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

Midway Rising

TM PRJ#1106734

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

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

Engineer of Work:

REGISTERED PROFESSIONAL ENGINEER
CHELISA A. PACK
No. 71026
Exp. 06-30-25
CIVIL
STATE OF CALIFORNIA

Chelisa A. Pack

Chelisa Pack, PE, RCE 71026

Provide Wet Signature and Stamp Above Line

Prepared For:

Midway Rising LLC

700 Second Street

Encinitas, CA 92024

(858) 435-4000

Prepared By:

PROJECT DESIGN CONSULTANTS
a Bowman company

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

Project Design Consultants

701 B Street, Suite 800

San Diego, CA, 92101

619-235-6471

Date:

12/19/2024

Approved by: City of San Diego Date

The City of SAN DIEGO

Written by: J.Novoa
Job No. 4443.10
P:\4443.10\Engr\Reports

Project Name: Midway Rising

Table of Contents

Project Name: Midway Rising

- Attachment 3: Structural BMP Maintenance Plan
  - Maintenance Agreement (Form DS-3247) (when applicable)
- Attachment 4: Copy of Plan Sheets Showing Permanent Storm Water BMPs
- Attachment 5: Project's Drainage Report
- 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: Midway Rising
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

71026

PE#

06/30/2025

Expiration Date

Chelisa Pack

Print Name

Project Design Consultants

Company

10/18/2024

Date

Engineer's Stamp

Project Name: Midway Rising

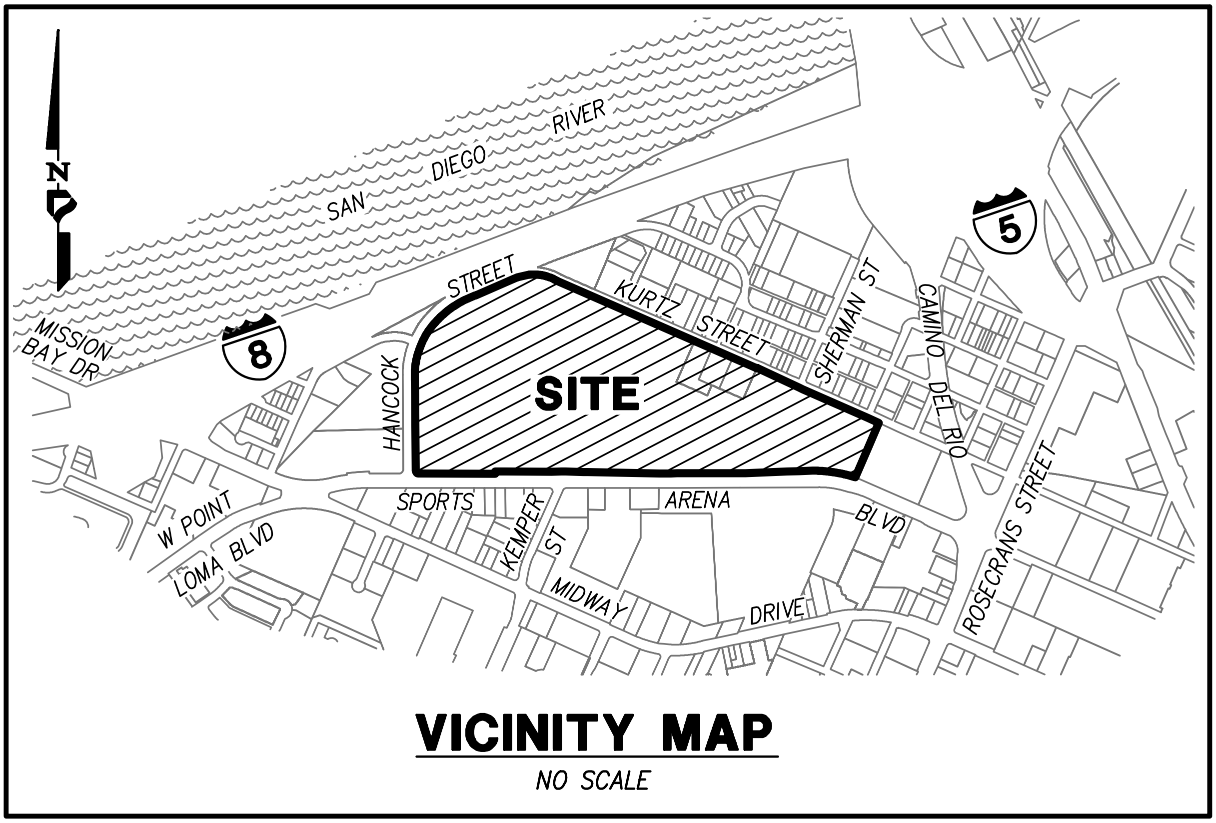
Submittal Record

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	10/26/23	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	**Initial Submittal**
2	02/15/24	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	2nd Submittal-Responding to City Comments
3	4/26/24	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	3rd Submittal-Added Specific Plan area to study and responding to City Comments
4	6/11/24	☑ **Preliminary Design/Planning/CEQA** ☐ **Final Design**	4th Submittal-Removal of Specific Plan area from study.
5	12/19/24	X Preliminary Design/Planning/CEQA	5th Submittal-Updated Drainage Report in Attachment 5.

Project Vicinity Map

Project Name: Midway Rising
Permit Application PRJ#1106734



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

Attach DS-560 form.

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Development Services

THE CITY OF SAN DIEGO

FORM
DS-560
September 2021

Stormwater Requirements Applicability Checklist

Project Address: 3500 Sports Arena Blvd San Diego, CA 92110 **Project Number:** 1106734

SECTION 1: Construction Stormwater Best Management Practices (BMP) Requirements

All construction sites are required to implement construction BMPs per the performance standards in the Stormwater Standards Manual. Some sites are also required to obtain coverage under the State Construction General Permit (CGP)[1], administered by the California State Water Resources Control Board.

For all projects, complete Part A - If the project is required to submit a Stormwater Pollution Prevention Plan (SWPPP) or Water Pollution Control Plan (WPCP), continue to Part B.

PART A – Determine Construction Phase Stormwater Requirements

1. Is the project subject to California's statewide General National Pollutant Discharge Elimination System (NPDES) permit for Stormwater Discharges Associated with Construction Activities, also known as the State Construction General Permit (CGP)? (Typically projects with land disturbance greater than or equal to 1 acre.)

   ◉ Yes, SWPPP is required; skip questions 2-4. ○ No; proceed to the next question.

2. Does the project propose construction or demolition activity, including but not limited to, clearing, grading, grubbing, excavation, or any other activity resulting in ground disturbance and/or contact with stormwater?

   ○ Yes, WPCP is required; skip questions 3-4. ○ No; proceed to the next question.

3. Does the project propose routine maintenance to maintain the original line and grade, hydraulic capacity, or original purpose of the facility? (Projects such as pipeline/utility replacement)

   ○ Yes, WPCP is required; skip question 4. ○ No; proceed to the next question.

4. Does the project only include the following Permit types listed below?

   - Electrical Permit, Fire Alarm Permit, Fire Sprinkler Permit, Plumbing Permit, Sign Permit, Mechanical Permit, Spa Permit.
   - Individual Right of Way Permits that exclusively include only ONE of the following activities: water service, sewer lateral, or utility service.
   - Right of Way Permits with a project footprint less than 150 linear feet that exclusively include only ONE of the following activities: curb ramp, sidewalk and driveway apron replacement, potholing, curb and gutter replacement, and retaining wall encroachments.

   ☐ Yes, no document is required.

Check one of the boxes below and continue to Part B

◉ **If you checked "Yes" for question 1**, an SWPPP is REQUIRED – **continue to Part B**

○ **If you checked "No" for question 1 and checked "Yes" for question 2 or 3**, a WPCP is REQUIRED. If the project proposes less than 5,000 square feet of ground disturbance AND has less than a 5-foot elevation change over the entire project area, a Minor WPCP may be required instead. **Continue to Part B**

○ **If you check "No" for all questions 1-3 and checked "Yes" for question 4,** Part B does not apply, and no document is required. **Continue to Section 2.**

[1] More information on the City's construction BMP requirements as well as CGP requirements can be found at http://www.sandiego.gov/stormwater/regulations/index.shtml

CLEAR FORM

PART B – Determine Construction Site Priority

This prioritization must be completed within this form, noted on the plans, and included in the SWPPP or WPCP. The city reserves the right to adjust the priority of projects both before and after construction. Construction projects are assigned an inspection frequency based on if the project has a "high threat to water quality." The City has aligned the local definition of "high threat to water quality" to the risk determination approach of the State Construction General Permit (CGP). The CGP determines risk level based on project specific sediment risk and receiving water risk. Additional inspection is required for projects within the Areas of Special Biological Significance (ASBS) watershed. **NOTE:** The construction priority does **NOT** change construction BMP requirements that apply to projects; rather, it determines the frequency of inspections that will be conducted by city staff.

Complete Part B and continue to Section 2

☐ **1. ASBS**

A. Projects located in the ASBS watershed.

☑ **2. High Priority**

A. Projects that qualify as Risk Level 2 or Risk Level 3 per the Construction General Permit (CGP) and are not located in the ASBS watershed.
B. Projects that qualify as LUP Type 2 or LUP Type 3 per the CGP and are not located in the ASBS watershed.

☐ **3. Medium Priority**

A. Projects that are not located in an ASBS watershed or designated as a High priority site.
B. Projects that qualify as Risk Level 1 or LUP Type 1 per the CGP and are not located in an ASBS watershed.
C. WPCP projects (>5,000 square feet of ground disturbance) located within the Los Peñasquitos watershed management area.

☐ **4. Low Priority**

A. Projects not subject to a Medium or High site priority designation and are not located in an ASBS watershed.

Section 2: Construction Stormwater BMP Requirements

Additional information for determining the requirements is found in the Stormwater Standards Manual.

PART C – Determine if Not Subject to Permanent Stormwater Requirements

Projects that are considered maintenance or otherwise not categorized as "new development projects" or "redevelopment projects" according to the Stormwater Standards Manual are not subject to Permanent Stormwater BMPs.

- **If "yes" is checked for any number in Part C**: Proceed to Part F and check "Not Subject to Permanent Stormwater BMP Requirements."
- **If "no" is checked for all the numbers in Part C:** Continue to Part D.

1. Does the project only include interior remodels and/or is the project entirely within an existing enclosed structure and does not have the potential to contact stormwater?

   ○ Yes ◉ No

2. Does the project only include the construction of overhead or underground utilities without creating new impervious surfaces?

   ○ Yes ◉ No

3. Does the project fall under routine maintenance? Examples include but are not limited to roof or exterior structure surface replacement, resurfacing or reconfiguring surface parking lots or existing roadways without expanding the impervious footprint, and routine replacement of damaged pavement (grinding, overlay and pothole repair).

   ○ Yes ◉ No

CLEAR FORM

PART D – PDP Exempt Requirements

PDP Exempt projects are required to implement site design and source control BMPs.

- **If "yes" is checked for any questions in Part D**, continue to Part F and check the box labeled "PDP Exempt."
- **If "no" is checked for all questions in Part D**, continue to Part E.

1. Does the project ONLY include new or retrofit sidewalks, bicycle lanes, or trails that:
   - Are designed and constructed to direct stormwater runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;
   - Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;
   - Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Stormwater Standards manual?

   ○ Yes, PDP exempt requirements apply ◉ No, proceed to next question

2. Does the project ONLY include retrofitting or redeveloping existing paved alleys, streets or roads designed and constructed in accordance with the Green Streets guidance in the City's Stormwater Standards Manual?

   ○ Yes, PDP exempt requirements apply ◉ No, proceed to next question

PART E – Determine if Project is a Priority Development Project (PDP)

Projects that match one of the definitions below are subject to additional requirements, including preparation of a Stormwater Quality Management Plan (SWQMP).

- **If "yes" is checked for any number in Part E**, continue to Part F and check the box labeled "Priority Development Project."
- **If "no" is checked for every number in Part E**, continue to Part F and check the box labeled "Standard Development Project."

1. **New development that creates 10,000 square feet or more of impervious surfaces collectively over the project site.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ○ Yes ◉ No

2. **Redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surfaces on an existing site of 10,000 square feet or more of impervious surfaces.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land. ◉ Yes ○ No

3. **New development or redevelopment of a restaurant.** Facilities that sell prepared foods and beverages for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification (SIC) 5812), and where the land development creates and/or replaces 5,000 square feet or more of impervious surface. ◉ Yes ○ No

4. **New development or redevelopment on a hillside.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site) and where the development will grade on any natural slope that is twenty-five percent or greater. ○ Yes ◉ No

5. **New development or redevelopment of a parking lot that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site).** ◉ Yes ○ No

6. **New development or redevelopment of streets, roads, highways, freeways, and driveways.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site). ◉ Yes ○ No

CLEAR FORM

7. **New development or redevelopment discharging directly to an environmentally sensitive area.** The project creates and/or replaces 2,500 square feet of impervious surface (collectively over the project site), and discharges directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands). ○ Yes ◉ No

8. **New development or redevelopment projects of retail gasoline outlet (RGO) that create and/or replaces 5,000 square feet of impervious surface.** The development project meets the following criteria: (a) 5,000 square feet or more or (b) has a projected Average Daily Traffic (ADT) of 100 or more vehicles per day. ○ Yes ◉ No

9. **New development or redevelopment projects of an automotive repair shop that creates and/or replaces 5,000 square feet or more of impervious surfaces.** Development projects categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534 or 7536-7539. ○ Yes ◉ No

10. **Other Pollutant Generating Project.** These projects are not covered in any of the categories above but involve the disturbance of one or more acres of land and are expected to generate post-construction phase pollutants, including fertilizers and pesticides. This category does not include projects creating less than 5,000 square feet of impervious area and projects containing landscaping without a requirement for the regular use of fertilizers and pesticides (such as a slope stabilization project using native plants). Impervious area calculations need not include linear pathways for infrequent vehicle use, such as emergency maintenance access or bicycle and pedestrian paths if the linear pathways are built with pervious surfaces or if runoff from the pathway sheet flows to adjacent pervious areas. ○ Yes ◉ No

PART F – Select the appropriate category based on the outcomes of Part C through Part E

1. The project is **NOT SUBJECT TO PERMANENT STORMWATER REQUIREMENTS** ○ Yes ◉ No

2. The project is a **STANDARD DEVELOPMENT PROJECT**. Site design and source control BMP requirements apply. See the Stormwater Standards Manual for guidance. ○ Yes ◉ No

3. The Project is **PDP EXEMPT**. Site design and source control BMP requirements apply. Refer to the Stormwater Standards Manual for guidance. ○ Yes ◉ No

4. The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control and structural pollutant control BMP requirements apply. Refer to the Stormwater Standards Manual for guidance on determining if the project requires hydromodification plan management. ◉ Yes ○ No

Martin Jones

Name of Owner or Agent

Senior Project Manager

Title

Signature

10/26/2023

Date

CLEAR FORM

Applicability of Permanent, Post-Construction Storm Water BMP Requirements			Form I-1
Project Identification			
Project Name: Midway Rising			
Permit Application Number: 1106734			Date: 6/10/24
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:			

