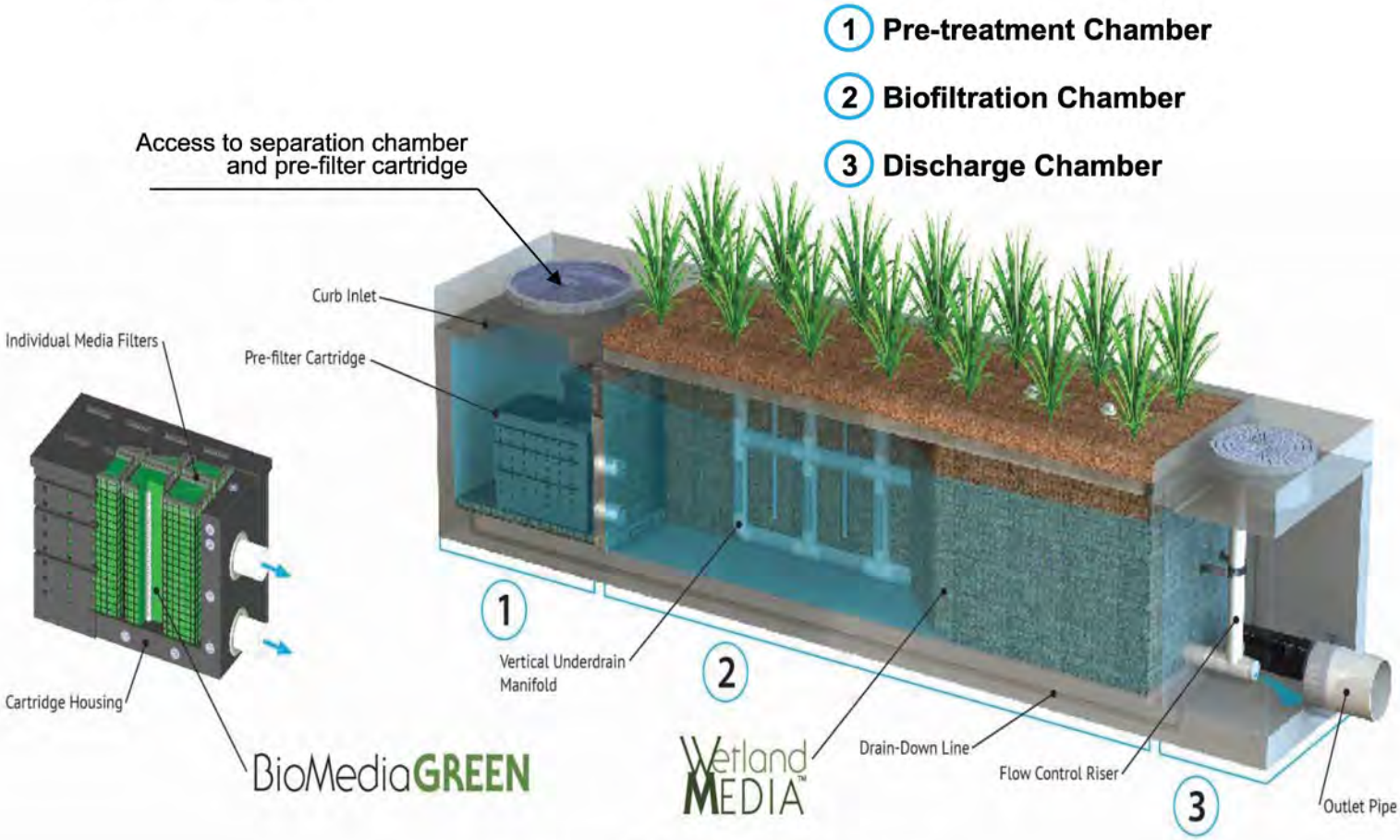
6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may not require irrigation after initial establishment.

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Sediment from Pre-Treatment Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Pre-Filter Cartridge Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



www.modularwetlands.com

Maintenance Overview

The time has come to maintain your Modular Wetland System Linear (MWS Linear). To ensure successful and efficient maintenance on the system we recommend the following. The MWS Linear can be maintained by removing the access hatches over the systems various chambers. All necessary pre-maintenance steps must be carried out before maintenance occurs, especially traffic control and other safety measures to protect the inspector and near-by pedestrians from any dangers associated with an open access hatch or manhole. Once traffic control has been set up per local and state regulations and access covers have been safely opened the maintenance process can begin. It should be noted that some maintenance activities require confined space entry. All confined space requirements must be strictly followed before entry into the system. In addition the following is recommended:

- Prepare the maintenance form by writing in the necessary information including project name, location, date & time, unit number and other info (see maintenance form).
- Set up all appropriate safety and cleaning equipment.
- Ensure traffic control is set up and properly positioned.
- Prepare a pre-checks (OSHA, safety, confined space entry) are performed.

Maintenance Equipment

Following is a list of equipment required for maintenance of the MWS Linear:

- Modular Wetland Maintenance Form
- Manhole hook or appropriate tools to access hatches and covers
- Protective clothing, flashlight and eye protection.
- 7/16" open or closed ended wrench.
- Vacuum assisted truck with pressure washer.
- Replacement BioMediaGREEN for Pre-Filter Cartridges if required (order from manufacturer).



Maintenance Steps

1. Pre-treatment Chamber (bottom of chamber)

   A. Remove access hatch or manhole cover over pre-treatment chamber and position vacuum truck accordingly.
   B. With a pressure washer spray down pollutants accumulated on walls and pre-filter cartridges.
   C. Vacuum out Pre-Treatment Chamber and remove all accumulated pollutants including trash, debris and sediments. Be sure to vacuum the floor until pervious pavers are visible and clean.
   D. If Pre-Filter Cartridges require media replacement move onto step 2. If not, replace access hatch or manhole cover.



Removal of access hatch to gain access below.



Insertion of vacuum hose into separation chamber.



Removal of trash, sediment and debris.



Fully cleaned separation chamber.

2. Pre-Filter Cartridges (attached to wall of pre-treatment chamber)

A. After finishing step 1 enter pre-treatment chamber.

B. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.

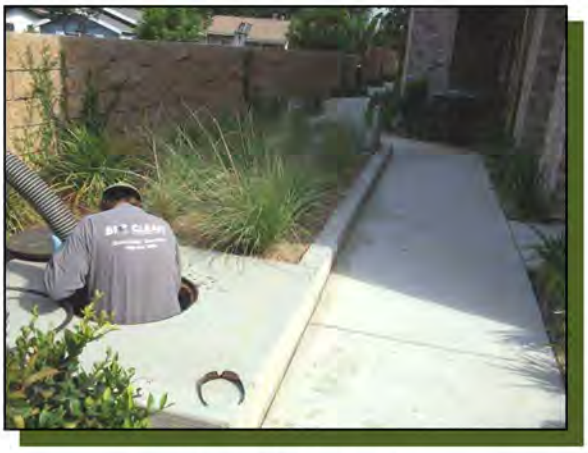


Pre-filter cartridges with tops on.



Inside cartridges showing media filters ready for replacement.

C. Place the vacuum hose over each individual media filter to suck out filter media.



Vacuuming out of media filters.

D. Once filter media has been sucked use a pressure washer to spray down inside of the cartridge and it's containing media cages. Remove cleaned media cages and place to the side. Once removed the vacuum hose can be inserted into the cartridge to vacuum out any remaining material near the bottom of the cartridge.

E. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase. Utilize the manufacture provided refilling trey and place on top of cartridge. Fill trey with new bulk media and shake down into place. Using your hands slightly compact media into each filter cage. Once cages are full removed refilling trey and replace cartridge top ensuring bolts are properly tightened.



Refilling trey for media replacement.



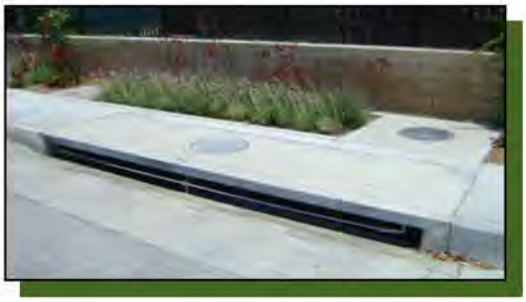
Refilling trey on cartridge with bulk media.



F. Exit pre-treatment chamber. Replace access hatch or manhole cover.

3. Biofiltration Chamber (middle vegetated chamber)

A. In general, the biofiltration chamber is maintenance free with the exception of maintaining the vegetation. Using standard gardening tools properly trim back the vegetation to healthy levels. The MWS Linear utilizes vegetation similar to surrounding landscape areas therefore trim vegetation to match surrounding vegetation. If any plants have died replace plants with new ones:





Inspection Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may not require irrigation after initial establishment.

Inspection Form



Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: _____

2972 San Luis Rey Road, Oceanside, CA 92058 P (760) 433-7640 F (760) 433-3176

Maintenance Report



Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments: _____

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

ATTACHMENT 4

Copy of Plan Sheets Showing Permanent Storm Water BMPs

Yards at the Bay

Project Name/_____

Use this checklist to ensure the required information has been included on the plans:

The plans must identify:

- [x] Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- [x] The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- [x] Details and specifications for construction of structural BMP(s)
- [x] Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- [x] How to access the structural BMP(s) to inspect and perform maintenance
- [x] Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
- [x] Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- [x] Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
- [x] Recommended equipment to perform maintenance
- [x] When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
- [x] Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
- [ ] All BMPs must be fully dimensioned on the plans
- [ ] When proprietary BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.

Bio Clean

A Forterra Company

Modular Wetlands® System Linear

A Stormwater Biofiltration Solution



OVERVIEW

The Bio Clean Modular Wetlands® System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint, higher treatment capacity, and a wide range of versatility. While most biofilters use little or no pretreatment, the Modular Wetlands® incorporates an advanced pretreatment chamber that includes separation and pre-filter cartridges. In this chamber, sediment and hydrocarbons are removed from runoff before entering the biofiltration chamber, reducing maintenance costs and improving performance.

Horizontal flow also gives the system the unique ability to adapt to the environment through a variety of configurations, bypass orientations, and diversion applications.



The Urban Impact

For hundreds of years, natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as cities grow and develop, our environment's natural filtration systems are blanketed with impervious roads, rooftops, and parking lots.

Bio Clean understands this loss and has spent years re-establishing nature's presence in urban areas, and rejuvenating waterways with the Modular Wetlands® System Linear.

PERFORMANCE

The Modular Wetlands® continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons, and bacteria. Since 2007 the Modular Wetlands® has been field tested on numerous sites across the country and is proven to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. In fact, the Modular Wetlands® harnesses some of the same biological processes found in natural wetlands in order to collect, transform, and remove even the most harmful pollutants.

66% REMOVAL OF DISSOLVED ZINC	**69%** REMOVAL OF TOTAL ZINC	**38%** REMOVAL OF DISSOLVED COPPER	**64%** REMOVAL OF TOTAL PHOSPHORUS

45% REMOVAL OF NITROGEN	**50%** REMOVAL OF TOTAL COPPER	**95%** REMOVAL OF MOTOR OIL	**67%** REMOVAL OF ORTHO PHOSPHORUS	**85%** REMOVAL OF TSS

APPROVALS

The Modular Wetlands® System Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation and perhaps the world. Here is a list of some of the most high-profile approvals, certifications, and verifications from around the country.

Washington State Department of Ecology TAPE Approved
The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft² loading rate. The highest performing BMP on the market for all main pollutant categories.

California Water Resources Control Board, Full Capture Certification
The Modular Wetlands® System is the first biofiltration system to receive certification as a full capture trash treatment control device.

Virginia Department of Environmental Quality, Assignment
The Virginia Department of Environmental Quality assigned the MWS Linear the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) regulation technical criteria.

Maryland Department of the Environment, Approved ESD
Granted Environmental Site Design (ESD) status for new construction, redevelopment, and retrofitting when designed in accordance with the design manual.

MASTEP Evaluation
The University of Massachusetts at Amherst – Water Resources Research Center issued a technical evaluation report noting removal rates up to 84% TSS, 70% total phosphorus, 68.5% total zinc, and more.

Rhode Island Department of Environmental Management, Approved BMP
Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% pathogens, 30% total phosphorus, and 30% total nitrogen.

ADVANTAGES

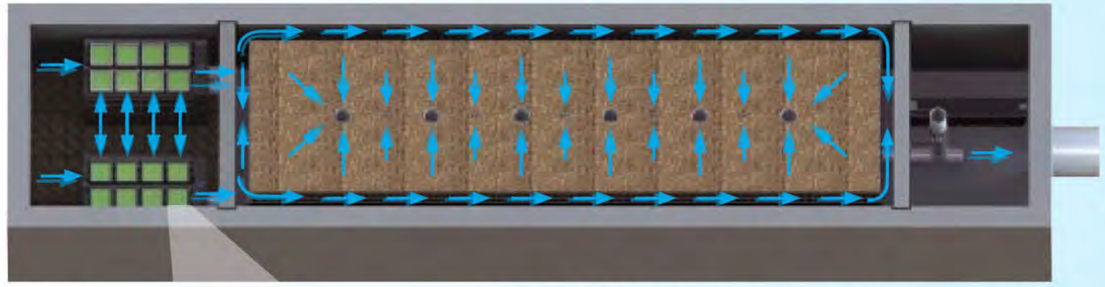
- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR

OPERATION

The Modular Wetlands® System Linear is the most efficient and versatile biofiltration system on the market, and it is the only system with horizontal flow which:

- Improves performance
- Reduces footprint
- Minimizes maintenance

Figure 1 & Figure 2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.



2x to 3x more surface area than traditional downward flow bioretention systems.

Figure 2, Top View



1 PRETREATMENT

SEPARATION

- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

PRE-FILTER CARTRIDGES

- Over 25 sq. ft. of surface area per cartridge
- Utilizes BioMediaGREEN™ filter material
- Removes over 80% of TSS and 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber

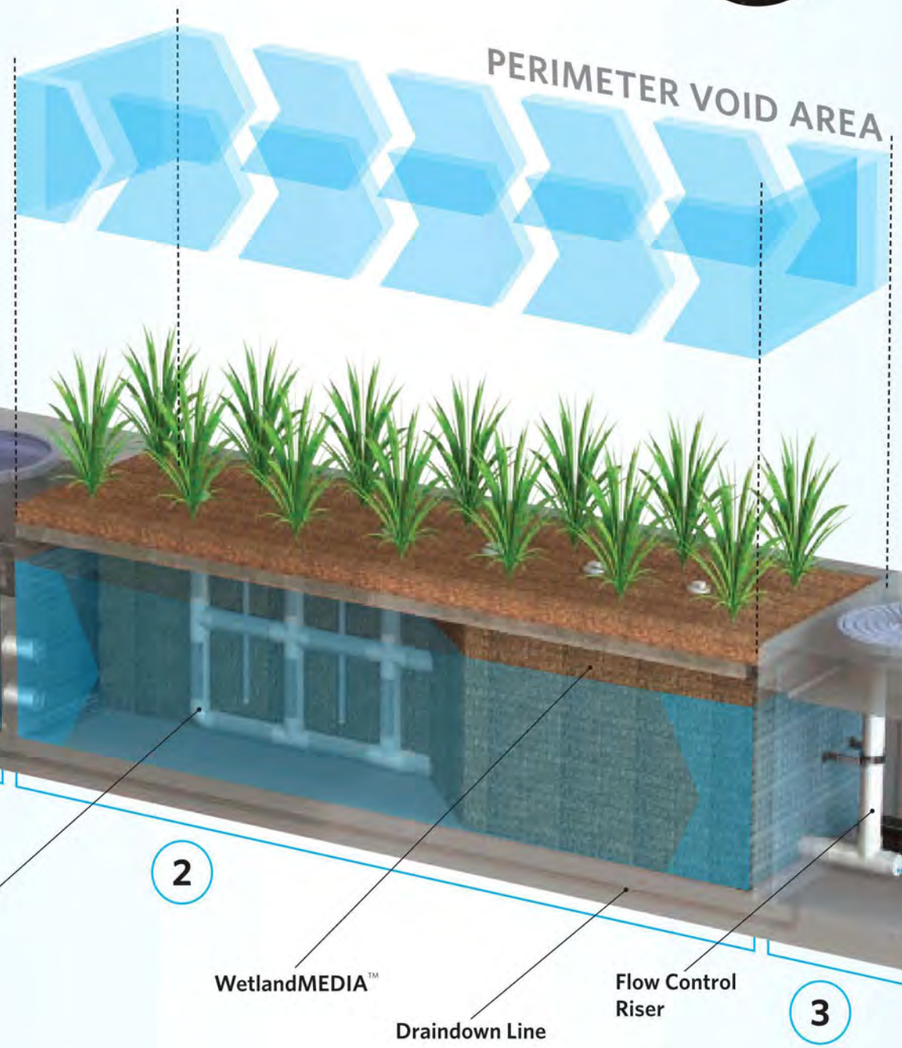


Figure 1

2 BIOFILTRATION

HORIZONTAL FLOW

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

PATENTED PERIMETER VOID AREA

- Vertically extends void area between the walls and the WetlandMEDIA™ on all four sides
- Maximizes surface area of the media for higher treatment capacity

WETLANDMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and lightweight

3 DISCHARGE

FLOW CONTROL

- Orifice plate controls flow of water through WetlandMEDIA™ to a level lower than the media's capacity
- Extends the life of the media and improves performance

DRAINDOWN FILTER

- The draindown is an optional feature that completely drains the pretreatment chamber
- Water that drains from the pretreatment chamber between storm events will be treated





CONFIGURATIONS

The Modular Wetlands® System Linear is the preferred biofiltration system of civil engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your storm drain design.



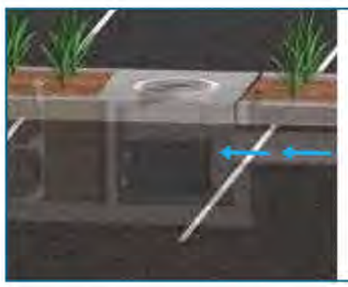
CURB TYPE

The Curb Type configuration accepts sheet flow through a curb opening and is commonly used along roadways and parking lots. It can be used in sump or flow-by conditions. Length of curb opening varies based on model and size.



GRATE TYPE

The Grate Type configuration offers the same features and benefits as the Curb Type but with a grated/drop inlet above the systems pretreatment chamber. It has the added benefit of allowing pedestrian access over the inlet. ADA-compliant grates are available to assure easy and safe access. The Grate Type can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



VAULT TYPE

The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pretreatment chamber, meaning the Modular Wetlands® can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/ bioretention systems. Another benefit of the "pipe-in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.



DOWNSPOUT TYPE

The Downspout Type is a variation of the Vault Type and is designed to accept a vertical downspout pipe from rooftop and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter, and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

ORIENTATIONS

SIDE-BY-SIDE



The Side-By-Side orientation places the pretreatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.

END-TO-END



The End-To-End orientation places the pretreatment and discharge chambers on opposite ends of the biofiltration chamber, therefore minimizing the width of the system to 5 ft. (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is that bypass must be external.

BYPASS

INTERNAL BYPASS WEIR (SIDE-BY-SIDE ONLY)

The Side-By-Side orientation places the pretreatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pretreatment chamber directly to the discharge chamber.

EXTERNAL DIVERSION WEIR STRUCTURE

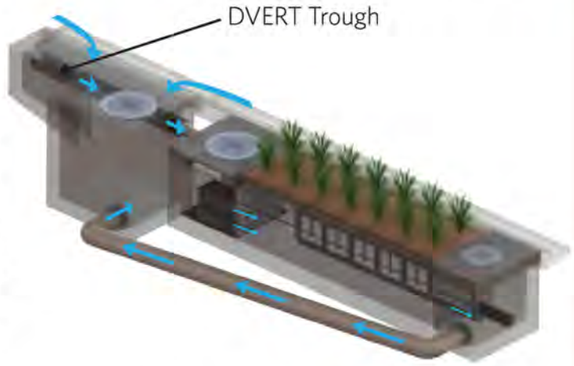
This traditional offline diversion method can be used with the Modular Wetlands® in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the Modular Wetlands® for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

FLOW-BY-DESIGN

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the Modular Wetlands® and into the standard inlet downstream.

DVERT LOW FLOW DIVERSION

This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the Modular Wetlands® via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over



to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allow the Modular Wetlands® to be installed anywhere space is available.

SPECIFICATIONS

FLOW-BASED DESIGNS

The Modular Wetlands® System Linear can be used in stand-alone applications to meet treatment flow requirements. Since the Modular Wetlands® is the only biofiltration system that can accept inflow pipes several feet below the surface, it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

MODEL #	DIMENSIONS	WETLANDMEDIA SURFACE AREA (sq. ft.)	TREATMENT FLOW RATE (cfs)
MWS-L-4-4	4' x 4'	23	0.052
MWS-L-4-6	4' x 6'	32	0.073
MWS-L-4-8	4' x 8'	50	0.115
MWS-L-4-13	4' x 13'	63	0.144
MWS-L-4-15	4' x 15'	76	0.175
MWS-L-4-17	4' x 17'	90	0.206
MWS-L-4-19	4' x 19'	103	0.237
MWS-L-4-21	4' x 21'	117	0.268
MWS-L-6-8	7' x 9'	64	0.147
MWS-L-8-8	8' x 8'	100	0.230
MWS-L-8-12	8' x 12'	151	0.346
MWS-L-8-16	8' x 16'	201	0.462
MWS-L-8-20	9' x 21'	252	0.577
MWS-L-8-24	9' x 25'	302	0.693
MWS-L-10-20	10' x 20'	302	0.693

VOLUME-BASED DESIGNS

HORIZONTAL FLOW BIOFILTRATION ADVANTAGE



Modular Wetlands® with Box Culvert Prestorage

The Modular Wetlands® System Linear offers a unique advantage in the world of biofiltration due to its exclusive horizontal flow design: Volume-Based Design. No other biofilter has the ability to be placed downstream of detention ponds, extended dry detention basins, underground storage systems and permeable paver reservoirs. The systems horizontal flow configuration and built-in orifice control allows it to be installed with just 6" of fall between inlet and outlet pipe for a simple connection to projects with shallow downstream tie-in points. In the example above, the Modular Wetlands® is installed downstream of underground box culvert storage. Designed for the water quality volume, the Modular Wetlands® will treat and discharge the required volume within local draindown time requirements.



Modular Wetlands® with Arch Plastic Chambers

DESIGN SUPPORT

Bio Clean engineers are trained to provide you with superior support for all volume sizing configurations throughout the country. Our vast knowledge of state and local regulations allow us to quickly and efficiently size a system to maximize feasibility. Volume control and hydromodification regulations are expanding the need to decrease the cost and size of your biofiltration system. Bio Clean will help you realize these cost savings with the Modular Wetlands®, the only biofilter than can be used downstream of storage BMPs.

ADVANTAGES

- LOWER COST THAN FLOW-BASED DESIGN
- MEETS LID REQUIREMENTS
- BUILT-IN ORIFICE CONTROL STRUCTURE
- WORKS WITH DEEP INSTALLATIONS

APPLICATIONS

The Modular Wetlands® System Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.



INDUSTRIAL

Many states enforce strict regulations for discharges from industrial sites. The Modular Wetlands® has helped various sites meet difficult EPA-mandated effluent limits for dissolved metals and other pollutants.



RESIDENTIAL

Low to high density developments can benefit from the versatile design of the Modular Wetlands®. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.



STREETS

Street applications can be challenging due to limited space. The Modular Wetlands® is very adaptable, and it offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.



PARKING LOTS

Parking lots are designed to maximize space and the Modular Wetlands'® 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.



COMMERCIAL

Compared to bioretention systems, the Modular Wetlands® can treat far more area in less space, meeting treatment and volume control requirements.



MIXED USE

The Modular Wetlands® can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications include:

• Agriculture • Reuse • Low Impact Development • Waste Water

PLANT SELECTION



Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the Modular Wetlands® System Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade, the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the Modular Wetlands®, giving the plants more contact time so that pollutants are more successfully decomposed, volatilized, and incorporated into the biomass of the Modular Wetlands'® micro/macro flora and fauna.

A wide range of plants are suitable for use in the Modular Wetlands®, but selections vary by location and climate. View suitable plants by visiting biocleanenvironmental.com/plants.

INSTALLATION



The Modular Wetlands® is simple, easy to install, and has a space-efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles precast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians is available to supervise installations and provide technical support.

MAINTENANCE



Reduce your maintenance costs, man hours, and materials with the Modular Wetlands®. Unlike other biofiltration systems that provide no pretreatment, the Modular Wetlands® is a self-contained treatment train which incorporates simple and effective pretreatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pretreatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pretreatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long-term operation, and there is absolutely no need to replace expensive biofiltration media.



Bio Clean
A Forterra Company

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010419R1A

ATTACHMENT 5

Drainage Report

Attach project's drainage report. Refer to the Subdivision Manual to determine the reporting requirements.

PRELIMINARY
DRAINAGE REPORT

YARDS AT THE BAY

City of Chula Vista, CA

City of Chula Vista Tentative Parcel Map and Coastal Development Permit_____

APN #: 571-330-36 Through 571-330-45
Project Address:
Marina Parkway and H Street,
Chula Vista, CA 91910

Prepared For:

WOHL Property Group
2251 San Diego Avenue, Suite A247
San Diego, CA 92110

Prepared By:

PROJECT DESIGN CONSULTANTS
a Bowman company

701 B Street, Suite 800
San Diego, CA 92101
619.235.6471

PDC Job No. 4508



Prepared by: Jonathan Teas, PE
Under the supervision of

Chelisa A. Pack, PE RCE 71026
Registration Expires 6/30/25

TABLE OF CONTENTS

1. INTRODUCTION 1

2. EXISTING AND PROPOSED DRAINAGE PATTERNS AND IMPROVEMENTS 2

2.1 Existing Drainage Patterns 2

2.2 Proposed Drainage Improvements 3

3. HYDROLOGY CRITERIA, METHODOLOGY, AND RESULTS 4

3.1 Hydrology Criteria 4

3.2 Hydrologic Methodology 4

3.3 Description of Hydrologic Modeling Software 5

3.4 Hydrology Results 6

4. HYDRAULIC CRITERIA, METHODOLOGY, AND RESULTS 6

5. CONCLUSION 6

TABLES

Table 1: Hydrology Criteria 4
Table 2: Hydrology Results 6

APPENDICES

1 Supplemental Information (Intensity Duration Frequency Curve, Runoff Coefficients)

2 Existing Conditions Rational Method Computer Output

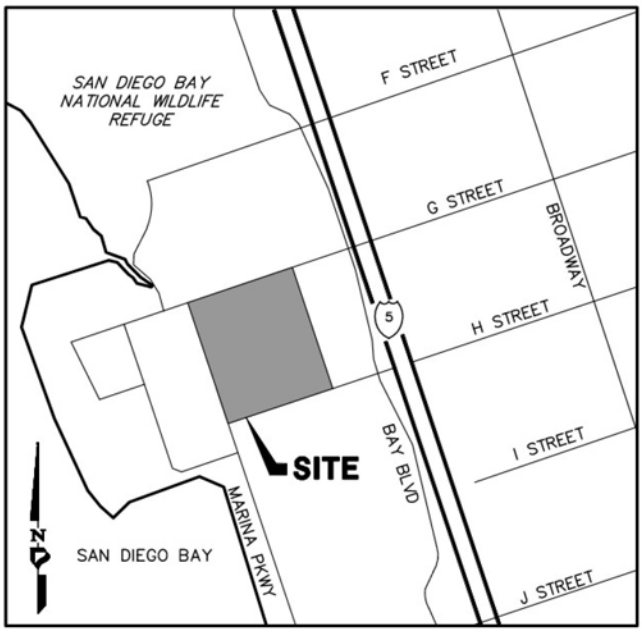
3 Proposed Conditions Rational Method Computer Output

4 Hydraulic Calculations

5 Drainage Exhibits

1. INTRODUCTION

This drainage report has been prepared in support of the preliminary design of the proposed storm drain improvements associated with the Yards at the Bay development project (Project) for a Tentative Parcel Map and Coastal Development Permit submittal. Total Project area is 35.91 acres and includes a development previously developed with two industrial buildings for manufacturing occupied by Rohr Aircraft Facility prior to 2020. The project is an active construction site for the demolition of the industrial buildings. The project is south of Sweetwater River, on the East side of Marina Parkway across from the Gaylord Resort development which is currently under construction. The project proposes commercial/light industrial uses with four large buildings, parking, and drive aisles. Fill will be imported in to the site to elevate the proposed buildings above existing grades. The additional fill will allow for additional protection against the effects of potential future sea level rise, as the site is close to the San Diego Bay. The southerly portion of the project consists of two undeveloped sloped pads which will not be developed with the project. A future development of the pads will likely consist of commercial uses; thus, we have treated these pads as commercial development for flow calculations.



VICINITY MAP
NOT TO SCALE

Figure 1: Vicinity Map

At present the site land consists mostly of parking and building roofs. There is very little if any natural terrain existing on the site. There is a small amount of runon 0.3 acres at the north easterly corner of the site where an SDG&E substation exists, the run-on sheet flows through the site for a short distance and then enters G Street.

Presently the urban run-off is split north and south of the site. There are various roof drain collections and grate inlets which direct the flow, splitting the north and south sides of the site. The proposed project will split the site in a similar way, however; minor grading adjustments will send more flow to the south, since the southerly storm drain has a higher capacity to handle the large flows conveyed on the site. One biofiltration basin and several Modular Wetland Units will be implemented to manage water. The proposed site's storm drain system will outlet into the existing storm drain facilities along the north and south end of the project respectively. Both north and south connections outlet to the San Diego Bay via pipe flow. For water quality management concerns refer to the Storm Water Quality Management Plan (SWQMP) prepared by Project Design Consultants for the proposed project treatment BMPs.

2. EXISTING AND PROPOSED DRAINAGE PATTERNS AND IMPROVEMENTS

The following sections provide descriptions of the existing and proposed drainage patterns and improvements for the project.

2.1 Existing Drainage Patterns (Pre-demolition Conditions)

There are on-site drainage facilities, including storm drain pipe with grate inlet and roof drain connections for the roofs and drive and parking aisles on the site which splits the site drainage between the North and South towards the San Diego Bay west of the site. The north system connects to an 36" RCP stub, and then outlets through an 54-inch RCP into a slough just northwest of the site. The slough is directly connect to the San Diego Bay. The south system connects to an 60" RCP stub, and then outlets through an 84-inch RCP that discharges into the San Diego Bay at the Chula Vista Marina. Refer to Exhibit A in Appendix 5 for the existing condition drainage map.

The Hydrologic Soil Group of the site consists of Soil Group D and an Unknown Soil Group. Per the NRCS Soil Map Survey, the easterly side of the site consists of HuC which is Soil Group D

and a portion of the westerly side of the site consists of Md which is Made Land and is not a known Soil Group. The NRCS Soil Map Survey is included in Appendix 1.

2.2 Proposed Drainage Improvements

The site will remove the existing site storm drain facilities and replace with similar facilities to meet the project needs, trench drains, grate and curb inlets will be used to pick up flow, and storm drain pipes to convey the site flow. Roof flow will be directed to the drive aisles and picked up with grate inlets or hard tied directly to the storm drain. The project maintains similar patterns to the existing conditions, discharging to north and south. However; the project site's drainage plan directs more flow south because there is more capacity in the on-site storm drain stub on the south site. As described in Section 2.1, the north storm drain system connects to a 36" stub. In contrast, the south system connect to an 60" stub. Directing more flow to the South stub was necessary in the proposed conditions, so that the Northerly 36" stub capacity is not over-burdened. Refer to Exhibit B in Appendix 5 for the proposed condition drainage map.

Water quality requirements will be managed with one biofiltration basin and several modular wetland units.

3. HYDROLOGY CRITERIA, METHODOLOGY, AND RESULTS

Hydrologic modeling was performed per City of Chula Vista Subdivision Manual criteria to provide the design flows for storm drain design and improvements.

3.1 Hydrology Criteria

Table 1 summarizes the hydrology assumptions and criteria used for hydrologic modeling.

Table 1: Hydrology Criteria

Existing and Proposed Hydrology:	100-year storm frequency
Soil Type:	Hydrologic Soil Group D & Unknown
Land Use / Runoff Coefficients:	Based on criteria presented in the Revised 2012 City of Chula Vista Subdivision Manual Section 3-200 Hydrology/Drainage/Urban Runoff.
Rainfall intensity:	Based on intensity duration frequency relationships presented in the 2017 Chula Vista Design Standards & Revised 2012 City of Chula Vista Subdivision Manual Section 3-200 Hydrology/Drainage/Urban Runoff, see Appendix 1.

3.2 Hydrologic Methodology

The Rational Method was used to determine the onsite 100-year storm flow for the design of the Project storm drainpipe improvements. The goal of this analysis was to:

- Determine the design flows for the sizing of any proposed storm drain improvements.
- Determine the differences in the drainage conditions between existing and proposed conditions to confirm there are no significant downstream impacts.

The AES Modified Rational Method program was used to calculate onsite and offsite runoff for the 100-year storm event. For the existing conditions model, a runoff coefficient of 0.90 ("Paved Surface") was used, since the entire site is nearly 100% impervious. For the proposed condition model, a representative runoff coefficient was assigned for each subarea. Therefore, a runoff

coefficient of 0.90 (“Paved Surface”) was used for areas that will be nearly 100% impervious, and other subareas were modeled as 0.85 runoff coefficient (“Commercial Areas”) and 0.45 (“Flat Vegetated Slopes”) was used only for the westerly large pervious area. For the two southerly undeveloped sloped pads on the project, a runoff coefficient of 0.85 (“Commercial Areas”) was used, because a future project may develop these areas in the future. However, these pads are not proposed to be developed with this project, and thus until the pads are developed the actual run-off from these areas will be more similar to Flat Vegetated Slopes 0.45 runoff coefficient which will contribute less runoff thus making the modeling included in this report conservative.

3.3 Description of Hydrologic Modeling Software

The Modified Rational Method was used to determine the 100-year storm flow for the design of the storm system. The Advanced Engineering Software (AES) Rational Method Program was used to perform the hydrologic calculations. This section provides a brief explanation of the computational procedure used in the computer model.

The AES Modified Rational Method Hydrology Program is a computer-aided design program where the user develops a node link model of the watershed. Developing independent node link models for each interior watershed and linking these sub-models together at confluence points creates the node link model. The intensity-duration-frequency relationships are applied to each of the drainage areas in the model to get the peak flow rates at each point of interest.

