Priority Development Project (PDP)
Storm Water Quality Management Plan (SWQMP)

Mercado Apartments

[Insert Permit Application Number]

[Insert Drawing Number (if applicable) and Internal Order Number (if applicable)]

☐ **Check if electing for offsite alternative compliance**

Engineer of Work:

REGISTERED PROFESSIONAL ENGINEER ROBERT D. DENTINO No. 45629 Exp. 12/31/26 CIVIL STATE OF CALIFORNIA

Robert D. Dentino 45629

Provide Wet Signature and Stamp Above Line

Prepared For:

MAAC

1355 Third Avenue

Chula Vista, CA 91911

619 409-1780

Prepared By:

Excel Engineering

440 State Place

Escondido, CA 92029

(760) 745-8118

Date:

12/16/2024

Approved by: City of San Diego Date

The City of SAN DIEGO

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Project Name: Mercado Apartments

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- Attachment 3: Structural BMP Maintenance Plan
    - Maintenance Agreement (Form DS-3247) (when applicable)
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- Attachment 6: Project's Geotechnical and Groundwater Investigation Report

Acronyms

APN	Assessor's Parcel Number
ASBS	Area of Special Biological Significance
BMP	Best Management Practice
CEQA	California Environmental Quality Act
CGP	Construction General Permit
DCV	Design Capture Volume
DMA	Drainage Management Areas
ESA	Environmentally Sensitive Area
GLU	Geomorphic Landscape Unit
GW	Ground Water
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
HU	Harvest and Use
INF	Infiltration
LID	Low Impact Development
LUP	Linear Underground/Overhead Projects
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PDP	Priority Development Project
PE	Professional Engineer
POC	Pollutant of Concern
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWPPP	Stormwater Pollutant Protection Plan
SWQMP	Storm Water Quality Management Plan
TMDL	Total Maximum Daily Load
WMAA	Watershed Management Area Analysis
WPCP	Water Pollution Control Program
WQIP	Water Quality Improvement Plan

Certification Page

Project Name: Mercado Apartments
Permit Application

I hereby declare that I am the Engineer in Responsible Charge of design of storm water BMPs for this project, and that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the requirements of the Storm Water Standards, which is based on the requirements of SDRWQCB 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 Storm Water Standards. 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 source control and site design 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

45629 — PE#

12-31-2026 — Expiration Date

Robert D. Dentino — Print Name

Excel Engineering — Company

12/16/2024 — Date

REGISTERED PROFESSIONAL ENGINEER
ROBERT D. DENTINO
No. 45629
Exp. 12/31/26
CIVIL
STATE OF CALIFORNIA

Engineer's Stamp

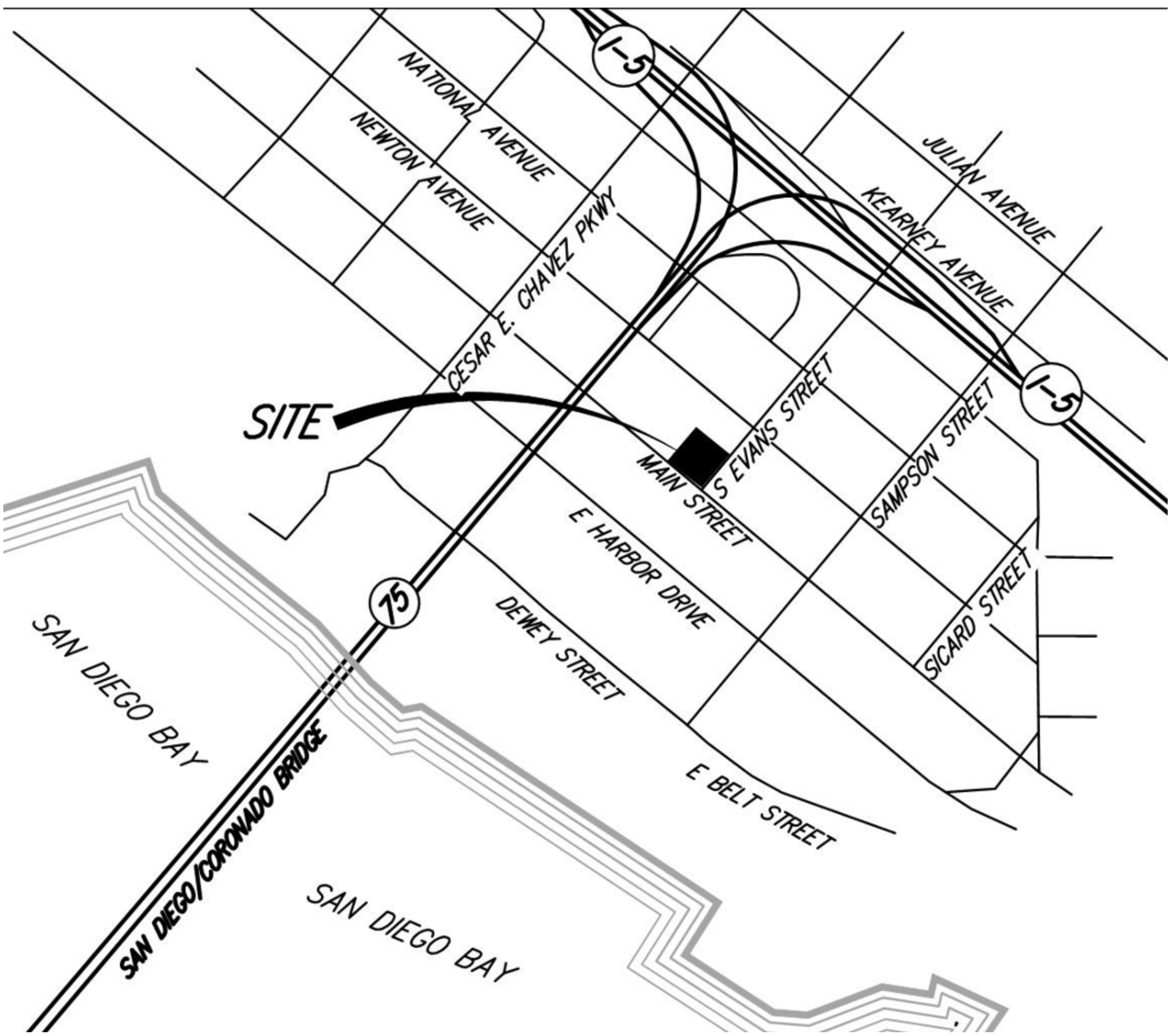
Submittal Record

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 last column indicate changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments.

Submittal Number	Date	Project Status	Changes
1		☑ Preliminary Design/Planning/CEQA ☐ Final Design	**Initial Submittal**
2	01/23/2023	☑ Preliminary Design/Planning/CEQA ☐ Final Design	1st Plan Check
3	6/22/2023	☑ Preliminary Design/Planning/CEQA ☐ Final Design	2nd Plan Check
4	10/18/2023	☑ Preliminary Design/Planning/CEQA ☐ Final Design	3rd Plan Check

Project Vicinity Map

Project Name: Mercado Apartments
Permit Application



City of San Diego Form DS-560 Storm Water Requirements Applicability Checklist

Attach DS-560 form.

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Applicability of Permanent, Post-Construction Storm Water BMP Requirements			Form I-1
Project Identification			
Project Name: Mercado Apartments			
Permit Application Number:			Date: 12/27/2021
Determination of Requirements			
The purpose of this form is to identify permanent, post-construction requirements that apply to the project. This form serves as a short summary of applicable requirements, in some cases referencing separate forms that will serve as the backup for the determination of requirements. Answer each step below, starting with **Step 1** and progressing through each step until reaching "Stop". Refer to the manual sections and/or separate forms referenced in each step below.			
Step	**Answer**	**Progression**	
Step 1: Is the project a "development project"? See Section 1.3 of the manual (Part 1 of Storm Water Standards) for guidance.	☑ Yes	Go to **Step 2**.	
	☐ No	**Stop**. Permanent BMP requirements do not apply. No SWQMP will be required. Provide discussion below.	
Discussion / justification if the project is not a "development project" (e.g., the project includes *only* interior remodels within an existing building):			
Step 2: Is the project a Standard Project, PDP, or PDP Exempt? To answer this item, see Section 1.4 of the manual in its entirety for guidance AND complete Form DS-560, Storm Water Requirements Applicability Checklist.	☐ Standard Project	**Stop.** Standard Project requirements apply	
	☑ PDP	PDP requirements apply, including PDP SWQMP. Go to **Step 3**.	
	☐ PDP Exempt	**Stop.** Standard Project requirements apply. Provide discussion and list any additional requirements below.	
Discussion / justification, and additional requirements for exceptions to PDP definitions, if applicable:			

Project Name: Mercado Apartments

Form I-1 Page 2 of 2		
Step	**Answer**	**Progression**
Step 3. Is the project subject to earlier PDP requirements due to a prior lawful approval? See Section 1.10 of the manual (Part 1 of Storm Water Standards) for guidance.	☐ Yes	Consult the City Engineer to determine requirements. Provide discussion and identify requirements below. Go to **Step 4**.
	☑ No	BMP Design Manual PDP requirements apply. Go to **Step 4**.
Discussion / justification of prior lawful approval, and identify requirements (<u>not required if prior lawful approval does not apply</u>):		
Step 4. Do hydromodification control requirements apply? See Section 1.6 of the manual (Part 1 of Storm Water Standards) for guidance.	☑ Yes	PDP structural BMPs required for pollutant control (Chapter 5) and hydromodification control (Chapter 6). Go to **Step 5**.
	☐ No	**Stop.** PDP structural BMPs required for pollutant control (Chapter 5) only. Provide brief discussion of exemption to hydromodification control below.
Discussion / justification if hydromodification control requirements do <u>not</u> apply:		
Step 5. Does protection of critical coarse sediment yield areas apply? See Section 6.2 of the manual (Part 1 of Storm Water Standards) for guidance.	☐ Yes	Management measures required for protection of critical coarse sediment yield areas (Chapter 6.2). **Stop.**
	☑ No	Management measures not required for protection of critical coarse sediment yield areas. Provide brief discussion below. **Stop.**
Discussion / justification if protection of critical coarse sediment yield areas does <u>not</u> apply: The area does not have any PCCSYA on or near the site.		

HMP Exemption Exhibit

Attach a HMP Exemption Exhibit that shows direct storm water runoff discharge from the project site to HMP exempt area. Include project area, applicable underground storm drain line and/or concrete lined channels, outfall information and exempt waterbody.
Reference applicable drawing number(s).

Exhibit must be provided on 11"x17" or larger paper.

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Site Information Checklist For PDPs	Form I-3B
Project Summary Information	
Project Name	Mercado Apartments
Project Address	2001 Newton Avenue, San Diego, CA, 92113
Assessor's Parcel Number(s) (APN(s))	538-672-04
Permit Application Number	
Project Watershed	Select One: ☐ San Dieguito River ☐ Penasquitos ☐ Mission Bay ☐ San Diego River ☑ San Diego Bay ☐ Tijuana River
Hydrologic subarea name with Numeric Identifier up to two decimal places (9XX.XX)	San Diego Mesa 908.2
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	0.974 Acres (42436.5 Square Feet)
Area to be disturbed by the project (Project Footprint)	0.974 Acres (42436.5 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	0.780 Acres (33,965.254 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	0.194 Acres (8,471.3 Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Project Area.	
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition	4% %

Project Name: Mercado Apartments

Form I-3B Page 2 of 11
Description of Existing Site Condition and Drainage Patterns
Current Status of the Site (select all that apply): ☑Existing development ☐Previously graded but not built out ☐Agricultural or other non-impervious use ☐Vacant, undeveloped/natural Description / Additional Information: The site is currently a developed residential complex.
Existing Land Cover Includes (select all that apply): ☑Vegetative Cover ☐Non-Vegetated Pervious Areas ☑Impervious Areas Description / Additional Information: The site consists of buildings, walkways, a parking lot and various vegetated areas in between.
Underlying Soil belongs to Hydrologic Soil Group (select all that apply): ☐NRCS Type A ☐NRCS Type B ☐NRCS Type C ☑NRCS Type D
Approximate Depth to Groundwater: ☐Groundwater Depth < 5 feet ☐5 feet < Groundwater Depth < 10 feet ☐10 feet < Groundwater Depth < 20 feet ☑Groundwater Depth > 20 feet
Existing Natural Hydrologic Features (select all that apply): ☐Watercourses ☐Seeps ☐Springs ☐Wetlands ☑None Description / Additional Information:

Project Name: Mercado Apartments

Form I-3B Page 3 of 11

Description of Existing Site Topography and Drainage

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. If runoff from offsite is conveyed through the site? If yes, quantification of 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 storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, and natural and constructed channels;
4. Identify all discharge locations from the existing project along with a summary of the 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.

Descriptions/Additional Information

The drainage through the existing residential site is urban.

There is one 12" storm drain line that has two inlets in the parking lot that takes in flow from the northwest section of parking lot. The storm drain flows southeast until it reaches Main Street and flows into the street through a sidewalk outlet. Flow from the buildings and adjacent walkways flows into area drains that are assumed to connect into the 12" storm drain line. The rest of the parking lot surface flows to another sidewalk outlet on main street where it flows along the street to meet up with the rest of the flow.

Form I-3B Page 4 of 11
Description of Proposed Site Development and Drainage Patterns
Project Description / Proposed Land Use and/or Activities: The project proposes to build a residential apartment complex. The complex will have a center courtyard and various walkways around the project site.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): The impervious features on this project are the apartment buildings and impervious concrete walkways and features.
List/describe proposed pervious features of the project (e.g., landscape areas): There will be some pervious landscaping in the center courtyard as well as as around the building, including the pervious water quality basins that will be on the outer edges of the site.
Does the project include grading and changes to site topography? ☑ Yes ☐ No Description / Additional Information: The project proposes to add new water quality basins, walls and surface slopes throughout the site.

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

☑ 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 and 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.

Description / Additional Information:

The proposed site consists of apartment buildings, a center plaza and various landscaped areas around the project. Water from the roof is captured with roof drains and is conveyed by either area drains or sheet flow to one of 4 biofiltration basins. All other water that falls on the site will be routed to the biofiltration basins through area drains or sheet flow as well. Water in the biofiltration basin flows through the basin's media, and when water exceeds the basin capacity it overtops a catch basin where it is piped to one of three outlets that lead to the street. From here, all three of the outlets flow along the existing gutter and confluence at the POC at the west corner of the site.

See the Q100 flow summary table below and the drainage study for this project for more information.

100 Year Runoff Flows	
Pre-Development	7.661 CFS
Post-Development	5.700 CFS

Project Name: Mercado Apartments

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

- ☑ Onsite storm drain inlets
- ☐ Interior floor drains and elevator shaft sump pumps
- ☐ Interior parking garages
- ☐ Need for future indoor & structural pest control
- ☑ Landscape/outdoor pesticide use
- ☐ Pools, spas, ponds, decorative fountains, and other water features
- ☐ Food service
- ☐ Refuse areas
- ☐ Industrial processes
- ☐ Outdoor storage of equipment or materials
- ☐ Vehicle and equipment cleaning
- ☐ Vehicle/equipment repair and maintenance
- ☐ Fuel dispensing areas
- ☐ Loading docks
- ☐ Fire sprinkler test water
- ☑ Miscellaneous drain or wash water
- ☑ Plazas, sidewalks, and parking lots

Description/Additional Information:

Project Name: Mercado Apartments

Form I-3B Page 7 of 11
Identification and Narrative of Receiving Water
Narrative describing flow path from discharge location(s), through urban storm conveyance system, to receiving creeks, rivers, and lagoons and ultimate discharge location to Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable) The water from the site enters a storm drain system that discharges to the Pacific Ocean.
Provide a summary of all beneficial uses of receiving waters downstream of the project discharge locations IND, NAV, COMM, REC-1. REC-2, BIOL, WILD, RARE,SPWN, MIGR, SHELL, EST
Identify all ASBS (areas of special biological significance) receiving waters downstream of the project discharge locations There are no ASBS in the recieving waters.
Provide distance from project outfall location to impaired or sensitive receiving waters The project is located around 1/2 mile away from the San Diego Bay.
Summarize information regarding the proximity of the permanent, post-construction storm water BMPs to the City's Multi-Habitat Planning Area and environmentally sensitive lands There is no environmentally sensitive lands within a 1.5 mile radius of the site.

Form I-3B Page 8 of 11

Identification of Receiving Water Pollutants of Concern

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 (Refer to Appendix K)	Pollutant(s)/Stressor(s) (Refer to Appendix K)	TMDLs/WQIP Highest Priority Pollutant (Refer to Table 1-4 in Chapter 1)
San Diego Bay Shoreline,near Coronado Bridge	Benthic Community Effects	Indicator Bacteria
	Sediment Toxicity	Dissolved Copper
		Lead
		Zinc (wet weather)

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 anticipated from the project site based on all proposed use(s) of the site (see Appendix B.6):

Pollutant	Not Applicable to the Project Site	Anticipated 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	☐	☑	☐

Form I-3B Page 9 of 11
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): 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 Discussion / Additional Information:

Form I-3B Page 10 of 11
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's HMP Exhibit.   There is one POC for this project at the west corner of the project on Main Street.
Has a geomorphic assessment been performed for the receiving channel(s)?   ☑ No, the low flow threshold is $0.1Q_2$ (default low flow threshold)   ☐ Yes, the result is the low flow threshold is $0.1Q_2$ ☐ Yes, the result is the low flow threshold is $0.3Q_2$ ☐ Yes, the result is the low flow threshold is $0.5Q_2$ If a geomorphic assessment has been performed, provide title, date, and preparer: NA
Discussion / Additional Information: (optional)   NA

Project Name: Mercado Apartments

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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.

NA

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.

NA

Source Control BMP Checklist for PDPs	Form I-4B		
Source Control BMPs			
All development projects must implement source control BMPs where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of the Storm Water Standards) for information to implement source control BMPs shown in this checklist. 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:			
4.2.2 Storm Drain Stenciling or Signage	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.2 not implemented:			
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:			

Form I-4B Page 2 of 2	
Source Control Requirement	**Applied?**
4.2.6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)	
On-site storm drain inlets	☑ Yes ☐ No ☐ N/A
Interior floor drains and elevator shaft sump pumps	☐ Yes ☐ No ☑ N/A
Interior parking garages	☐ Yes ☐ No ☑ N/A
Need for future indoor & structural pest control	☐ Yes ☐ No ☑ N/A
Landscape/Outdoor Pesticide Use	☑ Yes ☐ No ☐ N/A
Pools, spas, ponds, decorative fountains, and other water features	☐ Yes ☐ No ☑ N/A
Food service	☐ Yes ☐ No ☑ N/A
Refuse areas	☐ Yes ☐ No ☑ N/A
Industrial processes	☐ Yes ☐ No ☑ N/A
Outdoor storage of equipment or materials	☐ Yes ☐ No ☑ N/A
Vehicle/Equipment Repair and Maintenance	☐ Yes ☐ No ☑ N/A
Fuel Dispensing Areas	☐ Yes ☐ No ☑ N/A
Loading Docks	☐ Yes ☐ No ☑ N/A
Fire Sprinkler Test Water	☐ Yes ☐ No ☑ N/A
Miscellaneous Drain or Wash Water	☐ Yes ☐ No ☑ N/A
Plazas, sidewalks, and parking lots	☑ Yes ☐ No ☐ N/A
SC-6A: Large Trash Generating Facilities	☐ Yes ☐ No ☑ N/A
SC-6B: Animal Facilities	☐ Yes ☐ No ☑ N/A
SC-6C: Plant Nurseries and Garden Centers	☐ Yes ☐ No ☑ N/A
SC-6D: Automotive Facilities	☐ Yes ☐ No ☑ N/A
Discussion / justification if 4.2.6 not implemented. Clearly identify which sources of runoff pollutants are discussed. Justification must be provided for all "No" answers shown above.	

Project Name: Mercado Apartments

Site Design BMP Checklist for PDPs			Form I-5B
Site Design BMPs			
All development projects must implement site design BMPs where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of Storm Water Standards) for information to implement site design BMPs shown in this checklist. 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 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 site has no existing natural areas to conserve). Discussion / justification may be provided. A site map with implemented site design BMPs must be included at the end of this checklist.			
Site Design Requirement	**Applied?**		
4.3.1 Maintain Natural Drainage Pathways and Hydrologic Features	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.3.1 not implemented: The site is already developed.			
1-1 Are existing natural drainage pathways and hydrologic features mapped on the site map?	☐ Yes	☐ No	☑ N/A
1-2 Are trees implemented? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
1-3 Implemented trees meet the design criteria in 4.3.1 Fact Sheet (e.g. soil volume, maximum credit, etc.)?	☐ Yes	☐ No	☑ N/A
1-4 Is tree credit volume calculated using Appendix B.2.2.1 and SD-1 Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A
4.3.2 Have natural areas, soils and vegetation been conserved?	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.3.2 not implemented: The site is already a developed apartment complex.			

Project Name: Mercado Apartments

Form I-5B Page 2 of 4			
Site Design Requirement	**Applied?**		
4.3.3 Minimize Impervious Area	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.3 not implemented:			
4.3.4 Minimize Soil Compaction	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.4 not implemented:			
4.3.5 Impervious Area Dispersion	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.5 not implemented:			
5-1 Is the pervious area receiving runon from impervious area identified on the site map?	☐ Yes	☐ No	☑ N/A
5-2 Does the pervious area satisfy the design criteria in 4.3.5 Fact Sheet in Appendix E (e.g. maximum slope, minimum length, etc.)	☐ Yes	☐ No	☑ N/A
5-3 Is impervious area dispersion credit volume calculated using Appendix B.2.1.1 and 4.3.5 Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A

Form I-5B Page 3 of 4			
Site Design Requirement	**Applied?**		
4.3.6 Runoff Collection	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.6 not implemented:			
6a-1 Are green roofs implemented in accordance with design criteria in 4.3.6A Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
6a-2 Is the green roof credit volume calculated using Appendix B.2.1.2 and 4.3.6A Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A
6b-1 Are permeable pavements implemented in accordance with design criteria in 4.3.6B Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
6b-2 Is the permeable pavement credit volume calculated using Appendix B.2.1.3 and 4.3.6B Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A
4.3.7 Landscaping with Native or Drought Tolerant Species	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.7 not implemented:			
4.3.8 Harvest and Use Precipitation	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.3.8 not implemented:			
8-1 Are rain barrels implemented in accordance with design criteria in 4.3.8 Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☐ No	☑ N/A
8-2 Is the rain barrel credit volume calculated using Appendix B.2.2.2 and 4.3.8 Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A

Form I-5B Page 4 of 4
Insert Site Map with all site design BMPs identified:

Project Name: Mercado Apartments

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 BMP Design Manual, Part 1 of Storm Water Standards). 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 BMP Design 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 the City at the completion of construction. This includes requiring the project owner or project owner's representative to certify construction of the structural BMPs (complete Form DS-563). PDP structural BMPs must be maintained into perpetuity (see Chapter 7 of the BMP Design 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 BMP Design 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.

Step 1, the project was divided up and evaluated at the DMA scale. Each DMA area was classified as Self Treating, Self-Retaining or Draining to a Best Management Practice (BMP).

Step 2, For the DMAs that drain to BMPs, the appropriate runoff factors were applied to each area and the required Design Capture Volume (DCV) of each sub area calculated. For this project, Harvest and reuse is not considered feasible.

Step 3, due to the impermeability of the underlying soils, (soil type D), infiltration BMPs are not feasible.

Step 3A&B for the no infiltration condition leads to section 5.5.3 which is the Biofiltration BMP category. The various sizing methods included in Appendix B.5 were followed and the entire DCV can be treated within the proposed BMPs.

Step 4, each Biofiltration area is sized in accordance with the fact sheet BF-3 found in appendix E of the BMP design manual. This project requires hydromodification controls, so the Biofiltration units accomplish both storm water treatment and flow control mitigation in an integrated design.

(Continue on page 2 as necessary.)

Project Name: Mercado Apartments

Form I-6 Page 2 of
(Continued from page 1) DMA's 5, 7 & 8 are self-mitigating. Per section 5.2.1 self-mitigating areas must comply with the following requirements: • Vegetation in the natural or landscaped area is native and/or non-native/non-invasive drought tolerant species that do not require regular application of fertilizers and pesticides. • Soils are undisturbed native topsoil, or disturbed soils that have been amended and aerated to promote water retention characteristics equivalent to undisturbed native topsoil. • The incidental impervious areas are less than 5 percent of the self-mitigating area. DMA's 5, 7 & 8 are to be pervious area that drains directly offsite and will be landscaped to meet the above requirements. There is no incidental impervious areas for these DMA's.

Form I-6 Page of (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-A	
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 form DS-563	The Engineer of Work Robert Dentino Excel Engineering 440 State Place Escondido, CA 92029
Who will be the final owner of this BMP?	Project Owner
Who will maintain this BMP into perpetuity?	Project Owner
What is the funding mechanism for maintenance?	Project Owner

Project Name: Mercado Apartments

Form I-6 Page of (Copy as many as needed)
Structural BMP ID No. BMP-A
Construction Plan Sheet No.
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs):

Project Name: Mercado Apartments

Form I-6 Page of (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-B	
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 form DS-563	The Engineer of Work Robert Dentino Excel Engineering 440 State Place Escondido, CA 92029
Who will be the final owner of this BMP?	Project Owner
Who will maintain this BMP into perpetuity?	Project Owner
What is the funding mechanism for maintenance?	Project Owner

Form I-6 Page of (Copy as many as needed)
Structural BMP ID No.
Construction Plan Sheet No.
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs):

Project Name: Mercado Apartments

Form I-6 Page of (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-C	
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 form DS-563	The Engineer of Work Robert Dentino Excel Engineering 440 State Place Escondido, CA 92029
Who will be the final owner of this BMP?	Project Owner
Who will maintain this BMP into perpetuity?	Project Owner
What is the funding mechanism for maintenance?	Project Owner

Project Name: Mercado Apartments

Form I-6 Page of (Copy as many as needed)
Structural BMP ID No. BMP-C
Construction Plan Sheet No.
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs):

Project Name: Mercado Apartments

Form I-6 Page of (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-D	
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 form DS-563	The Engineer of Work Robert Dentino Excel Engineering 440 State Place Escondido, CA 92029
Who will be the final owner of this BMP?	Project Owner
Who will maintain this BMP into perpetuity?	Project Owner
What is the funding mechanism for maintenance?	Project Owner

Form I-6 Page of (Copy as many as needed)
Structural BMP ID No. BMP-D
Construction Plan Sheet No.
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs):

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Attachment 1
Backup For PDP Pollutant Control BMPs

This is the cover sheet for Attachment 1.

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Project Name: Mercado Apartments

Indicate which Items are Included:

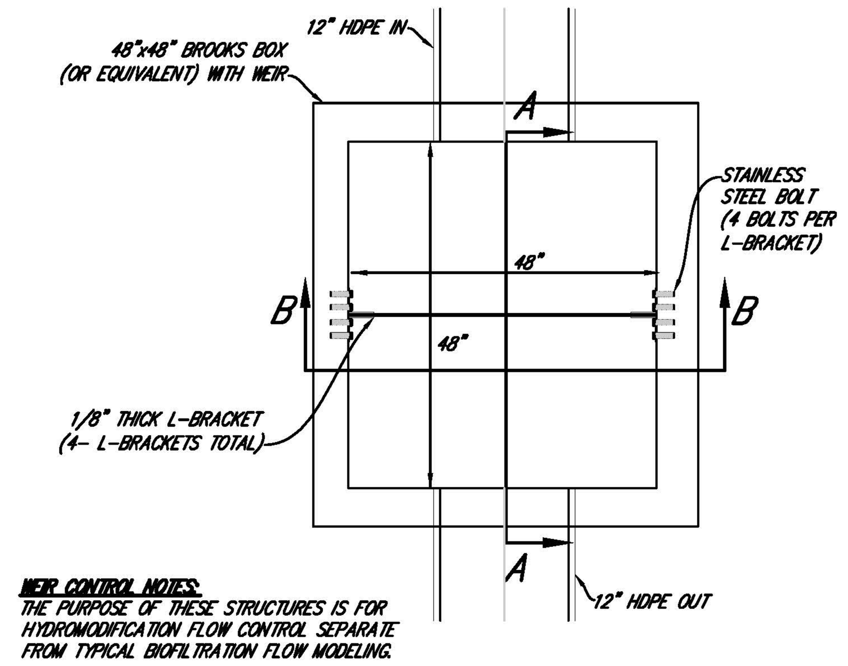
Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	☐ Included
Attachment 1b	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☐ Included 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 and signed by licensed geotechnical engineer*) ○ Form I-8A (optional) ○ Form I-8B (optional) • Partial Infiltration Condition: ○ Infiltration Feasibility Condition Letter (*Note: must be stamped and 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 and site design credit calculations	☑ Included

Project Name: Mercado Apartments

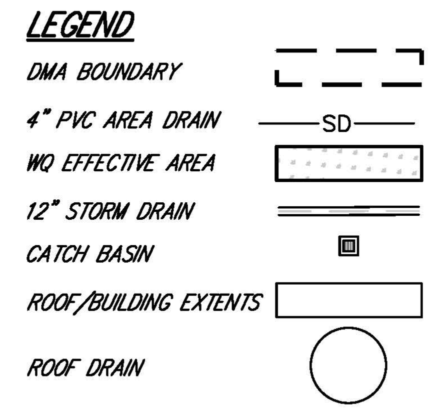
Use this checklist to ensure the required information has been included on the DMA Exhibit:

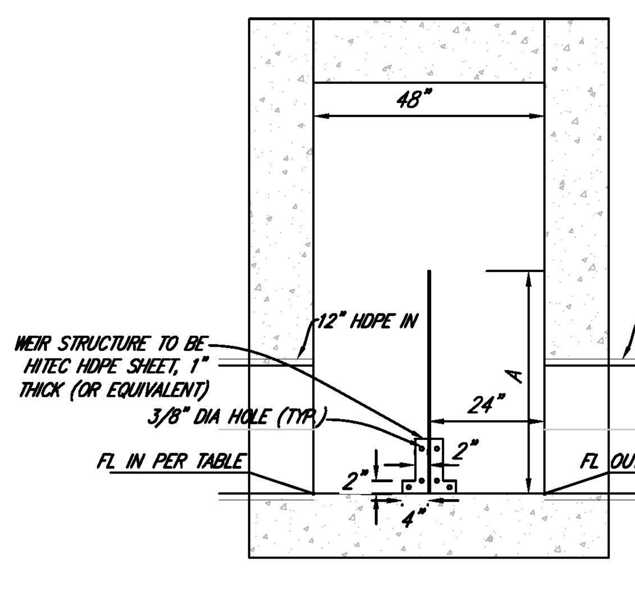
The DMA Exhibit must identify:

- ☑ 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, size/detail, and include cross-section)

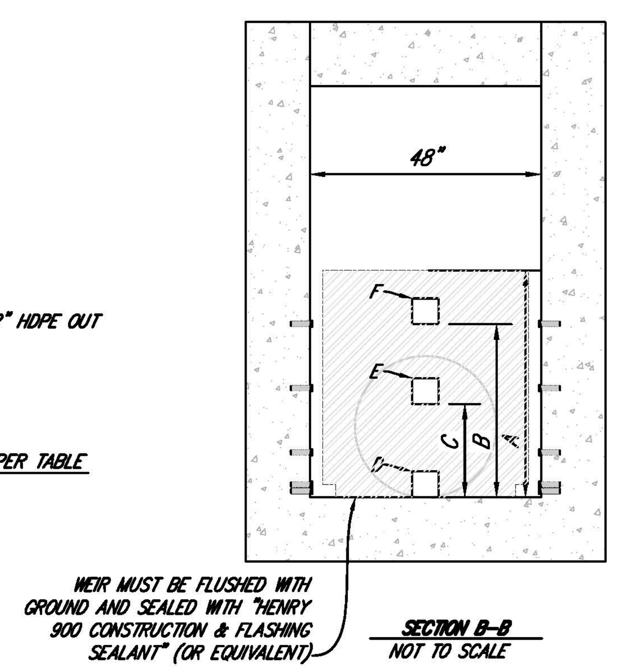


WEIR CONTROL STRUCTURE DETAIL 1
NOT TO SCALE





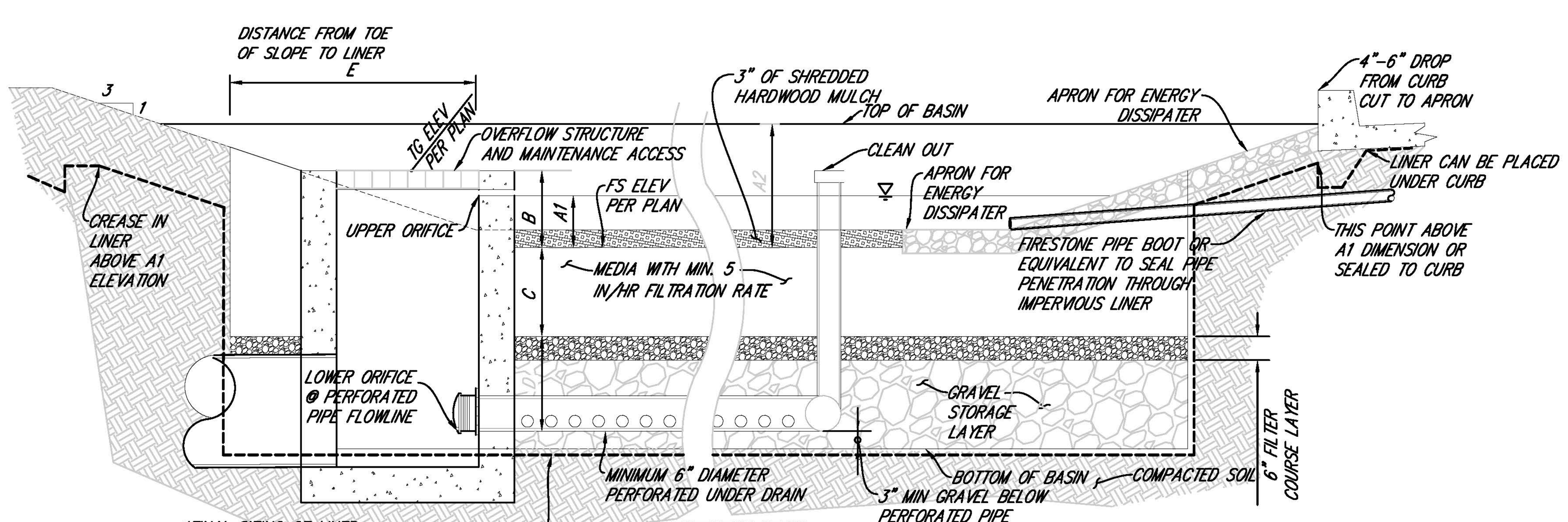
SECTION A-A
NOT TO SCALE



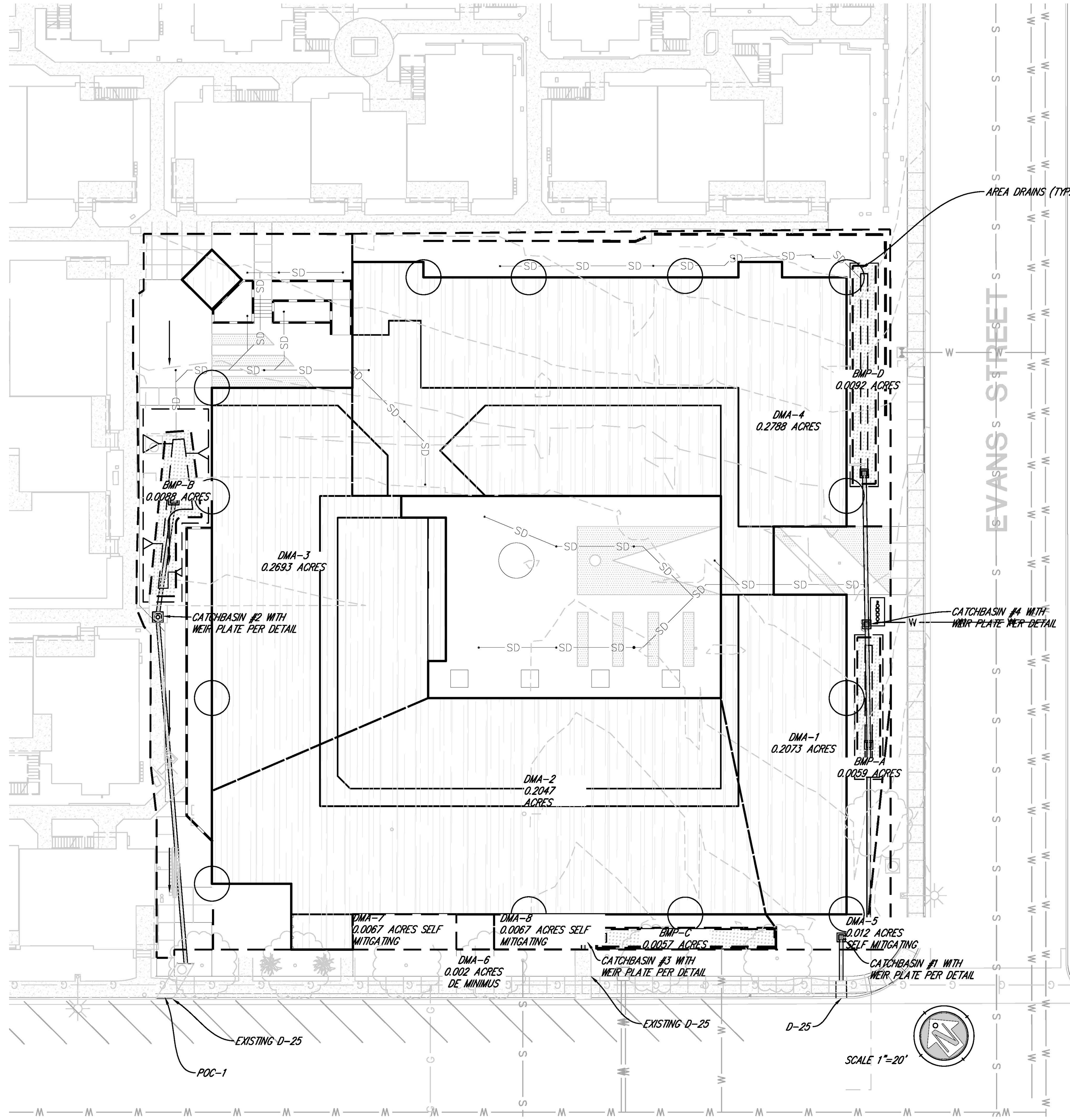
SECTION B-B
NOT TO SCALE

WEIR CONTROL STRUCTURE SUMMARY TABLE								
CATCHBASIN NUMBER	FL/IE IN	FL/IE OUT	A (INCH)	B (INCH)	C (INCH)	D WIDTHxHEIGHT (INCHXINCH)	E WIDTHxHEIGHT (INCHXINCH)	F WIDTHxHEIGHT (INCHXINCH)
1	35.07	35.06	20	9	6	½ x ½	½ x ½	4x3
2	34.50	34.50	21	12	6	1x1	1x1	4x4
3	35.57	35.51	18	–	–	½ x ½	–	–
4	35.65	35.65	18	–	9	¼ x ¼	½ x ½	–

BIOFILTRATION BASIN SUMMARY TABLE													
BASIN NAME	WATER QUALITY EFFECTIVE AREA (SQFT)	AREA OF FINISH SURFACE (SQFT)	VOLUME (CU-FT)	A1 (INCH)	A2 (INCH)	B (INCH)	C (INCH)	D (INCH)	E (FEET)	CATCHBASIN SIZE (INCHES)	LOWER ORIFICE DIAMETER (INCH)	UPPER ORIFICE NUMBER @ LENGTHXHEIGHT (INCH)	IMPERMEABLE LINER
BMP-A	250	70	311	–	12	9	18	12	2.25	48X48	0.5	—	YES
BMP-B	380	146	587	6	12	9	18	12	2.25	48X48	0.5	3 @ 6X1	YES
BMP-C	250	250	255	6	12	9	18	12	2.25	48x48	0.25	3 @ 1X1	YES
BMP-D	400	115	311	–	12	9	18	12	2.25	48x48	0.25	–	YES



BIOFILTRATION DETAIL
NOT TO SCALE

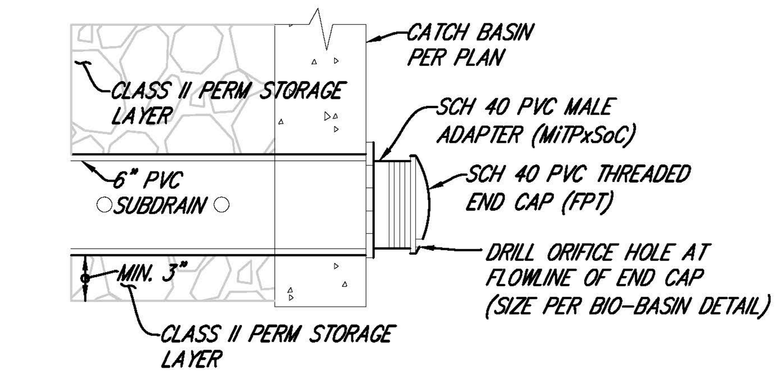


WATER QUALITY BASIN INSTALLATION NOTES:

1. 3 INCHES OF WELL-AGED, SHREDDED HARDWOOD MULCH.
2. AN UNDERDRAIN CLEANOUT WITH A MINIMUM 6-INCH DIAMETER AND LOCKABLE CAP IS PLACED EVERY 250 TO 300FEET AS REQUIRED BASED ON UNDERDRAIN LENGTH.
3. VEGETATION USED SHOULD BE SUITABLE FOR THE CLIMATE PER LANDSCAPE PLANS
4. FILTER COARSE IS A MINIMUM OF 6 INCHES PROVIDED IN TWO SEPARATE 3 INCH LAYERS. THE TOP LAYER SHALL BE MADE OF ASTM C33 CHOKER SAND AND THE BOTTOM LAYER BE OF ASTM NO. 8 AGGREGATE. MARKERS STAKES SHALL BE USED TO ENSURE UNIFORM LIFT THICKNESS.
5. AASHTO NO. 57 STONE OR CLASS 2 PERMEABLE PER CAL TRANS SPECIFICATION 68-1.025 IS RECOMMENDED FOR THE AGGREGATE STORAGE LAYER. WASHED, OPEN-GRADED CRUSHED ROCK MAY BE USED, HOWEVER, A 3 INCH MINIMUM WASHED ASTM NO. 8 AGGREGATE FILTER COURSE LAYER AT THE TOP OF THE CRUSHED ROCK IS REQUIRED.
6. IMPERMEABLE LINER SHALL BE INSTALLED WHEN THE BIOFILTRATION BASIN IS WITHIN 10 FEET OF RETAINING WALLS OR BUILDING FOUNDATIONS, OR AS RECOMMENDED BY THE SOILS ENGINEER, OR REQUIRED BY THESE PLANS. IMPERMEABLE LINER SHALL BE 30 MIL THICK (PER COUNTY OF SAN DIEGO GREEN STREETS DESIGN STANDARD DRAWING GS-3.00 AND COUNTY GREEN STREETS SUPPLEMENT TO CAL TRANS SPECIFICATIONS 20-11.08B) CONFIGURED TO ENTIRELY ENCOMPASS THE SIDES OF THE WATER QUALITY BASIN.
7. IMPERMEABLE LINER BE CONSTRUCTED IN COMPLIANCE WITH THE COUNTY OF SAN DIEGO GREEN STREETS SUPPLEMENT TO CAL TRANS SPECIFICATIONS 20-11.08B IF SOIL MEDIA LESS THAN 5IN/HR.
8. BIOFILTRATION SOIL MEDIA LAYER (BSM) SHALL CONSIST OF 60% TO 80% BY VOLUME SAND, UP TO 20% BY VOLUME TOPSOIL, AND UP 20% BY VOLUME COMPOST (PER COUNTY OF SAN DIEGO BMP DESIGN MANUAL SEPTEMBER 2020 APPENDIX F.2 SECTION 803-2 BLENDED BSM CRITERIA AND TESTING REQUIREMENTS) PLACED IN 6" LIFTS AND COMPACTED WITH WATER PRIOR TO THE NEXT LIFT. INITIAL PERMEABILITY SHALL BE 8" PER HOUR (WITH ASSUMED STABILIZED PERMEABILITY OF 5" PER HOUR).
9. 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.
10. THE DEPTH OF AGGREGATE PROVIDED (12-INCH TYPICAL) AND STORAGE LAYER CONFIGURATION IS ADEQUATE FOR PROVIDING CONVEYANCE FOR UNDERDRAIN FLOWS TO THE OUTLET STRUCTURE.
11. OVERFLOW STRUCTURE TO HAVE A MINIMUM OF 2 INCHES OF FREEBOARD FOR NON-CONJUNCTIVE USE BASINS.
12. ALL LINER INSTALLATIONS, FIELD WELDING OF SEAMS, AND OBSERVATION OF SOIL MIX PLACEMENT SHALL REQUIRE SPECIAL INSPECTION BY THE PROJECT GEOTECHNICAL ENGINEER OR OTHER QUALIFIED PERSON. A LETTER CERTIFYING PROPER INSTALLATION SHALL BE PROVIDED TO THE ENGINEER OF RECORD TO ACCEPTANCE OF THE FACILITIES.
13. SPECIAL INSPECTION SHALL BE REQUIRED FOR CONSTRUCTION OF ALL BIOFILTRATION BASINS. INSPECTION SHALL BE PERFORMED BY A QUALIFIED INDIVIDUAL (SUCH AS: ENGINEER OF RECORD, QSD). INSPECTION SHALL INCLUDE:
   - VERIFICATION OF OVERALL DIMENSIONS PRIOR TO PLACEMENT OF MATERIALS;
   - PLACEMENT OF THE LINER, IF REQUIRED;AND SEAMS OR PENETRATIONS
   - PLACEMENT OF THE GRAVEL, FILTER MATERIALS, AND FILTER MEDIA;
   - ALL INLET AND OUTLET STRUCTURES INCLUDING UNDERDRAINS, IF REQUIRED.
   - CONTRACTOR SHALL TAKE PICTURES AT EACH STAGE OF INSTALLATION AND SUBMITTED TO ENGINEER FOR VERIFICATION OF INSTALL.

   INSPECTOR SHALL BE GIVEN A MINIMUM OF 48 HOURS PRIOR TO INSPECTION. UPON COMPLETION THE INSPECTOR SHALL PROVIDE A CERTIFICATION TO THE ENGINEER OF WORK.

13. PROPOSED MATERIALS, SUCH AS AGGREGATE, FILTER MATERIAL, AND FILTER MEDIA SHALL BE SUBMITTED TO THE ENGINEER OF WORK FOR APPROVAL.



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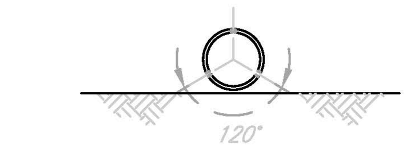

6" PVC PIPE PERFORATION LAYOUT DETAIL
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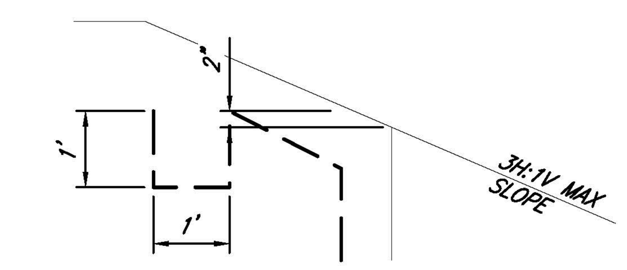

IMPERMEABLE LINER EDGE ANCHOR DETAIL
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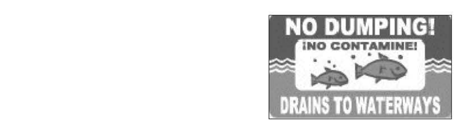

DETAIL
"NO DUMPING" AT CATCH BASINS

NOTE: ALL CATCH BASINS WITH GRATES SHALL BE STENCILED WITH CITY REQUIRED ITEM PER ABOVE DETAIL:

(DAS MANUFACTURING #SDO OR EQUIVALENT)

BMP MAINTENANCE NOTES:

1. MAINTENANCE OF BMPS A-D WILL BE PERFORMED, AT MINIMUM, WHEN THESE THRESHOLDS ARE EXCEEDED:
   - GRASS HIGHER THAN 4"
   - WILTING AND/OR DYING TREES, SHRUBS OR GRASS
   - EROSIVE CONDITIONS CAUSE PONDING AREA SIDE SLOPES TO EXCEED 3:1
   - SILT BUILDUP OF MORE THAN 2"
   - PONDING SURFACE DRAWDOWN TIME EXCEEDS 24 HOURS
   - PONDING ELEVATION EXCEEDS TOP OF POND ELEVATION
   - 2/3 OF MULCH HAS BEEN DECOMPOSED OR REMOVED
2. IN ORDER TO PERFORM MAINTENANCE ON THE STRUCTURAL BMP, IT IS RECOMMENDED THAT LAWN AND SHRUB CARE EQUIPMENT BE USED. COMPACTION OF BMP SOILS SHALL BE AVOIDED AND IT IS RECOMMENDED THAT HEAVY EQUIPMENT NOT BE USED.
3. INSPECTION OF THE OUTLET PIPE WILL BE PERFORMED THROUGH THE GRATED LID OF THE CATCH BASIN.
4. PRIMARY MAINTENANCE OF BIO-RETENTION BASINS INCLUDING STORM DRAIN PIPING, LANDSCAPE AND ANY OTHER STRUCTURAL CONTROL BMP'S SHOULD BE THE RESPONSIBILITY OF THE DEVELOPER AND LANDOWNER EITHER THROUGH A STORMWATER MAINTENANCE ASSESSMENT DISTRICT/PRIVATE SPECIAL DISTRICT OR HOME OWNER'S ASSOCIATION (HOA).
5. NO CRITICAL COARSE SEDIMENT YIELD AREAS ON-SITE OR CONVEYED FROM OFF-SITE TO ON-SITE
6. SOIL TYPE: D
7. DEPTH TO GROUND WATER >20 FT.

SELF-MITIGATING AREAS:

SELF-MITIGATING AREAS MUST COMPLY WITH REQUIREMENTS IN SECTION 5.2.1

DMA EXHIBIT
MERCADO

V:\21\2106\Engineering\SDP\Storm-SDP\Working Files\SWQMP\DMA EXHIBIT.dwg 12/23/2024 4:13 PM ORIGINAL PLOT SIZE: PDF 24X36

Project Name: Mercado Apartments

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)
DMA-1	0.207	0.186	90%	D	0.84	329	BMP-A	BIOFILTRATION	POC-1
DMA-2	0.205	0.166	94%	D	0.87	336	BMP-B	BIOFILTRATION	POC-1
DMA-3	0.269	0.161	68%	D	0.71	361	BMP-C	BIOFILTRATION	POC-1
DMA-4	0.279	0.056	78%	D	0.77	405	BMP-D	BIOFILTRATION	POC-1
DMA-5	0.012	0.000	0%	D	NA	NA	NA	SELF MITIGATING	POC-1
DMA-6	0.002	0.002	100%	D	NA	NA	NA	DE MINIMUS	POC-1
DMA-7	0.007	0.000	0%	D	NA	NA	NA	SELF MITIGATING	POC-1
DMA-8	0.007	0.000	0%	D	NA	NA	NA	SELF MITIGATING	POC-1
Summary of DMA Information (Must match project description and SWQMP Narrative)									
No. of DMAs	Total DMA Area (acres)	Total Impervious Area (acres)	% Imp		Area Weighted Runoff Coefficient	Total DCV (cubic feet)	Total Area Treated (acres)		No. of POCs
5	0.9875	0.642	79%		0.79	1431	0.96		1

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

Worksheet C.4-1: Categorization of Infiltration Feasibility Condition Based on Geotechnical Conditions[9]

1-4, 6	
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[11]? ☐ 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.

[9] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[10] 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.

[11] 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.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4 1: Form I 8A[10]
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.	
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.		

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4 1: Form I 8A[10]	
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.		
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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4 1: Form I 8A[10]	
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
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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4 1: Form I 8A[10]	
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.			

Part 1 Result – Full Infiltration Geotechnical Screening [12]	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

[12] 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.

1-4, 6	
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).	

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4 1: Form I 8A[10]	
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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4 1: Form I 8A[10]	
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
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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4 1: Form I 8A[10]	
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
Summarize findings and basis; provide references to related reports or exhibits.			

Part 2 – Partial Infiltration Geotechnical Screening Result[13]	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

[13] 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.

Worksheet C.4-2: Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions[14]

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	**Worksheet C.4 2: Form I 8B**[15]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
1-4, 6	
Criteria 1: Groundwater Screening	
1A	**Groundwater Depth.** Is the depth to seasonally high groundwater tables (normal high depth during the wet season) beneath the base of any full infiltration BMP greater than 10 feet? ☐ Yes; continue to Step 1B. ☐ No; The depth to groundwater is less than or equal to 10 feet, but site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to step 1B. ☑ No; The depth to groundwater is less than or equal to 10 feet and site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" for Criteria 1 Result.
1B	**Contaminated Soil/Groundwater.** Are proposed full infiltration BMPs at least 250 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP. ☐ Yes; continue to Step 1C. ☐ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1C. ☐ No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.

[14] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, part 3, or Part 4 determines a full, partial, or no infiltration condition.

[15] 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.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions		Worksheet C.4 2: Form I 8B[15]
1C	**Inadequate Soil Treatment Capacity.** Are full infiltration BMPs proposed in DMA soils that have adequate soil treatment capacity? The DMA has adequate soil treatment capacity if **ALL** of the following criteria (detailed in C.2.2.1) for all soil layers beneath the infiltrating surface are met: • USDA texture class is sandy loam or loam or silt loam or silt or sandy clay loam or clay loam or silty clay loam or sandy clay or silty clay or clay; and • Cation Exchange Capacity (CEC) greater than 5 milliequivalents/100g; and • Soil organic matter is greater than 1%; and • Groundwater table is equal to or greater than 10 feet beneath the base of the full infiltration BMP. ☐ Yes; continue to Step 1D. ☐ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1D. ☐ No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.	
1D	**Other Groundwater Contamination Hazards.** Are there site-specific groundwater contamination hazards not already mentioned (refer to Appendix C.2.2) that can be reasonably mitigated to support full infiltration BMPs? ☐ Yes; there are other contamination hazards identified that can be mitigated. Answer "Yes" to Criteria 1 Result. ☐ No; there are other contamination hazards identified that cannot be mitigated. Answer "No" to Criteria 1 Result. ☐ N/A; no contamination hazards are identified. Answer "Yes" to Criteria 1 Result.	
Criteria 1 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level? See Appendix C.2.2.8 for a list of typically reasonable and typically unreasonable mitigation measures. ☐ Yes; Continue to Part 1, Criteria 2. ✔ No; Continue to Part 1 Result.	

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4 2: Form I 8B[15]
Summarize groundwater quality and any mitigation measures proposed. Documentation should focus on groundwater table, mapped soil types and contaminated site locations.	