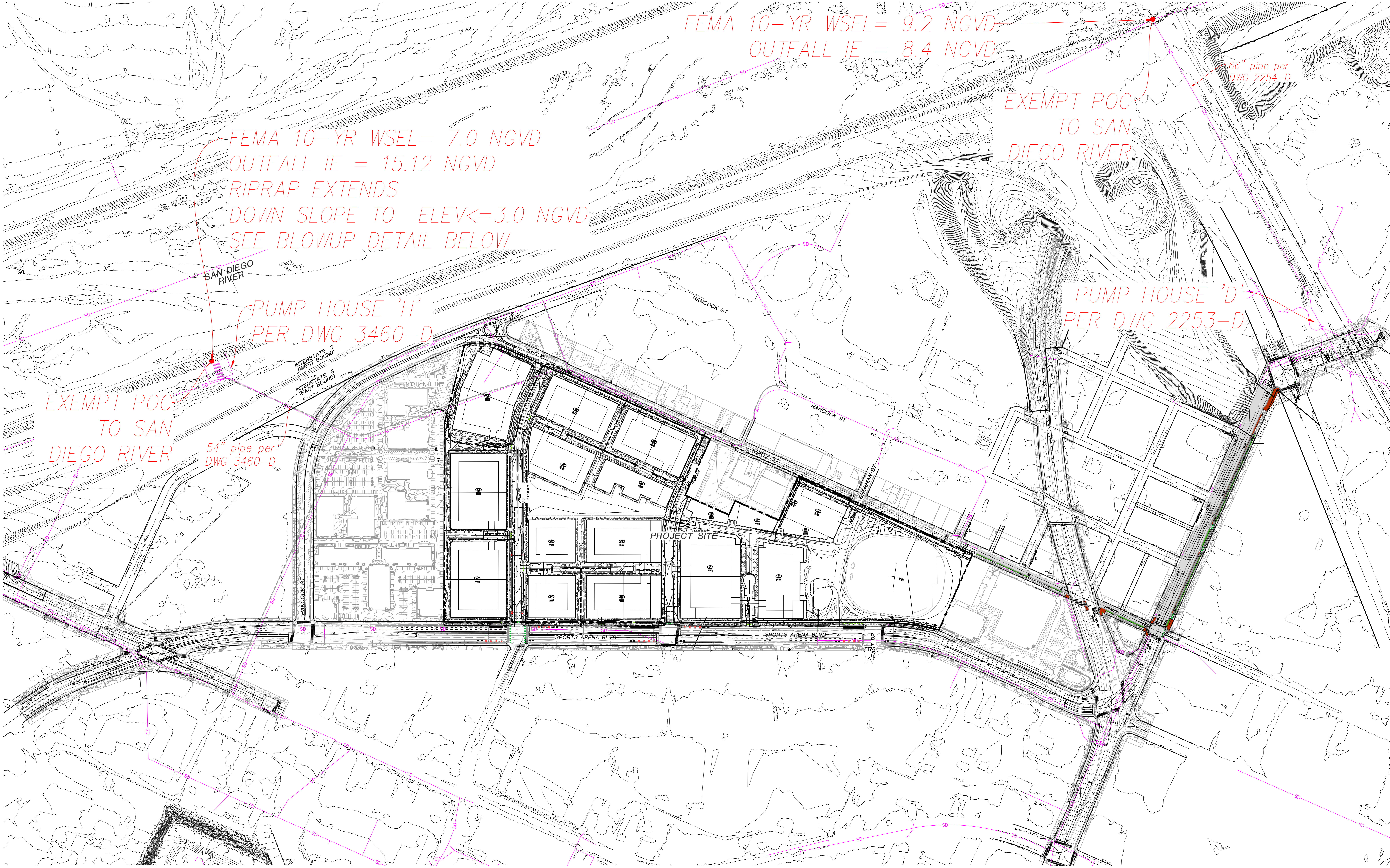
Project Name: Midway Rising

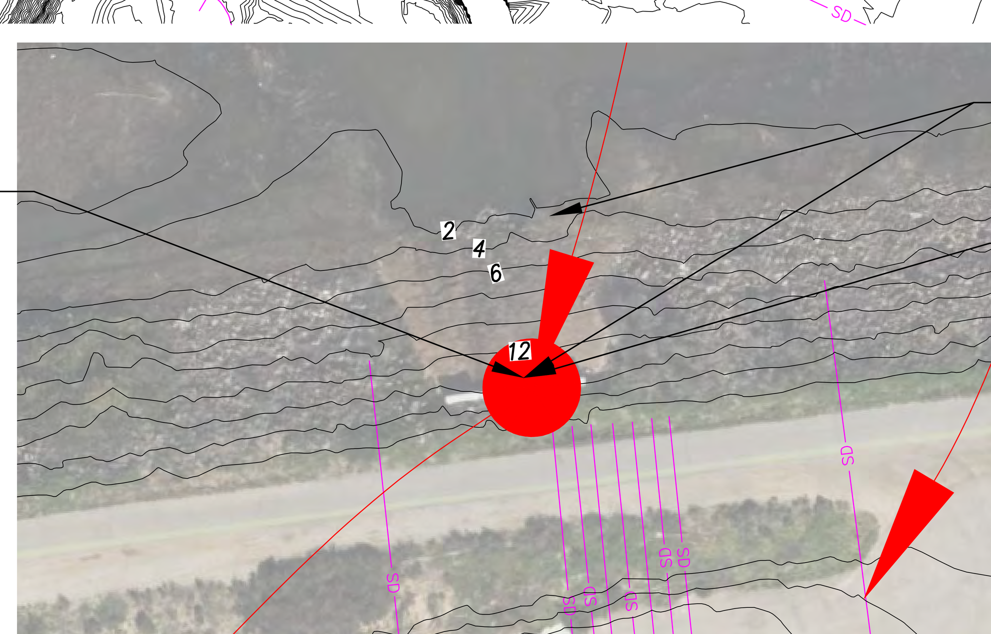
Form I-1 Page 2 of 2		
Step	**Answer**	**Progression**
Step 3. Is the project subject to earlier PDP requirements due to a prior lawful approval? See Section 1.10 of the manual (Part 1 of Storm Water Standards) for guidance.	☐ Yes	Consult the City Engineer to determine requirements. Provide discussion 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: The project is exempt from hydromodification control requirements because the project outlets to an exempt POC being the San Diego River. The outfall from the pump house which flows exit to the San Diego River has existing shotcrete and riprap and discharges below the 10-year WSE of the River. See HMP Exhibit for specific elevations and locations.		
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:		

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.





BLOW UP OF PUMP HOUSE H HMP EXEMPT OUTLET

N

150 75 0 150 300 450

SCALE: 1"=150'

SCALE: 1"=150'
JOB #: 4443.10
CREATED: 8/10/23

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

CITY OF SAN DIEGO
MIDWAY RISING
HMP EXEMPTION EXHIBIT
PROPOSED CONDITIONS

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 9 OF 12

SAN DIEGO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
CARLSBAD, CITY OF	060285	NATIONAL CITY, CITY OF	060293
CHULA VISTA, CITY OF	065021	OCEANSIDE, CITY OF	060294
CORONADO, CITY OF	060287	POWAY, CITY OF	060702
DEL MAR, CITY OF	060288	SAN DIEGO, CITY OF	060295
EL CAJON, CITY OF	060289	SAN DIEGO COUNTY, UNINCORPORATED AREAS	060284
ENCINITAS, CITY OF	060726	SAN MARCOS, CITY OF	060296
ESCONDIDO, CITY OF	060290	SANTEE, CITY OF	060703
IMPERIAL BEACH, CITY OF	060291	SOLANA BEACH, CITY OF	060725
LA MESA, CITY OF	060292	VISTA, CITY OF	060297
LEMON GROVE, CITY OF	060723		

REVISED: March 22, 2022

FLOOD INSURANCE STUDY NUMBER
06073CV009F

Version Number 2.4.3.0

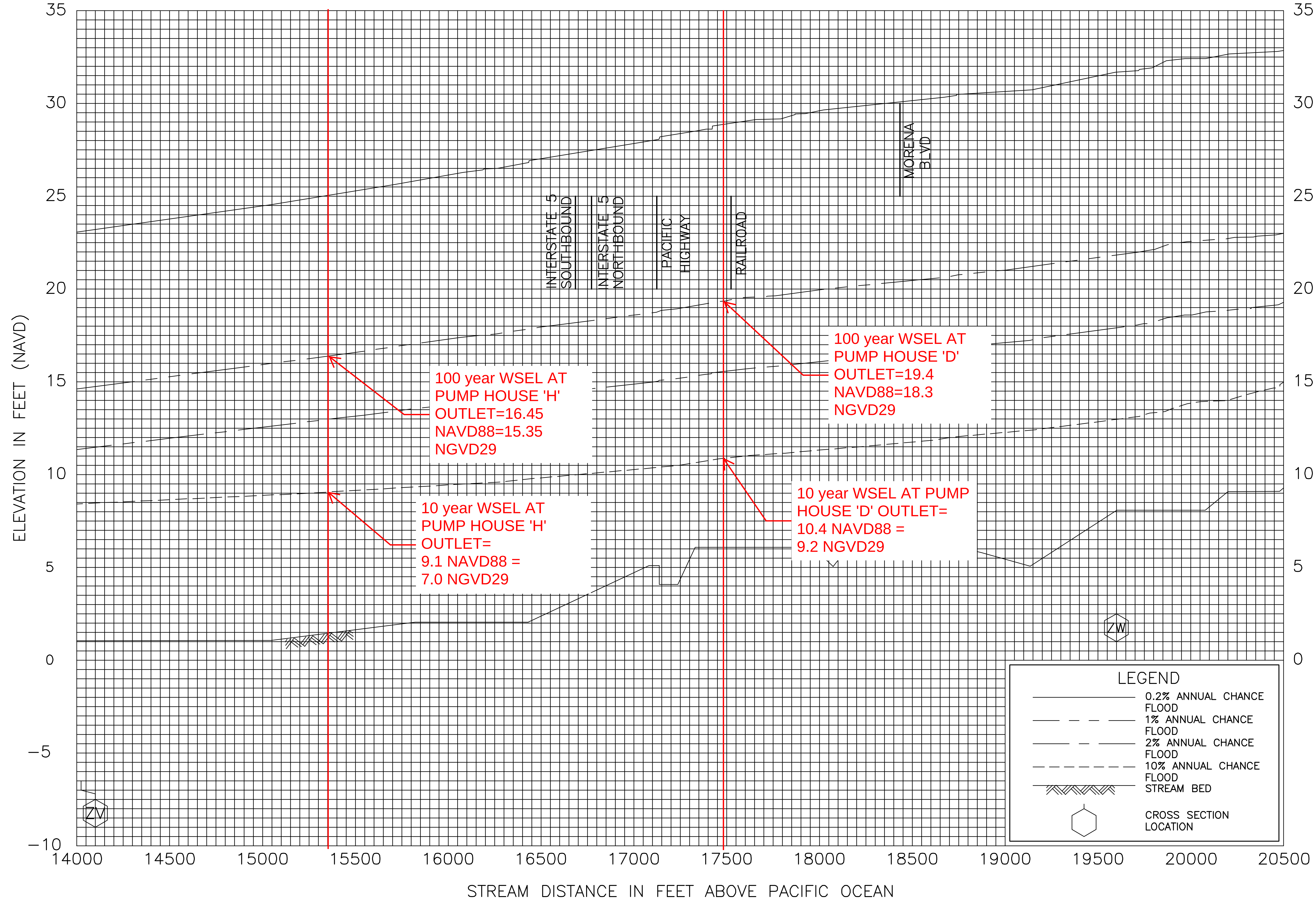
FEMA

Table 23: Floodway Data (continued)

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
ZT	2,028	920	8,370	4.3	10.5	10.5	10.5	0.0
ZU	7,268	894	9,057	4.0	12.3	12.3	12.3	0.0
ZV	14,028	865	7,381	4.9	14.7	14.7	14.7	0.0
ZW	19,598	876	8,833	5.7	21.8	21.8	21.8	0.0
ZX	23,862	898	6,677	5.9	26.5	26.5	26.5	0.0
ZY	25,563	952	5,972	8.0	28.2	28.2	28.8	0.6
ZZ	26,433	1,180	8,882	4.7	30.1	30.1	30.4	0.3
A	27,462	830	3,439	12.3	31.4	31.4	31.4	0.0
B	27,654	877	4,920	4.5	33.2	33.2	33.2	0.0
C	27,882	775	5,051	4.9	34.0	34.0	34.0	0.0
D	28,791	531	5,828	3.6	35.8	35.8	35.8	0.0
E	29,173	619	6,351	4.0	36.7	36.7	36.7	0.0
F	29,624	601	5,266	5.2	37.2	37.2	37.2	0.0
G	31,782	352	6,440	5.6	38.3	38.3	39.3	1.0
H	33,732	405	6,258	5.8	41.5	41.5	41.9	0.4
I	35,769	337	6,058	5.9	42.8	42.8	43.1	0.3
J	37,116	336	6,148	5.9	46.3	46.3	46.4	0.1
K	38,574	415	7,545	4.8	47.6	47.6	47.6	0.0
L	41,149	432	8,647	4.2	48.7	48.7	48.7	0.0
M	43,814	538	4,900	7.6	53.8	53.8	54.1	0.3
N	45,704	303	3,144	11.5	57.8	57.8	57.8	0.0
O	48,553	828	11,269	3.2	66.5	66.5	66.6	0.1
P	51,043	360	4,444	8.1	71.4	71.4	71.7	0.3
Q	52,448	462	6,382	5.6	72.7	72.7	73.2	0.5
R	53,280	372	5,667	6.4	73.7	73.7	74.2	0.5

[1]Feet above Pacific Ocean

TABLE 23	FEDERAL EMERGENCY MANAGEMENT AGENCY SAN DIEGO COUNTY, CALIFORNIA AND INCORPORATED AREAS	FLOODWAY DATA FLOODING SOURCE: SAN DIEGO RIVER



FLOOD PROFILES

SAN DIEGO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA
(AND INCORPORATED AREAS)

Receiving Waters and Conveyance Systems Exempt from Hydromodification Management Requirements

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

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Site Information Checklist For PDPs	Form I-3B
Project Summary Information	
Project Name	Midway Rising
Project Address	3500 Sports Arena Blvd San Diego, CA 92110
Assessor's Parcel Number(s) (APN(s))	441-590-04
Permit Application Number	1106734
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)	Mission San Diego Hydrologic Subarea (907.11)
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	49.21 Acres (2,143,790 Square Feet) (Including outparcel)
Area to be disturbed by the project (Project Footprint)	49.21 Acres (2,143,790 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	44.31 Acres (1,929,272 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	4.92 Acres (214,359 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	-7 %

Project Name: Midway Rising

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 consists of an existing Pechanga Arena for sports and entertainment with surrounding asphalt parking lot . There are two existing restaurant buildings and a gas station.
Existing Land Cover Includes (select all that apply): ☑Vegetative Cover ☐Non-Vegetated Pervious Areas ☑Impervious Areas Description / Additional Information: The site consists of a sports/entertainment arena with surrounding asphalt parking lot and landscape islands. Two restaurant buildings and a gas station located in the southern portion of project. Majority of the site is impervious.
Underlying Soil belongs to Hydrologic Soil Group (select all that apply): ☐NRCS Type A ☐NRCS Type B ☐NRCS Type C ☐NRCS Type D NRCS web soil survey is "Urban Land" and is therefore not classified.
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: Midway Rising

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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
1&2) The existing drainage conveyance is urban and presently a very minor runon amount. This runon area includes the adjacent parcel near the fence line/property line in the middle north area of the project. 3&4) There are currently on-site drainage facilities including inlets and stormdrain pipes with much of the site developed with asphalt surfacing and structures. The existing site sheet flows in three directions, with approximately 50% of the site towards the north and into existing stormdrain in Kurtz Street. Approximately 40% of the site drains south to SD in Sports Arena Blvd and drain west. Both of these systems eventually drain to the existing pump house north of I-8 and are pumped into the SD River Flood Control Channel. The remaining 10% flows southeast towards Rosecrans Street which eventually outlets to the same channel as the above two areas of the site above. There are three different discharge locations but all eventually outlet to the San Diego River. Discharge location #1 includes existing Systems 100 and 120. Discharge location 2 includes existing Systems 200, 250, and 280. Discharge location #3 includes existing Systems 300 and 320. Pre project drainage areas and design flows are located within the Midway Rising Drainage Study, located in Attachment 5.

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 VTM area includes the redevelopment of an existing sports arena and parking lot with a new sports/entertainment arena with commercial space, plazas, parks, a hotel, restaurants, and residential units. A portion of the residential units will qualify as affordable housing. The project area is within land owned by the City of San Diego, and the project proposes to develop the property into various uses via long term leases. The redevelopment may be accomplished in various phases. The project will include construction of two public streets through the project, Kemper Street and Frontier Drive. The other proposed streets within the development are proposed to be public. The redevelopment project will also include frontage improvements and traffic improvements.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): Impervious features of the project include multiple buildings, sports/entertainment arena, roads, and sidewalks throughout.
List/describe proposed pervious features of the project (e.g., landscape areas): Pervious features landscape areas, plazas throughout and park space.
Does the project include grading and changes to site topography? ☑ Yes ☐ No Description / Additional Information: Grading throughout the project will occur, but the intent is to maintain drainage pattern paths based on existing site topography.

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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 project will install an on-site storm drain system to collect and treat for pollutant control requirements onsite including an area drain network and modular wetlands and other walled biofiltration planters for treatment. Once treated, flow will tie to the existing storm drain adjacent to the site in various locations. Summary of pre and post project drainage areas and flows can be found in the Midway Rising Housing Drainage Study.

Project Name: Midway Rising

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

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

Description/Additional Information:

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 three discharge locations of the project tie to existing stormdrain infrastructure in which two locations go to an existing pump house then are pumped to the San Diego River and the third location also discharges to San Diego River. The San Diego River discharges into the Pacific Ocean north of Ocean Beach.
Provide a summary of all beneficial uses of receiving waters downstream of the project discharge locations Per the Basin plan, the San Diego River Watershed (inland surface waters) has the following beneficial uses: mun, agr, ind, proc, rec 1, rec 2, warm, cold and wild.
Identify all ASBS (areas of special biological significance) receiving waters downstream of the project discharge locations This is not applicable to the project. There are two ASBS in San Diego, the La Jolla ASBS and the Scripps ASBS. Key pollution threats include urban, road, and stormwater runoff. The Project does not drain to any of these immediate ASBS.
Provide distance from project outfall location to impaired or sensitive receiving waters The project's receiving water is the San Diego River, which is located immediately downstream of the development.
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 are no ESAs onsite.

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 River	Enterococcus, Fecal Coliform,	Per 2010 303(d), TMDL req'd
	Low dissolved oxygen	but not completed
	manganese, nitrogen	Per Jan. 2016 WQIP,
	phophorus, total dissolved solids	Highest Priority Pollutant is bacteria
	toxicity	

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): Under the municipal permit, the Project is exempt from meeting the hydromodification management requirements because it discharges to an underground storm drain system that empties directly to the San Diego River. This exemption is included in the Final WQIP for the watershed. The storm drain outfalls will be below the 10-Year water surface elevation to qualify for the HMP exemption. Refer to the HMP Exemption Exhibit that shows the project's direct discharge to the San Diego River. 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: The project is hydromodification exempt.

Project Name: Midway Rising

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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.   (N/A for this project)
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: (N/A for this project)
Discussion / Additional Information: (optional)

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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.
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.

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: No outdoor material storage areas planned.			
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: No outdoor work areas planned.			
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.	

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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: Site is a redevelopment, and there are no natural hydrologic features onsite to preserve.			
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:			

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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:
Refer to the DMA map for the site design BMPs for the project.

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. The project meets pollutant control and volume retention requirements outlined in the City of San Diego's Stormwater Standards. The first step was to assess Harvest and reuse. Harvest and reuse was not feasible onsite. Infiltration is next considered and the project geotechnical engineer has deemed the entire site to be a no-infiltration site for stormwater purposes. Refer to Attachment 1d for the infiltration feasibility letter. Therefore, raised lined biofiltration BMPs and compact biofiltration MWS units are included to treat the stormwater from the DMAs. Refer to Attachment 1A for the identification of the areas. The project proposes biofiltration planters throughout the development areas. Since the roof plan has not been delineated the location of the basins is to be determined but will surround the buildings in various locations. The landscape architect was able to provide more detailed delineation for Lots B2 and C2 and therefore, the DMA framework used for Lots B2 and C2 on the DMA exhibit will be used as the basis for the rest of the buildings throughout the project to meet water quality requirements. In addition, Modular Wetland System units will be incorporated into the design along with the required dispersion areas when biofiltration planters are not feasible. For example, it is envisioned that the majority of the on-grade areas will drain to Modular Wetland units, due to the high groundwater and vertical storm drain constraints. (Continue on page 2 as necessary.)	

Project Name: Midway Rising

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(Continued from page 1)

The volume retention is analyzed for the entire site and will be met with a combination of biofiltrations basins and impervious dispersion of hardscape to landscape areas. These dispersion areas utilized for the volume retention credit will be located within the courtyards using sidewalks and adjacent landscaping areas throughout the project. Some of the dispersion to landscape area will be less than 10 feet, but it meets the criteria when the contributing flow path length of the impervious area / pervious area width is less than or equal to 2 and a maximum slope of 5% (See page B-71 of the 2021 San Diego BMP Stormwater Standards).