3.4 Hydrology Results

The Rational Method as presented in the City of Chula Vista Subdivision Manual and County of San Diego Hydrology Manual was used to calculate the existing and proposed conditions peak storm flows. Table 2 below summarizes the Rational Method results for the comparison of the existing and proposed project site. The total peak 100-year flows under the post-prjoect condition are less than the pre-project condition peak flows. The peak flow to the south outlet increases slightly in the post-project condition, in order to alleviate downstream pipe capacity concerns for the north outlet, since the stub for the outlet has more pipe conveyance capacity that the storm drain stub for the north outlet.

Table 2: Hydrology Results

YARDS AT THE BAY HYDROLOGY SUMMARY								
	EXISTING CONDITIONS				PROPOSED CONDITIONS			
OUTFALL OF INTEREST	SYSTEM	AREA (ac)	TC (min)	Q100 (cfs)	SYSTEM	AREA (ac)	TC (min)	Q100 (cfs)
#1 (South)	100	18.6	6.5	102.7	100	23.2	7.18	109.1
#2 (North)	200	17.8	5.97	98.1	200	13.2	6.29	69.0
	TOTAL	36.4		200.8		36.4		178.1

4. HYDRAULIC CRITERIA, METHODOLOGY, AND RESULTS

Hydraulic analyses shall be performed during final engineering will include grate and curb inlet sizing, and HGL determination.

5. CONCLUSION

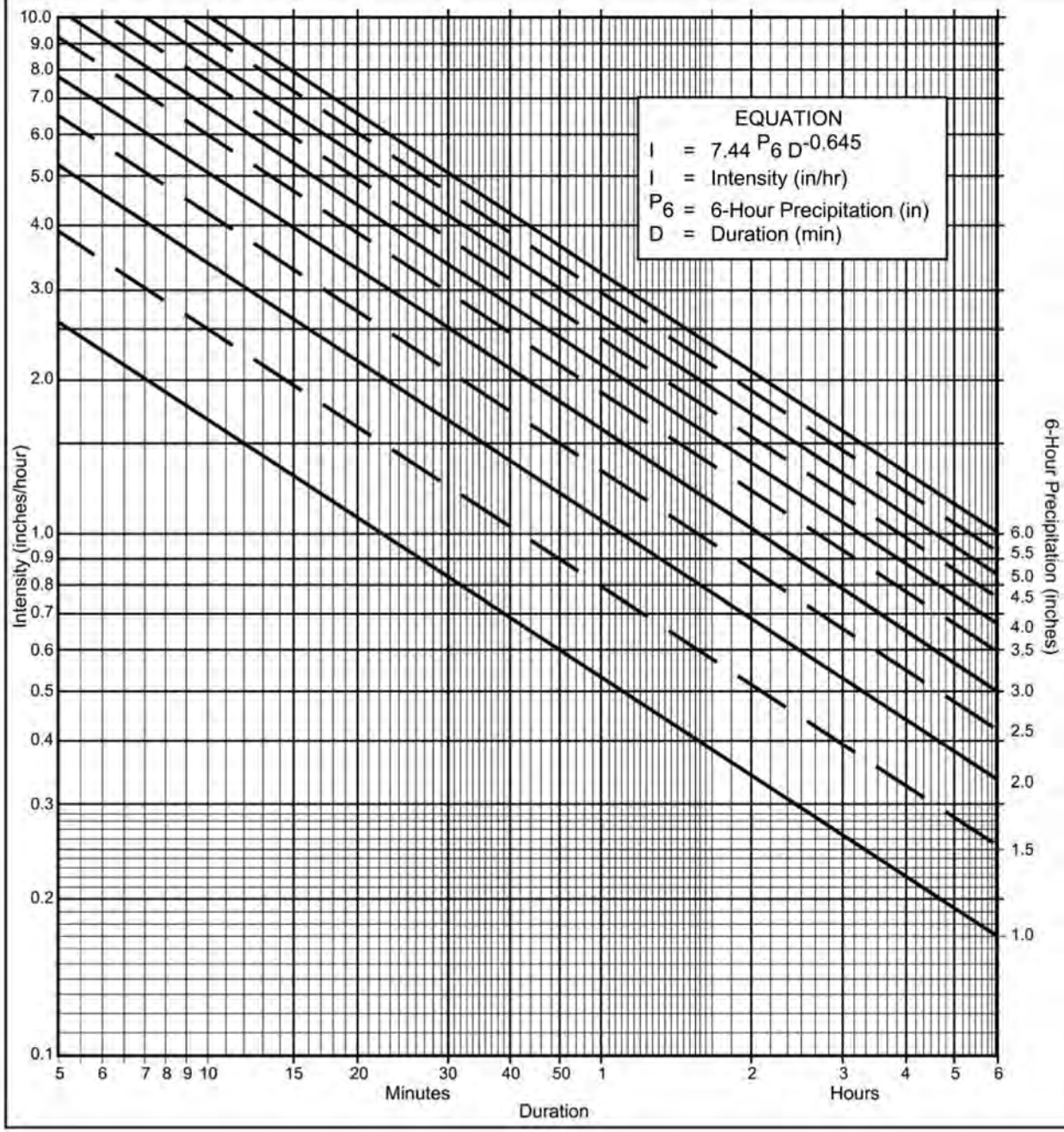
This drainage report has been prepared in support of the preliminary design of the storm drain improvements for the Tentative Parcel Map and Coastal Development Permit for the Yards at the Bay project. The purpose of this report is to provide peak discharges for use in designing the private storm drain systems for the project and to address issues regarding comparing the post-project flows to the pre-project flows. Table 2 indicates that the proposed conditions discharge

slightly more runoff to the south, but the overall total post-project 100-year flow is less compared to the existing condition.

The storm drain system will be sufficient to satisfy City of Chula Vista criteria in the post-development condition.

APPENDIX 1

Supplemental Information (Intensity Duration Frequency Curve, Runoff Coefficients)



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.6 in., P_{24} = 4.4, $\frac{P_6}{P_{24}}$ = 59.1 %(2)

(c) Adjusted P_6(2) = _____ in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1

3-203 Hydrology

Developers draining to a river or stream will be required to use the latest adopted County Hydrology Manual to determine the flows expected at a given frequency (Q10, Q50 Q100, etc,) Infill developments will use the following Hydrology requirements. The City Engineer will determine which projects may be considered "infill" projects.

3-203.1 Previously Approved Reports

Runoff quantities; as set forth or derived from the report prepared by Lawrence, Fogg, Florer and Smith titled "A Special Study of Storm Drain Facilities" on file in the office of the City Engineer may be used in the design of drainage facilities in Chula Vista. A hydrologic study prepared and approved at General Development Plan (GDP) or Specific Planning Area (SPA) plan may be used as determined by the City Engineer.

3-203.2

For local drainage basins, storm discharge flow may be estimated based on the Rational Method or the Modified Rational Method. For all lateral and major drainage basins the SCS method, U.S. Army Corps of Engineers HEC-1 computer method or other tabular or computer method may be used upon City Engineer approval.

3-203.3 Rational and Modified Rational Methods

(1) The rational method equation relates storm rainfall intensity (I), a selected runoff coefficient (C) and drainage area (A) to the peak runoff rate (Q):

$$Q = CIA \text{ (Empirical Units)}$$

where:

Q = Peak runoff in cubic feet per second
C = Runoff coefficient
I = Intensity, inches per hours
A = Drainage basin area in acres

Or

$$Q=0.278CIA \text{ (Metric Units)}$$

where:

Q = Peak runoff in cubic meters per second
C = Runoff coefficient
I = Intensity in millimeters per second
A = Drainage area in square kilometers

(2) Coefficient of Runoff: Consider probable development. Use highest number of the following values:

a)	Paved Surface	0.90
b)	Commercial Area	0.85
c)	Dense Residential (R2, R3)	0.75

d)	Normal Residential (R1)	0.65
e)	Suburban Property (RE)	0.55
f)	Barren Slopes Steep	0.80
g)	Barren Slopes Hilly	0.75
h)	" " Rolling	0.70
i)	" " Flat	0.65
j)	Vegetated Slopes Steep	0.60
k)	" " Hilly	0.55
l)	" " Rolling	0.50
m)	" " Flat	0.45
n)	Farm Land	0.35
o)	Parks, Golf Courses	0.30

NOTES:
Steep = Steep, rugged terrain with average slopes generally above 30%.
Hilly = Hilly terrain with average slopes of 10% to 30%.
Rolling = Rolling terrain with average slopes of 5% to 10%.
Flat = Relatively flat land, with average slopes of 0% to 5%.
Composite = Where drainage areas are composed of parts having different runoff characteristics, a weighted coefficient for the total drainage area may be used.

The runoff coefficient for a basin should be a composite coefficient made of the many different runoff coefficients for the sub-areas of the basin per equation:

$$\frac{CA_T = C_1A_1+C_2A_2+\ldots CnAn}{n}$$

(3) Time of Concentration (t_c = minutes) is the time required for runoff to flow from the most remote part of the watershed to the outlet point under consideration. With exceptions for limited natural watersheds, the time of concentration shall be calculated as follows:

a) $t_c = t_i + t_f$ where:

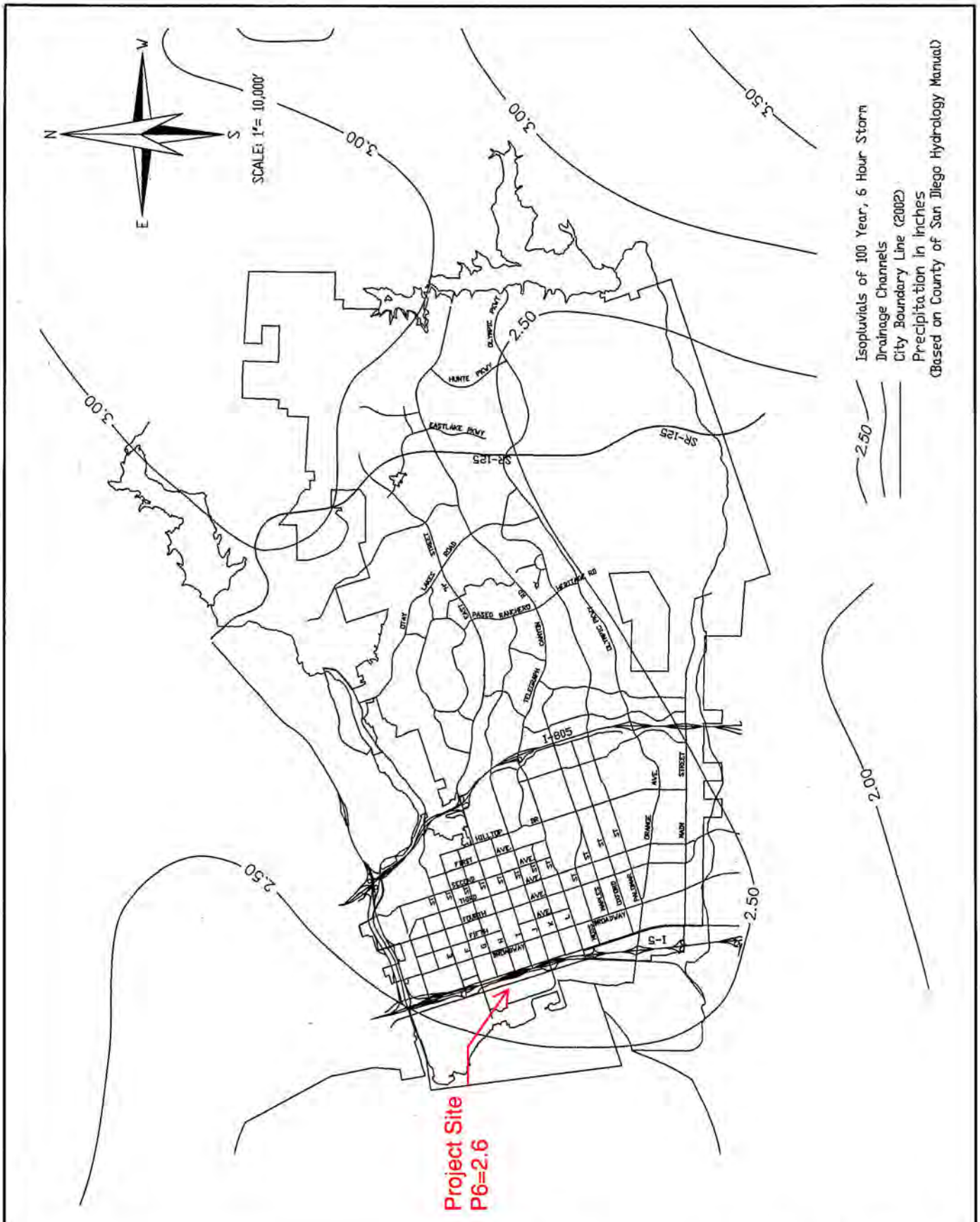
t_i = Initial time or overland flow time of concentration, the time required for runoff to flow to the first inlet or to the street gutter

t_f = Travel time of concentration, the time required for runoff to flow within street gutters to inlets, with channels or within storm drain pipes.

b) t_i may be calculated using the following natural watershed flow formula:

$$t_i = 60x\ [(11.9L^3)/H]^{0.385}$$

L = Length of water shed (miles)
H = Difference in elevation from furthermost point to the design point (feet).



REVISION	BY	APPROVED	DATE
ORIGINAL			01/02
REVISION	CVM	C. SWANSON	11/02
REVISION	DPH	W. VALLE	11/17

CITY OF CHULA VISTA
ENGINEERING & CAPITAL PROJECTS
STANDARD DRAWING

100-YEAR, 6-HOUR PRECIPITATION

WILLIAM S. VALLE 11/21/2017
CITY ENGINEER

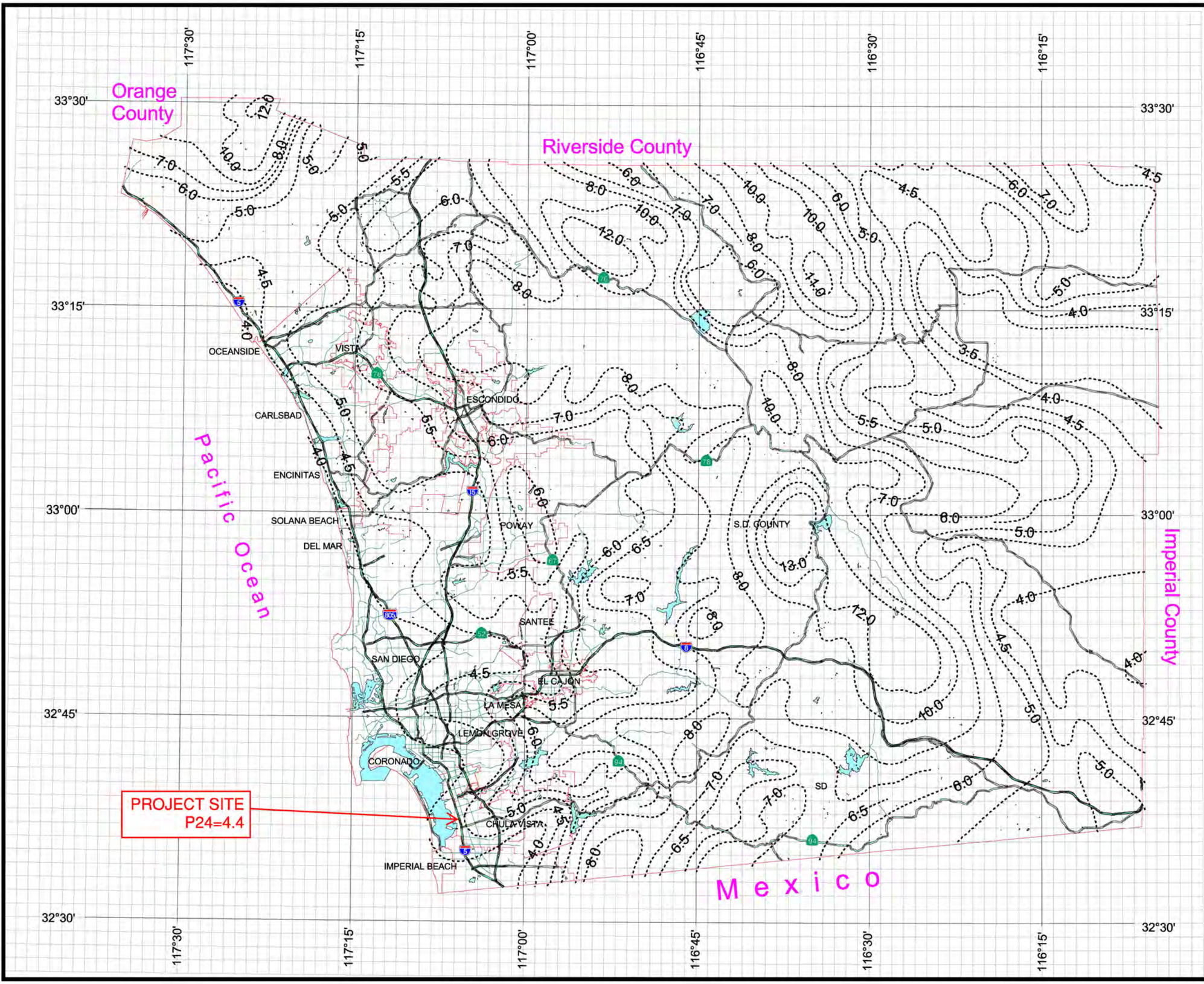
DRN-04

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)



DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

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Hydrologic Soil Group—San Diego County Area, California



Map Scale: 1:4,140 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 18, Sep 14, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 24, 2022—Apr 29, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HuC	Huerhuero-Urban land complex, 2 to 9 percent slopes	D	30.9	69.4%
Md	Made land		13.6	30.6%
Totals for Area of Interest			**44.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

117°6'19"W 32°38'3"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

117°5'42"W 32°37'33"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/26/2023 at 10:54 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX 2

Existing Conditions Rational Method Computer Output

EXISTING 100-YEAR RATIONAL ANALYSIS SYSTEM 100

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1509

                              Analysis prepared by:




 ------------------------------------------------------------------------
-
   FILE NAME: S100E100.DAT
   TIME/DATE OF STUDY: 08:30 07/19/2023
 ------------------------------------------------------------------------
-
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ------------------------------------------------------------------------
-
   2003 SAN DIEGO MANUAL CRITERIA

   USER SPECIFIED STORM EVENT(YEAR) = 100.00
   6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
   NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
   *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    1.50 0.0313 0.125 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 =  0.0 (FT*FT/S)
   *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
    OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*


**************************************************************************
   FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
 ------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

==========================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
```

```
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =      9.49
   DOWNSTREAM ELEVATION(FEET) =      9.38
   ELEVATION DIFFERENCE(FEET) =      0.11
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.207
   WARNING: THE MINIMUM OVERLAND FLOW SLOPE, 0.5%, IS USED IN Tc
CALCULATION!
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.55
   TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.55


****************************************************************************
   FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =      9.38  DOWNSTREAM(FEET) =      8.94
   CHANNEL LENGTH THRU SUBAREA(FEET) =    54.12   CHANNEL SLOPE =  0.0081
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.75
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.04
   AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   0.44
   Tc(MIN.) =    3.65
   SUBAREA AREA(ACRES) =     1.36       SUBAREA RUNOFF(CFS) =    8.38
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       8.94

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   2.36
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     104.12 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     6.64  DOWNSTREAM(FEET) =     5.81
   FLOW LENGTH(FEET) =   166.76   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.5 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   5.06
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       8.94
```

```
   PIPE TRAVEL TIME(MIN.) =   0.55    Tc(MIN.) =    4.20
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     270.88 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    1.54   SUBAREA RUNOFF(CFS) =    9.49
   TOTAL AREA(ACRES) =        3.0   TOTAL RUNOFF(CFS) =      18.43
   TC(MIN.) =    4.20

****************************************************************************
   FLOW PROCESS FROM NODE    103.00 TO NODE    105.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     5.81  DOWNSTREAM(FEET) =     4.30
   FLOW LENGTH(FEET) =   302.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.4 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.04
   ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      18.43
   PIPE TRAVEL TIME(MIN.) =   0.83    Tc(MIN.) =    5.03
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     572.88 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.822
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    1.02   SUBAREA RUNOFF(CFS) =    6.26
   TOTAL AREA(ACRES) =        4.0   TOTAL RUNOFF(CFS) =      24.62
   TC(MIN.) =    5.03

****************************************************************************
   FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  81
```

```
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.822
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    1.66   SUBAREA RUNOFF(CFS) =   10.19
   TOTAL AREA(ACRES) =        5.7   TOTAL RUNOFF(CFS) =      34.81
   TC(MIN.) =    5.03


****************************************************************************
   FLOW PROCESS FROM NODE    114.00 TO NODE    105.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.822
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    1.80   SUBAREA RUNOFF(CFS) =   11.05
   TOTAL AREA(ACRES) =        7.5   TOTAL RUNOFF(CFS) =      45.86
   TC(MIN.) =    5.03


****************************************************************************
   FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     4.30  DOWNSTREAM(FEET) =     3.31
   FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  39.0 INCH PIPE IS  26.6 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   7.60
   ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      45.86
   PIPE TRAVEL TIME(MIN.) =   0.44    Tc(MIN.) =    5.47
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =     772.88 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.464
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
```

```
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    0.79   SUBAREA RUNOFF(CFS) =    4.60
   TOTAL AREA(ACRES) =        8.3   TOTAL RUNOFF(CFS) =      48.05
   TC(MIN.) =    5.47


****************************************************************************
   FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 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.) =    5.47
   RAINFALL INTENSITY(INCH/HR) =   6.46
   TOTAL STREAM AREA(ACRES) =     8.26
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     48.05


****************************************************************************
   FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     13.83
   DOWNSTREAM ELEVATION(FEET) =     12.89
   ELEVATION DIFFERENCE(FEET) =      0.94
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.063
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.55
   TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.55


****************************************************************************
   FLOW PROCESS FROM NODE    108.00 TO NODE    109.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     12.89  DOWNSTREAM(FEET) =     11.50
   CHANNEL LENGTH THRU SUBAREA(FEET) =   166.90   CHANNEL SLOPE =  0.0083
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
```

```
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.02
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.05
   AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   1.36
   Tc(MIN.) =    3.42
   SUBAREA AREA(ACRES) =     1.45       SUBAREA RUNOFF(CFS) =    8.94
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       9.49

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   2.47
   LONGEST FLOWPATH FROM NODE    107.00 TO NODE    109.00 =     216.90 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    109.00 TO NODE    110.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     8.57  DOWNSTREAM(FEET) =     7.86
   FLOW LENGTH(FEET) =   112.90   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.9 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   5.62
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       9.49
   PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =    3.76
   LONGEST FLOWPATH FROM NODE    107.00 TO NODE    110.00 =     329.80 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    110.00 TO NODE    110.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    0.88   SUBAREA RUNOFF(CFS) =    5.43
   TOTAL AREA(ACRES) =        2.4   TOTAL RUNOFF(CFS) =      14.92
   TC(MIN.) =    3.76


****************************************************************************
   FLOW PROCESS FROM NODE    110.00 TO NODE    111.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
```

```
   ELEVATION DATA: UPSTREAM(FEET) =     7.86  DOWNSTREAM(FEET) =     7.05
   FLOW LENGTH(FEET) =   130.10   MANNING'S N =  0.013
   DEPTH OF FLOW IN  24.0 INCH PIPE IS  17.1 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.22
   ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      14.92
   PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    4.10
   LONGEST FLOWPATH FROM NODE    107.00 TO NODE    111.00 =     459.90 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    1.43   SUBAREA RUNOFF(CFS) =    8.82
   TOTAL AREA(ACRES) =        3.8   TOTAL RUNOFF(CFS) =      23.74
   TC(MIN.) =    4.10

****************************************************************************
   FLOW PROCESS FROM NODE    111.00 TO NODE    113.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     7.05  DOWNSTREAM(FEET) =     3.43
   FLOW LENGTH(FEET) =   578.20   MANNING'S N =  0.013
   DEPTH OF FLOW IN  27.0 INCH PIPE IS  22.0 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.85
   ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      23.74
   PIPE TRAVEL TIME(MIN.) =   1.41    Tc(MIN.) =    5.51
   LONGEST FLOWPATH FROM NODE    107.00 TO NODE    113.00 =    1038.10 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    113.00 TO NODE    113.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.433
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    1.99   SUBAREA RUNOFF(CFS) =   11.52
```

```
   TOTAL AREA(ACRES) =        5.8   TOTAL RUNOFF(CFS) =      33.81
   TC(MIN.) =    5.51

****************************************************************************
   FLOW PROCESS FROM NODE    112.00 TO NODE    112.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.433
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    4.49   SUBAREA RUNOFF(CFS) =   26.00
   TOTAL AREA(ACRES) =       10.3   TOTAL RUNOFF(CFS) =      59.81
   TC(MIN.) =    5.51

****************************************************************************
   FLOW PROCESS FROM NODE    113.00 TO NODE    106.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     3.43  DOWNSTREAM(FEET) =     0.12
   FLOW LENGTH(FEET) =   529.50   MANNING'S N =  0.013
   DEPTH OF FLOW IN  39.0 INCH PIPE IS  30.0 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   8.72
   ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      59.81
   PIPE TRAVEL TIME(MIN.) =   1.01    Tc(MIN.) =    6.52
   LONGEST FLOWPATH FROM NODE    107.00 TO NODE    106.00 =    1567.60 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    113.00 TO NODE    106.00 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.) =    6.52
   RAINFALL INTENSITY(INCH/HR) =   5.77
   TOTAL STREAM AREA(ACRES) =    10.33
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     59.81

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       48.05     5.47        6.464          8.26
```

```
    2       59.81     6.52        5.770         10.33

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       98.21     5.47       6.464
       2      102.70     6.52       5.770

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =     102.70   Tc(MIN.) =    6.52
   TOTAL AREA(ACRES) =       18.6
   LONGEST FLOWPATH FROM NODE    107.00 TO NODE    106.00 =    1567.60 FEET.

============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =       18.6  TC(MIN.) =      6.52
   PEAK FLOW RATE(CFS)   =     102.70

============================================================================

============================================================================
   END OF RATIONAL METHOD ANALYSIS
```

EXISTING 100-YEAR RATIONAL ANALYSIS SYSTEM 200

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1509

                            Analysis prepared by:




 ----------------------------------------------------------------------------
-
   FILE NAME: S200E200.DAT
   TIME/DATE OF STUDY: 08:46 07/20/2023
 ----------------------------------------------------------------------------
-
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ----------------------------------------------------------------------------
-
   2003 SAN DIEGO MANUAL CRITERIA

   USER SPECIFIED STORM EVENT(YEAR) = 100.00
   6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
   NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
   *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    1.50 0.0313 0.125 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 =  0.0 (FT*FT/S)
   *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
    OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*


****************************************************************************
   FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
```

```
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     14.16
   DOWNSTREAM ELEVATION(FEET) =     13.47
   ELEVATION DIFFERENCE(FEET) =      0.69
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.286
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      1.23
   TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      1.23


****************************************************************************
   FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     13.47  DOWNSTREAM(FEET) =     11.47
   CHANNEL LENGTH THRU SUBAREA(FEET) =   149.00   CHANNEL SLOPE =  0.0134
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.58
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.58
   AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   0.96
   Tc(MIN.) =    3.25
   SUBAREA AREA(ACRES) =     1.41       SUBAREA RUNOFF(CFS) =    8.69
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.6         PEAK FLOW RATE(CFS) =       9.93

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   2.94
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     199.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =    10.80  DOWNSTREAM(FEET) =    10.29
   FLOW LENGTH(FEET) =   147.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.7 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   4.55
   ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       9.93
   PIPE TRAVEL TIME(MIN.) =   0.54    Tc(MIN.) =    3.79
```

```
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     346.00 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    203.00 TO NODE    203.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    2.70   SUBAREA RUNOFF(CFS) =   16.65
   TOTAL AREA(ACRES) =        4.3   TOTAL RUNOFF(CFS) =      26.57
   TC(MIN.) =    3.79

****************************************************************************
   FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =    10.29  DOWNSTREAM(FEET) =     9.50
   FLOW LENGTH(FEET) =   228.10   MANNING'S N =  0.013
   DEPTH OF FLOW IN  33.0 INCH PIPE IS  23.9 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   5.76
   ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      26.57
   PIPE TRAVEL TIME(MIN.) =   0.66    Tc(MIN.) =    4.45
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    204.00 =     574.10 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    2.75   SUBAREA RUNOFF(CFS) =   16.95
   TOTAL AREA(ACRES) =        7.1   TOTAL RUNOFF(CFS) =      43.53
   TC(MIN.) =    4.45

****************************************************************************
   FLOW PROCESS FROM NODE    204.00 TO NODE    205.00 IS CODE =  31
```

```
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     9.50  DOWNSTREAM(FEET) =     6.61
   FLOW LENGTH(FEET) =   641.50   MANNING'S N =  0.013
   DEPTH OF FLOW IN  36.0 INCH PIPE IS  29.4 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   7.04
   ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      43.53
   PIPE TRAVEL TIME(MIN.) =   1.52    Tc(MIN.) =    5.97
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    205.00 =    1215.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    205.00 TO NODE    205.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.112
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    2.43   SUBAREA RUNOFF(CFS) =   13.37
   TOTAL AREA(ACRES) =        9.5   TOTAL RUNOFF(CFS) =      52.20
   TC(MIN.) =    5.97


****************************************************************************
   FLOW PROCESS FROM NODE    205.00 TO NODE    211.00 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.) =    5.97
   RAINFALL INTENSITY(INCH/HR) =   6.11
   TOTAL STREAM AREA(ACRES) =     9.49
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     52.20


****************************************************************************
   FLOW PROCESS FROM NODE    206.00 TO NODE    207.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
```

```
   UPSTREAM ELEVATION(FEET) =     10.00
   DOWNSTREAM ELEVATION(FEET) =      8.80
   ELEVATION DIFFERENCE(FEET) =      1.20
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.901
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.74
   TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.74


****************************************************************************
   FLOW PROCESS FROM NODE    207.00 TO NODE    208.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =      8.80  DOWNSTREAM(FEET) =      8.30
   CHANNEL LENGTH THRU SUBAREA(FEET) =   127.10   CHANNEL SLOPE =  0.0039
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.32
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.51
   AVERAGE FLOW DEPTH(FEET) =   0.21   TRAVEL TIME(MIN.) =   1.40
   Tc(MIN.) =    3.30
   SUBAREA AREA(ACRES) =     1.16       SUBAREA RUNOFF(CFS) =    7.15
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       7.89

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.27   FLOW VELOCITY(FEET/SEC.) =   1.75
   LONGEST FLOWPATH FROM NODE    206.00 TO NODE    208.00 =     177.10 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    209.00 TO NODE    209.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    2.64   SUBAREA RUNOFF(CFS) =   16.28
   TOTAL AREA(ACRES) =        3.9   TOTAL RUNOFF(CFS) =      24.17
   TC(MIN.) =    3.30


****************************************************************************
```

```
   FLOW PROCESS FROM NODE    208.00 TO NODE    210.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     5.90  DOWNSTREAM(FEET) =     2.96
   FLOW LENGTH(FEET) =   345.50   MANNING'S N =  0.013
   DEPTH OF FLOW IN  27.0 INCH PIPE IS  19.4 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   7.89
   ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      24.17
   PIPE TRAVEL TIME(MIN.) =   0.73    Tc(MIN.) =    4.03
   LONGEST FLOWPATH FROM NODE    206.00 TO NODE    210.00 =     522.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    210.00 TO NODE    210.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    0.78   SUBAREA RUNOFF(CFS) =    4.81
   TOTAL AREA(ACRES) =        4.7   TOTAL RUNOFF(CFS) =      28.98
   TC(MIN.) =    4.03


****************************************************************************
   FLOW PROCESS FROM NODE    212.00 TO NODE    212.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    3.65   SUBAREA RUNOFF(CFS) =   22.50
   TOTAL AREA(ACRES) =        8.4   TOTAL RUNOFF(CFS) =      51.48
   TC(MIN.) =    4.03


****************************************************************************
   FLOW PROCESS FROM NODE    210.00 TO NODE    211.00 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.) =    4.03
   RAINFALL INTENSITY(INCH/HR) =   6.85
   TOTAL STREAM AREA(ACRES) =     8.35
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     51.48

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       52.20     5.97        6.112          9.49
       2       51.48     4.03        6.850          8.35

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       86.75     4.03       6.850
       2       98.13     5.97       6.112

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      98.13   Tc(MIN.) =    5.97
   TOTAL AREA(ACRES) =       17.8
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    211.00 =    1215.60 FEET.

================================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =       17.8  TC(MIN.) =      5.97
   PEAK FLOW RATE(CFS)   =      98.13

================================================================================

================================================================================
   END OF RATIONAL METHOD ANALYSIS
```

APPENDIX 3

Proposed Conditions Rational Method Computer Output

PROPOSED 100-YEAR RATIONAL ANALYSIS SYSTEM 100

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1509

                              Analysis prepared by:




 ------------------------------------------------------------------------
-
   FILE NAME: S100D100.DAT
   TIME/DATE OF STUDY: 13:38 07/27/2023
 ------------------------------------------------------------------------
-
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ------------------------------------------------------------------------
-
   2003 SAN DIEGO MANUAL CRITERIA

   USER SPECIFIED STORM EVENT(YEAR) = 100.00
   6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
   NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
   *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 0.0313 0.167 0.0150

   GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
     1. Relative Flow-Depth =  0.10 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.*


**************************************************************************
   FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
 ------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     14.63
   DOWNSTREAM ELEVATION(FEET) =     13.70
   ELEVATION DIFFERENCE(FEET) =      0.93
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.070
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.43
   TOTAL AREA(ACRES) =      0.07   TOTAL RUNOFF(CFS) =      0.43


****************************************************************************
   FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     13.70  DOWNSTREAM(FEET) =     13.35
   CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0064
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.02
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.63
   AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   0.56
   Tc(MIN.) =    2.63
   SUBAREA AREA(ACRES) =     0.84       SUBAREA RUNOFF(CFS) =    5.18
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        0.9         PEAK FLOW RATE(CFS) =       5.61

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.21   FLOW VELOCITY(FEET/SEC.) =   1.97
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     105.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =    11.35  DOWNSTREAM(FEET) =     8.85
   FLOW LENGTH(FEET) =   392.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.9 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   4.99
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
```

```
   PIPE-FLOW(CFS) =       5.61
   PIPE TRAVEL TIME(MIN.) =   1.31    Tc(MIN.) =    3.94
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     497.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8779
   SUBAREA AREA(ACRES) =    0.72   SUBAREA RUNOFF(CFS) =    4.19
   TOTAL AREA(ACRES) =        1.6   TOTAL RUNOFF(CFS) =       9.80
   TC(MIN.) =    3.94


****************************************************************************
   FLOW PROCESS FROM NODE    104.00 TO NODE    103.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8804
   SUBAREA AREA(ACRES) =    0.21   SUBAREA RUNOFF(CFS) =    1.29
   TOTAL AREA(ACRES) =        1.8   TOTAL RUNOFF(CFS) =      11.10
   TC(MIN.) =    3.94


****************************************************************************
   FLOW PROCESS FROM NODE    103.00 TO NODE    105.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     8.85  DOWNSTREAM(FEET) =     6.24
   FLOW LENGTH(FEET) =   256.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.1 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   7.04
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      11.10
   PIPE TRAVEL TIME(MIN.) =   0.61    Tc(MIN.) =    4.55
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =     753.00 FEET.
```

```
****************************************************************************
   FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8716
   SUBAREA AREA(ACRES) =    0.75   SUBAREA RUNOFF(CFS) =    4.37
   TOTAL AREA(ACRES) =        2.6   TOTAL RUNOFF(CFS) =      15.46
   TC(MIN.) =    4.55


****************************************************************************
   FLOW PROCESS FROM NODE    107.00 TO NODE    105.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8832
   SUBAREA AREA(ACRES) =    1.78   SUBAREA RUNOFF(CFS) =   10.97
   TOTAL AREA(ACRES) =        4.4   TOTAL RUNOFF(CFS) =      26.44
   TC(MIN.) =    4.55


****************************************************************************
   FLOW PROCESS FROM NODE    106.00 TO NODE    105.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8851
   SUBAREA AREA(ACRES) =    0.56   SUBAREA RUNOFF(CFS) =    3.45
   TOTAL AREA(ACRES) =        4.9   TOTAL RUNOFF(CFS) =      29.89
   TC(MIN.) =    4.55


****************************************************************************
   FLOW PROCESS FROM NODE    108.00 TO NODE    105.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
PAVED SURFACE RUNOFF COEFFICIENT = .9000
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.8857
SUBAREA AREA(ACRES) =    0.21   SUBAREA RUNOFF(CFS) =    1.29
TOTAL AREA(ACRES) =        5.1   TOTAL RUNOFF(CFS) =      31.19
TC(MIN.) =    4.55


****************************************************************************
FLOW PROCESS FROM NODE    105.00 TO NODE    109.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     6.24  DOWNSTREAM(FEET) =     4.28
FLOW LENGTH(FEET) =   351.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  33.0 INCH PIPE IS  22.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   7.22
ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =      31.19
PIPE TRAVEL TIME(MIN.) =   0.81    Tc(MIN.) =    5.36
LONGEST FLOWPATH FROM NODE    100.00 TO NODE    109.00 =    1104.00 FEET.