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4 2: Form I 8B[15]
Criteria 2: Water Balance Screening	
2A	**Ephemeral Stream Setback.** Does the proposed full infiltration BMP meet both the following? • The full infiltration BMP is located at least 250 feet away from an ephemeral stream; **AND** • The bottom surface of the full infiltration BMP is at a depth 20 feet or greater from seasonally high groundwater tables. ☐ Yes; Answer "Yes" to Criteria 2 Result. ☐ No; Continue to Step 2B.
2B	**Mitigation Measures.** Can site layout changes be proposed to support full infiltration BMPs? ☐ Yes; the site can be reconfigured to mitigate potential water balance issues. Answer "Yes" to Criteria 2 Result. ☐ No; the site cannot be reconfigured to mitigate potential water balance issues. Continue to Step 2C and provide discussion.
2C	**Additional studies.** Do additional studies support full infiltration BMPs? In the event that water balance effects are used to reject full infiltration (anticipated to be rare), additional analysis shall be completed and documented by a qualified professional indicating the site-specific information evaluated and the technical basis for this finding. ☐ Yes; Answer "Yes" to Criteria 2 Result. ☐ No; Answer "No" to Criteria 2 Result.
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams? ☐ Yes; Continue to Part 1 Result. ☐ No; Continue to Part 1 Result.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4 2: Form I 8B[15]
Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth.	

Part 1 – Full Infiltration Groundwater and Water Balance Screening Result[16]	Result
If answers to Criteria 1 and 2 are "Yes", a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration based on groundwater conditions. If answer to Criteria 1 or Criteria 2 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design based on groundwater conditions. Proceed to Part 2.	☐ Full Infiltration ✔ Complete Part 2

[16] 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.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4 2: Form I 8B[15]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
1-4, 6	
Criteria 3: Groundwater Screening	

Contaminated Soil/Groundwater. Are partial infiltration BMPs proposed at least 100 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. This criterion is intentionally a smaller radius than full infiltration, as the potential quantity of infiltration from partial infiltration BMPs is smaller.

☐ Yes; Answer "Yes" to Criteria 3 Result.

☐ No; However, site layout changes can be proposed to avoid contaminated soils or soils that lack adequate treatment capacity. Select "Yes" to Criteria 3 Result. It is a requirement for the SWQMP preparer to identify potential mitigation measures.

☑ No; Contaminated soils or soils that lack adequate treatment capacity cannot be avoided and partial infiltration BMPs are not feasible. Select "No" to Criteria 3 Result.

Criteria 3 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 risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level?

☐ Yes; Continue to Part 2, Criteria 4.

☑ No; Skip to Part 2 Result.

Summarize findings and basis. Documentation should focus on mapped soil types and contaminated site locations.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions		Worksheet C.4 2: Form I 8B[15]
Criteria 4: Water Balance Screening		
Additional studies. In the event that water balance effects are used to reject partial infiltration (anticipated to be rare), a qualified professional must provide an analysis of the incremental effects of partial infiltration BMPs on the water balance compared to incidental infiltration under a no infiltration scenario (e.g. precipitation, irrigation, etc.).		
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 causing potential water balance issues such as change of seasonality of ephemeral streams? ☐ Yes: Continue to Part 2 Result. ☐ No: Continue to Part 2 Result.		
Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth.		
Part 2 – Partial Infiltration Groundwater and Water Balance Screening Result[17]	**Result**	
If answers to Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration based on groundwater and water balance conditions. If answer to Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site. The feasibility screening category is No Infiltration based on groundwater or water balance condition.	☐ Partial Infiltration Condition ☑ No Infiltration Condition	

[17] 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.

The City of SAN DIEGO	Project Name	Mercado Apartments	
	BMP ID	BMP-A	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5 1**	

1	Area draining to the BMP	9,029	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.84	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	329	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	21	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)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	493	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	128	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]	246	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	183	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]	228	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	228	sq. ft.
23	Provided BMP Footprint	250	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Mercado Apartments	
	BMP ID	BMP-B	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5 1**	

1	Area draining to the BMP	8,917	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.87	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	336	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	21	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)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	504	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	131	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]	252	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	187	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]	233	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	233	sq. ft.
23	Provided BMP Footprint	380	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Mercado Apartments	
	BMP ID	BMP-C	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5 1**	

1	Area draining to the BMP	11,732	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.71	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	361	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	21	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)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	541	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	141	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]	271	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	201	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]	250	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	250	sq. ft.
23	Provided BMP Footprint	250	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Mercado Apartments	
	BMP ID	BMP-D	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5 1**	

1	Area draining to the BMP	12,145	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.77	
3	85th percentile 24-hour rainfall depth	0.52	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	405	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	21	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)]	16.2	inches
15	Total Depth Treated [Line 13 + Line 14]	46.2	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	608	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	158	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]	304	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	225	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]	281	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	281	sq. ft.
23	Provided BMP Footprint	402	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

BMP-A BMP-B BMP-C BMP-D

Automated Worksheet B.3: BMP Performance (V2.0)

Category	#	Description	i	ii	iii	iv	vi	vii	viii	ix	x	Units
BMP Inputs	1	Drainage Basin ID or Name	DMA-1	DMA-2	DMA-3	DMA-4	-	-	-	-	-	sq-ft
	2	Design Infiltration Rate Recommended	0.000	0.000	0.000	0.000	-	-	-	-	-	in/hr
	3	Design Capture Volume Tributary to BMP	329	336	361	405	-	-	-	-	-	cubic-feet
	4	Is BMP Vegetated or Unvegetated?	Vegetated	Vegetated	Vegetated	Vegetated						unitless
	5	Is BMP Impermeably Lined or Unlined?	Lined	Lined	Lined	Lined						unitless
	6	Does BMP Have an Underdrain?	Underdrain	Underdrain	Underdrain	Underdrain						unitless
	7	Does BMP Utilize Standard or Specialized Media?	Standard	Standard	Standard	Standard						unitless
	8	Provided Surface Area	250	380	250	402						sq-ft
	9	Provided Surface Ponding Depth	6	6	6	6						inches
	10	Provided Soil Media Thickness	21	21	21	21						inches
	11	Provided Gravel Thickness (Total Thickness)	15	15	15	15						inches
	12	Underdrain Offset	3	3	3	3						inches
	13	Diameter of Underdrain or Hydromod Orifice (Select Smallest)	0.25	0.25	0.50	0.50						inches
	14	Specialized Soil Media Filtration Rate										in/hr
	15	Specialized Soil Media Pore Space for Retention										unitless
	16	Specialized Soil Media Pore Space for Biofiltration										unitless
	17	Specialized Gravel Media Pore Space										unitless
Retention Calculations	18	Volume Infiltrated Over 6 Hour Storm	0	0	0	0	0	0	0	0	0	cubic-feet
	19	Ponding Pore Space Available for Retention	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	unitless
	20	Soil Media Pore Space Available for Retention	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	unitless
	21	Gravel Pore Space Available for Retention (Above Underdrain)	0.00	0.00	0.00	0.00	0.40	0.40	0.40	0.40	0.40	unitless
	22	Gravel Pore Space Available for Retention (Below Underdrain)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	unitless
	23	Effective Retention Depth	2.25	2.25	2.25	2.25	0.00	0.00	0.00	0.00	0.00	inches
	24	Fraction of DCV Retained (Independent of Drawdown Time)	0.14	0.21	0.13	0.19	0.00	0.00	0.00	0.00	0.00	ratio
	25	Calculated Retention Storage Drawdown Time	120	120	120	120	0	0	0	0	0	hours
	26	Efficacy of Retention Processes	0.16	0.23	0.15	0.21	0.00	0.00	0.00	0.00	0.00	ratio
	27	Volume Retained by BMP (Considering Drawdown Time)	53	77	54	85	0	0	0	0	0	cubic-feet
	28	Design Capture Volume Remaining for Biofiltration	276	259	307	320	0	0	0	0	0	cubic-feet
Biofiltration Calculations	29	Max Hydromod Flow Rate through Underdrain	0.0030	0.0030	0.0118	0.0118	0.0000	0.0000	0.0000	0.0000	0.0000	cfs
	30	Max Soil Filtration Rate Allowed by Underdrain Orifice	0.51	0.34	2.04	1.27	0.00	0.00	0.00	0.00	0.00	in/hr
	31	Soil Media Filtration Rate per Specifications	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	in/hr
	32	Soil Media Filtration Rate to be used for Sizing	0.51	0.34	2.04	1.27	0.00	0.00	0.00	0.00	0.00	in/hr
	33	Depth Biofiltered Over 6 Hour Storm	3.06	2.02	12.23	7.61	0.00	0.00	0.00	0.00	0.00	inches
	34	Ponding Pore Space Available for Biofiltration	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	unitless
	35	Soil Media Pore Space Available for Biofiltration	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	unitless
	36	Gravel Pore Space Available for Biofiltration (Above Underdrain)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	unitless
	37	Effective Depth of Biofiltration Storage	15.00	15.00	15.00	15.00	0.00	0.00	0.00	0.00	0.00	inches
	38	Drawdown Time for Surface Ponding	12	18	3	5	0	0	0	0	0	hours
	39	Drawdown Time for Effective Biofiltration Depth	29	45	7	12	0	0	0	0	0	hours
	40	Total Depth Biofiltered	18.06	17.02	27.23	22.61	0.00	0.00	0.00	0.00	0.00	inches
	41	Option 1 - Biofilter 1.50 DCV: Target Volume	414	388	460	479	0	0	0	0	0	cubic-feet
	42	Option 1 - Provided Biofiltration Volume	376	388	460	479	0	0	0	0	0	cubic-feet
	43	Option 2 - Store 0.75 DCV: Target Volume	207	194	230	240	0	0	0	0	0	cubic-feet
	44	Option 2 - Provided Storage Volume	207	194	230	240	0	0	0	0	0	cubic-feet
	45	Portion of Biofiltration Performance Standard Satisfied	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	ratio
Result	46	Do Site Design Elements and BMPs Satisfy Annual Retention Requirements?	Yes	Yes	Yes	Yes	-	-	-	-	-	yes/no
	47	Overall Portion of Performance Standard Satisfied (BMP Efficacy Factor)	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	ratio
	48	**Deficit of Effectively Treated Stormwater**	**0**	**0**	**0**	**0**	**n/a**	**n/a**	**n/a**	**n/a**	**n/a**	cubic-feet

No Warning Messages

SEE ROW 38 FOR DRAWDOWN TIME FOR SURFACE PONDING

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Attachment 2
Backup for PDP Hydromodification Control Measures

This is the cover sheet for Attachment 2.

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

Project Name: Mercado Apartments

Indicate which Items are Included:

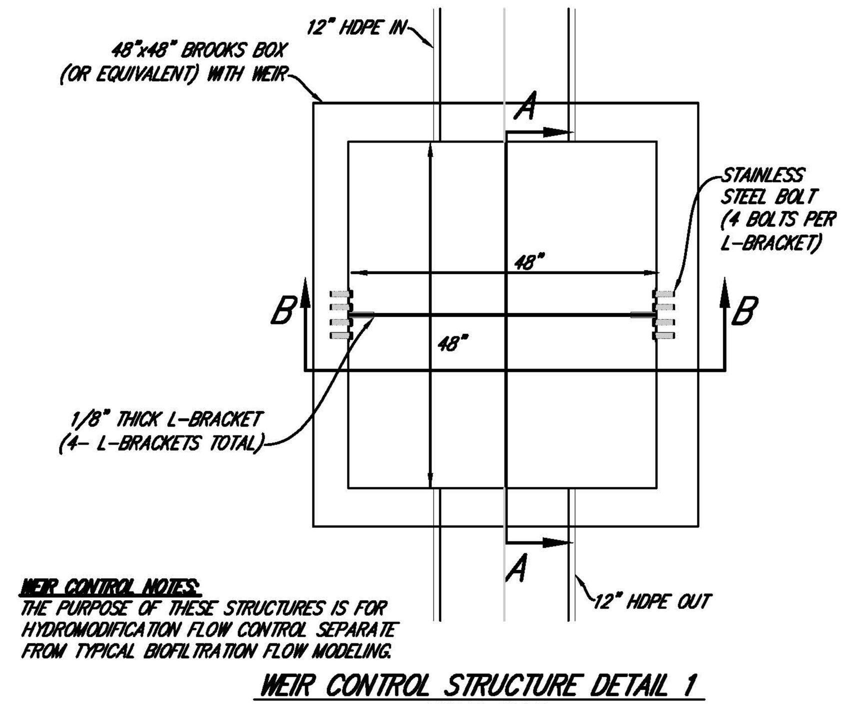
Attachment Sequence	Contents	Checklist
Attachment 2a	Hydromodification Management Exhibit (Required)	☑ Included See Hydromodification Management Exhibit Checklist.
Attachment 2b	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☑ 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

Project Name: Mercado Apartments

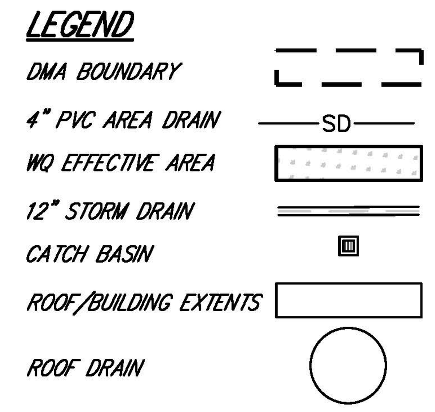
Use this checklist to ensure the required information has been included on the Hydromodification Management Exhibit:

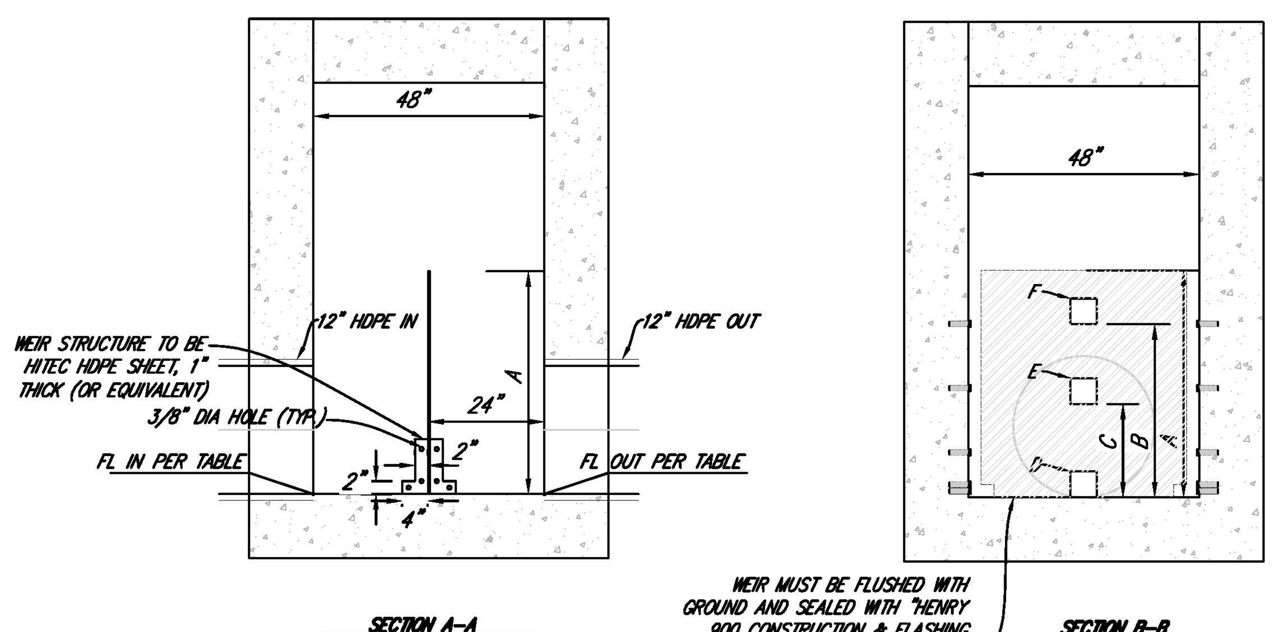
The Hydromodification Management Exhibit must identify:

- ☑ Underlying hydrologic soil group
- ☑ Approximate depth to groundwater
- ☑ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- ☑ Critical coarse sediment yield areas to be protected OR provide a separate map showing that the project site is outside of any critical coarse sediment yield areas
- ☑ Existing topography
- ☑ 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
- ☑ Point(s) of Compliance (POC) for Hydromodification Management
  Existing and proposed drainage boundary and drainage area to each POC (when necessary, create separate exhibits for pre-development and post-project conditions)
- ☑ Structural BMPs for hydromodification management (identify location, type of BMP, and size/detail).



WEIR CONTROL STRUCTURE DETAIL 1
NOT TO SCALE



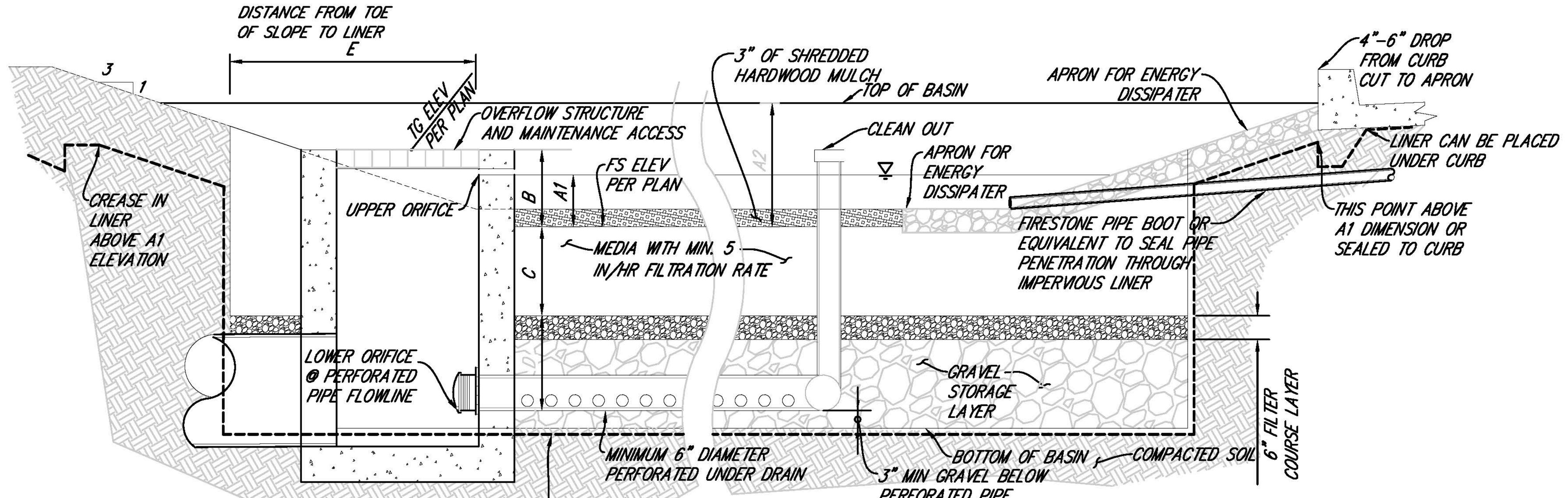


SECTION A-A
NOT TO SCALE

SECTION B-B
NOT TO SCALE

WEIR CONTROL STRUCTURE SUMMARY TABLE								
CATCHBASIN NUMBER	FL/IE IN	FL/IE OUT	A (INCH)	B (INCH)	C (INCH)	D WIDTHxHEIGHT (INCHXINCH)	E WIDTHxHEIGHT (INCHXINCH)	F WIDTHxHEIGHT (INCHXINCH)
1	35.07	35.06	20	9	6	½ x ½	½ x ½	4x3
2	34.50	34.50	21	12	6	1x1	1x1	4x4
3	35.57	35.51	18	–	–	½ x ½	–	–
4	35.65	35.65	18	–	9	¼ x ¼	½ x ½	–

BIOFILTRATION BASIN SUMMARY TABLE													
BASIN NAME	WATER QUALITY EFFECTIVE AREA (SQFT)	AREA OF FINISH SURFACE (SQFT)	VOLUME (CU-FT)	A1 (INCH)	A2 (INCH)	B (INCH)	C (INCH)	D (INCH)	E (FEET)	CATCHBASIN SIZE (INCHES)	LOWER ORIFICE DIAMETER (INCH)	UPPER ORIFICE NUMBER @ LENGTHXHEIGHT (INCH)	IMPERMEABLE LINER
BMP-A	250	70	311	–	12	9	18	12	2.25	48X48	0.5	—	YES
BMP-B	380	146	587	6	12	9	18	12	2.25	48X48	0.5	3 @ 6X1	YES
BMP-C	250	250	255	6	12	9	18	12	2.25	48x48	0.25	3 @ 1X1	YES
BMP-D	400	115	311	–	12	9	18	12	2.25	48x48	0.25	-	YES



BIOFILTRATION DETAIL
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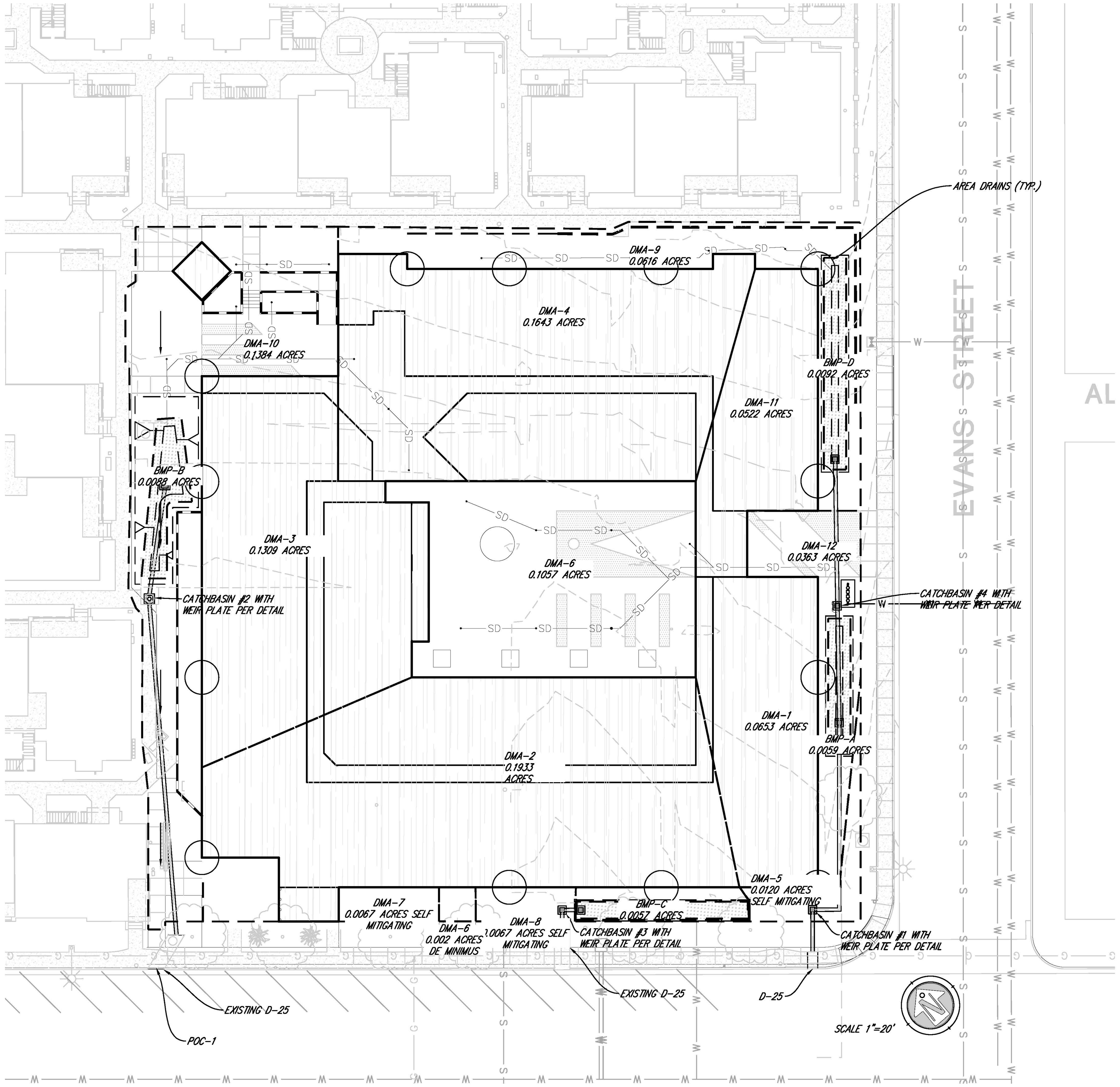

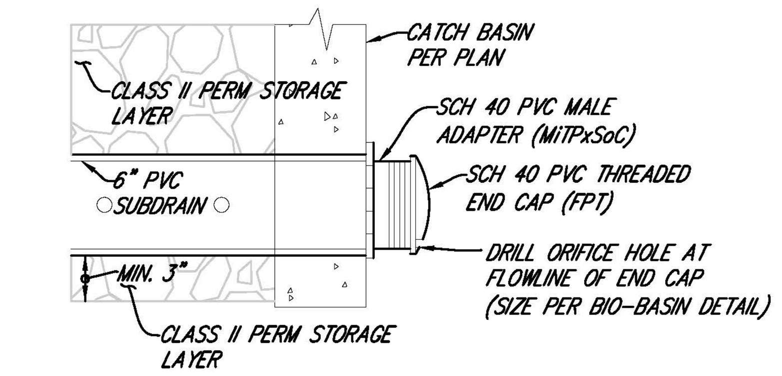

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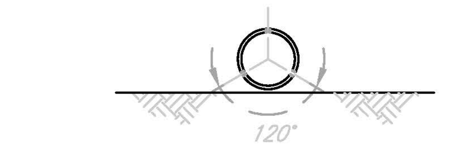
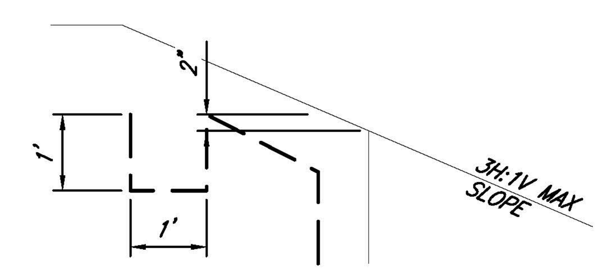


6" PVC PIPE PERFORATION LAYOUT DETAIL
NOT TO SCALE



IMPERMEABLE LINER EDGE ANCHOR DETAIL
NOT TO SCALE

DETAIL
"NO DUMPING" AT CATCH BASINS

NOTE: ALL CATCH BASINS WITH GRATES SHALL BE STENCILED WITH CITY REQUIRED ITEM PER ABOVE DETAIL:

(DAS MANUFACTURING #SDO OR EQUIVALENT)

WATER QUALITY BASIN INSTALLATION NOTES:

1. 3 INCHES OF WELL-AGED, SHREDDED HARDWOOD MULCH.
2. AN UNDERDRAIN CLEANOUT WITH A MINIMUM 6-INCH DIAMETER AND LOCKABLE CAP IS PLACED EVERY 250 TO 300FEET AS REQUIRED BASED ON UNDERDRAIN LENGTH.
3. VEGETATION USED SHOULD BE SUITABLE FOR THE CLIMATE PER LANDSCAPE PLANS
4. FILTER COARSE IS A MINIMUM OF 6 INCHES PROVIDED IN TWO SEPARATE 3 INCH LAYERS. THE TOP LAYER SHALL BE MADE OF ASTM C33 CHOKER SAND AND THE BOTTOM LAYER BE OF ASTM NO. 8 AGGREGATE. MARKERS STAKES SHALL BE USED TO ENSURE UNIFORM LIFT THICKNESS.
5. AASHTO NO. 57 STONE OR CLASS 2 PERMEABLE PER CAL TRANS SPECIFICATION 68-1.025 IS RECOMMENDED FOR THE AGGREGATE STORAGE LAYER. WASHED, OPEN-GRADED CRUSHED ROCK MAY BE USED, HOWEVER, A 3 INCH MINIMUM WASHED ASTM NO. 8 AGGREGATE FILTER COURSE LAYER AT THE TOP OF THE CRUSHED ROCK IS REQUIRED.
6. IMPERMEABLE LINER SHALL BE INSTALLED WHEN THE BIOFILTRATION BASIN IS WITHIN 10 FEET OF RETAINING WALLS OR BUILDING FOUNDATIONS, OR AS RECOMMENDED BY THE SOILS ENGINEER, OR REQUIRED BY THESE PLANS. IMPERMEABLE LINER SHALL BE 30 MIL THICK (PER COUNTY OF SAN DIEGO GREEN STREETS DESIGN STANDARD DRAWING GS-3.00 AND COUNTY GREEN STREETS SUPPLEMENT TO CAL TRANS SPECIFICATIONS 20-11.08B) CONFIGURED TO ENTIRELY ENCOMPASS THE SIDES OF THE WATER QUALITY BASIN.
7. IMPERMEABLE LINER BE CONSTRUCTED IN COMPLIANCE WITH THE COUNTY OF SAN DIEGO GREEN STREETS SUPPLEMENT TO CAL TRANS SPECIFICATIONS 20-11.08B IF SOIL MEDIA LESS THAN 5IN/HR.
8. BIOFILTRATION SOIL MEDIA LAYER (BSM) SHALL CONSIST OF 60% TO 80% BY VOLUME SAND, UP TO 20% BY VOLUME TOPSOIL, AND UP 20% BY VOLUME COMPOST (PER COUNTY OF SAN DIEGO BMP DESIGN MANUAL SEPTEMBER 2020 APPENDIX F.2 SECTION 803-2 BLENDED BSM CRITERIA AND TESTING REQUIREMENTS) PLACED IN 6" LIFTS AND COMPACTED WITH WATER PRIOR TO THE NEXT LIFT. INITIAL PERMEABILITY SHALL BE 8" PER HOUR (WITH ASSUMED STABILIZED PERMEABILITY OF 5" PER HOUR).
9. 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.
10. THE DEPTH OF AGGREGATE PROVIDED (12-INCH TYPICAL) AND STORAGE LAYER CONFIGURATION IS ADEQUATE FOR PROVIDING CONVEYANCE FOR UNDERDRAIN FLOWS TO THE OUTLET STRUCTURE.
11. OVERFLOW STRUCTURE TO HAVE A MINIMUM OF 2 INCHES OF FREEBOARD FOR NON-CONJUNCTIVE USE BASINS.
12. ALL LINER INSTALLATIONS, FIELD WELDING OF SEAMS, AND OBSERVATION OF SOIL MIX PLACEMENT SHALL REQUIRE SPECIAL INSPECTION BY THE PROJECT GEOTECHNICAL ENGINEER OR OTHER QUALIFIED PERSON. A LETTER CERTIFYING PROPER INSTALLATION SHALL BE PROVIDED TO THE ENGINEER OF RECORD TO ACCEPTANCE OF THE FACILITIES.
13. SPECIAL INSPECTION SHALL BE REQUIRED FOR CONSTRUCTION OF ALL BIOFILTRATION BASINS. INSPECTION SHALL BE PERFORMED BY A QUALIFIED INDIVIDUAL (SUCH AS: ENGINEER OF RECORD, QSD). INSPECTION SHALL INCLUDE:
   - VERIFICATION OF OVERALL DIMENSIONS PRIOR TO PLACEMENT OF MATERIALS;
   - PLACEMENT OF THE LINER, IF REQUIRED;AND SEAMS OR PENETRATIONS
   - PLACEMENT OF THE GRAVEL, FILTER MATERIALS, AND FILTER MEDIA;
   - ALL INLET AND OUTLET STRUCTURES INCLUDING UNDERDRAINS, IF REQUIRED.
   - CONTRACTOR SHALL TAKE PICTURES AT EACH STAGE OF INSTALLATION AND SUBMITTED TO ENGINEER FOR VERIFICATION OF INSTALL.

   INSPECTOR SHALL BE GIVEN A MINIMUM OF 48 HOURS PRIOR TO INSPECTION. UPON COMPLETION THE INSPECTOR SHALL PROVIDE A CERTIFICATION TO THE ENGINEER OF WORK.
13. PROPOSED MATERIALS, SUCH AS AGGREGATE, FILTER MATERIAL, AND FILTER MEDIA SHALL BE SUBMITTED TO THE ENGINEER OF WORK FOR APPROVAL.

BMP MAINTENANCE NOTES:

1. MAINTENANCE OF BMPS A-D WILL BE PERFORMED, AT MINIMUM, WHEN THESE THRESHOLDS ARE EXCEEDED:
   - GRASS HIGHER THAN 4"
   - WILTING AND/OR DYING TREES, SHRUBS OR GRASS
   - EROSIVE CONDITIONS CAUSE PONDING AREA SIDE SLOPES TO EXCEED 3:1
   - SILT BUILDUP OF MORE THAN 2"
   - PONDING SURFACE DRAWDOWN TIME EXCEEDS 24 HOURS
   - PONDING ELEVATION EXCEEDS TOP OF POND ELEVATION
   - 2/3 OF MULCH HAS BEEN DECOMPOSED OR REMOVED
2. IN ORDER TO PERFORM MAINTENANCE ON THE STRUCTURAL BMP, IT IS RECOMMENDED THAT LAWN AND SHRUB CARE EQUIPMENT BE USED. COMPACTION OF BMP SOILS SHALL BE AVOIDED AND IT IS RECOMMENDED THAT HEAVY EQUIPMENT NOT BE USED.
3. INSPECTION OF THE OUTLET PIPE WILL BE PERFORMED THROUGH THE GRATED LID OF THE CATCH BASIN.
4. PRIMARY MAINTENANCE OF BIO-RETENTION BASINS INCLUDING STORM DRAIN PIPING, LANDSCAPE AND ANY OTHER STRUCTURAL CONTROL BMP'S SHOULD BE THE RESPONSIBILITY OF THE DEVELOPER AND LANDOWNER EITHER THROUGH A STORMWATER MAINTENANCE ASSESSMENT DISTRICT/PRIVATE SPECIAL DISTRICT OR HOME OWNER'S ASSOCIATION (HOA).
5. NO CRITICAL COARSE SEDIMENT YIELD AREAS ON-SITE OR CONVEYED FROM OFF-SITE TO ON-SITE
6. SOIL TYPE: D
7. DEPTH TO GROUND WATER >20 FT.

SELF-MITIGATING AREAS:

SELF-MITIGATING AREAS MUST COMPLY WITH REQUIREMENTS IN SECTION 5.2.1

HMP EXHIBIT
MERCADO


Potential Critical Coarse Sediment Yield Areas
Mercado Apartments
Legend
PCCSYA
SITE
COLLEGE AREA
ROLANDO VILLAGE
NORMAL HEIGHTS
Pancho Villa Farmer's Market
Whaley House Museum
HILLCREST
NORTH PARK
CITY HEIGHTS
OAK PARK
San Diego Zoo
San Diego International Airport
LITTLE ITALY
San Diego
USS Midway Museum
Costco Wholesale
North Island Naval Air Station
LOGAN HEIGHTS
BARRIO LOGAN
Coronado
ado Beach
National City
Google Earth
Image Landsat / Copernicus
Data USGS
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INTRODUCTION

INTRODUCTION

This report provides Hydromodification and Water Quality design based on LID (Low Impact Development) principles for a proposed Industrial site development located on Newton Avenue, San Diego, California.

The Hydromodification and Water Quality calculations were performed utilizing continuous simulation analysis to size the storm water treatment and control facilities. Storm Water Management Model (SWMM) version 5.0 distributed by USEPA is the basis of all calculations within this report. SWMM generates peak flow recurrence frequencies and flow duration series statistics based on an assigned rain gauge for pre-development, unmitigated post-development flows and post-development mitigated flows to determine compliance with the State Water Resources Control Board Order No.R9-2015-001 and Hydromodification Management Plan (HMP) requirements.

The site has a total acreage and a developed tributary area of approximately 0.97 acres. This tributary area includes 11 DMAs. There are two points of compliance (POC) for each of the projects in the analysis. POC-1 is located on Main Street at the west corner of the site where water will leave the site in both the pre- and post-development conditions.

The Hydromodification and Water Quality system proposed for this project consists of 4 biofiltration basins that flow to POC-1. Bio-filtration is a process by which storm water is filtered through plant roots and a biologically active soil mix. On this site, the water will be released from the basins into the existing roadway where it follows its natural flow path that leads into the Pacific Ocean. The resulting outflows are shown to be equal to or less than all continuously simulated storms based on the historical data collected from the Lindbergh rain gage.

<u>Low Flow Threshold</u>

A downstream channel assessment has not been completed for this project and therefore the low flow threshold utilized for the system analysis is 10% of 2-year storm event (0.1Q2). This will be used as the low flow threshold to meet peak flow frequency and flow duration controls.

SECTION I. MODEL SETUP

Pre-development Model Setup

The SWMM model for this project's pre-development site is analyzed using historical rain gauge data. The Lindbergh rain gauge is utilized for this project. That data provides continuous precipitation input to a sub-catchment with its outfall based on the contributing basins imperviousness.

The imperviousness parameter in SWMM is the amount of effective or directly connected impervious area. The effective impervious area is the impervious area that drains directly to the Stormwater conveyance system. The pre-development condition is an existing apartment complex. For this study, the site is assumed to have 0% of impervious surface in the existing condition.

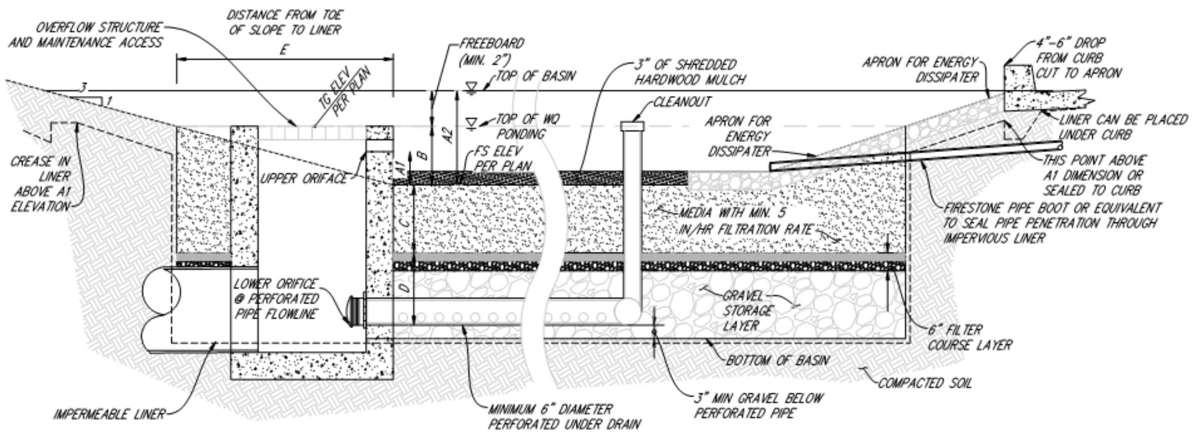
The site is currently made of apartment buildings. Existing roadways and developments sit to all sides. Drainage flows from east to west as sheet flow and through storm drain until it outlets to Main Street through sidewalk outlets. The water will then follow its existing overland flow path that leads to it discharging into the Pacific Ocean.

For SWMM model illustration see figure 3, or Pre-development map of this SWMM report.

Post-Development Model Setup

Figure 3 illustrates each contributing basin discharging its overland flow directly into the biofiltration system. Each biofiltration layer section has a similar configuration as seen as in the detail drawing below. There is no actual elevation entered in the program. The bottom elevation of the biofiltration surface storage is assumed at 0 ft. Storm drain pipe in the biofiltration basin is also utilized as a detention by having an orifice small flow restrictor at lower invert elevation of the downstream cleanout box and a bypass orifice/pipe to convey the bigger flow.

The impervious area within the project area is 33,965 square feet. The project proposes to build an apartment complex with a center patio surrounded by landscaping and biofiltration basins. Water is directed to biofiltration basins through area drains and surface flows. Once within the water quality treatment systems, the stormwater infiltrates through a treatment medium into underdrains that discharge into catchbasins. These catchbasins connect into a storm drain network that outlets into one of three sidewalk underdrains. Water then flows along the gutter to the POC.



BIOFILTRATION BASIN DETAIL
(NOT TO SCALE)

* NOTE: BOTTOM OF BASIN IS THE FINISH SURFACE OF BASIN AS SHOWN ON THE BIOFILTRATION DETAIL ABOVE. MULCH WILL THEN BE ADDED ON TOP OF BOTTOM OF BASIN/FINISH SURFACE OF BASIN.

Figure-1
Typical Bio-filtration Section

BIOFILTRATION BASIN SUMMARY TABLE

BASIN NAME	WATER QUALITY EFFECTIVE AREA (SQFT)	A1 (INCH)	A2 (INCH)	B (INCH)	C (INCH)	D (INCH)	E (FEET)	CATCHBASIN SIZE (INCHES)	LOWER ORIFACE DIAMETER (INCH)	UPPER ORIFACE NUMBER @ LENGTHXHEIGHT (INCH)	IMPERMEABLE LINER
BMP-A	250	-	12	9	18	12	2.25	48X48	0.5	—	YES
BMP-B	380	9	12	6	18	12	2.25	48X48	0.5	3 @ 6X1	YES
BMP-C	250	9	12	6	18	12	2.25	48x48	0.25	3 @ 1X1	YES
BMP-D	400	-	12	9	18	12	2.25	48x48	0.25	-	YES

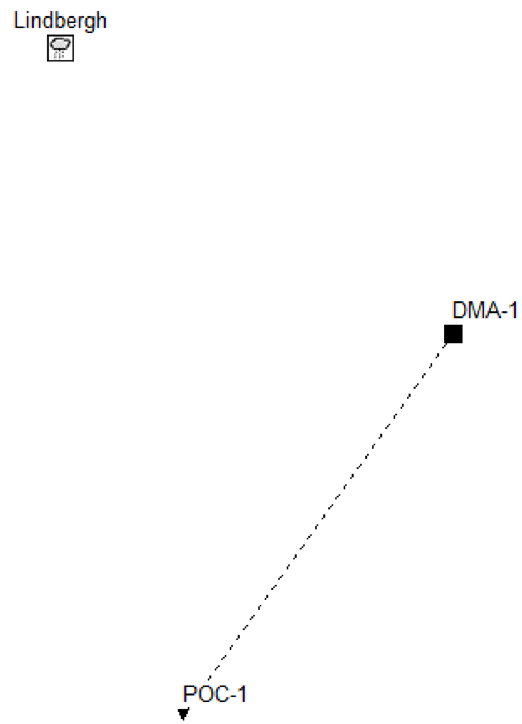


Fig.2
SWMM Pre-Development Mod

Fig.3

SWMM Post-Development Model

Post-Development Drainage Management Areas (DMAs)

The DMAs provide an important framework for feasibility screening, BMP prioritization and storm water management system configuration. DMAs are defined based on drainage patterns of the site and the BMPs to which they drain. The Bio-Basin Summary Table above, references a gravel depth of 12” which does not include the 3” minimum of gravel below the perforated pipe (see Figure-1 Typical Biofiltration Basin). Implying that the total gravel depth for this project is 15” (12” + 3” minimum). This 15” value is used in the SWMM model calculations the as the total storage depth.

In this project, DMA 1 drains to BMP B, and DMA 2 drains to BMP A. There is one self-mitigating DMA, DMA-3. This DMA flows offsite in the northeast corner of the site. To simplify calculations, POC 1 is shown as the northwest corner of the property where the rest of the site discharges. This is appropriate because the flow from both points confluence offsite shortly after discharging from the site, and DMA 3 is a relatively small section of the project. In the SWMM model and table below note that the total areas of each DMA are equal to the combination of the DMA area and its respective BMP area. For example, in this project the total area of DMA-2 = (DMA-2 Area) + (BMP-B Area) OR 0.590ac = (0.562ac) + (0.028ac).

DMA Table for Post-Development

[SUBCATCHMENTS]					
Name	Outlet	Area (ac)	%Imperv	Width	%Slope
DMA-1	BMP-A	0.065	100	20	5
DMA-2	BMP-B	0.193	100	50	5
DMA-3	BMP-C	0.130	100	50	5
DMA-4	BMP-D	0.164	100	25	5
DMA-6	BMP-A	0.106	90	30	0.5
DMA-9	BMP-D	0.052	0	25	1
DMA-10	BMP-B	0.133	50	50	1
DMA-11	BMP-D	0.052	100	25	5
DMA-12	BMP-A	0.030	60	20	1
BMP-A	POC-1	0.0059	0	7	0
BMP-B	POC-1	0.0057	0	10	0
BMP-C	POC-1	0.0057	0	10	0
BMP-D	POC-1	0.0092	0	7	0
	Total	0.97			

DMA Table for Pre-Development

[SUBCATCHMENTS]					
Name	Outlet	Area (ac)	%Imperv	Width	% Slope
DMA-3	BMP-C	0.97	100	120	1
	Total	0.97			

SECTION II. SYSTEM REPRESENTATION

SWMM is a distributed model, which means that a study area can be subdivided into any number of irregular sub-catchments to best capture the effect that spatial variability in topography, drainage pathways, land cover, and soil characteristics have on runoff generation. For modeling of Hydromodification calculations, there are four main system representations: Rain gage, Sub-catchment (contributing basin or LID area), Nodes and Links.

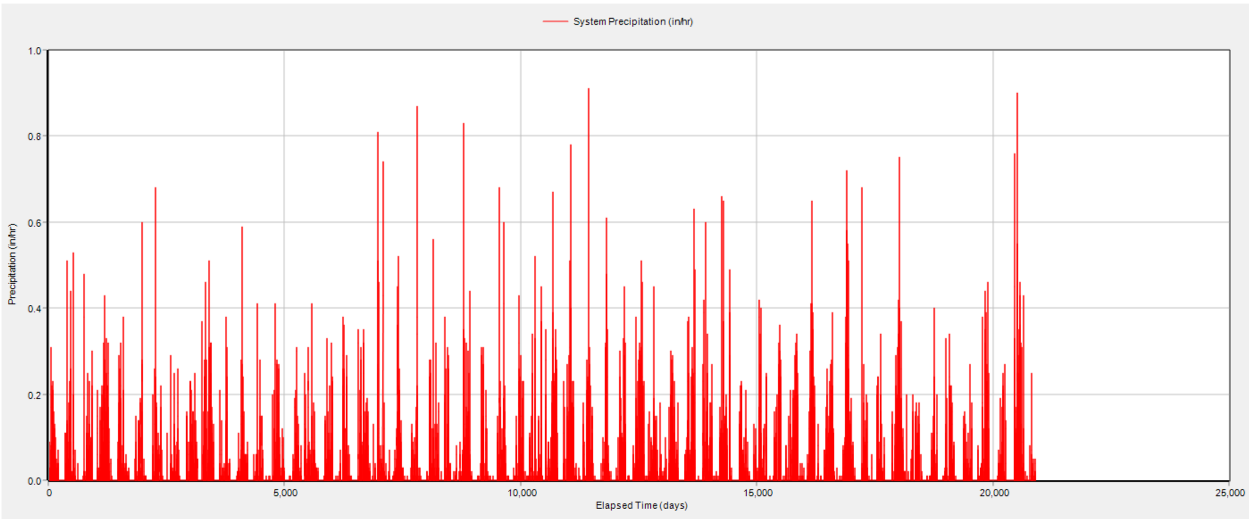


Fig. 2.1 – Time series rain data, which corresponds to runoff estimates for each of the 20,894 time steps (each date and hour) of the 44-year simulation period. (Inches/hour vs. elapsed time)

Rain Gauge

The properties of a rain gauge describe the source and format of the precipitation data that are applied to the study area. In this project, the rainfall data consist of a long-term rainfall record stored in a user-defined Time Series labeled as "Lindbergh" rain gauge station. The Lindbergh rain station was chosen due to its data quality and its location to the project site.

The rain gauge supplies precipitation data for one or more sub-catchment areas in a study region taken from the Project Clean Water website (www.projectcleanwater.org). This data file contains rainfall intensity, hourly-recorded time interval, and the dates of recorded precipitation each hour. The Lindbergh rain data has approximately 57 years of hourly precipitation data from 1948 to 2005 and generates 57 years of hourly runoff estimates, which corresponds to runoff estimates for each of the time steps (each date and hour) of the 57 year simulation period. See figure 2.1 for hourly precipitation intensity graph for 44 years in inches.

Sub-catchment (contributing basin or LID area)

A basin is modeled using a sub-catchment object, which contains some of the following properties:

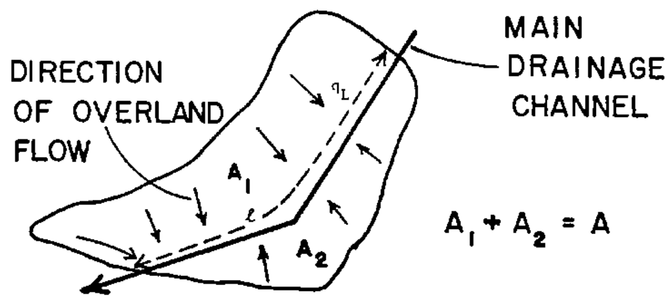
The rate of stormwater runoff and volume depends directly on the precipitation magnitude and its spatial and temporal distribution over the catchment. Each sub-catchment in SWMM is linked to a rain gauge object that describes the format and source of the rainfall input for the sub-catchment.

Area

This area is bounded by the sub-catchment boundary. Its value is determined directly from maps or field surveys of the site or by using SWMM's Auto-length tool when the sub-catchment is drawn to scale on SWMM's study area map. This Project is divided into several sub-catchments based on its outfall.

Width

Width can be defined as the sub-catchment's area divided by the length of the longest overland flow path that water can travel. When there are several such paths, one would use an average of their lengths to compute a width. If overland flow is visualized as running down –slope off an idealized, rectangular catchment, then the width of the sub-catchment is the physical width of overland flow.



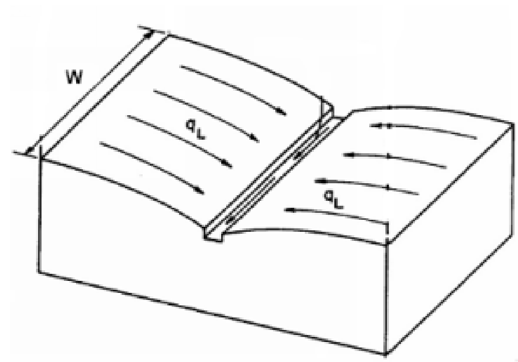


Figure-2-3 Idealized representation of a subcatchment.

Source: STORM WATER MANAGEMENT MODEL REFERENCE MANUAL VOLUME 1- JANUARY 2016

The method of calculations used following Figure 2-2 involves an estimation by Guo and Urbonas (2007). As stated in the Storm Water Management Model Reference Manual Vol. 1

A more fundamental approach to estimating both subcatchment width and slope has recently been developed by Guo and Urbonas (2007). The idea is to use "shape factors" to convert a natural watershed as pictured in Figure 2-2 into the idealized overland flow plane of Figure 2-3. A shape factor is an index that reflects how overland flows are collected in a watershed. The shape factor X for the actual watershed is defined as A/L^2 where A is the watershed area and L is the length of the watershed's main drainage channel (not necessarily the length of overland flow). The shape factor Y for the idealized watershed is W/L. Requiring that the areas of the actual and idealized watersheds be the same and that the potential energy in terms of the vertical fall along the drainage channel be preserved, Guo and Urbonas (2007) derive the following expression for the shape factor Y of the idealized watershed:

$Y = 2X(1.5 - Z)(2K - X)/(2K - 1)$ (3-12)

where K is an upper limit on the watershed shape factor. Guo and Urbonas (2007) recommend that K be between 4 and 6 and note that a value of 4 is used by Denver's Urban Drainage and Flood Control District.

Once Y is determined, the equivalent width W for the idealized watershed is computed as YL.

Applying this approach:

$X = (A \bullet 43{,}560\ ft^2/acre) / (L^2)$

$Z = A_m/A$

Z = skew factor, $0.5 \leq Z \leq 1$,
A_m = larger of the two areas on each side of the channel A = total area.

$W = L \bullet Y$

This width value is considerably lower than those derived from direct estimates of either the longest flow path length or the drainage channel length. As a result, it would most likely produce a longer time to peak for the runoff hydrograph.

Slope

This is the slope of the land surface over which runoff flows and is the same for both the pervious and impervious surfaces. It is the slope of what one considers being the overland flow path or its area-weighted average if there are several paths in the sub-catchment.

Imperviousness

This is the percentage of sub-catchment area covered by impervious surfaces such as sidewalks and roadways or any surfaces that rainfall cannot infiltrate.

Roughness Coefficient

The roughness coefficient reflects the amount of resistance that overland flow encounters as it runs off of the sub-catchment surface. The value used for this project's predevelopment is a 0.015 for short prairie grass, as is suggested as a default in the BMP Manual. The value for the post development is 0.15 for short, prairie grass as well to account for the landscaped pervious areas. The roughness coefficient for both impervious values is 0.012 for smooth asphalt pavement.

Infiltration Model

The pre-development condition is primarily empty land with moderate vegetation cover. Infiltration of rainfall from the pervious area of a sub-catchment into the unsaturated upper soil zone can be described using three different infiltration models: Horton, Green-Ampt, and Curve Number. There is no general agreement on which method of these three is the best.

The Green-Ampt method was chosen to calculate the infiltration of the pervious areas based on the availability of data for this project. It is invoked when editing the infiltration property of a sub-catchment.

The Hydrologic Soil Class identified for this project has a D rating. This determination was from Web Soil Survey and is provided as Attachment C of this projects SWMM report.

The default values shown in Table 1 for use in San Diego were used in this project based on the soil class within each DMA. The conductivity was reduced by 25% as described for both pre and post conditions as the site is already compacted.

Table 1 – Soil Infiltration Parameter

SWMM Parameter Name	Unit	Range	Use in San Diego
Infiltration	Method	HORTON GREEN_AMPT CURVE_NUMBER	GREEN_AMPT
Suction Head (Green-Ampt)	Inches	1.93 – 12.60 presented in Table A.2 of SWMM Manual	Hydrologic Soil Group A: 1.5 Hydrologic Soil Group B: 3.0 Hydrologic Soil Group C: 6.0 Hydrologic Soil Group D: 9.0
Conductivity (Green-Ampt)	Inches per hour	0.01 – 4.74 presented in Table A.2 of SWMM Manual by soil texture class 0.00 – Ç0.45 presented in Table A.3 of SWMM Manual by hydrologic soil group	Hydrologic Soil Group A: 0.3 Hydrologic Soil Group B: 0.2 Hydrologic Soil Group C: 0.1 Hydrologic Soil Group D: 0.025 Note: reduce conductivity by 25% in the post-project condition when native soils will be compacted. For fill soils in post-project condition, see Section G.1.4.3.
Initial Deficit (Green-Ampt)		The difference between soil porosity and initial moisture content. Based on the values provided in Table A.2 of SWMM Manual, the range for completely dry soil would be 0.097 to 0.375	Hydrologic Soil Group A: 0.30 Hydrologic Soil Group B: 0.31 Hydrologic Soil Group C: 0.32 Hydrologic Soil Group D: 0.33 Note: in long-term continuous simulation, this value is not important as the soil will reach equilibrium after a few storm events regardless of the initial moisture content specified.
Groundwater	yes/no	yes/no	NO
LID Controls			Project Specific
Snow Pack Land Uses Initial Buildup Curb Length			Not applicable to hydromodification management studies

Source: Model BMP Design Manual San Diego Region Appendices, February 26, 2016

LID controls

Utilizing LID controls within a SWMM project is a two-step process that:

- Creates a set of scale-independent LID controls that can be deployed throughout the study area,
- Assign any desired mix and sizing of these controls to designated sub-catchments.