The offsite and street frontage improvements will be addressed via a PDP-exempt green streets approach which may incorporate elements such as trees and noncontiguous sidewalk with dispersion areas and/or modular wetland units. Detailed locations will be provided during final engineering, but a conceptual design exhibit has been attached to Attachment 1e to show conceptually that the parkway areas will be proposed to have lots of pervious landscaped areas. Preliminary landscape hatch (color green) has been added to frontage of Sports Arena Blvd and Kurtz Ave. Specific green street elements will be detailed during final engineering, but the following are the current frontage improvements that should be considered PDP-exempt: 1) Proposed Hancock/Kurtz Street intersection improvements, 2) Frontage improvements on Kurtz Street, 3) Sports Arena Boulevard curb realignment and bike path improvements, and 4) Rosecrans parkway improvements.

Form I-6 Page 3 of 8 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. Walled Biofiltration Planter #1,3,5,6,13,15-17,23,24,27-35,38,40, 41, 43-45,47, 49,50	
Construction Plan Sheet No. TM Sheets 7, 8 & 9	
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	Chelisa Pack Project Design Consultants 619-235-6471
Who will be the final owner of this BMP?	Midway Rising, LLC
Who will maintain this BMP into perpetuity?	Midway Rising, LLC
What is the funding mechanism for maintenance?	Revenue from project

Form I-6 Page 4 of 8 (Copy as many as needed)
Structural BMP ID No. Walled Biofiltration Planter #1,3,5,6,13,15-17,23,24,27-35,38,40, 41, 43-45,47, 49,50
Construction Plan Sheet No. TM Sheets 7, 8 & 9
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): Preliminary sizing of walled biofiltration planters have been performed for this TM package. The required basin area for each building/roof area has been determined based on conceptual impervious and previous footprints. This was done to verify feasibility of setting aside the require BMP areas. As the design progresses to the final engineering stages, additional basins will be incorporated and split up to match the roof plan and downspout locations. The BMPs will be established based on the building, (roof), grading, and landscape design. Since this is a preliminary SWQMP, all of the proposed biofiltration planter BMPs are combined into one Form I-6. During final engineering, a separate Form I-6 will be provided for each structural BMP.

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Form I-6 Page 5 of 8 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. Modular Wetland System Units #2,4,14,18,25,26,39,42,46,48,51-54	
Construction Plan Sheet No. TM Sheets 7, 8 & 9	
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)~~ → BF-3 Compact Biofiltration ☐ 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	Chelisa Pack Project Design Consultants 619-235-6471
Who will be the final owner of this BMP?	Midway Rising, LLC
Who will maintain this BMP into perpetuity?	Midway Rising, LLC
What is the funding mechanism for maintenance?	Revenue from project

Project Name: Midway Rising

Form I-6 Page 6 of 8 (Copy as many as needed)
Structural BMP ID No. Modular Wetland System Units #2,4,14,18,25,26,39,42,46,48,51-54
Construction Plan Sheet No. TM Sheets 7, 8 & 9
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): Preliminary sizing of the private MWS units has been performed for this TM package. The BMPs are proposed for street areas and plazas where walled biofiltration planters are not feasible. Since this is a preliminary SWQMP, all of the proposed Modular Wetland System BMPs are combined into one Form I-6. During final engineering, a separate Form I-6 will be provided for each structural BMP.

Form I-6 Page 7 of 8 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. Modular Wetland System Units #7-12,19-22,36,37	
Construction Plan Sheet No. TM Sheets 7, 8 & 9	
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)~~ → BF-3 Compact Biofiltration ☐ 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	Chelisa Pack Project Design Consultants 619-235-6471
Who will be the final owner of this BMP?	City of San Diego
Who will maintain this BMP into perpetuity?	City of San Diego
What is the funding mechanism for maintenance?	City of San Diego

Project Name: Midway Rising

Form I-6 Page 8 of 8 (Copy as many as needed)
Structural BMP ID No. Modular Wetland System Units #7-12,19-22,36,37
Construction Plan Sheet No. TM Sheets 7, 8 & 9
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): Preliminary sizing of the public MWS units has been performed for this TM package. The BMPs are proposed for street areas and plazas where walled biofiltration planters are not feasible. Since this is a preliminary SWQMP, all of the proposed Modular Wetland System BMPs are combined into one Form I-6. During final engineering, a separate Form I-6 will be provided for each structural BMP.

Attachment 1
Backup For PDP Pollutant Control BMPs

This is the cover sheet for Attachment 1.

Project Name: Midway Rising

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	[X] 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: o Infiltration Feasibility Condition Letter (***Note: must be stamped and signed by licensed geotechnical engineer***) o Form I-8A (optional) o Form I-8B (optional) • Partial Infiltration Condition: o Infiltration Feasibility Condition Letter (***Note: must be stamped and signed by licensed geotechnical engineer***) o Form I-8A o Form I-8B • Full Infiltration Condition: o Form I-8A o Form I-8B o Worksheet C.4-3 o 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

ATTACHMENT 1A/1B

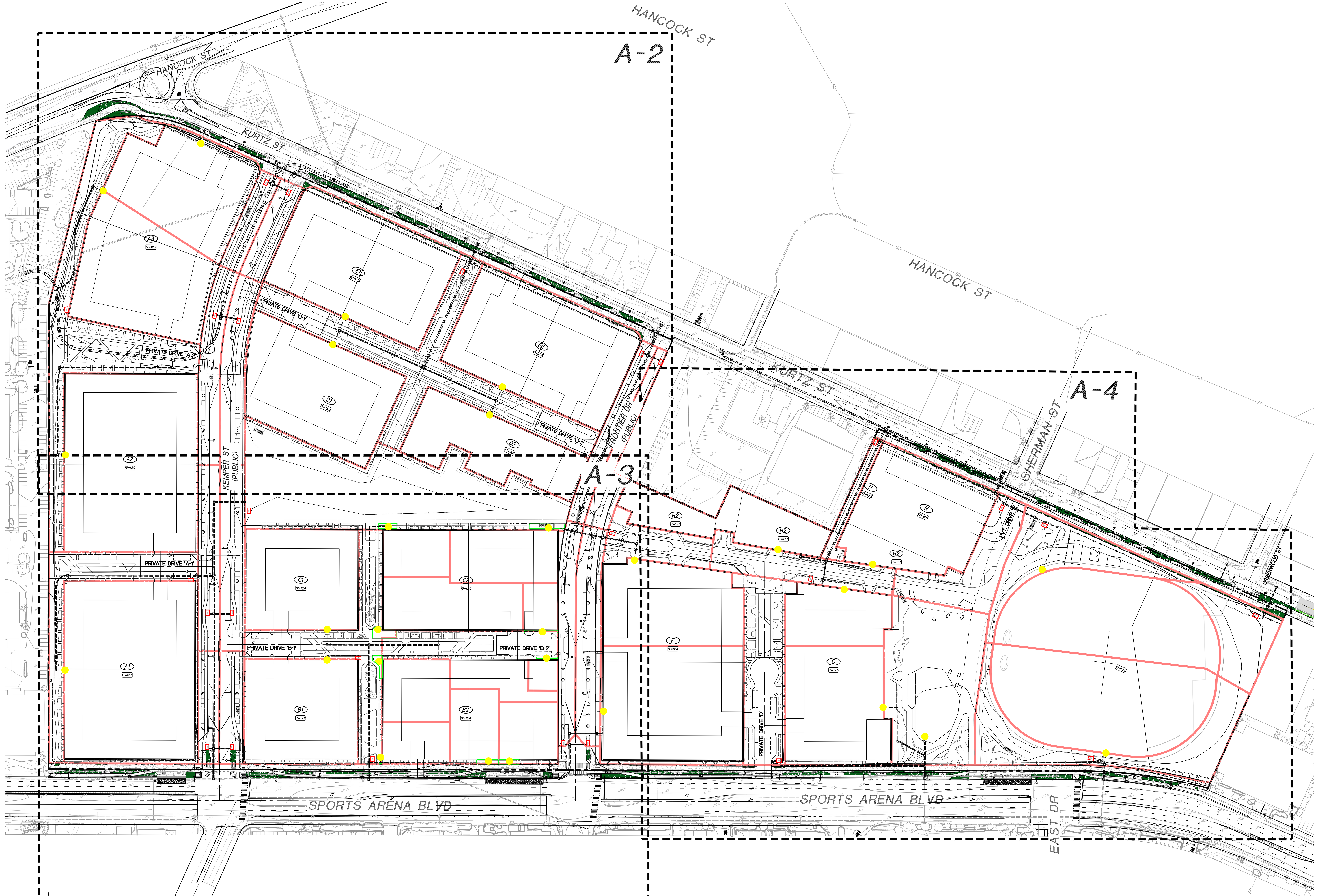
DMA EXHIBIT/TABULAR SUMMARY OF BMPS

Project Name: Midway Rising

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)



LEGEND:

DRAINAGE MANAGEMENT AREA (DMA)

BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)

BMP: MODULAR WETLAND UNIT

DRAINAGE FLOW DIRECTION

X.XX AC — DMA AREA

SCALE: 1"=60'

SCALE:	1"=60'
JOB #:	4443.10
CREATED:	8/10/23

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey
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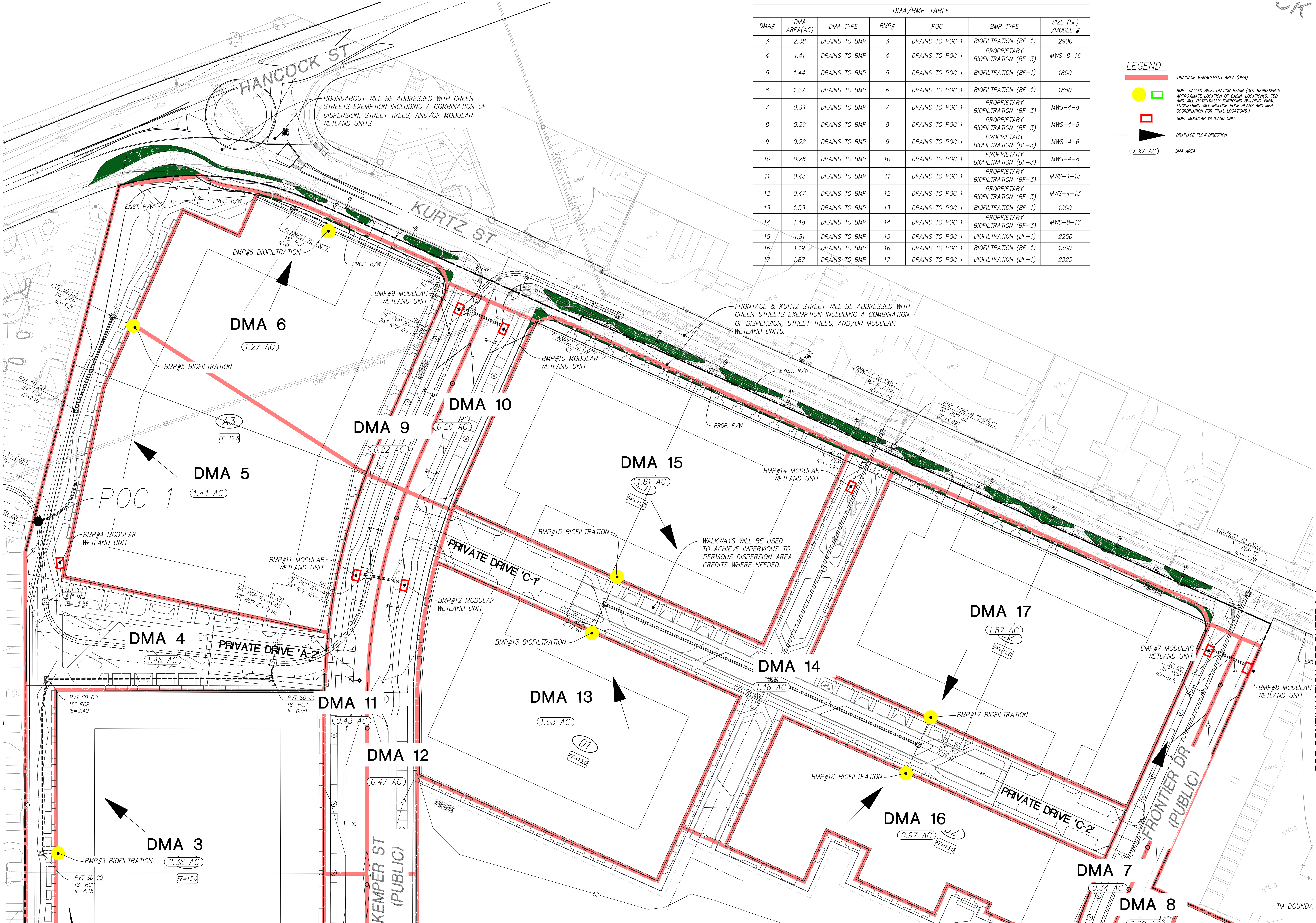
CITY OF SAN DIEGO

MIDWAY RISING

DMA EXHIBIT-KEY MAP
PROPOSED CONDITIONS
EXHIBIT A-1



DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
3	2.38	DRAINS TO BMP	3	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2900
4	1.41	DRAINS TO BMP	4	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-16
5	1.44	DRAINS TO BMP	5	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1800
6	1.27	DRAINS TO BMP	6	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1850
7	0.34	DRAINS TO BMP	7	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
8	0.29	DRAINS TO BMP	8	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
9	0.22	DRAINS TO BMP	9	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-6
10	0.26	DRAINS TO BMP	10	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
11	0.43	DRAINS TO BMP	11	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
12	0.47	DRAINS TO BMP	12	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
13	1.53	DRAINS TO BMP	13	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1900
14	1.48	DRAINS TO BMP	14	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-16
15	1.81	DRAINS TO BMP	15	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2250
16	1.19	DRAINS TO BMP	16	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1300
17	1.87	DRAINS TO BMP	17	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2325

LEGEND:

- DRAINAGE MANAGEMENT AREA (DMA)
- BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)
- BMP: MODULAR WETLAND UNIT
- DRAINAGE FLOW DIRECTION
- X.XX AC — DMA AREA

FOR CONTINUATION SEE SHEET A-4

FOR CONTINUATION SEE SHEET A-3

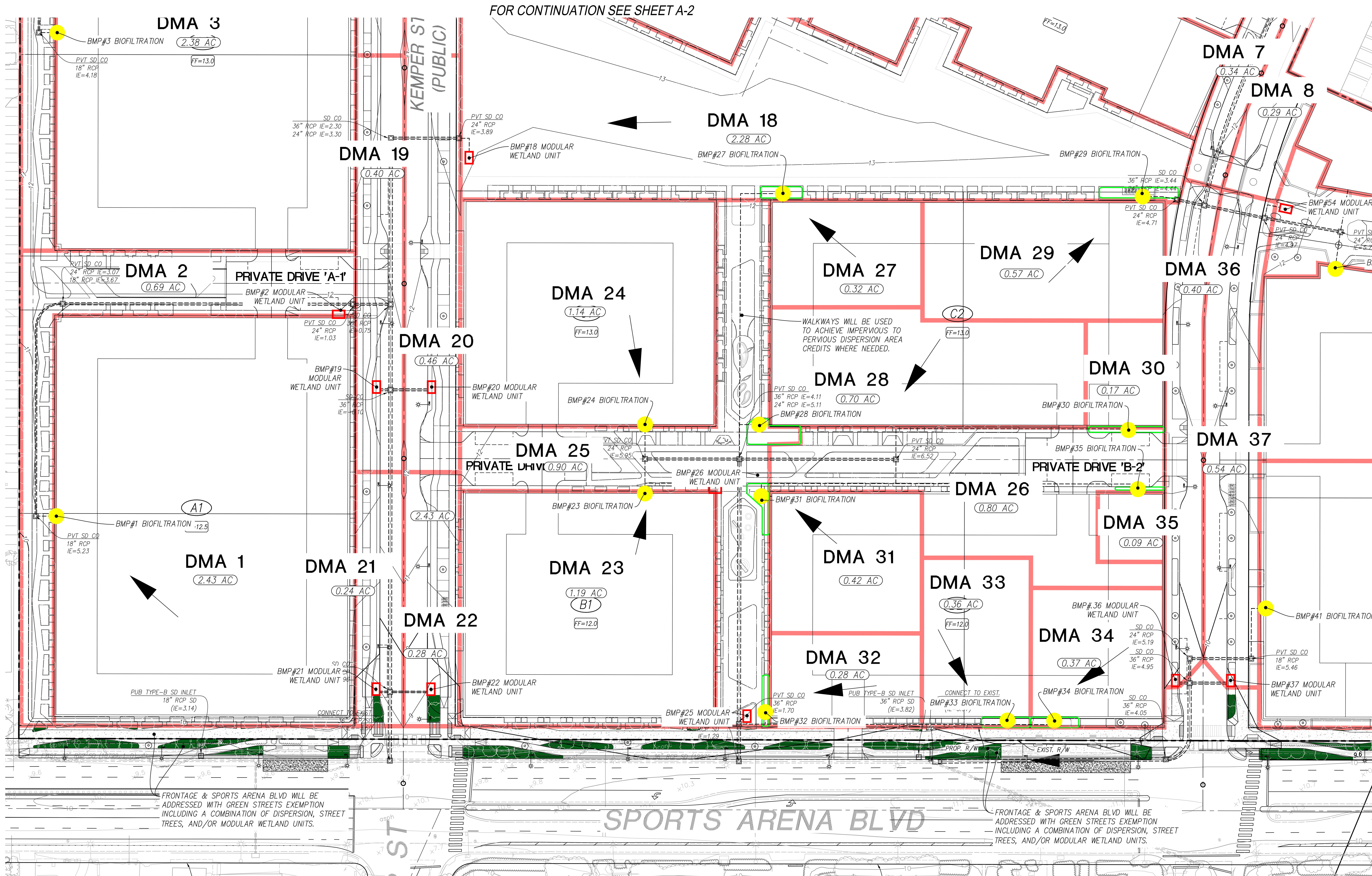
SCALE: 1"=30'
JOB #: 4443.10
CREATED: 8/10/23