****************************************************************************
FLOW PROCESS FROM NODE    109.00 TO NODE    109.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.550
COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.8784
SUBAREA AREA(ACRES) =    1.32   SUBAREA RUNOFF(CFS) =    7.35
TOTAL AREA(ACRES) =        6.5   TOTAL RUNOFF(CFS) =      37.17
TC(MIN.) =    5.36


****************************************************************************
FLOW PROCESS FROM NODE    109.00 TO NODE    110.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     4.28  DOWNSTREAM(FEET) =     3.60
FLOW LENGTH(FEET) =    90.30   MANNING'S N =  0.013
DEPTH OF FLOW IN  33.0 INCH PIPE IS  23.0 INCHES
```

```
   PIPE-FLOW VELOCITY(FEET/SEC.) =   8.42
   ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      37.17
   PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =    5.54
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    110.00 =    1194.30 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    109.00 TO NODE    110.00 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.) =    5.54
   RAINFALL INTENSITY(INCH/HR) =   6.41
   TOTAL STREAM AREA(ACRES) =     6.46
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     37.17


****************************************************************************
   FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     14.23
   DOWNSTREAM ELEVATION(FEET) =     13.50
   ELEVATION DIFFERENCE(FEET) =      0.73
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.244
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.37
   TOTAL AREA(ACRES) =      0.06   TOTAL RUNOFF(CFS) =      0.37


****************************************************************************
   FLOW PROCESS FROM NODE    112.00 TO NODE    113.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     13.50  DOWNSTREAM(FEET) =     12.60
   CHANNEL LENGTH THRU SUBAREA(FEET) =    53.10   CHANNEL SLOPE =  0.0169
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
```

```
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.70
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.58
   AVERAGE FLOW DEPTH(FEET) =   0.14   TRAVEL TIME(MIN.) =   0.34
   Tc(MIN.) =    2.59
   SUBAREA AREA(ACRES) =     1.08       SUBAREA RUNOFF(CFS) =    6.66
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       7.03

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.19   FLOW VELOCITY(FEET/SEC.) =   2.86
   LONGEST FLOWPATH FROM NODE    111.00 TO NODE    113.00 =     103.10 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    113.00 TO NODE    114.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =    11.10  DOWNSTREAM(FEET) =     8.44
   FLOW LENGTH(FEET) =   468.50   MANNING'S N =  0.013
   DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.5 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   4.94
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       7.03
   PIPE TRAVEL TIME(MIN.) =   1.58    Tc(MIN.) =    4.17
   LONGEST FLOWPATH FROM NODE    111.00 TO NODE    114.00 =     571.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    114.00 TO NODE    114.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8782
   SUBAREA AREA(ACRES) =    0.88   SUBAREA RUNOFF(CFS) =    5.12
   TOTAL AREA(ACRES) =        2.0   TOTAL RUNOFF(CFS) =      12.15
   TC(MIN.) =    4.17


****************************************************************************
   FLOW PROCESS FROM NODE    114.00 TO NODE    110.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
```

```
   ELEVATION DATA: UPSTREAM(FEET) =     7.31  DOWNSTREAM(FEET) =     3.60
   FLOW LENGTH(FEET) =   540.90   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  16.3 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.05
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      12.15
   PIPE TRAVEL TIME(MIN.) =   1.49    Tc(MIN.) =    5.66
   LONGEST FLOWPATH FROM NODE    111.00 TO NODE    110.00 =    1112.50 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    115.00 TO NODE    110.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.327
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8744
   SUBAREA AREA(ACRES) =    0.32   SUBAREA RUNOFF(CFS) =    1.72
   TOTAL AREA(ACRES) =        2.3   TOTAL RUNOFF(CFS) =      12.94
   TC(MIN.) =    5.66


****************************************************************************
   FLOW PROCESS FROM NODE    116.00 TO NODE    110.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.327
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8719
   SUBAREA AREA(ACRES) =    0.26   SUBAREA RUNOFF(CFS) =    1.40
   TOTAL AREA(ACRES) =        2.6   TOTAL RUNOFF(CFS) =      14.34
   TC(MIN.) =    5.66


****************************************************************************
   FLOW PROCESS FROM NODE    117.00 TO NODE    110.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.327
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8658
   SUBAREA AREA(ACRES) =    1.00   SUBAREA RUNOFF(CFS) =    5.38
   TOTAL AREA(ACRES) =        3.6   TOTAL RUNOFF(CFS) =      19.72
   TC(MIN.) =    5.66
```

```
****************************************************************************
   FLOW PROCESS FROM NODE    118.00 TO NODE    110.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.327
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8683
   SUBAREA AREA(ACRES) =    0.28   SUBAREA RUNOFF(CFS) =    1.59
   TOTAL AREA(ACRES) =        3.9   TOTAL RUNOFF(CFS) =      21.31
   TC(MIN.) =    5.66


****************************************************************************
   FLOW PROCESS FROM NODE    119.00 TO NODE    110.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.327
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8706
   SUBAREA AREA(ACRES) =    0.30   SUBAREA RUNOFF(CFS) =    1.71
   TOTAL AREA(ACRES) =        4.2   TOTAL RUNOFF(CFS) =      23.02
   TC(MIN.) =    5.66


****************************************************************************
   FLOW PROCESS FROM NODE    117.00 TO NODE    110.00 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.) =    5.66
   RAINFALL INTENSITY(INCH/HR) =   6.33
   TOTAL STREAM AREA(ACRES) =     4.18
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     23.02

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       37.17     5.54        6.413          6.46
       2       23.02     5.66        6.327          4.18

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

```
   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       59.71     5.54       6.413
       2       59.69     5.66       6.327

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      59.71   Tc(MIN.) =    5.54
   TOTAL AREA(ACRES) =       10.6
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    110.00 =    1194.30 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    110.00 TO NODE    120.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     3.60  DOWNSTREAM(FEET) =     1.46
   FLOW LENGTH(FEET) =   433.30   MANNING'S N =  0.013
   DEPTH OF FLOW IN  42.0 INCH PIPE IS  30.2 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   8.06
   ESTIMATED PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      59.71
   PIPE TRAVEL TIME(MIN.) =   0.90    Tc(MIN.) =    6.43
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    120.00 =    1627.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    120.00 TO NODE    120.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.822
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8739
   SUBAREA AREA(ACRES) =    0.63   SUBAREA RUNOFF(CFS) =    3.12
   TOTAL AREA(ACRES) =       11.3   TOTAL RUNOFF(CFS) =      59.71
   TC(MIN.) =    6.43
   NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE


****************************************************************************
   FLOW PROCESS FROM NODE    110.00 TO NODE    120.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.822
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
```

```
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8731
   SUBAREA AREA(ACRES) =    0.40   SUBAREA RUNOFF(CFS) =    1.98
   TOTAL AREA(ACRES) =       11.7   TOTAL RUNOFF(CFS) =      59.71
   TC(MIN.) =    6.43
   NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE


****************************************************************************
   FLOW PROCESS FROM NODE    110.00 TO NODE    120.00 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.) =    6.43
   RAINFALL INTENSITY(INCH/HR) =   5.82
   TOTAL STREAM AREA(ACRES) =    11.67
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     59.71


****************************************************************************
   FLOW PROCESS FROM NODE    121.00 TO NODE    122.00 IS CODE =  21
 --------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     11.00
   DOWNSTREAM ELEVATION(FEET) =     10.75
   ELEVATION DIFFERENCE(FEET) =      0.25
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.207
   WARNING: THE MINIMUM OVERLAND FLOW SLOPE, 0.5%, IS USED IN Tc
CALCULATION!
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.92
   TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.92


****************************************************************************
   FLOW PROCESS FROM NODE    122.00 TO NODE    123.00 IS CODE =  51
 --------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     10.75  DOWNSTREAM(FEET) =     10.17
   CHANNEL LENGTH THRU SUBAREA(FEET) =    99.00   CHANNEL SLOPE =  0.0059
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
```

```
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.82
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.39
   AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   1.19
   Tc(MIN.) =    4.39
   SUBAREA AREA(ACRES) =     0.29       SUBAREA RUNOFF(CFS) =    1.79
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       2.71

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   1.49
   LONGEST FLOWPATH FROM NODE    121.00 TO NODE    123.00 =     149.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    123.00 TO NODE    124.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   VEGETATED SLOPES (FLAT) RUNOFF COEFFICIENT = .4500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.7643
   SUBAREA AREA(ACRES) =    0.19   SUBAREA RUNOFF(CFS) =    0.59
   TOTAL AREA(ACRES) =        0.6   TOTAL RUNOFF(CFS) =       3.30
   TC(MIN.) =    4.39


****************************************************************************
   FLOW PROCESS FROM NODE    124.00 TO NODE    125.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     7.34  DOWNSTREAM(FEET) =     6.59
   FLOW LENGTH(FEET) =   124.10   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.1 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   4.29
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       3.30
   PIPE TRAVEL TIME(MIN.) =   0.48    Tc(MIN.) =    4.88
   LONGEST FLOWPATH FROM NODE    121.00 TO NODE    125.00 =     273.10 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    125.00 TO NODE    125.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
VEGETATED SLOPES (FLAT) RUNOFF COEFFICIENT = .4500
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.6520
SUBAREA AREA(ACRES) =    0.35   SUBAREA RUNOFF(CFS) =    1.08
TOTAL AREA(ACRES) =       1.0   TOTAL RUNOFF(CFS) =       4.38
TC(MIN.) =    4.88


****************************************************************************
FLOW PROCESS FROM NODE    126.00 TO NODE    125.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
PAVED SURFACE RUNOFF COEFFICIENT = .9000
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.7509
SUBAREA AREA(ACRES) =    0.65   SUBAREA RUNOFF(CFS) =    4.01
TOTAL AREA(ACRES) =       1.6   TOTAL RUNOFF(CFS) =       8.38
TC(MIN.) =    4.88


****************************************************************************
FLOW PROCESS FROM NODE    127.00 TO NODE    125.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
PAVED SURFACE RUNOFF COEFFICIENT = .9000
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.8138
SUBAREA AREA(ACRES) =    1.19   SUBAREA RUNOFF(CFS) =    7.34
TOTAL AREA(ACRES) =       2.8   TOTAL RUNOFF(CFS) =      15.72
TC(MIN.) =    4.88


****************************************************************************
FLOW PROCESS FROM NODE    125.00 TO NODE    120.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     6.59  DOWNSTREAM(FEET) =     1.46
FLOW LENGTH(FEET) =   219.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.5 INCHES
```

```
   PIPE-FLOW VELOCITY(FEET/SEC.) =  10.52
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      15.72
   PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    5.22
   LONGEST FLOWPATH FROM NODE    121.00 TO NODE    120.00 =     492.10 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    125.00 TO NODE    120.00 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.) =    5.22
   RAINFALL INTENSITY(INCH/HR) =   6.66
   TOTAL STREAM AREA(ACRES) =     2.82
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     15.72

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       59.71     6.43        5.822         11.67
       2       15.72     5.22        6.661          2.82

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       67.92     5.22       6.661
       2       73.45     6.43       5.822

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      73.45   Tc(MIN.) =    6.43
   TOTAL AREA(ACRES) =       14.5
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    120.00 =    1627.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    120.00 TO NODE    128.00 IS CODE =  31
 --------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     1.46  DOWNSTREAM(FEET) =     0.45
   FLOW LENGTH(FEET) =   264.70   MANNING'S N =  0.013
   DEPTH OF FLOW IN  48.0 INCH PIPE IS  34.0 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   7.72
   ESTIMATED PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      73.45
```

```
   PIPE TRAVEL TIME(MIN.) =   0.57    Tc(MIN.) =    7.00
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    128.00 =    1892.30 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    129.00 TO NODE    128.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.511
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8594
   SUBAREA AREA(ACRES) =    3.25   SUBAREA RUNOFF(CFS) =   15.23
   TOTAL AREA(ACRES) =       17.7   TOTAL RUNOFF(CFS) =      84.03
   TC(MIN.) =    7.00

****************************************************************************
   FLOW PROCESS FROM NODE    128.00 TO NODE    130.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     1.00  DOWNSTREAM(FEET) =     0.16
   FLOW LENGTH(FEET) =   109.60   MANNING'S N =  0.013
   DEPTH OF FLOW IN  42.0 INCH PIPE IS  33.6 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =  10.17
   ESTIMATED PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      84.03
   PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =    7.18
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    130.00 =    2001.90 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    128.00 TO NODE    130.00 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.) =    7.18
   RAINFALL INTENSITY(INCH/HR) =   5.42
   TOTAL STREAM AREA(ACRES) =    17.74
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     84.03

****************************************************************************
   FLOW PROCESS FROM NODE    130.00 TO NODE    131.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
```

```
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     13.73
   DOWNSTREAM ELEVATION(FEET) =     13.00
   ELEVATION DIFFERENCE(FEET) =      0.73
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.244
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.37
   TOTAL AREA(ACRES) =      0.06   TOTAL RUNOFF(CFS) =      0.37


****************************************************************************
   FLOW PROCESS FROM NODE    132.00 TO NODE    133.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     13.00  DOWNSTREAM(FEET) =     11.40
   CHANNEL LENGTH THRU SUBAREA(FEET) =   407.00   CHANNEL SLOPE =  0.0039
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.493
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.29
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.41
   AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   4.80
   Tc(MIN.) =    7.04
   SUBAREA AREA(ACRES) =     1.16       SUBAREA RUNOFF(CFS) =    5.73
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       6.03

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.24   FLOW VELOCITY(FEET/SEC.) =   1.66
   LONGEST FLOWPATH FROM NODE    130.00 TO NODE    133.00 =     457.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    133.00 TO NODE    134.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     8.60  DOWNSTREAM(FEET) =     4.60
   FLOW LENGTH(FEET) =   132.20   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.2 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   9.10
```

```
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       6.03
   PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =    7.28
   LONGEST FLOWPATH FROM NODE    130.00 TO NODE    134.00 =     589.20 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    135.00 TO NODE    134.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.374
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8611
   SUBAREA AREA(ACRES) =    4.27   SUBAREA RUNOFF(CFS) =   19.51
   TOTAL AREA(ACRES) =        5.5   TOTAL RUNOFF(CFS) =      25.41
   TC(MIN.) =    7.28


****************************************************************************
   FLOW PROCESS FROM NODE    135.00 TO NODE    134.00 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.) =    7.28
   RAINFALL INTENSITY(INCH/HR) =   5.37
   TOTAL STREAM AREA(ACRES) =     5.49
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     25.41

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       84.03     7.18        5.422         17.74
       2       25.41     7.28        5.374          5.49

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1      109.09     7.18       5.422
       2      108.69     7.28       5.374

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =     109.09   Tc(MIN.) =    7.18
   TOTAL AREA(ACRES) =       23.2
   LONGEST FLOWPATH FROM NODE    100.00 TO NODE    134.00 =    2001.90 FEET.
```

```
============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =       23.2  TC(MIN.) =      7.18
   PEAK FLOW RATE(CFS)   =     109.09

============================================================================

============================================================================
   END OF RATIONAL METHOD ANALYSIS
```

PROPOSED 100-YEAR RATIONAL ANALYSIS SYSTEM 200

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1509

                              Analysis prepared by:




 ------------------------------------------------------------------------
-
   FILE NAME: S200D200.DAT
   TIME/DATE OF STUDY: 13:41 07/27/2023
 ------------------------------------------------------------------------
-
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
 ------------------------------------------------------------------------
-
   2003 SAN DIEGO MANUAL CRITERIA

   USER SPECIFIED STORM EVENT(YEAR) = 100.00
   6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
   NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
   *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 0.0313 0.167 0.0150

   GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
     1. Relative Flow-Depth =  0.10 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.*


**************************************************************************
   FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
 ------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
================================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     14.63
   DOWNSTREAM ELEVATION(FEET) =     14.00
   ELEVATION DIFFERENCE(FEET) =      0.63
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.357
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.62
   TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.62


****************************************************************************
   FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

================================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     14.00  DOWNSTREAM(FEET) =     13.20
   CHANNEL LENGTH THRU SUBAREA(FEET) =    64.20   CHANNEL SLOPE =  0.0125
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.29
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.56
   AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   0.42
   Tc(MIN.) =    2.77
   SUBAREA AREA(ACRES) =     1.84       SUBAREA RUNOFF(CFS) =   11.34
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.9         PEAK FLOW RATE(CFS) =      11.96

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.25   FLOW VELOCITY(FEET/SEC.) =   2.99
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     114.20 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

================================================================================
   ELEVATION DATA: UPSTREAM(FEET) =    11.70  DOWNSTREAM(FEET) =     7.30
   FLOW LENGTH(FEET) =   503.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.6 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.71
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
```

```
   PIPE-FLOW(CFS) =      11.96
   PIPE TRAVEL TIME(MIN.) =   1.25    Tc(MIN.) =    4.02
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =     617.20 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    204.00 TO NODE    203.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    0.32   SUBAREA RUNOFF(CFS) =    1.97
   TOTAL AREA(ACRES) =        2.3   TOTAL RUNOFF(CFS) =      13.93
   TC(MIN.) =    4.02


****************************************************************************
   FLOW PROCESS FROM NODE    205.00 TO NODE    203.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    0.17   SUBAREA RUNOFF(CFS) =    1.05
   TOTAL AREA(ACRES) =        2.4   TOTAL RUNOFF(CFS) =      14.98
   TC(MIN.) =    4.02


****************************************************************************
   FLOW PROCESS FROM NODE    203.00 TO NODE    206.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     7.32  DOWNSTREAM(FEET) =     5.51
   FLOW LENGTH(FEET) =   151.10   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.4 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   7.94
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      14.98
   PIPE TRAVEL TIME(MIN.) =   0.32    Tc(MIN.) =    4.34
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =     768.30 FEET.
```

```
****************************************************************************
   FLOW PROCESS FROM NODE    203.00 TO NODE    206.00 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.) =    4.34
   RAINFALL INTENSITY(INCH/HR) =   6.85
   TOTAL STREAM AREA(ACRES) =     2.43
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.98


****************************************************************************
   FLOW PROCESS FROM NODE    207.00 TO NODE    208.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     14.50
   DOWNSTREAM ELEVATION(FEET) =     14.20
   ELEVATION DIFFERENCE(FEET) =      0.30
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.018
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      2.16
   TOTAL AREA(ACRES) =      0.35   TOTAL RUNOFF(CFS) =      2.16


****************************************************************************
   FLOW PROCESS FROM NODE    208.00 TO NODE    209.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     14.20  DOWNSTREAM(FEET) =     11.30
   CHANNEL LENGTH THRU SUBAREA(FEET) =   205.00   CHANNEL SLOPE =  0.0141
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.95
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.60
   AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   1.31
   Tc(MIN.) =    4.33
   SUBAREA AREA(ACRES) =     1.23       SUBAREA RUNOFF(CFS) =    7.58
```

```
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        1.6         PEAK FLOW RATE(CFS) =       9.74

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   3.01
   LONGEST FLOWPATH FROM NODE    207.00 TO NODE    209.00 =     255.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    210.00 TO NODE    209.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    0.13   SUBAREA RUNOFF(CFS) =    0.80
   TOTAL AREA(ACRES) =        1.7   TOTAL RUNOFF(CFS) =      10.54
   TC(MIN.) =    4.33


****************************************************************************
   FLOW PROCESS FROM NODE    211.00 TO NODE    209.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8894
   SUBAREA AREA(ACRES) =    0.46   SUBAREA RUNOFF(CFS) =    2.68
   TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =      13.22
   TC(MIN.) =    4.33


****************************************************************************
   FLOW PROCESS FROM NODE    209.00 TO NODE    206.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     6.10  DOWNSTREAM(FEET) =     5.50
   FLOW LENGTH(FEET) =    79.80   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  17.0 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.35
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      13.22
   PIPE TRAVEL TIME(MIN.) =   0.21    Tc(MIN.) =    4.54
```

```
   LONGEST FLOWPATH FROM NODE    207.00 TO NODE    206.00 =     334.80 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    209.00 TO NODE    206.00 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.) =    4.54
   RAINFALL INTENSITY(INCH/HR) =   6.85
   TOTAL STREAM AREA(ACRES) =     2.17
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     13.22

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       14.98     4.34        6.850          2.43
       2       13.22     4.54        6.850          2.17

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       27.62     4.34       6.850
       2       28.20     4.54       6.850

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      28.20   Tc(MIN.) =    4.54
   TOTAL AREA(ACRES) =        4.6
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    206.00 =     768.30 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    206.00 TO NODE    212.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     5.50  DOWNSTREAM(FEET) =     4.10
   FLOW LENGTH(FEET) =   286.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  33.0 INCH PIPE IS  22.0 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.72
   ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      28.20
   PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =    5.25
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    212.00 =    1054.30 FEET.
```

```
****************************************************************************
   FLOW PROCESS FROM NODE    212.00 TO NODE    212.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.638
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8959
   SUBAREA AREA(ACRES) =    0.97   SUBAREA RUNOFF(CFS) =    5.79
   TOTAL AREA(ACRES) =        5.6   TOTAL RUNOFF(CFS) =      33.12
   TC(MIN.) =    5.25


****************************************************************************
   FLOW PROCESS FROM NODE    212.00 TO NODE    213.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     4.10  DOWNSTREAM(FEET) =     3.80
   FLOW LENGTH(FEET) =    62.30   MANNING'S N =  0.013
   DEPTH OF FLOW IN  33.0 INCH PIPE IS  25.1 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   6.84
   ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      33.12
   PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    5.40
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    213.00 =    1116.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    212.00 TO NODE    213.00 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.) =    5.40
   RAINFALL INTENSITY(INCH/HR) =   6.52
   TOTAL STREAM AREA(ACRES) =     5.57
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     33.12


****************************************************************************
   FLOW PROCESS FROM NODE    214.00 TO NODE    215.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
```

```
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     14.22
   DOWNSTREAM ELEVATION(FEET) =     13.93
   ELEVATION DIFFERENCE(FEET) =      0.29
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.815
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.70
   TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.70


****************************************************************************
   FLOW PROCESS FROM NODE    215.00 TO NODE    216.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     13.90  DOWNSTREAM(FEET) =     13.60
   CHANNEL LENGTH THRU SUBAREA(FEET) =    40.90   CHANNEL SLOPE =  0.0073
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.21
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.58
   AVERAGE FLOW DEPTH(FEET) =   0.14   TRAVEL TIME(MIN.) =   0.43
   Tc(MIN.) =    4.25
   SUBAREA AREA(ACRES) =     0.52       SUBAREA RUNOFF(CFS) =    3.03
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.850
   TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       3.73

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.17   FLOW VELOCITY(FEET/SEC.) =   1.86
   LONGEST FLOWPATH FROM NODE    214.00 TO NODE    216.00 =      90.90 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    216.00 TO NODE    217.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     8.20  DOWNSTREAM(FEET) =     7.10
   FLOW LENGTH(FEET) =   186.00   MANNING'S N =  0.013
   ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
   DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.7 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   4.40
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       3.73
```

```
   PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =    4.95
   LONGEST FLOWPATH FROM NODE    214.00 TO NODE    217.00 =     276.90 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    217.00 TO NODE    217.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
   SUBAREA AREA(ACRES) =    1.22   SUBAREA RUNOFF(CFS) =    7.10
   TOTAL AREA(ACRES) =        1.9   TOTAL RUNOFF(CFS) =      10.83
   TC(MIN.) =    4.95

****************************************************************************
   FLOW PROCESS FROM NODE    217.00 TO NODE    218.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     7.10  DOWNSTREAM(FEET) =     6.10
   FLOW LENGTH(FEET) =   186.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  21.0 INCH PIPE IS  16.4 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   5.36
   ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      10.83
   PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =    5.53
   LONGEST FLOWPATH FROM NODE    214.00 TO NODE    218.00 =     462.90 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE    218.00 TO NODE    218.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.418
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8500
   SUBAREA AREA(ACRES) =    0.47   SUBAREA RUNOFF(CFS) =    2.56
   TOTAL AREA(ACRES) =        2.3   TOTAL RUNOFF(CFS) =      12.71
   TC(MIN.) =    5.53

****************************************************************************
   FLOW PROCESS FROM NODE    218.00 TO NODE    213.00 IS CODE =  31
```

```
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     6.10  DOWNSTREAM(FEET) =     3.80
   FLOW LENGTH(FEET) =   144.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.5 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   8.35
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      12.71
   PIPE TRAVEL TIME(MIN.) =   0.29    Tc(MIN.) =    5.82
   LONGEST FLOWPATH FROM NODE    214.00 TO NODE    213.00 =     606.90 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    218.00 TO NODE    213.00 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.) =    5.82
   RAINFALL INTENSITY(INCH/HR) =   6.21
   TOTAL STREAM AREA(ACRES) =     2.33
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     12.71

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       33.12     5.40        6.517          5.57
       2       12.71     5.82        6.212          2.33

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       44.92     5.40       6.517
       2       44.28     5.82       6.212

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      44.92   Tc(MIN.) =    5.40
   TOTAL AREA(ACRES) =        7.9
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    213.00 =    1116.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    213.00 TO NODE    219.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

================================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     3.80  DOWNSTREAM(FEET) =     2.50
   FLOW LENGTH(FEET) =   257.80   MANNING'S N =  0.013
   DEPTH OF FLOW IN  36.0 INCH PIPE IS  28.7 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   7.44
   ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      44.92
   PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =    5.98
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    219.00 =    1374.40 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    219.00 TO NODE    219.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

================================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.104
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8776
   SUBAREA AREA(ACRES) =    1.35   SUBAREA RUNOFF(CFS) =    7.00
   TOTAL AREA(ACRES) =        9.3   TOTAL RUNOFF(CFS) =      49.55
   TC(MIN.) =    5.98


****************************************************************************
   FLOW PROCESS FROM NODE    219.00 TO NODE    220.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

================================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     2.50  DOWNSTREAM(FEET) =     1.80
   FLOW LENGTH(FEET) =   114.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  36.0 INCH PIPE IS  28.7 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   8.21
   ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      49.55
   PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    6.21
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    220.00 =    1488.40 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    219.00 TO NODE    220.00 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.) =    6.21
```

```
   RAINFALL INTENSITY(INCH/HR) =   5.96
   TOTAL STREAM AREA(ACRES) =     9.25
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     49.55


****************************************************************************
   FLOW PROCESS FROM NODE    221.00 TO NODE    222.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     14.90
   DOWNSTREAM ELEVATION(FEET) =     11.50
   ELEVATION DIFFERENCE(FEET) =      3.40
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    1.344
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.37
   TOTAL AREA(ACRES) =      0.06   TOTAL RUNOFF(CFS) =      0.37


****************************************************************************
   FLOW PROCESS FROM NODE    222.00 TO NODE    223.00 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     11.60  DOWNSTREAM(FEET) =     10.20
   CHANNEL LENGTH THRU SUBAREA(FEET) =   106.60   CHANNEL SLOPE =  0.0131
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.91
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.84
   AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   0.97
   Tc(MIN.) =    2.31
   SUBAREA AREA(ACRES) =     0.50       SUBAREA RUNOFF(CFS) =    3.08
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        0.6         PEAK FLOW RATE(CFS) =       3.45

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.15   FLOW VELOCITY(FEET/SEC.) =   2.25
   LONGEST FLOWPATH FROM NODE    221.00 TO NODE    223.00 =     156.60 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    224.00 TO NODE    225.00 IS CODE =  81
```

```
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
   SUBAREA AREA(ACRES) =    0.53   SUBAREA RUNOFF(CFS) =    3.27
   TOTAL AREA(ACRES) =        1.1   TOTAL RUNOFF(CFS) =       6.72
   TC(MIN.) =    2.31


****************************************************************************
   FLOW PROCESS FROM NODE    223.00 TO NODE    225.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   VEGETATED SLOPES (FLAT) RUNOFF COEFFICIENT = .4500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8216
   SUBAREA AREA(ACRES) =    0.23   SUBAREA RUNOFF(CFS) =    0.71
   TOTAL AREA(ACRES) =        1.3   TOTAL RUNOFF(CFS) =       7.43
   TC(MIN.) =    2.31


****************************************************************************
   FLOW PROCESS FROM NODE    225.00 TO NODE    226.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     7.20  DOWNSTREAM(FEET) =     6.20
   FLOW LENGTH(FEET) =   158.70   MANNING'S N =  0.013
   DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.5 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =   5.21
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =       7.43
   PIPE TRAVEL TIME(MIN.) =   0.51    Tc(MIN.) =    2.82
   LONGEST FLOWPATH FROM NODE    221.00 TO NODE    226.00 =     315.30 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    227.00 TO NODE    226.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
PAVED SURFACE RUNOFF COEFFICIENT = .9000
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.8447
SUBAREA AREA(ACRES) =    0.55   SUBAREA RUNOFF(CFS) =    3.39
TOTAL AREA(ACRES) =        1.9   TOTAL RUNOFF(CFS) =      10.82
TC(MIN.) =    2.82

****************************************************************************
FLOW PROCESS FROM NODE    226.00 TO NODE    226.00 IS CODE =  81
----------------------------------------------------------------------------
-
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
VEGETATED SLOPES (FLAT) RUNOFF COEFFICIENT = .4500
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.8065
SUBAREA AREA(ACRES) =    0.20   SUBAREA RUNOFF(CFS) =    0.62
TOTAL AREA(ACRES) =        2.1   TOTAL RUNOFF(CFS) =      11.44
TC(MIN.) =    2.82

****************************************************************************
FLOW PROCESS FROM NODE    226.00 TO NODE    220.00 IS CODE =  31
----------------------------------------------------------------------------
-
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     6.20  DOWNSTREAM(FEET) =     1.80
FLOW LENGTH(FEET) =   181.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.3 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   9.82
ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =      11.44
PIPE TRAVEL TIME(MIN.) =   0.31    Tc(MIN.) =    3.12
LONGEST FLOWPATH FROM NODE    221.00 TO NODE    220.00 =     496.30 FEET.