The LID control type that was selected was a biofiltration cell that contains vegetation grown in an engineered soil mixture placed above a gravel drainage bed. Biofiltration provides storage, infiltration (depending on the soil type) and evaporation of both direct rainfall and runoff captured from surrounding areas. For this project, we do not allow infiltration to the existing/filled soil.

SECTION III. CONTINUED SIMULATION OPTIONS

Simulation Dates

These dates determine the starting and ending dates/times of a simulation and are chosen based on the rain data availability.

Start analysis on 10/17/1948
Start Reporting on 10/17/1948
End Analysis on 12/31/2005

Time Steps

The Time Steps establish the length of the time steps used for runoff computation, routing computation and results reporting. Time steps are specified in days and hours: minutes: seconds except for flow routing which is entered as decimal seconds.

Climatology

-Evaporation Data

The available evaporation data for San Diego County is taken Table G.1-1: Monthly Average Reference Evapotranspiration by ETo Zone for use in SWMM Models for Hydromodification Management Studies in San Diego County CIMIS Zone 6 (in/day).

January	February	March	April	May	June
0.060	0.080	0.110	0.150	0.170	0.190
July	August	September	October	November	December
0.190	0.180	0.150	0.110	0.080	0.060

SECTION IV. BIOFILTRATION AS LID CONTROL

LID controls are represented by a combination of vertical layers whose properties are defined on a per-unit-area basis. This allows an LID of the same design but differing coverage area to easily be placed within different sub-catchments of a study area. During a simulation, SWMM performs a moisture balance that keeps track of how much water moves between and is stored within each LID layer. If the biofiltration basin is full and water is leaving the upper weir, the flow is divided in two flows: the lower flow discharging from the bottom orifice directly draining to the point of compliance and the upper flow is routed at the top of the biofiltration basin and after routing, discharged to the point of compliance. In this project, we used 100% of the area of this specific sub-catchment for biofiltration.

1. Surface

Storage Depth
When confining walls or berms are present, this is the maximum depth to which water can pond above the surface of the unit before overflow occurs (in inches). In this project, storage depth is set at 6” before overflowing into the catchbasin or orifice.

Vegetation Volume Fraction
It is the fraction of the volume within the storage depth that is filled with vegetation. This is the volume occupied by stems and leaves, not their surface area coverage. This value is 0 for our project as is standard in the BMP Manual Appendix G.

Surface Roughness
Manning's n value for overland flow over a vegetative surface. This value is 0 for our project as is standard in the BMP Manual Appendix G.

Surface Slope
Slope of porous pavement surface or vegetative swale (percent). This value is 0 for our project as is standard in the BMP Manual Appendix G.

2. Soil

Thickness
The thickness of the soil layer in inches. We used a typical value of 18 inches soil thickness for biofiltration. The volume of pore space relative to total volume of soil (as a fraction). We designed it with a soil mix porosity of 0.40 maximum for a good percolation rate (Countywide Model SUSMP Table B1 – Soil Porosity Appendix A: Assumed Water Movement Hydraulics for Modeling BMPs).

Field Capacity
Volume of pore water relative to total volume after the soil has been allowed to drain fully (as a fraction). We used 0.2 for this soil. Below this level, vertical drainage of water through the soil layer does not occur. (See Table 1 – Soil Infiltration Parameter).

Wilting Point
Volume of pore water relative to total volume for a well-dried soil where only bound water remains

(as a fraction). The moisture content of the soil cannot fall below this limit.
We assumed the minimum moisture content within this biofiltration soil is 0.1.

Conductivity
Hydraulic conductivity for the fully saturated soil is 5 inches/hour. This is a design minimum value for percolation rate.

Conductivity Slope
Slope of the curve of log (conductivity) versus soil moisture content (dimensionless). Typical values range from 5 for sands to 15 for silty clay. We designed this soil to have a very good percolation rate therefore the conductivity slope is 5.

Suction Head
The average value of soil capillary suction along the wetting front (inches). This is the same parameter as used in the Green-Ampt infiltration model. Table 1 was utilized to determine the capillary of the soil mix top layer of a biofiltration system. The suction head will be 1.5 inches.

3. Storage Layer

The Storage Layer page of the LID Control Editor describes the properties of the crushed stone or gravel layer used in biofiltration cells as a bottom storage/drainage layer. The following data fields are displayed:

Height
This is the thickness of a gravel layer (inches). Gravel thickness varies for the BMP's in this project, please refer to summary tables in section 1 for more information.

Void Ratio
The volume of void space relative to the volume of solids in the layer. Typical values range from 0.5 to 0.75 for gravel beds. Note that porosity = void ratio / (1 + void ratio). We designed this void ratio to have a value of 0.67.

Seepage Rate
The rate at which water infiltrates into the native soil below the layer (in inches/hour). This would typically be the Saturated Hydraulic Conductivity of the surrounding sub-catchment if Green-Ampt infiltration is used. If a liner beneath the gravel layer is proposed, the seepage rate is assumed to be 0 in/hr.

Clogging Factor
Total volume of treated runoff it takes to completely clog the bottom of the layer divided by the void volume of the layer. For south east biofiltration, a value of 0 was used to ignore clogging since the system does NOT consider infiltration to the native soils. Clogging progressively reduces the Infiltration Rate in direct proportion to the cumulative volume of runoff treated and may only be of concern for infiltration trenches with permeable bottoms and no under drains. We assumed zero for the clogging factor since the infiltration rate is not considered.

4. Underdrain Layer

LID storage layers can contain an optional underdrain system that collects stored water from the bottom of the layer and conveys it to a conventional storm drain. The Underdrain page of the LID Control Editor describes the properties of this system. It contains the following data entry fields:

Drain Coefficient and Drain Exponent
Coefficient *C* and exponent *n* that determines the rate of flow through the underdrain as a function of height of stored water above the drain height. The following equation is used to compute this flow rate (per unit area of the LID unit):

$$q = C(h-Hd)^n$$

where q is the outflow (in/hr), h is the height of stored water (inches), and Hd is the drain height. A typical value for n would be 0.5 (making the drain act like an orifice).

Drain Offset Height
Height of any underdrain piping above the bottom of a storage layer (inches). In this project, this value was set to 3" as the underdrain piping is at the bottom of the 24" of the live gravel storage layer but above the 3" of dead gravel storage.

Table 3 – Summary of LID Drain/flow coefficient

IMP NAME	EFFECTIVE AREA (SQFT)	ORIFICE (IN)	LID STORAGE HEIGHT (IN)	BIOFILTRATION MEDIA (IN)	GRAVEL (IN)	UNDERDRAIN OFFSET (IN)	C
BMP-A	250	0.25	6	21	15	3	0.08188
BMP-B	380	0.25	6	21	15	3	0.05387
BMP-C	250	0.5	6	21	15	3	0.08187
BMP-D	400	0.5	6	21	15	3	0.20469

Note:
$q = C(h-Hd)^n$
C= $C_o A_o \frac{\sqrt{2}}{} \times 12^{0.5} \times 3600$

SECTION V. RUNNING THE SIMULATION

In general, the Run time will depend on the complexity of the watershed being modeled, the routing method used, and the size of the routing time step used. The larger the time steps, the faster the simulation, but the less detailed the results.

Model Results

SWMM's Status Report summarizes overall results for the 44-yr simulation. The runoff continuity error is 4.92% and the flow routing continuity error is 0.00%. When a run completes successfully, the mass continuity errors for runoff, flow routing, and pollutant routing will be displayed in the Run Status window. These errors represent the percent difference between initial storage + total inflow and final storage + total outflow for the entire drainage system. If they exceed some reasonable level, such as 10 percent, then the validity of the analysis results must be questioned. The most common reasons for an excessive continuity error are computational time steps that are too long or conduits that are too short.

In addition to the system continuity error, the Status Report produced by a run will list those nodes of the drainage network that have the largest flow continuity errors. If the error for a node is excessive, then one should first consider if the node in question is of importance to the purpose of the simulation. If it is, then further study is warranted to determine how the error might be reduced.

The SWMM program ranks the partial duration series, the exceedance frequency and the return period. They are computed using the Weibull formula for plotting position. See the flow duration curve and peak flow frequency on the following pages.

SECTION VI. RESULT ANALYSIS

Development of the Flow Duration Statistics

The flow duration statistics are also developed directly from the SWMM binary output file. It should be noted right from the start that the "durations" that we are talking about in this section have nothing to do with the "storm durations" presented in the peak flow statistics section. Other than using the same sequence of letters for the word, the two concepts have nothing to do with each other and the reader is cautioned not to confuse the two. The goal of the flow duration statistics is to determine, for the flow rates that fall within the hydromorphologicaly significant range, the length of time that each of those flow rates occur. Since the amount of sediment transported by a river or stream is proportional to the velocity of the water flowing and the length of time that velocity of flow acts on the sediment, knowing the velocity and length of time for each flow rate is very useful.

Methodology

The methodology for determining the flow duration curves comes from a document developed by the U.S. Geological Survey (USGS). The first stop on the journey to find this document was a link to the USGS water site (http://www.usgs.gov/water/). This link is found in Appendix E (SDHMP Continuous Simulation Modeling Primer), found in the County Hydromodification Management Plan[1]. On this web site a search for "Flow Duration Curves" leads to USGS Publication 1542-A, Flow-duration curves, by James K. Searcy 1959 (http://pubs.er.usgs.gov/publication/wsp1542A). In this publication the development of the flow duration curves is discussed in detail.

In Pub 1542-A, beginning on page 7 an example problem is used to illustrate the compilation of data used to create the flow duration plots. A completed form 9-217-c form shows the monthly tabulation of flow rates for Bowie Creek near Hattiesburg, Miss. For each flow range the number of readings is tabulated and then the total number of each flow rate is totaled for the year. It should be noted that while this example is for a stream with a minimum flow rate of 100cfs, for the purposes of run-off studies in Southern California the minimum flow rate of zero (0) cfs is the common low flow value. Once each of the year's data has been compiled the summary numbers from each year are transferred to form 9-217-d. On this form the total number of each flow rate is again totaled and the percentage of time exceeded calculated (as will be explained later under the discussion of our calculations). Once the data has been compiled a graph of Discharge Rate vs. Percent Time Exceeded is developed. As will be explained in the next section, the use of these curves leads to the amount of time each particular flow can be expected to occur (based on historical data).

How to Read the Graphs[2]

Figure 6-1 shows a flow duration curve for a hypothetical development. The three curves show what percentage of the time a range of flow rates are exceeded for three different conditions: pre-project, post-project and post-project with storm water mitigation. Under pre-project conditions the minimum geomorphically significant flow rate is 0.10cfs (assumed) and as read from the graph, flows would equal or exceed this value about 0.14% of the time (or about 12 hours per year) (0.0014 x 365days x 24

[1] FINAL HYDROMODIFICATION MANAGEMENT PLAN, Prepared for County of San Diego, California, March 2011, by Brown and Caldwell Engineering of San Diego.
(http://www.projectcleanwater.org/images/stories/Docs/LDS/HMP/0311_SD_HMP_wAppendices.pdf)

[2] The graph and the explanation were taken directly from Appendix E of the Hydromodification Plan

hour/day). For post-project conditions, this flow rate would occur more often – about 0.38% of the time (or about 33 hours per year) (0.0038 x 365days x 24 hour/day). This increase in the duration of the geomorphically significant flow after development illustrates why duration control is closely linked to protecting creeks from accelerated erosion.

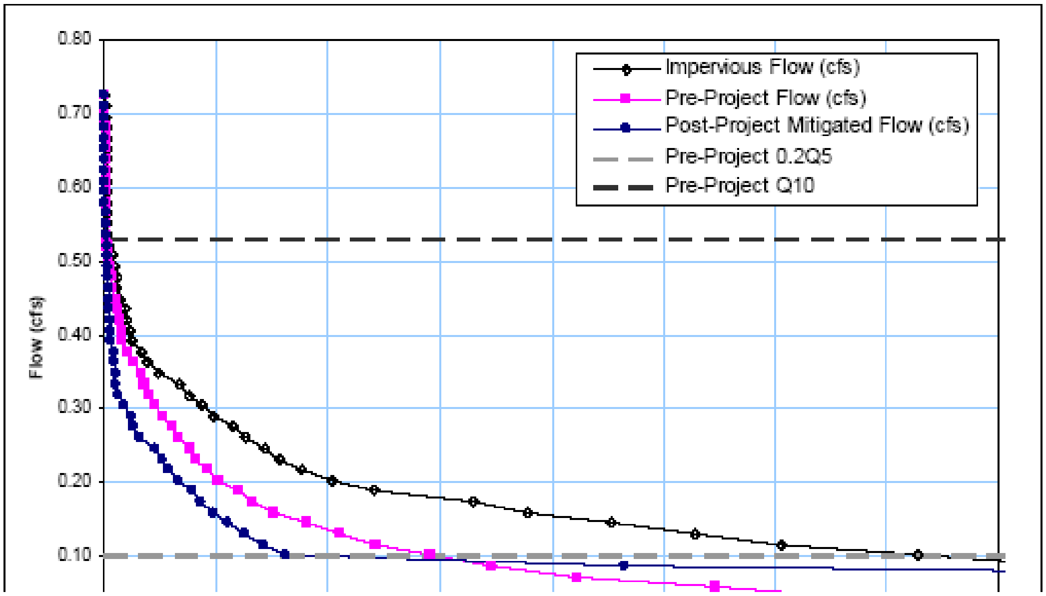


Figure 6-1. Flow Duration Series Statistics for a Hypothetical Development Scenario

% Time Exceeded

Figure 1. Flow Duration Series Statistics for a Hypothetical Development Scenario

Development of Flow Duration Curves

The first step in developing the flow duration curves is to count the number of occurrences of each flow rate. This is done by first rounding every non-zero flow value to an appropriate number of decimal places (say two places). This in effect groups each flow into closely related values or "bins" as they are referred to in publication 9-217d. Then the entire runoff record is queried for each value and the number of each value counted. The next step is to enter the results of the query into a grid patterned after form 9-217d. The data is entered in ascending order starting with the lowest flow first. The grid is composed of four columns. They are (from left to right) Discharge Rate, Number of **Periods (count),** Total Periods Exceeding (the total number of periods equal to or exceeding this value), and Percent Time Exceeded. Starting at the top row (row 1), the flow rate (which is often times zero) is entered with the corresponding number of times that value was found. The next column is the total number of values greater than or equal to that flow rate. For the first flow rate point, by definition all flow rate values are greater than or equal to this value, therefore the total number of runoff records of the rainfall record is entered here. The final column which is the percent of time exceeded is calculated by dividing the total periods exceeded by the total number of periods in the study. For the first row this number should be 100%

For the next row (row 2), the flow rate, and the flow rate count are entered. The total number of periods exceeding for row 2 is calculated by subtracting Number of Periods of row 1 from the Total

Periods Exceeding of line 1. This result is entered in the Total Periods Exceeding on row 2. As was the case for line 1, the final column is calculated by dividing the total periods exceeded by the total number of periods in the study. For the second row this number should be something less than 100% and continually decrease as we move down the chart. If all the calculations are correct, then everything should zero out on the last line of the calculations.

The final step in developing the flow duration curves is to make a plot of the Discharge Rate vs. the Percent Time Exceeded. For the purposes of this report, the first value corresponding to the zero flow rate is not plotted allowing the graph to be focused on the actual flow rate values.

The Flow Duration Analysis

The Peak Flow Statistics analysis is composed of the following series of files:

1. The Flow Duration Plot
2. Comparison of the Un-Mitigated Flow Duration Curve to the Pre-Development Curve (Pass/Fail)
3. Comparison of the Mitigated Flow Duration Curve to the Pre-Development Curve (Pass/Fail)
4. The calculations for the Pre-Development flow duration curve development (USGS9217d)
5. The calculations for the Post-Development flow duration curve development (USGS9217d)
6. The calculations for the Mitigated flow duration curve development (USGS9217d)

The Flow Duration Plot

The Flow Duration Curves Plot is the plotting of all three (pre, un-mitigated and mitigated) sets of Discharge Rate vs. the Percent Time Exceeded data point pair lists. In addition to these curves horizontal lines are plotted corresponding to the Q_{10} and Q_{lf} (low flow threshold) values. Within the geomorphically significant range (Q_{10} – Q_{lf}) one can see a visual representation of the relative positions of the flow duration curves. The flow duration curves are compared in an East/West (horizontal) direction to compare post development Discharge Rates to pre-development Discharge Rates. The pre-development curve is plotted in blue and the mitigated curve is plotted in green. As long as the post development curve lies to the left of the pre-development curve (mostly[3]), the project meets the peak flow hydromodification requirements.

Pass/Fail comparison of the curves

The next two sets of data are the point by point comparison of the post-development curve(s) and the pre-development curve. The Pass/Fail table is helpful in determining compliance since the plotted lines can be difficult to see at the scales suitable for use in a report. Each point on the post- development curve has a corresponding "Y" value (Flow Rate), and "X" value (% Time Exceeded). For each point on the post development curve, the "Y" value is used to interpolate the corresponding Percent Time Exceeded (X) value from the pre-development curve. Then the Post-development Percent Time Exceeded value is compared to the pre-development Percent Time Exceeded value. Based on the relative values of each point, pass/fail criteria are determined point by point.

For each set of data, the upper right hand header value shows the name of the file being displayed (ex. flowDurationPassFailMitigated.TXT). The first line of the file shows the name of the SWMM output file (*.out). The next line shows the time stamp of the SWMM file that is being analyzed. The time stamps of all of the report files should be within a minute or two of each other, otherwise there may have been

[3] See hydromodification limits for exceedance of pre-development values

tampering with the files. Each report run creates and prints all of the files and reports at one time so all the time stamps should be very close.

The first column is the zero based number of the point. The next two columns show the post development "X" and "Y" values. The next column shows the value interpolated between the two bounding points on the pre-development curve. The next three columns show the true or false values of the comparison of the two "X" values. The last column shows the resultant pass or fail status of the point. There are three ways a point can pass. They are:

1. Q_{post} being outside of the geomorphically significant range Q_{lf} to Q_{10}
2. Q_{post} being less than Q_{pre}
3. Q_{post} being less than 110% of the value of Q_{pre} if the point is between Q_{lf} and Q_{10}

There are two ways that a point can fail. They are:

1. Q_{post} being greater than 110% of Q_{pre} if the point is between Q_{lf} and Q_{10}
2. If more than 10% of the points are between 100% and 110% of Q_{pre} for the points between Q_{lf} and Q_{10}

A quick scan down the last column will quickly tell if there are any points that fail.

At the bottom of each set of data are the date stamp of the report to the left, and to the right is the page number/number of pages for the specific set of data (not the pages of the report!). Each new set of data has its own page numbering. Between the file name in the header row and the page numbering in the footer row, the engineer can readily scan the document for the data of interest.

Plan Check Suggestions

As was described under the peak flow section, is the responsibility of the reviewing agency to confirm that the data sets presented are valid results from consistent calculations, and that any and all results can be duplicated by manual methods and achieve the same results. In light of these goals, the plan checker is invited to consider the following tasks as part of the plan check process.

<u>Compare the Data Stamps for Each of the Statistics Files Used In This Analysis.</u>
As was described in the Peak Flows section, all report files should have time stamps that are nearly identical. If the time values are more than a few minutes apart then the potential for inconsistent results files should be investigated.

<u>Verify the Flow Rate Counts</u>
For each of the pre, and mitigated flow duration tables, a few randomly selected flow value counts should be checked against the values taken directly from the SWMM file. This can be done by opening the corresponding SWMM file, selecting the outfall node, selecting Report>Table>By Object, Setting the time format to Date/Time, selecting the appropriate node value, and clicking the OK button to generate a table of the date/time/Total Inflow values. Next step is to click in the left most header row of the SWMM table which will select the entire table. Now from the main menu select Edit>Copy To>Clipboard. Now open a new blank sheet in MS Excel (or suitable spread sheet program) select cell A1 and paste the results from the clipboard into the spread sheet. Now sort the values based on the Total Inflow column. This will group all the flow values together enabling the number of occurrences of

each value to be counted. At this point the a few (or all) of the counts on the various USGS9217d.txt files can be verified.

Manually Verify That the Percent Exceeded Values (form USGS9217d) are Correctly Calculated

The discharge rates and counts are confirmed as was described above. The top row should be the smallest runoff value (0.00cfs usually). Total Periods Exceeding of the first line should be the total number of rainfall records in the study. The percentage of Time Exceeding should be the total periods Exceeding divided by the total number of rainfall records in the study (100% for the first line). For each successive discharge rate, the total periods exceeding for the current line should be the total periods exceeding from the line above minus the number of periods from the line above. The number of periods and the number of periods exceeding should zero out at the last line.

Compare Plotted Curves to Table Data

Randomly check a few of the plotted points against the values verified above.

Verify by Observation that the plotted values of Q_{10} and Q_{lf} are reasonable.

Verify that the correct values for each of these return periods are plotted correctly on the graph.

Development of the Peak Flow Statistics

The peak flow statistics are developed directly from the binary output file produced by the SWMM program. The site is modeled three ways, Pre-Development, Post-Development-Unmitigated, and Post-Development-Mitigated. For each of these files a specific time period differentiating distinct storms is chosen. The SWMM results are extracted and each flow value is queried. The majority of the values for Southern California sites are zero flow. As each successive record is read, as soon as a non-zero value is read the time and flow value of that record are recorded as the beginning of an event. The first record is automatically recorded as the "tentative" peak value. As each successive non-zero value is read and the successive flow value is compared to the peak value and the greater value is retained as the peak value of the storm. As soon as a successive number of zero values equal to the predetermined storm separation value, then the time value of the last non-zero value is recorded as the end of the storm, the duration of the storm is the difference between the end time and the start time, and the peak value is recorded as the highest flow value between the start and end times.

Once the entire SWMM output file is read all of the distinct storm events will have been recorded in a special list. The storms will be in the order of their occurrence. To develop the peak flow statistics table the first step is to sort the storms in descending order of the peak flow value. Once the list is sorted then the relative rank of each storm is assigned with the highest ranking storm being the storm with the highest peak flow. There are several methods that can be used to determine which storm should be ranked above another equally valued storm. For the purposes of these studies an Ordinal ranking is used so that each storm has a unique rank number. Where two or more storms have equal flow values, the earlier storm is assigned the higher rank. This is done consistently throughout the storm record. Since we are only looking at peak flow statistics, it is assumed that the relative ranking of individual (but equal) storms is irrelevant to the calculations.

The exceedance frequency and return period are both computed using the Weibull formula for plotting position. Therefore, for a specific event the exceedance frequency F and the return period in years T are calculated using the following equations[4]:

[4] Pg 169-170 STORM WATER MANAGEMENT MODEL APPLICATIONS MANUAL, EPA/600/R-09/000 July 2009

$F=m/(n_R+1)$ and $T=n+1/m$

where m is the event's rank, n_R is the total number of events and n is the number of years under analysis.

Once the Peak flow statistics table is complete, a plot of Return Frequency vs. peak flow is created. All three conditions (pre, post and mitigated) are plotted on the same plot.

The Peak Flow Statistics Analysis

The Peak Flow Statistics analysis is composed of the following series of files:

1. The Peak Flow Frequency Plot
2. The Comparison of the Un-Mitigated Peak Flow Curve to the Pre-Development Curve (Pass/Fail)
3. The Comparison of the Mitigated Conditions Curve to the Pre-Development Curve (Pass/Fail)
4. The Peak Flow Statistics Calculation for the Pre-Development Curve.
5. The Peak Flow Statistics Calculation for the Un-Mitigated Curve.
6. The Peak Flow Statistics Calculation for the Mitigated Curve.

The Peak Flow Frequency Plot

The Peak Flow Frequency Curves are the plotting of all three (Pre, Un-Mitigated and Mitigated) sets of return Period vs peak flow data point pair lists. In addition to these curves horizontal lines are plotted corresponding to the Q_{10}, Q_5, Q_2 and Q_{lf} (low flow threshold) values. Within the geomorphically significant range ($Q_{10} – Q_{lf}$) one can see a visual representation of the relative positions of the peak flow curves. The peak flow curves are compared in a North/South (vertical) direction to compare post development peak flows to pre-development flows. The Pre-Development curve is plotted in blue, the unmitigated curve is plotted in red, and the mitigated curve is plotted in green. As long as the post development curve lies below the pre-development curve (mostly[5]), the project meets the peak flow hydromodification requirements.

Pass/Fail comparison of the curves

The next two sets of data are the point by point comparison of the post-development curve(s) and the pre-development curve. The Pass/Fail table is helpful in determining compliance since the plotted lines can be difficult to see at the scales suitable for use in a report. Each point on the post- development curve has a corresponding "X" value (Recurrence Interval), and "Y" value (Peak Flow). For each point on the post development curve, the "X" value is used to interpolate the corresponding peak flow value from the pre-development curve. Then the Post-development peak flow value is compared to the pre-development peak flow value. Based on the relative values of each point, pass/fail criteria are determined point by point.

For each set of data, the upper right hand header value shows the name of the file being displayed (ex. peakFlowPassFailMitigated.TXT). The first line of the file also shows this value. The next line shows the time stamp of the file that is being analyzed. The time stamps of all of the report files should be within a minute or two of each other, otherwise there may have been tampering with the files. Each report run creates and prints all of the files and reports at one time so all the time stamps should be very close. It

[5] See hydromodification limits for exceedance of pre-development values

should be noted that the SWMM.out files will not have related time stamps since each file is developed independently.

The first column is the zero based number of the point. The next two columns show the post development "X" and "Y" values. The next column shows the value interpolated between the two bounding points on the pre-development curve. The next three columns show the true or false values of the comparison of the two "Y" values. The last column shows the resultant pass or fail status of the point. There are three ways a point can pass. They are:

1. Point is outside of the geomorphically significant range Q_{10} – Q_{lf}
2. Q_{post} being less than Q_{pre}
3. Q_{post} being less than 110% of the value of Q_{pre} if the point is between Q_5 and Q_{10}[6]

There are four ways that a point can fail. They are:

1. Q_{post} being greater than Q_{pre} if the point is between Q_{lf} and Q_5
2. Q_{post} being greater than 110% of Q_{pre} if the point is between Q_{lf} and Q_{10}
3. If more than 10% of the points are between 100% and 110% of Q_{pre} for the points between Q_5 and Q_{10}
4. If the frequency interval for points > 100% of Q_{pre} is greater than 1 year for the points between Q_5 and Q_{10}

A quick scan down the last column will quickly tell if there are any points that fail.

At the bottom of each set of data are the date stamp of the report to the left, and to the right is the page number/number of pages for the specific set of data (not the pages of the report!). Each new set of data has its own page numbering. Between the file name in the header row and the page numbering in the footer row, the engineer can readily scan the document for the data of interest.

<u>The Peak Flow Statistics Calculations</u>

There are three sets of data for the Peak Flow Statistics calculations (Pre-Development, Un-Mitigated, and Mitigated). As was the case for the pass/fail data, the upper right hand corner of each sheet has the file name. The first row of the data is the SWMM file name. The second row is the SWMM file time stamp of the file being analyzed. The 4th, 5th, and 6th rows are the calculated values for Q_{10}, Q_5, and Q_2. These values are derived by linear interpolation between the nearest bounding points in the listing. While the relationship between the points in the peak flow analysis is not technically a linear relationship, the error introduced in using linear interpolation between such relatively close data points is assumed to be irrelevant. Finally, the footer row shows the report time and the page/number of pages of the data set.

As was previously discussed, each storm listed was determined by reading the flow values directly from the binary output file from the SWMM program. The storms were then sorted in descending order of peak flow values. Then each storm was assigned a unique rank, then the Frequency and Return Period were calculated using Weibull formulas. Every discharge value for the entire rainfall record is listed in each of these lists. It should be noted that the derivation of these peak flow statistics values use full precision (i.e. no rounding off) of the SWMM output values. Since the precision of the calculations may

[6] See section on how a point can fail point number 3 hereon

not be the same as the SWMM program uses, and also the assignment of rank to values of equal peak flow value may differ slightly from the way SWMM calculates the tables, minor variances in the data values and/or the order of storms can be expected.

Finally, as was previously stated, the values of the Return Period were plotted vs. the peak flow values to develop the peak flow frequency curves.

Plan Check Suggestions

As is the responsibility of the reviewing agency, any and all methods should be considered to verify that the SWMM analysis adequately models the site as far as hydrologic discharge is concerned, and that the data sets presented are valid results from consistent calculations, and that any and all results can be duplicated by manual methods and achieve the same results. In light of these goals, the plan checker is invited to consider the following tasks as part of the plan check process.

Compare the Data Stamps for Each of the Statistics Files Used In This Analysis.
For each set of calculations and report files, the first step of the process is to list out all the files in the report folder and delete those files. The very first step leaves the reports folder completely empty. Then as each successive step is performed, the results file is placed in the reports folder. Once all of the results files are complete, then the report file is compiled using the data directly from the files placed in the results folder. This means that the time stamps on each of the report files in the report should be within a minute or two depending on the speed of the computer. If the time values are more than a few minutes apart then the potential for inconsistent results files should be investigated.

Verify A Few Random Storm Statistics
For each of the Pre, Un-mitigate and Mitigated peak flow statics tables, a few randomly selected storms should be checked against the values taken directly from the SWMM file. This can be done by opening the corresponding SWMM file, selecting the outfall node, selecting Report>Table>By Object, Setting the time format to Date/Time, selecting the appropriate node value, and clicking the OK button to generate a table of the date/time/Total Inflow values. Now scroll down the list to the start date and time of the randomly selected storm. Verify that the start date, end date, and the highest flow value between the start and end date correspond to the values shown in the statistics table. Do this for a few storm to verify that the data corresponds to the SWMM output file. Verify by hand a few of the frequency and return period values.

Compare Plotted Curves to Table Data
Randomly check a few of the plotted points against the values found in the Peak Flow Frequency Tables.

Verify by Observation that the values of Q_{10}, Q_5, Q_2 and Q_{lf} are reasonable.
For each value shown on the reports, verify that the value shown for say Q10 is in between the next higher return period and the next lower period. Also verify that the correct values for each of these return periods are plotted correctly on the peak flow frequency graph.

Manually Verify That the Pass Fail Table Is Correctly Calculated
Select at random several points on each of the pass/fail tables to verify that the values for post X/Y and interpolated Y look reasonable. Also check that the various test results are shown accurately in the chart and also the final pass/fail result looks accurate.

Drawdown Time of Bio-filtration Surface Ponding

The drawdown time for hydromodification flow control facilities was calculated by assuming a starting water surface elevation coincident with the peak operating level in the bio-filtration facility such as the elevation at the weir or the emergency spillway overflow.

The instruction from the county of San Diego Department of Environmental Health (DEH) limits the drawdown time hydromodification flow control facilities to 96 hours. This restriction was implemented as mitigation to potential vector breeding issues and the subsequent risk to human health.

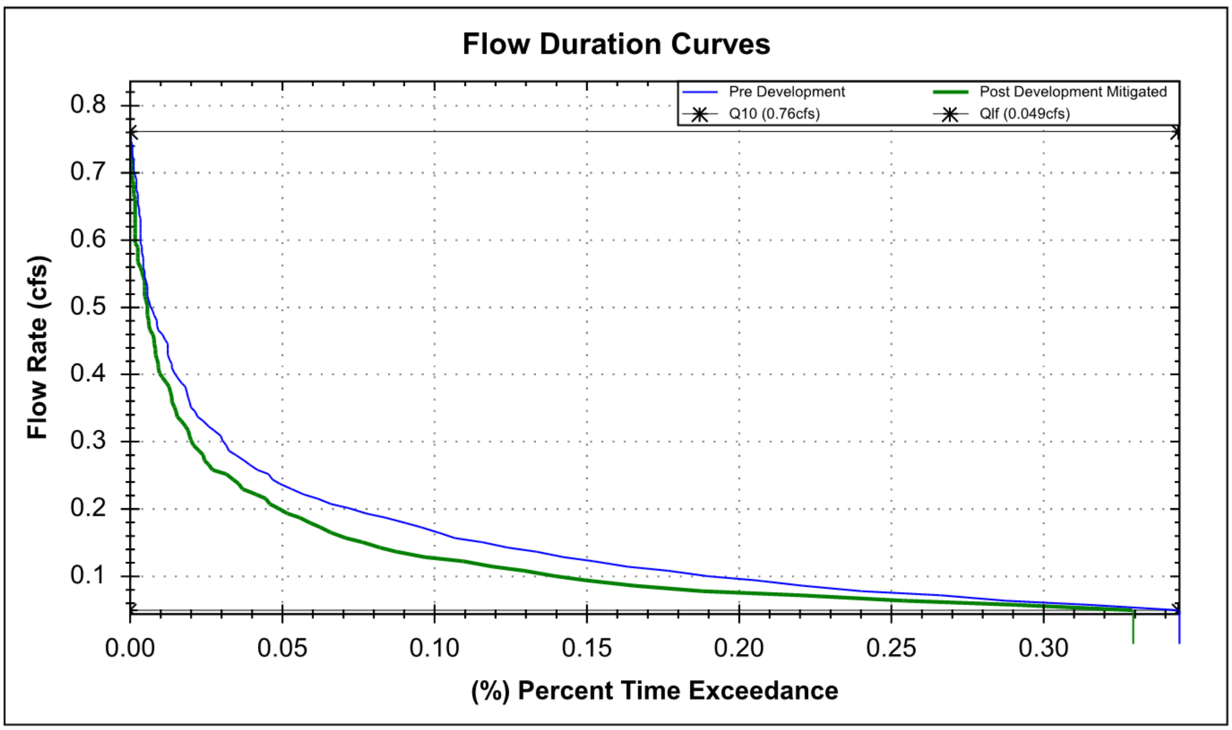
VII. SUMMARY AND CONCLUSION

Hydromodification calculations were performed utilizing continuous simulation to size storm water control facilities. SWMM (Storm Water Management Model) version 5.0 distributed by USEPA was used to generate computed peak flow recurrence and flow duration series statistics.

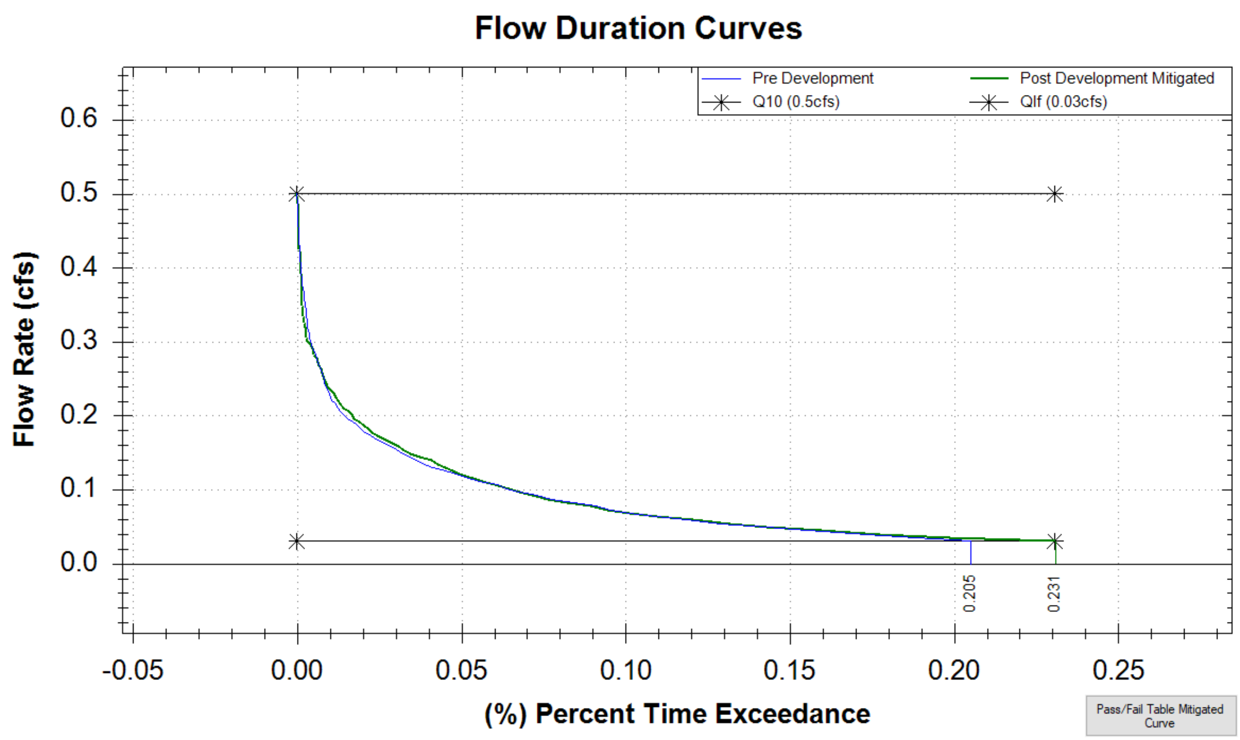
There are several tributary areas planned as commercial use treated by 2 biofiltration basins (labeled as BMP-# (Best Management Practices) with a total tributary area of approximately 0.97 acres. The areas were grouped based on its outfall and were analyzed for pre-development and post-development conditions; all basins drain to one point of compliance (POC).

The analyzed SWMM runs attached show that the proposed biofiltration facilities provided with variety of orifice flow control at the base of the gravel storage configured as shown in Figure 6-1 is in compliance with the HMP and BMP Manual.

On POC, the following flow duration curve shows the existing condition 30.7 hours (0.351×365days×24 hour/day = 30.7 hours).



For POC 1, with the proposed square footage of LID areas and orifices acting as the low flow restrictor configured as shown in Figure 1 the duration of the flow is 24.7 hours (0.282×365days×24 hour/day =24.7 hours). This flow duration is lower than the existing and meets the requirements.



For POC 1, with the proposed square footage of LID areas and orifices acting as the low flow restrictor configured as shown in Figure 1 the duration of the flow is 26.2 hours (0.231×365days×24 hour/day =20.2 hours). This flow duration is lower than the existing and meets the requirements.

Therefore, this study has demonstrated that the proposed optimized biofiltration basins are sufficient to meet the current HMP and BMP criteria (See Table 7-1).

PRE DEVELOPMENT

*.inp AND *.rpt FILES

```
[TITLE]
;;Project Title/Notes

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO

START_DATE           10/17/1948
START_TIME           08:00:00
REPORT_START_DATE    10/17/1948
REPORT_START_TIME    08:00:00
END_DATE             12/31/2005
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:30:00
DRY_STEP             24:00:00
ROUTING_STEP         0:01:00
RULE_STEP            00:00:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          0.06   0.08   0.11   0.15   0.17   0.19   0.19   0.18   0.15   0.11   0.08   0.06
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Lindbergh        INTENSITY 1:00     1.0      FILE       "R:\_Storm\HydMOD\Rain gauge Data\Lindbergh\ccda_lindbergh.dat" CCDA_Lindbergh IN

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
DMA-1            Lindbergh        POC-1            0.975    0        120      1        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ----------
```

```
;;-------------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1            0.012      0.15       0.05       0.1        25         OUTLET

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
DMA-1            9          0.01875    0.3        7          0

[LID_CONTROLS]
;;Name           Type/Layer Parameters
;;-------------- ---------- ----------
BMP-A            BC
BMP-A            SURFACE    6          0.0        0          0          5
BMP-A            SOIL       18         0.4        0.2        0.1        5          5          1.5
BMP-A            STORAGE    27         0.67       0          0
BMP-A            DRAIN      0.0666236261415065 0.5        3          6          0          0

BMP-B            BC
BMP-B            SURFACE    6          0.0        0          0          5
BMP-B            SOIL       18         0.4        0.2        0.1        5          5          1.5
BMP-B            STORAGE    15         0.67       0          0
BMP-B            DRAIN      0.0792853860641146 0.5        3          6          0          0

[LID_USAGE]
;;Subcatchment   LID Process      Number  Area       Width      InitSat    FromImp    ToPerv     RptFile                  DrainTo          FromPerv
;;-------------- ---------------- ------- ---------- ---------- ---------- ---------- ---------- ------------------------ ---------------- ----------

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC-1            0          FREE                        NO

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
STO-BMP-B        Storage    0          1032
STO-BMP-B                   1.5        2095.9
;
sto-bmp-a        Storage    0          1920.2
sto-bmp-a                   0.5        2326.5
;
Vault            Storage    0          16
Vault                       10         16
;
VAULT1           Storage    1          12.5
VAULT1                      3          12.5
VAULT1                      6          12.5
;
VAULT2           Storage    1          12.5
VAULT2                      3          12.5
VAULT2                      6          12.5

[REPORT]
;;Reporting Options
INPUT      YES
CONTROLS   YES
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

```

```
[TAGS]

[MAP]
DIMENSIONS 6262572.930 2031129.642 6270059.565 2035647.892
Units      Feet

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            6264532.598        2032829.529

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1            6265355.442        2033991.118

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Lindbergh        6264165.521        2034855.843
```

```

  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
  --------------------------------------------------------------


  *************
  Element Count
  *************
  Number of rain gages ...... 1
  Number of subcatchments ... 1
  Number of nodes ........... 1
  Number of links ........... 0
  Number of pollutants ...... 0
  Number of land uses ....... 0


  ****************
  Raingage Summary
  ****************
                                                        Data       Recording
  Name                 Data Source                      Type       Interval
  ------------------------------------------------------------------------
  Lindbergh            R:\_Storm\HydMOD\Rain gauge Data\Lindbergh\ccda_lindbergh.dat


  ********************
  Subcatchment Summary
  ********************
  Name                       Area     Width   %Imperv    %Slope Rain Gage
  Outlet
  ---------------------------------------------------------------------------------------------------
  --------------------
  DMA-1                      0.97    120.00      0.00    1.0000 Lindbergh
  POC-1


  ************
  Node Summary
  ************
                                         Invert      Max.    Ponded    External
  Name                 Type               Elev.     Depth      Area    Inflow
  -------------------------------------------------------------------------------
  POC-1                OUTFALL             0.00      0.00       0.0



  ********************
  Rainfall File Summary
  ********************
  Station    First        Last         Recording   Periods    Periods    Periods
  ID         Date         Date         Frequency  w/Precip    Missing    Malfunc.
  -------------------------------------------------------------------------------
  CCDA_Lindbergh 10/17/1948   12/31/2005      60 min     10219          0          0


  *********************************************************
  NOTE: The summary statistics displayed in this report are
  based on results found at every computational time step,
  not just on results from each reporting time step.
  *********************************************************

  ****************
  Analysis Options
  ****************
  Flow Units ............... CFS
```

```
  Process Models:
    Rainfall/Runoff ........ YES
    RDII ................... NO
    Snowmelt ............... NO
    Groundwater ............ NO
    Flow Routing ........... NO
    Water Quality .......... NO
  Infiltration Method ...... GREEN_AMPT
  Starting Date ............ 10/17/1948 08:00:00
  Ending Date .............. 12/31/2005 23:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 01:00:00
  Wet Time Step ............ 00:30:00
  Dry Time Step ............ 00:00:00


  *********************
  Control Actions Taken
  *********************


  **************************        Volume         Depth
  Runoff Quantity Continuity     acre-feet        inches
  **************************     ---------       -------
  Total Precipitation ......        45.648       561.826
  Evaporation Loss .........         3.168        38.992
  Infiltration Loss ........        35.864       441.408
  Surface Runoff ...........         8.740       107.567
  Final Storage ............         0.000         0.000
  Continuity Error (%) .....        -4.653


  **************************        Volume        Volume
  Flow Routing Continuity        acre-feet      10^6 gal
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......         8.740         2.848
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.000         0.000
  External Outflow .........         8.740         2.848
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.000         0.000
  Continuity Error (%) .....         0.000


  ***************************
  Subcatchment Runoff Summary
  ***************************


  ------------------------------------------------------------------------------------------
  ---------------------------------------
                            Total      Total      Total      Total     Imperv
                            Perv      Total       Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff
                           Runoff     Runoff      Runoff   Runoff   Coeff
  Subcatchment                in         in          in         in         in
  in         in    10^6 gal      CFS
  ------------------------------------------------------------------------------------------
  ---------------------------------------
  DMA-1                    561.83       0.00      38.99     441.41       0.00
```

```
      107.57     107.57        2.85     0.69   0.191


Analysis begun on:  Thu Dec 16 17:48:28 2021
Analysis ended on:  Thu Dec 16 17:48:53 2021
Total elapsed time: 00:00:25
```

POST DEVELOPMENT
*.inp AND *.rpt FILES

```
[TITLE]
;;Project Title/Notes

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO

START_DATE           10/17/1948
START_TIME           08:00:00
REPORT_START_DATE    10/17/1948
REPORT_START_TIME    08:00:00
END_DATE             12/31/2005
END_TIME             23:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:30:00
DRY_STEP             24:00:00
ROUTING_STEP         0:01:00
RULE_STEP            00:00:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
MONTHLY          0.06   0.08   0.11   0.15   0.17   0.19   0.19   0.18   0.15   0.11   0.08   0.06
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- ------ ------ ----------
Lindbergh        INTENSITY 1:00     1.0      FILE       "R:\_Storm\HydMOD\Rain gauge Data\Lindbergh\ccda_lindbergh.dat" CCDA_Lindbergh IN

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
BMP-A            Lindbergh        A-UPPER          0.0059   0        7        0        0
BMP-B            Lindbergh        B-UPPER          0.0057   0        10       0        0
BMP-C            Lindbergh        C-UPPER          0.0057   0        10       0        0
BMP-D            Lindbergh        D-UPPER          0.0092   0        7        0
```

```
0
DMA-1            Lindbergh        DMA-12           0.065    100      20       5
0
DMA-10           Lindbergh        BMP-B            0.1327   50       50       1
0
DMA-11           Lindbergh        BMP-D            0.0522   100      25       5
0
DMA-12           Lindbergh        BMP-A            0.0304   60       20       1
0
DMA-2            Lindbergh        BMP-C            0.193    100      50       5
0
DMA-3            Lindbergh        DMA-10           0.130    100      50       5
0
DMA-4            Lindbergh        DMA-9            0.164    100      25       5
0
DMA-6            Lindbergh        BMP-A            0.1057   90       30       0.5
0
DMA-9            Lindbergh        BMP-D            0.0524   0        25       1
0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo
PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ----------
----------
BMP-A            0.012      0.15       0.05       0.1        25         OUTLET
BMP-B            0.012      0.15       0.05       0.1        25         OUTLET
BMP-C            0.012      0.15       0.05       0.1        25         OUTLET
BMP-D            0.012      0.15       0.05       0.1        25         OUTLET
DMA-1            0.013      0.15       0.05       0.1        25         OUTLET
DMA-10           0.012      0.15       0.05       0.1        25         OUTLET
DMA-11           0.013      0.15       0.05       0.1        25         OUTLET
DMA-12           0.013      0.15       0.05       0.1        25         OUTLET
DMA-2            0.013      0.15       0.05       0.1        25         OUTLET
DMA-3            0.013      0.15       0.05       0.1        25         OUTLET
DMA-4            0.013      0.15       0.05       0.1        25         OUTLET
DMA-6            0.012      0.15       0.05       0.1        25         OUTLET
DMA-9            0.012      0.15       0.05       0.1        25         OUTLET

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
BMP-A            9          0.025      0.3        7          0
BMP-B            9          0.025      0.3        7          0
BMP-C            9          0.025      0.3        7          0
BMP-D            9          0.025      0.3        7          0
DMA-1            9          0.01875    0.3        7          0
DMA-10           9          0.01875    0.3        7          0
DMA-11           9          0.01875    .3         7          0
DMA-12           9          0.01875    0.3        7          0
DMA-2            9          0.01875    0.3        7          0
DMA-3            9          0.01875    0.3        7          0
DMA-4            9          0.025      .3         7          0
DMA-6            9          0.01875    0.3        7          0
DMA-9            9          0.025      .3         7          0

[LID_CONTROLS]
;;Name           Type/Layer Parameters
;;-------------- ---------- ----------
BMP-A            BC
BMP-A            SURFACE    6          0.0        0          0          5
BMP-A            SOIL       21         0.4        0.2        0.1        5
5          1.5
BMP-A            STORAGE    15         0.67       0          0
BMP-A            DRAIN      0.08187564 0.5        3          6          0
0
```

```

BMP-B            BC
BMP-B            SURFACE    6          0.0        0          0          5
BMP-B            SOIL       21         0.4        0.2        0.1        5
5          1.5
BMP-B            STORAGE    15         0.67       0.025      0
BMP-B            DRAIN      0.053865552 0.5        3          6          0
0

BMP-C            BC
BMP-C            SURFACE    6          0.0        0          0          5
BMP-C            SOIL       21         0.4        0.2        0.1        5
5          1.5
BMP-C            STORAGE    15         0.67       0          0
BMP-C            DRAIN      0.08187564 0.5        3          6          0
0

BMP-D            BC
BMP-D            SURFACE    6          0.0        0          0          5
BMP-D            SOIL       21         0.4        0.2        0.1        5
5          1.5
BMP-D            STORAGE    15         0.67       0          0
BMP-D            DRAIN      0.204689099 0.5        3          6          0
0

[LID_USAGE]
;;Subcatchment   LID Process      Number  Area       Width      InitSat    FromImp
ToPerv     RptFile                  DrainTo          FromPerv
;;-------------- ---------------- ------- ---------- ---------- ---------- ----------
---------- ------------------------ ---------------- ----------
BMP-A            BMP-A            1       257.00     0          0          0
0          "V:\20\20076\Engineering\SDP\Storm-SDP\Working Files\Hydmod\SWMM\bmpa.txt"
PIPE-3           0
BMP-B            BMP-B            1       248.29     0          0          0
0          "V:\20\20076\Engineering\SDP\Storm-SDP\Working Files\Hydmod\SWMM\bmpb.txt"
PIPE-1           0
BMP-C            BMP-C            1       248.29     0          0          0
0          *                        PIPE-2           0
BMP-D            BMP-D            1       400.75     0          0          0
0          *                        PIPE-4           0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
POC-1            0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params
N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ----------- ----------
---------------------------- -------- --------          -------- --------
B-UPPER          0        .5         0          TABULAR    B-UPPER
0        1
PIPE-1           0        2          0          TABULAR    PIPE-1
0        0
C-UPPER          0        0.5        0          TABULAR    C-UPPER
0        1
PIPE-2           0        2          0          TABULAR    PIPE-2
0        0
PIPE-3           0        2.5        0          TABULAR    PIPE-2
0        0
A-UPPER          0        0.3333     0          TABULAR    A-UPPER
0        1
D-UPPER          0        0.333      0          TABULAR    D-UPPER
0        0
PIPE-4           0        2          0          TABULAR    PIPE-2
```

```
0       0

[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
LOWER-ORIFACE    PIPE-1           POC-1            SIDE         0          0.61       NO       0
LOWER-ORIFACE-2  PIPE-2           POC-1            SIDE         0          0.61       NO       0
LOWER-ORIFACE-3  PIPE-3           POC-1            SIDE         0          0.61       NO       0
3                PIPE-1           POC-1            SIDE         0.5        0.61       NO       0
4                B-UPPER          PIPE-1           SIDE         0          0.61       NO       0
5                PIPE-3           POC-1            SIDE         0.75       0.61       NO       0
6                PIPE-1           POC-1            SIDE         1          0.61       NO       0
1                PIPE-3           POC-1            SIDE         .5         0.61       NO       0
LOWER            PIPE-4           PIPE-3           SIDE         0          0.61       NO       0
7                PIPE-4           PIPE-3           SIDE         0.75       0.61       NO       0
8                C-UPPER          PIPE-2           SIDE         0          0.61       NO       0
9                C-UPPER          PIPE-2           SIDE         0          0.61       NO       0
10               C-UPPER          PIPE-2           SIDE         0          0.61       NO       0
11               B-UPPER          PIPE-1           SIDE         0          0.61       NO       0
12               B-UPPER          PIPE-1           SIDE         0          0.61       NO       0

[WEIRS]
;;Name           From Node        To Node          Type         CrestHt    Qcoeff     Gated    EndCon   EndCoeff   Surcharge  RoadWidth  RoadSurf   Coeff. Curve
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- -------- ---------- ---------- ---------- ---------- ----------------
B-GRATE          B-UPPER          PIPE-1           TRANSVERSE   0.25       3.33       NO       0        0          YES
WEIR-PLATE       PIPE-1           POC-1            SIDEFLOW     1.75       3.33       NO       0        0          YES
C-GRATE          C-UPPER          PIPE-2           TRANSVERSE   .333       3.33       NO       0        0          YES
WEIR-PLATE-2     PIPE-2           POC-1            SIDEFLOW     1.5        3.33       NO       0        0          YES
A-GRATE          A-UPPER          PIPE-3           TRANSVERSE   0          3.33       NO       0        0          YES
WEIR-PLATE-3     PIPE-3           POC-1            SIDEFLOW     1.6667     3.33       NO       0        0          YES
D-GRATE          D-UPPER          PIPE-4           TRANSVERSE   0          3.33       NO       0        0          YES
2                PIPE-4           PIPE-3           SIDEFLOW     1.5        3.33       NO       0        0          YES

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
LOWER-ORIFACE    RECT_CLOSED  0.08333          0.08333    0          0
```

```
LOWER-ORIFACE-2  RECT_CLOSED  0.0417           0.0417     0          0
LOWER-ORIFACE-3  RECT_CLOSED  0.0417777        0.0417     0          0
3                RECT_CLOSED  0.08333          0.08333    0          0
4                RECT_CLOSED  0.08333          .5         0          0
5                RECT_CLOSED  0.25             0.333      0          0
6                RECT_CLOSED  0.25             0.25       0          0
1                RECT_CLOSED  0.0417777        0.0417     0          0
LOWER            RECT_CLOSED  0.0208           0.0208     0          0
7                RECT_CLOSED  0.0417           0.0417     0          0
8                RECT_CLOSED  .08333           .08333     0          0
9                RECT_CLOSED  .08333           .08333     0          0
10               RECT_CLOSED  .08333           08333      0          0
11               RECT_CLOSED  0.08333          0.5        0          0
12               RECT_CLOSED  0.08333          0.5        0          0
B-GRATE          RECT_OPEN    0.25             8          0          0
WEIR-PLATE       RECT_OPEN    3.5              2.5        0          0
C-GRATE          RECT_OPEN    0.25             8          0          0
WEIR-PLATE-2     RECT_OPEN    3                2.5        0          0
A-GRATE          RECT_OPEN    0.3333           8          0          0
WEIR-PLATE-3     RECT_OPEN    4                4          0          0
D-GRATE          RECT_OPEN    0.25             8          0          0
2                RECT_OPEN    4                4          0          0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
B-UPPER          Storage    0          384
B-UPPER                     0.5        845
;
PIPE-1           Storage    0          0
PIPE-1                      0.2        11.7
PIPE-1                      0.4        38.9
PIPE-1                      0.6        63.1
PIPE-1                      0.8        69.9
PIPE-1                      1          75.1
PIPE-1                      1.2        69.9
PIPE-1                      1.4        63.1
PIPE-1                      1.6        38.9
PIPE-1                      1.8        11.6
PIPE-1                      2          0.1
;
C-UPPER          Storage    0          250
C-UPPER                     0.5        250
;
PIPE-2           Storage    0          0
PIPE-2                      0.2        11.7
PIPE-2                      0.4        38.9
PIPE-2                      0.6        63.1
PIPE-2                      0.8        69.9
PIPE-2                      1          75.1
PIPE-2                      1.2        69.9
PIPE-2                      1.4        63.1
PIPE-2                      1.6        38.9
PIPE-2                      1.8        11.6
PIPE-2                      2          0.1
;
A-UPPER          Storage    0          256
A-UPPER                     0.333      328
;
D-UPPER          Storage    0          400
D-UPPER                     0.333      500

[REPORT]
;;Reporting Options
INPUT       YES
CONTROLS    YES
```

```
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 6262572.930 2031129.642 6270059.565 2035647.892
Units      Feet

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            6264409.791        2031553.867
B-UPPER          6264481.347        2033598.324
PIPE-1           6264230.901        2032632.318
C-UPPER          6266479.804        2031886.091
PIPE-2           6265672.244        2032228.538
PIPE-3           6267507.144        2031732.757
A-UPPER          6267573.589        2032862.319
D-UPPER          6267527.588        2034119.660
PIPE-4           6268120.481        2033439.878

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
LOWER-ORIFACE    6264082.678        2032499.428
LOWER-ORIFACE    6264108.234        2032151.871
LOWER-ORIFACE-2  6265299.130        2032146.759
LOWER-ORIFACE-2  6264757.349        2032141.648
LOWER-ORIFACE-3  6266162.913        2031722.535
LOWER-ORIFACE-3  6264598.904        2031783.868
3                6263960.011        2032570.984
3                6263960.011        2032013.870
4                6264133.790        2033644.324
4                6263868.010        2033250.766
5                6266178.247        2031405.644
5                6264726.682        2031405.644
6                6263837.343        2032632.318
6                6263770.899        2031983.203
1                6266060.690        2031569.200
1                6264772.682        2031656.090
LOWER            6267834.257        2033005.431
LOWER            6267834.257        2032100.759
7                6267951.813        2033143.432
7                6267946.702        2032049.648
8                6266484.915        2032228.538
8                6265871.578        2032243.871
9                6266382.692        2032100.759
9                6265886.912        2032141.648
10               6266300.914        2031978.092
10               6265846.022        2032034.314
11               6264190.012        2033506.323
11               6264016.233        2033168.988
12               6264322.902        2033383.656
12               6264179.790        2033046.320
B-GRATE          6264046.900        2033818.103
B-GRATE          6263689.120        2033271.211
WEIR-PLATE       6263627.787        2032770.319
WEIR-PLATE       6263568.868        2031898.706
C-GRATE          6266362.248        2031860.535
C-GRATE          6265774.466        2031855.424
WEIR-PLATE-2     6265283.797        2032356.316
WEIR-PLATE-2     6264665.348        2032371.650
A-GRATE          6267716.701        2032673.207
A-GRATE          6267737.145        2032110.981
```

```
WEIR-PLATE-3     6266265.136        2031221.643
WEIR-PLATE-3     6264655.126        2031221.643
D-GRATE          6267231.142        2033976.548
D-GRATE          6267430.477        2033567.657
2                6268069.369        2032918.542
2                6268089.814        2031916.758

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
BMP-A            6267527.588        2033056.543
BMP-B            6264568.237        2033915.215
BMP-C            6266801.806        2031911.647
BMP-D            6267512.255        2034508.107
DMA-1            6266950.029        2033475.656
DMA-10           6264920.906        2034574.552
DMA-11           6267082.919        2034175.883
DMA-12           6267353.809        2033455.212
DMA-2            6266454.248        2032683.429
DMA-3            6265396.242        2033199.655
DMA-4            6266336.692        2034017.438
DMA-6            6266070.913        2033363.211
DMA-9            6266525.804        2034784.109

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Lindbergh        6264507.962        2034844.757


[BACKDROP]
FILE       "V:\21\21061\Engineering\SDP\Storm-SDP\Working
Files\Hydromod\SWMM\Capture.JPG"
DIMENSIONS 6263835.461 2031129.642 6268797.034 2035647.892
```

```
  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
  --------------------------------------------------------------


  *************
  Element Count
  *************
  Number of rain gages ...... 1
  Number of subcatchments ... 13
  Number of nodes ........... 9
  Number of links ........... 23
  Number of pollutants ...... 0
  Number of land uses ....... 0


  ****************
  Raingage Summary
  ****************
                                                      Data       Recording
  Name                 Data Source                    Type       Interval
  ------------------------------------------------------------------------
  Lindbergh            R:\_Storm\HydMOD\Rain gauge Data\Lindbergh\ccda_lindbergh.dat


  ********************
  Subcatchment Summary
  ********************
  Name                       Area     Width   %Imperv    %Slope Rain Gage
  Outlet
  ------------------------------------------------------------------------------------------
  --------------------
  BMP-A                      0.01      7.00      0.00    0.0000 Lindbergh
  A-UPPER
  BMP-B                      0.01     10.00      0.00    0.0000 Lindbergh
  B-UPPER
  BMP-C                      0.01     10.00      0.00    0.0000 Lindbergh
  C-UPPER
  BMP-D                      0.01      7.00      0.00    0.0000 Lindbergh
  D-UPPER
  DMA-1                      0.07     20.00    100.00    5.0000 Lindbergh
  DMA-12
  DMA-10                     0.13     50.00     50.00    1.0000 Lindbergh
  BMP-B
  DMA-11                     0.05     25.00    100.00    5.0000 Lindbergh
  BMP-D
  DMA-12                     0.03     20.00     60.00    1.0000 Lindbergh
  BMP-A
  DMA-2                      0.19     50.00    100.00    5.0000 Lindbergh
  BMP-C
  DMA-3                      0.13     50.00    100.00    5.0000 Lindbergh
  DMA-10
  DMA-4                      0.16     25.00    100.00    5.0000 Lindbergh
  DMA-9
  DMA-6                      0.11     30.00     90.00    0.5000 Lindbergh
  BMP-A
  DMA-9                      0.05     25.00      0.00    1.0000 Lindbergh
  BMP-D


  *******************
  LID Control Summary
  *******************
                                   No. of        Unit        Unit       % Area    %
                                   Imperv      % Perv
```