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

CITY OF SAN DIEGO
MIDWAY RISING

DMA EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A-2



DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
1	2.43	DRAINS TO BMP	1	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2950
2	0.69	DRAINS TO BMP	2	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
18	2.28	DRAINS TO BMP	18	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-24
19	0.40	DRAINS TO BMP	19	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
20	0.46	DRAINS TO BMP	20	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
21	0.24	DRAINS TO BMP	21	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
22	0.28	DRAINS TO BMP	22	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
23	1.19	DRAINS TO BMP	23	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1500
24	1.14	DRAINS TO BMP	24	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1450
25	0.90	DRAINS TO BMP	25	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12
26	0.80	DRAINS TO BMP	26	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12

DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
27	0.32	DRAINS TO BMP	27	DRAINS TO POC 1	BIOFILTRATION (BF-1)	500
28	0.70	DRAINS TO BMP	28	DRAINS TO POC 1	BIOFILTRATION (BF-1)	950
29	0.57	DRAINS TO BMP	29	DRAINS TO POC 1	BIOFILTRATION (BF-1)	750
30	0.17	DRAINS TO BMP	30	DRAINS TO POC 1	BIOFILTRATION (BF-1)	250
31	0.42	DRAINS TO BMP	31	DRAINS TO POC 1	BIOFILTRATION (BF-1)	600
32	0.28	DRAINS TO BMP	32	DRAINS TO POC 1	BIOFILTRATION (BF-1)	450
33	0.35	DRAINS TO BMP	33	DRAINS TO POC 1	BIOFILTRATION (BF-1)	525
34	0.37	DRAINS TO BMP	34	DRAINS TO POC 1	BIOFILTRATION (BF-1)	550
35	0.09	DRAINS TO BMP	35	DRAINS TO POC 1	BIOFILTRATION (BF-1)	175
36	0.4	DRAINS TO BMP	36	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
37	0.76	DRAINS TO BMP	37	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
54	0.38	DRAINS TO BMP	54	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8

LEGEND:

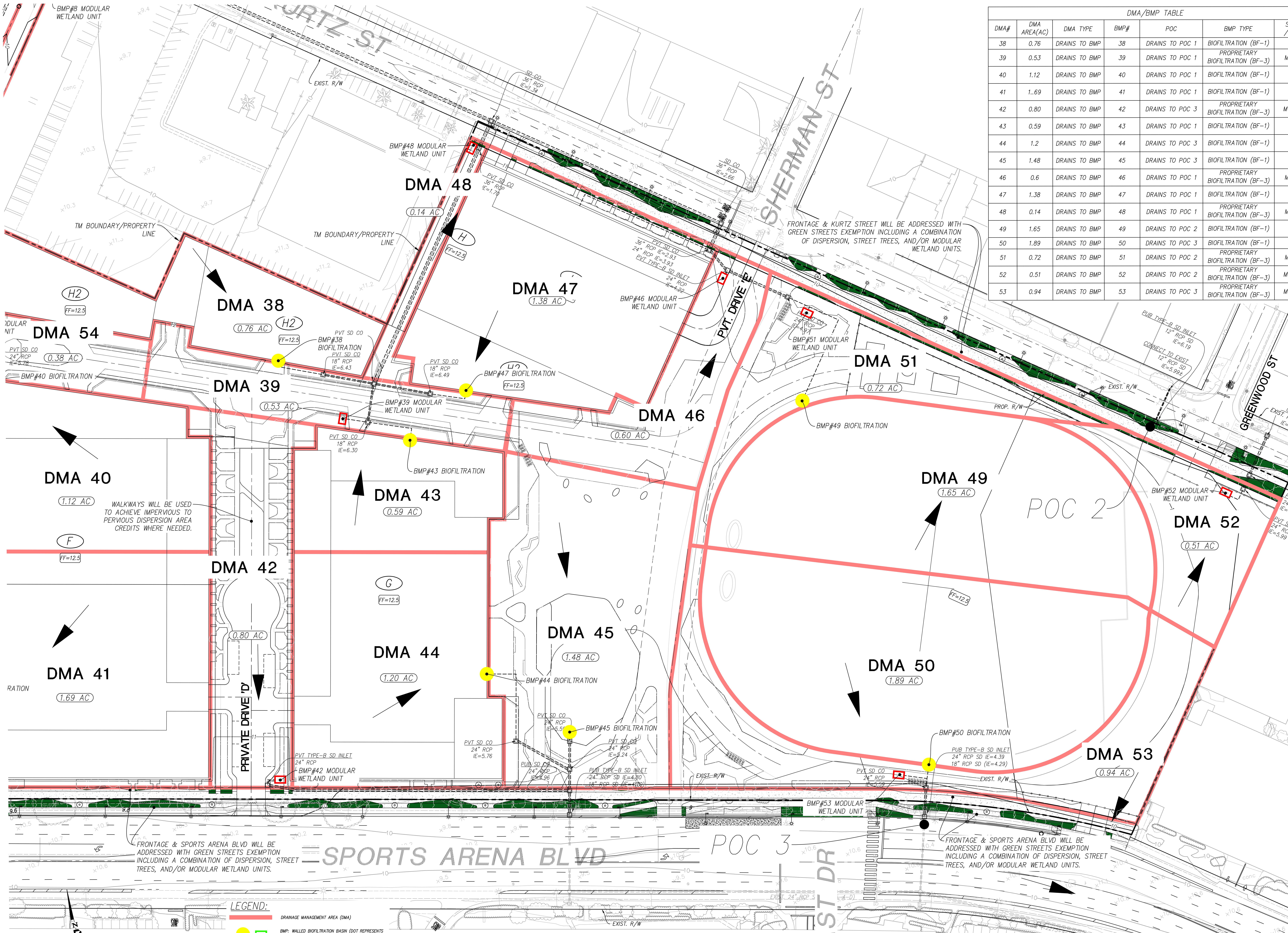
- DRAINAGE MANAGEMENT AREA (DMA)
- BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)
- BMP: MODULAR WETLAND UNIT
- DRAINAGE FLOW DIRECTION
- X.XX AC — DMA AREA

30 15 0 30 60 90
SCALE: 1"=30'

SCALE: 1"=30'
JOB #: 4443.10
CREATED: 8/10/23

PREPARED BY:
PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

CITY OF SAN DIEGO
MIDWAY RISING
DMA EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A-3



DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
38	0.76	DRAINS TO BMP	38	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1000
39	0.53	DRAINS TO BMP	39	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
40	1.12	DRAINS TO BMP	40	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1450
41	1..69	DRAINS TO BMP	41	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2100
42	0.80	DRAINS TO BMP	42	DRAINS TO POC 3	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12
43	0.59	DRAINS TO BMP	43	DRAINS TO POC 1	BIOFILTRATION (BF-1)	800
44	1.2	DRAINS TO BMP	44	DRAINS TO POC 3	BIOFILTRATION (BF-1)	1550
45	1.48	DRAINS TO BMP	45	DRAINS TO POC 3	BIOFILTRATION (BF-1)	1850
46	0.6	DRAINS TO BMP	46	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
47	1.38	DRAINS TO BMP	47	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1750
48	0.14	DRAINS TO BMP	48	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-4
49	1.65	DRAINS TO BMP	49	DRAINS TO POC 2	BIOFILTRATION (BF-1)	2050
50	1.89	DRAINS TO BMP	50	DRAINS TO POC 3	BIOFILTRATION (BF-1)	2350
51	0.72	DRAINS TO BMP	51	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
52	0.51	DRAINS TO BMP	52	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-15
53	0.94	DRAINS TO BMP	53	DRAINS TO POC 3	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12

LEGEND:

- DRAINAGE MANAGEMENT AREA (DMA)
- BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)
- BMP: MODULAR WETLAND UNIT
- DRAINAGE FLOW DIRECTION
- X.XX AC — DMA AREA

NOTE*:
*THIS DMA IS A PRIVATE PARCEL THAT IS INCLUDED IN THIS ANALYSIS ONLY FOR THE SPECIFIC PLAN AND EIR. THIS IS NOT INCLUDED IN THE VTM PACKAGE.

SCALE: 1"=30'
JOB #: 4443.10
CREATED: 8/10/23

PREPARED BY:
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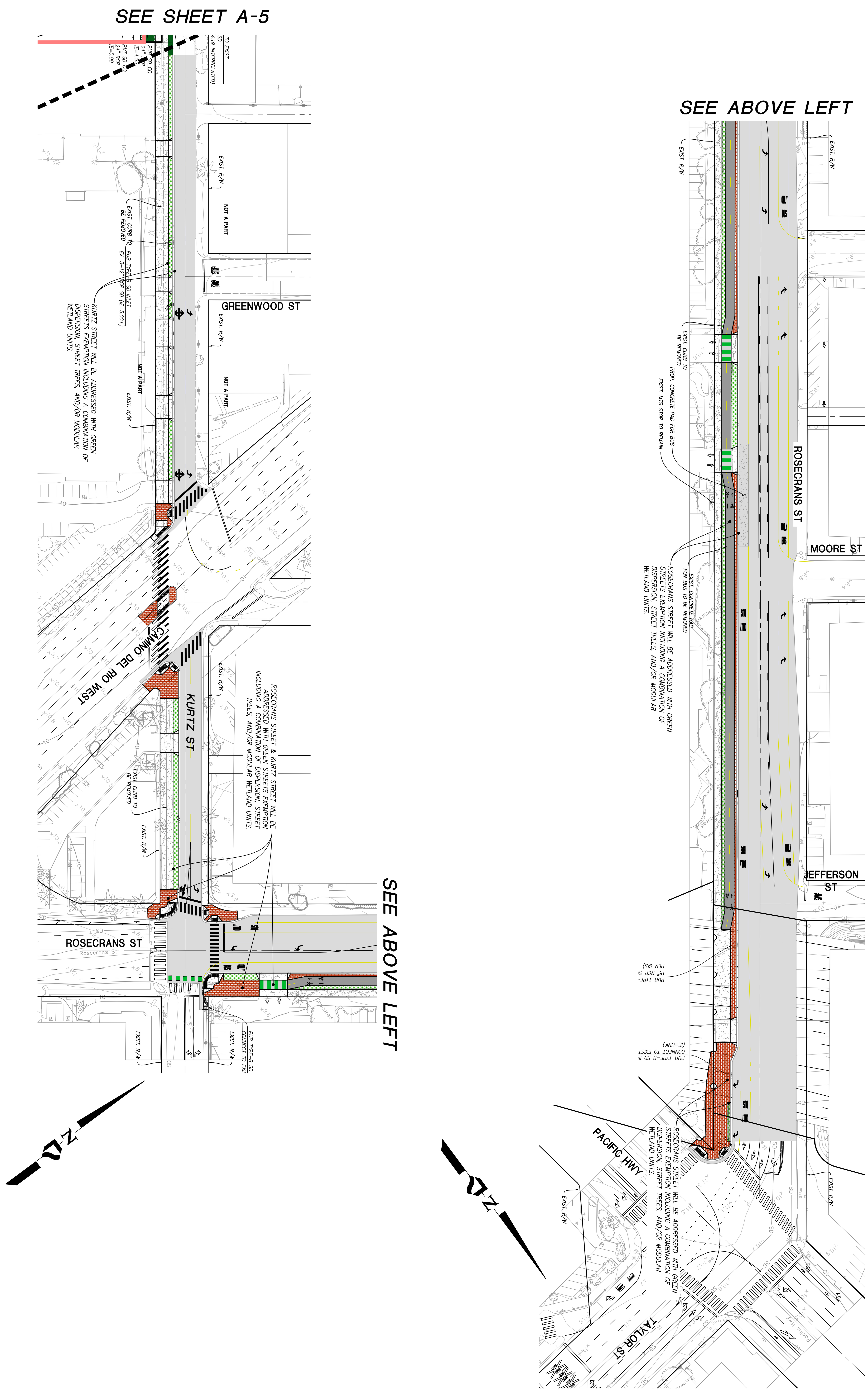
CITY OF SAN DIEGO
MIDWAY RISING
DMA EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A-4



LEGEND:

- DRAINAGE MANAGEMENT AREA (DMA)
- BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)
- BMP: MODULAR WETLAND UNIT
- DRAINAGE FLOW DIRECTION
- X.XX AC — DMA AREA

SCALE: 1"=40'
JOB #: 4443.10
CREATED: 8/10/23

PREPARED BY:

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CITY OF SAN DIEGO
MIDWAY RISING
DMA EXHIBIT-OFFSITE IMPROVEMENTS
PROPOSED CONDITIONS
EXHIBIT A-5

ATTACHMENT 1C

FORM I-7 HARVEST AND USE FEASIBILITY SCREENING CHECKLIST

Harvest and Use Feasibility Checklist	Worksheet B.3-1 : Form I-7

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

☑ Toilet and urinal flushing
☑ Landscape irrigation
☐ Other:___________

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

Landscape Irrigation:
Landscaping area = 4.92 ac Assume Mod. Water Use:
1470 g/ac/36 hours x 4.92 Ac. = 7232 gallons (CF/7.48 gallons) = 966.9 CF
Toilet & urinal flushing:
Expected Total Population: 9,000 (Estimate)
36 hr Demand=9.3 gal/res/day x 1.5 days/36 hr x 9,000 pop=125550 gallons (CF/7.48 gal) = 16784 CF

Total= 967+16784=17752 CF

3. Calculate the DCV using worksheet B-2.1.
DCV = 68949 (cubic feet)
[Provide a summary of calculations here]
See attached B-2-1 for DCV calculations.

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

Is harvest and use feasible based on further evaluation?
☐ Yes, refer to Appendix E to select and size harvest and use BMPs.
☑ No, select alternate BMPs.

ATTACHMENT 1D

INFILTRATION FEASIBILITY SUPPORTING DOCUMENTATION

Midway Rising LLC C/O
Zephyr Partners
700 Second Street
Encinitas, California 92024

Project No. SD760
January 5, 2024

Attention: Mr. Ryan Herrel
Executive Vice President

SUBJECT: STORM WATER INFILTRATION FEASIBILITY CONDITION (REVISED)
Midway Rising Sports Arena Complex (DMA 1 through DMA 54)
3220, 3240, 3250, and 3500 Sports Arena Boulevard
San Diego, California

Mr. Herrell:

As requested by the project civil engineer Project Design Consultants (PDC), Group Delta Consultants, Inc. (Group Delta) is providing this revised letter summarizing our interpretation of the storm water infiltration conditions with regards to the design of permanent storm water Best Management Practices (BMPs) for the proposed Sports Arena Complex located north of Sports Arena Boulevard and south of Kurtz Street in the Midway District of the City of San Diego.

We prepared this revised letter in general accordance with Appendix C.1.1 of the referenced *May 2021 City of San Diego Storm Water Standards* (referred to as the *Design Manual* herein). This letter presents our findings, conclusions, and our recommendation for the *No Infiltration* condition using the *Simple Feasibility Criteria* for the focus areas, which include Drainage Management Areas (DMA) 1 through 54. The locations of the DMAs are shown in Exhibit 1 (PDC, 2023).

DEVELOPMENT STATUS

DMA-1 through DMA-54 is currently occupied by the existing Pechanga Arena and surrounding surface parking. Low rise retail and commercial buildings occupy the eastern and southern portions of the site along with supplementary asphalt paved streets, pavement hardscapes, and supporting utilities.

PROJECT DESCRIPTION

The proposed development in DMA-1 through DMA-54 includes the construction of a new arena at the eastern end of the site, an entertainment plaza and hotel located centrally at the northern edge of the site, and 6 blocks of residential housing along the southern and western portions of the site. The blocks of housing will be residential over parking, residential over retail and parking, and residential over retail that will surround parking. The project will include several types of parks. The development includes the placement of up to 30,000 cubic yards of fill to raise portions of the site up to three feet to achieve the proposed building pad elevations to accommodate flooding. Additional improvements include asphalt concrete pavements, concrete flatwork, permanent storm water BMPs, subsurface utilities, and landscaping. The locations of the proposed improvements are shown in Exhibit 1 (PDC, 2023).

PLANNING PHASE INFILTRATION FEASIBILITY

It is our understanding that the infiltration BMP design for the project is currently in the *Planning Phase* as defined in Section C.2 of the Design Manual.

HISTORY OF DESIGN DISCUSSIONS

Prior to the onset of the planning phase, PDC discussed the lack of potential infiltration locations with Group Delta for the DMAs due to the location and depth of existing fill. Due to this constraint alone, it was determined there are no potential infiltration locations within DMA-1 through DMA-54.

CURRENT AND PREVIOUS INVESTIGATIONS

Group Delta conducted a subsurface investigation for the Sports Arena Complex that consisted of geotechnical borings, Cone Penetration Tests (CPTs), and geotechnical laboratory testing, which are described in detail in the referenced report (Group Delta, 2023a). In addition, A significant amount of background information is available within the site footprint and in the immediate vicinity. Please see our referenced Geotechnical Desktop Study Report (Group Delta, 2023b) for relevant historical geotechnical data.

GEOLOGY AND SUBSUFRACE CONDITIONS

Our subsurface investigation for the proposed Sports Arena Complex revealed that thick deposits of fill soils associated with prior site development and deep paralic estuarine deposits underlie the site. Old paralic deposits underlie these materials at depth. The geology and subsurface conditions are described in detail in the referenced reports (Group Delta, 2023a, 2023b). Salient findings to the infiltration feasibility conditions are summarized below.

Approximately 7 to 13 feet of existing fill soils overlie Paralic Estuarine and Old Paralic deposits across the site. The fill soils were observed to consist of clayey sand (SC), silty sand (SM), and poorly graded sand (SP) with apparent densities that vary from very loose to medium dense with corresponding variable shear strength, stiffness, and hydraulic conductivity.

Groundwater was encountered during Group Deltas geotechnical explorations across the site, completed between February and March of 2023. Groundwater was measured during drilling using a well sounder and pore pressure dissipation tests in the CPTs at depths ranging from 6 to 16 feet below existing ground surface (corresponding to elevations ranging from -4 to 2 feet NGVD 29).