****************************************************************************
FLOW PROCESS FROM NODE    228.00 TO NODE    220.00 IS CODE =  81
----------------------------------------------------------------------------
-
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
PAVED SURFACE RUNOFF COEFFICIENT = .9000
SOIL CLASSIFICATION IS "D"
AREA-AVERAGE RUNOFF COEFFICIENT = 0.8200
```

```
   SUBAREA AREA(ACRES) =    0.35   SUBAREA RUNOFF(CFS) =    2.16
   TOTAL AREA(ACRES) =        2.4   TOTAL RUNOFF(CFS) =      13.59
   TC(MIN.) =    3.12


****************************************************************************
   FLOW PROCESS FROM NODE    229.00 TO NODE    220.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   VEGETATED SLOPES (FLAT) RUNOFF COEFFICIENT = .4500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8026
   SUBAREA AREA(ACRES) =    0.12   SUBAREA RUNOFF(CFS) =    0.37
   TOTAL AREA(ACRES) =        2.5   TOTAL RUNOFF(CFS) =      13.96
   TC(MIN.) =    3.12


****************************************************************************
   FLOW PROCESS FROM NODE    226.00 TO NODE    220.00 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.) =    3.12
   RAINFALL INTENSITY(INCH/HR) =   6.85
   TOTAL STREAM AREA(ACRES) =     2.54
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     13.96

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       49.55     6.21        5.956          9.25
       2       13.96     3.12        6.850          2.54

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       57.04     3.12       6.850
       2       61.69     6.21       5.956

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      61.69   Tc(MIN.) =    6.21
   TOTAL AREA(ACRES) =       11.8
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    220.00 =    1488.40 FEET.
```

```
****************************************************************************
   FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 IS CODE =  31
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     1.80  DOWNSTREAM(FEET) =     1.00
   FLOW LENGTH(FEET) =    59.00   MANNING'S N =  0.013
   DEPTH OF FLOW IN  36.0 INCH PIPE IS  24.7 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =  11.94
   ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =      61.69
   PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    6.29
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    230.00 =    1547.40 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    220.00 TO NODE    230.00 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.) =    6.29
   RAINFALL INTENSITY(INCH/HR) =   5.91
   TOTAL STREAM AREA(ACRES) =    11.79
   PEAK FLOW RATE(CFS) AT CONFLUENCE =     61.69


****************************************************************************
   FLOW PROCESS FROM NODE    231.00 TO NODE    232.00 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

============================================================================
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
   UPSTREAM ELEVATION(FEET) =     15.40
   DOWNSTREAM ELEVATION(FEET) =     15.00
   ELEVATION DIFFERENCE(FEET) =      0.40
   URBAN SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.742
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.850
   NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
   SUBAREA RUNOFF(CFS) =      0.55
   TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.55


****************************************************************************
   FLOW PROCESS FROM NODE    232.00 TO NODE    233.00 IS CODE =  51
```

```
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     15.00  DOWNSTREAM(FEET) =     11.10
   CHANNEL LENGTH THRU SUBAREA(FEET) =   299.50   CHANNEL SLOPE =  0.0130
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
   MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.727
   PAVED SURFACE RUNOFF COEFFICIENT = .9000
   SOIL CLASSIFICATION IS "D"
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.46
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.08
   AVERAGE FLOW DEPTH(FEET) =   0.13   TRAVEL TIME(MIN.) =   2.40
   Tc(MIN.) =    5.14
   SUBAREA AREA(ACRES) =     0.64       SUBAREA RUNOFF(CFS) =    3.87
   AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
   TOTAL AREA(ACRES) =        0.7         PEAK FLOW RATE(CFS) =       4.42

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.16   FLOW VELOCITY(FEET/SEC.) =   2.38
   LONGEST FLOWPATH FROM NODE    231.00 TO NODE    233.00 =     349.50 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE    233.00 TO NODE    234.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.727
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8940
   SUBAREA AREA(ACRES) =    0.10   SUBAREA RUNOFF(CFS) =    0.57
   TOTAL AREA(ACRES) =        0.8   TOTAL RUNOFF(CFS) =       4.99
   TC(MIN.) =    5.14


****************************************************************************
   FLOW PROCESS FROM NODE    234.00 TO NODE    235.00 IS CODE =  81
 ----------------------------------------------------------------------------
-
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.727
   COMMERCIAL AREA RUNOFF COEFFICIENT = .8500
   SOIL CLASSIFICATION IS "D"
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.8757
   SUBAREA AREA(ACRES) =    0.59   SUBAREA RUNOFF(CFS) =    3.37
   TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       8.36
   TC(MIN.) =    5.14
```

```
****************************************************************************
   FLOW PROCESS FROM NODE    235.00 TO NODE    230.00 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.) =    5.14
   RAINFALL INTENSITY(INCH/HR) =   6.73
   TOTAL STREAM AREA(ACRES) =     1.42
   PEAK FLOW RATE(CFS) AT CONFLUENCE =      8.36

   ** CONFLUENCE DATA **
   STREAM     RUNOFF       Tc      INTENSITY      AREA
   NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
       1       61.69     6.29        5.905         11.79
       2        8.36     5.14        6.727          1.42

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

   ** PEAK FLOW RATE TABLE **
   STREAM     RUNOFF      Tc      INTENSITY
   NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
       1       62.52     5.14       6.727
       2       69.03     6.29       5.905

   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =      69.03   Tc(MIN.) =    6.29
   TOTAL AREA(ACRES) =       13.2
   LONGEST FLOWPATH FROM NODE    200.00 TO NODE    230.00 =    1547.40 FEET.

============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =       13.2  TC(MIN.) =      6.29
   PEAK FLOW RATE(CFS)   =      69.03