Subcatchment	LID Control	Units	Area	Width	Covered	Treated	Treated
BMP-A	BMP-A	1	257.00	0.00	99.99	0.00	0.00
BMP-B	BMP-B	1	248.29	0.00	100.00	0.00	0.00
BMP-C	BMP-C	1	248.29	0.00	100.00	0.00	0.00
BMP-D	BMP-D	1	400.75	0.00	100.00	0.00	0.00

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
POC-1	OUTFALL	0.00	0.00	0.0	
B-UPPER	STORAGE	0.00	0.50	0.0	
PIPE-1	STORAGE	0.00	2.00	0.0	
C-UPPER	STORAGE	0.00	0.50	0.0	
PIPE-2	STORAGE	0.00	2.00	0.0	
PIPE-3	STORAGE	0.00	2.50	0.0	
A-UPPER	STORAGE	0.00	0.33	0.0	
D-UPPER	STORAGE	0.00	0.33	0.0	
PIPE-4	STORAGE	0.00	2.00	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
LOWER-ORIFACE	PIPE-1	POC-1	ORIFICE			
LOWER-ORIFACE-2	PIPE-2	POC-1	ORIFICE			
LOWER-ORIFACE-3	PIPE-3	POC-1	ORIFICE			
3	PIPE-1	POC-1	ORIFICE			
4	B-UPPER	PIPE-1	ORIFICE			
5	PIPE-3	POC-1	ORIFICE			
6	PIPE-1	POC-1	ORIFICE			
1	PIPE-3	POC-1	ORIFICE			
LOWER	PIPE-4	PIPE-3	ORIFICE			
7	PIPE-4	PIPE-3	ORIFICE			
8	C-UPPER	PIPE-2	ORIFICE			
9	C-UPPER	PIPE-2	ORIFICE			
10	C-UPPER	PIPE-2	ORIFICE			
11	B-UPPER	PIPE-1	ORIFICE			
12	B-UPPER	PIPE-1	ORIFICE			
B-GRATE	B-UPPER	PIPE-1	WEIR			
WEIR-PLATE	PIPE-1	POC-1	WEIR			
C-GRATE	C-UPPER	PIPE-2	WEIR			
WEIR-PLATE-2	PIPE-2	POC-1	WEIR			
A-GRATE	A-UPPER	PIPE-3	WEIR			
WEIR-PLATE-3	PIPE-3	POC-1	WEIR			
D-GRATE	D-UPPER	PIPE-4	WEIR			
2	PIPE-4	PIPE-3	WEIR			

****

```
Cross Section Summary
********************
                                     Full     Full     Hyd.     Max.  No. of     Full
Conduit          Shape               Depth    Area     Rad.    Width  Barrels    Flow
---------------------------------------------------------------------------------------



********************
Rainfall File Summary
********************
Station    First        Last         Recording   Periods    Periods    Periods
ID         Date         Date         Frequency  w/Precip    Missing    Malfunc.
-------------------------------------------------------------------------------
CCDA_Lindbergh 10/17/1948   12/31/2005      60 min     10219          0          0


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 10/17/1948 08:00:00
Ending Date .............. 12/31/2005 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:30:00
Dry Time Step ............ 00:00:00
Routing Time Step ........ 60.00 sec


********************
Control Actions Taken
********************


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Initial LID Storage ......         0.005         0.058
Total Precipitation ......        44.567       561.826
Evaporation Loss .........         9.580       120.769
Infiltration Loss ........         8.236       103.829
Surface Runoff ...........         8.061       101.624
LID Drainage .............        20.156       254.089
Final Storage ............         0.012         0.153
Continuity Error (%) .....        -3.307


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
```

```
**************************       ---------     ---------
Dry Weather Inflow .......           0.000         0.000
Wet Weather Inflow .......          28.217         9.195
Groundwater Inflow .......           0.000         0.000
RDII Inflow ..............           0.000         0.000
External Inflow ..........           0.000         0.000
External Outflow .........          28.265         9.211
Flooding Loss ............           0.000         0.000
Evaporation Loss .........           0.011         0.004
Exfiltration Loss ........           0.000         0.000
Initial Stored Volume ....           0.000         0.000
Final Stored Volume ......           0.000         0.000
Continuity Error (%) .....          -0.210


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    60.00 sec
Average Time Step           :    60.00 sec
Maximum Time Step           :    60.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Imperv Runoff in	Perv Runoff in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
BMP-A	561.83	14391.23	1083.20	0.00	0.00	0.00	13867.15	2.22	0.18	0.927
BMP-B	561.83	16292.62	912.57	1836.86	0.00	0.00	14102.54	2.18	0.24	0.837
BMP-C	561.83	16033.28	1124.99	0.00	0.00	0.00	15466.69	2.39	0.18	0.932
BMP-D	561.83	9999.07	968.75	0.00	0.00	0.00	9591.56	2.40	0.20	0.908
DMA-1	561.83	0.00	105.16	0.00	474.25	0.00	474.25	0.84	0.06	0.844
DMA-10	561.83	465.47	70.11	276.14	467.01	232.82	699.83	2.52	0.24	0.681
DMA-11	561.83	0.00	104.12	0.00	475.96	0.00	475.96	0.67	0.05	0.847
DMA-12	561.83	1014.00	82.54	244.12	888.84	389.19	1278.02	1.05	0.09	0.811
DMA-2	561.83	0.00	105.62	0.00	473.53	0.00	473.53	2.48	0.18	0.843

DMA-3	561.83	0.00	104.62	0.00	475.15	0.00	475.15	1.68	0.12	0.846
DMA-4	561.83	0.00	107.34	0.00	470.86	0.00	470.86	2.10	0.15	0.838
DMA-6	561.83	0.00	99.62	41.97	421.85	13.88	435.73	1.25	0.10	0.776
DMA-9	561.83	1473.67	35.09	760.77	0.00	1281.40	1281.40	1.82	0.19	0.630

****
LID Performance Summary
****

Subcatchment	LID Control	Total Inflow in	Evap Loss in	Infil Loss in	Surface Outflow in	Drain Outflow in	Initial Storage in	Final Storage in	Continuity Error %
BMP-A	BMP-A	14953.06	1083.26	0.00	3906.78	9961.09	2.10	4.96	-0.01
BMP-B	BMP-B	16854.45	912.61	1836.94	6342.86	7760.32	2.10	4.72	-0.01
BMP-C	BMP-C	16595.11	1125.04	0.00	4528.07	10939.31	2.10	5.93	-0.01
BMP-D	BMP-D	10560.89	968.79	0.00	1274.57	8317.38	2.10	2.90	-0.01

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
POC-1	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
B-UPPER	STORAGE	0.00	0.17	0.17	11448 11:39	0.13
PIPE-1	STORAGE	0.00	1.36	1.36	11448 11:43	1.28
C-UPPER	STORAGE	0.00	0.01	0.01	7804 10:32	0.01
PIPE-2	STORAGE	0.01	1.65	1.65	20526 18:30	1.60
PIPE-3	STORAGE	0.02	1.53	1.53	20463 21:34	1.31
A-UPPER	STORAGE	0.00	0.04	0.04	11448 11:32	0.03
D-UPPER	STORAGE	0.00	0.04	0.04	20463 21:32	0.03
PIPE-4	STORAGE	0.03	1.59	1.59	20463 21:32	1.58

****
Node Inflow Summary
****