CONCLUSION

Per Section C.1 of the *Design* Manual, Full and partial infiltration BMPs shall not be placed within existing fill materials greater than 5 feet thick. The attached Exhibits 2, Exploration Locations, delineates the locations of our subsurface explorations, cross sections, and recommended infiltration setback due to the existing fill thickness at the site. Exhibits 3A and 3B, Geotechnical Cross Sections A-A' and B-B', illustrate that the thickness of fill is interpreted to be greater than 5 feet across the site. Based on the depth of existing fill underlying the site, there are no potential locations or typically reasonable design alternatives to achieve full or partial infiltration BMPs at DMA-1 through DMA-54. For this reason, we recommend the *No Infiltration* condition for final design of permanent storm water BMPs.

CLOSURE

Design and construction considerations with respect to on-site storm water infiltration are based on the criteria listed in *Section C.1* of the *Design Manual*. The conclusion and recommendations for storm water infiltration assume that soil conditions do not deviate appreciably from those described herein. If any of the design considerations addressed require further investigation or analyses, Group Delta may be contacted for additional services.

This report was prepared using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in similar localities. No warranty, expressed or implied, is made as to the conclusions and professional opinions included in this report.

The findings of this report are valid as of the present date. However, changes in the condition of the site can occur with the passage of time, whether due to natural processes or the work of humans on this or adjacent properties. In addition, changes in applicable or appropriate standards of practice may occur from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

We appreciate this opportunity to be of continued professional service. Feel free to contact the office with any questions or comments, or if you need anything else.

GROUP DELTA CONSULTANTS

REGISTERED PROFESSIONAL ENGINEER
CHRISTOPHER KELSO VONK
GE 3216
GEOTECHNICAL
STATE OF CALIFORNIA

Joshua Joksch
Staff Engineer

Christopher K. Vonk, G.E. 3216
Senior Geotechnical Engineer

Attachments: References
Exhibit 1 – DMA Exhibit Proposed Conditions, Exhibit A-1 to A-5, City of San Diego Midway Rising (Project Design Consultants, 2023)
Exhibit 2 – Exploration Locations
Exhibit 3A – Geotechnical Cross Section A-A'
Exhibit 3B – Geotechnical Cross Section B-B'

Distribution: Addressee, Mr. Ryan Herrell (rherrell@zephyrpartners.com)

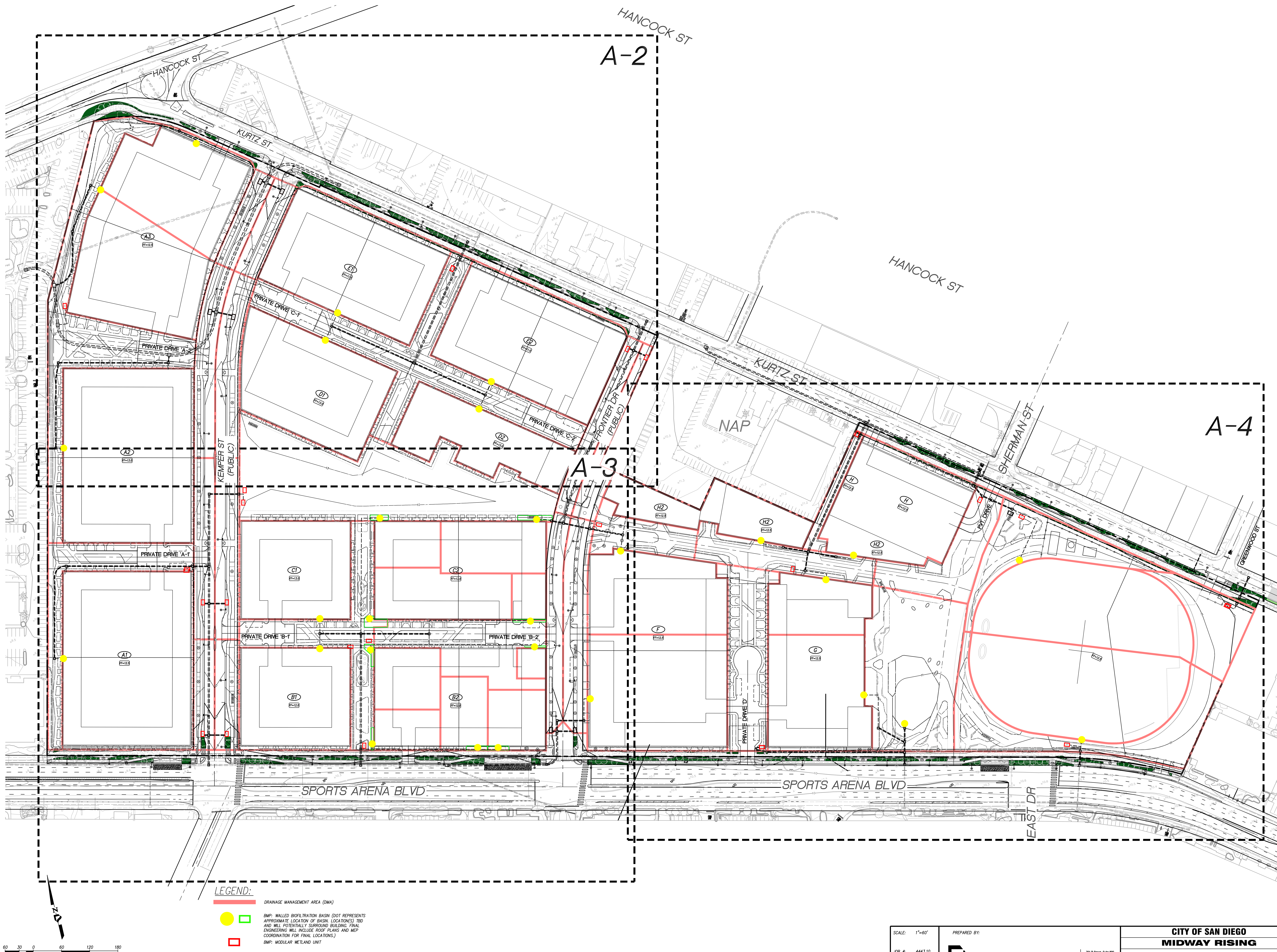
REFERENCES

City of San Diego (2021). *Storm Water Standards,* dated May 1.

Group Delta Consultants, Inc. (2023a). *Preliminary Geotechnical Investigation Report, Midway Rising Sports Arena Complex, 3220, 3240, 3250, and 3500, Sport Arena Boulevard, San Diego, California*, Project No. SD760, dated April 24.

Group Delta Consultants, Inc. (2023b). *Geotechnical Desktop Study Report, Midway Rising Sports Arena Complex, 3220, 3240, 3250, and 3500, Sport Arena Boulevard, San Diego, California*, Project No. SD760, dated February 3.

Project Design Consultants (2023). *DMA Exhibit Proposed Conditions, Exhibits A-1 to A-5, Midway Rising, City of San Diego*, plotted October 25.



LEGEND:

DRAINAGE MANAGEMENT AREA (DMA)

BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)

BMP: MODULAR WETLAND UNIT

DRAINAGE FLOW DIRECTION

X.XX AC — DMA AREA

SCALE: 1"=60'
JOB #: 4443.10
CREATED: 8/10/23

PREPARED BY:

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CITY OF SAN DIEGO

MIDWAY RISING

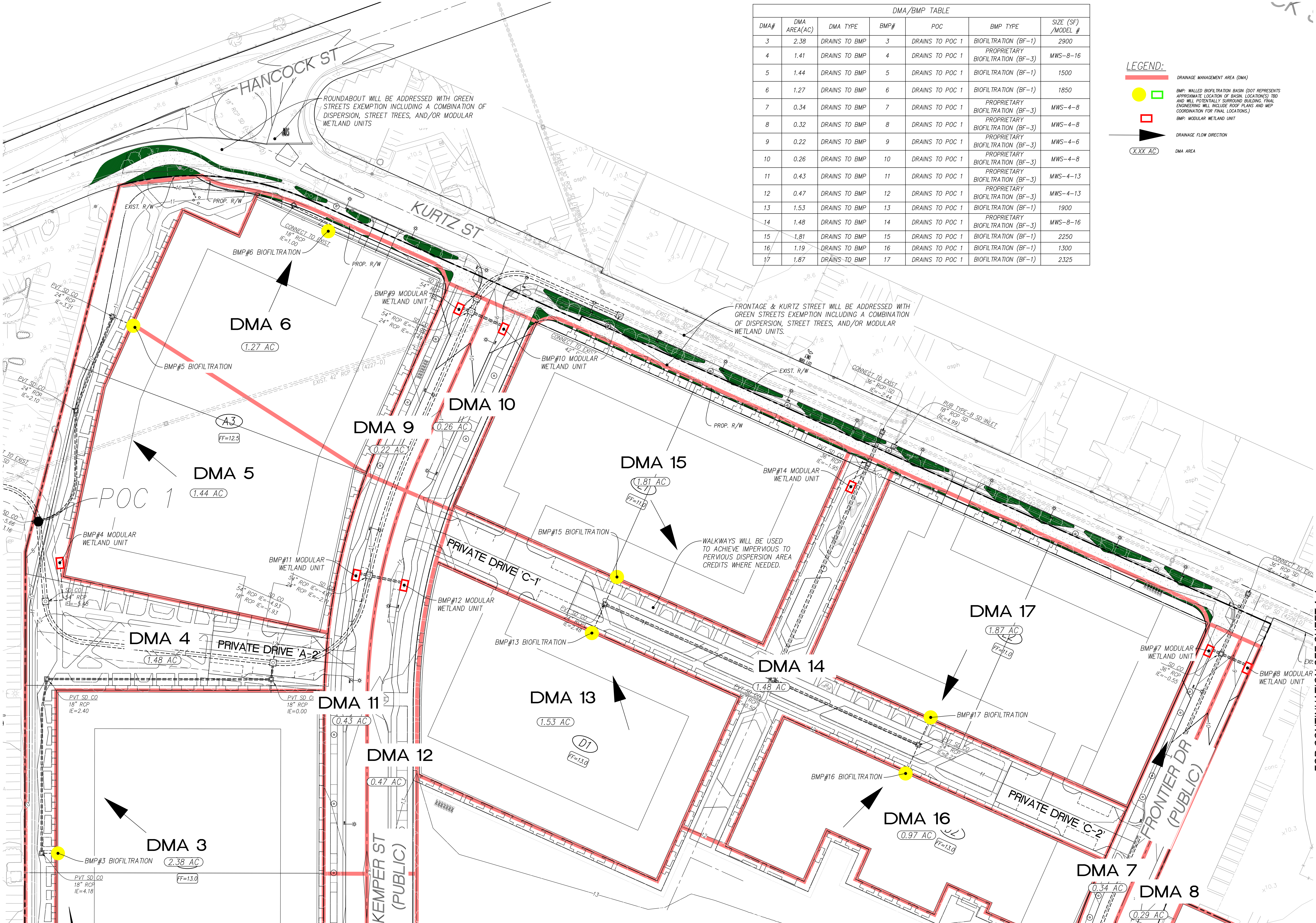
DMA EXHIBIT-KEY MAP
PROPOSED CONDITIONS
EXHIBIT A-1

DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
3	2.38	DRAINS TO BMP	3	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2900
4	1.41	DRAINS TO BMP	4	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-16
5	1.44	DRAINS TO BMP	5	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1500
6	1.27	DRAINS TO BMP	6	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1850
7	0.34	DRAINS TO BMP	7	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
8	0.32	DRAINS TO BMP	8	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
9	0.22	DRAINS TO BMP	9	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-6
10	0.26	DRAINS TO BMP	10	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
11	0.43	DRAINS TO BMP	11	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
12	0.47	DRAINS TO BMP	12	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
13	1.53	DRAINS TO BMP	13	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1900
14	1.48	DRAINS TO BMP	14	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-16
15	1.81	DRAINS TO BMP	15	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2250
16	1.19	DRAINS TO BMP	16	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1300
17	1.87	DRAINS TO BMP	17	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2325

LEGEND:

- DRAINAGE MANAGEMENT AREA (DMA)
- BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)
- BMP: MODULAR WETLAND UNIT
- DRAINAGE FLOW DIRECTION
- X.XX AC — DMA AREA



FOR CONTINUATION SEE SHEET A-3

FOR CONTINUATION SEE SHEET A-4

SCALE: 1"=30'
JOB #: 4443.10
CREATED: 8/10/23

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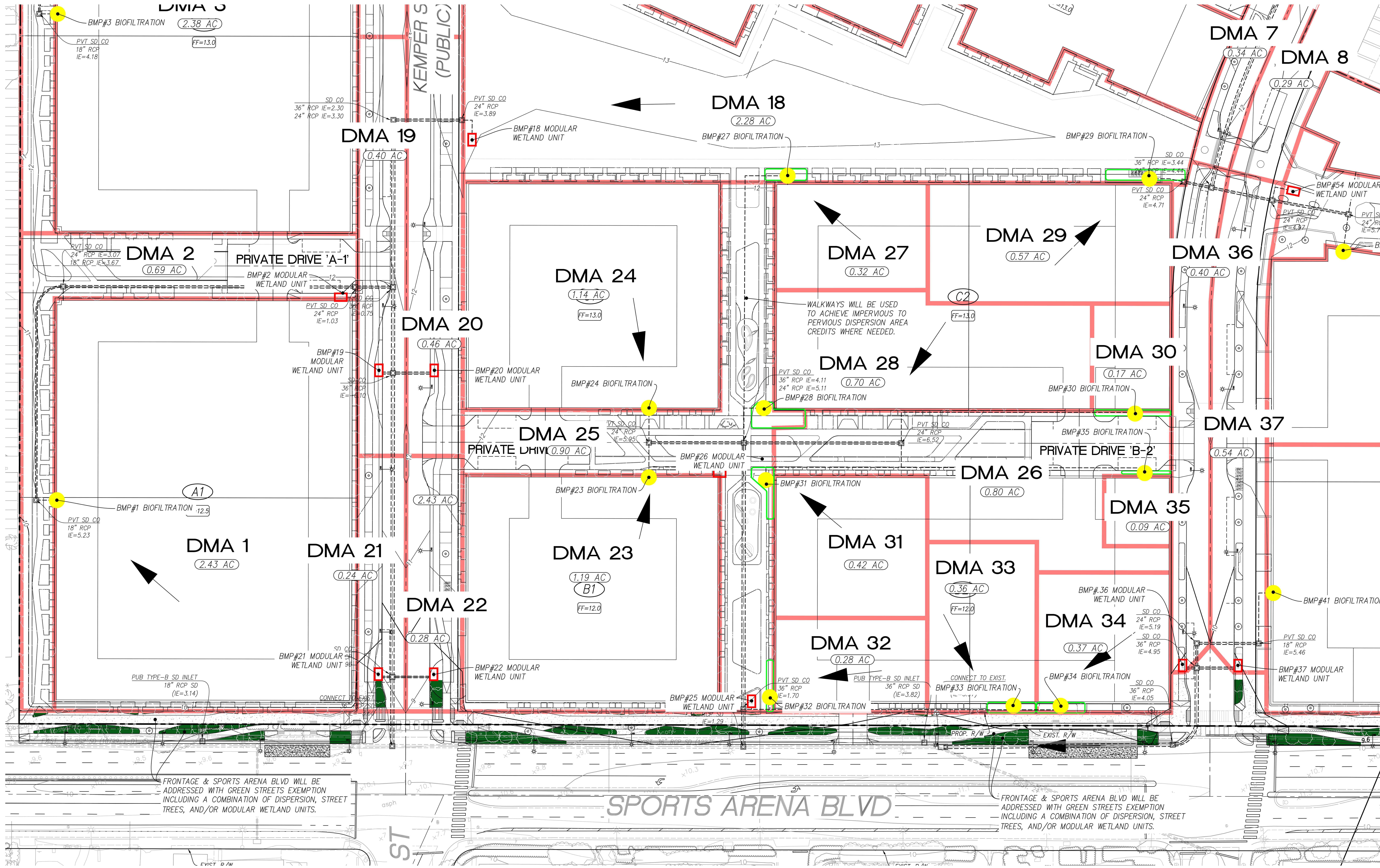
CITY OF SAN DIEGO
MIDWAY RISING
DMA EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A-2

FOR CONTINUATION SEE SHEET A-2



FOR CONTINUATION SEE SHEET A-4

DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
1	2.43	DRAINS TO BMP	1	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2950
2	0.69	DRAINS TO BMP	2	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
18	2.28	DRAINS TO BMP	18	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-24
19	0.40	DRAINS TO BMP	19	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
20	0.46	DRAINS TO BMP	20	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
21	0.24	DRAINS TO BMP	21	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
22	0.28	DRAINS TO BMP	22	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8
23	1.19	DRAINS TO BMP	23	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1500
24	1.14	DRAINS TO BMP	24	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1450
25	0.90	DRAINS TO BMP	25	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12
26	0.80	DRAINS TO BMP	26	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12

DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
27	0.32	DRAINS TO BMP	27	DRAINS TO POC 1	BIOFILTRATION (BF-1)	500
28	0.70	DRAINS TO BMP	28	DRAINS TO POC 1	BIOFILTRATION (BF-1)	950
29	0.57	DRAINS TO BMP	29	DRAINS TO POC 1	BIOFILTRATION (BF-1)	750
30	0.17	DRAINS TO BMP	30	DRAINS TO POC 1	BIOFILTRATION (BF-1)	250
31	0.42	DRAINS TO BMP	31	DRAINS TO POC 1	BIOFILTRATION (BF-1)	600
32	0.28	DRAINS TO BMP	32	DRAINS TO POC 1	BIOFILTRATION (BF-1)	450
33	0.35	DRAINS TO BMP	33	DRAINS TO POC 1	BIOFILTRATION (BF-1)	525
34	0.37	DRAINS TO BMP	34	DRAINS TO POC 1	BIOFILTRATION (BF-1)	550
35	0.09	DRAINS TO BMP	35	DRAINS TO POC 1	BIOFILTRATION (BF-1)	175
36	0.4	DRAINS TO BMP	36	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-13
37	0.76	DRAINS TO BMP	37	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12
54	0.38	DRAINS TO BMP	54	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-8

LEGEND:

DRAINAGE MANAGEMENT AREA (DMA)

BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)

BMP: MODULAR WETLAND UNIT

DRAINAGE FLOW DIRECTION

X.XX AC — DMA AREA

SCALE: 1"=30'

SCALE: 1"=30'