============================================================================

============================================================================
   END OF RATIONAL METHOD ANALYSIS
```

APPENDIX 4

Hydraulic Calculations

To be completed during Final Engineering

APPENDIX 5

Drainage Exhibits

EXISTING 54" STORM DRAIN DISCHARGES TO SLOUGH WHICH CONNECTS TO SAN DIEGO BAY

SYSTEM 200
TOTAL Q100 = 98.3 CFS
TOTAL AREA = 17.8 AC

G STREET

EXISTING 36" STORM DRAIN STUB PER 2001 BP SD MAP

EXISTING SDG&E FACILITY (NAP)

0.78 AC
3.65 AC
2.43 AC
2.75 AC
1.16 AC
2.64 AC
2.70 AC
0.12 AC
1.36 AC
0.20 AC
1.41 AC
1.54 AC
0.09 AC
0.09 AC
1.66 AC
4.49 AC
1.45 AC
1.02 AC
1.80 AC
0.88 AC
EXISTING 60" STORM DRAIN STUB PER DWG 11014-8
0.79 AC
1.99 AC
1.43 AC

SYSTEM 100
TOTAL Q100 = 102.70 CFS
TOTAL AREA = 18.6 AC

H STREET

EXISTING 72" STORM DRAIN STUB PER DWG 11014-7

LEGEND:

- PROPERTY BOUNDARY
- DRAINAGE BOUNDARY
- DRAINAGE SYSTEM
- OVERLAND FLOW DIRECTION
- EXISTING STORM DRAIN OVER 12" DIAMETER
- SD — EXISTING STORM DRAIN UNDER 12" DIAMETER
- 0.17 AC — DRAINAGE AREA
- 100 — DRAINAGE NODE

N

50 25 0 50 100
SCALE: 1"=50'

SCALE:	1"=50'
JOB #:	4508
CREATED:	7/12/23

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

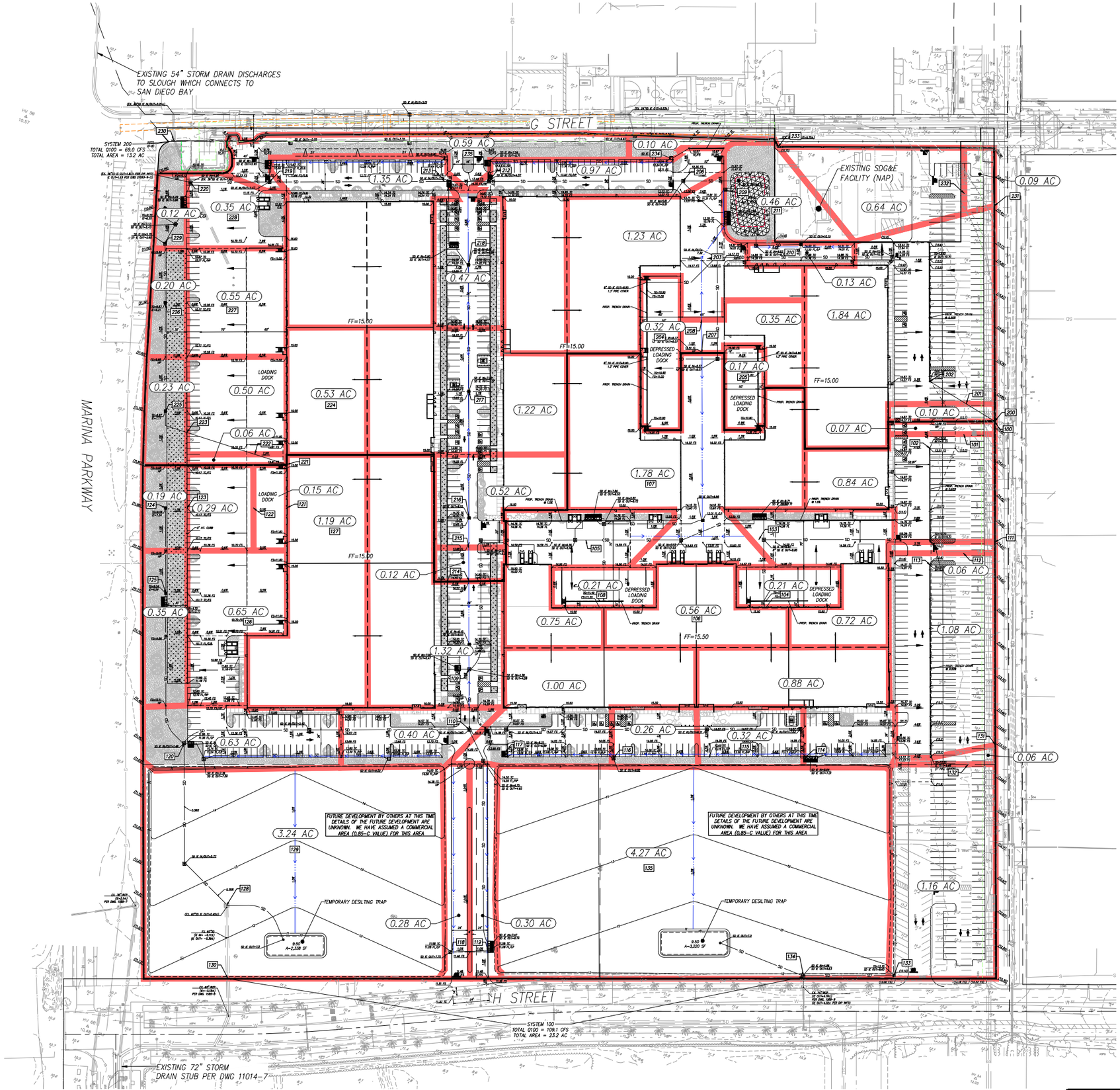
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CITY OF CHULA VISTA

YARDS AT THE BAY - PARCEL B

EXISTING DRAINAGE EXHIBIT
EXHIBIT A

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SCALE: 1"=50'	PREPARED BY:	CITY OF CHULA VISTA	
JOB #: 4508	PROJECT DESIGN CONSULTANTS Planning | Landscape Architecture | Engineering | Survey	YARDS AT THE BAY - PARCEL B	
CREATED: 7/12/23	701 B Street, Suite 800 San Diego, CA 92101 619.235.6471 Tel 619.234.0349 Fax	PROPOSED DRAINAGE EXHIBIT EXHIBIT B	

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Project Name/_____

ATTACHMENT 6

Project's Geotechnical and Groundwater Investigation Report

Attach project's geotechnical and groundwater investigation report. Refer to Appendix C.4 to determine the reporting requirements.

UPDATED LIMITED GEOTECHNICAL INVESTIGATION

COLLINS AEROSPACE REDEVELOPMENT SITE – PARCEL B NORTHEAST CORNER OF H STREET AND MARINA PARKWAY CHULA VISTA, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

WOHL

DECEMBER 17, 2021
PROJECT NO. G2560-52-01

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G2560-52-01
December 17, 2021

PW Wohl G Street LLC
c/o Wohl Property Group
1081 Camino Del Rio South, Suite 115
San Diego, California 92108

Attention: Mr. Emil Wohl

Subject: UPDATED LIMITED GEOTECHNICAL INVESTIGATION
COLLINS AEROSPACE REDEVELOPMENT SITE – PARCEL B
NORTHEAST CORNER OF H STREET AND MARINA PARKWAY
CHULA VISTA, CALIFORNIA

Dear Mr. Wohl:

In accordance with your request and authorization of our Proposal No. LG-20158 dated June 3, 2020, we herein submit the results of our updated limited geotechnical investigation for the subject project. We performed our limited investigation to evaluate the underlying soil and geologic conditions and potential geologic hazards, and to assist in the design of the proposed site improvements. The accompanying report presents the results of our study and preliminary conclusions and recommendations pertaining to geotechnical aspects of the proposed project.

Should you have questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Matt Love
RCE 84154



Shawn Foy Weedon
GE 2714



Michael C. Ertwine
CEG 2659



MRL:SFW:MCE:arm:kv

(e-mail) Addressee

TABLE OF CONTENTS

1. PURPOSE AND SCOPE 1

2. SITE AND PROJECT DESCRIPTION 2

3. GEOLOGIC SETTING 3

4. SOIL AND GEOLOGIC CONDITIONS 4
   - 4.1 Undocumented Fill (Qudf) 4
   - 4.2 Bay Deposits (Qb) 5
   - 4.3 Old Paralic Deposits (Qop) 5
   - 4.4 San Diego Formation (Tsd) 5

5. GROUNDWATER 5

6. GEOLOGIC HAZARDS 6
   - 6.1 Faulting and Seismicity 6
   - 6.2 Ground Rupture 7
   - 6.3 Liquefaction Potential and Seismically Induced Settlement 7
   - 6.4 Storm Surge, Tsunamis, and Seiches 9
   - 6.5 Hazardous Subsurface Materials 11

7. CONCLUSIONS AND RECOMMENDATIONS 12
   - 7.1 General 12
   - 7.2 Excavation and Soil Characteristics 13
   - 7.3 Grading 14
   - 7.4 Settlement Considerations 17
   - 7.5 Mitigation of Liquefaction 18
   - 7.6 Mitigation of Fill-Load Related Settlement 19
   - 7.7 Seismic Design Criteria 19
   - 7.8 Site Drainage and Moisture Protection 21
   - 7.9 Testing and Observation Services During Construction 21
   - 7.10 Grading and Foundation Plan Review 22

LIMITATIONS AND UNIFORMITY OF CONDITIONS

MAPS AND ILLUSTRATIONS
- Figure 1, Geologic Map

APPENDIX A
- FIELD INVESTIGATION

APPENDIX B
- PREVIOUS FIELD INVESTIGATIONS AND LABORATORY TESTING RESULTS

APPENDIX C
- LIQUEFACTION ANALYSIS

APPENDIX D
- GRADING SPECIFICATIONS

LIST OF REFERENCES

LIMITED GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of our limited geotechnical investigation related to the planned improvements to the subject property currently identified as Collins Aerospace – Parcel B in the City of Chula Vista, California (see Vicinity Map).



Vicinity Map

The purpose of this limited geotechnical investigation is to evaluate the surface and subsurface soil conditions and general site geology, and to identify geotechnical constraints that may affect development of the property including faulting, liquefaction and seismic shaking based on the 2019 CBC seismic design criteria. In addition, we provided recommendations for remedial grading, shallow foundations, concrete slab-on-grade, concrete flatwork, and retaining walls.

We reviewed the following plans and reports in preparation of this report:

1. *Limited Geotechnical Investigation, Collins Aerospace Redevelopment Site – Parcel A, Chula Vista, California,* prepared by Geocon Incorporated, dated October 12, 2020 (Project No. G2559-52-01).

2. *Geotechnical Investigation, OMPPA Project on Goodrich Property, Chula Vista, California,* prepared by Geocon Incorporated, dated September 12, 2005 (Project No. 07050-22-30).

3. *Limited Geotechnical Investigation, B.F. Goodrich Site Development, Chula Vista, California,* prepared by Geocon Incorporated, dated June 24, 1999 (Project No. 06327-22-01).

4. *Soil Investigation, Sauder Furnace Foundation, Building No. 1, Column E11-F11, Chula Vista, California,* prepared by Geocon Incorporated, dated July 14, 1980 (Project No. 02080-02-02).

The scope of this investigation included reviewing readily available published and unpublished geologic literature (see List of References), performing engineering analyses and preparing this report. We also advanced 5 exploratory Cone Penetrometer Tests (CPTs) to a maximum depth of 80 feet. Appendix A presents the CPT soundings and details of the field investigation. Appendix B presents the exploratory boring logs and laboratory testing from investigations previously performed on or adjacent to the property. The locations of the current CPTs and previous borings/CPTs at the property are shown on the Geologic Map, Figure 1. Appendix C presents the results of our current liquefaction analysis along with pertinent results from the Parcel A site.

2. SITE AND PROJECT DESCRIPTION

The Collins Aerospace – Parcel B property consists of the western portion of the existing Collins Aerospace facility (also identified as Rohr Industries, B. F. Goodrich and/or UTC Aerospace property). The Existing Site Map shows the current site conditions.



Existing Site Map

The property is bounded by H Street to the south, Marina Parkway and the future Gaylord Chula Vista Hotel and Convention Center to the west, and the remainder of the Collins Aerospace facility to the east and north. An existing rail line is present along the eastern border of the property. The site is currently occupied by a large industrial warehouse building along with several small ancillary

buildings and structures, and an on-grade asphalt concrete and Portland Cement concrete parking lots along with other associated improvements. Additionally, a San Diego Gas & Electric substation is located on the northeast corner of the property. Existing grades are relatively flat with elevations of approximately 8 to 12 feet Mean Sea Level (MSL) on the west and east, respectively.

Based on discussions with you, we understand the proposed development will consist of demolition of the existing warehouse building and ancillary structures and construction of new concrete-tilt-up style warehouse buildings and a hotel building along with other associated improvements. We do not expect the site will require storm water management devices. No other information is known at this time.

3. GEOLOGIC SETTING

Regionally, the site is located in the Peninsular Ranges geomorphic province. The province is bounded by the Transverse Ranges to the north, the San Jacinto Fault Zone on the east, the Pacific Ocean coastline on the west, and the Baja California on the south. The province is characterized by elongated northwest-trending mountain ridges separated by straight-sided sediment-filled valleys. The northwest trend is further reflected in the direction of the dominant geologic structural features of the province that are northwest to west-northwest trending folds and faults, such as the nearby Rose Canyon fault zone.

Locally, the site is within the coastal plain of San Diego County. The coastal plain is underlain by a thick sequence of relatively undisturbed and non-conformable sedimentary bedrock units that thicken to the west and range in age from Upper Cretaceous age through the Pleistocene age which have been deposited on Cretaceous to Jurassic age igneous and volcanic bedrock. Geomorphically, the coastal plain is characterized by a series of 21, stair-stepped marine terraces (younger to the west) that have been dissected by west flowing rivers. The coastal plain is a relatively stable block that is dissected by relatively few faults consisting of the potentially active La Nacion Fault Zone and the active Rose Canyon Fault Zone.

The site is located on the western portion of the coastal plain. Artificial fill, young alluvial flood-plain deposits (Bay Deposits), and marine sedimentary units consisting of Pleistocene-age Old Paralic Deposits (formerly known as the Bay Point Formation) make up the geologic sequence at the site. The Old Paralic Deposits are shallow marine deposits generally consisting of sand and silty sand units interfingered with layers of silt and clay. Based on published geologic information, we expect this unit to be in excess of 150 to 160 feet deep and extend below the current sea level. The mapped geologic conditions at the site is presented on the Regional Geologic Map.



Regional Geologic Map

4. SOIL AND GEOLOGIC CONDITIONS

Based on our review of published geologic maps, and the current and previous investigations at the site, we expect the site is underlain by two surficial soil types (consisting of undocumented fill and Holocene-age Bay Deposits) and two formational unit (consisting of Old Paralic Deposits and the San Diego Formation). The occurrence, distribution, and description of each unit encountered is shown on the Geologic Map, Figure 1 and on the boring logs in Appendix B. The geologic units are discussed herein in order of increasing age.

4.1 Undocumented Fill (Qudf)

We expect that undocumented fill associated with the existing site improvements is present across the majority of the site to depths of about 5 to 10 feet. In general, the fill consists of loose to medium dense, moist to wet, silty sand and possesses a "very low" to "low" expansion index (expansion index of 50 or less). The fill located below the groundwater elevation possesses a potential for liquefaction. Additionally, we understand that a zone of debris fill is located along the previous shoreline of the bay (along the western edge of the property). These materials are composed of concrete and trash debris mixed with soil that extend to depths of 5 to 10 feet. The upper portion of the undocumented fill is likely unsuitable for the support of proposed structures or structural fill and will require remedial grading. However, we expect the remedial grading operations will be limited to the groundwater elevation and/or saturated soil conditions.

4.2 Bay Deposits (Qb)

The Bay Deposits (bay mud) exist below the undocumented fill or at-grade to a maximum depth of approximately 15 to 20 feet on the western portion of the site and 20 to 30 feet on the eastern portion of the site. The bay deposits generally consist of very loose to medium dense, silty and clayey sand and soft, wet to saturated, sandy silt and clay. Sandy portions of the Bay Deposits are potentially liquefiable when subjected to strong ground motion. Additionally, the soft muds within the Bay Deposits are subject to consolidation settlement. The amount of settlement that could occur is a function of how thick the layer is, how compressible the layer is and the magnitude of the new vertical load (weight of new fill or future building loads). We consider these materials unsuitable for the support of structures or structural fill in their present condition.

4.3 Old Paralic Deposits (Qop)

The Quaternary-age Old Paralic Deposits (formally called the Bay Point Formation) exist below the undocumented fill and/or Bay Deposits across the site. The Old Paralic Deposits consist of medium dense to very dense sand layers interbedded with stiff clay and silt layers. The Old Paralic Deposits are considered suitable for the support of the proposed structures. However, we do not expect the Old Paralic Deposits will be encountered during the construction of the planned improvements.

4.4 San Diego Formation (Tsd)

Based on published geologic information, we expect the San Diego Formation underlies the Old Paralic Deposits. Based on our experience in the area, the top of the San Diego Formation is at about 150 to 160 feet deep (an elevation of -140 to -150 MSL). The San Diego Formation consists of dense to very dense silty, to clayey sandstone and siltstone. We do not expect to encounter the San Diego Formation during the construction of the planned improvements.

5. GROUNDWATER

We previously encountered groundwater at depths ranging from about 8 to 20 feet below the existing ground surface (approximate elevation of 1 to 7 feet above MSL). In addition, we encountered groundwater during our current study within the CPTs at depths ranging from approximately 5 to 8 feet below the existing ground surface (approximate elevation of 2 to 5 feet above MSL). Several groundwater monitoring wells have been installed on and adjacent to the property. Based on review of our existing information in the vicinity of the site, the groundwater depths range from about 3 to 11 feet below grade. The water elevations fluctuate due to tidal influences. The groundwater should be considered brackish due to the close proximity to the San Diego Bay and Pacific Ocean. Groundwater will be a factor in development especially in liquefaction remediation, deep foundation design and construction, grading operations and utility installation. A groundwater elevation of 6 feet above MSL should be incorporated into the design and construction operations. In addition, the soil about 2 to

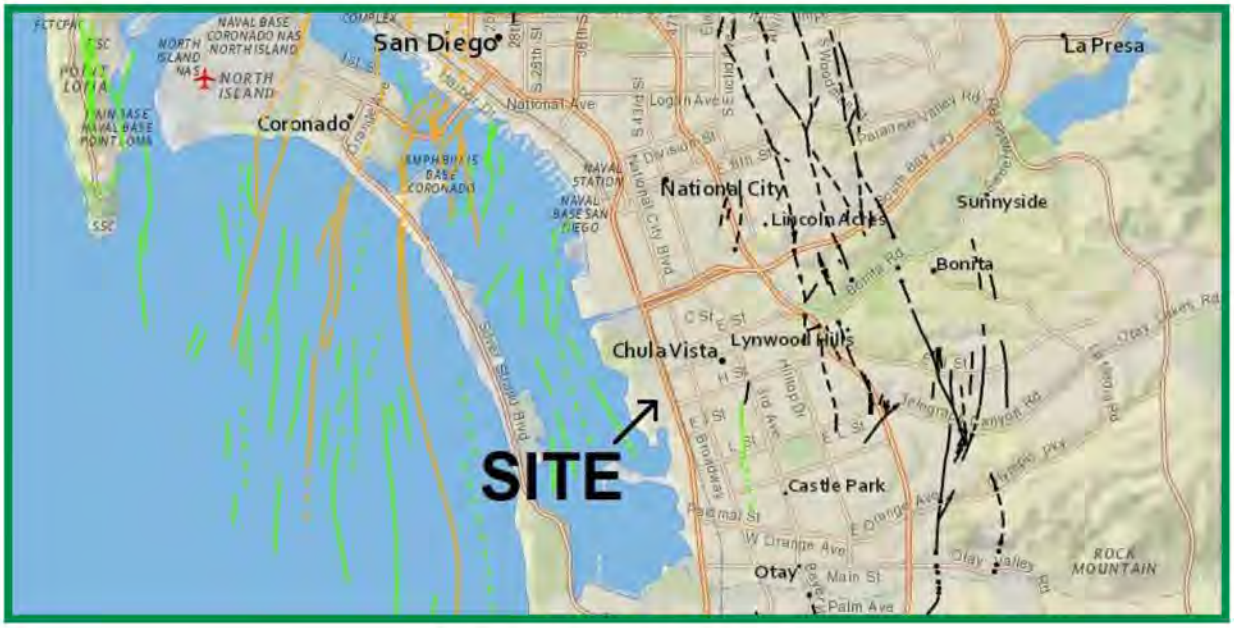
3 feet above the groundwater elevation may be saturated. Groundwater and seepage is dependent on seasonal precipitation, tidal influence, irrigation, land use, among other factors, and varies as a result. Proper surface drainage will be important to future performance of the project.

6. GEOLOGIC HAZARDS

6.1 Faulting and Seismicity

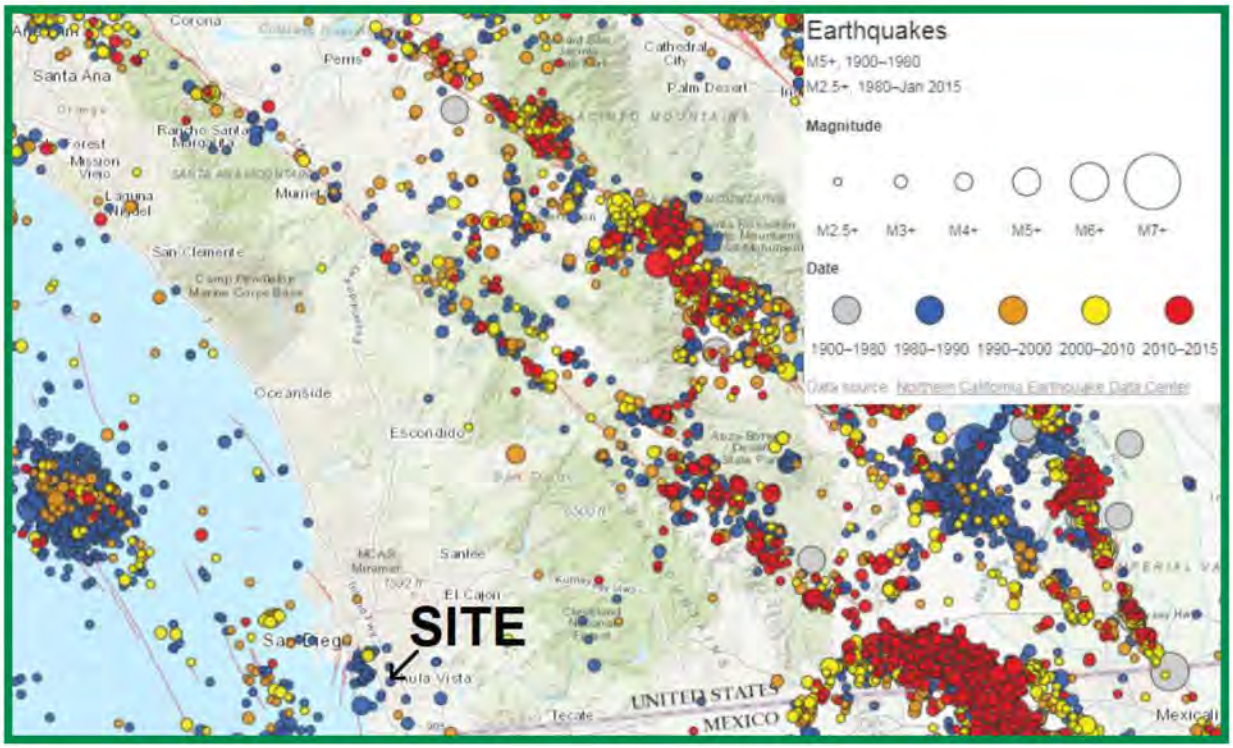
A review of the referenced geologic materials and our knowledge of the general area indicate that the site is not underlain by active, potentially active, or inactive faults. An active fault is defined by the California Geological Survey (CGS) as a fault showing evidence for activity within the last 11,700 years. The site is not located within a State of California Earthquake Fault Zone.

The USGS has developed a program to evaluate the approximate location of faulting in the area of properties. The following figure shows the location of the existing faulting in the San Diego County and Southern California region. The fault traces are shown as solid, dashed and dotted that represent well-constrained, moderately constrained and inferred, respectively. The fault line colors represent faults with ages less than 150 years (red), 15,000 years (orange), 130,000 years (green), 750,000 years (blue) and 1.6 million years (black).



Faults in Southern California

The San Diego County and Southern California region is seismically active. The following figure presents the occurrence of earthquakes with a magnitude greater than 2.5 from the period of 1900 through 2015 according to the Bay Area Earthquake Alliance website.



Earthquakes in Southern California

Considerations important in seismic design include the frequency and duration of motion and the soil conditions underlying the site. Seismic design of structures should be evaluated in accordance with the California Building Code (CBC) guidelines currently adopted by the local agency.

6.2 Ground Rupture

Ground surface rupture occurs when movement along a fault is sufficient to cause a gap or rupture where the upper edge of the fault zone intersects the ground surface. The potential for ground rupture is considered to be very low due to the absence of active faults at the subject site.

6.3 Liquefaction Potential and Seismically Induced Settlement

Liquefaction typically occurs when a site is located in a zone with seismic activity, onsite soils are cohesionless or silt/clay with low plasticity, groundwater is encountered within 50 feet of the surface, and soil densities are less than about 70 percent of the maximum dry densities. If the four previous criteria are met, a seismic event could result in a rapid pore water pressure increase from the earthquake-generated ground accelerations.

The surficial soil (undocumented fill and Bay Deposits) at the site is generally loose/soft and considered to possess a potential for liquefaction below the groundwater elevation. The Multi-Jurisdictional-Hazard Mitigation Plan (2017) maps the site as having zones of liquefiable layers.



Liquefaction Hazard Map

The current standard of practice, as outlined in the *Recommended Procedures for Implementation of DMG Special Publication 117A, Guidelines for Analyzing and Mitigating Liquefaction in California* requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

We performed liquefaction analyses with our CPT soundings using the program CLiq (Version 3.0). This program utilizes the 2001 NCEER method of analysis. We used a static groundwater elevation of 6 feet MSL, a modal magnitude of 6.12 earthquake (attributed to the Rose Canyon Fault), and a peak horizontal site acceleration, PGA_M, of 0.636g calculated from ASCE 7-16 Section 11.8.3. This semi-empirical method is based on correlations with the data collected from the CPT soundings and field performance data.

The liquefaction analyses (included in Appendix C) indicate the surficial soils to depths between approximately 5 and 30 feet below the existing grade at the locations the CPTs could be prone to between about ¼ and 1 ¼ inches during ground motion. We estimate the differential settlement of ⅔ the total settlement ranging from about 0.2 to 0.9 inches over relatively small distances in accordance with SP117. Additionally, relatively thin and isolated lenses of soil within the Old Paralic Deposits between 30 and 50 feet are potentially liquefiable.

Sand boils occur where liquefiable soil is extruded upward through the soil deposit to the ground surface. Providing an increase in overburden pressure and a compacted fill mat can mitigate surface manifestation. Research presented by Ishihara (1985) indicates that the presence of a non-liquefiable surface layer typically results in the effects of at-depth liquefaction from reaching the surface. Modifications to Ishihara's chart have been made to include higher ground accelerations (Ishihara's 1985 chart was based on a 0.25g ground acceleration) by Youd and Garris (1995). Based on Youd's modified curves and the thickness of the non-liquefiable soil layer (layer above the assumed groundwater table), the potential for surface manifestation is possible unless ground improvements are performed.

Lateral spreading occurs when liquefiable soil is in the immediate vicinity of a free face such as a slope. Factors controlling lateral displacement include earthquake magnitude, distance from the earthquake epicenter, thickness of liquefiable soil layer, grain size characteristics, fines content of the soil and SPT blow counts. Bartlett and Youd (1995) have concluded that lateral spreading is restricted to sediments with corrected SPT blow counts of 15 or less for earthquake magnitudes less than or equal to 8.0. The potential of lateral spreading in the liquefiable soil below the groundwater table is not considered an adverse impact to the proposed development due to relatively flat topography of the site and distance to the San Diego Bay from the site.