```
-------------------------------------------------------------------------------------------
                                 Maximum  Maximum                  Lateral
                                 Total        Flow
                                 Lateral    Total  Time of Max      Inflow
                                 Inflow     Balance
```

Node	Type	Inflow CFS	Inflow CFS	Occurrence days	Occurrence hr:min	Inflow Volume 10^6 gal	Volume 10^6 gal	Error Percent
POC-1	OUTFALL	0.00	0.78	11448	11:34	0	9.21	0.000
B-UPPER	STORAGE	0.24	0.24	11448	11:31	0.982	0.982	-0.000
PIPE-1	STORAGE	0.00	0.22	11448	11:39	1.2	2.18	0.039
C-UPPER	STORAGE	0.18	0.18	11448	11:31	0.701	0.701	-3.837
PIPE-2	STORAGE	0.00	0.23	20526	18:30	1.69	2.42	0.207
PIPE-3	STORAGE	0.00	0.36	20463	21:32	1.6	4.62	0.036
A-UPPER	STORAGE	0.18	0.18	11448	11:31	0.626	0.626	-0.000
D-UPPER	STORAGE	0.20	0.20	20463	21:31	0.318	0.318	0.000
PIPE-4	STORAGE	0.01	0.20	20463	21:32	2.08	2.4	0.047

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CFS
B-UPPER	0.000	0	0	0	0.077	25	11448	11:38	0.22
PIPE-1	0.000	0	0	0	0.070	79	11448	11:42	0.22
C-UPPER	0.000	0	0	0	0.003	3	7804	10:32	0.23
PIPE-2	0.000	0	0	0	0.085	96	20526	18:30	0.31
PIPE-3	0.000	0	0	0	0.079	97	20463	21:34	0.35
A-UPPER	0.000	0	0	0	0.009	10	11448	11:31	0.18
D-UPPER	0.000	0	0	0	0.015	10	20463	21:32	0.20
PIPE-4	0.001	1	0	0	0.082	93	20463	21:31	0.20

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC-1	7.38	0.01	0.78	9.210
System	7.38	0.01	0.78	9.210

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
LOWER-ORIFACE	ORIFICE	0.04	11448 11:43			0.00
LOWER-ORIFACE-2	ORIFICE	0.01	20526 18:30			0.00
LOWER-ORIFACE-3	ORIFICE	0.01	20463 21:34			0.00
3	ORIFICE	0.03	11448 11:43			0.00
4	ORIFICE	0.07	11448 11:39			0.00
5	ORIFICE	0.33	20463 21:34			0.00
6	ORIFICE	0.15	11448 11:43			0.00
1	ORIFICE	0.01	20463 21:34			0.00
LOWER	ORIFICE	0.00	20463 21:32			0.00
7	ORIFICE	0.01	20463 21:32			0.00
8	ORIFICE	0.00	7804 10:32			0.00
9	ORIFICE	0.00	7804 10:32			0.00
10	ORIFICE	0.23	20526 18:30			0.00
11	ORIFICE	0.07	11448 11:39			0.00
12	ORIFICE	0.07	11448 11:39			0.00
B-GRATE	WEIR	0.00	0 00:00			0.00
WEIR-PLATE	WEIR	0.00	0 00:00			0.00
C-GRATE	WEIR	0.00	0 00:00			0.00
WEIR-PLATE-2	WEIR	0.30	20526 18:30			0.00
A-GRATE	WEIR	0.18	11448 11:32			0.00
WEIR-PLATE-3	WEIR	0.00	0 00:00			0.00
D-GRATE	WEIR	0.20	20463 21:32			0.00
2	WEIR	0.19	20463 21:32			0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Mon Dec 20 15:58:07 2021
Analysis ended on: Mon Dec 20 16:01:04 2021
Total elapsed time: 00:02:57

Underdrain and Drawdown Results

The following table summarizes the underdrain coefficients used for each of the BMP units and translates the C factor coefficient to an equivalent round orifice diameter based on 1/16th inch increments. The drawdown equations are based on standard falling head drawdown theory. The primary drawdown number of interest is the surface drawdown based on vector concerns. The various soil and gravel storage layer calculations consider the void ratio and porosity of the respective layer. It should be noted that these drawdown calculations only consider the volume of water within the bioretention units. If the bioretention unit utilizes any storage above the berm height, then that storage drawdown is in addition to the values shown in the table below. Those calculations, if present, are shown elsewhere in the report. The derivation and explanation of the equations used to determine the values displayed in the chart are discussed in the following two sections of this portion of the report.

Sub Cat Name*	LID Process*	LID Area (sf)*	Orifice D (1/16in)	UD C factor*	T surf (in)*	T soil (in)*	T store (in)*	n (soil)*	e (store)*	Drawdown surface (hr)	Drawdown Soil (hr)	Drawdown Storage (hr)	Drawdown total (hr)
BMP-A	BMP-A	250	4	0.08188	6	21	15	0.4	0.67	12.8	19.7	33.9	66.4
BMP-B	BMP-B	380	4	0.05387	6	21	15	0.4	0.67	19.4	29.9	51.6	100.9
BMP-C	BMP-C	250	8	0.08187	6	21	15	0.4	0.67	3.2	4.9	8.5	16.6
BMP-D	BMP-D	400	8	0.20469	6	21	15	0.4	0.67	5.1	7.9	13.6	26.6

The character * in the column heading indicates that the values was read directly from the SWMM inp file.
Assume: orifice coefficient C_o = 0.61, void ratio for surface = 1.0, centroid of underdrain orifice is located at h=0

Underdrain C Factor Equations

Based on the slotted drain example in the SWMM Drain Advisor (EPA SWMM 5.1 Help/Contents/Reference/Special Dialog Forms/LID Editors/LID Control Editor/LID Drain System/Drain Advisor) the underdrain coefficient C is the ratio of the orifice area (total slot area) to the LID area times a constant (60,000).

SWMM Ex: If the drain consists of slotted pipes where the slots act as orifices, then the drain exponent would be 0.5 and the drain coefficient would be 60,000 times the ratio of total slot area to LID area. For example, drain pipe with five 1/4" diameter holes per foot spaced 50 feet apart would have an area ratio of 0.000035 and a drain coefficient of 2.

The 60,000 constant in the above example corresponds to the combined constants in the standard orifice equation:

(Standard Orifice Equation)

$$q=C_oA_o\sqrt{2g\quad\overline{h}}\ (cfs)$$

and

(SWMM Underdrain Equation (per unit area))

$$q=q/A_{LID}$$

$$or$$

$$q=C_oA_o/A_{LID}\sqrt{2g\quad\overline{h}}\ (cfs/sf)$$

With a Co=0.6 and converting $\sqrt{2g}$ to units of inches and hours the constant becomes 60,046.

So the underdrain C factor per unit area of the LID becomes:

$$C=60{,}046\ A_o/A_{LID}\ (in^{\wedge 1/2}/hr)$$

$$and$$

$$q=C*h^{1/2}$$

Drawdown Equations

The drawdown equations presented in the chart are the drawdown times for the respective layers within the bioretention unit (only). If the bioretention unit includes storage ponding above the berm height, then the drawdown time for the storage portion is in addition to the values shown in the chart. Those calculations (if present) are shown elsewhere in the report. For most cases the storage drawdown time will be comparatively short as compared to the bioretention drawdown times.

To derive a general formula that relates drawdown time for each layer of the bioretention unit in terms of the SWMM C factor, we set the change in water volume with respect to time equal to the standard orifice equation (found in the County Hydraulics manual):

$$q = \frac{dh}{dt} nAp = CoAo\sqrt{2gh}$$

Where n = porosity of the layer, A_P = area of the BMP unit, Co = orifice coefficient, Ao = area of the orifice, and g = gravity constant. The porosity n for the surface layer is 1.0, and the values for the soil and storage layers read from the SWMM LID definitions.

Solving the definite integral from h1 to h2

$$\int_{h=h1}^{h=h2} h^{-0.5} dh = \int_{t=0}^{t=T} \frac{CoAo\sqrt{2g}}{nAp}\ dt$$

$$2(\sqrt{h2} - \sqrt{h1}) = \frac{CoAo\sqrt{2g}}{nAp}\ (T)$$

$$Or$$

$$2n(\sqrt{h2} - \sqrt{h1}) = C\ (T)$$

$$where: C = \frac{CoAo\sqrt{2g}}{Ap}\quad (in^{\wedge 1/2}/hr)$$

Solving for T:

$$T = \frac{2n(\sqrt{h2} - \sqrt{h1})}{C}\ (hr)$$

Where h2(in) is the total beginning head above the underdrain orifice at t=0 and h1(in) is the total ending head above the orifice at t=T. Ex: h2 for surface = depth of gravel storage plus depth of soil layer plus berm height, and h1 for surface = depth of gravel storage plus depth of soil layer.

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Attachment 3
Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

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Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 3	Maintenance Agreement (Form DS-3247) (when applicable)	☐ Included ☑ Not applicable

WILL BE PROVIDED WITH FINAL ENGINEERING CONSTRUCTION DOCUMENTS

Attachment 4
Copy of Plan Sheets Showing Permanent Storm Water BMPs

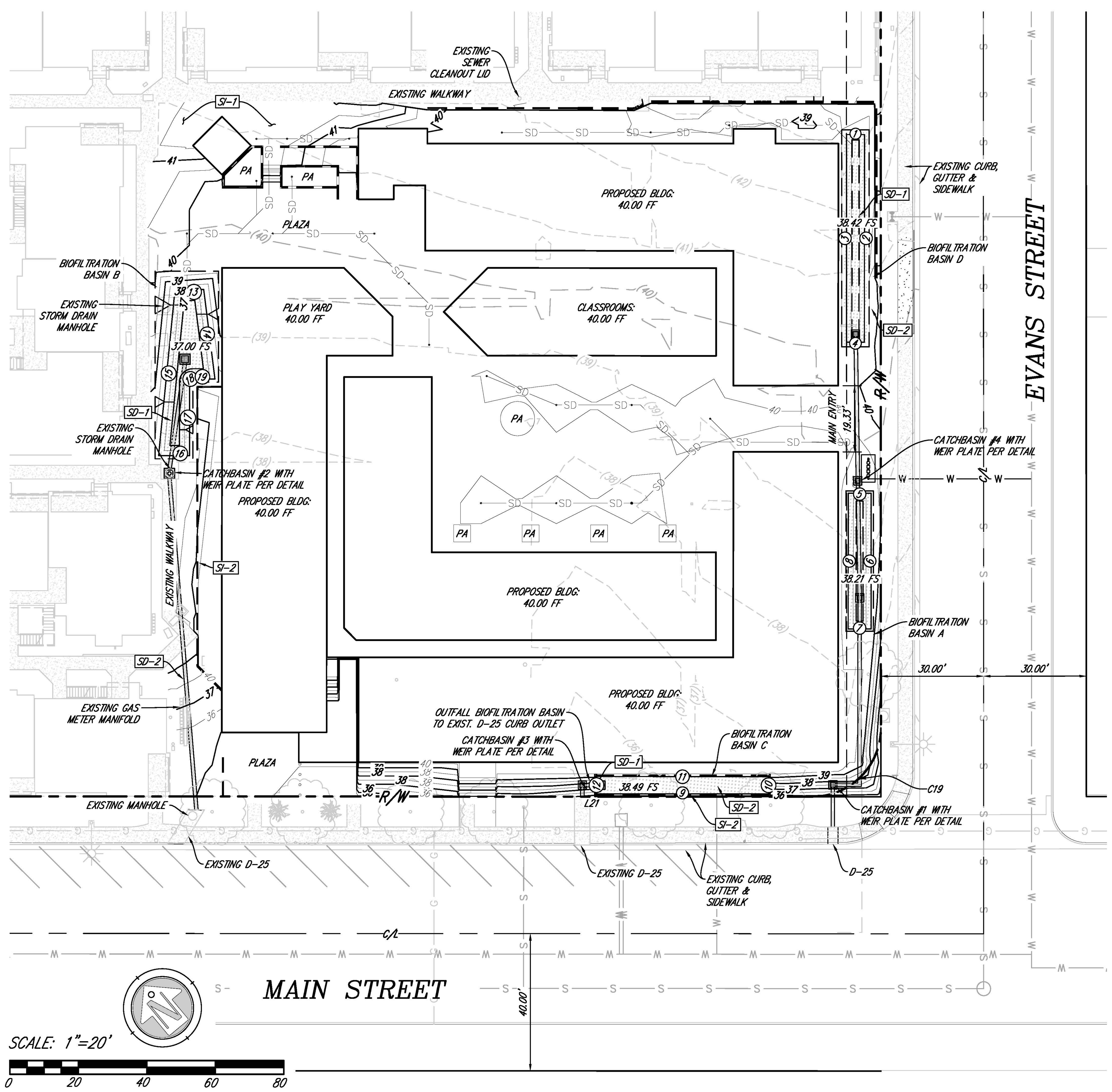
This is the cover sheet for Attachment 4.

Project Name: Mercado Apartments

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

The plans must identify:

- ☑ Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- ☑ The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- ☑ Details and specifications for construction of structural BMP(s)
- ☑ Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- ☑ How to access the structural BMP(s) to inspect and perform maintenance
- ☑ 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)
- ☑ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- ☑ 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)
- ☑ Recommended equipment to perform maintenance
- ☑ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
- ☑ 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.



STORM DRAIN IMPROVEMENTS

- SD-1 36"X36" CATCH BASIN
- SD-2 4" PVC AREA DRAIN
- SD-3 CURB OUTLET
- SD-4 12" PVC PIPE

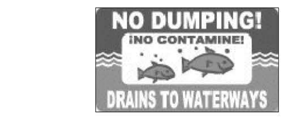
BMP IMPERMEABLE LINER DATA			
NO.	LENGTH	DELTA/BRG	RADIUS
1	6.50'	S50°10'26"E	--
2	61.86'	S39°49'16"W	--
3	61.86'	N39°49'16"E	--
4	6.50'	N50°10'26"W	--
5	6.50'	S50°10'31"E	--
6	39.50'	S39°49'29"W	--
7	6.50'	N50°10'31"W	--
8	39.50'	N39°49'29"E	--
9	50.00'	N50°10'31"W	--
10	5.00'	S39°49'29"W	--
11	50.00'	S50°10'31"E	--
12	5.00'	N39°49'29"E	--
13	4.44'	S54°15'43"E	--
14	24.81'	S32°39'28"W	--
15	46.72'	N45°26'59"E	--
16	3.94'	N50°10'31"W	--
17	20.61'	S39°49'29"W	--
18	2.29'	Δ=078°13'45"	1.68
19	5.63'	N50°10'31"W	--
C19	31.43'	Δ=090°02'41"	20.00

WATER QUALITY BASIN INSTALLATION NOTES:

1. 3 INCHES OF WELL-AGED, SHREDDED HARDWOOD MULCH.
2. AN UNDERDRAIN CLEANOUT WITH A MINIMUM 6-INCH DIAMETER AND LOCKABLE CAP IS PLACED EVERY 250 TO 300FEET AS REQUIRED BASED ON UNDERDRAIN LENGTH.
3. VEGETATION USED SHOULD BE SUITABLE FOR THE CLIMATE PER LANDSCAPE PLANS
4. FILTER COARSE IS A MINIMUM OF 6 INCHES PROVIDED IN TWO SEPARATE 3 INCH LAYERS. THE TOP LAYER SHALL BE MADE OF ASTM C33 CHOKER SAND AND THE BOTTOM LAYER BE OF ASTM NO. 8 AGGREGATE. MARKERS STAKES SHALL BE USED TO ENSURE UNIFORM LIFT THICKNESS.
5. AASHTO NO. 57 STONE OR CLASS 2 PERMEABLE PER CAL TRANS SPECIFICATION 68-1.025 IS RECOMMENDED FOR THE AGGREGATE STORAGE LAYER. WASHED, OPEN-GRADED CRUSHED ROCK MAY BE USED, HOWEVER, A 3 INCH MINIMUM WASHED ASTM NO. 8 AGGREGATE FILTER COURSE LAYER AT THE TOP OF THE CRUSHED ROCK IS REQUIRED.
6. IMPERMEABLE LINER SHALL BE INSTALLED WHEN THE BIOFILTRATION BASIN IS WITHIN 10 FEET OF RETAINING WALLS OR BUILDING FOUNDATIONS, OR AS RECOMMENDED BY THE SOILS ENGINEER, OR REQUIRED BY THESE PLANS. IMPERMEABLE LINER SHALL BE 30 MIL THICK (PER COUNTY OF SAN DIEGO GREEN STREETS DESIGN STANDARD DRAWING GS-3.00 AND COUNTY GREEN STREETS SUPPLEMENT TO CAL TRANS SPECIFICATIONS 20-11.08B) CONFIGURED TO ENTIRELY ENCOMPASS THE SIDES OF THE WATER QUALITY BASIN.
7. IMPERMEABLE LINER BE CONSTRUCTED IN COMPLIANCE WITH THE COUNTY OF SAN DIEGO GREEN STREETS SUPPLEMENT TO CAL TRANS SPECIFICATIONS 20-11.08B IF SOIL MEDIA LESS THAN 5IN/HR.
8. BIOFILTRATION SOIL MEDIA LAYER (BSM) SHALL CONSIST OF 60% TO 80% BY VOLUME SAND, UP TO 20% BY VOLUME TOPSOIL, AND UP 20% BY VOLUME COMPOST (PER COUNTY OF SAN DIEGO BMP DESIGN MANUAL SEPTEMBER 2020 APPENDIX F.2 SECTION 803-2 BLENDED BSM CRITERIA AND TESTING REQUIREMENTS) PLACED IN 6" LIFTS AND COMPACTED WITH WATER PRIOR TO THE NEXT LIFT. INITIAL PERMEABILITY SHALL BE 8" PER HOUR (WITH ASSUMED STABILIZED PERMEABILITY OF 5" PER HOUR).
9. 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.
10. THE DEPTH OF AGGREGATE PROVIDED (12-INCH TYPICAL) AND STORAGE LAYER CONFIGURATION IS ADEQUATE FOR PROVIDING CONVEYANCE FOR UNDERDRAIN FLOWS TO THE OUTLET STRUCTURE.
11. OVERFLOW STRUCTURE TO HAVE A MINIMUM OF 2 INCHES OF FREEBOARD FOR NON-CONJUNCTIVE USE BASINS.
12. ALL LINER INSTALLATIONS, FIELD WELDING OF SEAMS, AND OBSERVATION OF SOIL MIX PLACEMENT SHALL REQUIRE SPECIAL INSPECTION BY THE PROJECT GEOTECHNICAL ENGINEER OR OTHER QUALIFIED PERSON. A LETTER CERTIFYING PROPER INSTALLATION SHALL BE PROVIDED TO THE ENGINEER OF RECORD TO ACCEPTANCE OF THE FACILITIES.
13. SPECIAL INSPECTION SHALL BE REQUIRED FOR CONSTRUCTION OF ALL BIOFILTRATION BASINS. INSPECTION SHALL BE PERFORMED BY A QUALIFIED INDIVIDUAL (SUCH AS: ENGINEER OF RECORD, QSD). INSPECTION SHALL INCLUDE:
   - VERIFICATION OF OVERALL DIMENSIONS PRIOR TO PLACEMENT OF MATERIALS;
   - PLACEMENT OF THE LINER, IF REQUIRED;AND SEAMS OR PENETRATIONS
   - PLACEMENT OF THE GRAVEL, FILTER MATERIALS, AND FILTER MEDIA;
   - ALL INLET AND OUTLET STRUCTURES INCLUDING UNDERDRAINS, IF REQUIRED.
   - CONTRACTOR SHALL TAKE PICTURES AT EACH STAGE OF INSTALLATION AND SUBMITTED TO ENGINEER FOR VERIFICATION OF INSTALL.

   INSPECTOR SHALL BE GIVEN A MINIMUM OF 48 HOURS PRIOR TO INSPECTION. UPON COMPLETION THE INSPECTOR SHALL PROVIDE A CERTIFICATION TO THE ENGINEER OF WORK.

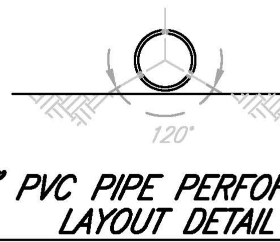
13. PROPOSED MATERIALS, SUCH AS AGGREGATE, FILTER MATERIAL, AND FILTER MEDIA SHALL BE SUBMITTED TO THE ENGINEER OF WORK FOR APPROVAL.



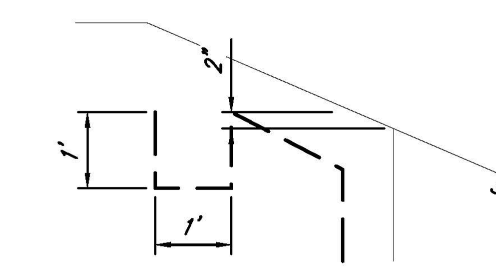
DETAIL
"NO DUMPING" AT CATCH BASINS

NOTE: ALL CATCH BASINS WITH GRATES SHALL BE STENCILED WITH CITY REQUIRED ITEM PER ABOVE DETAIL:

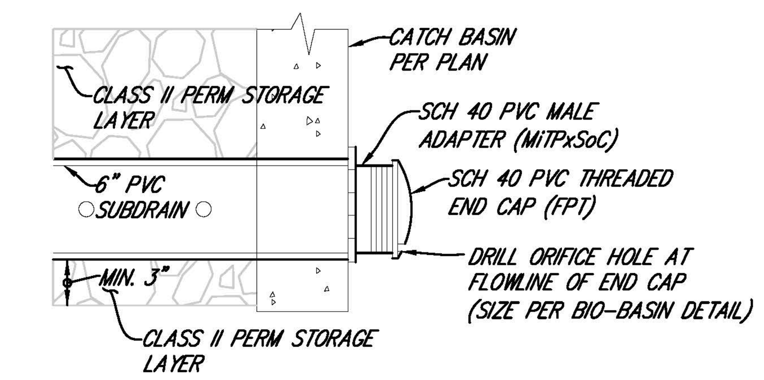
(DAS MANUFACTURING #SDO OR EQUIVALENT)



6" PVC PIPE PERFORATION LAYOUT DETAIL
NOT TO SCALE



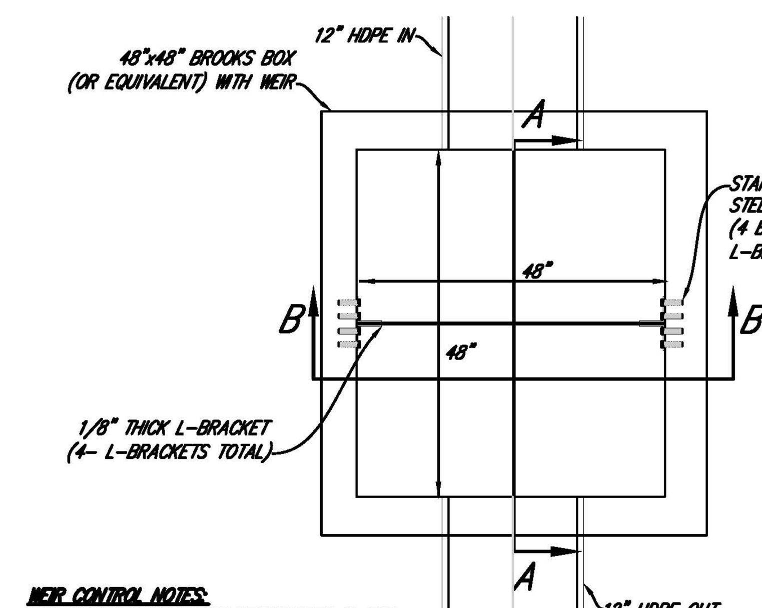
IMPERMEABLE LINER EDGE ANCHOR DETAIL
NOT TO SCALE



ORIFICE DETAIL
NOT TO SCALE

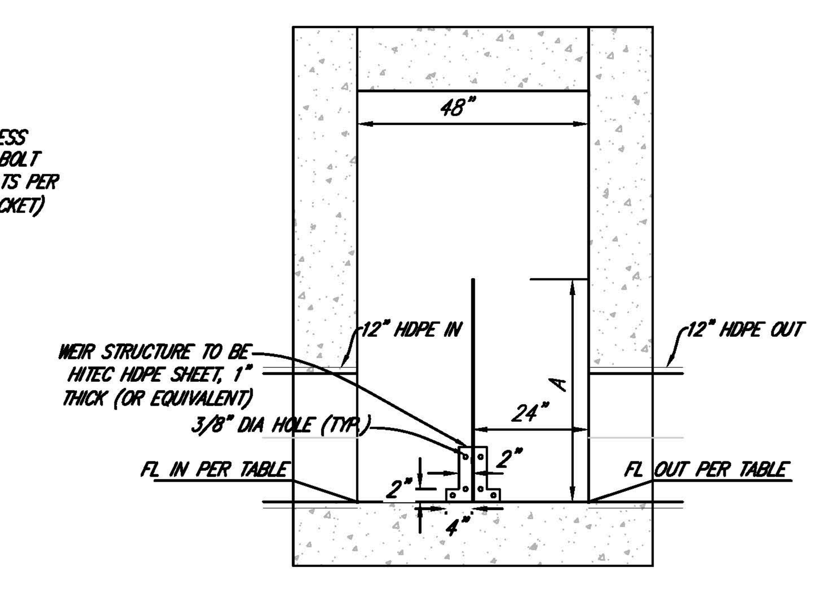
NOTE: THE PROPOSED PROJECT WILL COMPLY WITH ALL THE REQUIREMENTS OF THE CURRENT CITY OF SAN DIEGO STORM WATER STANDARDS MANUAL BEFORE A GRADING OR BUILDING PERMIT IS ISSUED. IT IS THE RESPONSIBILITY OF THE OWNER/DESIGNER/APPLICANT ENSURE THAT THE CURRENT STORM WATER PERMANENT BMP DESIGN STANDARDS ARE INCORPORATED INTO THE PROJECT.

WEIR CONTROL STRUCTURE SUMMARY TABLE								
CATCHBASIN NUMBER	FL/IE IN	FL/IE OUT	A (INCH)	B (INCH)	C (INCH)	D WIDTHxHEIGHT (INCHXINCH)	E WIDTHxHEIGHT (INCHXINCH)	F WIDTHxHEIGHT (INCHXINCH)
1	35.07	35.06	20	9	6	½ x ½	½ x ½	4x3
2	34.50	34.50	21	12	6	1x1	1x1	4x4
3	35.57	35.51	18	–	–	½ x ½	–	–
4	35.65	35.65	18	–	9	½ x ½	–	–

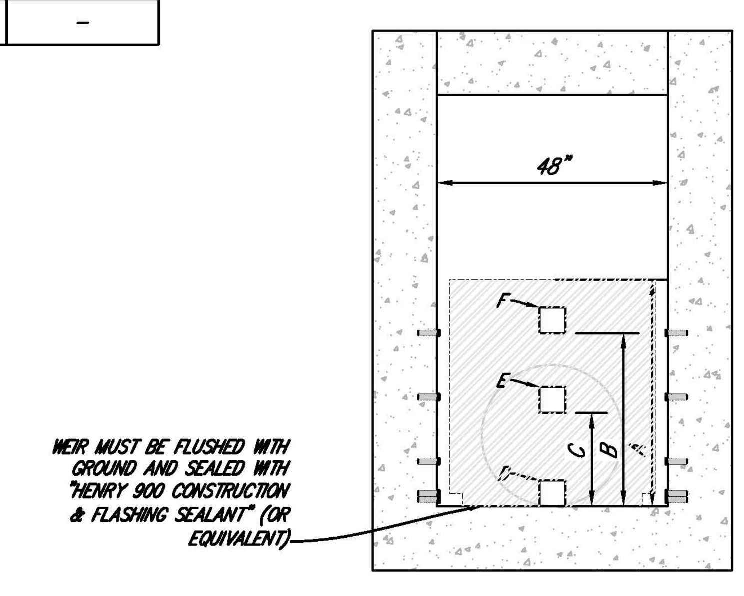


WEIR CONTROL NOTES:
THE PURPOSE OF THESE STRUCTURES IS FOR HYDROMODIFICATION FLOW CONTROL SEPARATE FROM TYPICAL BIOFILTRATION FLOW MODELING.

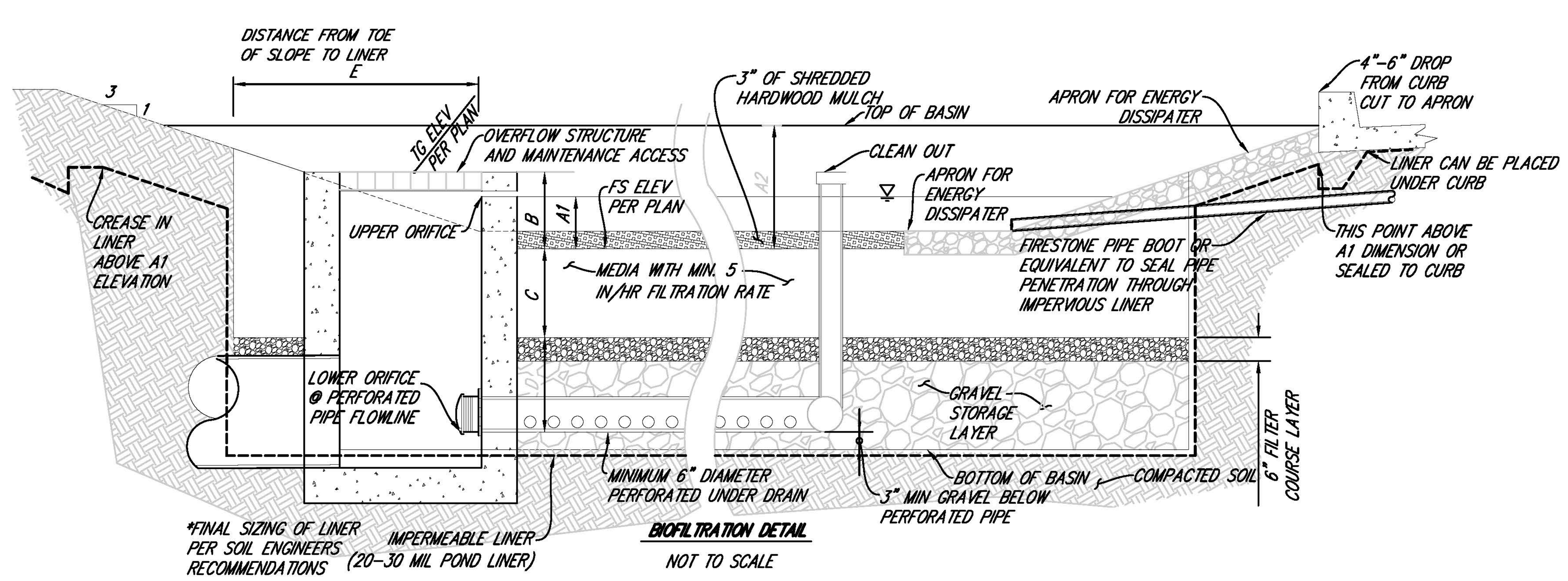
WEIR CONTROL STRUCTURE DETAIL 1
NOT TO SCALE



SECTION A-A
NOT TO SCALE



SECTION B-B
NOT TO SCALE



BIOFILTRATION DETAIL
NOT TO SCALE

BIOFILTRATION BASIN SUMMARY TABLE														
BASIN NAME	WATER QUALITY EFFECTIVE AREA (SQFT)	AREA OF FINISH SURFACE (SQFT)	VOLUME (CU-FT)	A1 (INCH)	A2 (INCH)	B (INCH)	C (INCH)	D (INCH)	E (FEET)	CATCHBASIN SIZE (INCHES)	LOWER ORIFACE DIAMETER (INCH)	UPPER ORIFACE NUMBER @ LENGTHXHEIGHT (INCH)	IMPERMEABLE LINER
BMP-A	250	70	198	–	12	9	18	12	2.25	48X48	0.5	—	YES
BMP-B	380	146	587	6	12	9	18	12	2.25	48X48	0.5	3 @ 6X1	YES
BMP-C	250	250	255	6	12	9	18	12	2.25	48x48	0.25	3 @ 1X1	YES
BMP-D	400	115	311	–	12	9	18	12	2.25	48x48	0.25	–	YES

EXCEL ENGINEERING
LAND PLANNING • ENGINEERING • SURVEYING
440 STATE PLACE, ESCONDIDO, CA 92029
PH (760)745-8118 FX (760)745-1890

PRIVATE CONTRACT

PLAN SET DATE: 10-24-2022
REVISED: 10-18-2023

BMP SHEET FOR:
MERCADO APARTMENTS
2001 NEWTON AVE
SAN DIEGO, CA 92113

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 4 OF 5 SHEETS

PROJECT NO.

V.T.M.

FOR CITY ENGINEER | DATE

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	EXCEL			
AS-BUILTS				

1882-6245
NAD83 COORDINATES

192-1722
LAMBERT COORDINATES

CONTRACTOR____ DATE STARTED____
INSPECTOR____ DATE COMPLETED____

Sheet TM-4

K:\21\21061\Engineering\SDP\Sheets - SDP\21061-TM04 BMP SHEET.dwg 10/17/2023 5:36 PM ORIGINAL PLOT SIZE: ----

Attachment 5
Drainage Report

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

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Hydrology Report

Mercado Apartments

2001 Newton Avenue
San Diego, CA, 92113

Prepared for:
MAAC
1355 Third Avenue
Chula Vista CA, 91911

Prepared by:

EXCEL ENGINEERING
LAND PLANNING ENGINEERING SURVEYING

440 State Place
Escondido, CA 92029
Tel: (760) 745-8118
Project No: 21061

Date Prepared:
January 23, 2023

Table of Contents

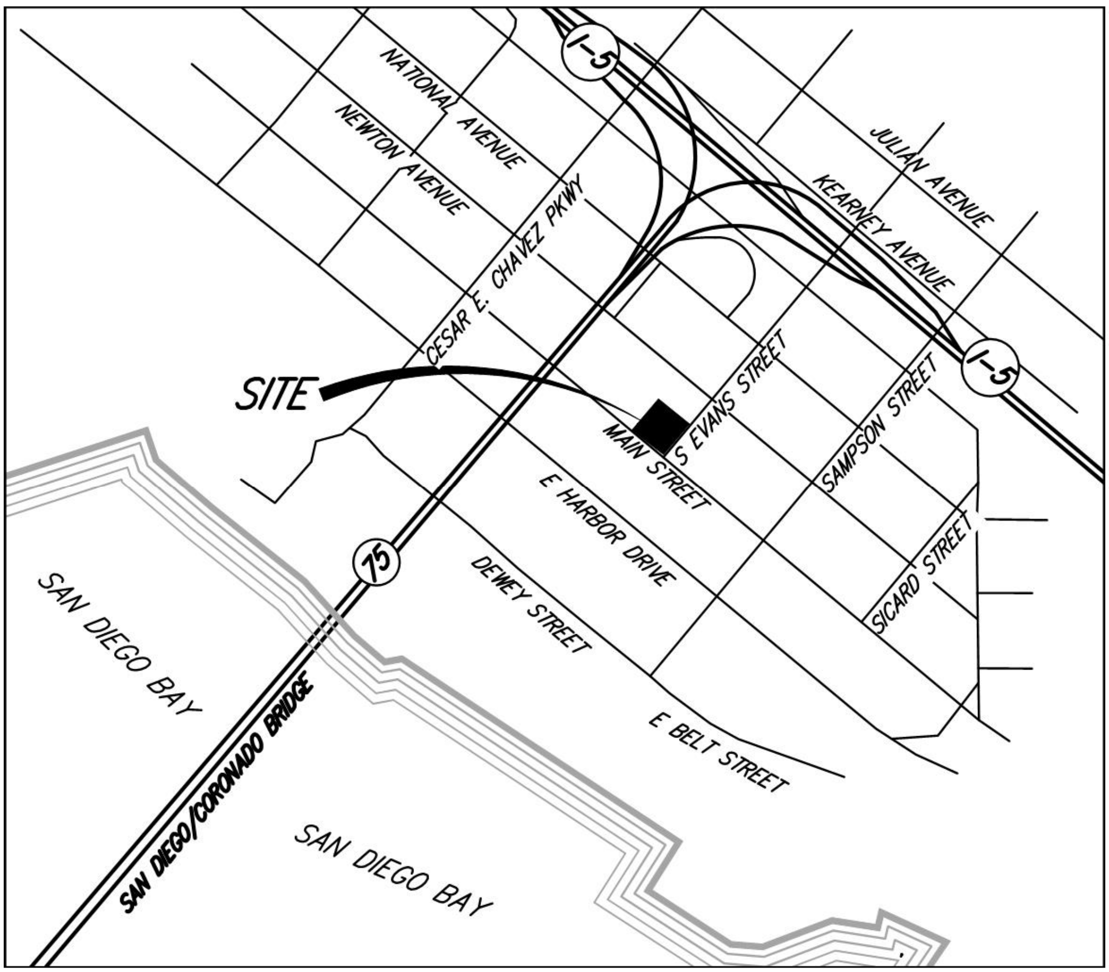
1.0 Project Description

1.1 Project Purpose

This project proposes to remove the existing apartment complex and build new apartments with a center courtyard, a play yard and amenities.

1.2 Project Location and Vicinity Map

This project is located in the City of San Diego near the I-75 and 1-5 interchange at the intersection of Main Street and South Evans Street.



2.0 Description of Watershed

2.1 Pre-Development and Existing Conditions

The existing site consists primarily of apartment buildings and a parking lot. The parking lot slopes generally to the southwest between 0.5% and 2%. Flows from the parking lot either go to a southerly D-25 that outlets water to the street or enter a storm drain system that outlets at another D-25 at the west corner of the project. Offsite street flows follow the gutter flow line and all water from the site confluences at one main POC at the west corner of the site.

2.2 Post-Development Conditions

The proposed site consists of apartment buildings, a center plaza and various landscaped areas around the project. Water from the roof is captured with roof drains and is conveyed by either area drains or sheet flow to one of 4 biofiltration basins. All other water that falls on the site will be routed to the biofiltration basins through area drains or sheet flow as well. Water in the biofiltration basin flows through the basin's media, and when water exceeds the basin capacity it overtops a catch basin where it is piped to one of three outlets that lead to the street. From here, all three of the outlets flow along the existing gutter and confluence at the POC at the west corner of the site.

2.3 Hydrologic Unit Contribution

This Project lies within the San Diego Bay Watershed of the San Diego Mesa Hydrologic Unit (908.2).

3.0 Methodology

3.1 Hydrology Software

The main program is the "San Diego County Rational Hydrology Program" by CIVILCADD/CIVILDESIGN Engineering Software, 1991-2004 Version 7.4, refereed hereafter as "CIVILD". This program specifically utilizes the methods prescribed in the County of San Diego Hydrology Manual and is one of the approved programs for the use in the San Diego area.

3.2 Routing Software

AutoCad 2015 Hydraflow Hydrograph extension is used in this step to allow the proposed water quality treatment ponds to be used as flow control facilities. The hydrograph developed from the rational method is then manually entered into this software and routed into a detention pond.

3.3 Soils Type Determination

See appendix E for more the Soil Group determination map information. The area on and around this site does not have a soil type classification because of it's urban status. Because of this, a soil type "D" was used because it is the most common soil type found closest to the site.

3.4 Isopluvial Value Determination

The isopluvial values for the 100-year 6 hour and 24-hour storm events were determined by plotting the projects location on the respective exhibits from Appendix B of the Hydrology Manual.

4.0 Calculations

4.1 Determine Project Watershed

To determine if the proposed project will have a negative impact of the downstream facilities, the proposed site design must ensure that the peak flow from the 100-year storm are equal to or less than the existing peak flow conditions.

4.2 Calculate Runoff Coefficient

The proposed project and offsite runoff area is believed to be primarily within hydraulic soil group D.

To determine the runoff coefficient "C" for this study, Table 3-1 of the San Diego Hydrology Manual is utilized. The percent impervious for each area and a soil type D was used to calculate the "C" value for each node in both the existing and the proposed conditions.

For the proposed condition, the "C" value for the buildings and middle courtyard was calculated using the maximum impervious percentage in the table of 95% and a soil type D. For the rest of the site, the percent impervious for the non-roof areas was calculated and the appropriate "C" value using the percent impervious and soil type D was used. Please refer to the calculations in Appendix D and Table 3-1 in the San Diego Hydrology manual for the runoff coefficient used for each node.

4.3 Calculate Storm Flows Using the Rational Method

The Rational Method (RM) is used to determine the maximum runoff rate from the 100-year storm event. The RM application is highly effective in urban and rural watersheds for the design of storm drains and small drainage structures. Application of the rational method is based on a simple formula that relates runoff producing potential of the watershed drainage area (A), runoff coefficient (C) rainfall intensity (I) for a particular length of time (T_c), which is the time required for water to flow from the most remote point of the basin to the location being analyzed. Thus the following equation is used:

Q = CIA

Where:
Q = peak discharge, in cubic feet per second (cfs)
C = runoff coefficient
I = average rainfall intensity for a duration equal to Tc
T_c = time of concentration (note: if the computed Tc is less than 5 minutes, then use 5 minutes for computing the peak discharge, Q)
A = Drainage area contributing to the design location, in acres

A summary table of the pre- and post- development flows at the POC is shown below. Since all post-development flows are less than the pre-development flows, the site will not have a negative impact on the downstream facilities.

100 Year Runoff Flows	
Pre-Development	7.661 CFS
Post-Development	5.700 CFS

5.0 Other Studies

5.1 Storm Water Quality Management Plan (SWQMP)

Please see the Storm Water Quality Management Plan that was submitted with the Precise Grading Plan and Report.

6.0 Summary/Conclusion

The proposed project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. No significant alteration of any stream or river will occur on this site due to grading operations. All defined drainage channels are due to erosive effects of high velocity runoff from the uphill slopes. The development of the site will help mitigate further erosion downstream.

The proposed project does not create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems. The flows from the project leave the site at less than predeveloped rates per the mitigated flow rates shown.

The proposed project does not place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps. No housing is proposed, and no FIRM identified flood hazard areas are located on the parcel.

The proposed project does not place structures within a 100-year flood hazard area which would impede or redirect flood flows. No FIRM identified flood hazard areas are located on the parcel.

The proposed project does not expose people or structures to a significant risk of loss, injury or death involving flooding as a result of the failure of a levee or dam. No levees or dams are proposed, and all runoff is being mitigated in properly designed flow control basins with redundancies. This will be noted in the conclusion.

Because the project is not located within or discharges to navigable waters, water of the United States, or federal jurisdictional wetlands, as defined by the Clean Water Act, no 401/404 permit is required.

The analysis of the 100-year storm event shows that this project will effectively convey the resulting runoff in the mitigated condition.

7.0 References

County of San Diego, Department of Public Works, Flood Control Section, June 2003 San Diego County Hydrology Manual

8.0 Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project. That I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions codes, and that the design is consistent with current design.

I understand that the check of the project drawings and specifications by the City of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

ENGINEER OF WORK
Excel Engineering
440 State Place
Escondido, CA 92029
Tel – (760)745-8118
Fax – (760)745-1890

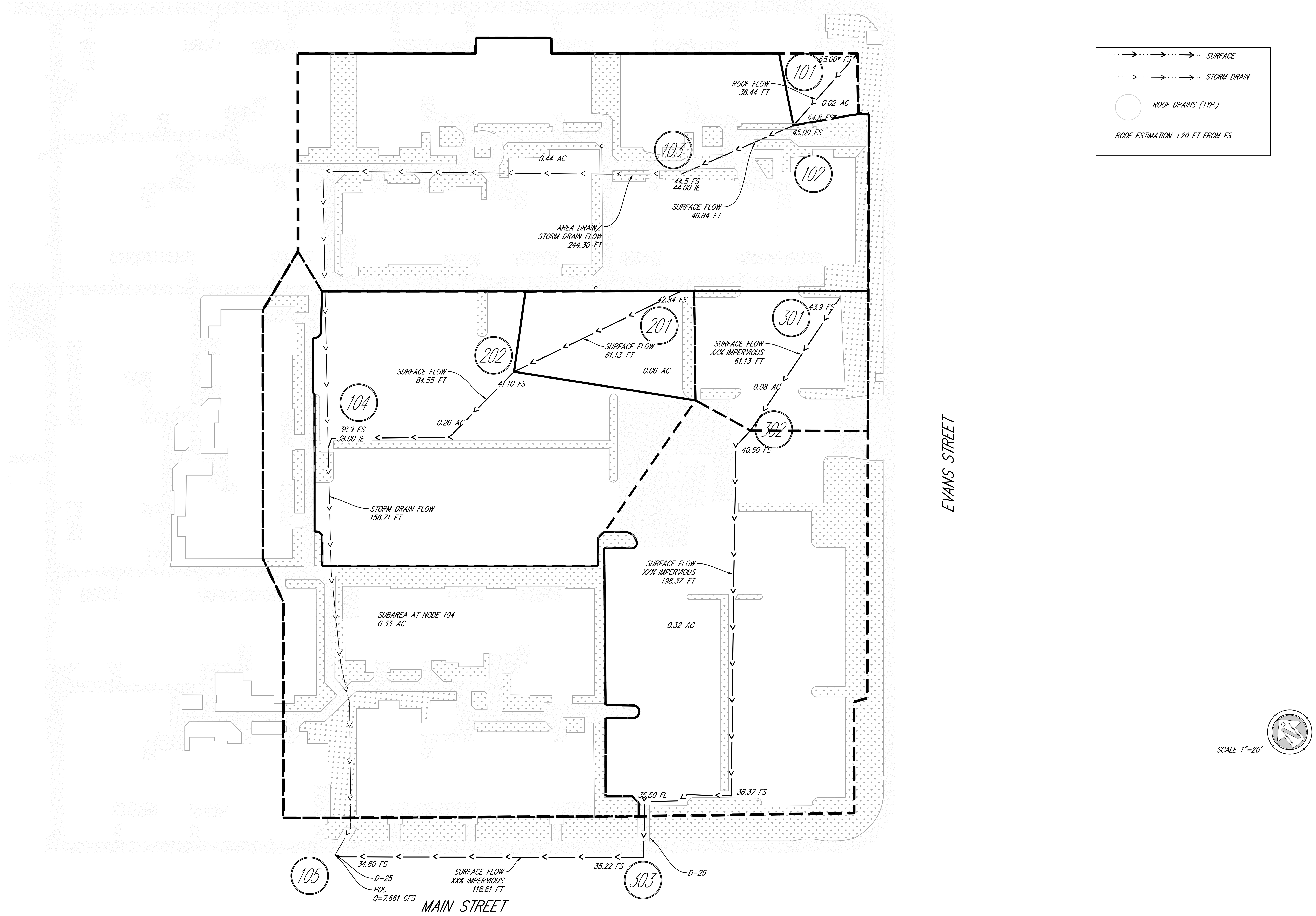
Project Number: 21061

12/23/2024

Robert D. Dentino, RCE 45629 Date
Registration Expires: December 31, 2026

9.0 Attachments

Attachment A – Pre & Post Development Hydrology Maps



PRE-DEVELOPMENT EXHIBIT

MERCADO

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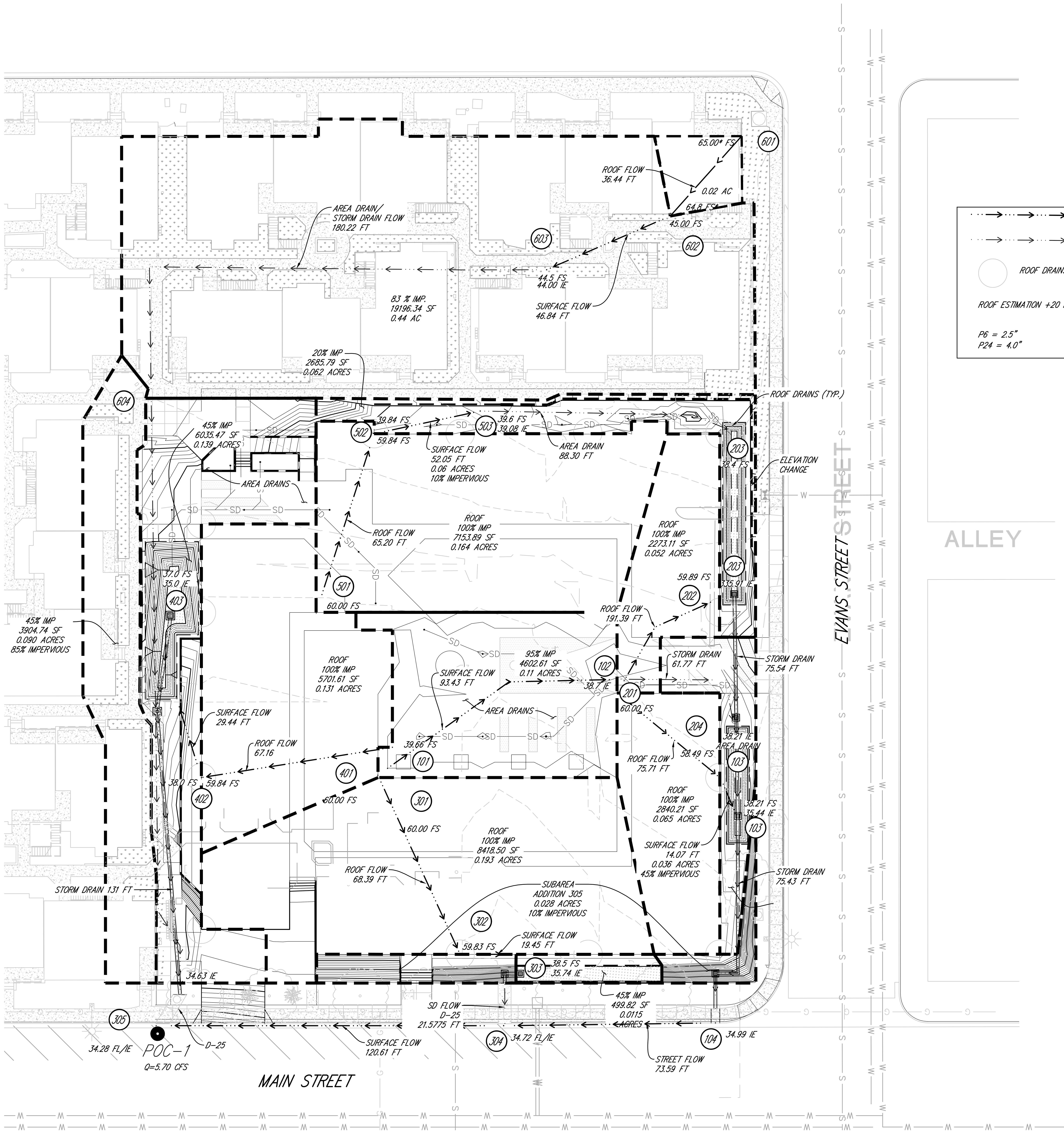

SURFACE

STORM DRAIN

ROOF DRAINS (TYP.)

ROOF ESTIMATION +20 FT FROM FS

P6 = 2.5"
P24 = 4.0"

SCALE 1"=20'

POST-DEVELOPMENT EXHIBIT
MERCADO

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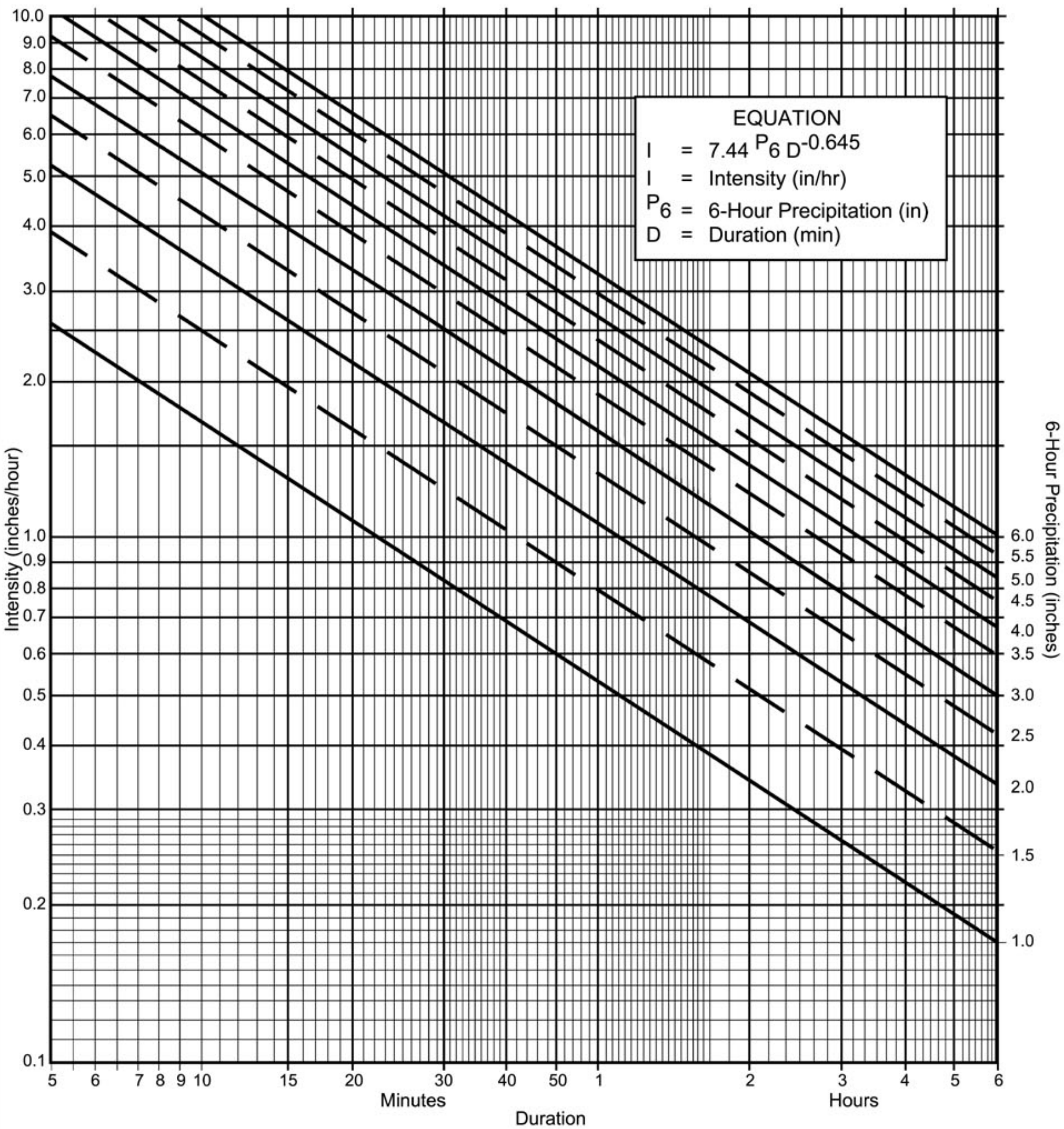
Attachment B - Figures and Tables from the SD Hydrology Manual 2003

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service



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 ______ year

(b) P_6 = ______ in., P_{24} = ______, $\frac{P_6}{P_{24}}$ = ______ %(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

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

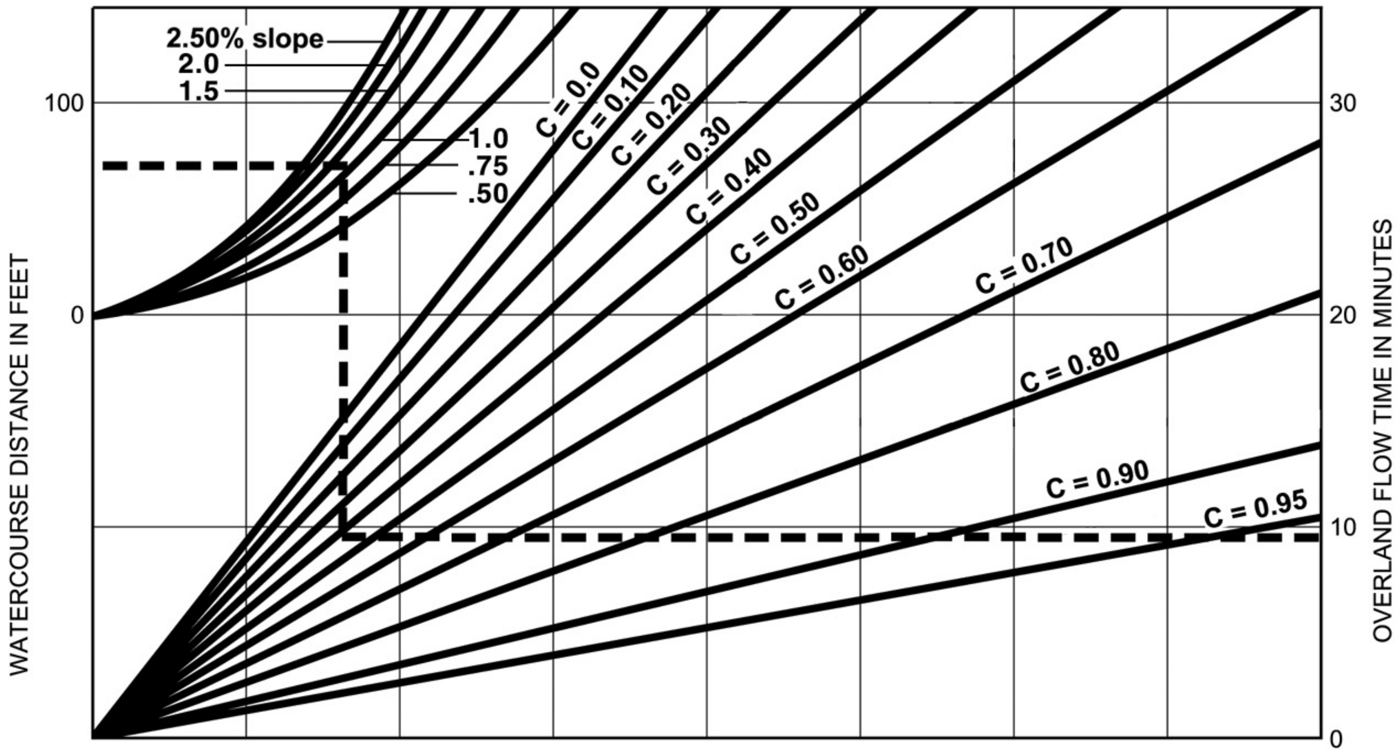
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description



EXAMPLE:

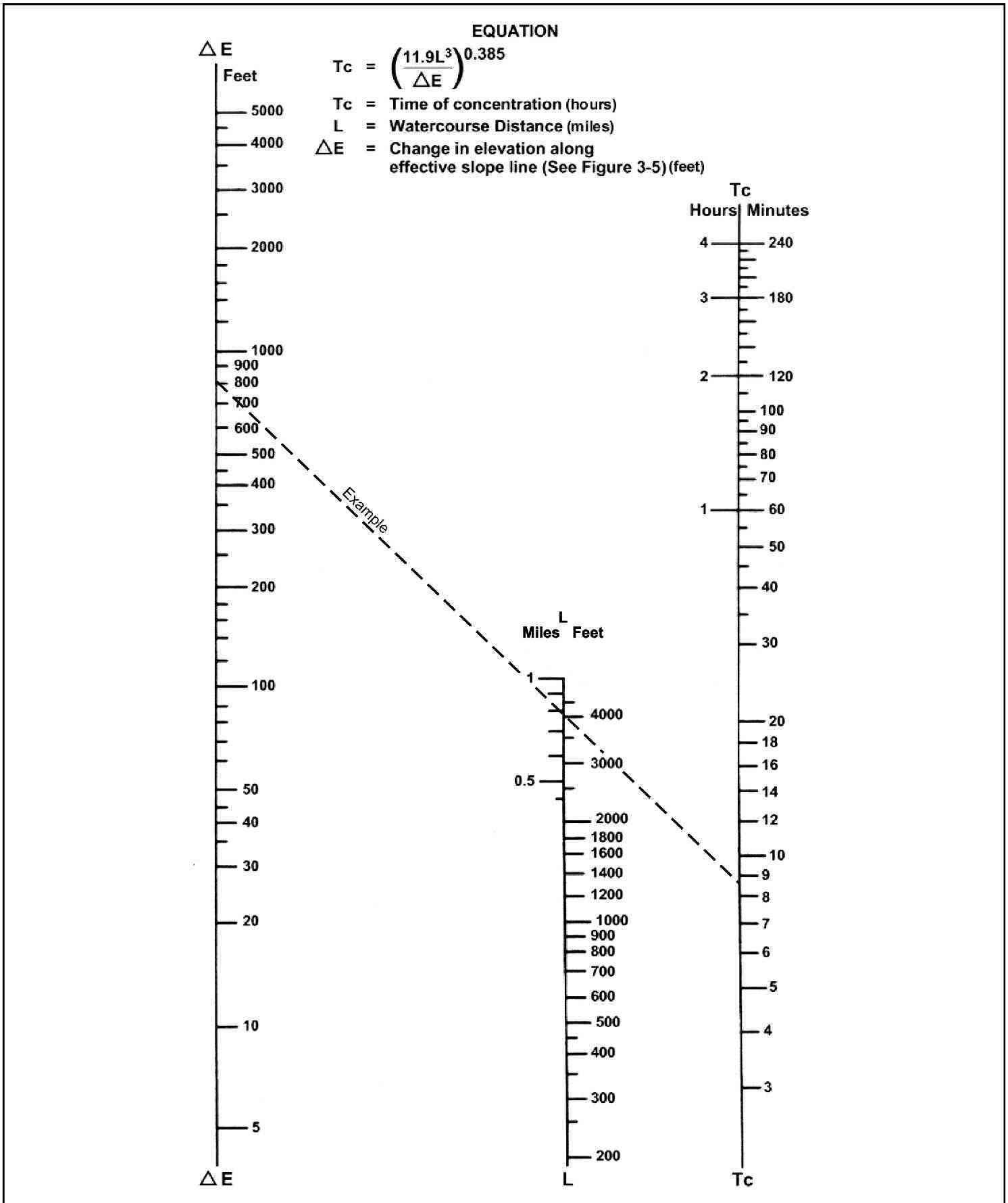
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

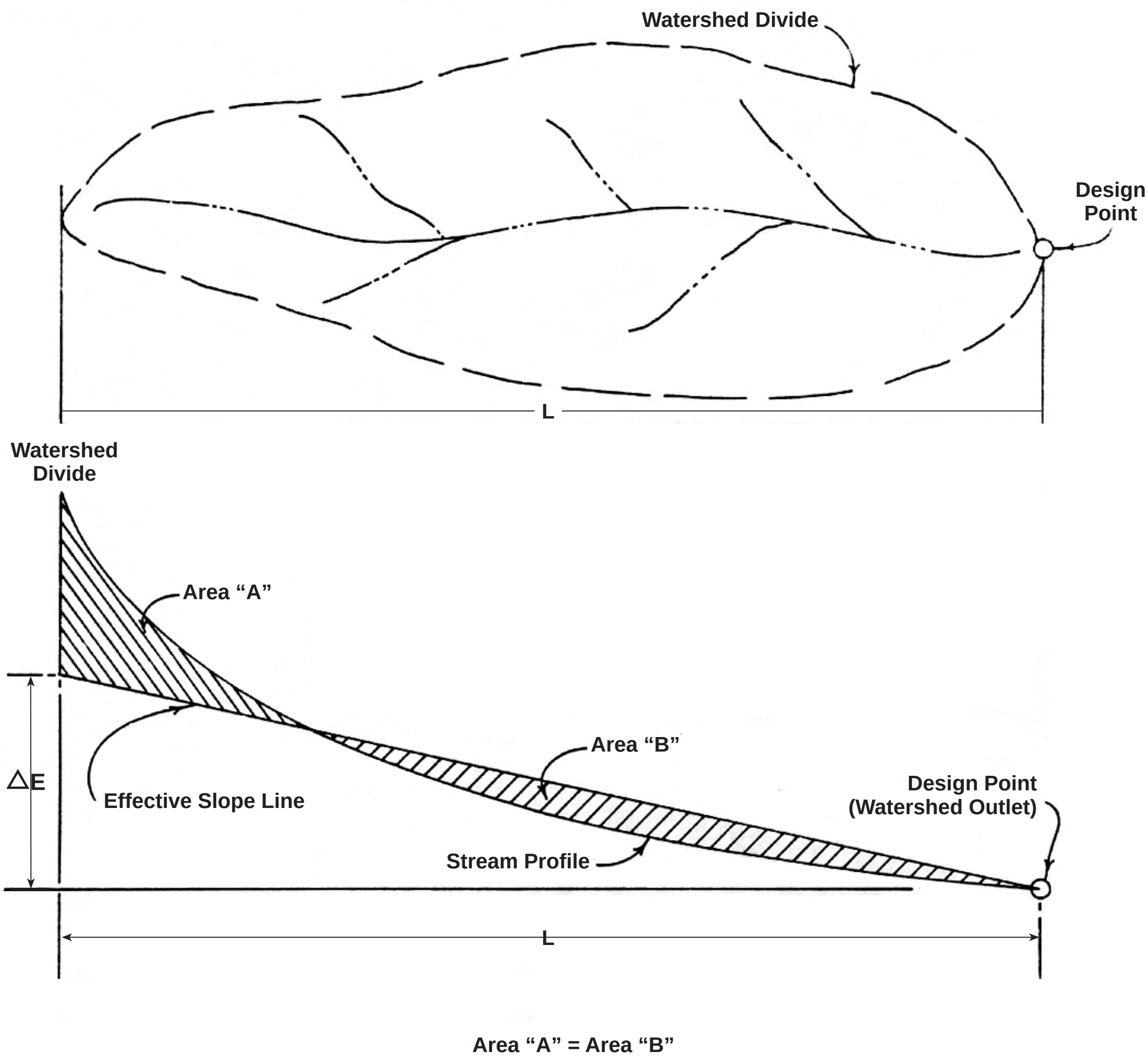


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

3-4

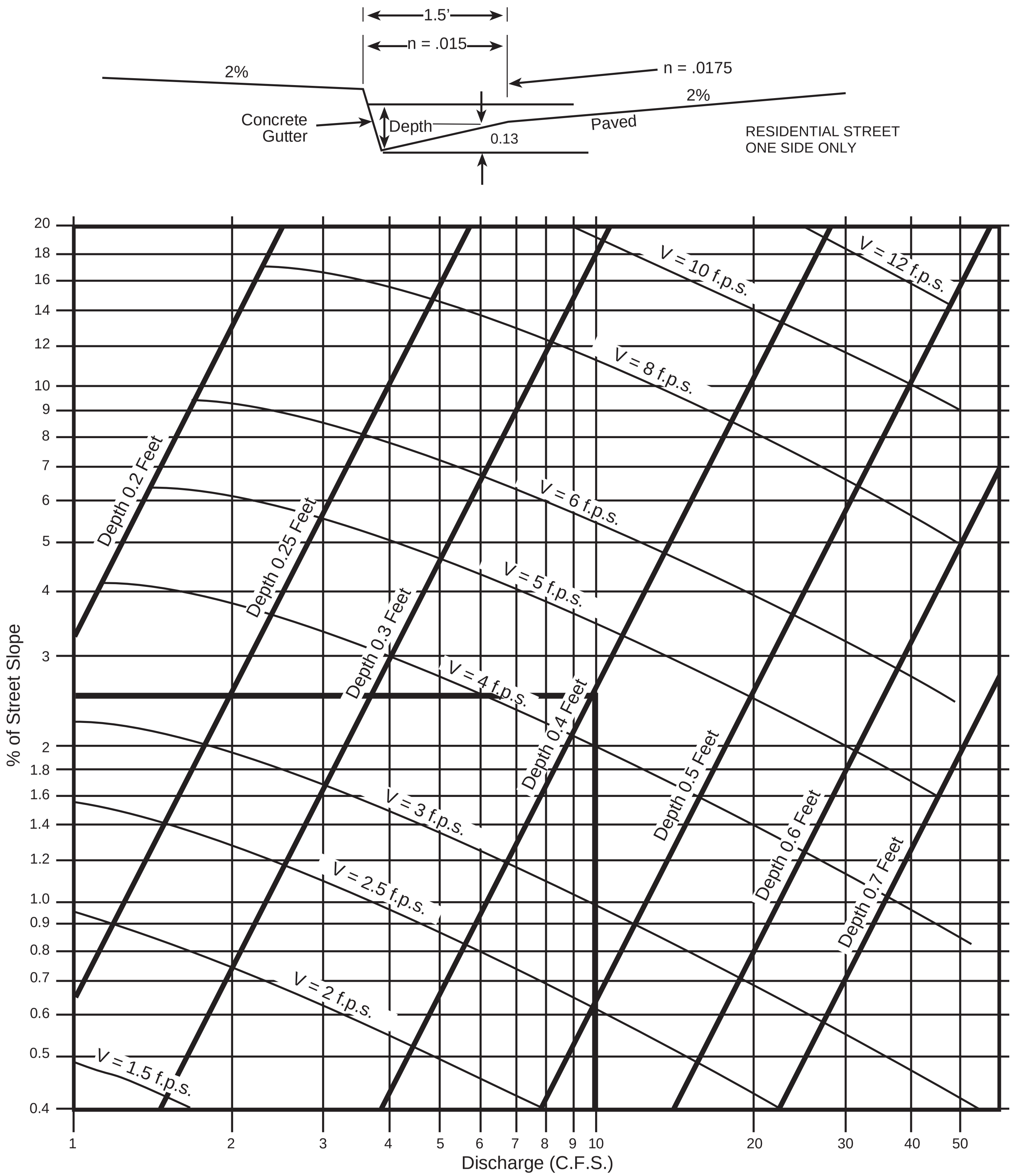
Nomograph for Determination of Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-5

Computation of Effective Slope for Natural Watersheds



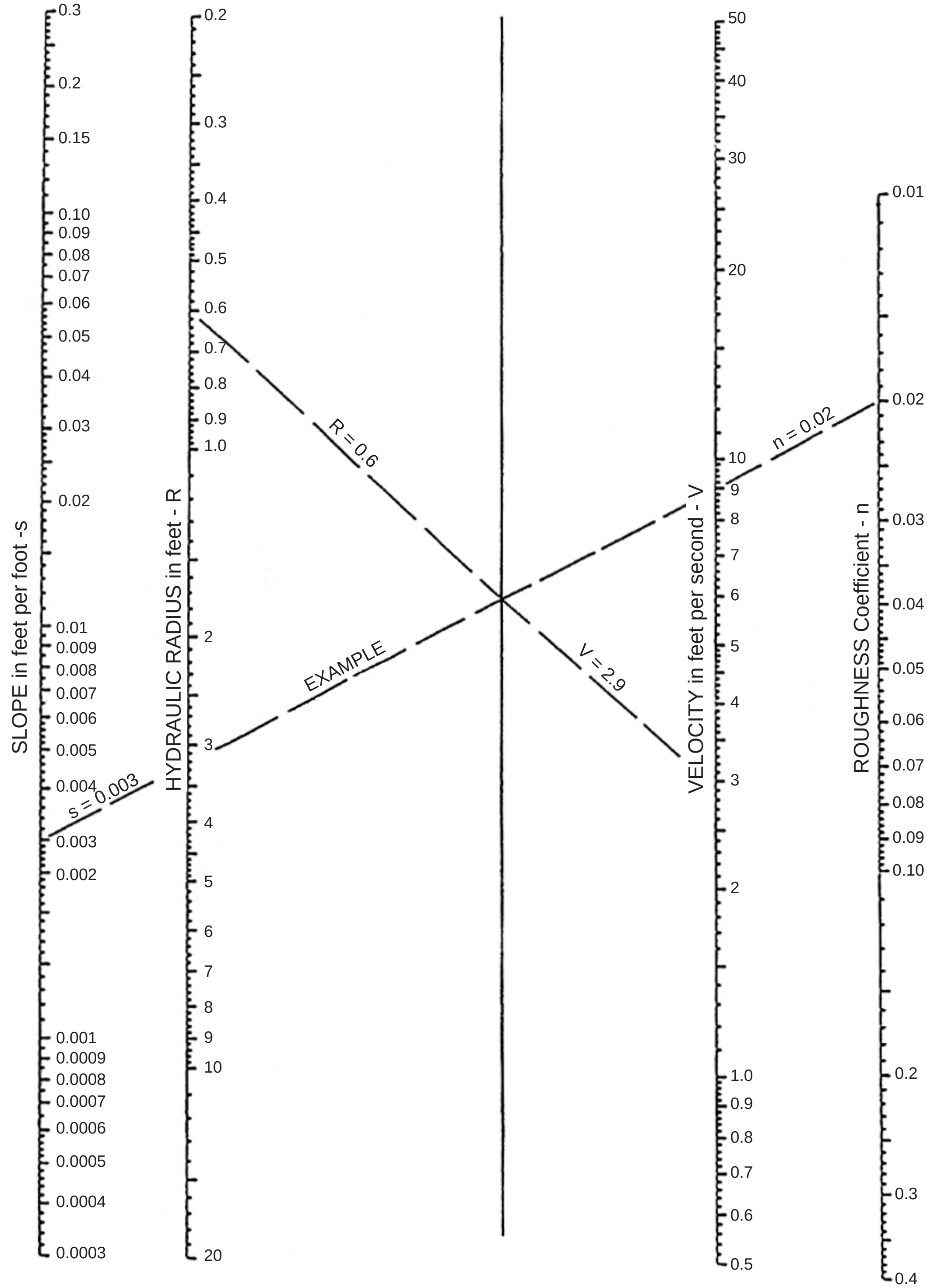
EXAMPLE:
Given: Q = 10   S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE 3-6

Gutter and Roadway Discharge - Velocity Chart

EQUATION: $V = \frac{1.49}{n} R^{2/3} s^{1/2}$



GENERAL SOLUTION

SOURCE: USDOT, FHWA, HDS-3 (1961)

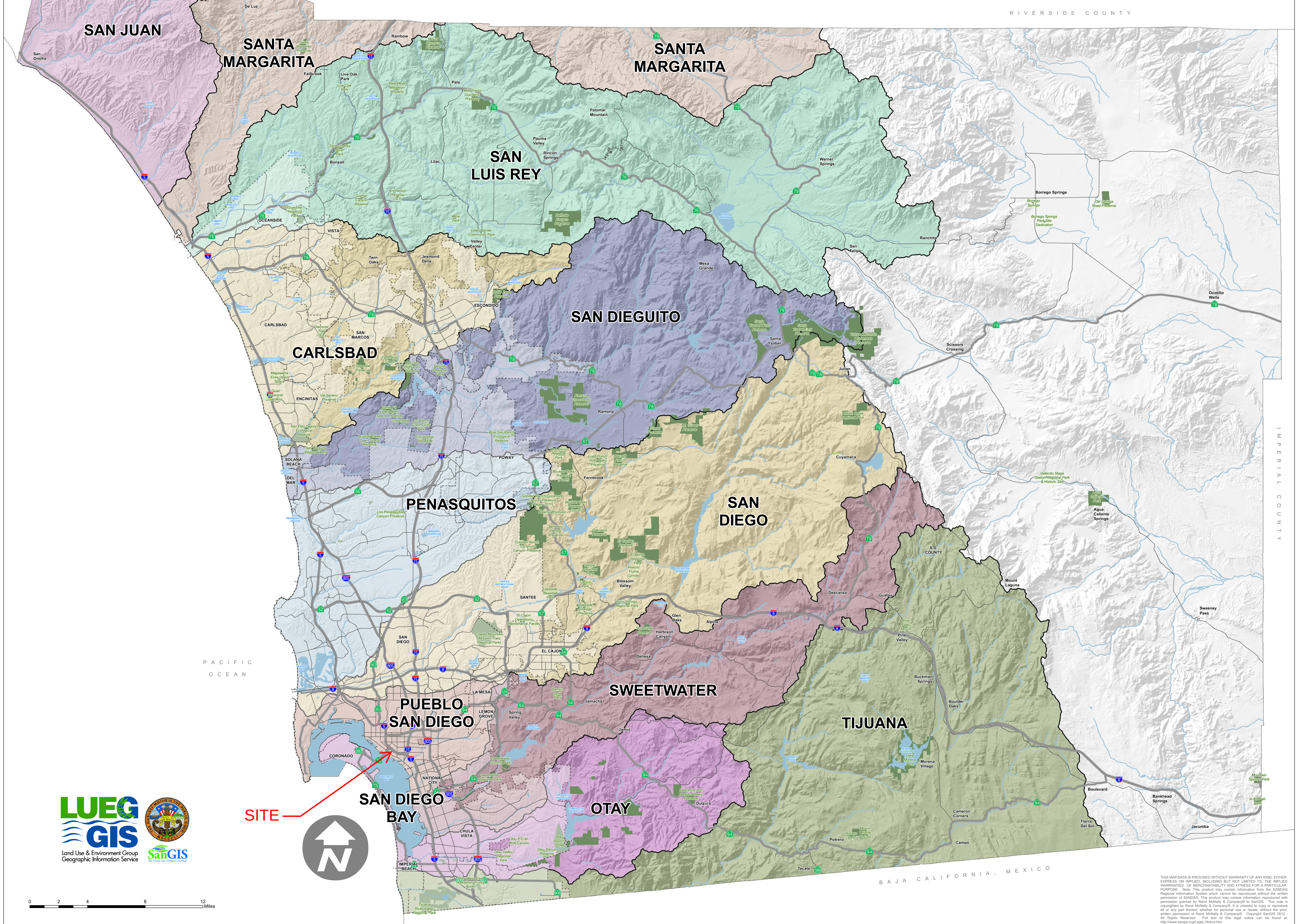
FIGURE 3-7

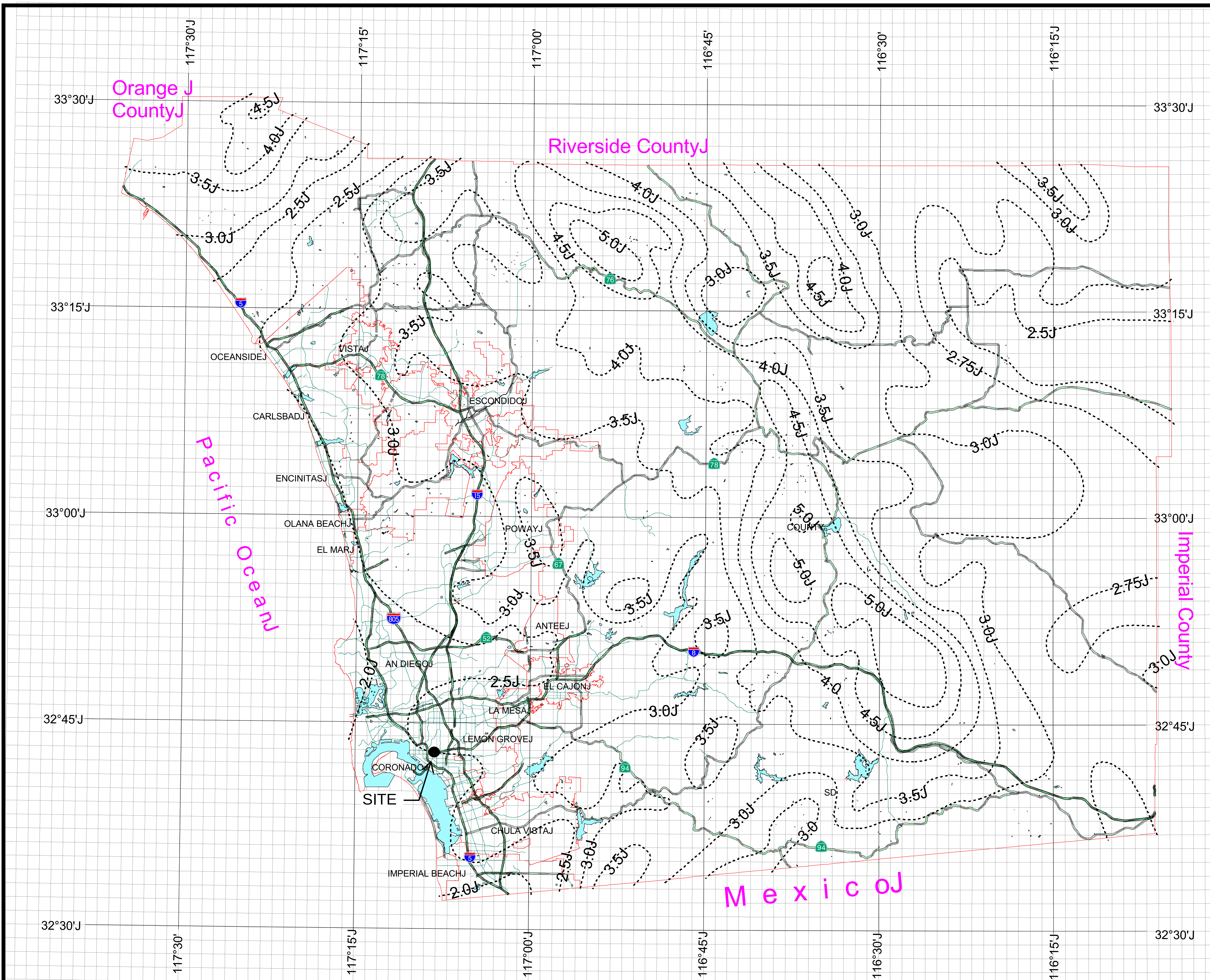
Manning’s Equation Nomograph

Attachment C - Watershed Information

Watershed Map, Soils Index Map, Rainfall Isopluvial Maps

San Diego County Pacific Watersheds





County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

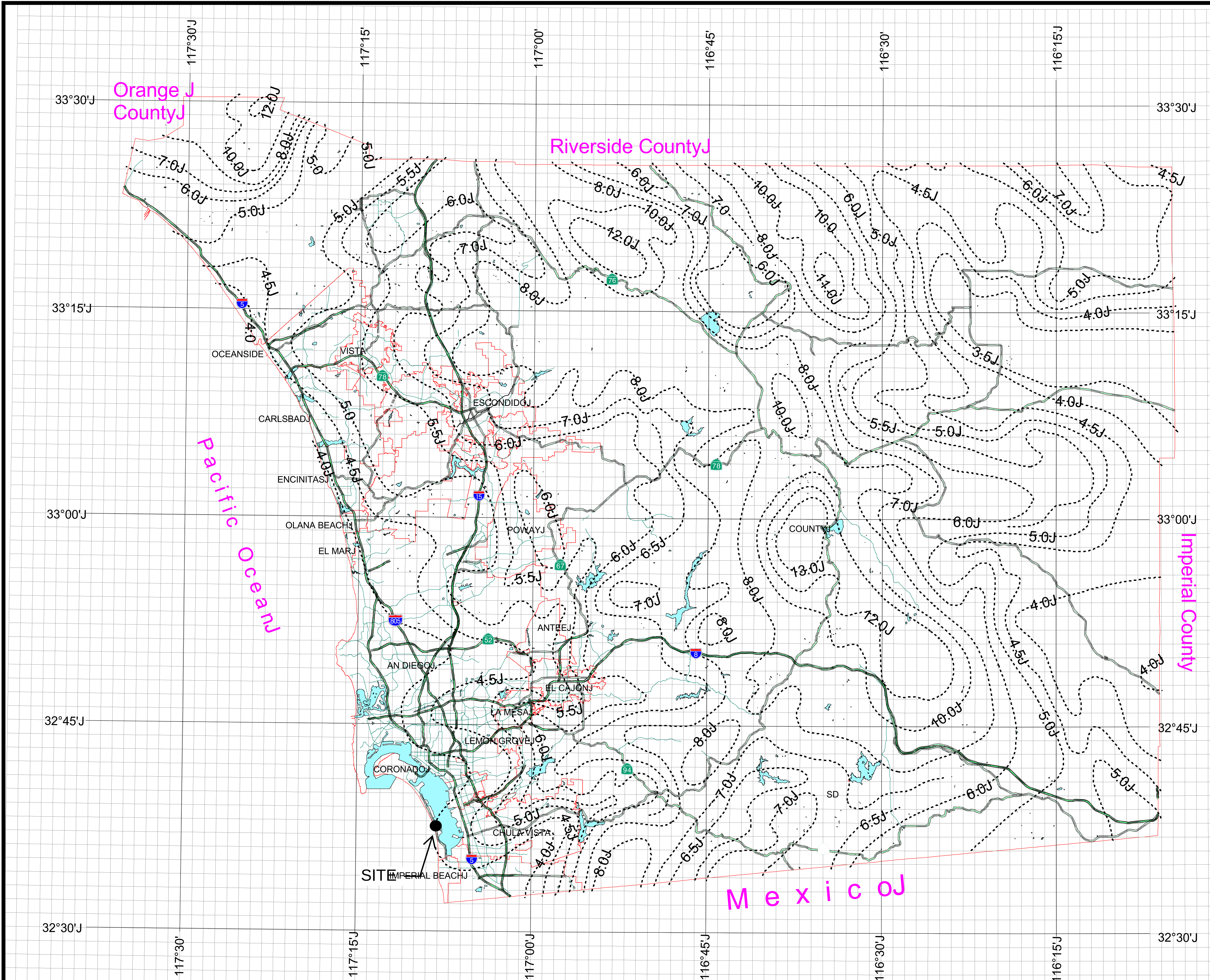
Isopluvial (inches)

Department of Public Works
Geographic Information Services

We Have San Diego Covered!

N
W E
S

3 0 3 Miles



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
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N W E S

3 0 3 Miles

Attachment D - Rational Method Runoff Calculations

Pre Development Calculations

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        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 07/22/21
------------------------------------------------------------------------
MERCADO APARTMENTS

PRE-DEVELOPMENT
HYDROLOGY Q100 CALCULATIONS
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 *********   Hydrology Study Control Information **********

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Program License Serial Number 6332

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Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  2.500
24 hour precipitation(inches) =  4.000
P6/P24 =    62.5%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   36.440(Ft.)
Highest elevation =   65.000(Ft.)
Lowest elevation =   64.800(Ft.)
Elevation difference =    0.200(Ft.) Slope =  0.549 %
Top of Initial Area Slope adjusted by User to  0.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.50 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.49 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  50.000^.5)/(   0.500^(1/3)]=   4.49
Calculated TC of    4.490 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.108(CFS)
Total initial stream area =       0.020(Ac.)


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Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.296(CFS)
Depth of flow =   0.160(Ft.), Average velocity =   1.899(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00               0.50
    2             10.00               0.00
    3             20.00               0.30
    4             30.00               0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      1.296(CFS)
  '     '    flow top width =      8.533(Ft.)
  '     '    velocity=    1.899(Ft/s)
  '     '    area =      0.683(Sq.Ft)
  '     '    Froude number =     1.183

Upstream point elevation =    45.000(Ft.)
Downstream point elevation =    44.500(Ft.)
Flow length =    46.840(Ft.)
Travel time  =    0.41 min.
Time of concentration =    4.90 min.
Depth of flow =   0.160(Ft.)
Average velocity =   1.899(Ft/s)
Total irregular channel flow =     1.296(CFS)
Irregular channel normal depth above invert elev. =   0.160(Ft.)
Average velocity of channel(s) =   1.899(Ft/s)
 Adding area flow to channel
Calculated TC of    4.901 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.377
Subarea runoff =      2.377(CFS) for      0.440(Ac.)
Total runoff =      2.485(CFS)  Total area =       0.460(Ac.)
Depth of flow =   0.204(Ft.), Average velocity =   2.235(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =    44.000(Ft.)
Downstream point/station elevation =    38.000(Ft.)
Pipe length  =   244.30(Ft.) Slope =   0.0246  Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     2.485(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     2.485(CFS)
Normal flow depth in pipe =    6.58(In.)
Flow top width inside pipe =    7.98(In.)
Critical Depth =    8.30(In.)
Pipe flow velocity =      7.18(Ft/s)
Travel time through pipe =    0.57 min.
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      Time of concentration (TC) =     5.47 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      104.000 to Point/Station      104.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      0.460(Ac.)
      Runoff from this stream =      2.485(CFS)
      Time of concentration =    5.47 min.
      Rainfall intensity =     6.217(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      201.000 to Point/Station      202.000
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      [COMMERCIAL area type                        ]
      (General Commercial    )
      Impervious value, Ai = 0.850
      Sub-Area C Value = 0.820
      Initial subarea total flow distance  =   61.130(Ft.)
      Highest elevation =   42.840(Ft.)
      Lowest elevation =   41.100(Ft.)
      Elevation difference =    1.740(Ft.) Slope =  2.846 %
      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
      The maximum overland flow distance is 85.00 (Ft)
      for the top area slope value of   2.85 %, in a development type of
       General Commercial
      In Accordance With Figure 3-3
      Initial Area Time of Concentration =   3.28 minutes
      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
      TC = [1.8*(1.1-0.8200)*(  85.000^.5)/(   2.850^(1/3)]=   3.28
      Calculated TC of    3.277 minutes is less than 5 minutes,
       resetting TC to 5.0 minutes for rainfall intensity calculations
      Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
      Subarea runoff =      0.324(CFS)
      Total initial stream area =       0.060(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      202.000 to Point/Station      104.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
      ______________________________________________________________________
      Estimated mean flow rate at midpoint of channel =      1.026(CFS)
      Depth of flow =   0.110(Ft.), Average velocity =   2.288(Ft/s)
          ******* Irregular Channel Data ***********
      -----------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00              0.60
          2              5.00              0.50
          3              5.10              0.00
          4             20.00              0.20
          5             40.00              0.50
      Manning's 'N' friction factor =   0.015
      -----------------------------------------------------------------
      Sub-Channel flow  =     1.026(CFS)
        '     '    flow top width =     8.185(Ft.)
        '     '    velocity=    2.288(Ft/s)
```

```
         '     '    area =      0.448(Sq.Ft)
         '     '    Froude number =     1.723

      Upstream point elevation =    41.100(Ft.)
      Downstream point elevation =    38.900(Ft.)
      Flow length =    84.550(Ft.)
      Travel time  =    0.62 min.
      Time of concentration =    3.89 min.
      Depth of flow =   0.110(Ft.)
      Average velocity =   2.288(Ft/s)
      Total irregular channel flow =     1.026(CFS)
      Irregular channel normal depth above invert elev. =   0.110(Ft.)
      Average velocity of channel(s) =   2.288(Ft/s)
       Adding area flow to channel
      Calculated TC of    3.893 minutes is less than 5 minutes,
       resetting TC to 5.0 minutes for rainfall intensity calculations
      Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      [COMMERCIAL area type                        ]
      (General Commercial    )
      Impervious value, Ai = 0.850
      Sub-Area C Value = 0.820
      Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.820  CA =      0.262
      Subarea runoff =      1.404(CFS) for      0.260(Ac.)
      Total runoff =      1.728(CFS)  Total area =       0.320(Ac.)
      Depth of flow =   0.133(Ft.), Average velocity =   2.607(Ft/s)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      104.000 to Point/Station      104.000
      **** SUBAREA FLOW ADDITION ****

      ______________________________________________________________________
      Calculated TC of    3.893 minutes is less than 5 minutes,
       resetting TC to 5.0 minutes for rainfall intensity calculations
      Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      [COMMERCIAL area type                        ]
      (General Commercial    )
      Impervious value, Ai = 0.850
      Sub-Area C Value = 0.820
      Time of concentration =     3.89 min.
      Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for total area
      (Q=KCIA) is C = 0.820  CA =      0.533
      Subarea runoff =      1.782(CFS) for      0.330(Ac.)
      Total runoff =      3.511(CFS)  Total area =       0.650(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      104.000 to Point/Station      104.000
      **** CONFLUENCE OF MINOR STREAMS ****

      ______________________________________________________________________
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      0.650(Ac.)
      Runoff from this stream =      3.511(CFS)
      Time of concentration =    3.89 min.
      Rainfall intensity =     6.587(In/Hr)
      Summary of stream data:
```

```
      Stream   Flow rate      TC            Rainfall Intensity
       No.        (CFS)      (min)                    (In/Hr)


      1         2.485      5.47             6.217
      2         3.511      3.89             6.587
      Qmax(1) =
             1.000 *    1.000 *     2.485) +
             0.944 *    1.000 *     3.511) + =      5.798
      Qmax(2) =
             1.000 *    0.712 *     2.485) +
             1.000 *    1.000 *     3.511) + =      5.280

      Total of 2 streams to confluence:
      Flow rates before confluence point:
             2.485       3.511
      Maximum flow rates at confluence using above data:
              5.798       5.280
      Area of streams before confluence:
              0.460       0.650
      Results of confluence:
      Total flow rate =      5.798(CFS)
      Time of concentration =     5.468 min.
      Effective stream area after confluence =      1.110(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      104.000 to Point/Station      105.000
      **** PIPEFLOW TRAVEL TIME (Program estimated size) ****
      ______________________________________________________________________
      Upstream point/station elevation =    38.000(Ft.)
      Downstream point/station elevation =    34.800(Ft.)
      Pipe length  =   158.71(Ft.) Slope =   0.0202  Manning's N = 0.012
      No. of pipes = 1  Required pipe flow  =     5.798(CFS)
      Nearest computed pipe diameter  =     15.00(In.)
      Calculated individual pipe flow  =     5.798(CFS)
      Normal flow depth in pipe =    8.23(In.)
      Flow top width inside pipe =   14.93(In.)
      Critical Depth =   11.70(In.)
      Pipe flow velocity =      8.41(Ft/s)
      Travel time through pipe =    0.31 min.
      Time of concentration (TC) =     5.78 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      105.000 to Point/Station      105.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
      Along Main Stream number: 1 in normal stream number 1
      Stream flow area =      1.110(Ac.)
      Runoff from this stream =      5.798(CFS)
      Time of concentration =    5.78 min.
      Rainfall intensity =     5.997(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      301.000 to Point/Station      302.000
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      [COMMERCIAL area type                        ]
      (General Commercial    )
```

```
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   61.130(Ft.)
Highest elevation =   43.900(Ft.)
Lowest elevation =   40.500(Ft.)
Elevation difference =    3.400(Ft.) Slope =  5.562 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   5.56 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.70 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  90.000^.5)/(   5.560^(1/3)]=   2.70
Calculated TC of    2.699 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.432(CFS)
Total initial stream area =       0.080(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      303.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.296(CFS)
Depth of flow =   0.252(Ft.), Average velocity =   2.086(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2             20.00              0.20
    3             21.50              0.00
    4             23.00              0.20
    5             40.00              0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      1.296(CFS)
  '     '    flow top width =      9.395(Ft.)
  '     '    velocity=    2.086(Ft/s)
  '     '    area =      0.621(Sq.Ft)
  '     '    Froude number =     1.430

Upstream point elevation =    40.500(Ft.)
Downstream point elevation =    35.220(Ft.)
Flow length =   317.180(Ft.)
Travel time  =    2.53 min.
Time of concentration =    5.23 min.
Depth of flow =   0.252(Ft.)
Average velocity =   2.086(Ft/s)
Total irregular channel flow =     1.296(CFS)
Irregular channel normal depth above invert elev. =   0.252(Ft.)
Average velocity of channel(s) =   2.086(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      6.396(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.396(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.328
Subarea runoff =      1.666(CFS) for      0.320(Ac.)
Total runoff =      2.098(CFS)  Total area =       0.400(Ac.)
Depth of flow =   0.281(Ft.), Average velocity =   2.226(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      105.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow =   0.275(Ft.), Average velocity =   1.544(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00               0.60
    2              2.00               0.50
    3              2.10               0.00
    4             20.00               0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      2.098(CFS)
  '     '    flow top width =      9.890(Ft.)
  '     '    velocity=    1.544(Ft/s)
  '     '    area =      1.359(Sq.Ft)
  '     '    Froude number =     0.734

Upstream point elevation =    35.220(Ft.)
Downstream point elevation =    34.800(Ft.)
Flow length =   118.810(Ft.)
Travel time  =    1.28 min.
Time of concentration =    6.52 min.
Depth of flow =   0.275(Ft.)
Average velocity =   1.544(Ft/s)
Total irregular channel flow =     2.098(CFS)
Irregular channel normal depth above invert elev. =   0.275(Ft.)
Average velocity of channel(s) =   1.544(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.400(Ac.)
Runoff from this stream =      2.098(CFS)
Time of concentration =    6.52 min.
Rainfall intensity =     5.553(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)      (min)                  (In/Hr)


1        5.798      5.78             5.997
2        2.098      6.52             5.553
Qmax(1) =
       1.000 *    1.000 *     5.798) +
       1.000 *    0.888 *     2.098) + =      7.661
Qmax(2) =
       0.926 *    1.000 *     5.798) +
       1.000 *    1.000 *     2.098) + =      7.467

Total of 2 streams to confluence:
Flow rates before confluence point:
```

```
             5.798        2.098
      Maximum flow rates at confluence using above data:
              7.661         7.467
      Area of streams before confluence:
              1.110         0.400
      Results of confluence:
      Total flow rate =      7.661(CFS)
      Time of concentration =     5.783 min.
      Effective stream area after confluence =      1.510(Ac.)
      End of computations, total study area =           1.510 (Ac.)
```