JOB #: 4443.10

CREATED: 8/10/23

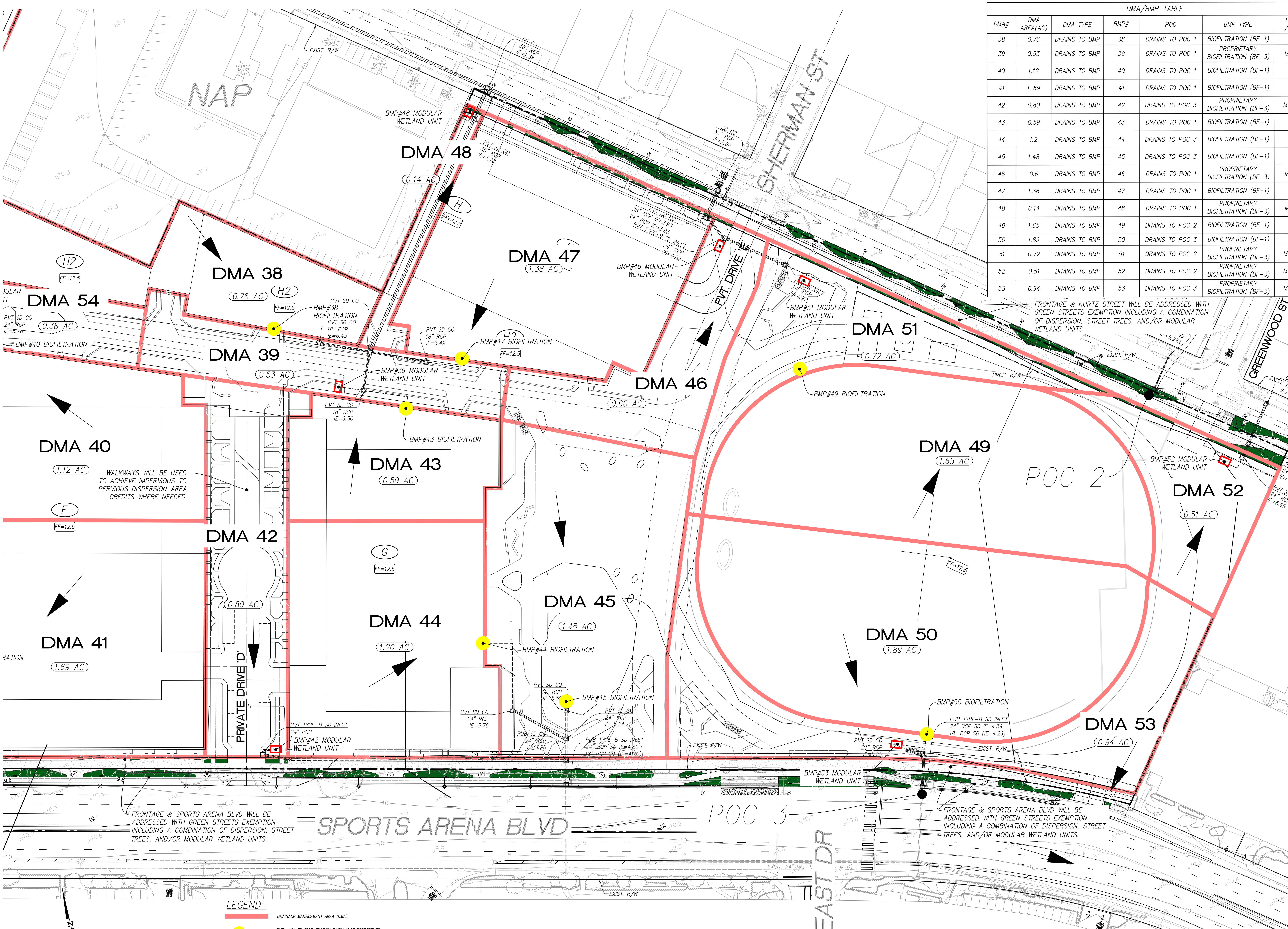
PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

CITY OF SAN DIEGO

MIDWAY RISING

DMA EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A-3



DMA/BMP TABLE

DMA#	DMA AREA(AC)	DMA TYPE	BMP#	POC	BMP TYPE	SIZE (SF) /MODEL #
38	0.76	DRAINS TO BMP	38	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1000
39	0.53	DRAINS TO BMP	39	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
40	1.12	DRAINS TO BMP	40	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1450
41	1..69	DRAINS TO BMP	41	DRAINS TO POC 1	BIOFILTRATION (BF-1)	2100
42	0.80	DRAINS TO BMP	42	DRAINS TO POC 3	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12
43	0.59	DRAINS TO BMP	43	DRAINS TO POC 1	BIOFILTRATION (BF-1)	800
44	1.2	DRAINS TO BMP	44	DRAINS TO POC 3	BIOFILTRATION (BF-1)	1550
45	1.48	DRAINS TO BMP	45	DRAINS TO POC 3	BIOFILTRATION (BF-1)	1850
46	0.6	DRAINS TO BMP	46	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-8
47	1.38	DRAINS TO BMP	47	DRAINS TO POC 1	BIOFILTRATION (BF-1)	1750
48	0.14	DRAINS TO BMP	48	DRAINS TO POC 1	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-4
49	1.65	DRAINS TO BMP	49	DRAINS TO POC 2	BIOFILTRATION (BF-1)	2050
50	1.89	DRAINS TO BMP	50	DRAINS TO POC 3	BIOFILTRATION (BF-1)	2350
51	0.72	DRAINS TO BMP	51	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION (BF-3)	MWS-8-12
52	0.51	DRAINS TO BMP	52	DRAINS TO POC 2	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-17
53	0.94	DRAINS TO BMP	53	DRAINS TO POC 3	PROPRIETARY BIOFILTRATION (BF-3)	MWS-4-15

LEGEND:

- DRAINAGE MANAGEMENT AREA (DMA)
- BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)
- BMP: MODULAR WETLAND UNIT
- DRAINAGE FLOW DIRECTION
- X.XX AC — DMA AREA

SCALE: 1"=30'

SCALE: 1"=30'
JOB #: 4443.10
CREATED: 8/10/23

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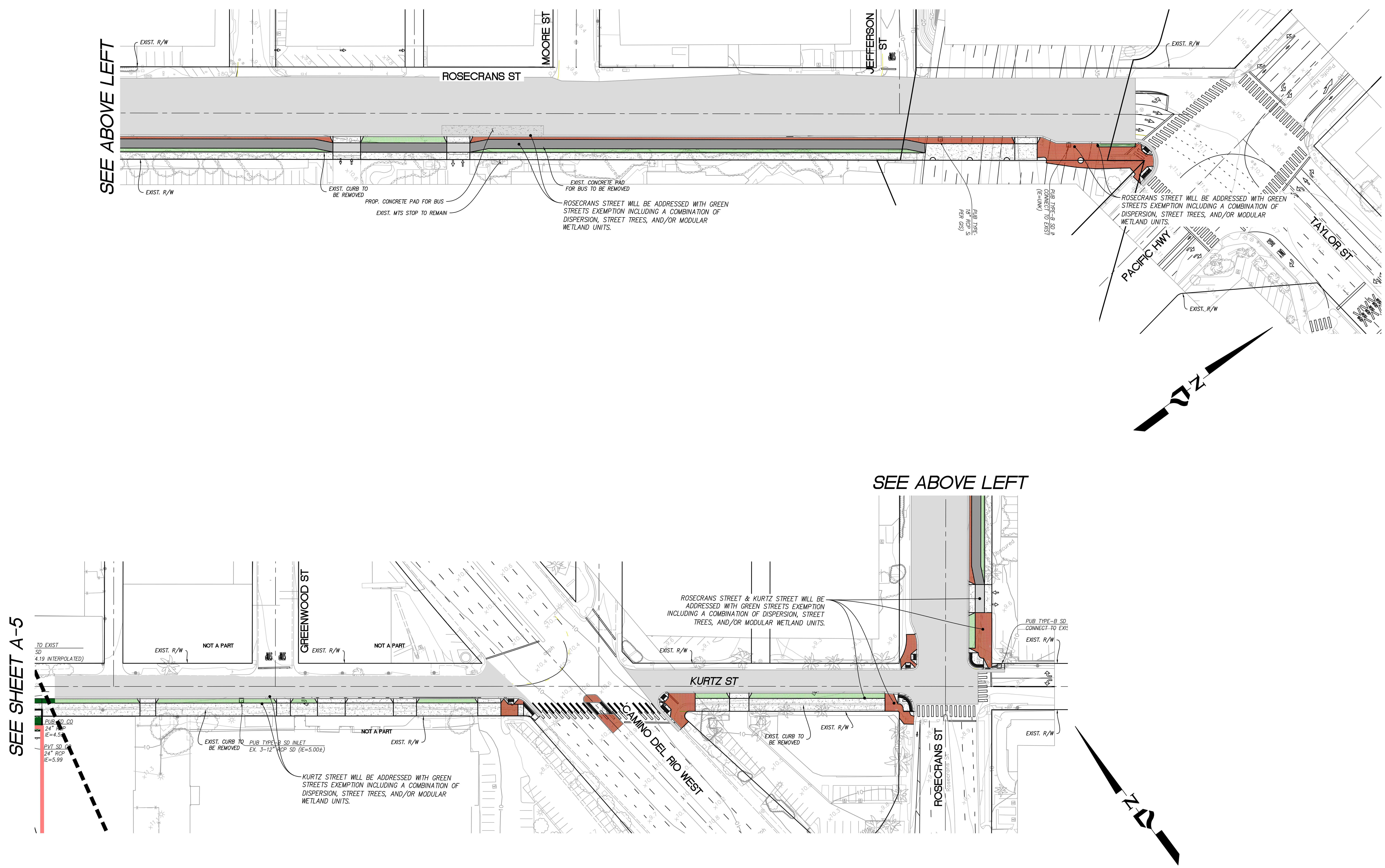
CITY OF SAN DIEGO
MIDWAY RISING
DMA EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A-4



LEGEND:

- DRAINAGE MANAGEMENT AREA (DMA)
- BMP: WALLED BIOFILTRATION BASIN (DOT REPRESENTS APPROXIMATE LOCATION OF BASIN. LOCATION(S) TBD AND WILL POTENTIALLY SURROUND BUILDING. FINAL ENGINEERING WILL INCLUDE ROOF PLANS AND MEP COORDINATION FOR FINAL LOCATIONS.)
- BMP: MODULAR WETLAND UNIT
- DRAINAGE FLOW DIRECTION
- X.XX AC — DMA AREA

SCALE: 1"=40'

SCALE:	1"=40'
JOB #:	4443.10
CREATED:	8/10/23

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

CITY OF SAN DIEGO

MIDWAY RISING

DMA EXHIBIT-OFFSITE IMPROVEMENTS
PROPOSED CONDITIONS
EXHIBIT A-5

FILE PATH: N:\Projects\SD\SD700\SD760 Zephyr Sports Arena Complex Redevelopment\11. Drafting\2. Geo Inv Rpt\SD760 - Figure 2.dwg
PLOTTED DATE: 12/18/2023 3:20:16 PM SAVED BY: brendaa

EXPLANATION

- APPROXIMATE LIMITS OF SITE DEVELOPMENT
- INFILTRATION SETBACK DUE TO EXISTING FILL
- A-23-016 — APPROXIMATE LOCATION OF GROUP DELTA HOLLOW-STEM AUGER BORING
- R-23-002 — APPROXIMATE LOCATION OF GROUP DELTA MUD ROTARY WASH BORING
- CPT-23-028 — APPROXIMATE LOCATION OF GROUP DELTA CONE PENETRATON TEST (CPT)
- A — A' — APPROXIMATE LOCATION OF CROSS SECTIONS
- TD=106.2' — TOTAL DEPTH OF GROUP DELTA EXPLORATION

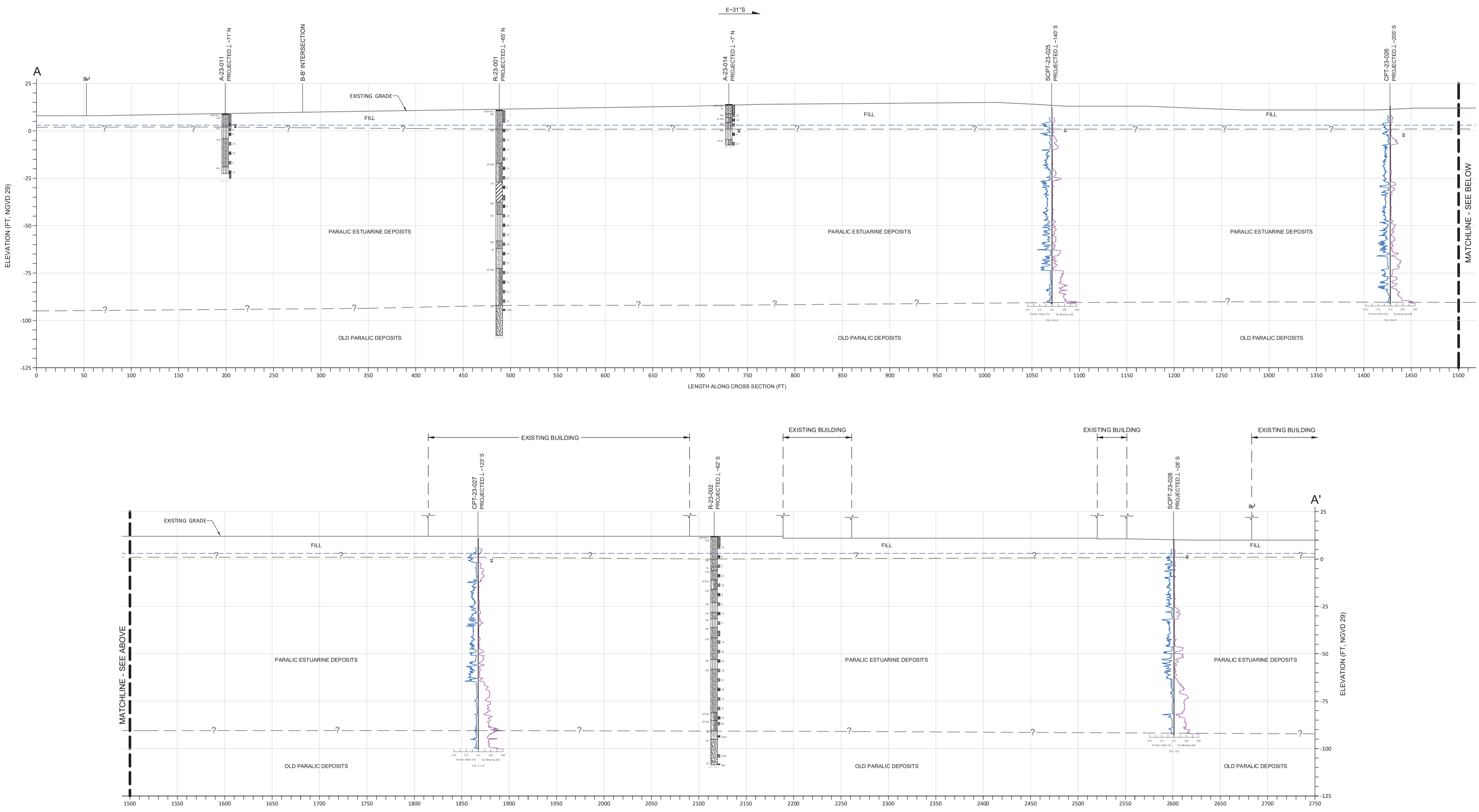
N

0 200' 400'

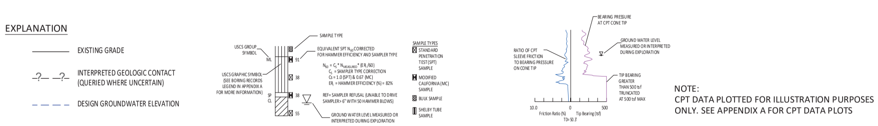
NOTE: DIRECTION, SCALE AND LOCATIONS ARE APPROXIMATE

REFERENCE: GOOGLE, INC (2023) GOOGLE EARTH PRO, AERIAL IMAGERY DATED: AUGUST 1, 2021

SPORTS ARENA COMPLEX MIDWAY RISING	EXPLORATION LOCATIONS	GROUP DELTA	
		PROJECT NUMBER	FIGURE NUMBER
		SD760	2



EXPLANATION



NOTE:
CPT DATA PLOTTED FOR ILLUSTRATION PURPOSES ONLY. SEE APPENDIX A FOR CPT DATA PLOTS

SCALE (FT): V 25' H 0' 25' 50'

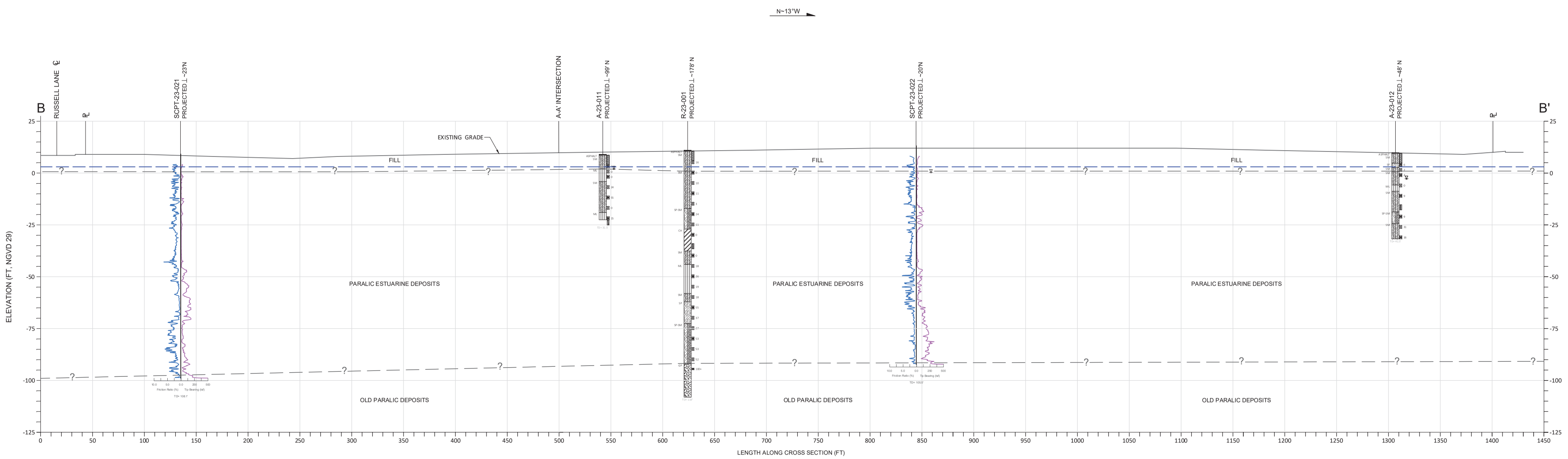
NOTE: DIRECTIONS, LOCATIONS, ELEVATIONS, AND SCALE ARE APPROXIMATE
REFERENCE: PRE-EXISTING TOPOGRAPHY FROM EXISTING UTILITIES AND EASEMENTS BASE MAP, PROJECT DESIGN CONSULTANTS (02/2023)