The mitigation of potential hazards due to liquefaction can be accomplished by the densification or removal of the potentially liquefiable soil or the use of foundation systems that still provide acceptable structural support should liquefaction occur. Soil densification can be accomplished by compaction grouting, vibrocompaction, soil mixing, and deep dynamic compaction (among others). We understand the use of vibrocompaction or stone columns may be unacceptable due to the creation of potential vertical pathways for contamination and potential distress to existing structures. Soil densification is generally used to increase the density and provide liquefaction mitigation of sensitive soil to relatively shallow depths over large areas. Deep foundation systems may be used to transmit structural loads to bearing depths below the liquefiable zones and may consist of driven piles or drilled piles. Deep foundations are designed to mitigate damage to the structures supported on the piles; however, they do not generally reduce the potential for damage to underground utilities and peripheral site improvements. The effects of differential settlement between ridged structures and attached settlement-sensitive surface improvements can be mitigated by designing the utilities to accommodate differential movement at the connections.

6.4 Storm Surge, Tsunamis, and Seiches

Storm surges are large ocean waves that sweep across coastal areas when storms make landfall. Storm surges can cause inundation, severe erosion and backwater flooding along the water front. The site is located approximately 800 feet from San Diego Bay, is at an elevation of about 10 feet or greater above Mean Sea Level (MSL) and is protected from ocean waves by the Silver Strand

to the west. Based on historic and predicated wave heights and runout lengths, the proposed site elevation with neighboring topographic features is likely sufficient to mitigate the risk; therefore, the potential of storm surges affecting the site is considered low.

A tsunami is a series of long period waves generated in the ocean by a sudden displacement of large volumes of water. Causes of tsunamis include underwater earthquakes, volcanic eruptions, or offshore slope failures. The first-order driving force for locally generated tsunamis offshore southern California is expected to be tectonic deformation from large earthquakes (Legg, *et al.*, 2002). Historically, tsunami wave heights have ranged up to 3.7 feet in the San Diego area. Wave heights and run-up elevations from tsunamis along the San Diego Coast have historically fallen within the normal range of the tides. The Multi-Jurisdictional Hazard Mitigation Plan (2017) maps zones of possible tsunami inundation for coastal areas throughout the county. The site is not included within one of these high-risk hazard areas. Therefore, we consider the risk of a tsunami hazard at the site to be low.



Tsunami Inundation Map

A seiche is a run-up of water within a lake or embayment triggered by fault- or landslide-induced ground displacement. The site is located approximately 800 feet from San Diego Bay, is at an elevation of about 10 feet or greater above Mean Sea Level (MSL) and is protected from ocean waves by the Silver Strand to the west. Based on historic and predicated wave heights and runout lengths, we expect the proposed site elevation is sufficient to mitigate the risk; therefore, we consider the potential for seiches to impact the site low.

6.5 Hazardous Subsurface Materials

We understand contaminated soil and groundwater have been encountered at locations in the vicinity of the property associated with past and current uses as an industrial facility (AECOM, 2017). Where proposed remedial grading, installation of utilities or other improvements extend into areas identified as containing contaminated soil and/or contaminated groundwater, special provisions may be required for the health and safety of workers and to limit movement of the contamination in accordance with the project environmental consultant. Construction techniques to limit movement of contaminates may be required. Additionally, we understand the use of certain ground improvement techniques (i.e. stone columns or wick drains, modifying the use of pipe bedding and certain types of deep foundations) may be restricted due to the existing contaminated soil.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 From a geotechnical engineering standpoint, we opine the subject site is suitable for proposed improvements provided the recommendations presented herein are implemented in design and construction of the project.

7.1.2 The site may be subject to geologic hazards, including moderate to strong seismic shaking, liquefaction, seismically induced settlement and consolidation settlement. We included recommendations for the mitigation of these geologic hazards herein. From a geotechnical engineering standpoint, we opine soil or geologic conditions do not exist at the subject site that is considered adverse to proposed improvements at the site, assuming they are designed to accommodate the potential geologic hazards at the site or be mitigated during the construction operations.

7.1.3 Based on a review of the referenced documents and our experience in the area, we expect the site is underlain by undocumented fill and Bay Deposits overlying Old Paralic Deposits and San Diego Formation. The existing formational units are considered suitable for support of structural loads from the proposed development. However, remedial grading and possible ground modification of the surficial materials situated may need to be performed.

7.1.4 We encountered groundwater at a depth of approximately 5 to 8 feet below the existing ground surface (approximate elevation of 2 to 5 feet above MSL). Groundwater will likely have a significant influence on construction of deep utilities (if constructed), and during remedial grading. Dewatering will likely be required for excavations below the fluctuating groundwater elevation. The project should be designed with a groundwater elevation of 6 feet MSL.

7.1.5 We expect that grading of the site will consist of removal of the upper portions of the surficial materials (undocumented fill and/or Old Paralic Deposits) within areas that are to receive new fill or structures supported on shallow foundations. These removals will likely be limited to within 2 to 3 feet above groundwater elevations due to saturated soil conditions. Removals within the proposed pavement areas can likely be limited to the upper 1 to 2 feet of existing soil.

7.1.6 Proposed structures may be supported on a shallow foundation system bearing in compacted fill, assuming that the estimated seismic and static load settlements can be accommodated by the structure. Alternatively, we expect the settlement-sensitive structures would be supported by a deep foundation system or by a shallow foundation system over ground that

has been modified to mitigate the liquefaction potential (i.e. ground improvements). We should be contacted to provide foundation recommendations when the proposed structures are planned.

7.1.7 Adequate drainage provisions are imperative to the performance of the development. Site drainage should be maintained to direct surface runoff into controlled drainage devices. Positive site drainage should be maintained away from structures and pavements and tops of slopes and directed to storm drain facilities.

7.2 Excavation and Soil Characteristics

7.2.1 Excavation of the fill, Bay Deposits and Old Paralic Deposits should generally be possible with moderate to heavy effort using conventional, heavy-duty equipment during grading and trenching operations.

7.2.2 Based on the soil encountered during previous investigations for the site, we expect the soil is considered to be "non-expansive" and "expansive" (expansion index [EI] of 20 or less and greater than 20, respectively) as defined by 2019 California Building Code (CBC) Section 1803.5.3. Table 7.2.1 presents soil classifications based on the expansion index. We expect a majority of the soil encountered possess a "very low" to "low" expansion potential (EI of 50 or less).

TABLE 7.2.1
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM D 4829 Expansion Classification	2019 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

7.2.3 Previously reported laboratory water-soluble sulfate content test results indicate the on-site materials possess "S0" to "S2" sulfate exposure to concrete structures as defined by 2019 CBC Section 1904 and ACI 318-14 Chapter 19. Table 7.2.2 presents a summary of concrete requirements set forth by 2019 CBC Section 1904 and ACI 318. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

TABLE 7.2.2
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

Exposure Class		Water-Soluble Sulfate (SO_4) Percent by Weight	Cement Type (ASTM C 150)	Maximum Water to Cement Ratio by Weight[1]	Minimum Compressive Strength (psi)
S0		SO_4<0.10	No Type Restriction	n/a	2,500
S1		0.10≤SO_4<0.20	II	0.50	4,000
S2		0.20≤SO_4≤2.00	V	0.45	4,500
S3	Option 1	SO_4>2.00	V+Pozzolan or Slag	0.45	4,500
	Option 2		V	0.40	5,000

[1] Maximum water to cement ratio limits do not apply to lightweight concrete

7.2.4 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, further evaluation by a corrosion engineer may be performed if improvements susceptible to corrosion are planned.

7.3 Grading

7.3.1 Grading should be performed in accordance with the recommendations provided in this report, the *Recommended Grading Specifications* contained in Appendix D and the local grading ordinance. Where the recommendations of this section conflict with Appendix D, the recommendations of this section take precedence. Geocon Incorporated should observe the grading operations on a full-time basis and provide testing during the fill placement.

7.3.2 Prior to commencing grading, a preconstruction conference should be held at the site with the regulatory agency inspector, developer, grading and underground contractors, civil engineer, and geotechnical engineer in attendance. Special soil handling and/or the grading plans can be discussed at that time.

7.3.3 Grading of the site should commence with the demolition of existing structures, removal of existing improvements, vegetation, and deleterious debris. The depth of vegetation removal should be such that material exposed in cut areas or soil to be used as fill is relatively free of organic matter. Material generated during stripping and site demolition should be exported from the site. Asphalt and concrete should not be mixed with the fill soil unless approved by the Geotechnical Engineer.

7.3.4 We expect the future buildings and ancillary structures may be supported on a shallow foundation system bearing in compacted fill, assuming that the estimated seismic and static

load settlements can be accommodated by the structures. Alternatively, we expect that other settlement-sensitive structures would be supported by a deep foundation system or by a shallow foundation system over ground that has been modified to mitigate the liquefaction potential (i.e. ground improvements).

7.3.5 For structures situated on a shallow foundation system, the upper 5 feet of materials or 2 feet below proposed foundations (whichever results in a deeper removal) should be removed and replaced with properly compacted fill. However, the removals should be limited to a depth of approximately 2 to 3 feet above groundwater. The removals should extend at least 10 feet outside of the proposed foundation zones.

7.3.6 The removal excavations can be limited to the upper 2 feet of the surficial soils prior to additional fill placement in areas where the planned structures will be supported by deep foundations. Alternatively, the removals can also be limited to the upper 3 feet subsequent to performing ground modification techniques, as necessary and where appropriate

7.3.6 In areas of proposed improvements outside of the building areas, the upper 1 to 2 feet of existing soil should be processed, moisture conditioned as necessary and recompacted. Deeper removals may be required in areas where loose or saturated materials are encountered. The removals should extend at least 2 feet outside of the improvement area, where possible. Table 7.3.1 provides a summary of the grading recommendations.

TABLE 7.3.1
SUMMARY OF GRADING RECOMMENDATIONS

Area	Removal Requirements
Supported by Shallow Foundation System (without Ground Improvements)	Removal of Upper 5 Feet of Existing Materials or 2 Feet Below Footings (Limited to 2 to 3 feet Above Groundwater)
Structures Supported by Deep Foundations	Removal of Upper 2 Feet of Existing Materials
Structures Supported by Shallow Foundation System (with Ground Improvements)	Removal of upper 3 Feet of Materials After Ground Improvements Performed
Site Development	Process Upper 1 to 2 Feet of Existing Materials
Grading Limits	10 Feet Outside of Buildings/2 Feet Outside of Improvement Areas, Where Possible
Exposed Bottoms of Remedial Grading	Scarify Upper 12 Inches

7.3.7 Prior to fill soil being placed, the existing ground surface should be scarified, moisture conditioned as necessary, and compacted to a depth of at least 12 inches. Deeper removals

may be required if saturated or loose fill soil is encountered. A representative of Geocon should be on-site during removals to evaluate the limits of the remedial grading.

7.3.8 Some areas of overly wet and saturated soil could be encountered due to the existing landscape and pavement areas. The saturated soil would require additional effort prior to placement of compacted fill or additional improvements. Stabilization of the soil would include scarifying and air-drying, removing and replacement with drier soil, use of stabilization fabric (e.g. Tensar TX7 or other approved fabric), or chemical treating (i.e. cement or lime treatment).

7.3.9 The contractor should be careful during the remedial grading operations to avoid a "pumping" condition at the base of the removals. Where recompaction of the excavated bottom will result in a "pumping" condition, the bottom of the excavation should be tracked with low ground pressure earthmoving equipment prior to placing fill. If needed to improve the stability of the excavation bottoms, reinforcing fabric or 2- to 3-inch crushed rock can be placed prior to placement of compacted fill.

7.3.10 The site should then be brought to final subgrade elevations with fill compacted in layers. In general, soil native to the site is suitable for use from a geotechnical engineering standpoint as fill if relatively free from vegetation, debris and other deleterious material. Layers of fill should be about 6 to 8 inches in loose thickness and no thicker than will allow for adequate bonding and compaction. Fill, including backfill and scarified ground surfaces, should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM Test Procedure D 1557. Fill materials placed below optimum moisture content may require additional moisture conditioning prior to placing additional fill. The upper 12 inches of subgrade soil underlying pavement should be compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content shortly before paving operations.

7.3.11 Import fill (if necessary) should consist of the characteristics presented in Table 7.3.2. Geocon Incorporated should be notified of the import soil source and should perform laboratory testing of import soil prior to its arrival at the site to determine its suitability as fill material.

TABLE 7.3.2
SUMMARY OF IMPORT FILL RECOMMENDATIONS

Soil Characteristic	Values
Expansion Potential	"Very Low" to "Medium" (Expansion Index of 90 or less)
Particle Size	Maximum Dimension Less Than 3 Inches
	Generally Free of Debris

7.4 Settlement Considerations

7.4.1 As previously discussed, the site is underlain by undocumented fill and Bay Deposits that extend below the groundwater table which may be subjected to settlement from consolidation and seismically induced liquefaction. We expect that heavily loaded structures would be supported on deep foundation system or by a shallow foundation system over ground that has been modified to mitigate the liquefaction potential (i.e. ground improvements). It is generally not practical to mitigate liquefaction induced settlements for improvements such as parking lots, roadways, utilities or other improvements not directly related to life safety.

7.4.1 The soft clays within the Bay Deposits at the site are potentially subject to consolidation settlement (densification by the removal of water within the soil) under loads imposed by placement of fill. The amount of settlement that could occur is a function of how thick the layer is, how compressible the layer is and the magnitude of the new vertical load (weight of new fill).We understand that site grades will likely be raised about 5 feet to accommodate future sea level rise concerns, and have provided estimated settlement based on that assumption. We should provide updated consolidation settlement estimates once structural plans and site grading plans are available.

Table 7.7 provides a summary of the estimated static and seismic settlements for the project. We should provide updated estimates once building locations and loads are designed.

TABLE 7.7
SUMMARY OF ESTIMATED SETTLEMENT DUE TO STATIC AND SEISMIC LOADING

Foundation Type	Estimated Total Seismic Settlement (inches)	Estimated Consolidation Settlement due to New Fill (inches)	Assumed Static Settlement Due to New Foundation Loads (inches)
Shallow Foundations (without Ground Improvements)	1 ¼	½	1

*Assuming site grades are raised 5 feet.

7.5 Mitigation of Liquefaction

7.5.1 Based on our analysis discussed herein, we estimate a potential of up to 1¼ inches of total liquefaction settlement during PGA_M ground motion. Mitigation of liquefiable soil may be necessary for settlement-sensitive structures. Several alternatives are generally available for mitigation including deep foundations, ground improvements and structural mitigation.

7.5.2 Ground improvement techniques mitigate liquefaction by densifying existing soil through the use of stone columns, deep dynamic compaction, compaction grouting, soil mixing or other densification method. We do not recommend that deep dynamic compaction be used for densification due to the proximity of adjacent facilities and biologically sensitive areas, and the limited influence depth of the method in fine grained materials. In addition, compaction grouting may not be economical due to the expected depth and the area of the required improvements.

7.5.3 Ground improvement using stone columns may be used from a geotechnical engineering standpoint that consist of densifying existing soils with a vibrating probe and placing crushed rock. However, the amount of fine-grained material may limit the effectiveness of the stone columns. The pattern and depth of ground improvements may vary depending on the purposes of mitigation and stratigraphic conditions but the depths of improvement would be approximately 30 feet with spacing of approximately 8 to 10 feet and a diameter of 30 inches. The specialty contractor should determine the final spacing and diameter to obtain the necessary densification as outlined below. Following stone column construction, CPTs should be performed to check if the soil mitigation is successful. The post-production CPTs should show a maximum of 1 inch of total settlements using generally accepted calculation parameters, unless noted otherwise by the structural engineer.

7.5.4 Soil/cement mixing is a soil improvement technique of mechanically blending a cementitious binder into existing unsuitable soils to create load bearing columns. As the soil mixing tool is advanced into the ground, cement-based slurry is pumped through the hollow stem of the shaft and injected into the soil through jets located on the backside of the leading rotating mixing blades. The mixing blades on the tool mix the soil with the slurry. Injection and mixing will continue to design depth. When design depth is reached, the mixing tool is withdrawn, leaving behind stabilized soil mix columns. Soil mix piles are typically designed and installed by a specialty geotechnical contractor.

7.5.5 Following soil modification construction, the upper 3 feet of the upper soils will be disturbed and should be removed and recompacted as discussed herein.

7.5.6 The liquefaction stone column mitigation should extend at least 15 feet laterally outside the edge of planned building structures, where practical. Mitigation within non-structure areas

will be limited to that improvement obtained by nearby remediation within structure areas. We can provide additional recommendations for the ground improvement techniques when the improvement has been selected.

7.6 Mitigation of Fill-Load Related Settlement