Post Development Calculations

Used as a user defined input at node 305.

```
        San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
    Rational Hydrology Study        Date: 10/29/21
------------------------------------------------------------------------
MERCADO APARTMENTS
POST-DEVELOPMENT
HYDROLOGYQ100 CALCULATIONS
NORTH SIDE
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------


Program License Serial Number 6332

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  2.500
24 hour precipitation(inches) =  4.000
P6/P24 =    62.5%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      601.000 to Point/Station      602.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   36.440(Ft.)
Highest elevation =   65.000(Ft.)
Lowest elevation =   64.800(Ft.)
Elevation difference =    0.200(Ft.) Slope =  0.549 %
Top of Initial Area Slope adjusted by User to  0.500 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.50 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.49 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  50.000^.5)/(   0.500^(1/3)]=   4.49
Calculated TC of    4.490 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.108(CFS)
Total initial stream area =        0.020(Ac.)


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```
Process from Point/Station      602.000 to Point/Station      603.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.296(CFS)
Depth of flow =   0.160(Ft.), Average velocity =   1.899(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2             10.00              0.00
    3             20.00              0.30
    4             30.00              0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      1.296(CFS)
  '     '    flow top width =      8.533(Ft.)
  '     '    velocity=    1.899(Ft/s)
  '     '    area =      0.683(Sq.Ft)
  '     '    Froude number =     1.183

Upstream point elevation =    45.000(Ft.)
Downstream point elevation =    44.500(Ft.)
Flow length =    46.840(Ft.)
Travel time  =    0.41 min.
Time of concentration =    4.90 min.
Depth of flow =   0.160(Ft.)
Average velocity =   1.899(Ft/s)
Total irregular channel flow =     1.296(CFS)
Irregular channel normal depth above invert elev. =   0.160(Ft.)
Average velocity of channel(s) =   1.899(Ft/s)
 Adding area flow to channel
Calculated TC of    4.901 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.377
Subarea runoff =      2.377(CFS) for      0.440(Ac.)
Total runoff =      2.485(CFS)  Total area =       0.460(Ac.)
Depth of flow =   0.204(Ft.), Average velocity =   2.235(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      603.000 to Point/Station      305.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =    44.000(Ft.)
Downstream point/station elevation =    38.000(Ft.)
Pipe length   =   244.30(Ft.) Slope =   0.0246  Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     2.485(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     2.485(CFS)
Normal flow depth in pipe =    6.58(In.)
Flow top width inside pipe =    7.98(In.)
Critical Depth =    8.30(In.)
Pipe flow velocity =      7.18(Ft/s)
Travel time through pipe =    0.57 min.
```

```
Time of concentration (TC) =     5.47 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Rainfall intensity (I) =      6.217(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     5.47 min.
Rainfall intensity =      6.217(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.451
Subarea runoff =      0.319(CFS) for      0.090(Ac.)
Total runoff =      2.804(CFS)  Total area =      0.550(Ac.)
End of computations, total study area =          0.550 (Ac.)
```

Post Development Calculations

```
        San Diego County Rational Hydrology Program

 CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2019 Version 9.1

 Rational method hydrology  program based on
 San Diego County Flood Control Division 2003 hydrology manual
     Rational Hydrology Study        Date: 12/09/21
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  *********   Hydrology Study Control Information **********

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 Program License Serial Number 6332

 ------------------------------------------------------------------------
 Rational hydrology study storm event year is   100.0
 English (in-lb) input data Units used

 Map data precipitation entered:
 6 hour,  precipitation(inches) =  2.500
 24 hour precipitation(inches) =  4.000
 P6/P24 =    62.5%
 San Diego hydrology manual 'C' values used


 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 Process from Point/Station      201.000 to Point/Station      202.000
 **** INITIAL AREA EVALUATION ****
 ______________________________________________________________________
 Decimal fraction soil group A = 0.000
 Decimal fraction soil group B = 0.000
 Decimal fraction soil group C = 0.000
 Decimal fraction soil group D = 1.000
 [INDUSTRIAL area type                        ]
 (General Industrial       )
 Impervious value, Ai = 0.950
 Sub-Area C Value = 0.870
 Initial subarea total flow distance  =  191.390(Ft.)
 Highest elevation =   60.000(Ft.)
 Lowest elevation =   56.170(Ft.)
 Elevation difference =    3.830(Ft.) Slope =  2.001 %
 INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
 The maximum overland flow distance is 70.00 (Ft)
 for the top area slope value of   2.00 %, in a development type of
  General Industrial
 In Accordance With Figure 3-3
 Initial Area Time of Concentration =   2.75 minutes
 TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
 TC = [1.8*(1.1-0.8700)*(  70.000^.5)/(   2.000^(1/3)]=   2.75
 Calculated TC of    2.749 minutes is less than 5 minutes,
  resetting TC to 5.0 minutes for rainfall intensity calculations
 Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
 Subarea runoff =      0.298(CFS)
 Total initial stream area =       0.052(Ac.)


 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 Process from Point/Station      202.000 to Point/Station      203.000
```

```
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow =   0.082(Ft.), Average velocity =  10.965(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00               0.25
    2              1.00               0.00
    3              2.00               0.25
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      0.298(CFS)
  '     '    flow top width =      0.659(Ft.)
  '     '    velocity=   10.965(Ft/s)
  '     '    area =      0.027(Sq.Ft)
  '     '    Froude number =     9.518

Upstream point elevation =    59.980(Ft.)
Downstream point elevation =    39.790(Ft.)
Flow length =    30.000(Ft.)
Travel time  =    0.05 min.
Time of concentration =    2.79 min.
Depth of flow =   0.082(Ft.)
Average velocity =  10.965(Ft/s)
Total irregular channel flow =     0.298(CFS)
Irregular channel normal depth above invert elev. =   0.082(Ft.)
Average velocity of channel(s) =  10.965(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.052(Ac.)
Runoff from this stream =      0.298(CFS)
Time of concentration =    2.79 min.
Rainfall intensity =     6.587(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      501.000 to Point/Station      502.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =   65.200(Ft.)
Highest elevation =   60.000(Ft.)
Lowest elevation =   59.840(Ft.)
Elevation difference =    0.160(Ft.) Slope =  0.245 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.25 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.65 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  50.000^.5)/(   0.250^(1/3)]=   4.65
Calculated TC of    4.647 minutes is less than 5 minutes,
```

```
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      0.940(CFS)
Total initial stream area =       0.164(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      502.000 to Point/Station      503.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
!!Warning: Water is above left or right bank elevations
!!Warning: Water is above left or right bank elevations
!!Warning: Water is above left or right bank elevations
Estimated mean flow rate at midpoint of channel =      0.984(CFS)
Depth of flow =   0.714(Ft.), Average velocity =   0.338(Ft/s)
!!Warning: Water is above left or right bank elevations
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.70
    2              4.00              0.00
    3              8.00              0.70
Manning's 'N' friction factor =   0.150
-----------------------------------------------------------------
Sub-Channel flow  =      0.984(CFS)
  '     '    flow top width =      8.000(Ft.)
  '     '    velocity=    0.338(Ft/s)
  '     '    area =      2.910(Sq.Ft)
  '     '    Froude number =     0.099

Upstream point elevation =    39.840(Ft.)
Downstream point elevation =    39.600(Ft.)
Flow length =    52.400(Ft.)
Travel time  =    2.58 min.
Time of concentration =    7.23 min.
Depth of flow =   0.714(Ft.)
Average velocity =   0.338(Ft/s)
Total irregular channel flow =     0.984(CFS)
Irregular channel normal depth above invert elev. =   0.714(Ft.)
Average velocity of channel(s) =   0.338(Ft/s)
!!Warning: Water is above left or right bank elevations
 Adding area flow to channel
Rainfall intensity (I) =      5.193(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                     ]
(2.0 DU/A or Less       )
Impervious value, Ai = 0.200
Sub-Area C Value = 0.460
The area added to the existing stream causes a
a lower flow rate of Q =      0.889(CFS)
therefore the upstream flow rate of Q =      0.940(CFS) is being used
Rainfall intensity =      5.193(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.758  CA =      0.171
Subarea runoff =      0.000(CFS) for      0.062(Ac.)
Total runoff =      0.940(CFS)  Total area =       0.226(Ac.)
Depth of flow =   0.704(Ft.), Average velocity =   0.332(Ft/s)
!!Warning: Water is above left or right bank elevations


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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Process from Point/Station      503.000 to Point/Station      203.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =    39.083(Ft.)
Downstream point/station elevation =    38.400(Ft.)
Pipe length  =    88.30(Ft.) Slope =   0.0077  Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     0.940(CFS)
Given pipe size =      6.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
     1.961(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      2.110(Ft.)
 Minor friction loss =      0.534(Ft.)  K-factor =   1.50
Pipe flow velocity =      4.79(Ft/s)
Travel time through pipe =    0.31 min.
Time of concentration (TC) =     7.54 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      203.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.226(Ac.)
Runoff from this stream =      0.940(CFS)
Time of concentration =    7.54 min.
Rainfall intensity =     5.055(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1        0.298      2.79             6.587
2        0.940      7.54             5.055
Qmax(1) =
       1.000 *    1.000 *     0.298) +
       1.000 *    0.371 *     0.940) + =      0.646
Qmax(2) =
       0.767 *    1.000 *     0.298) +
       1.000 *    1.000 *     0.940) + =      1.169

Total of 2 streams to confluence:
Flow rates before confluence point:
       0.298       0.940
Maximum flow rates at confluence using above data:
        0.646       1.169
Area of streams before confluence:
        0.052       0.226
Results of confluence:
Total flow rate =      1.169(CFS)
Time of concentration =     7.537 min.
Effective stream area after confluence =      0.278(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      203.000 to Point/Station      103.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =    35.910(Ft.)
Downstream point/station elevation =    35.450(Ft.)
Pipe length  =    75.43(Ft.) Slope =   0.0061  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.169(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     1.169(CFS)
Normal flow depth in pipe =    5.43(In.)
```

```
       Flow top width inside pipe =   11.94(In.)
       Critical Depth =    5.47(In.)
       Pipe flow velocity =      3.39(Ft/s)
       Travel time through pipe =    0.37 min.
       Time of concentration (TC) =     7.91 min.


       +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       Process from Point/Station      103.000 to Point/Station      103.000
       **** CONFLUENCE OF MINOR STREAMS ****

       Along Main Stream number: 1 in normal stream number 1
       Stream flow area =      0.278(Ac.)
       Runoff from this stream =      1.169(CFS)
       Time of concentration =    7.91 min.
       Rainfall intensity =     4.901(In/Hr)


       +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       Process from Point/Station      101.000 to Point/Station      102.000
       **** INITIAL AREA EVALUATION ****

       Decimal fraction soil group A = 0.000
       Decimal fraction soil group B = 0.000
       Decimal fraction soil group C = 0.000
       Decimal fraction soil group D = 1.000
       [INDUSTRIAL area type                        ]
       (General Industrial       )
       Impervious value, Ai = 0.950
       Sub-Area C Value = 0.870
       Initial subarea total flow distance  =   93.430(Ft.)
       Highest elevation =   39.660(Ft.)
       Lowest elevation =   39.250(Ft.)
       Elevation difference =    0.410(Ft.) Slope =  0.439 %
       Top of Initial Area Slope adjusted by User to  0.500 %
       INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
       The maximum overland flow distance is 50.00 (Ft)
       for the top area slope value of   0.50 %, in a development type of
        General Industrial
       In Accordance With Figure 3-3
       Initial Area Time of Concentration =   3.69 minutes
       TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
       TC = [1.8*(1.1-0.8700)*(  50.000^.5)/(   0.500^(1/3)]=   3.69
       Calculated TC of    3.688 minutes is less than 5 minutes,
        resetting TC to 5.0 minutes for rainfall intensity calculations
       Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
       Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
       Subarea runoff =      0.630(CFS)
       Total initial stream area =       0.110(Ac.)


       +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
       Process from Point/Station      102.000 to Point/Station      103.000
       **** PIPEFLOW TRAVEL TIME (User specified size) ****

       Upstream point/station elevation =    38.700(Ft.)
       Downstream point/station elevation =    38.200(Ft.)
       Pipe length  =    61.77(Ft.) Slope =   0.0081  Manning's N = 0.012
       No. of pipes = 1  Required pipe flow  =     0.630(CFS)
       Given pipe size =      8.00(In.)
       Calculated individual pipe flow  =     0.630(CFS)
       Normal flow depth in pipe =    4.17(In.)
       Flow top width inside pipe =    7.99(In.)
       Critical Depth =    4.48(In.)
       Pipe flow velocity =      3.43(Ft/s)
       Travel time through pipe =    0.30 min.
```

```
      Time of concentration (TC) =     3.99 min.


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      103.000 to Point/Station      103.000
      **** CONFLUENCE OF MINOR STREAMS ****
      ______________________________________________________________________
      Along Main Stream number: 1 in normal stream number 2
      Stream flow area =      0.110(Ac.)
      Runoff from this stream =      0.630(CFS)
      Time of concentration =    3.99 min.
      Rainfall intensity =     6.587(In/Hr)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      201.000 to Point/Station      204.000
      **** INITIAL AREA EVALUATION ****
      ______________________________________________________________________
      Decimal fraction soil group A = 0.000
      Decimal fraction soil group B = 0.000
      Decimal fraction soil group C = 0.000
      Decimal fraction soil group D = 1.000
      [INDUSTRIAL area type                        ]
      (General Industrial       )
      Impervious value, Ai = 0.950
      Sub-Area C Value = 0.870
      Initial subarea total flow distance  =   75.710(Ft.)
      Highest elevation =   60.000(Ft.)
      Lowest elevation =   58.490(Ft.)
      Elevation difference =    1.510(Ft.) Slope =  1.994 %
      INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
      The maximum overland flow distance is 70.00 (Ft)
      for the top area slope value of   2.00 %, in a development type of
       General Industrial
      In Accordance With Figure 3-3
      Initial Area Time of Concentration =   2.75 minutes
      TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
      TC = [1.8*(1.1-0.8700)*(  70.000^.5)/(   2.000^(1/3)]=   2.75
      Calculated TC of    2.749 minutes is less than 5 minutes,
       resetting TC to 5.0 minutes for rainfall intensity calculations
      Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
      Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
      Subarea runoff =      0.372(CFS)
      Total initial stream area =       0.065(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
      Process from Point/Station      204.000 to Point/Station      103.000
      **** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
      ______________________________________________________________________
      Estimated mean flow rate at midpoint of channel =      0.476(CFS)
      Depth of flow =   0.075(Ft.), Average velocity =  16.973(Ft/s)
          ******* Irregular Channel Data ***********
      -----------------------------------------------------------------
      Information entered for subchannel number 1 :
      Point number      'X' coordinate     'Y' coordinate
          1              0.00               0.40
          2              2.00               0.00
          3              4.00               0.40
      Manning's 'N' friction factor =   0.012
      -----------------------------------------------------------------
      Sub-Channel flow  =      0.476(CFS)
        '     '     flow top width =      0.749(Ft.)
        '     '     velocity=   16.974(Ft/s)
        '     '     area =      0.028(Sq.Ft)
        '     '     Froude number =    15.460
```

```
Upstream point elevation =    59.880(Ft.)
Downstream point elevation =    38.210(Ft.)
Flow length =    14.070(Ft.)
Travel time  =    0.01 min.
Time of concentration =    2.76 min.
Depth of flow =   0.075(Ft.)
Average velocity =  16.973(Ft/s)
Total irregular channel flow =     0.476(CFS)
Irregular channel normal depth above invert elev. =   0.075(Ft.)
Average velocity of channel(s) =  16.973(Ft/s)
 Adding area flow to channel
Calculated TC of    2.763 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(14.5 DU/A or Less      )
Impervious value, Ai = 0.500
Sub-Area C Value = 0.630
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.784  CA =      0.079
Subarea runoff =      0.149(CFS) for      0.036(Ac.)
Total runoff =      0.522(CFS)  Total area =       0.101(Ac.)
Depth of flow =   0.078(Ft.), Average velocity =  17.371(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      103.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.101(Ac.)
Runoff from this stream =      0.522(CFS)
Time of concentration =    2.76 min.
Rainfall intensity =     6.587(In/Hr)
Summary of stream data:

Stream   Flow rate      TC           Rainfall Intensity
 No.       (CFS)      (min)                 (In/Hr)


1        1.169      7.91             4.901
2        0.630      3.99             6.587
3        0.522      2.76             6.587
Qmax(1) =
       1.000 *    1.000 *     1.169) +
       0.744 *    1.000 *     0.630) +
       0.744 *    1.000 *     0.522) + =      2.026
Qmax(2) =
       1.000 *    0.504 *     1.169) +
       1.000 *    1.000 *     0.630) +
       1.000 *    1.000 *     0.522) + =      1.742
Qmax(3) =
       1.000 *    0.349 *     1.169) +
       1.000 *    0.693 *     0.630) +
       1.000 *    1.000 *     0.522) + =      1.367

Total of 3 streams to confluence:
Flow rates before confluence point:
       1.169      0.630      0.522
Maximum flow rates at confluence using above data:
```

```
        2.026        1.742        1.367
Area of streams before confluence:
        0.278        0.110        0.101
Results of confluence:
Total flow rate =      2.026(CFS)
Time of concentration =     7.908 min.
Effective stream area after confluence =      0.489(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation =    35.440(Ft.)
Downstream point/station elevation =    34.990(Ft.)
Pipe length  =    75.40(Ft.) Slope =   0.0060  Manning's N = 0.012
No. of pipes = 1  Required pipe flow  =     2.026(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.026(CFS)
Normal flow depth in pipe =    7.25(In.)
Flow top width inside pipe =   11.74(In.)
Critical Depth =    7.28(In.)
Pipe flow velocity =      4.08(Ft/s)
Travel time through pipe =    0.31 min.
Time of concentration (TC) =     8.22 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      304.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow =   0.318(Ft.), Average velocity =   1.979(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.50
    2             10.00              0.00
    3             10.10              0.50
    4             15.00              0.60
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      2.026(CFS)
  '     '    flow top width =      6.431(Ft.)
  '     '    velocity=    1.979(Ft/s)
  '     '    area =      1.024(Sq.Ft)
  '     '    Froude number =     0.874

Upstream point elevation =    34.990(Ft.)
Downstream point elevation =    34.720(Ft.)
Flow length =    73.590(Ft.)
Travel time  =    0.62 min.
Time of concentration =    8.84 min.
Depth of flow =   0.318(Ft.)
Average velocity =   1.979(Ft/s)
Total irregular channel flow =     2.026(CFS)
Irregular channel normal depth above invert elev. =   0.318(Ft.)
Average velocity of channel(s) =   1.979(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      304.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.489(Ac.)
```

```
Runoff from this stream =      2.026(CFS)
Time of concentration =    8.84 min.
Rainfall intensity =     4.562(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =   68.390(Ft.)
Highest elevation =   60.000(Ft.)
Lowest elevation =   59.830(Ft.)
Elevation difference =    0.170(Ft.) Slope =  0.249 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.25 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.65 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  50.000^.5)/(   0.250^(1/3)]=   4.65
Calculated TC of    4.647 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      1.106(CFS)
Total initial stream area =       0.193(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      303.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.140(CFS)
Depth of flow =   0.106(Ft.), Average velocity =  16.783(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00               0.25
    2              1.00               0.00
    3              3.00               0.25
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      1.140(CFS)
  '     '    flow top width =      1.277(Ft.)
  '     '    velocity=   16.784(Ft/s)
  '     '    area =      0.068(Sq.Ft)
  '     '    Froude number =    12.822

Upstream point elevation =    59.830(Ft.)
Downstream point elevation =    38.500(Ft.)
Flow length =    19.400(Ft.)
Travel time  =    0.02 min.
Time of concentration =    4.67 min.
Depth of flow =   0.106(Ft.)
Average velocity =  16.783(Ft/s)
Total irregular channel flow =     1.140(CFS)
```

```
Irregular channel normal depth above invert elev. =   0.106(Ft.)
Average velocity of channel(s) =  16.783(Ft/s)
 Adding area flow to channel
Calculated TC of    4.666 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(10.9 DU/A or Less      )
Impervious value, Ai = 0.450
Sub-Area C Value = 0.600
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.854  CA =      0.175
Subarea runoff =      0.047(CFS) for      0.012(Ac.)
Total runoff =      1.153(CFS)  Total area =       0.205(Ac.)
Depth of flow =   0.107(Ft.), Average velocity =  16.831(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      304.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =    35.740(Ft.)
Downstream point/station elevation =    34.720(Ft.)
Pipe length  =    21.60(Ft.) Slope =   0.0472  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.153(CFS)
Given pipe size =      6.00(In.)
Calculated individual pipe flow  =     1.153(CFS)
Normal flow depth in pipe =    4.65(In.)
Flow top width inside pipe =    5.01(In.)
Critical depth could not be calculated.
Pipe flow velocity =      7.06(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     4.72 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      304.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.205(Ac.)
Runoff from this stream =      1.153(CFS)
Time of concentration =    4.72 min.
Rainfall intensity =     6.587(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)      (min)                  (In/Hr)


1        2.026      8.84             4.562
2        1.153      4.72             6.587
Qmax(1) =
       1.000 *    1.000 *     2.026) +
       0.693 *    1.000 *     1.153) + =      2.825
Qmax(2) =
       1.000 *    0.534 *     2.026) +
       1.000 *    1.000 *     1.153) + =      2.235

Total of 2 streams to confluence:
Flow rates before confluence point:
```

```
          2.026       1.153
Maximum flow rates at confluence using above data:
          2.825        2.235
Area of streams before confluence:
          0.489        0.205
Results of confluence:
Total flow rate =      2.825(CFS)
Time of concentration =     8.835 min.
Effective stream area after confluence =      0.694(Ac.)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      305.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow =   0.381(Ft.), Average velocity =   1.927(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00               0.50
    2             10.00               0.00
    3             10.10               0.50
    4             15.00               0.60
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      2.825(CFS)
  '     '    flow top width =      7.695(Ft.)
  '     '    velocity=    1.927(Ft/s)
  '     '    area =      1.466(Sq.Ft)
  '     '    Froude number =     0.778

Upstream point elevation =    34.720(Ft.)
Downstream point elevation =    34.280(Ft.)
Flow length =   120.610(Ft.)
Travel time  =    1.04 min.
Time of concentration =    9.88 min.
Depth of flow =   0.381(Ft.)
Average velocity =   1.927(Ft/s)
Total irregular channel flow =     2.825(CFS)
Irregular channel normal depth above invert elev. =   0.381(Ft.)
Average velocity of channel(s) =   1.927(Ft/s)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.694(Ac.)
Runoff from this stream =      2.825(CFS)
Time of concentration =    9.88 min.
Rainfall intensity =     4.246(In/Hr)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      401.000 to Point/Station      402.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                         ]
(General Industrial       )
Impervious value, Ai = 0.950
```

```
Sub-Area C Value = 0.870
Initial subarea total flow distance  =   62.840(Ft.)
Highest elevation =   60.000(Ft.)
Lowest elevation =   59.840(Ft.)
Elevation difference =    0.160(Ft.) Slope =  0.255 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 50.00 (Ft)
for the top area slope value of   0.25 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.65 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*(  50.000^.5)/(   0.250^(1/3)]=   4.65
Calculated TC of    4.647 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      0.745(CFS)
Total initial stream area =        0.130(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      402.000 to Point/Station      403.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.063(CFS)
Depth of flow =   0.213(Ft.), Average velocity =   4.676(Ft/s)
    ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
    1              0.00              0.40
    2              2.00              0.00
    3              4.00              0.40
Manning's 'N' friction factor =   0.013
-----------------------------------------------------------------
Sub-Channel flow  =      1.063(CFS)
  '     '    flow top width =      2.133(Ft.)
  '     '    velocity=    4.676(Ft/s)
  '     '    area =      0.227(Sq.Ft)
  '     '    Froude number =     2.523

Upstream point elevation =    38.000(Ft.)
Downstream point elevation =    37.000(Ft.)
Flow length =    29.440(Ft.)
Travel time  =    0.10 min.
Time of concentration =    4.75 min.
Depth of flow =   0.213(Ft.)
Average velocity =   4.676(Ft/s)
Total irregular channel flow =     1.063(CFS)
Irregular channel normal depth above invert elev. =   0.213(Ft.)
Average velocity of channel(s) =   4.676(Ft/s)
 Adding area flow to channel
Calculated TC of    4.752 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      6.587(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[MEDIUM DENSITY RESIDENTIAL                  ]
(14.5 DU/A or Less      )
Impervious value, Ai = 0.500
Sub-Area C Value = 0.630
Rainfall intensity =      6.587(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
```

```
(Q=KCIA) is C = 0.746  CA =      0.201
Subarea runoff =      0.581(CFS) for      0.140(Ac.)
Total runoff =      1.326(CFS)  Total area =       0.270(Ac.)
Depth of flow =   0.232(Ft.), Average velocity =   4.941(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      403.000 to Point/Station      305.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

______________________________________________________________________
Upstream point/station elevation =    35.000(Ft.)
Downstream point/station elevation =    34.280(Ft.)
Pipe length  =   132.00(Ft.) Slope =   0.0055  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.326(CFS)
Given pipe size =      12.00(In.)
Calculated individual pipe flow  =     1.326(CFS)
Normal flow depth in pipe =    6.03(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =    5.84(In.)
Pipe flow velocity =      3.36(Ft/s)
Travel time through pipe =    0.66 min.
Time of concentration (TC) =     5.41 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** SUBAREA FLOW ADDITION ****

______________________________________________________________________
Rainfall intensity (I) =      6.262(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                     ]
(2.0 DU/A or Less       )
Impervious value, Ai = 0.200
Sub-Area C Value = 0.460
Time of concentration =     5.41 min.
Rainfall intensity =      6.262(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.719  CA =      0.214
Subarea runoff =      0.015(CFS) for      0.028(Ac.)
Total runoff =      1.341(CFS)  Total area =       0.298(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** CONFLUENCE OF MINOR STREAMS ****

______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.298(Ac.)
Runoff from this stream =      1.341(CFS)
Time of concentration =    5.41 min.
Rainfall intensity =     6.262(In/Hr)


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Process from Point/Station      601.000 to Point/Station      305.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

______________________________________________________________________
User specified 'C' value of 0.820 given for subarea
Rainfall intensity (I) =      6.216(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.47 min.  Rain intensity =      6.22(In/Hr)
Total area =      0.550(Ac.)  Total runoff =     2.804(CFS)
```

```

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** CONFLUENCE OF MINOR STREAMS ****

______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      0.550(Ac.)
Runoff from this stream =      2.804(CFS)
Time of concentration =    5.47 min.
Rainfall intensity =     6.216(In/Hr)
Summary of stream data:

Stream   Flow rate     TC            Rainfall Intensity
 No.       (CFS)      (min)                   (In/Hr)


1        2.825      9.88             4.246
2        1.341      5.41             6.262
3        2.804      5.47             6.216
Qmax(1) =
       1.000 *    1.000 *     2.825) +
       0.678 *    1.000 *     1.341) +
       0.683 *    1.000 *     2.804) + =      5.649
Qmax(2) =
       1.000 *    0.547 *     2.825) +
       1.000 *    1.000 *     1.341) +
       1.000 *    0.989 *     2.804) + =      5.659
Qmax(3) =
       1.000 *    0.554 *     2.825) +
       0.993 *    1.000 *     1.341) +
       1.000 *    1.000 *     2.804) + =      5.700

Total of 3 streams to confluence:
Flow rates before confluence point:
       2.825        1.341        2.804
Maximum flow rates at confluence using above data:
        5.649        5.659        5.700
Area of streams before confluence:
        0.694        0.298        0.550
Results of confluence:
Total flow rate =      5.700(CFS)
Time of concentration =     5.470 min.
Effective stream area after confluence =      1.542(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      305.000
**** 6 HOUR HYDROGRAPH ****

______________________________________________________________________
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Hydrograph Data - Section 6, San Diego County Hydrology manual, June 2003


Time of Concentration =   5.47
Basin Area =     1.54 Acres
6 Hour Rainfall =  2.500 Inches
Runoff Coefficient =  0.799
Peak Discharge =     5.70 CFS
     Time (Min)     Discharge (CFS)
       0               0.000
       5               0.183
       10               0.185
       15               0.189
       20               0.190
       25               0.194
       30               0.196
```

```
                35                0.200
                40                0.202
                45                0.206
                50                0.209
                55                0.213
                60                0.216
                65                0.221
                70                0.224
                75                0.229
                80                0.232
                85                0.239
                90                0.242
                95                0.249
                100                0.253
                105                0.260
                110                0.265
                115                0.273
                120                0.278
                125                0.288
                130                0.293
                135                0.305
                140                0.311
                145                0.325
                150                0.332
                155                0.348
                160                0.357
                165                0.376
                170                0.387
                175                0.411
                180                0.424
                185                0.455
                190                0.472
                195                0.513
                200                0.538
                205                0.596
                210                0.632
                215                0.725
                220                0.786
                225                0.961
                230                1.094
                235                1.606
                240                2.263
                245                5.700
                250                1.288
                255                0.862
                260                0.674
                265                0.565
                270                0.492
                275                0.439
                280                0.398
                285                0.366
                290                0.340
                295                0.318
                300                0.299
                305                0.283
                310                0.269
                315                0.257
                320                0.245
                325                0.236
                330                0.227
                335                0.218
                340                0.211
                345                0.204
                350                0.198
                355                0.192
                360                0.187
```

```
           365               0.182
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          6 - H O U R    S T O R M
                     R u n o f f     H y d r o g r a p h
      --------------------------------------------------------------------
                  Hydrograph in   1   Minute intervals ((CFS))

      --------------------------------------------------------------------
    Time(h+m) Volume Ac.Ft   Q(CFS)  0         1.4       2.8       4.3       5.7
    ----------------------------------------------------------------------
      0+ 0       0.0000      0.00  Q         |         |         |         |
      0+ 1       0.0001      0.04  Q         |         |         |         |
      0+ 2       0.0002      0.07  Q         |         |         |         |
      0+ 3       0.0003      0.11  Q         |         |         |         |
      0+ 4       0.0005      0.15  VQ        |         |         |         |
      0+ 5       0.0008      0.18  VQ        |         |         |         |
      0+ 6       0.0010      0.18  VQ        |         |         |         |
      0+ 7       0.0013      0.18  VQ        |         |         |         |
      0+ 8       0.0015      0.18  VQ        |         |         |         |
      0+ 9       0.0018      0.18  VQ        |         |         |         |
      0+10       0.0020      0.19  VQ        |         |         |         |
      0+11       0.0023      0.19  VQ        |         |         |         |
      0+12       0.0025      0.19  VQ        |         |         |         |
      0+13       0.0028      0.19  VQ        |         |         |         |
      0+14       0.0031      0.19  VQ        |         |         |         |
      0+15       0.0033      0.19  VQ        |         |         |         |
      0+16       0.0036      0.19  VQ        |         |         |         |
      0+17       0.0038      0.19  VQ        |         |         |         |
      0+18       0.0041      0.19  VQ        |         |         |         |
      0+19       0.0044      0.19  VQ        |         |         |         |
      0+20       0.0046      0.19  VQ        |         |         |         |
      0+21       0.0049      0.19  VQ        |         |         |         |
      0+22       0.0051      0.19  VQ        |         |         |         |
      0+23       0.0054      0.19  VQ        |         |         |         |
      0+24       0.0057      0.19  VQ        |         |         |         |
      0+25       0.0059      0.19  VQ        |         |         |         |
      0+26       0.0062      0.19  |Q        |         |         |         |
      0+27       0.0065      0.19  |Q        |         |         |         |
      0+28       0.0068      0.20  |Q        |         |         |         |
      0+29       0.0070      0.20  |Q        |         |         |         |
      0+30       0.0073      0.20  |Q        |         |         |         |
      0+31       0.0076      0.20  |Q        |         |         |         |
      0+32       0.0078      0.20  |Q        |         |         |         |
      0+33       0.0081      0.20  |Q        |         |         |         |
      0+34       0.0084      0.20  |Q        |         |         |         |
      0+35       0.0087      0.20  |Q        |         |         |         |
      0+36       0.0089      0.20  |Q        |         |         |         |
      0+37       0.0092      0.20  |Q        |         |         |         |
      0+38       0.0095      0.20  |Q        |         |         |         |
      0+39       0.0098      0.20  |Q        |         |         |         |
      0+40       0.0100      0.20  |Q        |         |         |         |
      0+41       0.0103      0.20  |Q        |         |         |         |
      0+42       0.0106      0.20  |Q        |         |         |         |
      0+43       0.0109      0.20  |Q        |         |         |         |
      0+44       0.0112      0.21  |Q        |         |         |         |
      0+45       0.0115      0.21  |Q        |         |         |         |
      0+46       0.0117      0.21  |Q        |         |         |         |
      0+47       0.0120      0.21  |QV       |         |         |         |
      0+48       0.0123      0.21  |QV       |         |         |         |
      0+49       0.0126      0.21  |QV       |         |         |         |
      0+50       0.0129      0.21  |QV       |         |         |         |
      0+51       0.0132      0.21  |QV       |         |         |         |
      0+52       0.0135      0.21  |QV       |         |         |         |
      0+53       0.0138      0.21  |QV       |         |         |         |
      0+54       0.0140      0.21  |QV       |         |         |         |
      0+55       0.0143      0.21  |QV       |         |         |         |
```

```
 0+56       0.0146      0.21  |QV        |         |         |         |
 0+57       0.0149      0.21  |QV        |         |         |         |
 0+58       0.0152      0.21  |QV        |         |         |         |
 0+59       0.0155      0.22  |QV        |         |         |         |
 1+ 0       0.0158      0.22  |QV        |         |         |         |
 1+ 1       0.0161      0.22  |QV        |         |         |         |
 1+ 2       0.0164      0.22  |QV        |         |         |         |
 1+ 3       0.0167      0.22  |QV        |         |         |         |
 1+ 4       0.0170      0.22  |QV        |         |         |         |
 1+ 5       0.0173      0.22  |QV        |         |         |         |
 1+ 6       0.0176      0.22  |QV        |         |         |         |
 1+ 7       0.0179      0.22  |Q V       |         |         |         |
 1+ 8       0.0183      0.22  |Q V       |         |         |         |
 1+ 9       0.0186      0.22  |Q V       |         |         |         |
 1+10       0.0189      0.22  |Q V       |         |         |         |
 1+11       0.0192      0.22  |Q V       |         |         |         |
 1+12       0.0195      0.23  |Q V       |         |         |         |
 1+13       0.0198      0.23  |Q V       |         |         |         |
 1+14       0.0201      0.23  |Q V       |         |         |         |
 1+15       0.0204      0.23  |Q V       |         |         |         |
 1+16       0.0207      0.23  |Q V       |         |         |         |
 1+17       0.0211      0.23  |Q V       |         |         |         |
 1+18       0.0214      0.23  |Q V       |         |         |         |
 1+19       0.0217      0.23  |Q V       |         |         |         |
 1+20       0.0220      0.23  |Q V       |         |         |         |
 1+21       0.0223      0.23  |Q V       |         |         |         |
 1+22       0.0227      0.23  |Q V       |         |         |         |
 1+23       0.0230      0.24  |Q V       |         |         |         |
 1+24       0.0233      0.24  |Q V       |         |         |         |
 1+25       0.0237      0.24  |Q V       |         |         |         |
 1+26       0.0240      0.24  |Q  V      |         |         |         |
 1+27       0.0243      0.24  |Q  V      |         |         |         |
 1+28       0.0246      0.24  |Q  V      |         |         |         |
 1+29       0.0250      0.24  |Q  V      |         |         |         |
 1+30       0.0253      0.24  |Q  V      |         |         |         |
 1+31       0.0256      0.24  |Q  V      |         |         |         |
 1+32       0.0260      0.24  |Q  V      |         |         |         |
 1+33       0.0263      0.25  |Q  V      |         |         |         |
 1+34       0.0267      0.25  |Q  V      |         |         |         |
 1+35       0.0270      0.25  |Q  V      |         |         |         |
 1+36       0.0273      0.25  |Q  V      |         |         |         |
 1+37       0.0277      0.25  |Q  V      |         |         |         |
 1+38       0.0280      0.25  |Q  V      |         |         |         |
 1+39       0.0284      0.25  |Q  V      |         |         |         |
 1+40       0.0287      0.25  |Q  V      |         |         |         |
 1+41       0.0291      0.25  |Q  V      |         |         |         |
 1+42       0.0294      0.26  |Q  V      |         |         |         |
 1+43       0.0298      0.26  |Q  V      |         |         |         |
 1+44       0.0301      0.26  |Q   V     |         |         |         |
 1+45       0.0305      0.26  |Q   V     |         |         |         |
 1+46       0.0309      0.26  |Q   V     |         |         |         |
 1+47       0.0312      0.26  |Q   V     |         |         |         |
 1+48       0.0316      0.26  |Q   V     |         |         |         |
 1+49       0.0320      0.26  |Q   V     |         |         |         |
 1+50       0.0323      0.26  |Q   V     |         |         |         |
 1+51       0.0327      0.27  |Q   V     |         |         |         |
 1+52       0.0331      0.27  |Q   V     |         |         |         |
 1+53       0.0334      0.27  |Q   V     |         |         |         |
 1+54       0.0338      0.27  |Q   V     |         |         |         |
 1+55       0.0342      0.27  |Q   V     |         |         |         |
 1+56       0.0346      0.27  |Q   V     |         |         |         |
 1+57       0.0349      0.28  |Q   V     |         |         |         |
 1+58       0.0353      0.28  |Q   V     |         |         |         |
 1+59       0.0357      0.28  |Q   V     |         |         |         |
 2+ 0       0.0361      0.28  |Q    V    |         |         |         |
 2+ 1       0.0365      0.28  |Q    V    |         |         |         |
```

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  2+ 2     0.0369     0.28  |Q    V   |         |         |         |
  2+ 3     0.0372     0.28  |Q    V   |         |         |         |
  2+ 4     0.0376     0.29  | Q   V   |         |         |         |
  2+ 5     0.0380     0.29  | Q   V   |         |         |         |
  2+ 6     0.0384     0.29  | Q   V   |         |         |         |
  2+ 7     0.0388     0.29  | Q   V   |         |         |         |
  2+ 8     0.0392     0.29  | Q   V   |         |         |         |
  2+ 9     0.0396     0.29  | Q   V   |         |         |         |
  2+10     0.0400     0.29  | Q   V   |         |         |         |
  2+11     0.0404     0.30  | Q   V   |         |         |         |
  2+12     0.0409     0.30  | Q   V   |         |         |         |
  2+13     0.0413     0.30  | Q   V   |         |         |         |
  2+14     0.0417     0.30  | Q   V   |         |         |         |
  2+15     0.0421     0.30  | Q    V  |         |         |         |
  2+16     0.0425     0.31  | Q    V  |         |         |         |
  2+17     0.0430     0.31  | Q    V  |         |         |         |
  2+18     0.0434     0.31  | Q    V  |         |         |         |
  2+19     0.0438     0.31  | Q    V  |         |         |         |
  2+20     0.0442     0.31  | Q    V  |         |         |         |
  2+21     0.0447     0.31  | Q    V  |         |         |         |
  2+22     0.0451     0.32  | Q    V  |         |         |         |
  2+23     0.0455     0.32  | Q    V  |         |         |         |
  2+24     0.0460     0.32  | Q    V  |         |         |         |
  2+25     0.0464     0.32  | Q    V  |         |         |         |
  2+26     0.0469     0.33  | Q    V  |         |         |         |
  2+27     0.0473     0.33  | Q    V  |         |         |         |
  2+28     0.0478     0.33  | Q    V  |         |         |         |
  2+29     0.0482     0.33  | Q     V |         |         |         |
  2+30     0.0487     0.33  | Q     V |         |         |         |
  2+31     0.0492     0.34  | Q     V |         |         |         |
  2+32     0.0496     0.34  | Q     V |         |         |         |
  2+33     0.0501     0.34  | Q     V |         |         |         |
  2+34     0.0506     0.34  | Q     V |         |         |         |
  2+35     0.0511     0.35  | Q     V |         |         |         |
  2+36     0.0515     0.35  | Q     V |         |         |         |
  2+37     0.0520     0.35  | Q     V |         |         |         |
  2+38     0.0525     0.35  | Q     V |         |         |         |
  2+39     0.0530     0.35  | Q     V |         |         |         |
  2+40     0.0535     0.36  | Q     V |         |         |         |
  2+41     0.0540     0.36  | Q      V|         |         |         |
  2+42     0.0545     0.36  | Q      V|         |         |         |
  2+43     0.0550     0.37  | Q      V|         |         |         |
  2+44     0.0555     0.37  | Q      V|         |         |         |
  2+45     0.0560     0.38  | Q      V|         |         |         |
  2+46     0.0565     0.38  | Q      V|         |         |         |
  2+47     0.0571     0.38  | Q      V|         |         |         |
  2+48     0.0576     0.38  | Q      V|         |         |         |
  2+49     0.0581     0.38  | Q      V|         |         |         |
  2+50     0.0587     0.39  | Q      V|         |         |         |
  2+51     0.0592     0.39  | Q      V|         |         |         |
  2+52     0.0597     0.40  | Q      V|         |         |         |
  2+53     0.0603     0.40  | Q       V         |         |         |
  2+54     0.0609     0.41  | Q       V         |         |         |
  2+55     0.0614     0.41  | Q       V         |         |         |
  2+56     0.0620     0.41  | Q       V         |         |         |
  2+57     0.0626     0.42  | Q       V         |         |         |
  2+58     0.0631     0.42  | Q       V         |         |         |
  2+59     0.0637     0.42  | Q       V         |         |         |
  3+ 0     0.0643     0.42  | Q       V         |         |         |
  3+ 1     0.0649     0.43  |  Q      V         |         |         |
  3+ 2     0.0655     0.44  |  Q      V         |         |         |
  3+ 3     0.0661     0.44  |  Q      |V        |         |         |
  3+ 4     0.0667     0.45  |  Q      |V        |         |         |
  3+ 5     0.0673     0.45  |  Q      |V        |         |         |
  3+ 6     0.0680     0.46  |  Q      |V        |         |         |
  3+ 7     0.0686     0.46  |  Q      |V        |         |         |
```

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3+ 8      0.0693     0.47  |  Q      |V        |         |         |
3+ 9      0.0699     0.47  |  Q      |V        |         |         |
3+10      0.0705     0.47  |  Q      |V        |         |         |
3+11      0.0712     0.48  |  Q      |V        |         |         |
3+12      0.0719     0.49  |  Q      | V       |         |         |
3+13      0.0726     0.50  |  Q      | V       |         |         |
3+14      0.0733     0.51  |  Q      | V       |         |         |
3+15      0.0740     0.51  |  Q      | V       |         |         |
3+16      0.0747     0.52  |  Q      | V       |         |         |
3+17      0.0754     0.52  |  Q      | V       |         |         |
3+18      0.0761     0.53  |  Q      | V       |         |         |
3+19      0.0769     0.53  |  Q      | V       |         |         |
3+20      0.0776     0.54  |  Q      | V       |         |         |
3+21      0.0784     0.55  |  Q      |  V      |         |         |
3+22      0.0791     0.56  |  Q      |  V      |         |         |
3+23      0.0799     0.57  |   Q     |  V      |         |         |
3+24      0.0807     0.58  |   Q     |  V      |         |         |
3+25      0.0816     0.60  |   Q     |  V      |         |         |
3+26      0.0824     0.60  |   Q     |  V      |         |         |
3+27      0.0832     0.61  |   Q     |  V      |         |         |
3+28      0.0841     0.62  |   Q     |   V     |         |         |
3+29      0.0849     0.63  |   Q     |   V     |         |         |
3+30      0.0858     0.63  |   Q     |   V     |         |         |
3+31      0.0867     0.65  |   Q     |   V     |         |         |
3+32      0.0876     0.67  |   Q     |   V     |         |         |
3+33      0.0886     0.69  |   Q     |   V     |         |         |
3+34      0.0895     0.71  |   Q     |   V     |         |         |
3+35      0.0905     0.72  |    Q    |    V    |         |         |
3+36      0.0916     0.74  |    Q    |    V    |         |         |
3+37      0.0926     0.75  |    Q    |    V    |         |         |
3+38      0.0936     0.76  |    Q    |    V    |         |         |
3+39      0.0947     0.77  |    Q    |    V    |         |         |
3+40      0.0958     0.79  |    Q    |     V   |         |         |
3+41      0.0969     0.82  |    Q    |     V   |         |         |
3+42      0.0981     0.86  |     Q   |     V   |         |         |
3+43      0.0993     0.89  |     Q   |     V   |         |         |
3+44      0.1006     0.93  |     Q   |     V   |         |         |
3+45      0.1019     0.96  |     Q   |      V  |         |         |
3+46      0.1033     0.99  |     Q   |      V  |         |         |
3+47      0.1047     1.01  |      Q  |      V  |         |         |
3+48      0.1061     1.04  |      Q  |      V  |         |         |
3+49      0.1076     1.07  |      Q  |      V  |         |         |
3+50      0.1091     1.09  |      Q  |       V |         |         |
3+51      0.1107     1.20  |       Q |       V |         |         |
3+52      0.1125     1.30  |        Q|       V |         |         |
3+53      0.1145     1.40  |        Q|        V|         |         |
3+54      0.1165     1.50  |         Q        V|         |         |
3+55      0.1187     1.61  |         |Q       V|         |         |
3+56      0.1211     1.74  |         | Q       V         |         |
3+57      0.1237     1.87  |         |  Q      V         |         |
3+58      0.1265     2.00  |         |   Q     |V        |         |
3+59      0.1294     2.13  |         |   Q     |V        |         |
4+ 0      0.1325     2.26  |         |    Q    | V       |         |
4+ 1      0.1366     2.95  |         |         Q V       |         |
4+ 2      0.1416     3.64  |         |         |  V Q    |         |
4+ 3      0.1476     4.33  |         |         |   V     Q         |
4+ 4      0.1545     5.01  |         |         |    V    |    Q    |
4+ 5      0.1623     5.70  |         |         |      V  |         Q
4+ 6      0.1689     4.82  |         |         |       V |  Q      |
4+ 7      0.1744     3.94  |         |         |      Q V|         |
4+ 8      0.1786     3.05  |         |         |Q       V|         |
4+ 9      0.1816     2.17  |         |    Q    |         V         |
4+10      0.1833     1.29  |        Q|         |         V         |
4+11      0.1850     1.20  |       Q |         |         V         |
4+12      0.1865     1.12  |      Q  |         |         |V        |
4+13      0.1879     1.03  |      Q  |         |         |V        |
```

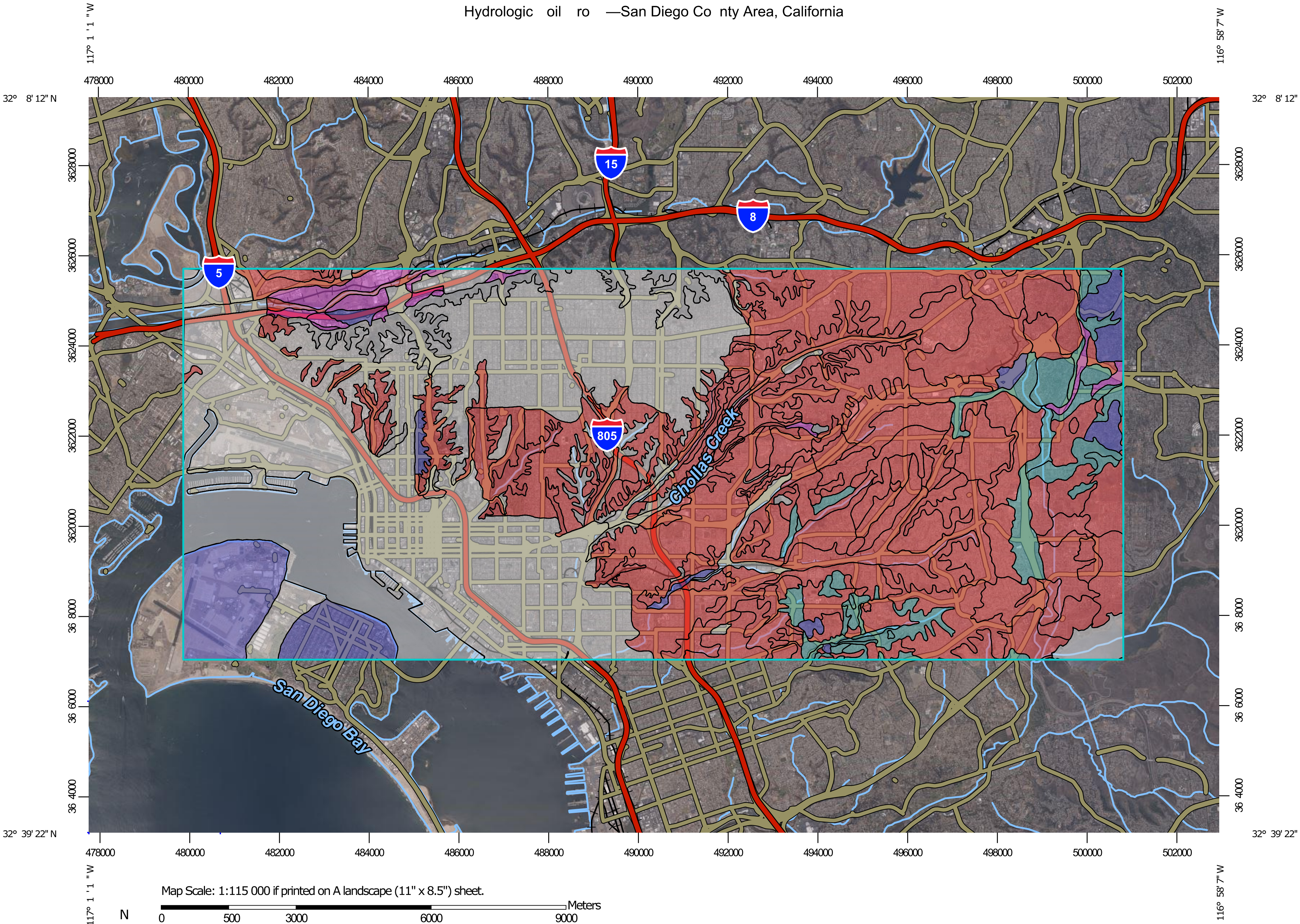
```
 4+14    0.1893    0.95  |     Q    |          |          |V         |
 4+15    0.1904    0.86  |     Q    |          |          |V         |
 4+16    0.1916    0.82  |    Q     |          |          | V        |
 4+17    0.1927    0.79  |    Q     |          |          | V        |
 4+18    0.1937    0.75  |    Q     |          |          | V        |
 4+19    0.1947    0.71  |   Q      |          |          | V        |
 4+20    0.1956    0.67  |   Q      |          |          | V        |
 4+21    0.1965    0.65  |   Q      |          |          | V        |
 4+22    0.1974    0.63  |   Q      |          |          |  V       |
 4+23    0.1982    0.61  |   Q      |          |          |  V       |
 4+24    0.1990    0.59  |   Q      |          |          |  V       |
 4+25    0.1998    0.56  |  Q       |          |          |  V       |
 4+26    0.2006    0.55  |  Q       |          |          |  V       |
 4+27    0.2013    0.54  |  Q       |          |          |  V       |
 4+28    0.2020    0.52  |  Q       |          |          |  V       |
 4+29    0.2027    0.51  |  Q       |          |          |  V       |
 4+30    0.2034    0.49  |  Q       |          |          |   V      |
 4+31    0.2040    0.48  |  Q       |          |          |   V      |
 4+32    0.2047    0.47  |  Q       |          |          |   V      |
 4+33    0.2053    0.46  |  Q       |          |          |   V      |
 4+34    0.2059    0.45  |  Q       |          |          |   V      |
 4+35    0.2066    0.44  |  Q       |          |          |   V      |
 4+36    0.2071    0.43  |  Q       |          |          |   V      |
 4+37    0.2077    0.42  | Q        |          |          |   V      |
 4+38    0.2083    0.41  | Q        |          |          |   V      |
 4+39    0.2089    0.41  | Q        |          |          |   V      |
 4+40    0.2094    0.40  | Q        |          |          |    V     |
 4+41    0.2099    0.39  | Q        |          |          |    V     |
 4+42    0.2105    0.39  | Q        |          |          |    V     |
 4+43    0.2110    0.38  | Q        |          |          |    V     |
 4+44    0.2115    0.37  | Q        |          |          |    V     |
 4+45    0.2120    0.37  | Q        |          |          |    V     |
 4+46    0.2125    0.36  | Q        |          |          |    V     |
 4+47    0.2130    0.36  | Q        |          |          |    V     |
 4+48    0.2135    0.35  | Q        |          |          |    V     |
 4+49    0.2140    0.34  | Q        |          |          |    V     |
 4+50    0.2144    0.34  | Q        |          |          |    V     |
 4+51    0.2149    0.34  | Q        |          |          |    V     |
 4+52    0.2153    0.33  | Q        |          |          |     V    |
 4+53    0.2158    0.33  | Q        |          |          |     V    |
 4+54    0.2162    0.32  | Q        |          |          |     V    |
 4+55    0.2167    0.32  | Q        |          |          |     V    |
 4+56    0.2171    0.31  | Q        |          |          |     V    |
 4+57    0.2175    0.31  | Q        |          |          |     V    |
 4+58    0.2180    0.31  | Q        |          |          |     V    |
 4+59    0.2184    0.30  | Q        |          |          |     V    |
 5+ 0    0.2188    0.30  | Q        |          |          |     V    |
 5+ 1    0.2192    0.30  | Q        |          |          |     V    |
 5+ 2    0.2196    0.29  | Q        |          |          |     V    |
 5+ 3    0.2200    0.29  | Q        |          |          |     V    |
 5+ 4    0.2204    0.29  | Q        |          |          |     V    |
 5+ 5    0.2208    0.28  |Q         |          |          |     V    |
 5+ 6    0.2212    0.28  |Q         |          |          |     V    |
 5+ 7    0.2215    0.28  |Q         |          |          |      V   |
 5+ 8    0.2219    0.27  |Q         |          |          |      V   |
 5+ 9    0.2223    0.27  |Q         |          |          |      V   |
 5+10    0.2227    0.27  |Q         |          |          |      V   |
 5+11    0.2230    0.27  |Q         |          |          |      V   |
 5+12    0.2234    0.26  |Q         |          |          |      V   |
 5+13    0.2238    0.26  |Q         |          |          |      V   |
 5+14    0.2241    0.26  |Q         |          |          |      V   |
 5+15    0.2245    0.26  |Q         |          |          |      V   |
 5+16    0.2248    0.25  |Q         |          |          |      V   |
 5+17    0.2252    0.25  |Q         |          |          |      V   |
 5+18    0.2255    0.25  |Q         |          |          |      V   |
 5+19    0.2259    0.25  |Q         |          |          |      V   |
```

```
5+20       0.2262      0.25  |Q        |         |         |      V  |
5+21       0.2265      0.24  |Q        |         |         |      V  |
5+22       0.2269      0.24  |Q        |         |         |      V  |
5+23       0.2272      0.24  |Q        |         |         |       V |
5+24       0.2275      0.24  |Q        |         |         |       V |
5+25       0.2278      0.24  |Q        |         |         |       V |
5+26       0.2282      0.23  |Q        |         |         |       V |
5+27       0.2285      0.23  |Q        |         |         |       V |
5+28       0.2288      0.23  |Q        |         |         |       V |
5+29       0.2291      0.23  |Q        |         |         |       V |
5+30       0.2294      0.23  |Q        |         |         |       V |
5+31       0.2297      0.22  |Q        |         |         |       V |
5+32       0.2300      0.22  |Q        |         |         |       V |
5+33       0.2303      0.22  |Q        |         |         |       V |
5+34       0.2307      0.22  |Q        |         |         |       V |
5+35       0.2310      0.22  |Q        |         |         |       V |
5+36       0.2313      0.22  |Q        |         |         |       V |
5+37       0.2315      0.22  |Q        |         |         |       V |
5+38       0.2318      0.21  |Q        |         |         |       V |
5+39       0.2321      0.21  |Q        |         |         |       V |
5+40       0.2324      0.21  |Q        |         |         |       V |
5+41       0.2327      0.21  |Q        |         |         |       V |
5+42       0.2330      0.21  |Q        |         |         |       V |
5+43       0.2333      0.21  |Q        |         |         |        V|
5+44       0.2336      0.21  |Q        |         |         |        V|
5+45       0.2339      0.20  |Q        |         |         |        V|
5+46       0.2341      0.20  |Q        |         |         |        V|
5+47       0.2344      0.20  |Q        |         |         |        V|
5+48       0.2347      0.20  |Q        |         |         |        V|
5+49       0.2350      0.20  |Q        |         |         |        V|
5+50       0.2352      0.20  |Q        |         |         |        V|
5+51       0.2355      0.20  |Q        |         |         |        V|
5+52       0.2358      0.20  |Q        |         |         |        V|
5+53       0.2360      0.19  |Q        |         |         |        V|
5+54       0.2363      0.19  |Q        |         |         |        V|
5+55       0.2366      0.19  |Q        |         |         |        V|
5+56       0.2368      0.19  |Q        |         |         |        V|
5+57       0.2371      0.19  |Q        |         |         |        V|
5+58       0.2374      0.19  |Q        |         |         |        V|
5+59       0.2376      0.19  |Q        |         |         |        V|
6+ 0       0.2379      0.19  |Q        |         |         |        V|
6+ 1       0.2381      0.19  |Q        |         |         |        V|
6+ 2       0.2384      0.18  |Q        |         |         |        V|
6+ 3       0.2386      0.18  |Q        |         |         |        V|
6+ 4       0.2389      0.18  |Q        |         |         |        V|
6+ 5       0.2391      0.18  |Q        |         |         |        V|
----------------------------------------------------------------------




End of computations, total study area =           1.542 (Ac.)
```

Attachment E – Soils Group Determination



Map Scale: 1:115 000 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 500, 3000, 6000, 9000

eet: 0, 5000, 0000, 20000, 30000

N

Map projection: Web Mercator Corner coordinates: WGS8 Edge tics: UTM Zone 11N WGS8

MAP LEGEND

Area of nterest (A)

Area of I terest (AOI)

Soils

Soil ating Polygons

- A
- A/D
-
- /D
- C
- C/D
- D
- Not rated or ot available

So l at ng L nes

- A
- A/D
-
- /D
- C
- C/D
- D
- Not rated or ot available

So l at ng Po nts

- A
- A/D
-
- /D
- C
- C/D
- D
- Not rated or ot available

Water eatures

Stream a d Ca al

ransportat on

- Rail
- I ter tate Hig way
- US Route
- Major Road
- Local Road

Background

Aerial P otograp y

MAP N MA N

T e oil urvey t at compri e your AOI were mapped at 1:24,000.