SPORTS ARENA COMPLEX
MIDWAY RISING

GEOTECHNICAL
CROSS SECTION A-A'

GROUP DELTA

PROJECT NUMBER: SD760
FIGURE NUMBER: 3A



EXPLANATION

EXISTING GRADE

INTERPRETED GEOLOGIC CONTACT (QUERIED WHERE UNCERTAIN)

DESIGN GROUNDWATER ELEVATION

NOTE:
CPT DATA PLOTTED FOR ILLUSTRATION PURPOSES ONLY. SEE APPENDIX A FOR CPT DATA PLOTS

SCALE (FT): V 25' H 0' 25' 50'

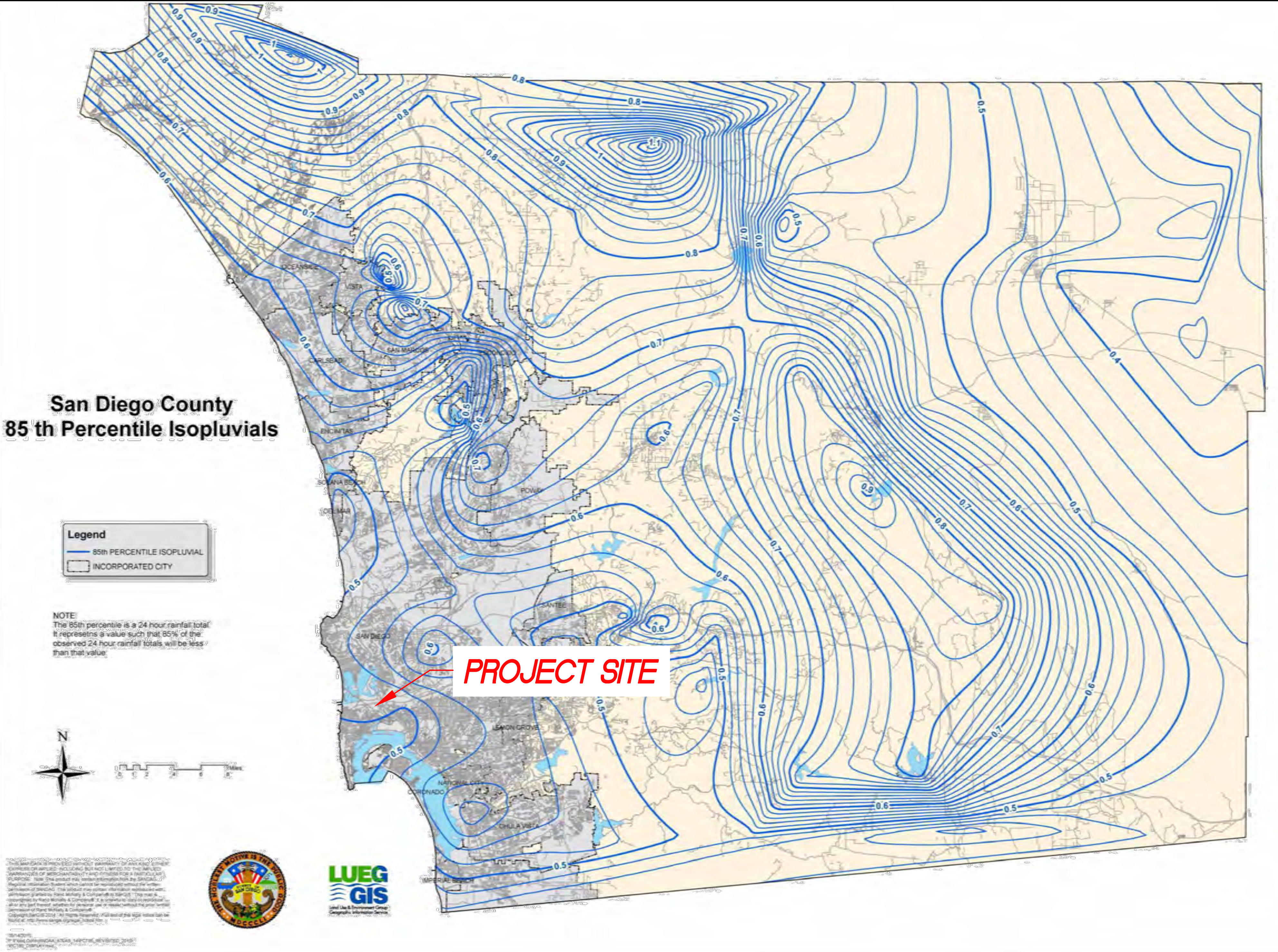
NOTE: DIRECTIONS, LOCATIONS, ELEVATIONS, AND SCALE ARE APPROXIMATE
REFERENCE: PRE-EXISTING TOPOGRAPHY FROM EXISTING UTILITIES AND EASEMENTS BASE MAP, PROJECT DESIGN CONSULTANTS (02/2023)

SPORTS ARENA COMPLEX MIDWAY RISING	GEOTECHNICAL CROSS SECTION B-B'	GROUP DELTA
		PROJECT NUMBER SD760 / FIGURE NUMBER 3B

ATTACHMENT 1E

POLLUTANT CONTROL BMP DESIGN WORKSHEETS/CALCULATIONS

San Diego County 85 th Percentile Isopluvials



Total Site DCV Calculations (DCV from Biofiltration planters and DCV MWUs) & Volume Retention

Project: Midway Rising

Worksheet B.2-1: DCV

85th percentile 24-hr storm depth from Figure B.1.= 0.51 in

DMA ID	BMP ID	BMP Drainage Area (ac)	BMP Drainage Area (SF)	Impervious Area (ac)	Amended Soils (ac) (C=0.1)	Natural A Soils (ac) (C=0.1)	Natural B Soils (ac) (C=0.14)	Natural C Soils (ac) (C=0.23)	Natural D Soils (ac) (C=0.3)	% Impervious	Composite C[1]	Tree Credit Volume (cf)	Rain Barrels Credit Volume (cf)	Design Capture Volume (DCV) (CF)
TOTAL SITE	TOTAL SITE	47.69	2077510	40.59	7.1					85%	0.78	0	0	68949

Notes:

1) Equation for composite C factor = (0.9*Impervious Area +C*Pervious Area)/Total Area per BMP Design Manual.

C factors are from Table B.1-1 of Jan 2018 City BMP Design Manual.

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	TOTAL SITE	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	2077510	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.780905122	
3	85^{th} percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	68949	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = 0.0000013 x Line 8^3 - 0.000057 x Line 8^2 + 0.0086 x Line 8 - 0.014 When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	1586	cu. ft.

The City of SAN DIEGO

Project Name	Midway Rising	
BMP ID	TOTAL SITE	

Volume Retention for No Infiltration Condition — **Worksheet B.5-6**

1	Area draining to the biofiltration BMP	2077510	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.780905122	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]	1622338	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]	48670	sq. ft.
5	Biofiltration BMP Footprint	39875	sq. ft.

sum of all biofiltration planters

Landscape Area (must be identified on DS-3247)

	Identification	1	2	3	4	5
6	Landscape area that meet the requirements in SD-B and SD-F Fact Sheet (sq. ft.)	15000				
7	Impervious area draining to the landscape area (sq. ft.)	15000				
8	Impervious to Pervious Area ratio [Line 7/Line 6]	1.00	0.00	0.00	0.00	0.00
9	Effective Credit Area If (Line 8 >1.5, Line 6, Line 7/1.5]	10000	0	0	0	0

10	Sum of Landscape area [sum of Line 9 Id's 1 to 5]	10000	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]	49875	sq. ft.

Volume Retention Performance Standard

12	Is Line 11 ≥ Line 4?	Volume Retention Performance Standard is Met	
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]	1.02	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]	1586	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]	-31.71671181	cu. ft.

Site Design BMP

	Identification	Site Design Type	Credit	
16	1			cu. ft.
	2			cu. ft.
	3			cu. ft.
	4			cu. ft.
	5			cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Line 16 Credits for Id's 1 to 5] Provide documentation of how the site design credit is calculated in the PDP SWQMP.		0	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met		

Biofiltration Planters DCV Calculations

Project: Midway Rising

Worksheet B.2-1: DCV

85th percentile 24-hr storm depth from Figure B.1.= 0.51 in

DMA ID	BMP ID	BMP Drainage Area (ac)	BMP Drainage Area (SF)	Impervious Area (ac)	Amended Soils (ac) (C=0.1)	Natural A Soils (ac) (C=0.1)	Natural B Soils (ac) (C=0.14)	Natural C Soils (ac) (C=0.23)	Natural D Soils (ac) (C=0.3)	% Impervious	Composite C^1	Tree Credit Volume (cf)	Rain Barrels Credit Volume (cf)	Design Capture Volume (DCV) (CF)
1	1	2.43	106020	2.43	0					100%	0.90	0	0	4055
3	3	2.38	103806	2.38	0					100%	0.90	0	0	3971
5	5	1.44	62777	1.44	0					100%	0.90	0	0	2401
6	6	1.27	55310	1.27	0					100%	0.90	0	0	2116
13	13	1.53	66454	1.53	0					100%	0.90	0	0	2542
15	15	1.81	78785	1.81	0					100%	0.90	0	0	3014
16	16	0.97	42197	0.97	0					100%	0.90	0	0	1614
17	17	1.87	81624	1.87	0					100%	0.90	0	0	3122
23	23	1.19	51705	1.19	0					100%	0.90	0	0	1978
24	24	1.14	49808	1.14	0					100%	0.90	0	0	1905
27	27	0.32	14001	0.32	0					100%	0.90	0	0	536
28	28	0.70	30636	0.70	0					100%	0.90	0	0	1172
29	29	0.57	24985	0.57	0					100%	0.90	0	0	956
30	30	0.17	7250	0.17	0					100%	0.90	0	0	277
31	31	0.42	18501	0.42	0					100%	0.90	0	0	708
32	32	0.28	12268	0.28	0					100%	0.90	0	0	469
33	33	0.36	15839	0.36	0					100%	0.90	0	0	606
34	34	0.37	15993	0.37	0					100%	0.90	0	0	612
35	35	0.09	3999	0.09	0					100%	0.90	0	0	153
38	38	0.76	33058	0.76	0					100%	0.90	0	0	1264
40	40	1.12	48961	1.12	0					100%	0.90	0	0	1873
41	41	1.69	73687	1.69	0					100%	0.90	0	0	2819
43	43	0.59	25715	0.59	0					100%	0.90	0	0	984
44	44	1.20	52486	1.20	0					100%	0.90	0	0	2008
45	45	1.48	64676	1.48	0					100%	0.90	0	0	2474
47	47	1.38	60262	1.38	0					100%	0.90	0	0	2305
49	49	1.65	72023	1.65	0					100%	0.90	0	0	2755
50	50	1.89	82439	1.89	0					100%	0.90	0	0	3153
SUM:		31.11	1355265.00	31.11										

Notes:

1) Equation for composite C factor = (0.9*Impervious Area +C*Pervious Area)/Total Area per BMP Design Manual.

C factors are from Table B.1-1 of May 2021 City BMP Design Manual.

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	3	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	103806	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	3971	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	5956	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1527	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]	2978	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	2127	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]	2803	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	2803	sq. ft.
23	Provided BMP Footprint	2900	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	Midway Rising	
	BMP ID	5	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	62777	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2401	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3602	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	924	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]	1801	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1286	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]	1695	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1695	sq. ft.
23	Provided BMP Footprint	1800	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	6	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	55310	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2116	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3173	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	814	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]	1587	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1133	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]	1493	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1493	sq. ft.
23	Provided BMP Footprint	1850	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	13	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	66454	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2542	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3813	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	978	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]	1906	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1362	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]	1794	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1794	sq. ft.
23	Provided BMP Footprint	1900	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	Midway Rising
	BMP ID	15

Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	78785	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	3014	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	4520	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1159	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]	2260	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1614	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]	2127	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	2127	sq. ft.
23	Provided BMP Footprint	2250	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	16	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	42197	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1614	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	2421	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	621	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]	1211	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	865	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]	1139	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1139	sq. ft.
23	Provided BMP Footprint	1300	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	17	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	81624	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	3122	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	4683	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1201	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]	2342	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1673	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]	2204	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	2204	sq. ft.
23	Provided BMP Footprint	2325	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	23	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	51705	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1978	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	2967	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	761	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]	1483	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1059	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]	1396	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1396	sq. ft.
23	Provided BMP Footprint	1500	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	24	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	49808	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1905	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	2858	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	733	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]	1429	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1021	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]	1345	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1345	sq. ft.
23	Provided BMP Footprint	1450	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	27	

Sizing Method for Pollutant Removal Criteria		Worksheet B.5-1	
1	Area draining to the BMP	14001	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	536	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	803	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	206	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]	402	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	287	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]	378	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	378	sq. ft.
23	Provided BMP Footprint	500	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	28	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	30636	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1172	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1758	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	451	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]	879	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	628	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]	827	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	827	sq. ft.
23	Provided BMP Footprint	950	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	29	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	24985	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	956	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1434	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	368	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]	717	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	512	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]	675	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	675	sq. ft.
23	Provided BMP Footprint	750	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO		Project Name	Midway Rising
		BMP ID	30
Sizing Method for Pollutant Removal Criteria			**Worksheet B.5-1**

1	Area draining to the BMP	7250	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	277	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	416	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	107	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]	208	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	149	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]	196	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	196	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	Midway Rising	
	BMP ID	31	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	18501	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	708	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1061	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	272	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]	531	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	379	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]	500	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	500	sq. ft.
23	Provided BMP Footprint	600	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	32	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	12268	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	469	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	704	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	180	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]	352	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	251	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]	331	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	331	sq. ft.
23	Provided BMP Footprint	450	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	33	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	15839	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	606	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	909	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	233	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]	454	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	325	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]	428	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	428	sq. ft.
23	Provided BMP Footprint	525	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	34	

	Sizing Method for Pollutant Removal Criteria	Worksheet B.5-1	
1	Area draining to the BMP	15993	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	612	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	918	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	235	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]	459	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	328	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]	432	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	432	sq. ft.
23	Provided BMP Footprint	550	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	35	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	3999	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	153	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	229	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	59	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]	115	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	82	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]	108	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	108	sq. ft.
23	Provided BMP Footprint	175	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	38	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	33058	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1264	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1897	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	486	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]	948	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	677	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]	893	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	893	sq. ft.
23	Provided BMP Footprint	1000	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	Midway Rising	
	BMP ID	40	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	48961	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	1873	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	2809	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	720	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]	1405	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1003	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]	1322	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1322	sq. ft.
23	Provided BMP Footprint	1450	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	41	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	73687	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2819	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	4228	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1084	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]	2114	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1510	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]	1990	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1990	sq. ft.
23	Provided BMP Footprint	2100	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	Midway Rising
	BMP ID	43

Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	25715	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	984	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	1475	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	378	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]	738	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	527	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]	694	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	694	sq. ft.
23	Provided BMP Footprint	800	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO	Project Name	Midway Rising	
	BMP ID	44	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	

1	Area draining to the BMP	52486	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85^{th} percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2008	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3011	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	772	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]	1506	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1075	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]	1417	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1417	sq. ft.
23	Provided BMP Footprint	1550	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

Project Name	Midway Rising		
BMP ID	45		

Sizing Method for Pollutant Removal Criteria — Worksheet B.5-1

1	Area draining to the BMP	64676	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2474	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3711	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	951	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]	1855	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1325	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]	1746	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1746	sq. ft.
23	Provided BMP Footprint	1850	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	Midway Rising
	BMP ID	47

Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	60262	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2305	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	3458	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	887	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]	1729	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1235	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]	1627	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1627	sq. ft.
23	Provided BMP Footprint	1750	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	Midway Rising	
	BMP ID	49	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	72023	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85th percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	2755	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	4132	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1060	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]	2066	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1476	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]	1945	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	1945	sq. ft.
23	Provided BMP Footprint	2050	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

The City of SAN DIEGO

	Project Name	Midway Rising	
	BMP ID	50	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	82439	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.90	
3	85^{th} percentile 24-hour rainfall depth	0.51	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	3153	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	24	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	12	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	5	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	30	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	16.8	inches
15	Total Depth Treated [Line 13 + Line 14]	46.8	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	4730	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	1213	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]	2365	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	1689	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]	2226	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	2226	sq. ft.
23	Provided BMP Footprint	2350	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