7.6.1 We expect that site grades will be raised and that additional settlement due to fill-load related consolidation would occur. The actual magnitude of fill-load related settlement should be evaluated once grading plans are available. Areas for proposed buildings, roadways and other settlement sensitive improvements will be subject to consolidation settlement where site grades are being raised. We expect the consolidation settlement due to the placement of new fill to take 2 to 8 months. This time could be reduced through the use of surcharge fill loading or the installation of wick drains, if possible. The use of surcharge fill may be advantageous for the proposed buildings supported on shallow foundations, while surcharging the portions of the site planned for non-structural improvements may not be necessary. Surcharge fill is additional fill material placed on above finish grade (in building pad areas) to decrease the settlement time for consolidation prior to construction of improvements. The use of surcharge fill requires double handling of the surcharge soil and is generally 5 to 10 feet thick plus the thickness of the proposed fill extending slightly outside the building footprint. Surcharging does not generally provide mitigation of liquefaction potential but does reduce the potential for surface manifestation. We should provide additional recommendations regarding the surcharging and the potential need for settlement monitoring once grading plans are available.

7.7 Seismic Design Criteria

7.7.1 Table 7.4.1 summarizes site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. We used the computer program *U.S. Seismic Design Maps*, provided by the Structural Engineers Association (SEA) to calculate the seismic design parameters. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. However, we expect the proposed buildings will possess a period of less than 0.5 second; therefore, the building improvements can be designed based on the soil conditions (ASCE 7-16, Section 20.3.1). The values presented herein are for the risk-targeted maximum considered earthquake (MCE_R). Sites designated as Site Class D, E and F may require additional analyses if requested by the project structural engineer and client.

TABLE 7.4.1
2019 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2019 CBC Reference
Site Class	E	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.234g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.411g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.200	Table 1613.2.3(1)
Site Coefficient, F_V	2.377*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.481g	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.978g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.987g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.652g*	Section 1613.2.4 (Eqn 16-39)

* Using the code-based values presented in this table, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed by the project structural engineer. Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis should be performed for projects for Site Class "E" sites with Ss greater than or equal to 1.0g and for Site Class "D" and "E" sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed.

7.7.2 Table 7.4.2 presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

TABLE 7.4.2
ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.556g	Figure 22-7
Site Coefficient, F_{PGA}	1.144	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.636g	Section 11.8.3 (Eqn 11.8-1)

7.7.3 Conformance to the criteria in Tables 7.4.1 and 7.4.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur in the event of a large earthquake. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

7.8 Site Drainage and Moisture Protection

7.8.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1804.4 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

7.8.2 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

7.8.3 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. We recommend that area drains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes be used. In addition, where landscaping is planned adjacent to the pavement, we recommend construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material.

7.9 Testing and Observation Services During Construction

7.9.1 Geocon Incorporated should provide geotechnical testing and observation services during the grading operations, foundation construction, utility installation, retaining wall backfill and pavement installation. Table 7.13 presents the typical geotechnical observations we would expect for the proposed improvements.

TABLE 7.13
EXPECTED GEOTECHNICAL TESTING AND OBSERVATION SERVICES

Construction Phase	Observations	Expected Time Frame
Ground Modification	Ground Modification Installation	Full Time
	Confirmation Testing	Part Time to Full Time
Grading	Base of Removal	Part Time During Removals
	Fill Placement and Soil Compaction	Full Time
Foundations	Foundation Excavation Observations	Part Time
Utility Backfill	Fill Placement and Soil Compaction	Part Time to Full Time
Retaining Wall Backfill	Fill Placement and Soil Compaction	Part Time to Full Time
Subgrade for Sidewalks, Curb/Gutter and Pavement	Soil Compaction	Part Time
Pavement Construction	Base Placement and Compaction	Part Time
	Asphalt Concrete Placement and Compaction	Full Time

7.10 Grading and Foundation Plan Review

7.10.1 Geocon Incorporated should review the project foundation plans prior to final design submittal to check if additional analysis and/or additional recommendations are required.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

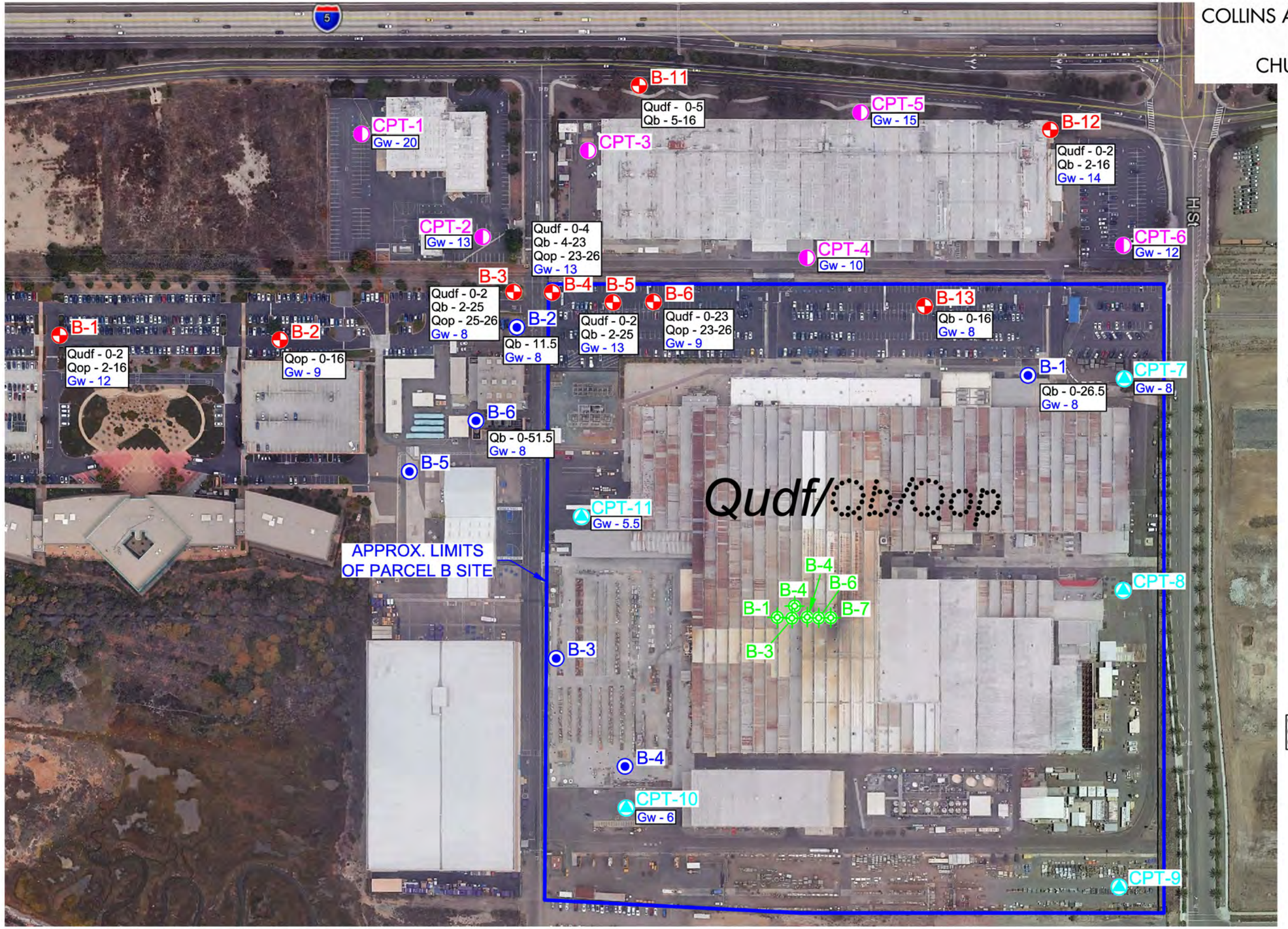
1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

COLLINS AEROSPACE REDEVELOPMENT
PARCEL B
CHULA VISTA, CALIFORNIA



0' 100' 200' 300' 400'

SCALE 1"=200'(on 11x17)

GEOCON LEGEND

Qudf .....UNDOCUMENTED FILL

Qb.....BAY DEPOSITS
(Dotted Where Buried)

Qop.....OLD PARALIC DEPOSITS
(Dotted Where Buried)

CPT-11 .....APPROX. LOCATION OF CPT
(Current Study)

CPT-6 .....APPROX. LOCATION OF CPT
(Geocon, 2020)

B-11 .....APPROX. LOCATION OF BORING
(Geocon, 2005)

B-6 .....APPROX. LOCATION OF BORING
(Geocon, 1999)

B-7 .....APPROX. LOCATION OF BORING
(Geocon, 1980)

Qudf - 0-4
Qb - 4-23
Qop - 23-26 .....PREVIOUSLY ENCOUNTERED
GEOLOGIC CONDITIONS (In Feet)
Qudf = Undocumented fill
Qb = Bay Deposits
Qop = Old Paralic Deposits

Gw - 15 .....GROUNDWATER DEPTH (In Feet)

THE GEOGRAPHICAL INFORMATION MADE AVAILABLE FOR DISPLAY WAS PROVIDED BY GOOGLE EARTH, SUBJECT TO A LICENSING AGREEMENT. THE INFORMATION IS FOR ILLUSTRATIVE PURPOSES ONLY; IT IS NOT INTENDED FOR CLIENT'S USE OR RELIANCE AND SHALL NOT BE REPRODUCED BY CLIENT. CLIENT SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS GEOCON FROM ANY LIABILITY INCURRED AS A RESULT OF SUCH USE OR RELIANCE BY CLIENT.

GEOLOGIC MAP

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. G2560 - 52 - 01
FIGURE 1
DATE 12 - 17 - 2021

Plotted:03/01/2021 9:18AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G2560-52-01 Collins Parcel B\SHEETS\G2560-52-01 GeoMap-BoringLocationMap.dwg

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

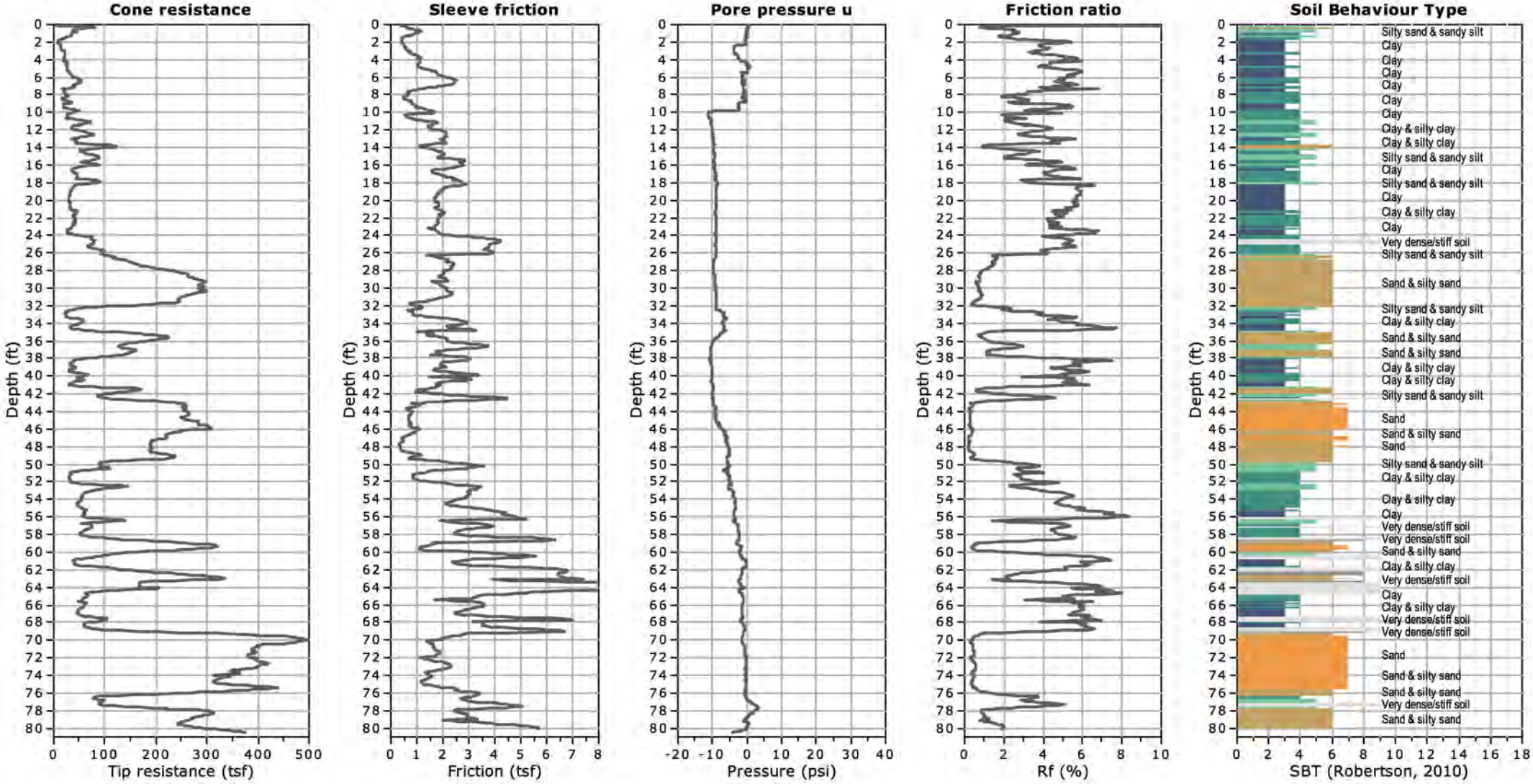
We performed our field investigation on February 11, 2021 that consisted of performing 5 CPTs (CPT-7 through -11). The CPTs extended to a maximum depth of approximately 80 feet, and the locations of the CPTs are shown on the Geologic Map, Figure 1. The CPT soundings are presented herein. We located the CPTs in the field using a measuring tape and existing reference points; therefore, actual locations may deviate slightly.

Kehoe Testing & Engineering performed the CPTs. The soil conditions encountered during the field investigation were automatically logged in a nearly continuous profile of penetration resistance as each CPT sounding was being conducted. The recorded tip stress, sleeve stress, and pore pressure of the soil is used to develop a stratigraphic interpretation of the soil profile.

Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: Geocon / Collins Parcel B
Location: 850 Lagoon Dr, Chula Vista, CA

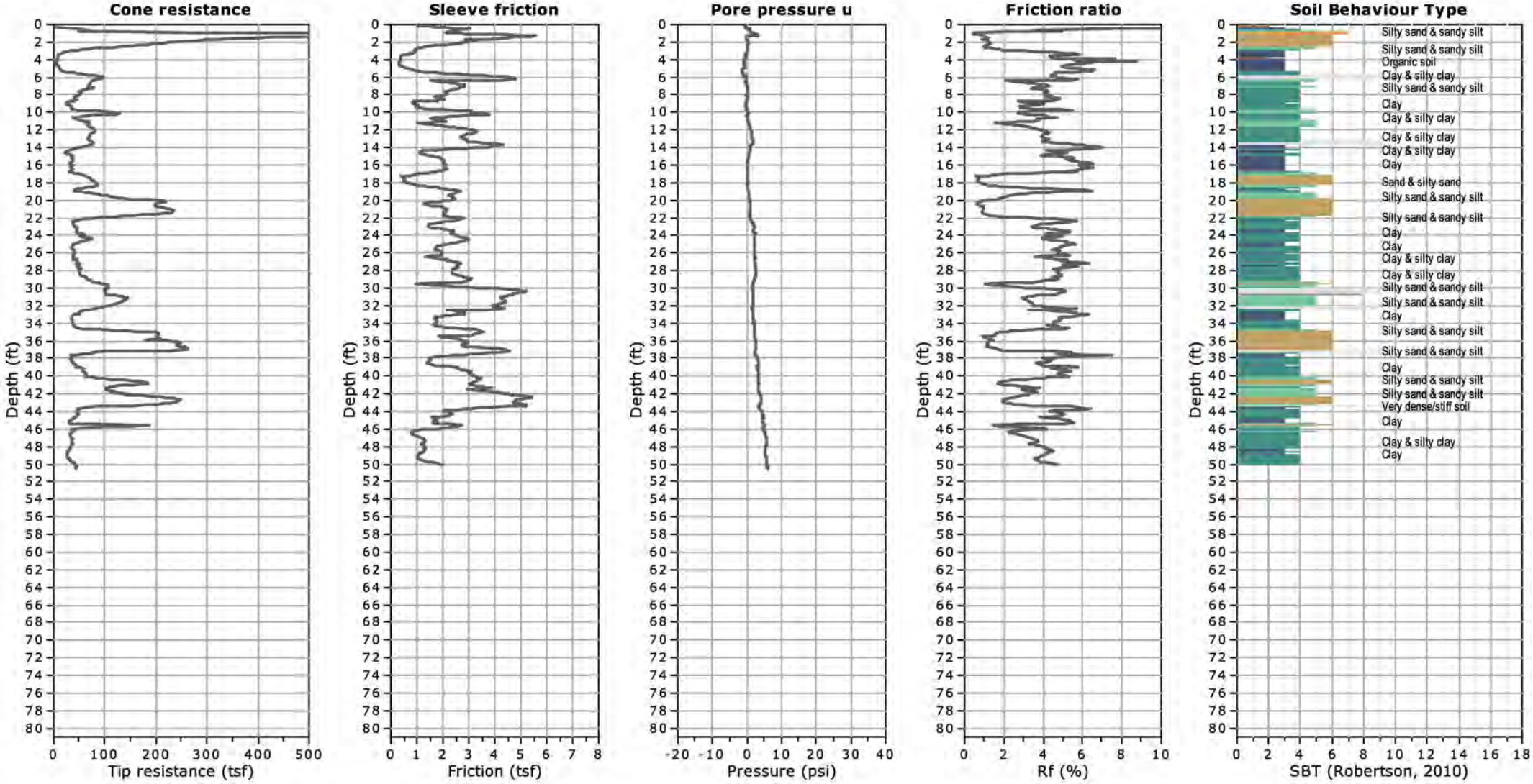
CPT-7
Total depth: 80.46 ft, Date: 2/11/2021



Kehoe Testing and Engineering
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www.kehoetesting.com

Project: **Geocon / Collins Parcel B**
Location: **850 Lagoon Dr, Chula Vista, CA**

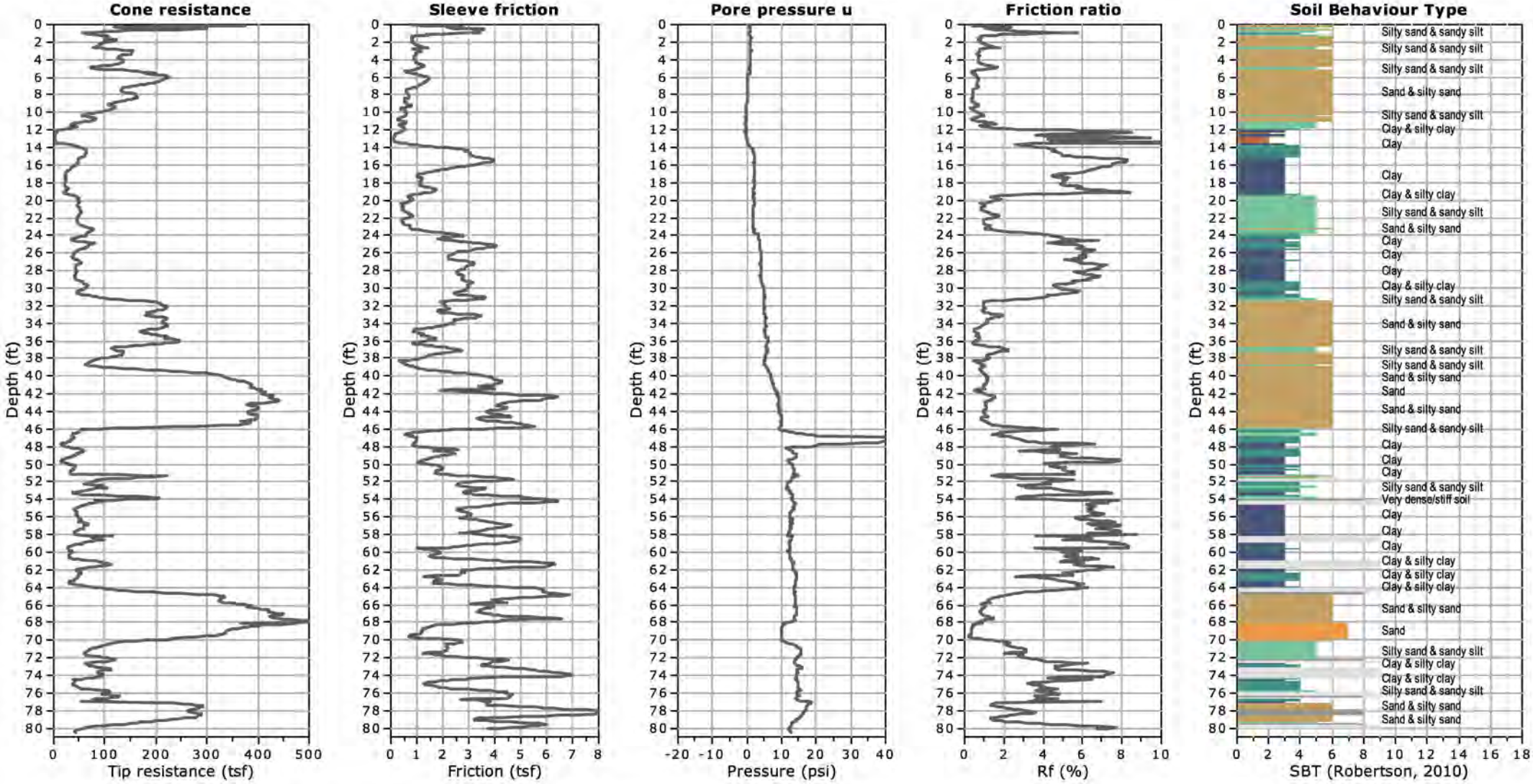
CPT-8
Total depth: 50.53 ft, Date: 2/11/2021



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www.kehoetesting.com

Project: Geocon / Collins Parcel B
Location: 850 Lagoon Dr, Chula Vista, CA

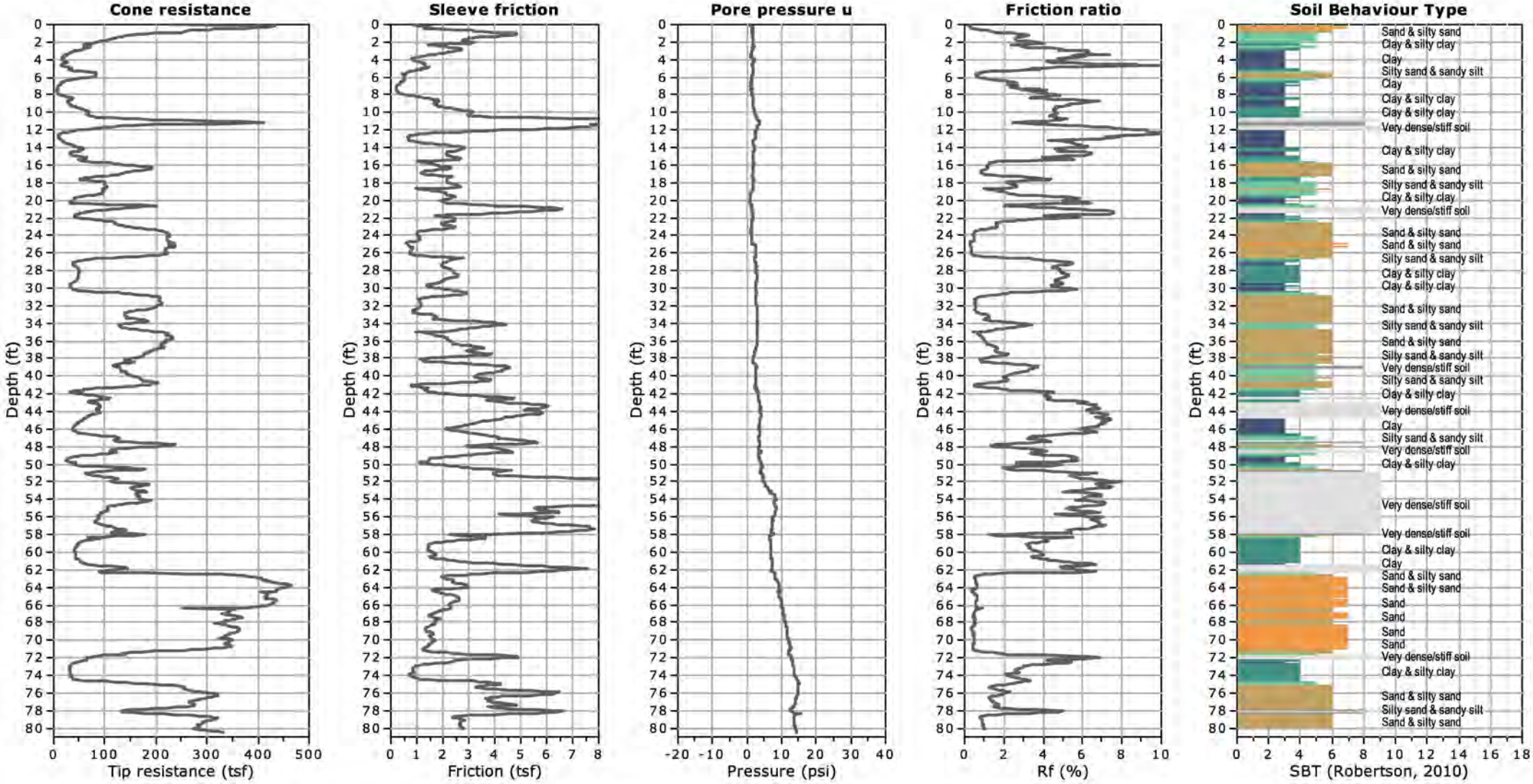
CPT-9
Total depth: 80.46 ft, Date: 2/11/2021



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Project: **Geocon / Collins Parcel B**
Location: **850 Lagoon Dr, Chula Vista, CA**

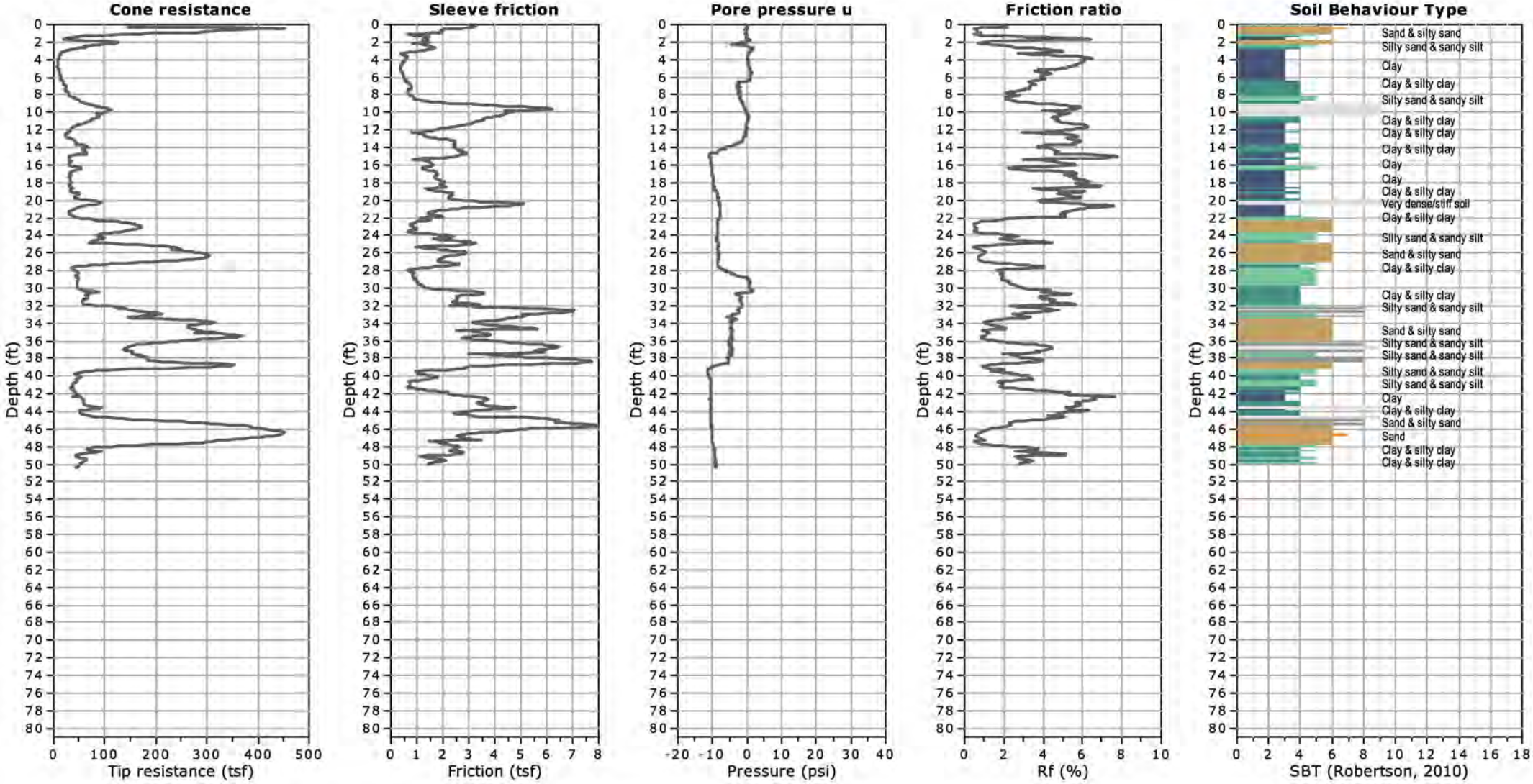
CPT-10
Total depth: 80.46 ft, Date: 2/11/2021



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Project: **Geocon / Collins Parcel B**
Location: **850 Lagoon Dr, Chula Vista, CA**

CPT-11
Total depth: 50.41 ft, Date: 2/11/2021



APPENDIX B

APPENDIX B

PREVIOUS BORING LOGS AND LABORATORY TESTING RESULTS

FOR

COLLINS AEROSPACE REDEVELOPMENT SITE – PARCEL B
NORTHEAST CORNER OF H STREET AND MARINA PARKWAY
CHULA VISTA, CALIFORNIA

PROJECT NO. G2560-52-01

PROJECT NO. 07050-22-30

BORING B 1

ELEV. (MSL.) ~16.5' DATE COMPLETED 07-12-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					GRAVEL 4" thick			
2	B1-1			SM	**FILL** Loose, moist, moderate brown, Silty, fine SAND			
4	B1-2				**BAY POINT FORMATION** Hard, moist, medium brown, Sandy CLAY	76	124.0	11.7
6	B1-3			CL		50/6"	120.2	13.4
8					Dense, moist, moderate olive brown, Clayey, fine SAND with 1" to 2" thick, stiff to hard clay layers			
10	B1-4			SC		41		
12			▽		-Groundwater depth of 12' at the end of drilling			
14			▼		-Groundwater depth of 14' during drilling			
16	B1-5					39	105.7	20.1
					BORING TERMINATED AT 16 FEET Backfilled with approximately 5.5 cu. ft. of hydrated bentonite chips			

Figure A-1,
Log of Boring B 1, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)

▨ ... DISTURBED OR BAG SAMPLE ◣ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 2

ELEV. (MSL.) ~12.3' DATE COMPLETED 07-12-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					4"ASPHALT			
					4" AGGREGATE BASE			
2	B2-1				**BAY POINT FORMATION**			
	B2-2			SC	Very dense, moist, moderate yellowish brown, Clayey SAND	74	120.4	13.1
4	B2-3				Very hard, moist, moderate brown, CLAY with sand	92/10"	117.7	12.5
6				CL				
8					Very dense, wet, pale yellowish brown, poorly graded, fine to medium SAND			
			▽		-Groundwater depth of 9' at the end of drilling			
10	B2-4		▼	SP	-Groundwater depth of 10' during drilling	52		
12								
14				SW	Very dense, wet to saturated, pale yellowish brown, well graded, fine to coarse SAND			
	B2-5					54	112.1	15.1
16					BORING TERMINATED AT 16 FEET Backfilled with approximately 5.5 cu. ft. of hydrated bentonite grout, capped with concrete			

Figure A-2,
Log of Boring B 2, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▨ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 3

ELEV. (MSL.) ~12' DATE COMPLETED 07-11-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					ASPHALT 4" thick			
2	B3-1			SM	**FILL** Loose, moist, medium brown, Silty SAND			
	B3-2			CL	**BAY DEPOSITS** Hard, moist, moderate brown, CLAY with fine sand	30	112.1	16.4
4					Very dense, moist, moderate yellowish brown, Silty, fine SAND			
6	B3-3		▼	SM		92	102.9	20.9
8					Medium dense, wet to saturated, moderate yellowish brown, poorly graded, fine to medium SAND with silt			
10	B3-4			SP-SM		18		
12					-2" clay layer			
14					Dense, saturated, medium yellow brown, poorly graded, fine to medium SAND			
16	B3-5					41	114.6	16.1
18				SP				
20	B3-6					34		
22								
24								
26	B3-7			CL	**BAY POINT FORMATION** Hard, moist, moderate olive brown and dark yellowish orange, CLAY with sand	58	103.7	22.8
					BORING TERMINATED AT 26 FEET Backfilled with approximately 9 cu. ft. of hydrated bentonite grout, capped with concrete			

Figure A-3,
Log of Boring B 3, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▮ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▨ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 4

ELEV. (MSL.) ~12.3' DATE COMPLETED 07-11-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					ASPHALT 3" thick			
2	B4-1 B4-2			CL	**FILL** Hard, moist, moderate brown, mottled black, Sandy CLAY	98	94.2	13.3
4					**BAY DEPOSITS**			
6	B4-3			CL	Hard, moist, moderate to dark yellowish brown, CLAY with sand	60		
8					Medium dense, moist, moderate to dark yellowish brown, Clayey SAND			
10	B4-4					18		
12			▼	SC				
14					-Wet to saturated below 13 feet			
16	B4-5					32	110.4	19.3
18					Medium dense, saturated, pale yellowish brown, poorly graded, fine to medium SAND			
20	B4-6			SP	-Possible slough	11		
22								
24					**BAY POINT FORMATION**			
26	B4-7			CL	Hard, moist, moderate olive brown, CLAY	72	102.8	21.5
					BORING TERMINATED AT 26 FEET Backfilled with approximately 9 cu. ft. of hydrated bentonite grout, capped with concrete			

Figure A-4,
Log of Boring B 4, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)

▨ ... DISTURBED OR BAG SAMPLE ◥ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 5

ELEV. (MSL.) ~11.5' DATE COMPLETED 07-11-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0			ASPHALT 4" thick			
2	B5-1	SM	**FILL** Loose, moist, moderate brown, Silty SAND			
	B5-2		**BAY DEPOSITS** Dense, moist, moderate brown, Clayey SAND	50/6"	106.1	7.6
4						
6	B5-3			42	115.2	14.7
8		SC				
10	B5-4			34		
12			▼			
14						
16	B5-5		Dense, wet to saturated, moderate brown, Silty SAND	41	103.2	23.6
18		SM				
20	B5-6			39		
22						
24						
			BORING TERMINATED AT 25 FEET Backfilled with approximately 8.5 cu. ft. of hydrated bentonite grout, capped with concrete			

Figure A-5,
Log of Boring B 5, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▮ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▩ ... DISTURBED OR BAG SAMPLE
- ◣ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 6

ELEV. (MSL.) ~11.5' DATE COMPLETED 07-11-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0			ASPHALT 3" thick			
2	B6-1	CL	**BAY DEPOSITS** Very stiff to hard, moist, moderate to dark yellowish brown, CLAY with sand			
4						
6	B6-2			76	115.4	16.4
8						
10	B6-3	SC	Medium dense, wet, moderate yellowish brown, Clayey SAND with layers (1" to 2") of clay, micaceous	30		
12						
14		SP	Medium dense, wet, dark yellowish brown, poorly graded, fine SAND, micaceous			
16	B6-4			25	109.3	17.4
18						
20	B6-5			20		
22						
24		CL	**BAY POINT FORMATION** Hard, moist, pale yellowish brown, CLAY			
26	B6-6			40	103.8	21.5
			BORING TERMINATED AT 26 FEET Backfilled with approximately 9 cu. ft. of hydrated bentonite grout, capped with concrete			

Figure A-6,
Log of Boring B 6, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS: ☐ ... SAMPLING UNSUCCESSFUL; ◧ ... STANDARD PENETRATION TEST; ■ ... DRIVE SAMPLE (UNDISTURBED); ⊠ ... DISTURBED OR BAG SAMPLE; ◥ ... CHUNK SAMPLE; ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 10

ELEV. (MSL.) ~10.5' DATE COMPLETED 07-27-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B10-1				ASPHALT 2" thick			
2				SC	**FILL** Medium dense, damp, light to dark brown, Clayey SAND			
4	B10-2				**BAY DEPOSITS** Stiff, moist, dark yellowish brown, CLAY with sand	15	100.9	23.9
6	B10-3			CL		31	116.2	16.3
8					Medium dense, moist, moderate yellowish brown, Clayey SAND			
10	B10-4		▼	SC		21		
12					Medium dense, wet to saturated, dark yellowish brown, Silty, medium -grained SAND			
14				SM				
16	B10-5				Stiff, moist, dark reddish brown, Silty CLAY		104.9	22.0
18				CL				
20	B10-6				**BAY POINT FORMATION** Hard, moist, light olive gray, CLAY	30		
22				CL				
24								
26	B10-7				Very dense, moist, olive brown and reddish brown mottled, Silty SAND	50/5"	107.2	21.3
28				SM				
30	B10-8					50/6"		
					BORING TERMINATED AT 31 FEET Backfilled with approximately 10.5 cu. ft. of hydrated bentonite chips, capped with concrete			

Figure A-10,
Log of Boring B 10, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 11

ELEV. (MSL.) _____ DATE COMPLETED 07-27-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B11-1			CL	**FILL** Stiff, dry, brown, Sandy CLAY			
2	B11-2			SM	Loose to medium dense, dry, reddish brown, fine-grained Silty SAND			6.4
4								
6	B11-3				**BAY DEPOSITS** Medium dense, dry to damp, brown with white, Clayey, medium-grained SAND	56	112.0	5.5
8								
10	B11-4			SC		23		
12					-Becomes moist to wet			
14								
16	B11-5				-Medium- to coarse-grained sand	27	114.0	15.4
					BORING TERMINATED AT 16 FEET Backfilled with approximately 5.5 cu. ft. of hydrated bentonite chips			

Figure A-11,
Log of Boring B 11, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07050-22-30

BORING B 12

ELEV. (MSL.) _____ DATE COMPLETED 07-27-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B12-1			SC	**FILL** Loose, dry, light brown, Clayey, fine-grained SAND			
2				CL	Stiff, moist, dark brown, Silty CLAY			
	B12-2				**BAY DEPOSITS**	18	93.9	5.2
4				SC	Medium dense, damp, brown, Clayey SAND			
	B12-3					30	107.4	4.5
6					Very stiff, damp, dark brown, Sandy CLAY			
8				CL				
10	B12-4				Very hard, damp, dark brown, Silty CLAY with sand	50/6"		
12				CL				
			▼		Very stiff, wet to saturated, dark grayish brown, Sandy, Silty CLAY			
14				CL				
	B12-5					32	100.9	22.6
16					BORING TERMINATED AT 16 FEET Backfilled with approximately 5.5 cu. ft. of hydrated bentonite chips			

Figure A-12,
Log of Boring B 12, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS: ☐ ... SAMPLING UNSUCCESSFUL; ▥ ... STANDARD PENETRATION TEST; ■ ... DRIVE SAMPLE (UNDISTURBED); ⊠ ... DISTURBED OR BAG SAMPLE; ◪ ... CHUNK SAMPLE; ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES

PROJECT NO. 07050-22-30

BORING B 13

ELEV. (MSL.) ~11.5' DATE COMPLETED 07-12-2005

EQUIPMENT CME 75

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					ASPHALT 3" thick			
2	B13-1				**BAY DEPOSITS** Hard, moist, moderate brown, Sandy CLAY; trace gravel			
	B13-2					39	109.6	18.4
4								
6	B13-2			CL		77	111.9	18.0
8			▽		-Groundwater depth of 8' at the end of drilling			
10	B13-3		▼		-Groundwater depth of 10' during drilling -Becomes firm, with 3"-6" interbeds of loose clayey sand	20		
12								
14								
16	B13-4					58		
					BORING TERMINATED AT 16 FEET Backfilled with approximately 5.5 cu. ft. of hydrated bentonite grout, capped with concrete			

Figure A-13,
Log of Boring B 13, Page 1 of 1

07050-22-30.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▩ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▨ ... DISTURBED OR BAG SAMPLE
- ◣ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 06327-22-01

BORING B 1

ELEV. (MSL.) _____ DATE COMPLETED 6/2/99

EQUIPMENT IR A-300

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		GW	3" ASPHALT BASE MATERIAL Medium dense, brownish gray, moist, Silty SAND and Sandy angular GRAVEL to 1"			
2	B1-1	SM	**ALLUVIUM AND TIDAL FLAT DEPOSIT** Medium dense, reddish brown, moist, Silty, coarse SAND	27	119.0	10.9
4	B1-2					
6	B1-3	CH	Very stiff, light gray to pale brown, moist, plastic CLAY	24		
8	B1-4					
10	B1-5	SM	Dense, medium grayish brown, mottled, wet, Clayey and Silty, micaceous SAND. Grainsize and grading varies widely in thin layers	31		
12						
14						
16	B1-6	MH	Very stiff, grayish to olive brown, wet, Clayey, micaceous SILT, laminate with scattered chalky carbonate nodules	25		
18		MH	Very stiff, grayish to olive brown, wet, Clayey, micaceous SILT, laminate with scattered chalky carbonate nodules			
20	B1-7	CL	Stiff to very stiff, medium brownish gray and reddish mottled, wet, Silty, plastic CLAY with fine SAND	17		
22						
24						
26	B1-8	MH	Stiff to very stiff, medium brownish gray, wet, Clayey, micaceous, plastic SILT with variable fine SAND	18		
			BORING TERMINATED AT 26.5 FEET			

Figure A-1, Log of Boring B 1

BFGR

SAMPLE SYMBOLS: ☐ ... SAMPLING UNSUCCESSFUL; ◧ ... STANDARD PENETRATION TEST; ■ ... DRIVE SAMPLE (UNDISTURBED); ⊠ ... DISTURBED OR BAG SAMPLE; ◣ ... CHUNK SAMPLE; ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 06327-22-01

BORING B 2

ELEV. (MSL.) _____ DATE COMPLETED 6/2/99

EQUIPMENT IR A-300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				GW	3" ASPHALT 12" BASE MATERIAL Medium dense, grayish brown, moist, Silty and Sandy angular gravel to 1"			
2	B2-1			CL	**ALLUVIUM AND TIDAL FLAT DEPOSITS** Stiff, medium reddish brown, moist, fine Sandy, plastic CLAY	17		
4								
6	B2-3			SM	Dense, medium brown, moist to wet, Silty, micaceous, fine to medium SAND	43		
8			▼					
10	B2-4			SM	Medium dense, medium brown, moist to wet, Silty, micaceous, fine to coarse SAND	16		
					BORING TERMINATED AT 11.5 FEET			

Figure A-2, Log of Boring B 2

BFGR

SAMPLE SYMBOLS: ☐ ... SAMPLING UNSUCCESSFUL; ◧ ... STANDARD PENETRATION TEST; ■ ... DRIVE SAMPLE (UNDISTURBED); ⊠ ... DISTURBED OR BAG SAMPLE; ◺ ... CHUNK SAMPLE; ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 06327-22-01

BORING B 3

ELEV. (MSL.) _____ DATE COMPLETED 6/2/99