Plea e rely o t e bar cale o eac map eet or map mea ureme t .

Source o Map: Natural Re ource Co ervatio Service
Web Soil Survey URL:
Coordi ate Sy tem: Web Mercator (EPSG:3857)

Map rom t e Web Soil Survey are ba ed o t e Web Mercator projectio , w ic pre erve directio a d ape but di tort di ta ce a d area. A projectio t at pre erve area, uc a t e Alber equal-area co ic projectio , ould be u ed i more accurate calculatio o di ta ce or area are required.

T i product i ge erated rom t e USDA-NRCS certi ied data a o t e ver io date( ) li ted below.

Soil Survey Area: Sa Diego Cou ty Area, Cali or ia
Survey Area Data: Ver io 1 , Sep 13, 2021

Soil map u it are labeled (a pace allow) or map cale 1:50,000 or larger.

Date( ) aerial image were p otograp ed: Dec 7, 2014—Feb 2 , 2020

T e ort op oto or ot er ba e map o w ic t e oil li e were compiled a d digitized probably di er rom t e backgrou d imagery di played o t e e map . A a re ult, ome mi or i ti g o map u it bou darie may be evide t.

End of Report

Attachment 6
Geotechnical and Groundwater Investigation Report

Attach project's geotechnical and groundwater investigation report. Refer to Appendix C.4 to determine the reporting requirements.

June 14, 2022

Project No. 13324.001

To: MAAC Real Estate Development
1355 Third Avenue, CA
Chula Vista, California 91911

Attention: Steve Blanden

Subject: Geotechnical Response to City of San Diego Cycle 4 Preliminary Review LDR-Geology Review Comments, Proposed Mercado Apartments, San Diego, California, PRJ1054951

In accordance with your request, this letter has been prepared to provide geotechnical responses to the City of San Diego Cycle 4 Preliminary Review LDR-Geology Review Comments, dated January 21, 2022, Project Number 696585. Our responses to the City of San Diego Cycle Issue Comments are summarized below.

For clarity, the City of San Diego review comments are italicized and numbered in accordance with the order presented on the City comment sheet. It should also be noted that comments addressed below are specific to the geotechnical aspects of the project and other comments for other disciplines are not addressed in this letter.

2. The proposed project is located in the "Downtown Special Fault Zone" as shown on the City's Seismic Safety Study Geologic Hazards Map. Projects in this zone require a geotechnical report, including a fault hazards study to determine if "active" or "potentially active" faults traverse the site.

A geotechnical report (Leighton, 2021), included as Attachment 4, has been provided for the subject project. With respect to a fault hazards study, it is our professional opinion that no Holocene-active or pre-Holocene faults traverse the site. This opinion is supported by our recent site-specific exploration (Leighton, 2021), our review of available geologic literature (Attachment 1), previously completed fault studies at the site and in the immediate area (Attachment 2), and our experience regarding fault hazard in the downtown San Diego area. Furthermore, there are no known or mapped Holocene-active or pre-Holocene faults that project toward the site, transecting, or passing nearby or within the site boundaries. Specifically, with respect to previous fault studies performed at the site, we reviewed a fault trench log (T-1) from a previous site study by Geocon. The fault trench is 7 to 10 feet deep that trends in a Northwest direction across the previous site development a total of 660 linear feet. The trench log is included as Attachment 3. Based on our review, the middle to late Pleistocene-aged Paralic Deposits (previously known as Bay Point Formation) and overlying pre-Holocene-aged deposits at the site were noted to be uniform, continuous, and unfaulted. Please note, that we concur with the findings of the Geocon trench log and faulting report.

In addition, we reviewed a previously completed fault study in the immediate area north of the project site (Leighton, 2010). No Holocene-active or pre-Holocene faults were noted to traverse the site. Lastly, our review of historical topographic maps did not indicate any geomorphic expressions, such as offset streams, sag ponds, pressure ridges, or lineal topographic expressions, across the subject site that characteristically result from Holocene-active faulting. Based on this information, it continues to be our professional opinion that the subject site is not transected by any Holocene-active or pre-Holocene faults. The fault rupture hazard for the site is in our opinion, low, and is not a constraint to the proposed site development. Given the results of our investigation, we find that the site is suitable and safe for the proposed project.

3. Submit a geotechnical investigation report that addresses the site and proposed development. For information regarding geotechnical reports, consider reviewing the City's Guidelines for Geotechnical Reports.

As noted above, we have included the geotechnical investigation report (Leighton, 2021) for the subject project as part of this letter (please see Attachment 4).

4. Note – Storm Water Requirements for the proposed conceptual development will be evaluated by LDR-Engineering review. Priority Development Projects (PDPs) may require an investigation of storm water infiltration feasibility in accordance with the Storm Water Standards (including Appendix C and D). Check with your LDR-Engineering reviewer on requirements. LDR-Engineering may determine that LDR-Geology review of a storm water infiltration evaluation is required.

It is our professional opinion that storm water infiltration at the site is not feasible due to the presence and depth of undocumented fill (i.e., greater than 5 feet), the adjacent underground utilities and existing settlement sensitive improvements. Accordingly, we have categorized the site as “No Infiltration”.

If you have any questions regarding our letter, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,
LEIGHTON AND ASSOCIATES, INC.

PROFESSIONAL GEOLOGIST
MICHAEL D. JENSEN
NO. 2457
CERTIFIED
ENGINEERING
GEOLOGIST
Exp. 07/31/22
STATE OF CALIFORNIA

Mike D. Jensen, CEG 2457
Associate Engineering Geologist

Attachments
1) References
2) Site Vicinity Exploration Map
3) Geocon Trench Log
4) Leighton Geotechnical Report (Leighton, 2021)

Distribution: (1) Addressee

REFERENCES

City of San Diego, 2008, Seismic Safety Study, Geologic Hazards and Faults, Grid Tile 17.

Geocon, 1993, Fault Evaluation, Mercado Apartments, Project No. 04749-31-02, dated January 14, 1995.

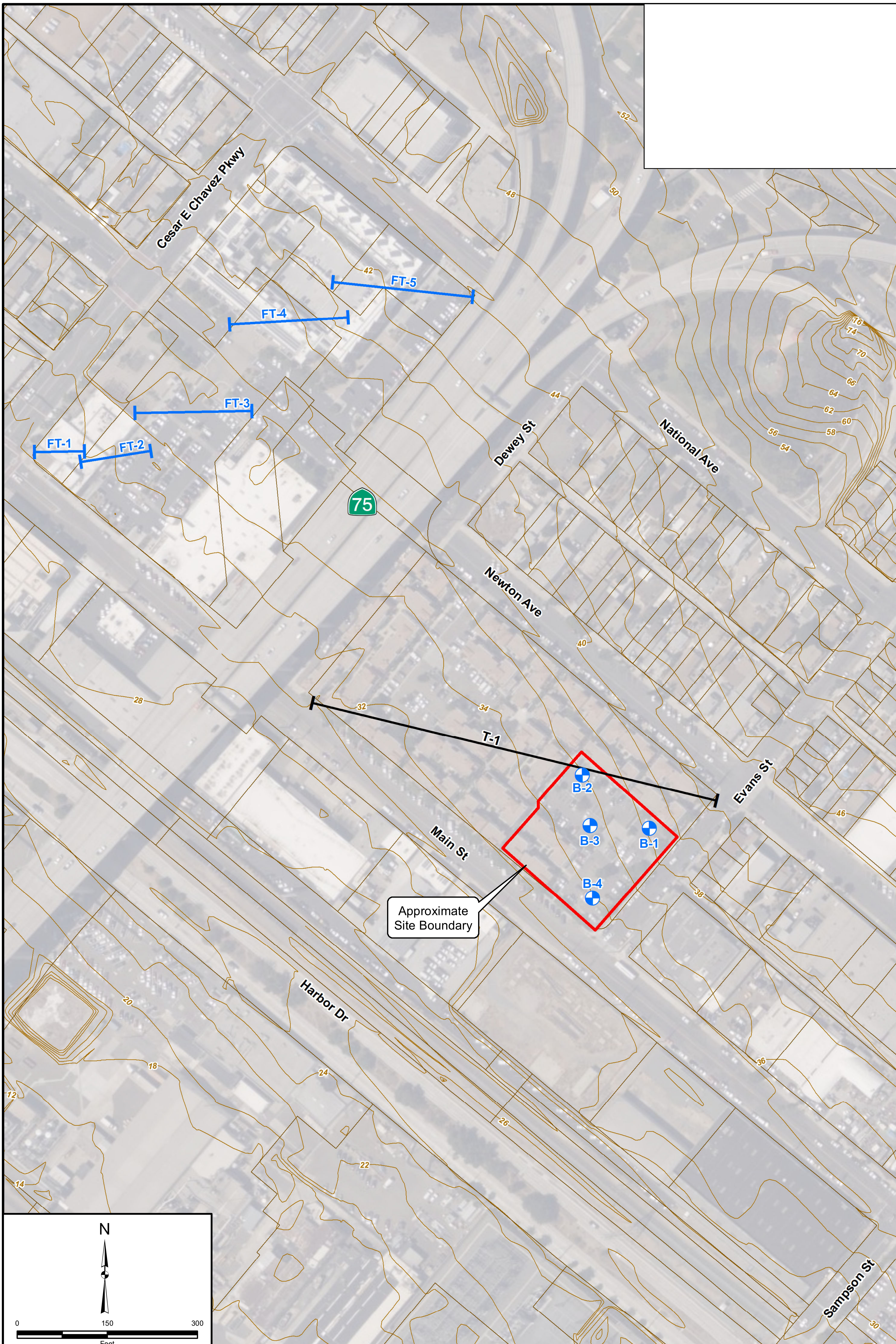
Kennedy, M.P., and Tan, S.S., 2008, Geologic Map of the San Diego Quadrangle, California, California Geologic Survey, 1:100,000 scale.

Kennedy, M.P. and Clarke, S.H., 1999, Age of Faulting in San Diego Bay in the Vicinity of the Coronado Bridge – An Addendum to - Analysis of Late Quaternary Faulting in San Diego Bay and Hazards to the Coronado Bridge: California Division of Mines and Geology, Open File Report 97-10B.

Leighton and Associates, Inc., 2021, Geotechnical Investigation, Proposed Mercado Apartments, Residential Development, Main Street and South Evans Street, San Diego, California, Project No. 13324.001, dated December 9, 2021.

________________, 2000, Fault Study, Proposed Crosby Street Mercado, San Diego, California, Project No. 040112-002, dated July 19, 2000.

Martinez + Cutri Urban Studio Corporation, 2021, Site Plan, MAAC Apartments, dated July 6, 2021.



Project: 13324.001	Eng/Geol: WDO/MDJ
Scale: 1 " = 150 '	Date: May 2022
Base Map: ESRI ArcGIS Online 2022	
Author: (mmurphy)	

SITE VICINITY EXPLORATION MAP

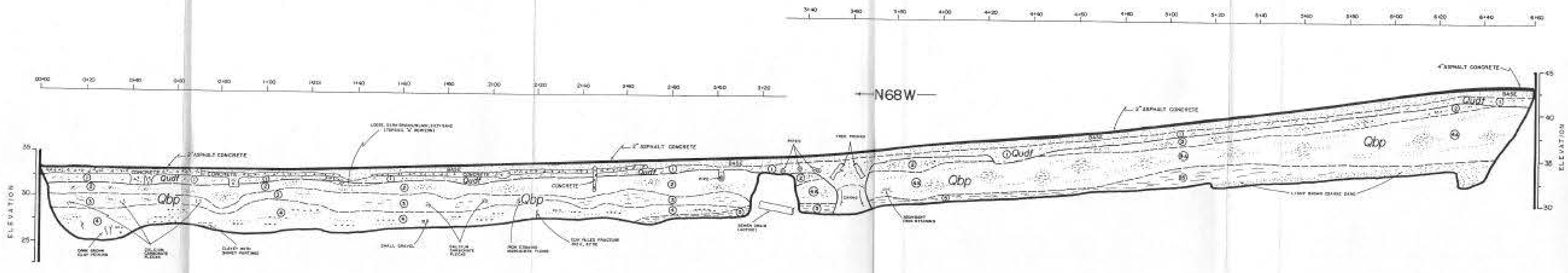
MAAC Mercado Apartments
South Evans and Main St
San Diego, California

FIGURE 1

Leighton

Map Saved as P:\Drafting\13324\001\Maps\13324-001_F01_SVEM_2022-05-05.mxd on 5/5/2022 3:55:00 PM

MERCADO APARTMENTS



TRENCH LOG T-1

SCALE: 1"= 5' (VERT.) 1"= 20' (HORIZ.)

LEGEND

Qudf.... UNDOCUMENTED FILL

1 Loose to medium dense, damp to moist, dark red brown to brown, Silty to Clayey, fine SAND (SM-SC); predominantly medium dense, occasional debris including clay tile, pipe, wire, tree trunks (Undocumented Fill)

Qbp.... BAY POINT FORMATION

2 Medium dense, slightly moist to moist, red brown Silty, fine to medium SAND (SM); with coarse sand, occasional clayey seams, manganese staining, upper portions porous (Very Weathered Bay Point Formation - poorly developed "B" Horizon)

3 Stiff to very stiff, moist, dark red brown to dark gray brown, Clayey SAND to Sandy CLAY (SC-CL); occasional caliche carbonate flecks, iron oxide staining (Weathered Bay Point Formation - poorly developed "C" Horizon)

4 Dense, damp to moist, light brown, Silty to Clayey, fine to coarse SAND (SM-SC), predominantly Silty SAND, manganese staining (Bay Point Formation)

4a Dense to very dense, moist, red brown, Silty to Clayey, fine to coarse SAND (SM-SC); iron staining, manganese flecks (Weathered Bay Point Formation)

5 Very stiff/dense, slightly moist to very moist, dark olive brown, Clayey, fine to coarse SAND to Sandy CLAY (SC-CL); polished on parting surfaces (Bay Point Formation)

APPROX. LOCATION OF GEOLOGIC CONTACT (short dash where generalized)

GEOCON INCORPORATED

GEOTECHNICAL ENGINEERS AND ENGINEERING GEOLOGISTS

PROJECT NO. 04749-32-02

FIG. A-11

DATE 1-14-1993

TRENCH LOG T-1

Leighton and Associates, Inc.
A Leighton Group Company

GEOTECHNICAL INVESTIGATION

PROPOSED MERCADO APARTMENTS RESIDENTIAL DEVELOPMENT

MAIN ST AND SOUTH EVANS ST

SAN DIEGO, CALIFORNIA 92111

Prepared For **MAAC REAL ESTATE DEVELOPMENT**
1355 THIRD AVENUE, CA
CHULA VISTA, CALIFORNIA 91911

Prepared By **LEIGHTON AND ASSOCIATES, INC.**
3934 MURPHY CANYON RD, STE B-205
SAN DIEGO, CA 92123

Project Number 13324.001

December 9, 2021

Leighton 60th Anniversary

Leighton and Associates, Inc.
A Leighton Group Company

December 9, 2021

Project No. 13324.001

MAAC Real Estate Development
1355 Third Avenue, CA
Chula Vista, California 91911

Attention: Ms. Thea-Marie Sauca

Subject: Geotechnical Investigation
Proposed Mercado Apartments
Residential Development
Main Street and South Evans Street
San Diego, California 92111

In accordance with your request and authorization, Leighton and Associates, Inc. (Leighton) has conducted a geotechnical investigation for the proposed Mercado Residential development located on Main Street and South Evans Street in San Diego, California. Based on the results of our study, it is our professional opinion that the site is suitable for development of such a project. The accompanying geotechnical report presents a summary of our current investigation and provides geotechnical conclusions and recommendations.

If you have any questions regarding our report, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

PROFESSIONAL GEOLOGIST MICHAEL D. JENSEN NO. 2457 CERTIFIED ENGINEERING GEOLOGIST Exp 07/31/22 STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER WILLIAM D. OLSON No. 45283 Exp. 9/30/22 CIVIL STATE OF CALIFORNIA

Mike D. Jensen, CEG 2457
Associate Engineering Geologist
mjensen@leightongroup.com

William D. Olson, RCE 45283
Associate Engineer
dolson@leightongroup.com

Distribution: (1) Digital Copy

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Appendices

1.0 INTRODUCTION

We recommend that all individuals utilizing this report read the preceding information sheet prepared by the Geoprofessional Business Association (GBA) and the Limitations, Section 7.0, located at the end of this report.

1.1 Purpose and Scope of Services

This report presents the results of our geotechnical investigation for the proposed Mercado Residential development located on Main Street and South Evans Street in San Diego, California (Figure 1). Our investigation included geotechnical exploration and laboratory testing of selected soil samples. The purpose of the geotechnical investigation was to evaluate existing geotechnical conditions and potential geologic hazards present at the site, and provide specific geotechnical conclusions and recommendations for the currently proposed residential development.

The scope of services for our preliminary geotechnical investigation included:

- Coordination with DigAlert to locate potential underground utilities on site.
- Review of pertinent available geotechnical literature, geologic maps, and aerial photographs (Appendix A).
- A subsurface exploration program consisting of four (4) geotechnical borings to depths of 26.5 to 51.5 feet below the existing ground surface (bgs). The borings were excavated to provide soil thickness, type, and distribution across the subject site. Logs of the geotechnical borings are presented in Appendix B.
- Laboratory testing of representative soil samples obtained from the subsurface exploration. Laboratory test results are included in Appendix C.
- Evaluation of site seismicity.
- Compilation and analysis of the geotechnical data obtained from the field investigation and laboratory testing
- Preparation of this geotechnical report presenting the findings of our study and providing conclusions and recommendations relative to the currently proposed development.

1.2 Site Description

The project site is a developed square shaped parcel, which encompasses approximately 1 acre and is currently occupied by an existing paved parking area with associated improvements and landscaping. In general, the property is bound by existing residential development to the north and west, Main Street to the southwest, and South Evans Street to the southeast. Currently, the site topography is relatively flat, with the ground surface varying from 37 to 41 feet above mean sea level (msl).

Site Latitude and Longitude
32.697355º N
117.143261º W

1.3 Proposed Development

Based on preliminary site plans (Martinez and Cutri, 2021), we understand the project will consist of construction of 92 units, a courtyard, play yard, landscaping with associated improvements. We anticipate site grading will be minor with cuts and fills of 1 to 3 feet. Two of the existing apartment buildings adjacent to Main Street will be demolished to make room for the new residential building. We anticipate the new buildings will be one- to two-story, wood-framed structures with conventional foundations slab on grade floors. Foundation and Civil plans were not available at the time of preparing this report.

2.0 SUBSURFACE EXPLORATION AND LABORATORY TESTING

2.1 Site Investigation

Prior to the subsurface exploration, we marked the proposed locations and notified DigAlert to identify buried utilities. Our subsurface investigation consisted of the excavation, logging and sampling of four (4) 8-inch small diameter hollow-stem augur (HSA) boring (B-1) was drilled to approximately 26.5-51.5 feet below the existing ground surface (bgs). The purpose of our subsurface exploration was to evaluate the underlying stratigraphy, physical characteristics, and specific engineering properties of the soils beneath the site. The geotechnical borings were drilled using a heavy-duty truck-mounted drill rig.

The exploratory excavations were logged by a geologist from our firm. Representative bulk and relatively undisturbed samples were obtained at frequent intervals for laboratory testing. Subsequent to logging and sampling, the boring excavations were backfilled. The approximate locations of the geotechnical borings are shown on the Geotechnical Map (Figure 2) and the logs are presented in Appendix B.

2.2 Laboratory Testing

Laboratory testing performed on representative soil samples obtained during the subsurface explorations included expansion potential, direct shear, moisture & density, and geochemical characteristics of the subsurface soils. A discussion of the laboratory tests performed and a summary of the laboratory test results are presented in Appendix C.

3.0 SUMMARY OF GEOTECHNICAL CONDITIONS

3.1 Geologic Setting

The project area is situated in the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California and varies in width from approximately 30 to 100 miles (Norris and Webb, 1990). The province is characterized by mountainous terrain on the east composed mostly of Mesozoic igneous and metamorphic rocks, and relatively low-lying coastal terraces to the west underlain by late Cretaceous-age, Tertiary-age, and Quaternary-age sedimentary units. Most of the coastal region of the County of San Diego, including the site, occur within this coastal region and are underlain by sedimentary units. Specifically, the site is located within the coastal plain section of the Peninsular Range Geomorphic Province of California, which generally consists of subdued landforms underlain by sedimentary bedrock.

3.2 Site Specific Geology

Based on our subsurface exploration and review of pertinent geologic literature and maps (Appendix A), the site is underlain by undocumented artificial fill and Quaternary-aged Old Paralic Deposits. A brief description of the geologic units encountered on the site is presented below. The approximate aerial distributions of those units are shown on the Geotechnical Map (Figure 2).

3.2.1 Undocumented Artificial Fill (Afu)

The undocumented artificial fill soils were encountered in all four soil borings and appear to be associated with previous site grading. As encountered, the material consists of medium dense to dense, light brown to dark and reddish-brown, dry to damp, silty sand. The majority of the fill also had few to some gravel, asphalt and concrete pieces throughout. Approximately 5 to 7 feet of undocumented fill was encountered in our borings. All existing fill soils onsite should be considered compressible and unsuitable in their present condition for support of structural elements.

3.2.2 Quaternary-aged Old Paralic Deposits (Qop)

Quaternary-aged Old Paralic Deposits underlie the undocumented fill and extend to the total depth as explored in all of the soil borings (B-1 to B-4). As observed, these deposits generally consist of medium dense to very dense, light tan to mottled brown, damp to wet, silty sand to sandy silt to clayey sand. Abundant shells were encountered below 20-22 feet bgs in two borings (B-1 and B-4). A consistent gravel bed crosses the entire site at depths ranging 10 to 11.5 feet below the existing ground surface (bgs).

3.3 Surface and Groundwater

No indication of surface water or evidence of surface ponding was encountered during our geotechnical investigation performed at the site. However, surface water may drain as sheet flow across the site during rainy periods.

Ground water was encountered in B-1 during our exploration at a depth of 37 feet bgs. Based on the anticipated grading and foundation depth, groundwater is not anticipated to affect the project.

Seasonal fluctuations in groundwater elevations should be anticipated over time. Local perched groundwater conditions or surface seepage may develop once site development is completed and stormwater infiltration and landscape irrigation commence.

3.4 Engineering Characteristics of On-site Soils

Based on the results of our laboratory testing of representative on-site soils, and our professional experience on similar sites with similar soils conditions, the engineering characteristics of the on-site soils are discussed below.

3.4.1 Compressible Soils

The site is underlain by undocumented artificial fill materials. The upper 5 to 7 feet of the undocumented artificial fill, and the weathered Paralic Deposits are considered compressible in their current state. Recommendations for remedial grading of these soils are provided in the following sections of this report.

3.4.2 Expansion Potential

Based on our testing, the expansion potential of the on-site soil is anticipated to range from very low to medium. However, the on-site clayey soil may have a medium to high expansion potential, therefore, geotechnical observations and/or laboratory testing upon completion of the graded pads is recommended to determine the actual expansion potential of finish grade soils on the site.

3.4.3 Soil Corrosivity

A preliminary screening of the on-site soils was performed to evaluate their potential corrosive effect on concrete and ferrous metals. In summary, laboratory testing on one representative soil samples obtained during our subsurface exploration evaluated pH, minimum electrical resistivity, and chloride and soluble sulfate content. The sample tested had a measured pH of 7.8, and a measured minimum electrical resistivity of 1300 ohm-cm. Test results also indicated that the samples had a chloride content of 180 parts per million (ppm), and soluble a sulfate content of 165 ppm.

3.4.4 Excavation Characteristics

The site is underlain by Paralic Deposits which consists of silty to clayey sand. With regards to the proposed project, it is anticipated these on-site soils can be excavated with conventional heavy-duty construction equipment. Beds of friable sands may experience caving during unsupported excavation or drilling.

3.4.5 Infiltration

Field percolation tests were not performed at the site due to depth of settlement sensitive undocumented fill. Based on the presence and depth of undocumented fill (i.e., greater than 5 feet), the adjacent underground utilities and existing settlement sensitive improvements, the site is not considered feasible for infiltration and is therefore categorized as “No Infiltration”.

4.0 SEISMICITY

4.1 Regional Tectonic Setting

The site is located within the Peninsular Ranges Geomorphic Province, which is traversed by several major active faults. The Whittier-Elsinore, San Jacinto, and the San Andreas faults are major active fault systems located east of the site, and the Rose Canyon, Newport-Inglewood (offshore), and Coronado Bank are active faults located west to northwest of the site (Jennings, 2010).

The Rose Canyon fault zone consists predominantly of right-lateral strike-slip faults that extend south-southeast bisecting the San Diego metropolitan area. Various fault strands display strike-slip, normal, oblique, or reverse components of displacement. The Rose Canyon fault zone extends offshore at La Jolla and continues north-northwest subparallel to the coastline. The offshore segments are poorly constrained regarding location and character. South of downtown, the fault zone splits into several splays that underlie San Diego Bay, Coronado, and the ocean floor south of Coronado (Treiman, 1993 and 2000; Kennedy and Clarke, 1999). Portions of the fault zone in the Mount Soledad, Rose Canyon, and downtown San Diego areas have been designated by the State of California (CGS, 2003) as being Earthquake Fault Zones.

4.2 Local Faulting

The California Geologic Survey (CGS, 2007) define a Holocene-active fault as a fault which has "had surface displacement within Holocene time (about the last 11,700 years)." Our review of available geologic literature (Appendix A) indicates that there are no known pre-Holocene or Holocene-active faults transecting the site. The subject site is within the Newport-Inglewood Rose Canyon fault zone, specifically the Silver Strand section. CGS has this fault section categorized as a Holocene fault zone without historic record. The nearest active fault is the Rose Canyon (offshore) fault zone located approximately 1.2 miles west of the site (USGS, 2014).

4.3 Seismicity

The site is considered to lie within a seismically active region, as is all of Southern California. As previously mentioned above, the Rose Canyon (offshore) fault zone located approximately 1.2 miles west of the site is considered the 'active' fault having the most significant effect at the site from a design standpoint.

4.4 Seismic Hazards

Severe ground shaking is most likely to occur during an earthquake on one of the regional active faults in Southern California. The effect of seismic shaking may be mitigated by adhering to the California Building Code or state-of-the-art seismic design parameters of the Structural Engineers Association of California.

4.4.1 Shallow Ground Rupture

As mentioned above, no pre-Holocene or Holocene-active faults are mapped crossing or projecting toward the site. Due to the absence of faults at the site, surface rupture from faulting is considered low.

4.4.2 Mapped Fault Zones

The site is located within a California State mapped Earthquake Fault Zone (EFZ), the Silver Strand section of the Newport-Inglewood Rose Canyon fault zone. As previously discussed, the subject site is not underlain by known faults. A fault evaluation was not performed as part of this investigation.

4.4.3 Site Class

Utilizing 2019 California Building Code (CBC) procedures, we have characterized the site soil profile to be Site Class D based on our experience with similar sites in the project area and the results of our subsurface evaluation. It should be noted, per Section 11.4.8 of ASCE 7-16, a ground motion hazard analysis shall be performed in accordance with Section 21.2 for structures having a fundamental period of vibration greater than 0.5s on Site Class D sites where S_1 is greater than or equal to 0.2g. However, although S_1 is greater than 0.2g at the site, it is anticipated that the proposed residential buildings will have a fundamental period of vibration of less than 0.5s based on our current understanding. Therefore, a site-specific ground motion analysis is assumed to be not required according to ASCE 7-16 Section 11.4.8; however, the project structural engineer needs to confirm this assumption.

4.4.4 Building Code Mapped Spectral Acceleration Parameters

The effect of seismic shaking may be mitigated by adhering to the California Building Code and state-of-the-art seismic design practices of the Structural Engineers Association of California. Provided below in Table 2 are the spectral acceleration parameters for the project determined in accordance with the 2019 CBC (CBSC, 2019) and the ATC Hazards Web Application.

Table 1. CBC Mapped Spectral Acceleration Parameters

Site Class	D		
Site Coefficients	F_a F_v	= =	1 null
Mapped MCE Spectral Accelerations	S_S S_1	= =	1.522g 0.509g
Site Modified MCE Spectral Accelerations	S_{MS} S_{M1}	= =	1.522g null
Design Spectral Accelerations	S_{DS} S_{D1}	= =	1.015g 0.608g
Transitional Period	F_v S_{M1*}	= =	1.791g 0.912g
	S_{D1*} $T_s = S_{D1}/S_{DS}$	= =	null 0.599s

*Site-specific ground motion hazard analysis is required for determination of S_{M1} and S_{D1} for use in seismic design. Value of S_{D1} presented is only for the purposes of determining T_S as per Supplement 1 to ASCE 7-16 (ASCE, 2018).

Utilizing ASCE Standard 7-16, in accordance with Section 11.8, the following additional parameters for the peak horizontal ground acceleration are associated with the Geometric Mean Maximum Considered Earthquake (MCE_G). The mapped MCE_G peak ground acceleration (PGA) is 0.693g for the site. For a Site Class D, the F_{pga} is 1.1 and the mapped peak ground acceleration adjusted for Site Class effects (PGA_m) is 0.763g for the site.

Since the mapped spectral response at 1-second period is less than 0.75g, then all structures subject to the criteria in Section 1613A.2.5 of the 2019 CBC are assigned Seismic Design Category D.

4.5 Secondary Seismic Hazards

In general, secondary seismic hazards can include soil liquefaction, seismically-induced settlement, lateral displacement, surface manifestations of liquefaction, landsliding, seiches, and tsunamis. The potential for secondary seismic hazards at the subject site is discussed below.

4.5.1 Liquefaction and Dynamic Settlement

Liquefaction and dynamic settlement of soils can be caused by strong vibratory motion due to earthquakes. Granular soils tend to densify when subjected to shear strains induced by ground shaking during earthquakes. Research and historical data indicate that loose granular soils underlain by a near surface groundwater table are most susceptible to liquefaction, while the most clayey materials are not susceptible to liquefaction. Liquefaction is characterized by a loss of shear strength in the affected soil layer, thereby causing the soil to behave as a viscous liquid. This effect may be manifested at the ground surface by settlement and, possibly, sand boils where insufficient confining overburden is present over liquefied layers. Where sloping ground conditions are present, liquefaction-induced instability can result.

The site is underlain by very dense Paralic Deposits. Since the potentially compressible and weathered upper portions of the surficial materials are recommended for removal, the underlying very dense character of the Paralic Deposits, and the lack of a shallow groundwater table, it is our opinion that the potential for liquefaction and seismic related settlement across the site is nil.

4.5.2 Lateral Spread

Empirical relationships have been derived (Youd et al., 1999) to estimate the magnitude of lateral spread due to liquefaction. These relationships include parameters such as earthquake magnitude, distance of the earthquake from the site, slope height and angle, the thickness of liquefiable soil, and gradation characteristics of the soil.

The susceptibility to earthquake-induced lateral spread is considered to be low for the site because of the nil susceptibility to liquefaction and relatively level ground surface in the site vicinity.

4.5.3 Tsunamis and Seiches

Based upon the California Emergency Management Agency Tsunami Inundation Map (CalEMA, 2009), the site is not located within a tsunami inundation area. In addition, proposed elevation of the site with respect to sea level, the possibility of seiches and/or tsunamis is considered nil.

4.6 Landslides

Several formations within the San Diego region are particularly prone to landsliding. These formations generally have high clay content and mobilize when they become saturated with water. Other factors, such as steeply dipping bedding that project out of the face of the slope and/or the presence of fracture planes, will also increase the potential for landsliding.

No landslides or indications of deep-seated landsliding were indicated at the site during our field exploration or our review of available geologic literature, topographic maps, and stereoscopic aerial photographs. Furthermore, our field reconnaissance and the local geologic maps indicate the site is generally underlain by favorable oriented geologic structure, consisting of massively bedded sandstone. Therefore, the potential for significant landslides or large-scale slope instability at the site is considered low.

4.7 Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 2017); the site is not located within a floodplain. Based on our review of topographic maps, the site is not located downstream of a dam or within a dam inundation area. Based on this review and our site reconnaissance, the potential for flooding of the site is considered low.

5.0 CONCLUSIONS

Based on the results of our geotechnical investigation of the site, it is our opinion that the proposed project is feasible from a geotechnical standpoint, provided the following conclusions and recommendations are incorporated into the project plans and specifications.

- As the site is located in the seismically active southern California area, all structures should be designed to tolerate the dynamic loading resulting from seismic ground motions;
- The site is not transected by pre-Holocene or Holocene-active faults;
- Based on our subsurface exploration and review of pertinent geotechnical literature and geologic maps, the site is underlain by Quaternary-aged Old Paralic Deposits, capped by variable but generally limited thicknesses of undocumented artificial fill;
- The undocumented fill and weathered formational materials are loose, dry, and porous and/or potentially compressible in their present state and will require removal and recompaction in areas of proposed development or future fill;
- Based on laboratory testing and visual observation, the undocumented artificial fill, and Paralic Deposits possess a very low to medium expansion potential;
- The existing onsite soils are generally suitable for use as engineered fill, provided they are free of organic material, debris, and rock fragments larger than 8 inches in maximum dimension;
- If import soils are planned, the soils should be granular in nature, and have an expansion index less than 50 (per ASTM Test Method D 4829) and have a low corrosion impact to the proposed improvements;
- Based on the results of our subsurface exploration, it anticipated that the surficial soils and formational materials may be excavated with conventional heavy-duty construction equipment;
- Based on our experience with similar sites and the results of our exploration of the site, excavations within the underlying undocumented fill and Paralic Deposits have zones of cohesionless and friable sands that will likely cave or slough during site excavation deeper than 10 feet (bgs). Care in these cases should be exercised which may include the excavation of shorter open-face segments and shoring. Caving of the friable sand should be anticipated especially when sandy soil loses moisture;
- Groundwater should not be encountered during grading activities. Groundwater was encountered during our exploration at 37 feet below the ground surface. Localized seepage along the contact between the surficial soils and the formational materials may occur;
- Based on the results of our geotechnical evaluation, it is our opinion that the proposed multi-family buildings can be supported on conventional foundations;

- In general, when recompacted as fill soil, the surficial units (undocumented fill and weathered Paralic Deposits) are anticipated to shrink while the denser unweathered Paralic Deposit materials are likely to bulk;
- Although Leighton does not practice corrosion engineering, laboratory test results indicate the soils present on the site have a negligible potential for sulfate attack on normal concrete. However, the onsite soils are considered to have a corrosive potential for buried uncoated ferrous metal. A corrosion consultant may be consulted to provide additional recommendations.
- Based on the results of our geotechnical study, we do not recommend the practice of surface water infiltration into near surface soils at the site due to the depth of compressible undocumented fill that is greater than 5 feet, the and settlement sensitive improvements.

6.0 RECOMMENDATIONS

6.1 Earthwork

Earthwork should be performed in accordance with the following recommendations and the General Earthwork and Grading Specifications for Rough Grading included in Appendix D. In case of conflict, the following recommendations shall supersede those in Appendix D. The contract between the developer and earthwork contractor should be worded such that it is the responsibility of the contractor to place the fill properly and in accordance with the recommendations of this report and the specifications in Appendix D, notwithstanding the testing and observation of the geotechnical consultant during construction.

6.2 Site Preparation

Prior to grading, the proposed residential development and areas with improvements should be stripped of vegetation, cleared of surface and subsurface obstructions, including any existing debris and undocumented or loose fill soils or weathered formational materials. Removed vegetation and debris should be properly disposed of offsite. All areas to receive fill and/or other surface improvements should be scarified to a minimum depth of 6 inches, brought to above-optimum moisture conditions, and recompacted to at least 90 percent relative compaction (based on ASTM Test Method D1557). Any water wells located within the areas of proposed improvements that do not remain in operation should be abandoned in accordance with County of San Diego Health Department guidelines.

6.3 Removal and Recompaction

The undocumented fill and weathered Paralic Deposits that occur on site are potentially compressible in their present state and may settle under the surcharge of fills or foundation loadings. In areas that will receive additional fill soils that will support settlement-sensitive structures or other improvements (such as retaining walls, roadway utility lines, etc.), these soils should be removed down to competent material determined by the geotechnical consultant, moisture-conditioned, and recompacted to a minimum 90 percent relative compaction (based on ASTM D1557) prior to placing fill. Fill soils should be free of debris and organic materials (trees, shrubs, stumps, roots, leaves, and mulch derived from vegetation). The removal limit should be established by a 1:1 projection from the edge of fill soil supporting settlement-sensitive structures downward and outward to competent material identified by the geotechnical consultant. The undocumented fill across the site is generally on the order of up to 7 feet in depth; however, deeper undocumented fills may be encountered. Therefore, we recommend that the all undocumented fill, soil horizon, and weathered Paralic Deposits be removed during grading. Minimum removal depths should extend to 2 feet below the bottom of foundation footings. The lateral limits of the removal bottom should extend 10 feet outside the building limits where possible. Actual depths and limits of removals should be evaluated by the geotechnical consultant during grading. The bottom of all removals should be evaluated by a Certified Engineering Geologist to confirm conditions are as anticipated.

In non-building areas, such as, the paved parking areas, concrete hardscape, and trash/recycling enclosure areas we recommended that the upper 2 feet of soil materials below pre-graded topography/existing grade or proposed subgrade elevations, whichever is deeper be removed. Horizontally, the limits of the removal bottoms should extend at least 2 feet laterally beyond the limits of the proposed improvements.

6.4 Excavations

Sloping temporary excavations may be utilized when adequate space allows. Based on the results of our evaluation, we provide the following recommendations for sloped excavations in fill soils or competent formational materials without seepage conditions. Friable sand exists at depth at the site and caving should be anticipated especially when sandy soil lose moisture.

Table 2. Maximum Slope Ratios

Excavation Depth (feet)	Maximum Slope Ratio In Fill Soils	Maximum Slope Ratio In Paralic Deposits
0 to 4	1:1 (Horizontal to Vertical)	1:1(Horizontal to Vertical)
4 to 20	1½ :1 (Horizontal to Vertical)	1½ :1 (Horizontal to Vertical)

The above values are based on the assumption that no surcharge loading or equipment is present within 10 feet of the top of slope. Care should be taken during design of excavations adjacent to the existing structures so that foundation support is preserved. A “competent person” should observe the slope on a daily basis for signs of instability.

6.5 Structural Fills

The onsite soils are generally suitable for use as compacted fill provided they are free of organic materials and debris. Areas to receive structural fill and/or other surface improvements should be scarified to a minimum depth of 6 inches, brought to at least 2% above optimum moisture content, and recompacted to at least 90 percent relative compaction (based on ASTM D1557). The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in thickness. Fill soils should be placed at a minimum of 90 percent relative compaction (based on ASTM D1557) and moisture conditioned to at least 2 percent above optimum moisture content. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant.

Fills placed on slopes steeper than 5 to 1 (horizontal to vertical) should be keyed and benched into dense formational soils (see Appendix D for benching detail). Oversize material may be incorporated into structural fills if placed in accordance with the recommendations in Appendix D.

6.6 Foundation and Slab Considerations

At the time of drafting this report, foundation loads were not known. However, based on our understanding of the project, conventional foundations are considered suitable for support of the proposed improvements. Foundations and slabs should be designed in accordance with structural considerations and the following recommendations. These recommendations assume that the soils encountered within 5 feet of pad grade have a low to medium expansion potential (EI<70). The foundation recommendations below assume that all building foundations will be underlain by properly compacted fill soils.

6.6.1 Foundation and Slab Design

We anticipate that the proposed structure can be supported on properly compacted fill by isolated spread and/or continuous footings designed in accordance with the following criteria.

Table 3: Allowable Bearing Values for Conventional Footings

Depth Below Subgrade (feet) *	Allowable Soil Bearing Value for Isolated Spread Footings (Minimum Width of 2 feet)	Allowable Soil Bearing Value for Continuous Wall Footings (Minimum Width of 1.5 feet)
2	3,000 psf	3,000 psf
3	4,000 psf	4,000 psf

* Does not include the thickness of slab or the sand layer beneath the slab.

The above values are for dead plus live loads and may be increased by one-third for short-term wind or seismic loads.

Shallow conventional foundations for associated ancillary structures, if any, founded in properly compacted engineered fill materials should be designed based on an allowable bearing capacity of 2,000 psf. This capacity assumes a minimum foundation depth of 18 inches and minimum width of 18 and 12 inches for spread and continuous footings, respectively.

Concrete slabs-on-grade should be designed by the project Structural Engineer in accordance with the 2019 California Building Code (CBC) for a soil with low expansion potential. The slab-on-grade should be reinforced with reinforcing bars placed at mid-height in the slab. Slabs should also be designed for the anticipated traffic loading using a modulus of subgrade reaction of 125 pounds per cubic inch. Slabs should have crack joints at spacings designed by the structural engineer. Columns should be structurally isolated from slabs. Slabs should be a minimum of 5 inches thick and reinforced with No. 3 rebars at 18 inches on center or No. 4 rebars at 24 inches on center (each way). A moisture barrier may be placed in areas of the slab where a reduction of moisture vapor up through the concrete slab is desired (such as below equipment, closet areas, etc.).

6.6.2 Settlement

Our recommended allowable bearing capacity is generally based on a total allowable, post construction settlement of approximately 1 inch. Differential settlement is estimated at approximately ½ inch over a horizontal distance of 30 feet. Since settlements are a function of footing size and contact bearing pressures, larger differential settlements can be expected between adjacent columns or walls where a large differential loading conditions exists.

6.6.3 Foundation Setback

We understand the site is essentially flat, however, if slopes are planned the following recommendations may be utilized. We recommend a minimum horizontal setback distance from the face of slopes for all structural foundations, footings, and other settlement-sensitive structures as indicated on the Table 4 below. This distance is measured from the outside bottom edge of the footing, horizontally to the slope face, and is based on the slope height. However, the foundation setback distance may be revised by the geotechnical consultant on a case-by-case basis if the geotechnical conditions are different than anticipated.

Table 4: Minimum Foundation Setback from Slope Faces

Slope Height	Setback
less than 5 feet	5 feet
5 to 15 feet	7 feet
15 to 30 feet	10 feet

Please note that the soils within the structural setback area possess poor lateral stability, and improvements (such as retaining walls, sidewalks, fences, pavements, etc.) constructed within this setback area may be subject to lateral movement and/or differential settlement. Potential distress to such improvements may be mitigated by providing a deepened footing or a grade beam foundation system to support the improvement.

In addition, open or backfilled utility trenches that parallel or nearly parallel structure footings should not encroach within an imaginary 2:1 (horizontal to vertical) downward sloping line starting 9 inches above the bottom edge of the footing and should also not be located closer than 18 inches from the face of the footing. Deepened footings should meet the setbacks as described above. Also, over-excavation should be accomplished such that deepening of footings to accomplish the setback will not introduce a cut/fill transition bearing condition.

Where pipes may cross under footings, the footings should be specially designed. Pipe sleeves should be provided where pipes cross through footings or footing walls and sleeve clearances should provide for possible footing settlement, but not less than 1 inch around the pipe.

6.6.4 Lateral Resistance and Retaining Wall Design Pressures

The proposed retaining walls should be designed for the lateral soil pressures exerted on them, the magnitude of which depends primarily on the type of soil used as backfill and the amount of deformation the wall can yield under the lateral load. Walls that are under restrained conditions and cannot yield under the applied load (e.g., basement walls) should be designed for the ‘at-rest’ pressure condition.

Passive pressure is used to compute soil resistance to lateral structural movement.

For design purposes, the following lateral earth pressure values for level backfill are recommended for walls backfilled with onsite soils of very low to low (EI<50) expansion potential or undisturbed in-place materials.

Table 5: Static Equivalent Fluid Weight (pcf)

Conditions	Level
Active	35
At-Rest	55
Passive	350 (Maximum of 3 ksf)

If conditions other than those covered herein are anticipated, the equivalent fluid pressure values should be provided on an individual case basis by the geotechnical engineer.

In addition to the above lateral forces due to retained earth, surcharge due to above grade loads on wall backfill should be considered in design of a retaining wall. A surcharge load for a restrained or unrestrained wall resulting from automobile traffic may be assumed to be equivalent to a uniform lateral pressure of 75 psf which is in addition to the equivalent fluid pressure given above. For other uniform surcharge loads, a uniform pressure equal to 0.35q should be applied to the wall (where q is the surcharge pressure in psf).

The provided wall pressures assume walls are backfilled with free draining materials and water is not allowed to accumulate behind walls. Specifically, where walls are not designed to consider hydrostatic conditions, in order to mitigate the potential for hydrostatic build-up behind the basement walls, drainage board should be extended from 2 feet below the ground surface to relief valves or by piping to a sump at the lowest wall elevations. Waterproofing should be designed by the structural engineer and/or architect.

Where wall backfill is utilized, it should be compacted by mechanical methods to at least 90 percent relative compaction, based on ASTM D1557. We recommend compaction effort be increased to 95 percent where backfill will support building foundations of distress sensitive appurtenant improvements. Wall footings should be designed in accordance with the foundation design recommendations and reinforced in accordance with structural considerations.

Lateral soil resistance developed against lateral structural movement can be obtained from the passive pressure value provided above. Further, for sliding resistance, the friction coefficient of 0.35 may be used at the concrete and soil interface. These values may be increased by one-third when considering loads of short duration including wind or seismic loads. The total resistance may be taken as the sum of the frictional and passive resistance provided the passive portion does not exceed two-thirds of the total resistance.

The account for potential redistribution of forces during a seismic event, basement walls should also be checked considering an additional seismic pressure distribution equal to 9H psf applied as a uniform pressure, where H equals the overall retained height in feet. If conditions other than those covered herein are anticipated, the equivalent fluid pressure values should be provided on an individual case basis by the geotechnical engineer.

6.7 Preliminary Pavement Design

The preliminary pavement section design below is based on an assumed Traffic Index (TI), our visual classification of the subject site soils, experience with other projects in the area, and our limited laboratory testing. Actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils that are exposed at the finished subgrade elevations across the site at the completion of the mass grading operations. Preliminary flexible pavement sections have been evaluated in general accordance with the Caltrans method for flexible pavement design. Based on an assumed R-value of 15, preliminary pavement sections for planning purposes is given in Table 6 below:

Table 6. Preliminary Pavement Sections

Assumed Traffic Index (TI)	Asphalt Concrete (inches)	Aggregate Base (inches)
4.5	3.0	7.0
5.0	4.0	6.0
6.0	4.0	10.0

Prior to placement of the aggregate base, the upper 12 inches of subgrade soils should be scarified, moisture-conditioned to at least optimum moisture content and compacted to a minimum 95 percent relative compaction based on American Standard of Testing and Materials (ASTM) Test Method D1557.

Class 2 Aggregate Base or Crushed Aggregate Base should then be placed and compacted at a minimum 95 percent relative compaction in accordance with ASTM Test Method D1557. The aggregate base material (AB) should be a maximum of 6 inches thick below the curb and gutter and extend a minimum of 6 inches behind the back of the curb. The AB should conform to and placed in accordance with the approved grading plans, and latest revision of the Standard Specifications Public Works Construction (Greenbook).

The Asphalt Concrete (AC) material should conform to Caltrans Standard Specifications, Sections 39 and 92, with a Performance Grade (PG) of 64-10, and the County of San Diego requirements. The placement of the AC should be in accordance with the approved grading plans, Section 203-6 of the “Greenbook” Standard Specifications for Public Works Construction, and the County of San Diego requirements. AC sections greater than 3-inches thick, should be placed in two lifts. The 1st lift should be a 2-inch minimum base course consisting of a 3/4-inch maximum coarse aggregate. The 2nd lift should be a 2-inch minimum surface capping course consisting of a 1/2-inch maximum coarse aggregate. No single lift shall be greater than 3 inches.

If pavement areas are adjacent to heavily watered landscaping areas, we recommend some measures of moisture control be taken to prevent the subgrade soils from becoming saturated. It is recommended that the concrete curbing, separating the landscaping area from the pavement, extend below the aggregate base to help seal the ends of the sections where heavy landscape watering may have access to the aggregate base. Concrete swales should be designed if asphalt pavement is used for drainage of surface waters.

For areas subject to regular truck loading (i.e., trash truck apron), we recommend a full depth of Portland Cement Concrete (PCC) section of 7 inches with appropriate steel reinforcement and crack-control joints as designed by the project structural engineer. We recommend that sections be as nearly square as possible. A 3,500-psi mix that produces a 550-psi modulus of rupture should be utilized.

All pavement section materials should conform to and be placed in accordance with the latest revision of the California Department of Transportation Standard Specifications (Caltrans) and American Concrete Institute (ACI) codes. The upper 12 inches of subgrade soil and all aggregate base should be compacted to a relative compaction of at least 95 percent (based on ASTM Test Method D1557) and to a moisture content above optimum content.

6.8 Geochemical Considerations

Concrete in direct contact with soil or water that contains a high concentration of soluble sulfates can be subject to chemical deterioration commonly known as “sulfate attack.” Soluble sulfate results (Appendix C) indicate negligible soluble sulfate content for a representative soil samples. We recommend that concrete in contact with earth materials be designed in accordance with Section 4 of ACI 318-14 (ACI, 2014). We recommend sulfate testing be performed once finish grades are attained.

Laboratory test results also identified pH, chloride content, and electrical resistivity. Utilizing Caltrans criteria, a site is considered to be corrosive if chloride concentration is 500 ppm or greater, or pH is 5.5 or less. High chloride concentrations can be corrosive to reinforcing steel. Highly acid soils, pH of 5.5 or less, can also affect concrete durability. Low electrical resistivity can cause corrosion of buried ferrous metals. Based on laboratory test results for a representative sample, the onsite soils have an electrical resistivity of 1300 ohm-cm, a pH of 7.8, and a chloride concentration of 180 ppm, therefore, the site is not considered corrosive site per Caltrans criteria.

6.9 Infiltration Best Management Practices

Regarding Best Management Practices (BMP) and Low Impact Development (LID) measures, we are of the opinion that infiltration basins, and other on-site storm water retention and infiltration systems can potentially create adverse perched groundwater conditions, both on-site and off-site, when not installed using proper design recommendations (such as the use of liners) and infiltration design parameters. Based on the results of our geotechnical study, we do not recommend the practice of surface water infiltration into near surface soils at the site due to the depth of undocumented fill greater than 5 feet, the proximity of numerous subterranean structures and settlement sensitive improvements, along with the dense nature of the underlying materials.

6.10 Control of Groundwater and Surface Water

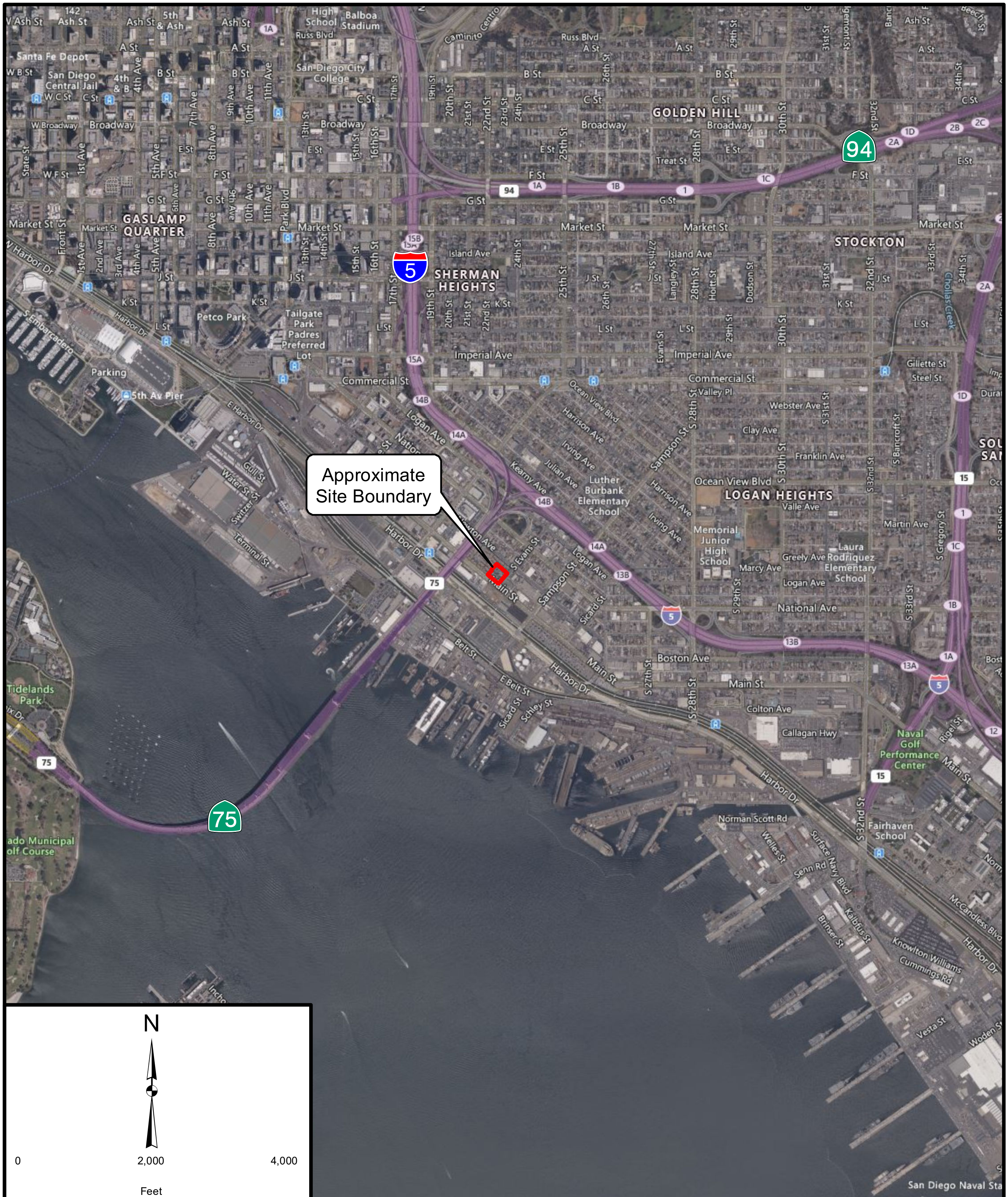
Our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site development, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation. This sometimes occurs where relatively impermeable bedrock materials are overlain by granular fill soils. In addition, during slope excavations, seepage in cut slopes may be encountered. We recommend that an engineering geologist be present during grading operations to evaluate seepage areas. Drainage devices for reduction of water accumulation can be recommended when these conditions are observed.

We recommend that measures be taken to properly finish grade the building area, such that drainage water from the building area is directed away from building foundations (2 percent minimum grade for a distance of 5 feet), floor slabs, and tops of slopes. Ponding of water should not be permitted, and installation of roof gutters which outlet into a drainage system is considered prudent. Planting areas at grade should be provided with positive drainage directed away from the building. Drainage and subdrain design for these facilities should be provided by the design civil engineer.

7.0 LIMITATIONS

The findings, conclusions and recommendations in this report are based in part upon data that were obtained from widely spaced subsurface investigations and limited geotechnical analysis. Such information is by necessity incomplete. The nature of many sites is such that differing geotechnical or geological conditions can occur within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, the findings, conclusions, and recommendations presented in this report can be relied upon only if Leighton has the opportunity to review final grading plans and to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site.

FIGURES



Project: 13324.001	Eng/Geol: NJT/MJD
Scale: 1 " = 2,000 '	Date: November 2021

Base Map: ESRI ArcGIS Online 2021

SITE LOCATION MAP

MAAC Mercado Apartments
South Evans and Main St
San Diego, CA

FIGURE 1

Leighton

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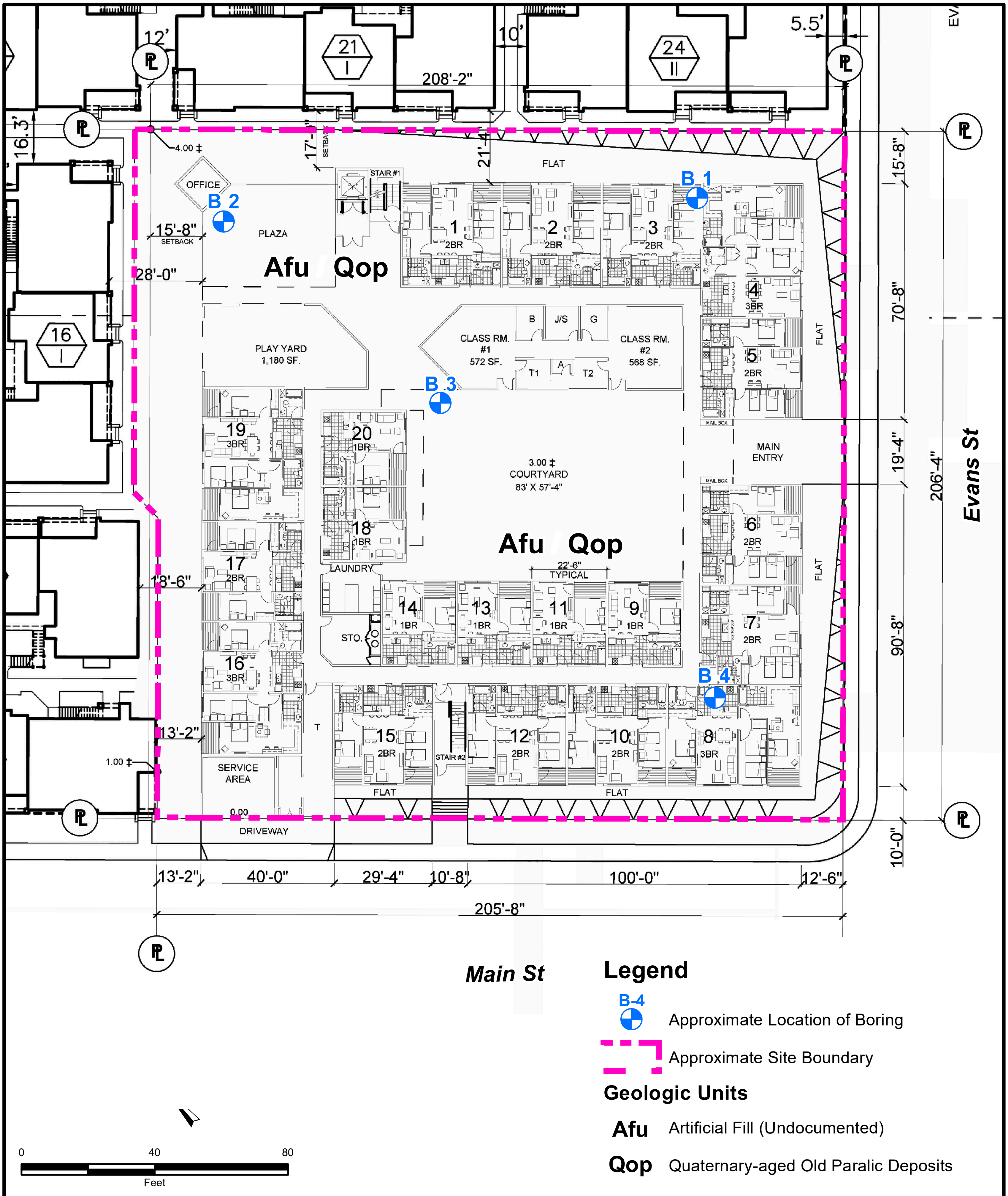

Project: 13324.001	Eng/Geol: WDO/MDJ	**GEOTECHNICAL MAP** MAAC Mercado Apartments South Evans and Main St San Diego, California	**FIGURE 2**
Scale: 1 " = 40 '	Date: December 2021		Leighton
Base Map: Sheet No. A1.0, Site Plan by Martinez & Cutri			

Map Saved as P:\Drafting\13324\001\Maps\13324-001_F02_GM_2021-11-12A.mxd on 12/6/2021 2:59:37 PM

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

BORING LOGS

GEOTECHNICAL BORING LOG B-1

Project No.	13324.001	**Date Drilled**	11-8-21
Project	MAAC Mercado Apartments	**Logged By**	DKJ
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	41' msl
Location	See Figure 2	**Sampled By**	DKJ

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0								3" ASPHALT CONCRETE	
40				B-1 (0.75"-2')				SM	6" AGGREGATE BASE	
									UNDOCUMENTED ARTIFICIAL FILL (Afu) @ 0.75': Silty SAND with gravel, loose, light brown to brown, damp, concrete and asphalt chunks	
				B-2 (3.5'-4.5')					@ 3.5': becomes more fine-grained, damp	
								SM	**QUATERNARY-AGED OLD PARALICS (Qop)** @ 4': Silty SAND, very dense, light brown, damp, medium-grained	
	5			R-1	30 39 50/3"	128	9		@ 5': becomes very dense	
35										
				S-1	32 50/4"				@ 7': Silty SAND, very dense, red-brown, damp, medium-grained	
	10			R-2	38 42 50/5"	124	5			
30									@ 11': 0.5' thick gravel layer	
	15			S-2	6 7 10				@ 15': Silty SAND, medium dense, brown with black mottling, damp, micaceous, roots, slightly friable, fine-grained	
25										
									@ 19': increase in clay content	
	20			R-3	33 50/5"	100	9		@ 20': Silty SAND, very dense, light brown to dark brown, damp, slightly friable, oxidation mottling, micaceous, fine-grained	
20										
	25			S-3	12 13 18			ML	@ 25': Clayey SILT, very stiff, dark gray, damp, micaceous, oxidized	
15										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG B-1

Project No.	13324.001	**Date Drilled**	11-8-21
Project	MAAC Mercado Apartments	**Logged By**	DKJ
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	41' msl
Location	See Figure 2	**Sampled By**	DKJ

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
11	30			R-4	9, 15, 18	97	28	ML	@ 30': Clayey SILT, very stiff, dark gray, moist, some shell fragments, oxidized	
	34								@ 34': abundant shell fragments	
6	35			S-4	15, 18, 27			SM	@ 35': Silty SAND, very dense, light gray with yellow mottling, moist, shell fragments, medium-grained, friable	
	37								@ 37': Groundwater measured at end of day.	
1	40			R-5	12, 20, 20	87	30	CH	@ 40': Sandy CLAY, hard, dark gray, saturated, micaceous, oxidized, 3" slightly cemented shell lense	
-4	45			S-5	6, 7, 12				@ 45': becomes very stiff, vertical black clay infill noted	
-9	50			R-6	8, 21, 44	87	34		@ 50': Sandy CLAY, hard, dark gray, saturated, micaceous, oxidation mottling observed	

Depth scale: 30, 35, 40, 45, 50, 55, 60. Elevation scale: 10, 5, 0, -5, -10, -15.

Total Depth = 51.5 Feet (bgs)
Groundwater measured at 37 Feet (bgs) after 5 hours
Backfilled on 11/8/2021

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG B-2

Project No. 13324.001
Project MAAC Mercado Apartments
Drilling Co. Baja Exploration
Drilling Method Hollow Stem Auger - 140lb - Autohammer - 30" Drop
Location See Figure 2

Date Drilled 11-8-21
Logged By DKJ
Hole Diameter 8"
Ground Elevation 40' msl
Sampled By DKJ

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N–S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
40	0								3" ASPHALT CONCRETE	
									6" AGGREGATE BASE	
				B-1 (1'-3')				SM	**UNDOCUMENTED ARTIFICIAL FILL (Afu)** @ 0.75': Silty SAND, medium dense, dark brown to red-brown, moist, oxidation, asphalt and concrete pieces, wood and shell fragments, trace fine gravel	
35	5			R-1	11 11 21	126	11		@ 5': trace fine gravel, asphalt fragments	DS
				S-1	11 18 33			SM	**QUATERNARY-AGED OLD PARALIC DEPOSITS (Qop)** @ 7': Silty SAND, very dense, light brown, damp, fine- to medium-grained, slightly oxidized	
30	10			R-2	17 33 48	128	9	GM	@ 10': Sandy GRAVEL, increase in gravels at 11'	
								SM	@ 11.5': Silty SAND, very dense, light brown, damp, fine- to medium-grained, slightly oxidized @ 13': becomes brown	
25	15			S-2	13 13 18				@ 15.5': becomes red-brown, oxidized	
20	20			R-3	12 20 35	102	21	ML	@ 20': Silty SAND, very stiff, yellow brown, moist, micaceous, carbonate stringers, oxidation, laminations	
15	25			S-3	8 15 23				@ 25': black mottling observed	
10	30								**Total Depth = 26.5 Feet (bgs)** **No Groundwater Encountered During Drilling** **Backfilled on 11/8/21**	

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
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- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-3

Project No.	13324.001	**Date Drilled**	11-8-21
Project	MAAC Mercado Apartments	**Logged By**	DKJ
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	38' msl
Location	See Figure 2	**Sampled By**	DKJ

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
38	0							3" ASPHALT CONCRETE	
								6" AGGREGATE BASE	
			B-1 (1'-2')				SM	**UNDOCUMENTED ARTIFICIAL FILL (Afu)** @ 0.75': Silty SAND with gravel, medium dense to dense, dark brown to brown, damp, asphalt and concrete chunks, fine-grained	
35								@ 3': becomes dark brown to black	
	5		R-1	17 28 39	126	10		@ 4.5': becomes red brown, possible weathered paralic deposits	
30			S-1	12 16 16			SM	**QUATERNARY-AGED OLD PARALIC DEPOSITS (Qop)** @ 7': Silty SAND, dense, light brown with white blebs, damp, fine- to medium-grained	
	10		R-2	18 32 34	122	7		@ 11': fine gravel layer encountered	
25								@ 14': becomes light brown with black mottling	
	15		S-2	12 15 21				@ 15': Silty very fine SAND to Sandy SILT, very dense to very stiff, dark gray to brown, damp, friable, laminated, micaceous, oxidized	
20									
	20		R-3	21 40 50/4"	89	31			
							ML	@ 21': Sandy SILTSTONE, hard, gray, damp, shell layer below	
15								@ 24': clay content increase	
	25		S-3	13 20 25			SM	@ 24.6': Silty SAND, dense, light brown, damp, friable	
10									
	30								

Total Depth = 26.5 Feet (bgs)
No Groundwater Encountered During Drilling
Backfilled on 11/8/2021

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-4

Project No.	13324.001	**Date Drilled**	11-8-21
Project	MAAC Mercado Apartments	**Logged By**	DKJ
Drilling Co.	Baja Exploration	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	37' msl
Location	See Figure 2	**Sampled By**	DKJ

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N–S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0								3" ASPHALT CONCRETE	
									7" AGGREGATE BASE	
35				B-1 (1'-2')				SM	**UNDOCUMENTED ARTIFICIAL FILL (Afu)** @ 0.83': Silty SAND, medium dense, dark brown, moist, asphalt and concrete chunks	
				B-2 (2.5'-4')				SM	**QUATERNARY-AGED OLD PARALIC DEPOSITS (Qop)** @ 2.5': Silty SAND, medium dense, light brown with white blebs, damp, fine- to medium-grained	CR, EI
30	5			S-1	10 11 13					
	10			R-1	20 37 37	125	7	GM	@ 10': coarse Sandy GRAVEL	
25								SM	@ 11.5': Silty SAND, very dense, brown with black mottling, damp, slightly friable, very fine to fine grained, micaceous, laminated	
20	15			S-2	14 16 45			ML	@ 15': Sandy SILT, hard, yellow-brown, damp, very fine-grained, calcium carbonate stringers, oxidation	
	20			R-2	17 20 24	107	12	SM	@ 20': Silty SAND, dense, light brown, damp, abundant shells	
15									@ 22': shell fragments observed	
	25			S-3	12 14 15				@ 25': becomes light brown, some cemented shell fragments	
10	30								**Total Depth = 26.5 Feet (bgs)** **No Groundwater Encountered During Drilling** **Backfilled on 11/8/2021**	

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

APPENDIX C

LABORATORY TEST RESULTS

APPENDIX C

Laboratory Testing Procedures and Test Results

Direct Shear Strength Test: Direct shear testing, in accordance with ASTM D3080, was performed on a representative sample which was soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The sample was tested under various normal loads, using a motor-driven, strain-controlled, direct-shear testing apparatus. The test results are presented in the accompanying plots.

Expansion Index Test: The expansion potential of selected materials was evaluated by the Expansion Index Text, ASTM Test Method 4829. The specimens were molded under a given compactive energy to approximately 50 percent saturation. The prepared 1-inch thick by 4-inch diameter specimens were loaded to an equivalent 144 psf surcharge and were inundated with water until volumetric equilibrium was reached. The results are presented in the table below:

Sample Location	Sample Description	Expansion Index	Expansion Potential
B-4 @ 2 to 5 Ft	Silty SAND	10	Very Low

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with Caltrans Test Method CT643 for Steel or CT532 for concrete and standard geochemical methods. The results are presented in the table below:

Sample Location	Sample Description	pH	Minimum Resistivity (ohms-cm)
B-4 @ 2 to 5 Ft	Silty SAND	7.8	1300

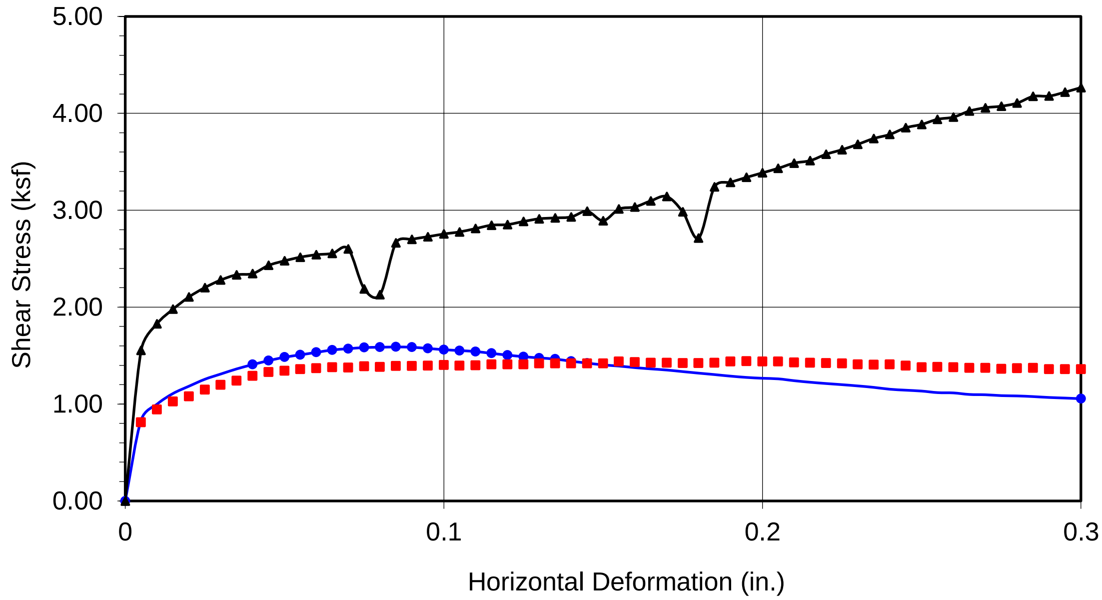
Chloride Content: Chloride content was tested in accordance with Caltrans Test Method CT422. The results are presented below:

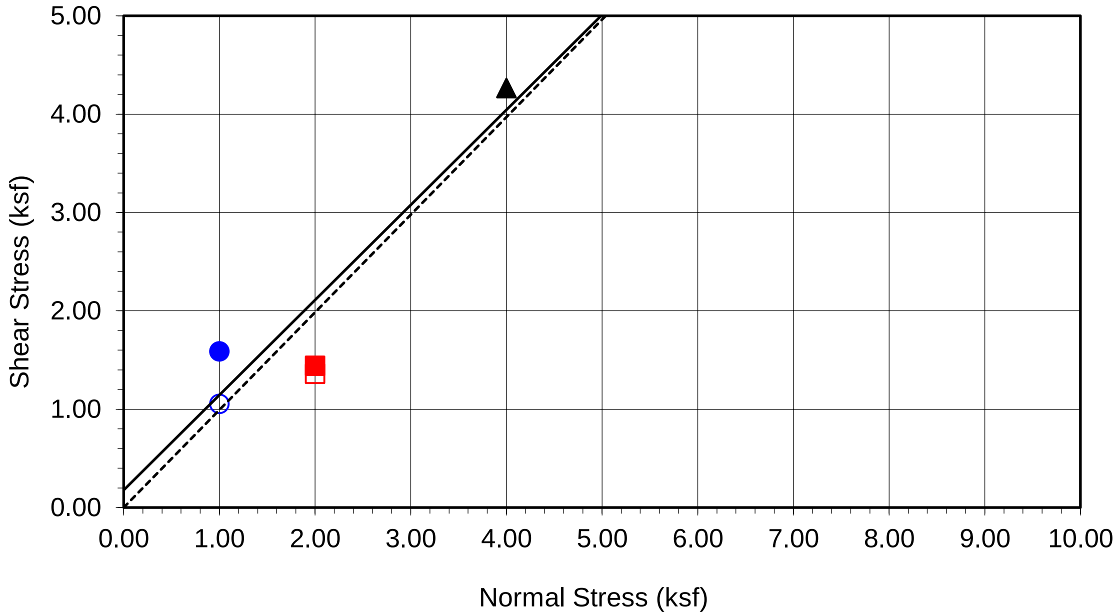
Sample Location	Sample Description	Chloride Content, ppm
B-4 @ 2 to 5 Ft	Silty SAND	180

Soluble Sulfates: The soluble sulfate contents of selected samples were determined by standard geochemical methods (Caltrans Test Method CT417). The test results are presented in the table below:

Sample Location	Sample Description	Sulfate Content, ppm	Potential Degree of Sulfate Attack*
B-4 @ 2 to 5 Ft	Silty SAND	<150	S0

*Based on the 2014 edition of American Concrete Institute (ACI) Committee 318R, Table No. 4.2.1.





Boring No.	**B-2**
Sample No.	**R-1**
Depth (ft)	**5**
Sample Type:	Ring

Soil Identification:
Clayey Sand (SC), Dark Reddish Brown.

Strength Parameters

	C (psf)	ϕ (°)
Peak	177	44
Ultimate	0	45

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.589	■ 1.442	▲ 4.266
Shear Stress @ End of Test (ksf)	○ 1.055	□ 1.360	△ 4.266
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	10.87	10.87	10.87
Dry Density (pcf)	120.8	117.7	125.5
Saturation (%)	74.2	68.0	85.4
Soil Height Before Shearing (in.)	0.9919	0.9653	0.9579
Final Moisture Content (%)	13.8	14.1	13.8

Leighton

DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 13324.001

Maac Mercado Apts Prelim Geo

11-21

APPENDIX D

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

1.0 General

1.1 Intent

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical

Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified. Backfill shall be placed and densified to a minimum of 90 percent of relative compaction from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

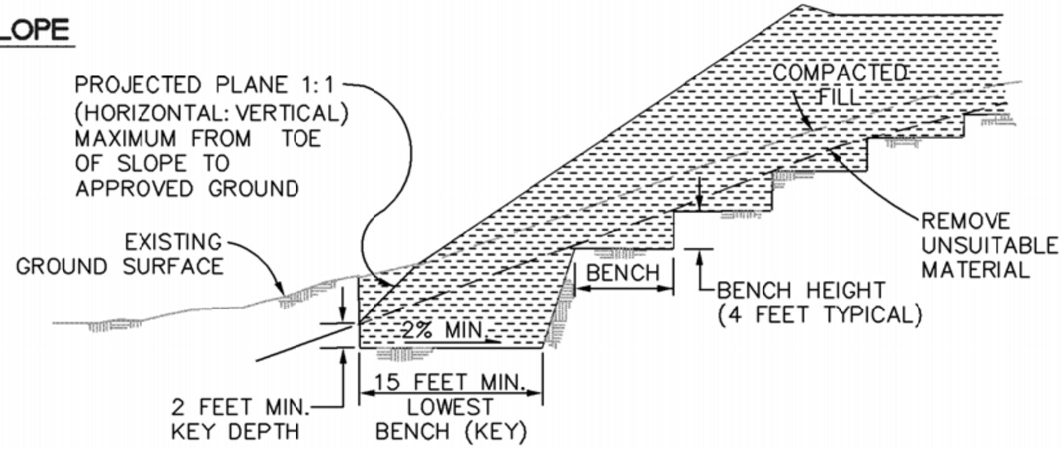
7.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

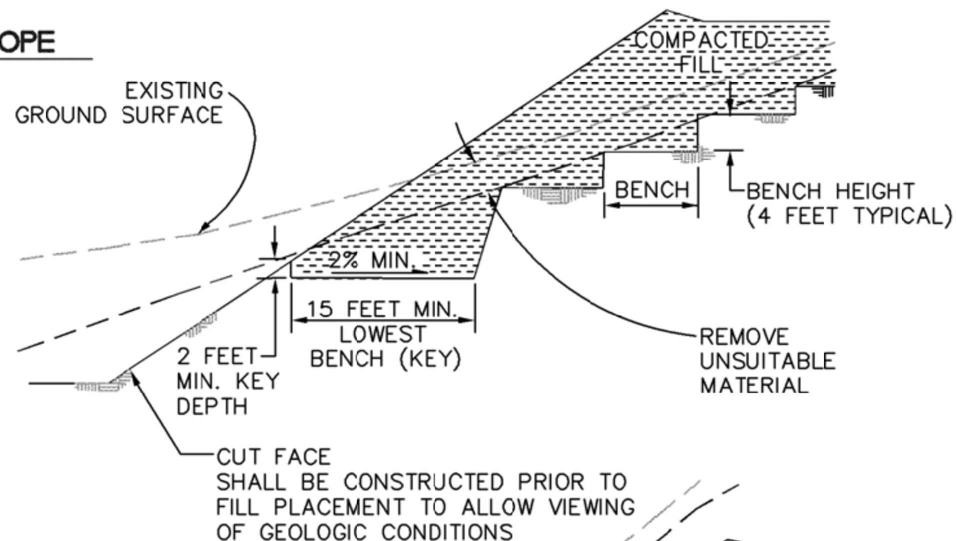
7.4 Observation and Testing

The densification of the bedding around the conduits shall be observed by the Geotechnical Consultant.

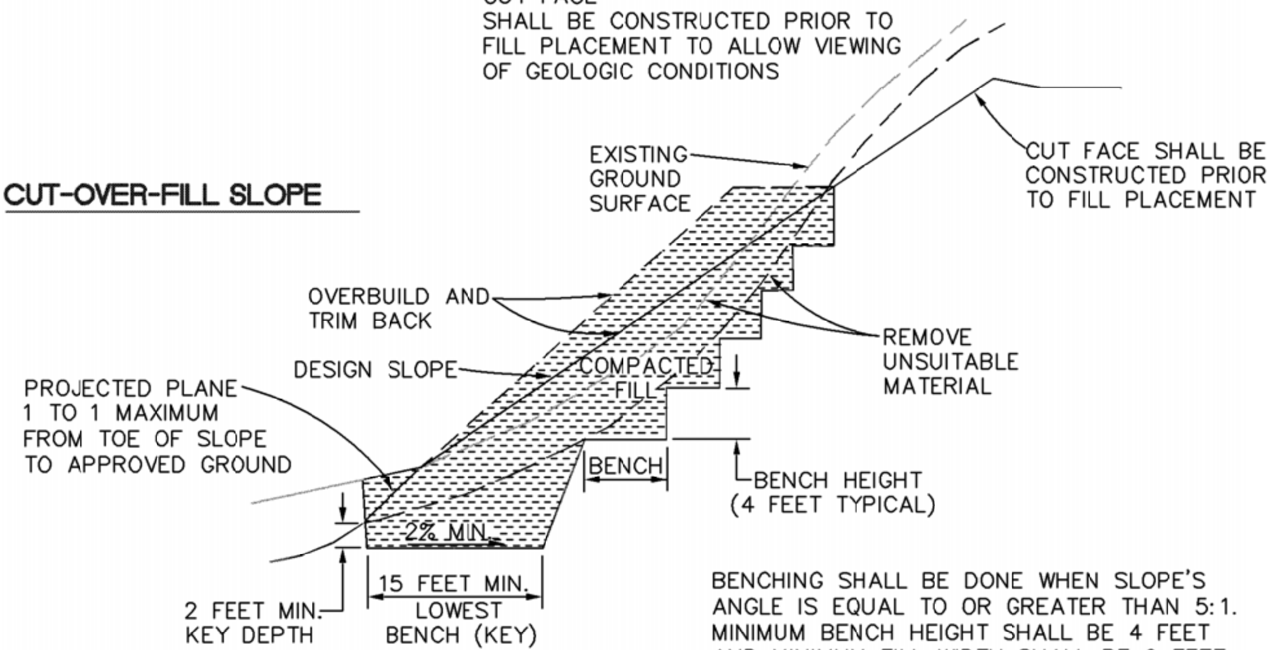
FILL SLOPE



FILL-OVER-CUT SLOPE

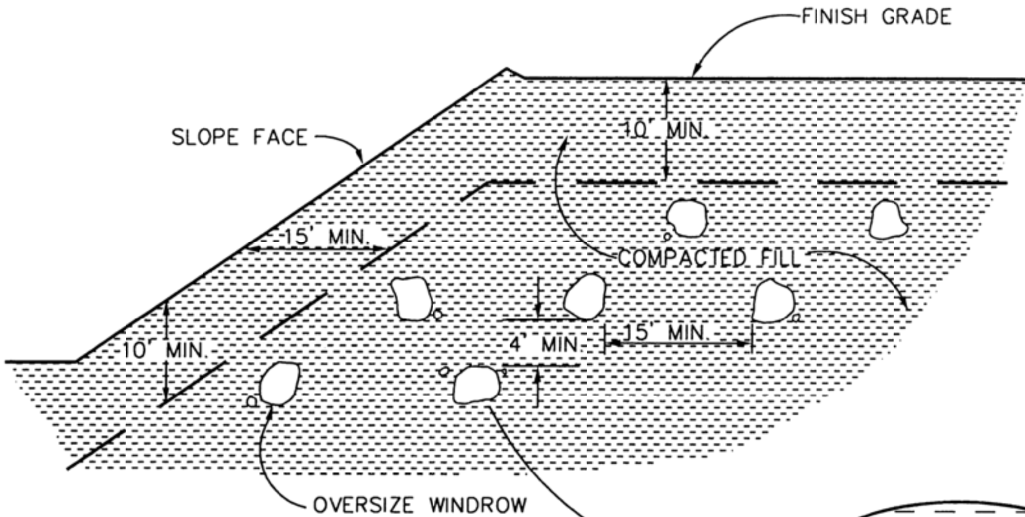


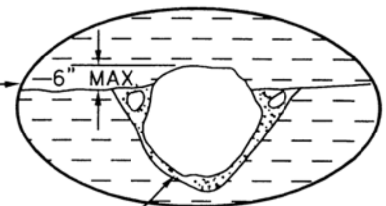
CUT-OVER-FILL SLOPE



BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

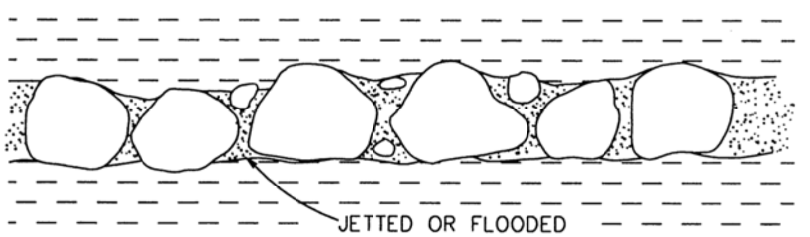
KEYING ND ENCHING	GENERAL EART WORK AND GRADING SPECIFICATIONS ST NDARD DET IL A





DETAIL

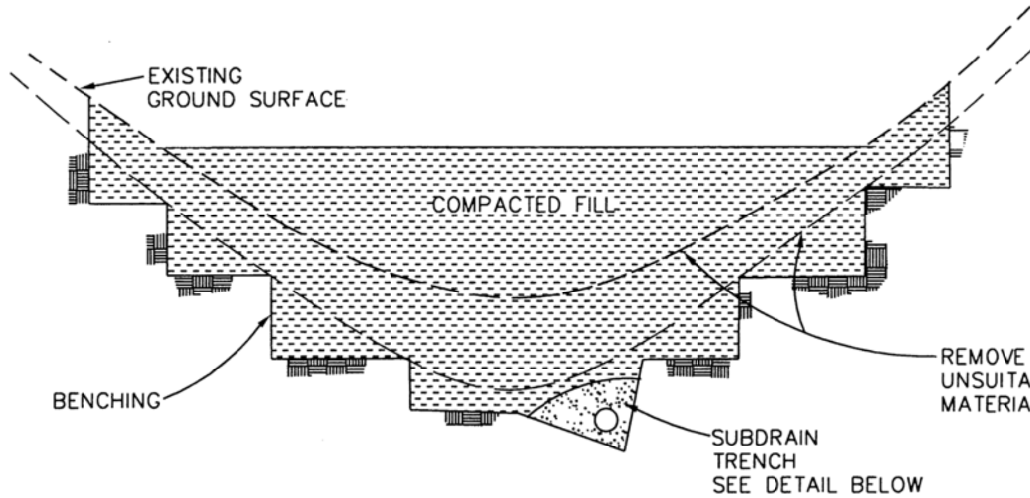
* OVERSIZE ROCK IS LARGER THAN 8 INCHES IN LARGEST DIMENSION.
* EXCAVATE A TRENCH IN THE COMPACTED FILL DEEP ENOUGH TO BURY ALL THE ROCK.
* BACKFILL WITH GRANULAR SOIL JETTED OR FLOODED IN PLACE TO FILL ALL THE VOIDS.
* DO NOT BURY ROCK WITHIN 10 FEET OF FINISH GRADE.
* WINDROW OF BURIED ROCK SHALL BE PARALLEL TO THE FINISHED SLOPE.

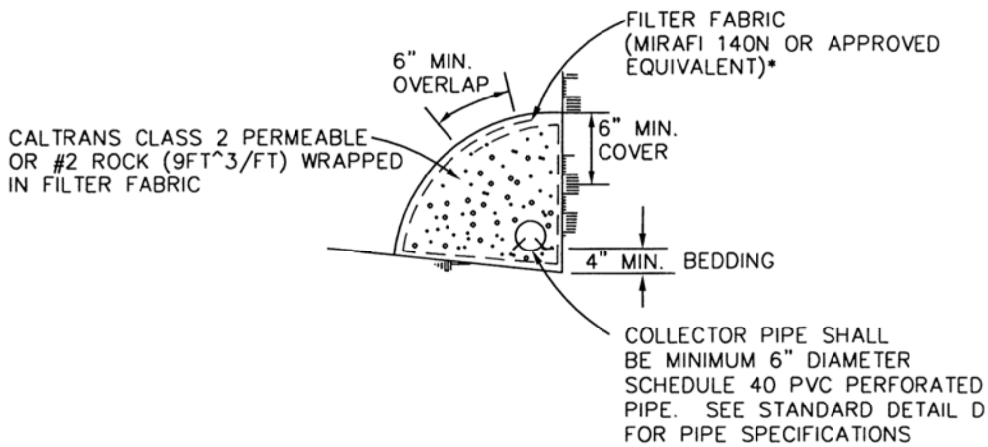


TYPICAL PROFILE ALONG WINDROW

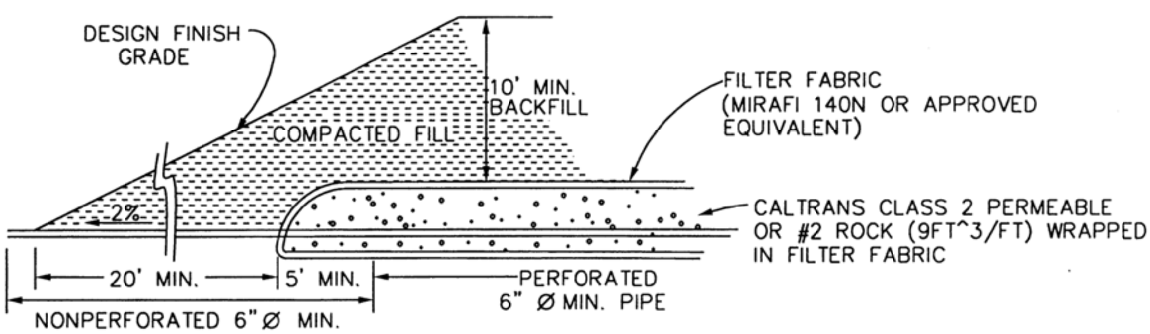
OVERSIZE ROCK ISPOSAL

GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL B



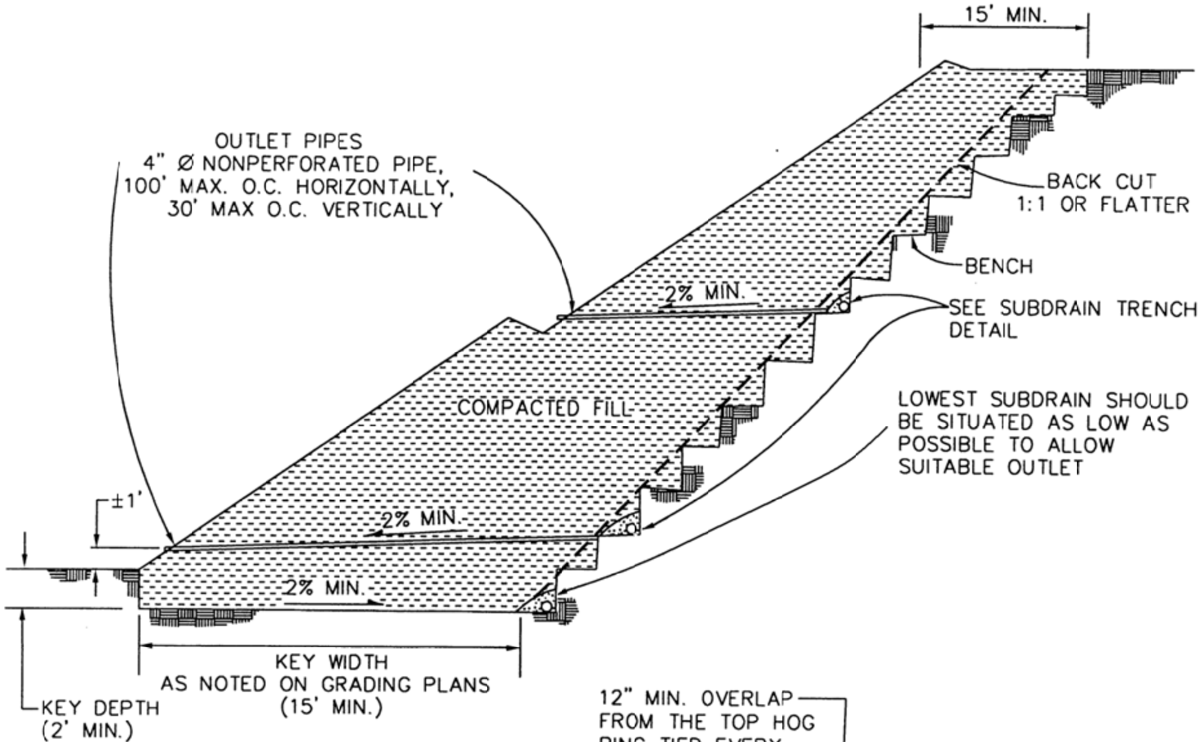


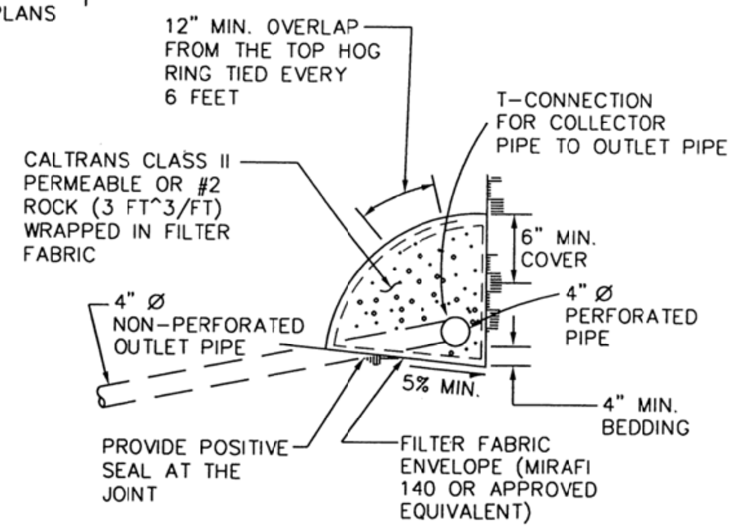
SUBDRAIN DETAIL



DETAIL OF CANYON SUBDRAIN OUTLET

CANYON SUBDRAINS	GENERAL EARTHWO K AND GRADING SPECIFICAT ONS STANDARD DETAIL C





SUBDRAIN TRENCH DETAIL

SUBDRAIN INSTALLATION – subdrain collector pipe shall be installed with perforation down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drill holes are used. All subdrain pipes shall have a gradient of at least 2% towards the outlet.

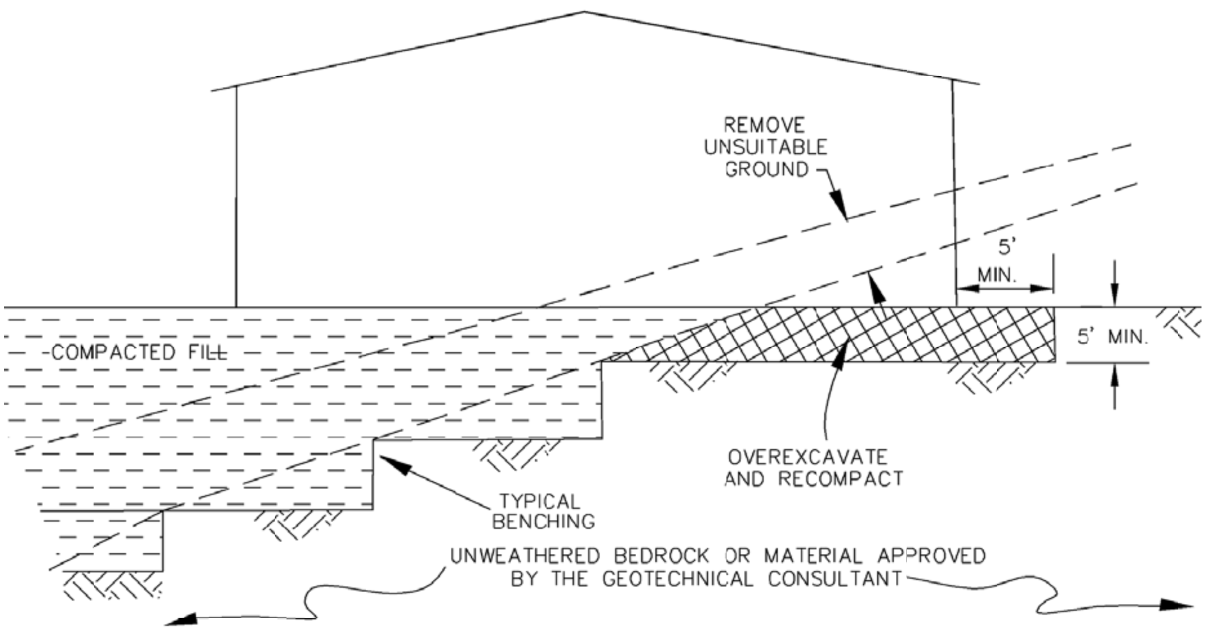
SUBDRAIN PIPE – Subdrain pipe shall be ASTM D2751, SDR 23.5 or ASTM D1527, Schedule 40, or ASTM D3034, SDR 23.5, Schedule 40 Polyvinyl Chloride Plastic (PVC) pipe.

All outlet pipe shall be placed in a trench no wider than twice the subdrain pipe.

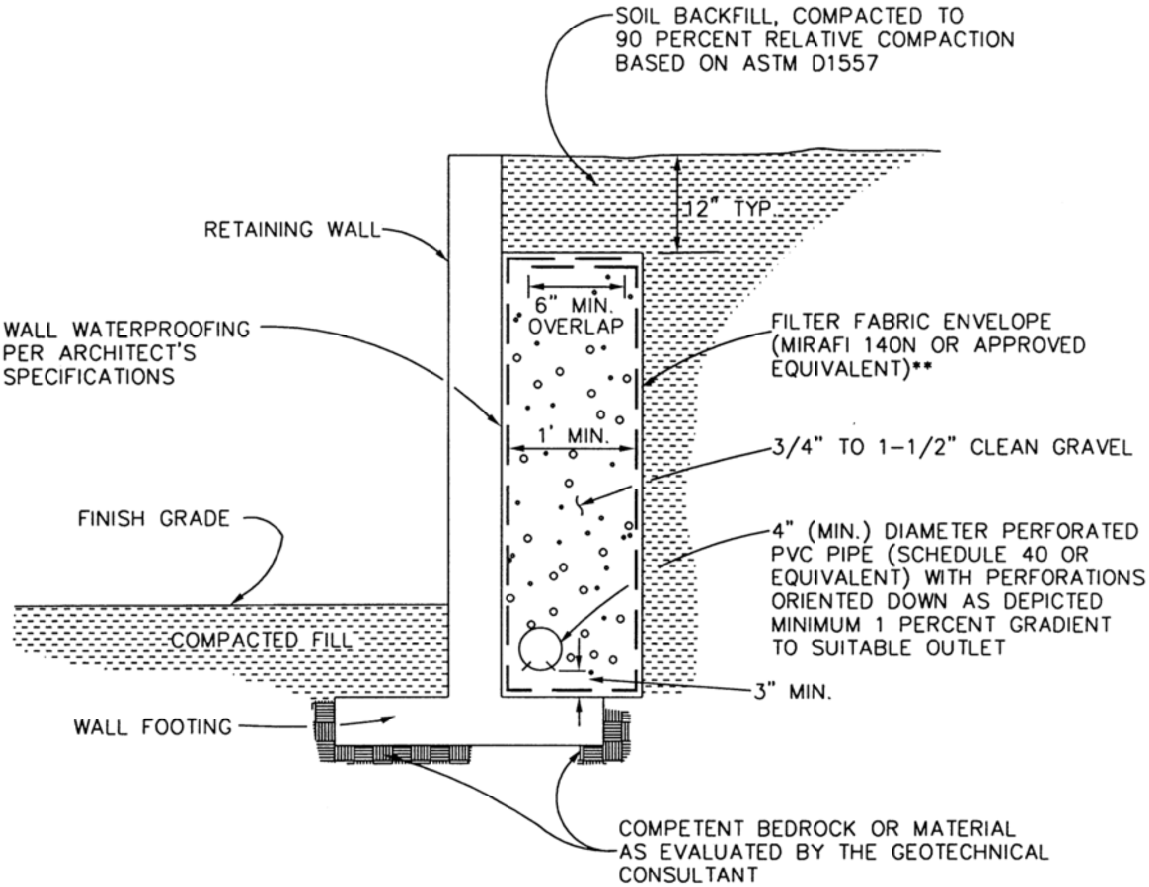
BUTTRESS R
REPLACEMENT
FILL SUBDRAINS

GENERAL EARTHW RK AND
GRADING SPECIFICATIONS
ST NDARD DET IL D

CUT-FILL TRANSITION LOT OVEREXCAVATION



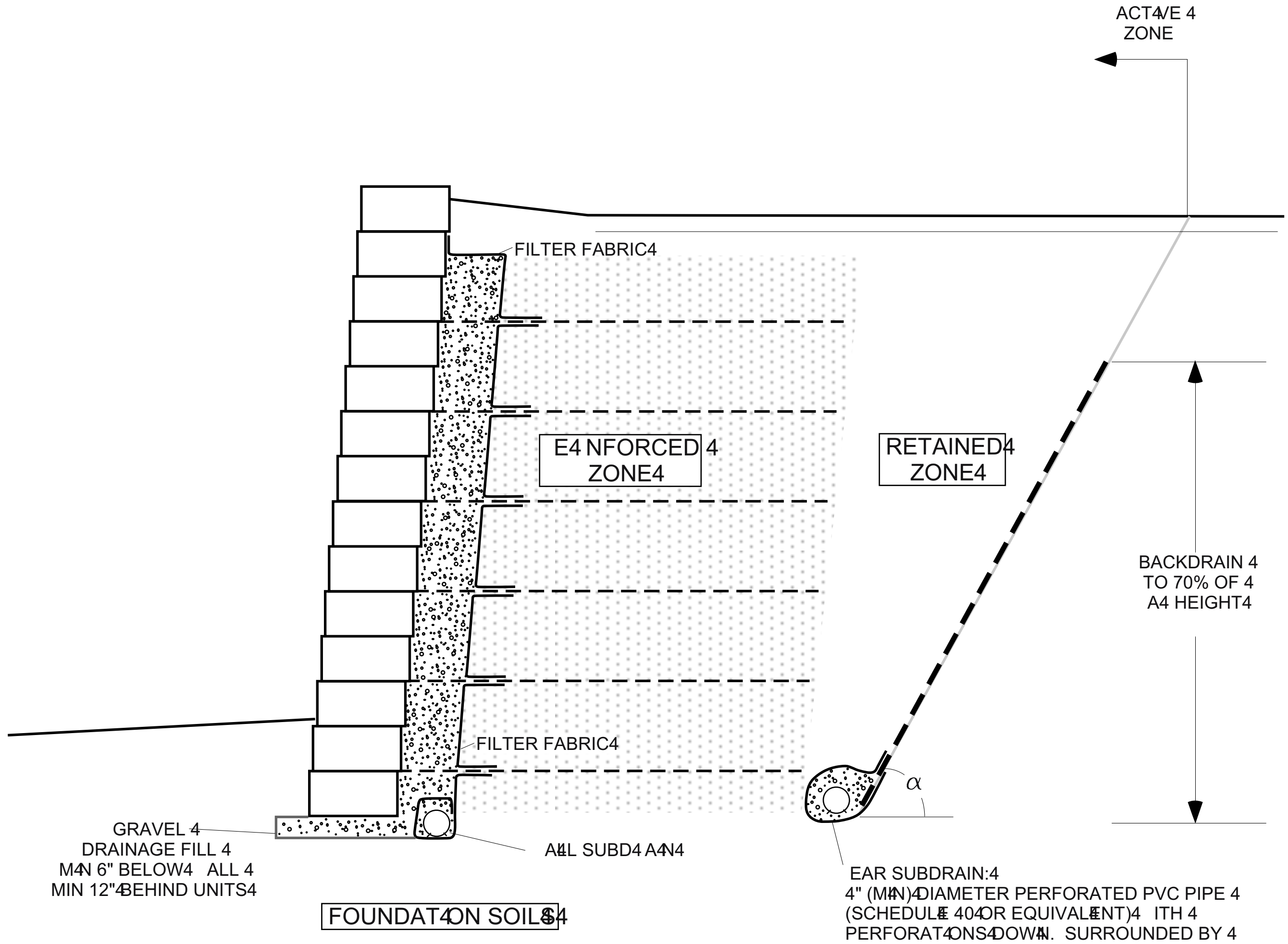
TRANSITION OT ILLS	ENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAIL



NOTE: UPON REVIEW BY THE GEOTECHNICAL CONSULTANT, COMPOSITE DRAINAGE PRODUCTS SUCH AS MIRADRAIN OR J-DRAIN MAY BE USED AS AN ALTERNATIVE TO GRAVEL OR CLASS 2 PERMEABLE MATERIAL. INSTALLATION SHOULD BE PERFORMED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

RETAINING A RAINAGE

GENERAL EART ORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL F



NOTES:4

1)4MATERIAL GRADAT4ON AND PLAST4CITY4

EINFORCED ZONE:4

SIEVE SIZE4	% PASSING4
14NCH 4	100 4
NO. 4 4	20-100 4
NO. 40 4	0-60 4
NO. 2004	0-35 4

GRAVEL DRAINAGE FILL:4

SIEVE SIZE4	% PASSING4
14NCH 4	100 4
3/4 INCH4	75-100 4
NO. 4 4	0-60 4
NO. 40 4	0-50 4
NO. 2004	0-5 4

FOR WA4 HEIGHT4 <410 FEET, PLAST4CITY4NDEX4<420 4
FOR WA4 HEIGHT4 10 TO 20 FEET, PLAST4CITY4NDEX4<410 4
FOR T4ERED WALLS, USE COMB4NED WALL HEIGHTS 4
A4L DESIGNER TO REQUEST4SITE-SPECIFIC CRITE4A FOR W4A4 HEIGHT4 >420 FEET4

2)4CONT4 ACTOR TO4USE SOILS W4TH4N THE RETAINED AND REINFORCED ZONES THAT4MEET4THE ST4 ENGTH REQUIREMENTS4OF WA4 DESIGN. 4

3)4GEOGRID REINFORCEMENT4TO BE4DESIGNED4BY WA4 DESIGNER CONSIDERING INTERNA4,4EXTERNAL,4AND COMPOUND STABIL4TY. 4

3)4GEOGRID TO BE4PRETENSIONED DURING INSTA4 AT4ON.

4) IMPROVEMENTS4 ITHIN THE4ACT4VE4ZONE4ARE4SUSCEPT4BLE4TO POST-CONST4UCT4ION SETT4EMENT. ANGLE4$\alpha = 45+\phi/2$, WHERE 4ϕ IS THE 4 FRICT4ON ANGLE OF THE MATER4AL IN THE RETAINED ZONE. 4

5)4BACKDRAIN SHOULD CONSIST4OF J-DRAIN4302 (OR EQUIVALENT)4OR 6-4NCH4THICK DRAINAGE FILL W4 APPED IN FILTE4FABRIC. PERCENT4 COVERAGE OF BACKDRAIN TO BE PER GEOTECHNICAL REVIEW44

SEGMENTAL4 RETA4NING4 A4S4

GENERAL4EARTH4 O4K AND 4
GRADING SPECIFICAT4ONS 4
STANDARD DETA4 G4

END OF REPORT