EQUIPMENT IR A-300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					3" ASPHALT			
					3" BASE MATERIAL Medium dense, grayish brown, moist, Silty and Sandy ANGULAR gravel to 1"			
2	B3-1							
	B3-2			CH	**ALLUVIUM AND TIDAL FLAT DEPOSITS**	6		
4	B3-3				Soft to firm, medium reddish brown, and grayish brown mottled, moist to wet, plastic CLAY, with fine to coarse SAND, common fine roots	17		
6								
			▼					
8								
10	B3-4			MH	Very stiff, medium grayish to olive brown, wet, Clayey, micaceous SILT	33		
					BORING TERMINATED AT 11.5 FEET			

Figure A-3, Log of Boring B 3

BFGR

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)

▨ ... DISTURBED OR BAG SAMPLE ◣ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 06327-22-01

BORING B 4

ELEV. (MSL.) _____ DATE COMPLETED 6/2/99

EQUIPMENT IR A-300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					3" ASPHALT			
	B4-1			GW	BASE MATERIAL Medium dense, gray, moist, Silty SAND and GRAVEL, strong hydrocarbon or solvent odor			
2					BORING TERMINATED AT 2 FEET			

Figure A-4, Log of Boring B 4

BFGR

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)

⊠ ... DISTURBED OR BAG SAMPLE ◥ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 06327-22-01

BORING B 5

ELEV. (MSL.) _____ DATE COMPLETED **6/2/99**

EQUIPMENT **IR A-300**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					8" CONCRETE			
2	B5-1			GW	BASE MATERIAL Medium dense, dark gray, moist, Silty and Sandy angular GRAVEL, strong hydrocarbon or solvent odor			
					BORING TERMINATED AT 2.5 FEET			

Figure A-5, Log of Boring B 5

BFGR

SAMPLE SYMBOLS: ☐ ... SAMPLING UNSUCCESSFUL; ◧ ... STANDARD PENETRATION TEST; ■ ... DRIVE SAMPLE (UNDISTURBED); ▨ ... DISTURBED OR BAG SAMPLE; ◥ ... CHUNK SAMPLE; ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06327-22-01

BORING B 6

ELEV. (MSL.) _____ DATE COMPLETED 6/2/99

EQUIPMENT IR A-300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					3" ASPHALT 12" BASE MATERIAL			
2	B6-1 B6-2			SC	Medium dense, medium grayish brown, moist, Silty and Sandy angular GRAVEL ALLUVIUM AND TIDAL FLAT DEPOSITS Firm to stiff, medium reddish brown, moist, fine to medium Sandy, plastic CLAY	16	114.9	19.1
4								
6	B6-3			ML	Very stiff to hard, medium reddish brown, moist to wet, Clayey and fine Sandy SILT	35		
8			▼					
10	B6-4			ML	Medium dense, pale brown and grayish brown, mottled, wet, Silty, micaceous, fine SAND. Faint hydrocarbon or solution odor	15		
12								
14								
16	B6-5			MH	Stiff to very stiff, pale brown and olive brown, wet, Clayey, micaceous SILT with common chalky carbonate nodules	26		
18								
20	B6-6			SM	Medium dense, pale brown, wet, Silty, micaceous, fine to medium SAND. Spitty dark staining and faint hydrocarbon or solvent odor	17		
22								
24								
26	B6-7			SM MH	Medium dense, pale to medium brown, wet, Silty, micaceous, fine to medium SAND	21		
28				CH	Stiff, medium brown and orange mottled, wet, Clayey, micaceous SILT Stiff to very stiff, olive brown to olive gray, wet, plastic CLAY			

Figure A-6, Log of Boring B 6

BFGR

SAMPLE SYMBOLS: □ ... SAMPLING UNSUCCESSFUL; ◧ ... STANDARD PENETRATION TEST; ■ ... DRIVE SAMPLE (UNDISTURBED); ⊠ ... DISTURBED OR BAG SAMPLE; ◥ ... CHUNK SAMPLE; ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. 06327-22-01

BORING B 6

ELEV. (MSL.) _____ DATE COMPLETED 6/2/99

EQUIPMENT IR A-300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B6-8			SM	Medium dense to dense, medium brown and olive brown, mottled, wet, wet, Silty, micaceous, fine SAND. Much sand slough in hole	41		
32								
34								
36	B6-9			SM	Medium dense, pale brown and gray mottled, wet, Silty, micaceous, fine SAND. Much sand slough in hole	25		
38								
40	B6-10			SM	Medium dense, medium brown, wet, slightly Clayey, micaceous, fine to medium SAND. Much sand slough in hole	16		
42								
44								
46	B6-11				-Little sand in hole at 45 feet	21		
48								
50	B6-12			SM	Medium dense, medium brown, wet, Silty, micaceous, fine to medium SAND. Little slough in hole	20		
					BORING TERMINATED AT 51.5 FEET			

Figure A-7, Log of Boring B 6

BFGR

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)

⊠ ... DISTURBED OR BAG SAMPLE ◥ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-2080-T02
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 1		
0				16 inch Concrete Slab		
				4 inch Asphalt		
2				FILL Moderately firm, moist, dark brown, Silty, Clayey SAND		
4						
6				BAY POINT FORMATION Moderately firm, moist, reddish-brown to brown, Clayey, Silty SAND-Sandy SILT		
8	1-1		20		104.8	22.5
10	1-2		27	Grading medium stiff to stiff, moist, brown to dark brown, Silty CLAY, with some sand, occasional fine gravel	107.9	21.0
12						
14						
16	1-3		69	Grades to stiff, moist, light brown to brown, Sandy, Clayey SILT	120.2	16.6
18				Grading to medium stiff, moist, greenish-grayish-brown, Sandy, micaceous, Clayey SILT		
20	1-4		23		99.9	27.3
22						
24						
26	1-5		62	Grading to dense, saturated, gray-brown, slightly Silty and Clayey, well graded SAND	125.1	13.2
28						
30						
31	1-6		69	BORING TERMINATED AT 31.0 FEET	112.1	25.7

Figure 7, Log of Test Boring 1

File No. D-2080-T02
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 2		
0				12 inch Concrete Slab		
				6 inch Sand/Gravel Base		
2				FILL Moderately firm, moist, brown to dark brown, Clayey, Silty SAND-Silty, Sandy CLAY		
4						
6	2-1		19	BAY POINT FORMATION Moderately firm, moist, brown	NO RECOVERY	
	2-2		29	reddish-brown, Clayey, Silty SAND-Sandy SILT	100.2	25.2
8				Grading medium stiff to stiff, moist, brown, Silty CLAY, with occasional fine gravel and some sand		
10	2-3		36		110.4	20.1
				(grading dark brown below 10 feet)		
12						
14						
	2-4		60		113.1	18.2
16				Grading to stiff, moist, light brown to brown, Sandy, Clayey SILT		
	2-5		30		103.4	23.9
18				Grading to medium Stiff, light greenish-gray to tan, slightly Sandy, micaceous, Clayey SILT		
20	2-6		40		90.1	32.2
22				Grading to stiff, moist, light brown to brown, Sandy Clayey SILT		
24						
	2-7		54	Grading to dense, saturated, brown, Silty, Clayey, well graded SAND	121.5	14.7
26						
28						
30						

Figure 8. Log of Test Boring 2

Continued next page

File No. D-2080-TO2
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 2 CONTINUED		
30	2-8		65	Grading with less SILT and CLAY	107.5	20.8
32				(Clay grading in and out below 32 feet)		
34	2-9		29	Grading to stiff, moist, grayish-brown, with orange and tan streaking, slightly Sandy, Silty CLAY/ Clayey SILT	98.2	26.8
36						
38						
40				(Grading with thin layers of heavy shell fragments below 40 feet)		
42						
44						
46	2-10		51	Grading to dense, saturated, gray-brown, very fine, Sandy SILT-Silty SAND (micaceous)	101.5	22.2
48						
50				Grading to stiff, saturated, gray-brown, Silty, Clayey, fine to medium SAND		
52						
54						
	2-11		95		118.0	15.9
56				BORING TERMINATED AT 56 FEET		

Figure 9, Log of Test Boring 2 Continued

File No. D 2080-T02
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 3		
0				16 inch Concrete Slab		
2				6 inch Sand/Gravel Base		
4				FILL Moderately firm, brown to dark brown, moist, Clayey, Silty SAND		
6	3-1		23	BAY POINT FORMATION Moderately firm, moist, brown, Clayey, Silty SAND-Sandy SILT	105.2	22.2
8				Grading to medium stiff to stiff, moist, brown to dark brown, Sandy Silty CLAY		
10	3-2		31		104.6	23.1
12						
14				Grading to stiff, moist, light brown, Sandy Clayey SILT		
16	3-3		75		116.0	17.8
18				Grading to medium stiff, light greenish-gray/tan, slightly Sandy, micaceous, Clayey SILT		
20	3-4		38		99.6	27.1
22				BORING TERMINATED AT 21.0 FEET		

Figure 10. Log of Test Boring 3

File No. D-2080-TO2
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 4		
0				12 inch Concrete Slab		
				5 inch Asphalt		
2				FILL Moderately firm, moist, brown to dark brown, Clayey, Silty, SAND/ Sandy CLAY		
4						
	4-1		17		107.0	21.2
6				BAY POINT FORMATION Moderately firm, moist, brown, Clayey, Silty SAND-Sandy SILT		
8				Grading to stiff, moist, brown to dark brown, Slightly Sandy, Silty CLAY		
10	4-2		31		104.0	23.6
12						
14				Grading to stiff, moist, light brown, Sandy,Clayey SILT		
	4-3		75		112.0	19.5
16						
18				Grading to medium stiff, light greenish-gray to brown, slightly Sandy, micaceous, Clayey SILT		
20	4-4		37		98.7	26.3
22				Grading to stiff, moist, light brown to brown, Sandy Clayey SILT-Silty CLAY		
24				Grading to dense, saturated, brown, Silty, Clayey, well graded SAND		
	4-5		80		125.9	14.1
26				BORING TERMINATED AT 26.0 FEET		

Figure 11, Log of Test Boring 4

File No. D-2080-T02
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 5		
0				20 inch Concrete Slab		
2				FILL Moderately firm, moist, dark brown to brown, Clayey, Silty SAND, with occasional gravel		
4				BAY POINT FORMATION Moderately firm, moist, brown to reddish-brown, Clayey, Silty SAND - Sandy SILT		
6						
8				Grading to stiff, moist, brown to dark brown, Sandy, Sitly CLAY		
10	5-1		32		106.6	22.4
12						
14				Grading to stiff, moist, light brown to brown, Sandy, Clayey SILT		
16	5-2		57		113.7	18.0
18	5-3		23	Grading to medium stiff, moist, light greenish-gray to brown, slightly Sandy, Clayey SILT (micaceous)	97.8	28.6
20						
22				Grading to stiff, moist, light brown to brown, Sandy, Clayey SILT		
24				Medium dense, Silty and Clayey, well graded SAND		
26	5-4		25		NO RECOVERY	
28	5-5a		72		116.5	17.3
	5-5b			Grading to dense, saturated, brown to gray, well graded SAND some silt	118.6	14.2
30						

Figure 12, Log of Test Boring 5

Continued next page

File No. D-2080-TO2
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 5 CONTINUED		
30	5-6		70		105.3	21.7
32						
34	5-7		55	Grading to stiff, moist, greenish-gray to brown, with tan streaking slightly Sandy, Silty CLAY	101.5	24.9
36				BORING TERMINATED AT 35.0 FEET		

Figure 13, Log of Test Boring 5 Continued

File No. D-2080-TO2
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 6		
0				6 inch Concrete Slab		
2				FILL Loose to moderately firm, moist, brown to dark brown, Silty Clayey SAND, with gravel		
4	6-1		16	BAY POINT FORMATION Moderately firm, moist, brown, Clayey, Silty SAND to Sandy, Silty CLAY	NO RECOVERY	
6	6-2		27		106.6	21.3
8						
10	6-3		34	Grading to medium stiff, moist, dark brown, Sandy, Silty CLAY	105.9	23.0
12						
14						
16	6-4		64		114.2	18.7
18				Grades medium stiff, moist, light gray to greenish-brown, Sandy Silty CLAY-Clayey SILT		
20	6-5		33		91.0	32.0
22				BORING TERMINATED AT 21.0 FEET		

Figure 14. Log of Test Boring 6

File No. D-2080-TO2
July 14, 1980

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING NO. 7		
0				6 inch Concrete Slab		
	7-1		48	6 inch Sand/fine Gravel Base	~~107.1~~	~~11.0~~
2				FILL Moderately firm, damp to moist, dark brown, slightly Clayey, Silty fine to medium SAND	107.1	11.0
4						
	7-2		26	BAY POINT FORMATION Moderately firm, moist, brown, Clayey, Silty SAND to Sandy SILT	113.8	17.3
6						
8				Grading to stiff, moist, brown, Silty CLAY, with occasional fine gravel		
10	7-3		49		106.1	22.1
12						
14						
	7-4		71	(Grading with thin lense of brown-tan, Clayey SILT	114.0	18.2
16						
18						
20	7-5		19	Grades medium stiff, moist, light greenish gray, slightly Sandy, micaceous, Clayey SILT	93.9	35.6
22						
24				Grading to dense, moist, brown, slightly Silty, Clayey SAND-Sandy CLAY		
	a 7-6b		52		86.7 124.5	35.6 12.8
26				BORING TERMINATED AT 26.0 FEET		

Figure 15, Log of Test Boring 7

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected soil samples were tested for their in-place dry density and moisture content, shear strength, gradation, permeability, and compaction and consolidation characteristics. Selected soils samples were also tested for R-value, thermal resistivity, pH, resistivity, and water-soluble sulfate content. The results of our laboratory tests are presented in Tables B-I through B-VI and on Figures B-1 through B-3. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.

TABLE B-I
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080-03

Sample No.	Sample Top Depth (feet)	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
B3-2	2	102.9	20.9	300	39
B3-7	25	103.7	22.8	320	32
B4-5	15	110.4	19.3	290	37
B5-5	15	103.2	23.6	320	31
B9-5	15	94.0	29.3	720	32

TABLE B-II
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557-02

Sample No.	Sample Top Depth (feet)	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
B2-1	1	Dark brown, Clayey SAND, trace gravel (SC)	131.2	9.2
B9-1	1	Dark reddish brown, Sandy CLAY, trace gravel (CL)	127.6	8.6

TABLE B-III
SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 643

Sample No.	Sample Top Depth (feet)	pH	Resistivity (ohm centimeters)
B1-1	1	7.4	3380
B10-1	0	7.9	390

TABLE B-IV
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Sample Top Depth (feet)	Water Soluble Sulfate (%)
B1-1	1	0.040
B10-1	0	0.290

TABLE B-V
SUMMARY OF LABORATORY R-VALUE TEST RESULTS
CALIFORNIA TEST NO. 301

Sample No.	Sample Top Depth (feet)	Description	R-Value
B13-1	1	Dark reddish brown, Sandy CLAY, trace gravel	Less than 5

TABLE B-VI
SUMMARY OF LABORATORY PERMEABILITY TEST RESULTS
ASTM D 5084-00

Sample No.	Sample Top Depth (feet)	Description	Permeability (cm/sec)
B4-3	5	Dark brown, Sandy, lean CLAY	4.99E-09
B7-3	5	Dark yellowish brown, lean CLAY with sand	6.36E-09
B8-5	25	Olive, fat CLAY	1.35E-08

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected soil samples were tested for their in-place dry density and moisture content, shear strength characteristics, expansion potential, maximum dry unit weight and optimum moisture content, soluble sulfate content, pH and resistivity, grain size distribution and consolidation characteristics.

The results of our laboratory tests are presented on Tables B-I through B-V and Figures B-1 through B-3. The in-place dry density and moisture content results are indicated on the exploratory boring logs.

TABLE B-I
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
B1-2	119.0	10.9	600	37
B6-2	114.9	19.1	100	31

TABLE B-II
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS

Sample No.	Moisture Content		Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
B1-1	7.9	19.8	117.6	7
B6-1	8.2	18.5	117.8	20

TABLE B-III
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS

Sample No.	Description	Maximum Dry Density(pcf)	Optimum Moisture Content (% dry wt.)
B1-1	Red brown, Silty, coarse SAND	129.0	8.5
B2-1	Brown, Clayey, fine SAND	128.0	10.5

TABLE B-IV
SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS

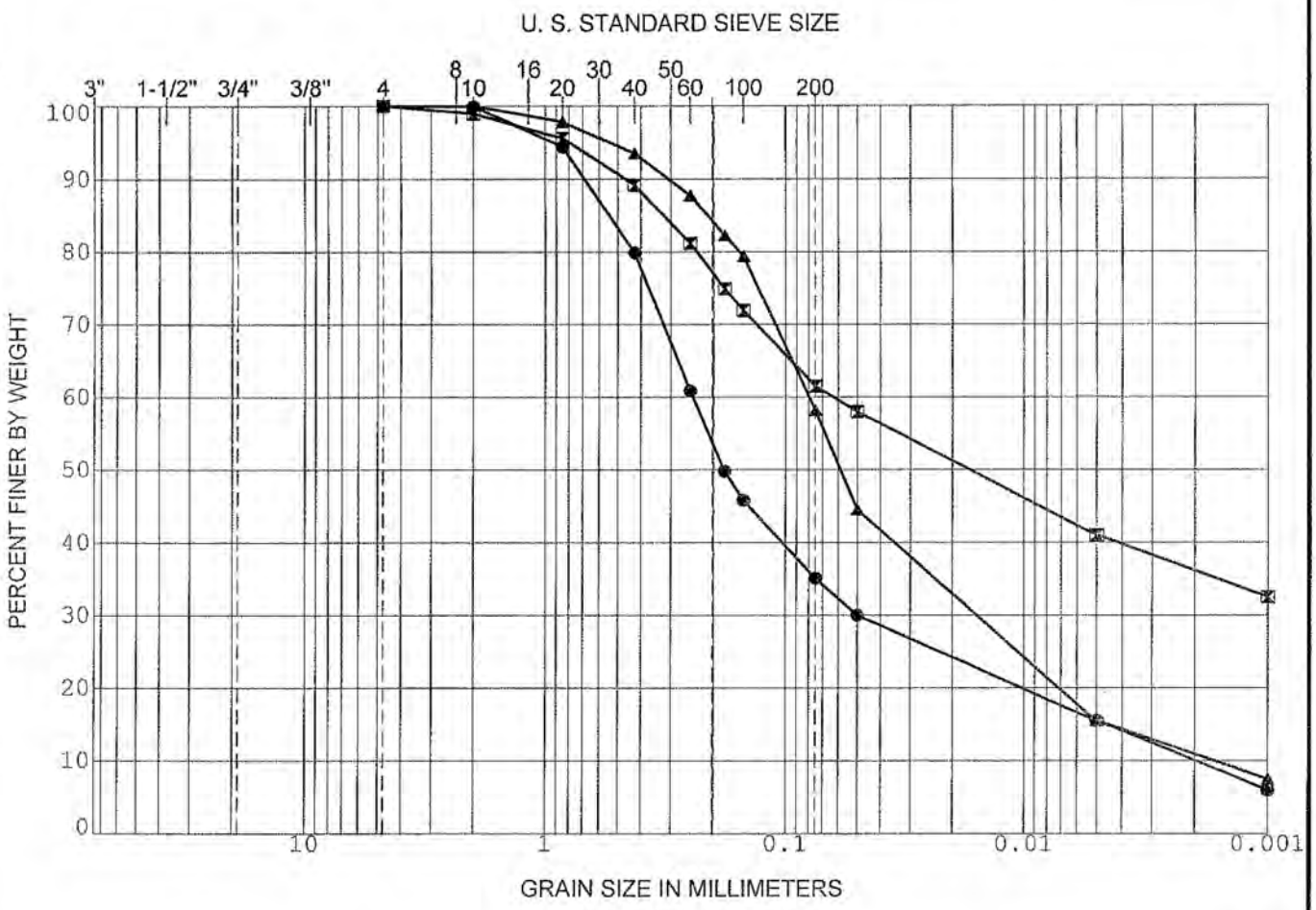
Sample No.	Water Soluble Sulfate (%)
B1-1	0.005 (50 ppm)

TABLE B-V
SUMMARY OF LABORATORY pH and RESISTIVITY TEST RESULTS

Sample No.	pH	Minimum Resistivity (ohm-centimeters)
B1-1	8.5	1334

PROJECT NO. 07050-22-30

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



	SAMPLE	DEPTH (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	B4-4	10.0	SC				
■	B7-4	10.0	CL				
▲	B8-4	20.0	SC				

GRADATION CURVE

GOODRICH OMPPA PROJECT

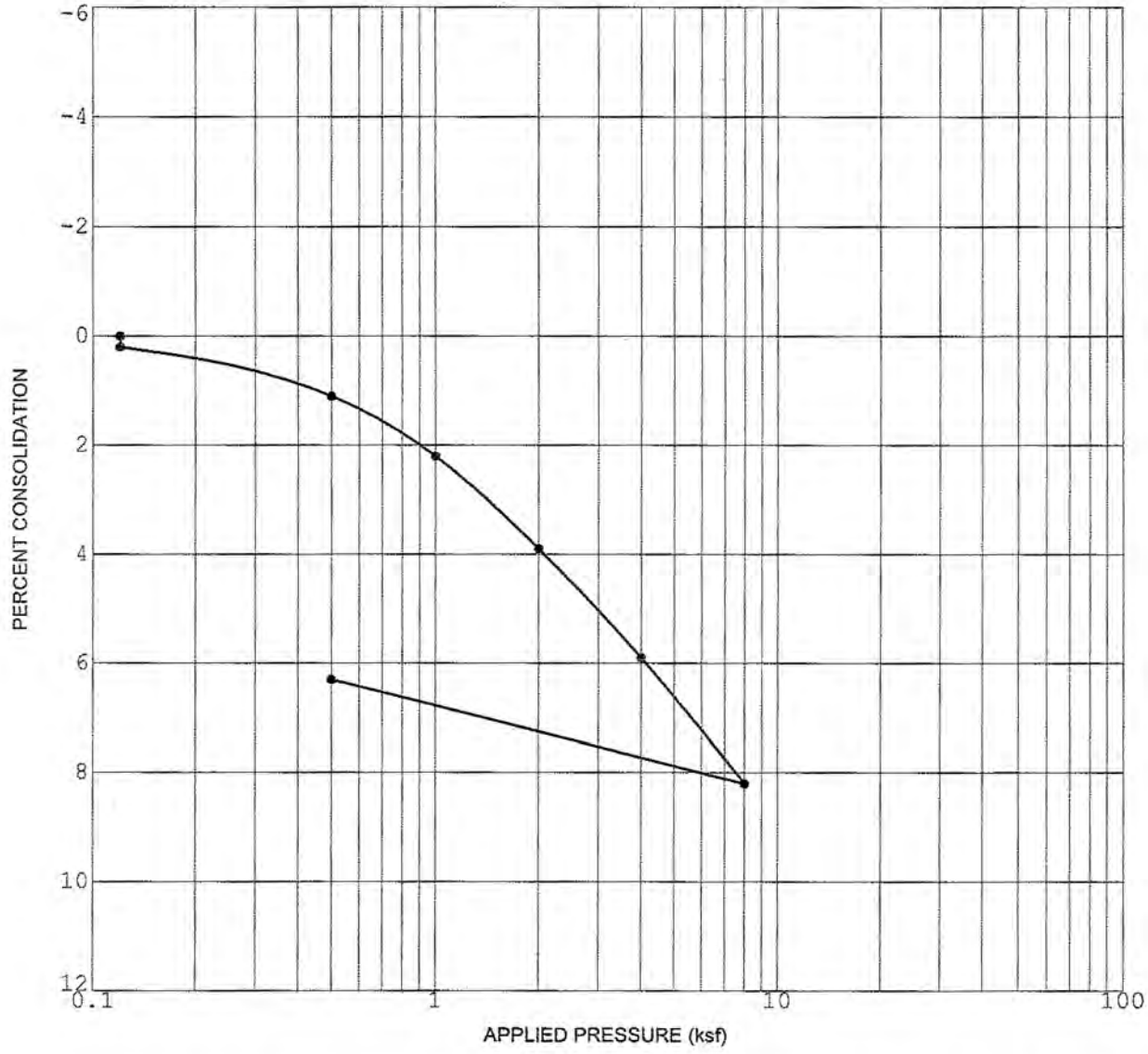
CHULA VISTA, CALIFORNIA

07050-22-30.GPJ

Figure B-1

PROJECT NO. 07050-22-30

SAMPLE NO. B3-7



Initial Dry Density (pcf)	103.4	Initial Saturation (%)	99.9
Initial Water Content (%)	22.8	Sample Saturated at (ksf)	.125

CONSOLIDATION CURVE

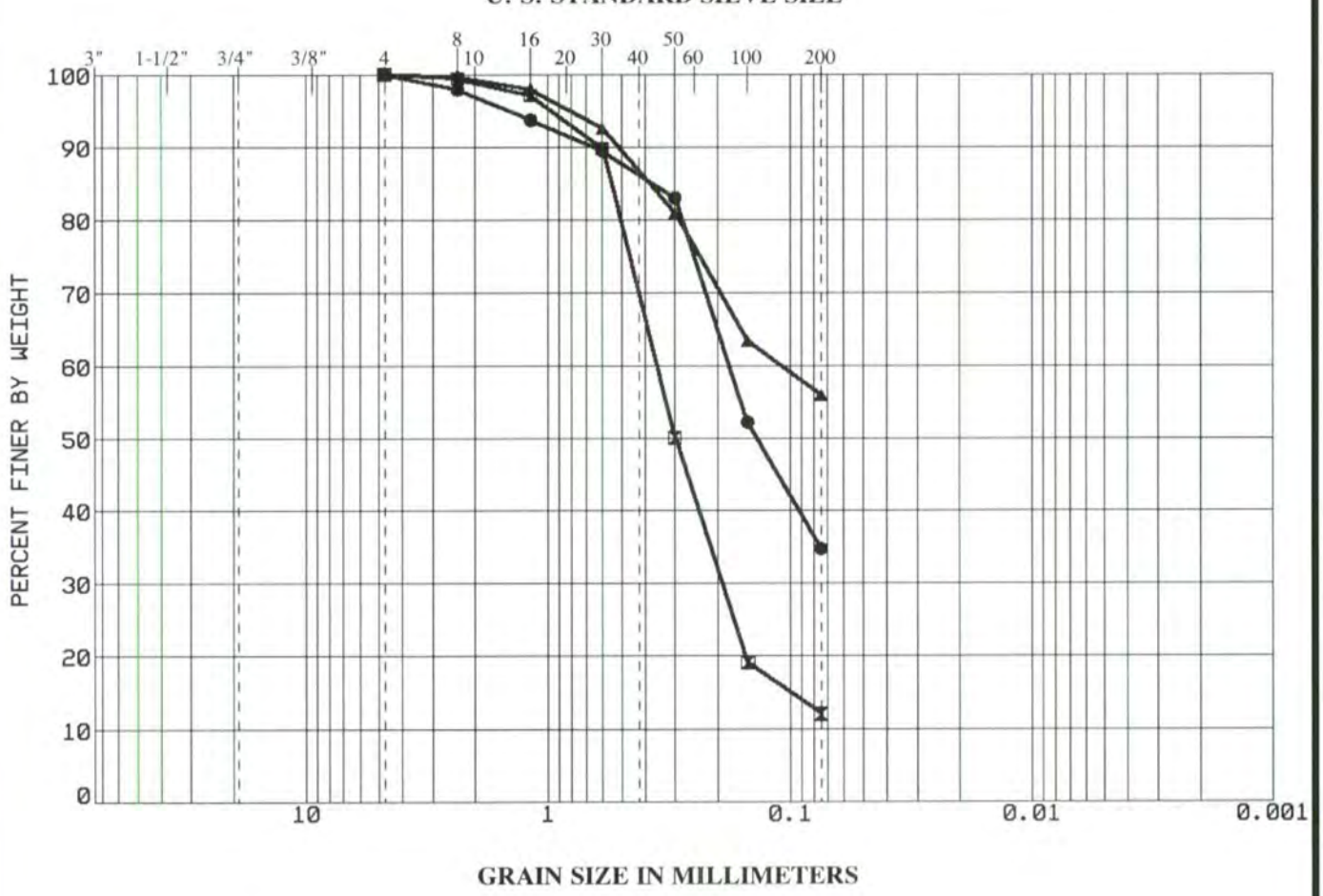
GOODRICH OMPPA PROJECT

CHULA VISTA, CALIFORNIA

07050-22-30.GPJ

Figure B-2

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



	SAMPLE	Depth (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	B6-4	10.0	(ML) Sandy SILT				
⊠	B6-6	20.0	(SM) Silty SAND				
▲	B6-10	40.0	(SM) Silty SAND				

GRADATION CURVE

BF GOODRICH

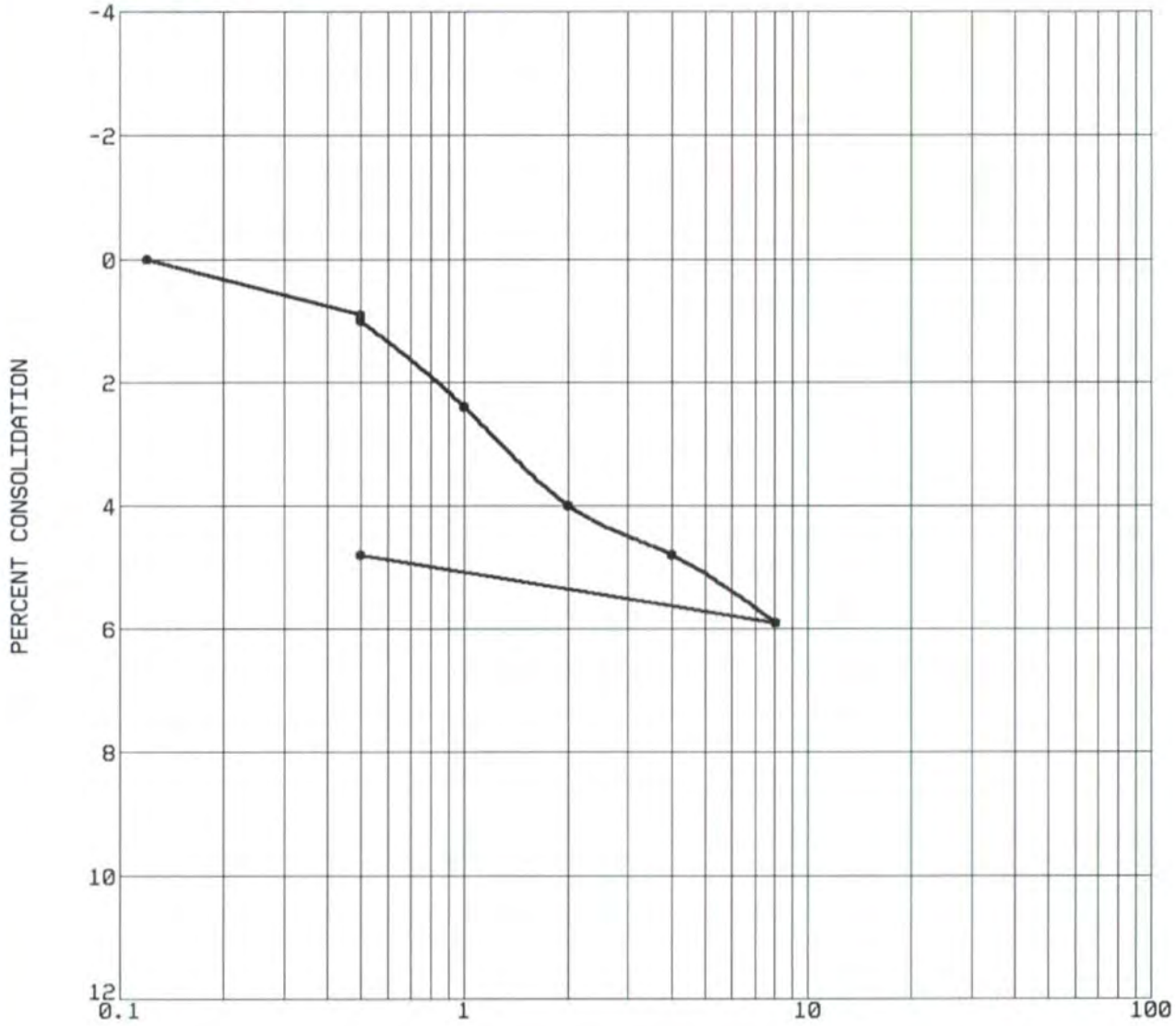
SAN DIEGO, CALIFORNIA

BFGR

Figure B-1

PROJECT NO. 06327-22-01

SAMPLE NO. B1-2



Initial Dry Density (pcf)	115.3	Initial Saturation (%)	71.6
Initial Water Content (%)	11.8	Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

BF GOODRICH

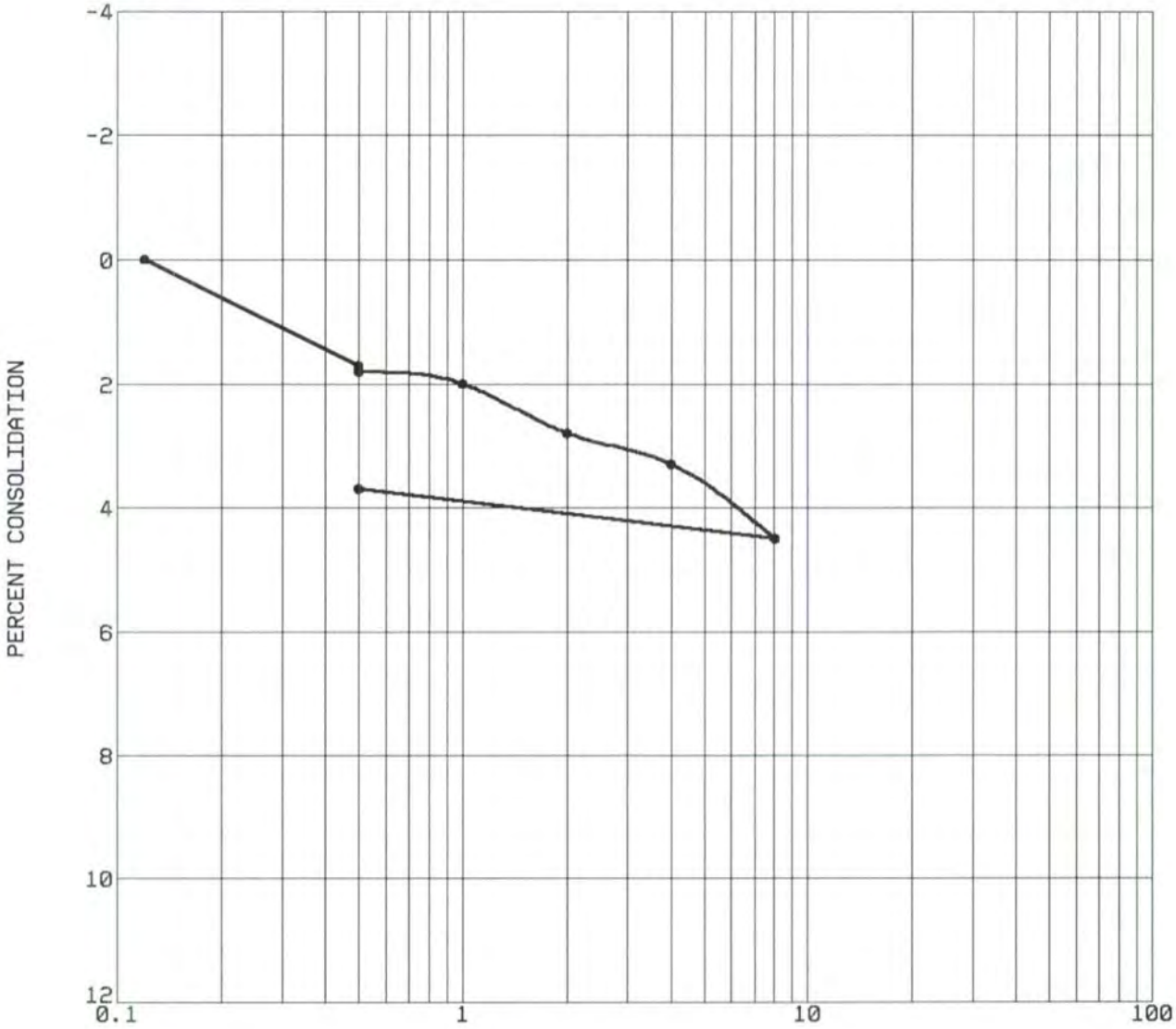
SAN DIEGO, CALIFORNIA

BFGR

Figure B-2

PROJECT NO. 06327-22-01

SAMPLE NO. B6-2



Initial Dry Density (pcf)	125.9
Initial Water Content (%)	13.1

Initial Saturation (%)	100
Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

BF GOODRICH

SAN DIEGO, CALIFORNIA

BFGR

Figure B-3

APPENDIX C

APPENDIX C

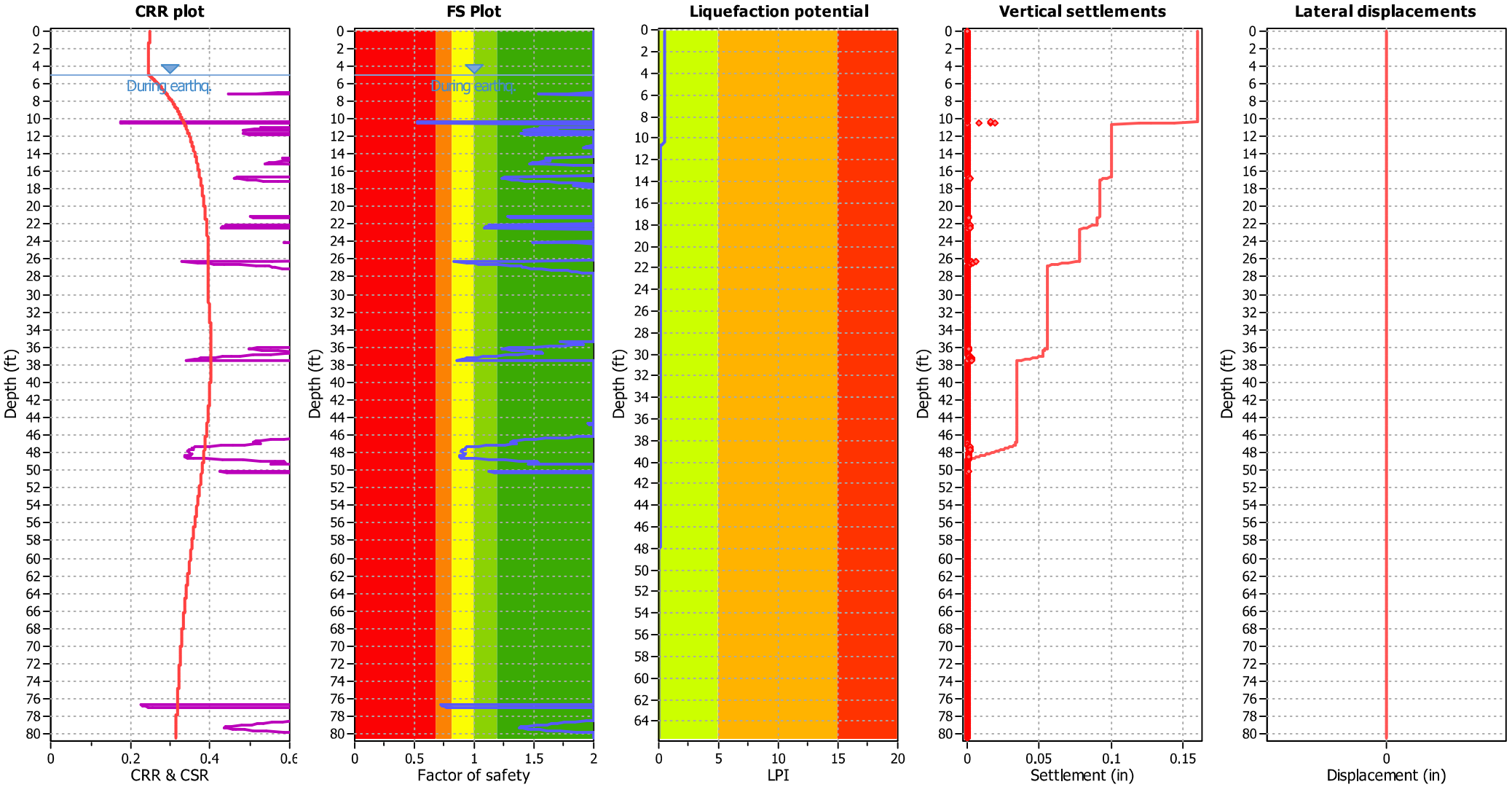
LIQUEFACTION ANALYSIS

FOR

COLLINS AEROSPACE REDEVELOPMENT SITE – PARCEL B
NORTHEAST CORNER OF H STREET AND MARINA PARKWAY
CHULA VISTA, CALIFORNIA

PROJECT NO. G2560-52-01

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	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:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.64	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

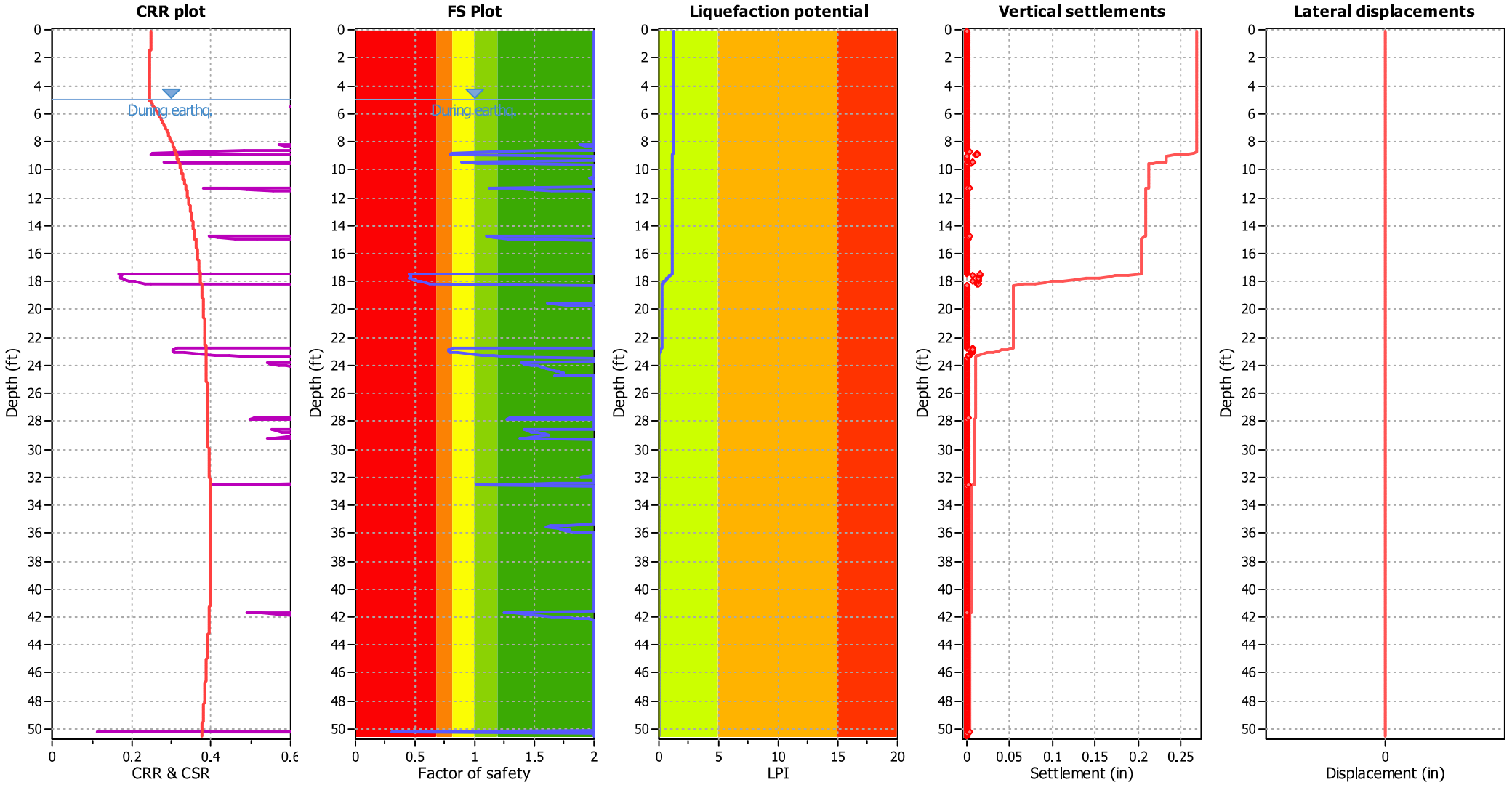
F.S. color scheme

- 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.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_o applied:	Yes
Earthquake magnitude M_w:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.64	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

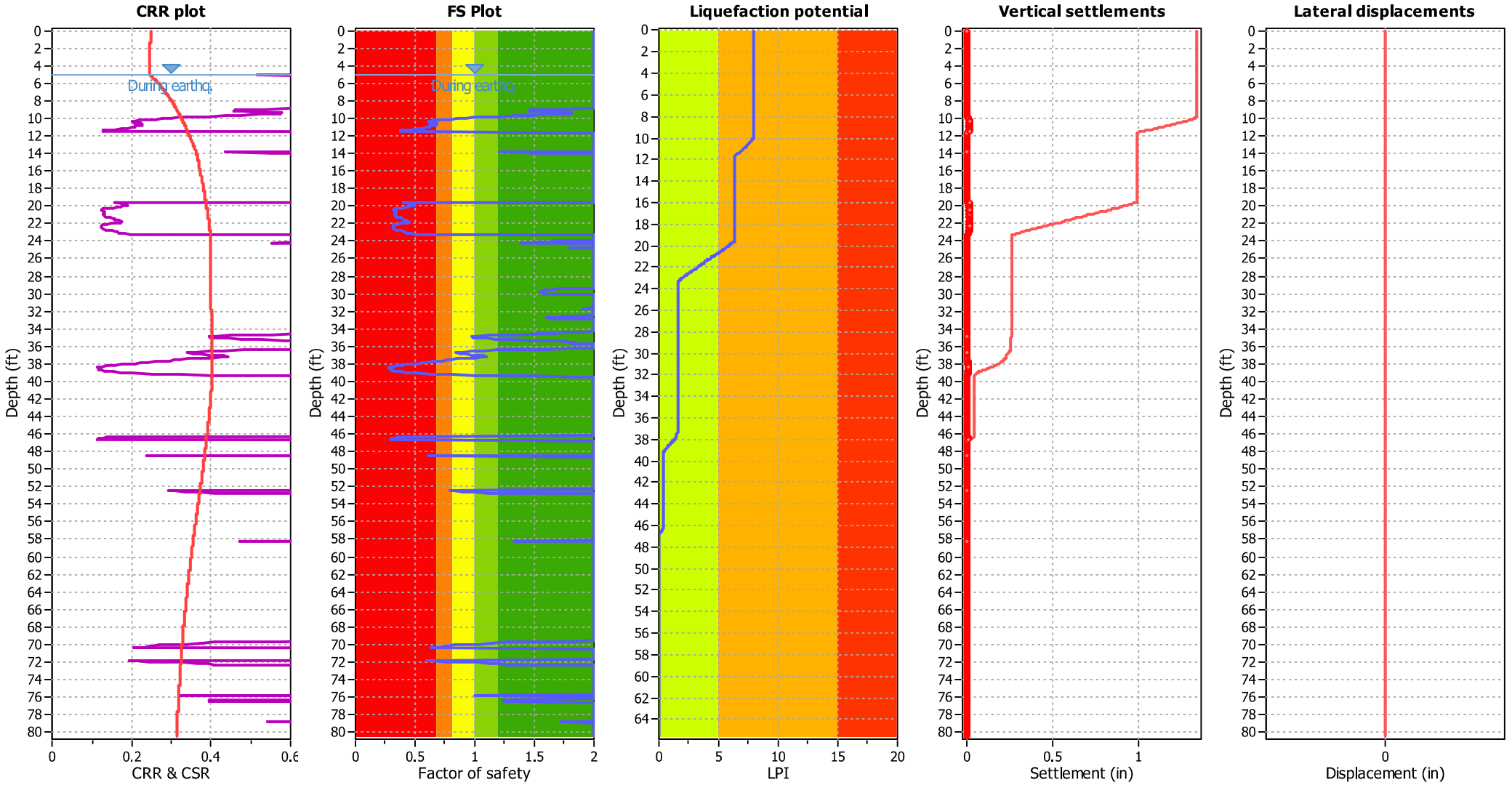
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
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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.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_o applied:	Yes
Earthquake magnitude M_w:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.64	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

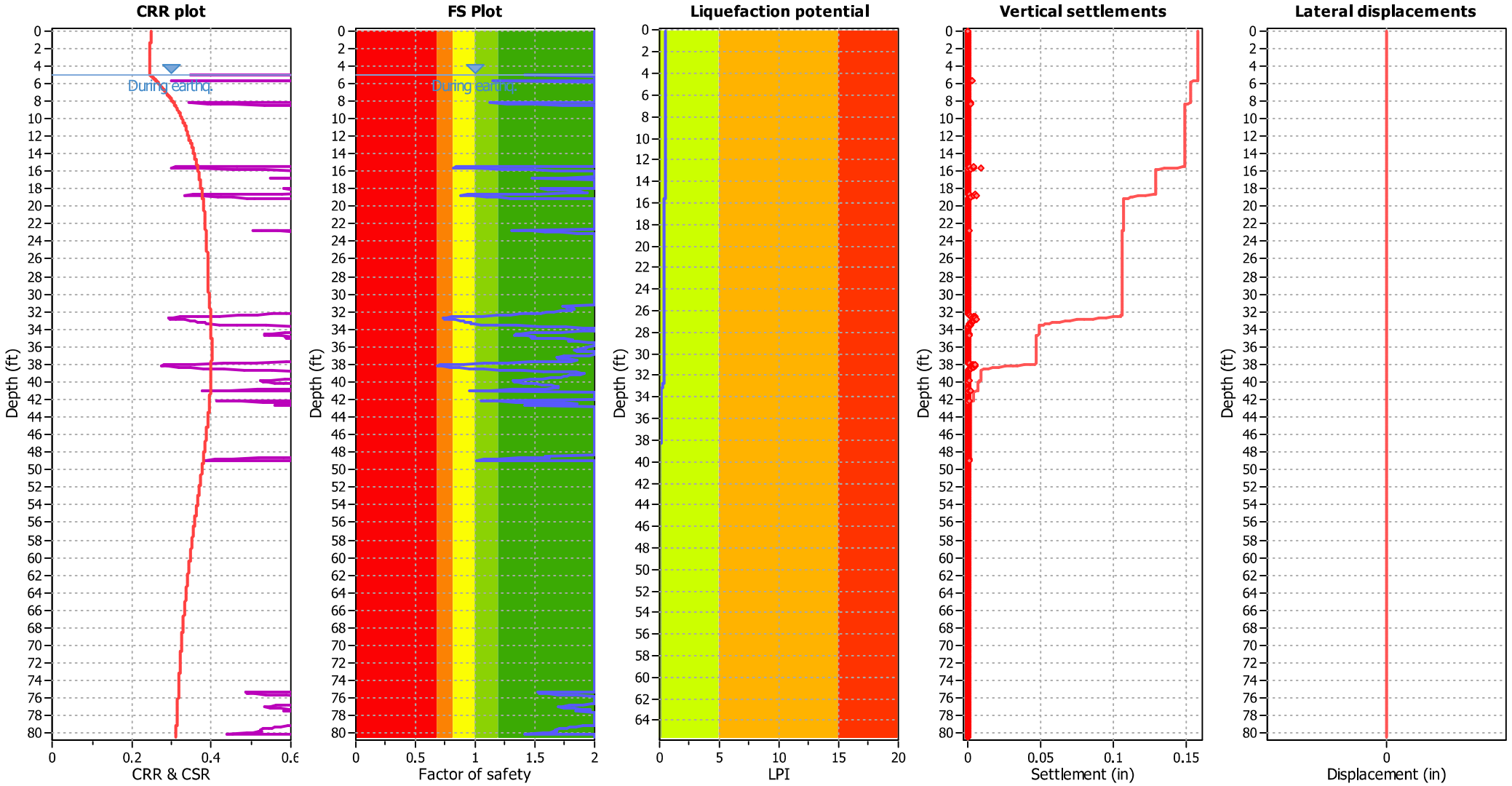
F.S. color scheme

- 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.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	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:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.64	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

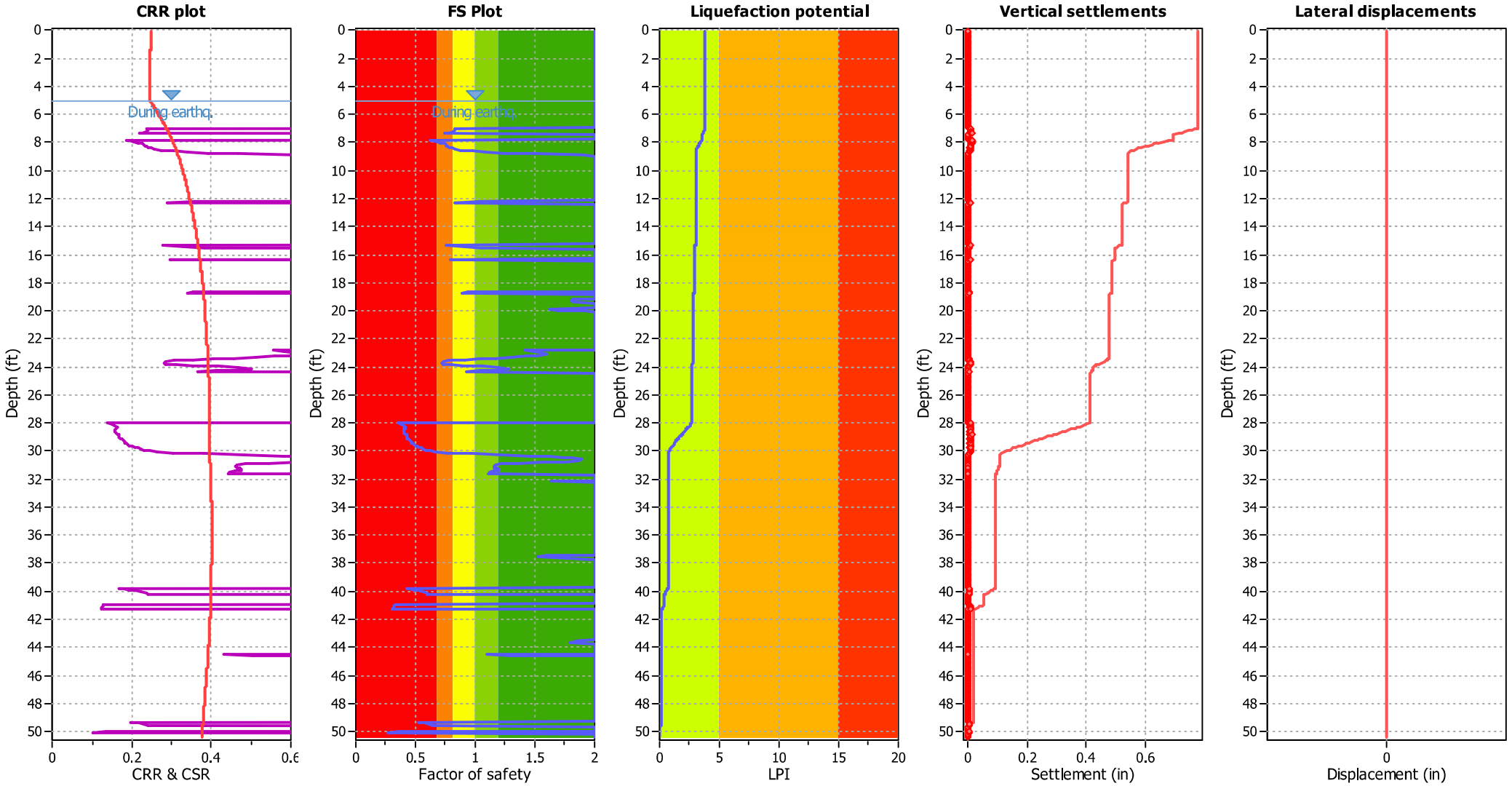
F.S. color scheme

- 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.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_o applied:	Yes
Earthquake magnitude M_w:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.64	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

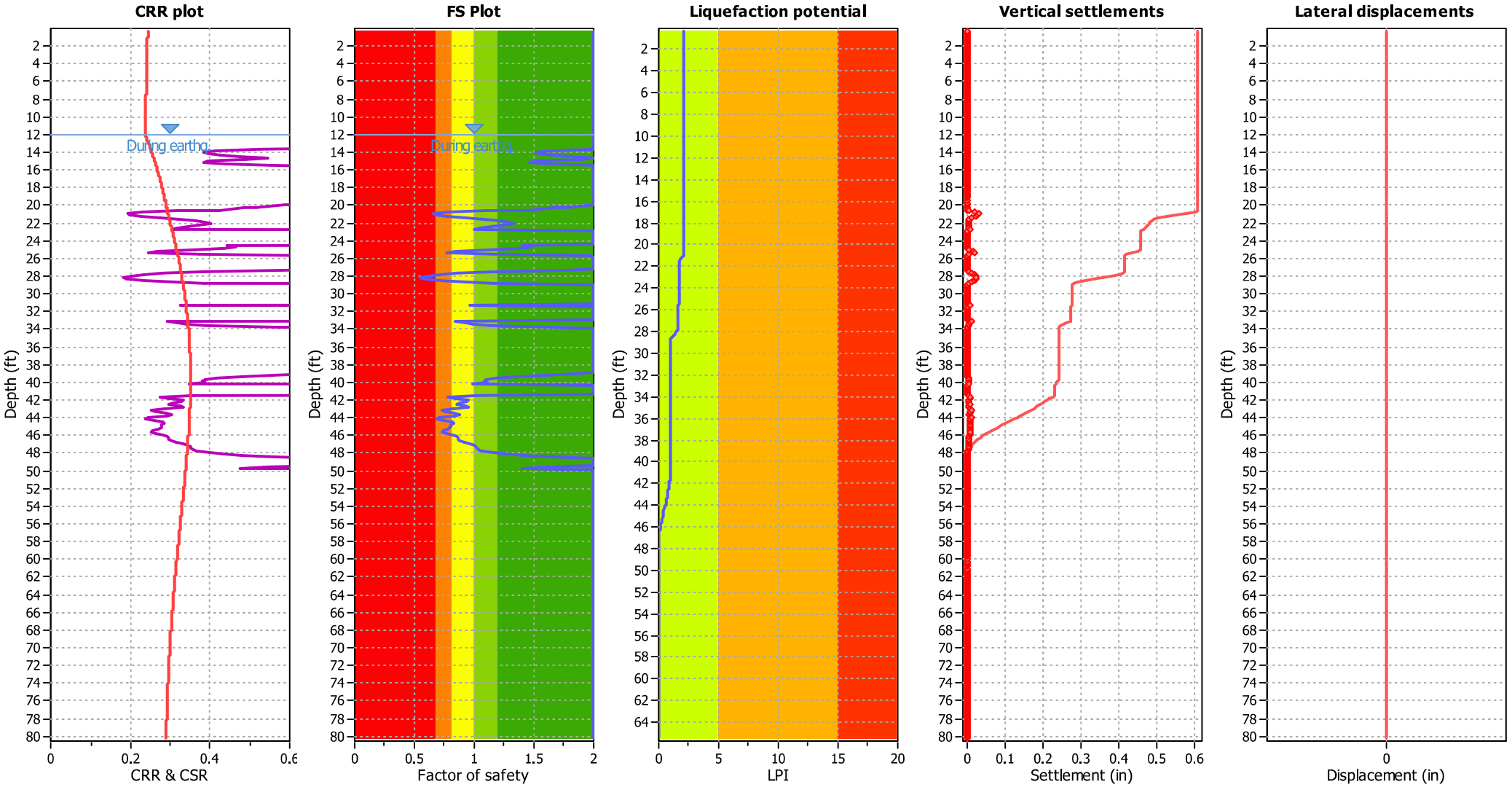
F.S. color scheme

- 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.):	12.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	12.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

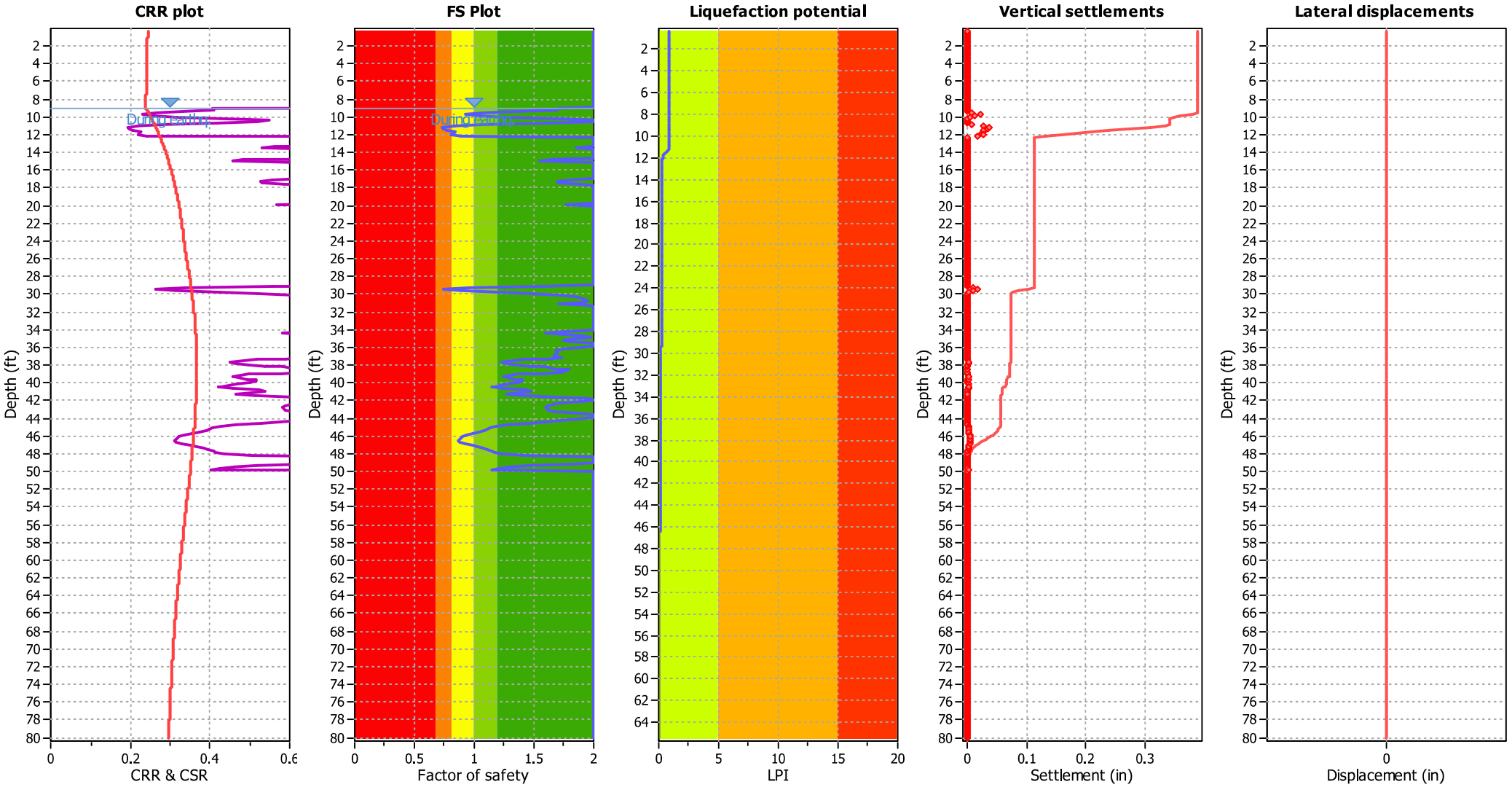
F.S. color scheme

- 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.):	9.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	9.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

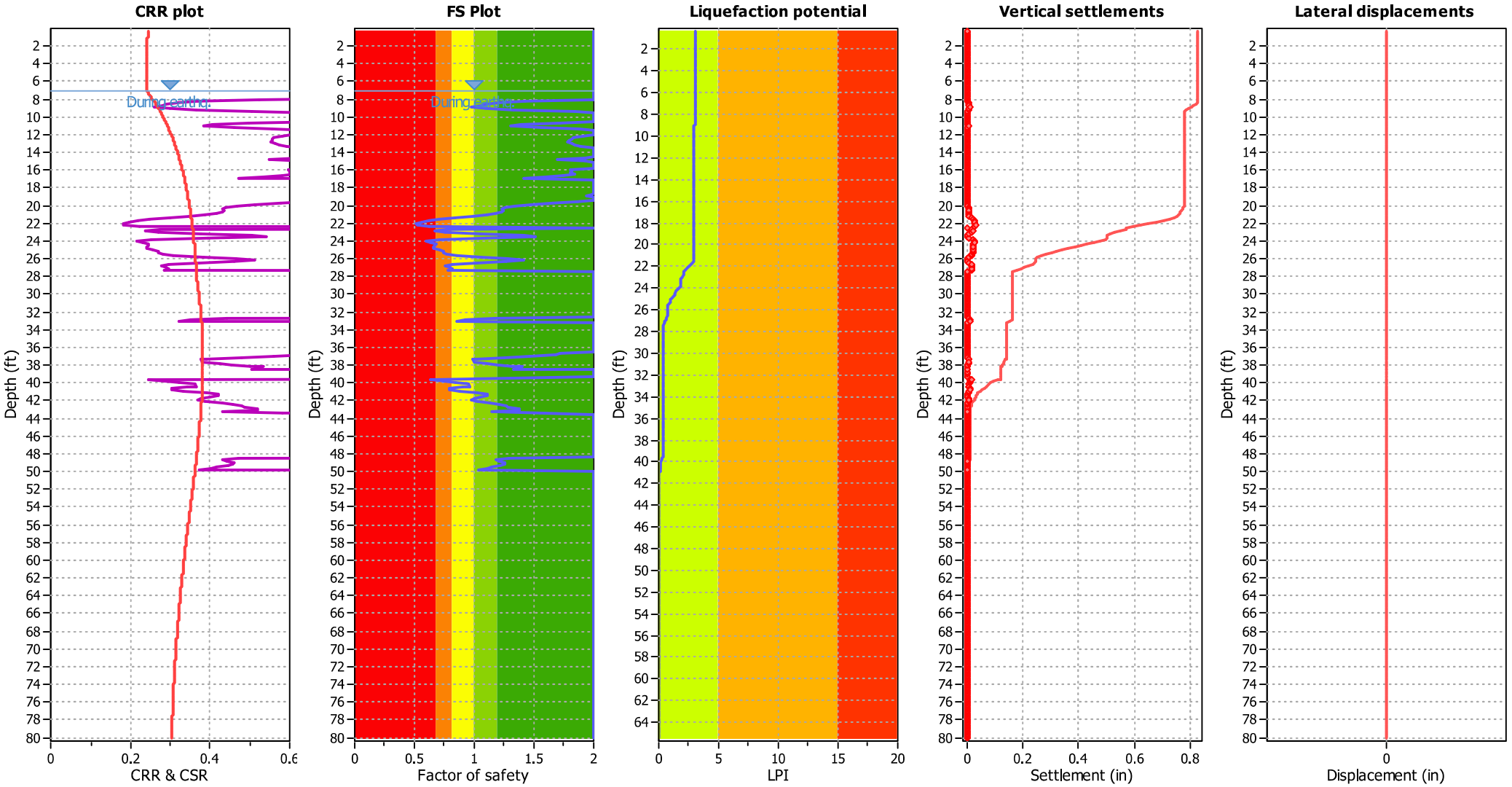
F.S. color scheme

- 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.):	7.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.12	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.63	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	7.00 ft	Fill height:	N/A	Limit depth:	50.00 ft

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 D

APPENDIX D

GENERAL GRADING RECOMMENDATIONS

FOR

COLLINS AEROSPACE REDEVELOPMENT SITE – PARCEL B
NORTHEAST CORNER OF H STREET AND MARINA PARKWAY
CHULA VISTA, CALIFORNIA

PROJECT NO. G2560-52-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9

and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

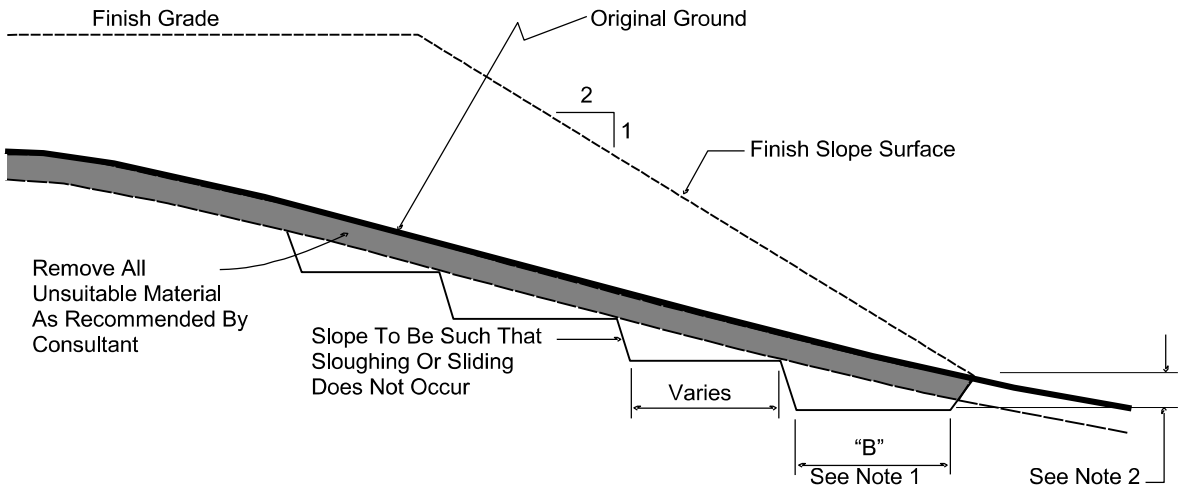
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

DETAIL NOTES: (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection

variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

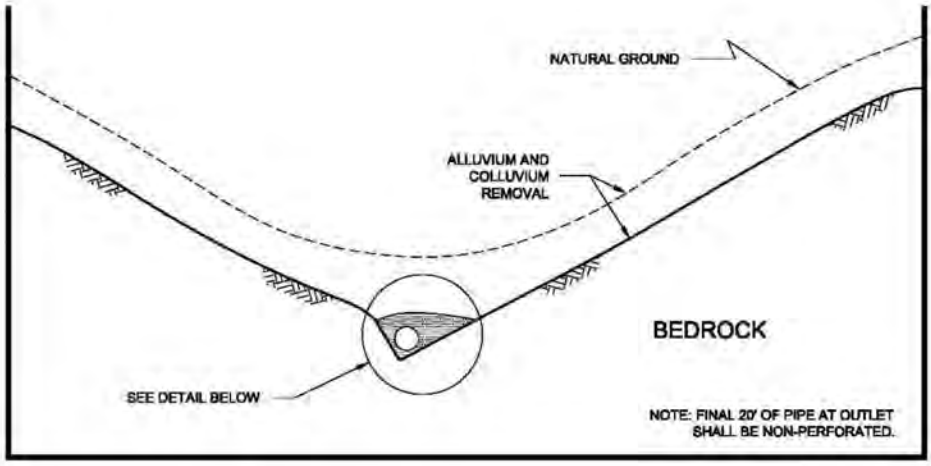
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

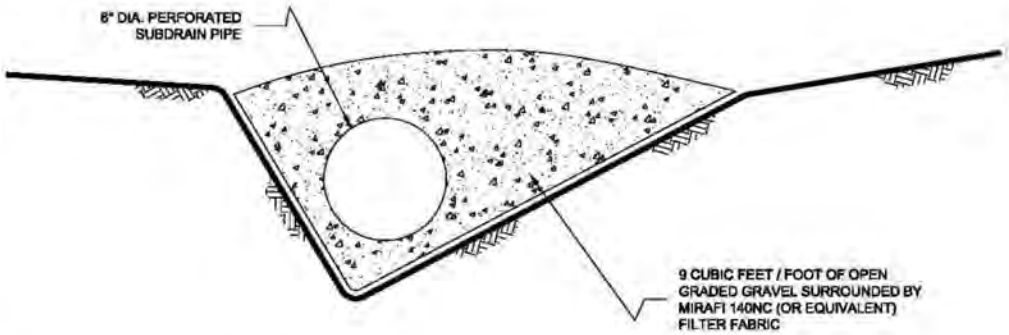
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

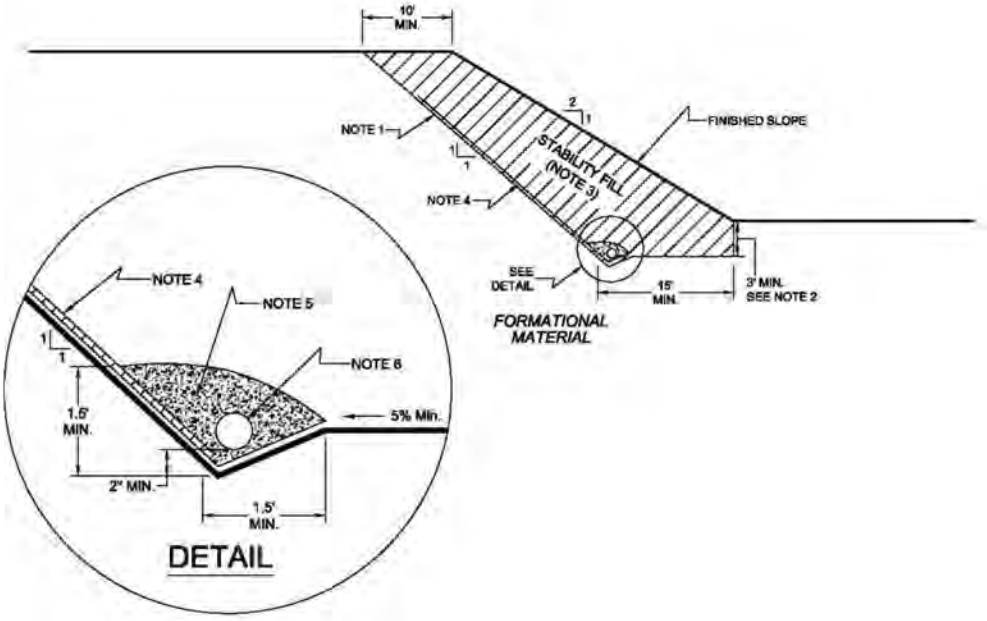
1.....8-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2.....6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

NO SCALE

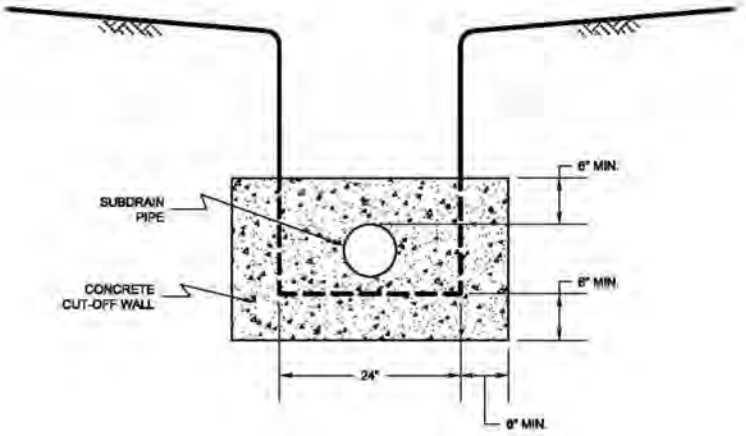
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

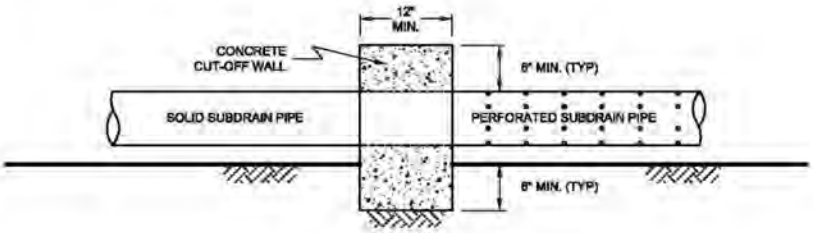
TYPICAL CUT OFF WALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW

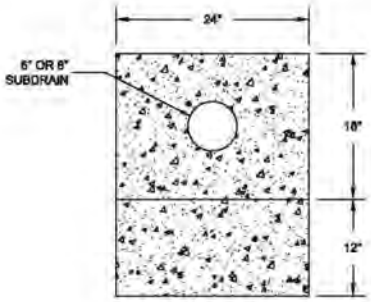


NO SCALE

7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

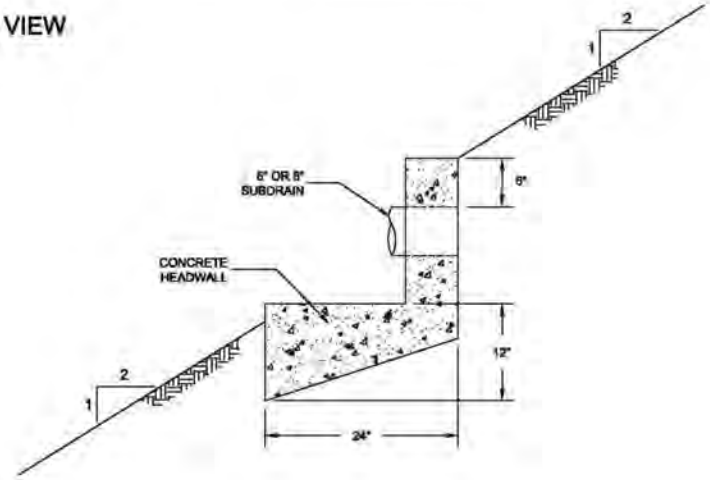
TYPICAL HEADWALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an "as-built" map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

LIST OF REFERENCES

1. *2019 California Building Code, California Code of Regulations, Title 24, Part 2, based on the 2018 International Building Code*, prepared by California Building Standards Commission, dated July 2019.

2. American Society of Civil Engineers (ASCE*), ASCE 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, 2017.

3. AECOM, *Report of Annual Groundwater Monitoring and Sampling – 2017, Rohr Inc., North Campus, Chula Vista, California,* dated October 18, 2017 (Project No. 60509378).

4. California Department of Conservation, Division of Mines and Geology, *Probabilistic Seismic Hazard Assessment for the State of California,* Open File Report 96-08, 1996.

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