MWS DCV Calculations

Modular Wetland Sizing Calculations

85th percentile 24-hr storm depth from Figure B.1.= 0.51 in

BMP-ID	DCV	DCV retained	A (sf)	Impervious Area (sf)	%IMP	C	1.5 x Q (cfs)	Treatment Capacity (cfs)	Q100 (cfs)	BMP Size
BMP-2	848	0	30238	21166.6	70%	0.66	0.137	0.23	2.9	MWS-L-8-8
BMP-4	1806	0	64395	45076.5	70%	0.66	0.293	0.462	6.2	MWS-L-8-16
BMP-7	513	0	14723	13250.7	90%	0.82	0.083	0.115	1.4	MWS-L-4-8
BMP-8	434	0	12467	11220.3	90%	0.82	0.070	0.144	1.2	MWS-L-4-13
BMP-9	340	0	9743	8768.7	90%	0.82	0.055	0.073	0.9	MWS-L-4-6
BMP-10	395	0	11332	10198.8	90%	0.82	0.064	0.115	1.1	MWS-L-4-8
BMP-11	646	0	18530	16677	90%	0.82	0.105	0.144	1.8	MWS-L-4-13
BMP-12	713	0	20470	18423	90%	0.82	0.116	0.144	2.0	MWS-L-4-13
BMP-14	2252	0	64610	58149	90%	0.82	0.365	0.462	6.2	MWS-L-8-16
BMP-18	3467	0	99493	89543.7	90%	0.82	0.562	0.693	9.5	MWS-L-8-24
BMP-19	605	0	17369	15632.1	90%	0.82	0.098	0.144	1.7	MWS-L-4-13
BMP-20	700	0	20075	18067.5	90%	0.82	0.113	0.144	1.9	MWS-L-4-13
BMP-21	369	0	10593	9533.7	90%	0.82	0.060	0.115	1.0	MWS-L-4-8
BMP-22	427	0	12241	11016.9	90%	0.82	0.069	0.115	1.2	MWS-L-4-8
BMP-25	1360	0	39027	35124.3	90%	0.82	0.220	0.346	3.7	MWS-L-8-12
BMP-26	1210	0	34720	31248	90%	0.82	0.196	0.346	3.3	MWS-L-8-12
BMP-36	601	0	17232	15508.8	90%	0.82	0.097	0.144	1.7	MWS-L-4-13
BMP-37	817	0	23446	21101.4	90%	0.82	0.132	0.346	2.2	MWS-L-8-8
BMP-39	808	0	23178	20860.2	90%	0.82	0.131	0.23	2.2	MWS-L-8-8
BMP-42	1216	0	34906	31415.4	90%	0.82	0.197	0.346	3.3	MWS-L-8-12
BMP-46	916	0	26280	23652	90%	0.82	0.148	0.23	2.5	MWS-L-8-8
BMP-48	219	0	6271	5643.9	90%	0.82	0.035	0.052	0.6	MWS-L-4-4
BMP-51	1089	0	31251	28125.9	90%	0.82	0.176	0.346	3.0	MWS-L-8-8
BMP-52	768	0	22024	19821.6	90%	0.82	0.124	0.206	2.1	MWS-L-4-15
BMP-53	1427	0	40961	36864.9	90%	0.82	0.231	0.346	3.9	MWS-L-8-12
BMP-54	469	0	16721	11704.7	70%	0.66	0.076	0.175	1.6	MWS-L-4-8
SUM	=		722296	616090.9						

1. 1.5 X Water quality flow rate = 1.5 x 0.2 x C x A
2. Q100 is based on Hydrology Calculation in Drainage Report

PUBLIC BMP FORM I-10
For
BMPs#7-12,19-22,36-37

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Compact (high rate) biofiltration BMPs have a media filtration rate greater than 5 in/hr. and a media surface area smaller than 3% of contributing area times adjusted runoff factor. Compact biofiltration BMPs are typically proprietary BMPs that may qualify as biofiltration.

A compact biofiltration BMP may satisfy the pollutant control requirements for a DMA onsite in some cases. This depends on the characteristics of the DMA **and** the performance certification/data of the BMP. If the pollutant control requirements for a DMA are met onsite, then the DMA is not required to participate in an offsite storm water alternative compliance program to meet its pollutant control obligations.

An applicant using a compact biofiltration BMP to meet the pollutant control requirements onsite must complete Section 1 of this form and include it in the PDP SWQMP. A separate form must be completed for each DMA. In instances where the City Engineer does not agree with the applicant's determination, Section 2 of this form will be completed by the City and returned to the applicant.

Section 1: Biofiltration Criteria Checklist (Appendix F)

Refer to Part 1 of the Storm Water Standards to complete this section. When separate forms/worksheets are referenced below, the applicant must also complete these separate forms/worksheets (as applicable) and include in the PDP SWQMP. The criteria numbers below correspond to the criteria numbers in Appendix F.

Criteria	Answer	Progression
Criteria 1 and 3: What is the infiltration condition of the DMA? Refer to Section 5.4.2 and Appendix C of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance. Applicant must complete and include the following in the PDP SWQMP submittal to support the feasibility determination: • Infiltration Feasibility Condition Letter; or • Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B. Applicant must complete and include all applicable sizing worksheets in the SWQMP submittal	○ Full Infiltration Condition	**Stop**. Compact biofiltration BMP is not allowed.
	○ Partial Infiltration Condition	Compact biofiltration BMP is only allowed, if the target volume retention is met onsite (Refer to Table B.5-1 in Appendix B.5). Use Worksheet B.5-2 in Appendix B.5 to estimate the target volume retention (Note: retention in this context means reduction). If the required volume reduction is achieved **proceed to Criteria 2**. If the required volume reduction is not achieved, compact biofiltration BMP is not allowed. **Stop**.
	◉ No Infiltration Condition	Compact biofiltration BMP is allowed if volume retention criteria in Table B.5-1 in Appendix B.5 for the no infiltration condition is met. Compliance with this criterion must be documented in the PDP SWQMP. If the criteria in Table B.5-1 is met **proceed to Criteria 2**. If the criteria in Table B.5-1 is not met, compact biofiltration BMP is not allowed. **Stop**.

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Provide basis for Criteria 1 and 3:

Feasibility Analysis:

Summarize findings and include either infiltration feasibility condition letter or Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B in the PDP SWQMP submittal.

If Partial Infiltration Condition:

Provide documentation that target volume retention is met (include Worksheet B.5-2 in the PDP SWQMP submittal). Worksheet B.5-7 in Appendix B.5 can be used to estimate volume retention benefits from landscape areas.

If No Infiltration Condition:

Provide documentation that the volume retention performance standard is met (include Worksheet B.5-2 in the PDP SWQMP submittal) in the PDP SWQMP submittal. Worksheet B.5-6 in Appendix B.5 can be used to document that the performance standard is met.

All applicable Appendix B.5 Worksheets are included in the SWQMP Attachment 1e which show that the performance standard has been met.

Criteria	Answer	Progression
Criteria 2: Is the compact biofiltration BMP sized to meet the performance standard from the MS4 Permit? Refer to Appendix B.5 and Appendix F.2 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Meets Flow based Criteria	Use guidance from **Appendix F.2.2** to size the compact biofiltration BMP to meet the flow based criteria. Include the calculations in the PDP SWQMP. Use parameters for sizing consistent with manufacturer guidelines and conditions of its third party certifications (i.e. a BMP certified at a loading rate of 1 gpm/sq. ft. cannot be designed using a loading rate of 1.5 gpm/sq. ft.) **Proceed to Criteria 4.**
	○ Meets Volume based Criteria	Provide documentation that the compact biofiltration BMP has a total static (i.e. non-routed) storage volume, including pore-spaces and pre-filter detention volume (Refer to Appendix B.5 for a schematic) of at least 0.75 times the portion of the DCV not reliably retained onsite. **Proceed to Criteria 4.**
	○ Does not Meet either criteria	**Stop**. Compact biofiltration BMP is not allowed.

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Provide basis for Criteria 2:

Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., loading rate, etc., as applicable).

Refer to Attachment 1e for standard sheet provided by vendor.

Criteria	Answer	Progression
Criteria 4: Does the compact biofiltration BMP meet the pollutant treatment performance standard for the projects most significant pollutants of concern? Refer to Appendix B.6 and Appendix F.1 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Yes, meets the TAPE certification.	Provide documentation that the compact BMP has an appropriate TAPE certification for the projects most significant pollutants of concern. **Proceed to Criteria 5.**
	○ Yes, through other third-party documentation	Acceptance of third-party documentation is at the discretion of the City Engineer. The City engineer will consider, (a) the data submitted; (b) representativeness of the data submitted; and (c) consistency of the BMP performance claims with pollutant control objectives in Table F.1-2 and Table F.1-1 while making this determination. If a compact biofiltration BMP is not accepted, a written explanation/ reason will be provided in Section 2. **Proceed to Criteria 5.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 4:

Provide documentation that identifies the projects most significant pollutants of concern and TAPE certification or other third party documentation that shows that the compact biofiltration BMP meets the pollutant treatment performance standard for the projects most significant pollutants of concern.

See Attachment 1e for Tape Certification and Modular Wetland Calculations, Modular Wetland Brochure, Fact Sheet.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Criteria	**Answer**	**Progression**
Criteria 5: Is the compact biofiltration BMP designed to promote appropriate biological activity to support and maintain treatment process? Refer to Appendix F of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Yes	Provide documentation that the compact biofiltration BMP support appropriate biological activity. Refer to Appendix F for guidance. **Proceed to Criteria 6.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 5:

Provide documentation that appropriate biological activity is supported by the compact biofiltration BMP to maintain treatment process.

A modular wetland system will be utilized for pollutant treatment control. The BMP unit(s) will have plants. Refer to the Criteria 5 Checklist from Appendix F and the MWS plant selection included in Attachment 1e.

Criteria	Answer	Progression
Criteria 6: Is the compact biofiltration BMP designed with a hydraulic loading rate to prevent erosion, scour and channeling within the BMP?	◉ Yes	Provide documentation that the compact biofiltration BMP is used in a manner consistent with manufacturer guidelines and conditions of its third-party certification. **Proceed to Criteria 7.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 6:

Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., maximum tributary area, maximum inflow velocities, etc., as applicable).

Per Appendix B of the City BMP Design Manual, a proposed BMP should meet the performance standard (per Appendix B.6.2.2) as certified through a third party field scale evaluation. The MWS performance standard was conducted by the Washington State Department of Ecology. Their results are provided in the TAPE certification. Refer to Attachment 1e.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Criteria	**Answer**	**Progression**
Criteria 7: Is the compact biofiltration BMP maintenance plan consistent with manufacturer guidelines and conditions of its third-party certification (i.e., maintenance activities, frequencies)?	◯ Yes, and the compact BMP is privately owned, operated and not in the public right of way.	Submit a maintenance agreement that will also include a statement that the BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification. **Stop**. The compact biofiltration BMP meets the required criteria.
	⦿ Yes, and the BMP is either owned or operated by the City or in the public right of way.	Approval is at the discretion of the City Engineer. The city engineer will consider maintenance requirements, cost of maintenance activities, relevant previous local experience with operation and maintenance of the BMP type, ability to continue to operate the system in event that the vending company is no longer operating as a business or other relevant factors while making the determination. **Stop**. Consult the City Engineer for a determination.
	◯ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 7:

Include copy of manufacturer guidelines and conditions of third-party certification in the maintenance agreement. PDP SWQMP must include a statement that the compact BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification.

Refer to Attachment 3A for Maintenance Guidelines for the Modular Wetland System.

Compact (high rate) Biofiltration BMP Checklist	Form I-10
Section 2: Verification (For City Use Only)	
Is the proposed compact BMP accepted by the City Engineer for onsite pollutant control compliance for the DMA?	○ Yes ○ No, See explanation below
Explanation/reason if the compact BMP is not accepted by the City for onsite pollutant control compliance:	

PRIVATE BMP FORM I-10
For
BMPs#2,4,14,18,25,26,
39,42,46,48,51-54

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Compact (high rate) biofiltration BMPs have a media filtration rate greater than 5 in/hr. and a media surface area smaller than 3% of contributing area times adjusted runoff factor. Compact biofiltration BMPs are typically proprietary BMPs that may qualify as biofiltration.

A compact biofiltration BMP may satisfy the pollutant control requirements for a DMA onsite in some cases. This depends on the characteristics of the DMA **and** the performance certification/data of the BMP. If the pollutant control requirements for a DMA are met onsite, then the DMA is not required to participate in an offsite storm water alternative compliance program to meet its pollutant control obligations.

An applicant using a compact biofiltration BMP to meet the pollutant control requirements onsite must complete Section 1 of this form and include it in the PDP SWQMP. A separate form must be completed for each DMA. In instances where the City Engineer does not agree with the applicant's determination, Section 2 of this form will be completed by the City and returned to the applicant.

Section 1: Biofiltration Criteria Checklist (Appendix F)

Refer to Part 1 of the Storm Water Standards to complete this section. When separate forms/worksheets are referenced below, the applicant must also complete these separate forms/worksheets (as applicable) and include in the PDP SWQMP. The criteria numbers below correspond to the criteria numbers in Appendix F.

Criteria	Answer	Progression
Criteria 1 and 3: What is the infiltration condition of the DMA? Refer to Section 5.4.2 and Appendix C of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance. Applicant must complete and include the following in the PDP SWQMP submittal to support the feasibility determination: • Infiltration Feasibility Condition Letter; or • Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B. Applicant must complete and include all applicable sizing worksheets in the SWQMP submittal	○ Full Infiltration Condition	**Stop**. Compact biofiltration BMP is not allowed.
	○ Partial Infiltration Condition	Compact biofiltration BMP is only allowed, if the target volume retention is met onsite (Refer to Table B.5-1 in Appendix B.5). Use Worksheet B.5-2 in Appendix B.5 to estimate the target volume retention (Note: retention in this context means reduction). If the required volume reduction is achieved **proceed to Criteria 2**. If the required volume reduction is not achieved, compact biofiltration BMP is not allowed. **Stop**.
	⦿ No Infiltration Condition	Compact biofiltration BMP is allowed if volume retention criteria in Table B.5-1 in Appendix B.5 for the no infiltration condition is met. Compliance with this criterion must be documented in the PDP SWQMP. If the criteria in Table B.5-1 is met **proceed to Criteria 2**. If the criteria in Table B.5-1 is not met, compact biofiltration BMP is not allowed. **Stop**.

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Provide basis for Criteria 1 and 3:

Feasibility Analysis:

Summarize findings and include either infiltration feasibility condition letter or Worksheet C.4-1: Form I-8A and Worksheet C.4-2: Form I-8B in the PDP SWQMP submittal.

If Partial Infiltration Condition:

Provide documentation that target volume retention is met (include Worksheet B.5-2 in the PDP SWQMP submittal). Worksheet B.5-7 in Appendix B.5 can be used to estimate volume retention benefits from landscape areas.

If No Infiltration Condition:

Provide documentation that the volume retention performance standard is met (include Worksheet B.5-2 in the PDP SWQMP submittal) in the PDP SWQMP submittal. Worksheet B.5-6 in Appendix B.5 can be used to document that the performance standard is met.

All applicable Appendix B.5 Worksheets are included in the SWQMP Attachment 1e which show that the performance standard has been met.

Criteria	Answer	Progression
Criteria 2: Is the compact biofiltration BMP sized to meet the performance standard from the MS4 Permit? Refer to Appendix B.5 and Appendix F.2 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Meets Flow based Criteria	Use guidance from **Appendix F.2.2** to size the compact biofiltration BMP to meet the flow based criteria. Include the calculations in the PDP SWQMP. Use parameters for sizing consistent with manufacturer guidelines and conditions of its third party certifications (i.e. a BMP certified at a loading rate of 1 gpm/sq. ft. cannot be designed using a loading rate of 1.5 gpm/sq. ft.) **Proceed to Criteria 4.**
	○ Meets Volume based Criteria	Provide documentation that the compact biofiltration BMP has a total static (i.e. non-routed) storage volume, including pore-spaces and pre-filter detention volume (Refer to Appendix B.5 for a schematic) of at least 0.75 times the portion of the DCV not reliably retained onsite. **Proceed to Criteria 4.**
	○ Does not Meet either criteria	**Stop**. Compact biofiltration BMP is not allowed.

Compact (high rate) Biofiltration BMP Checklist	Form I-10

Provide basis for Criteria 2:

Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., loading rate, etc., as applicable).

Refer to Attachment 1e for standard sheet provided by vendor.

Criteria	Answer	Progression
Criteria 4: Does the compact biofiltration BMP meet the pollutant treatment performance standard for the projects most significant pollutants of concern? Refer to Appendix B.6 and Appendix F.1 of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Yes, meets the TAPE certification.	Provide documentation that the compact BMP has an appropriate TAPE certification for the projects most significant pollutants of concern. **Proceed to Criteria 5.**
	○ Yes, through other third-party documentation	Acceptance of third-party documentation is at the discretion of the City Engineer. The City engineer will consider, (a) the data submitted; (b) representativeness of the data submitted; and (c) consistency of the BMP performance claims with pollutant control objectives in Table F.1-2 and Table F.1-1 while making this determination. If a compact biofiltration BMP is not accepted, a written explanation/ reason will be provided in Section 2. **Proceed to Criteria 5.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 4:

Provide documentation that identifies the projects most significant pollutants of concern and TAPE certification or other third party documentation that shows that the compact biofiltration BMP meets the pollutant treatment performance standard for the projects most significant pollutants of concern.

See Attachment 1e for Tape Certification and Modular Wetland Calculations, Modular Wetland Brochure, Fact Sheet.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Criteria	**Answer**	**Progression**
Criteria 5: Is the compact biofiltration BMP designed to promote appropriate biological activity to support and maintain treatment process? Refer to Appendix F of the BMP Design Manual (Part 1 of Storm Water Standards) for guidance.	◉ Yes	Provide documentation that the compact biofiltration BMP support appropriate biological activity. Refer to Appendix F for guidance. **Proceed to Criteria 6.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 5:

Provide documentation that appropriate biological activity is supported by the compact biofiltration BMP to maintain treatment process.

A modular wetland system will be utilized for pollutant treatment control. The BMP unit(s) will have plants. Refer to the Criteria 5 Checklist from Appendix F and the MWS plant selection included in Attachment 1e.

Criteria	**Answer**	**Progression**
Criteria 6: Is the compact biofiltration BMP designed with a hydraulic loading rate to prevent erosion, scour and channeling within the BMP?	◉ Yes	Provide documentation that the compact biofiltration BMP is used in a manner consistent with manufacturer guidelines and conditions of its third-party certification. **Proceed to Criteria 7.**
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 6:

Provide documentation that the BMP meets the numeric criteria and is designed consistent with the manufacturer guidelines and conditions of its third-party certification (i.e., maximum tributary area, maximum inflow velocities, etc., as applicable).

Per Appendix B of the City BMP Design Manual, a proposed BMP should meet the performance standard (per Appendix B.6.2.2) as certified through a third party field scale evaluation. The MWS performance standard was conducted by the Washington State Department of Ecology. Their results are provided in the TAPE certification. Refer to Attachment 1e.

Compact (high rate) Biofiltration BMP Checklist		Form I-10
Criteria	**Answer**	**Progression**
Criteria 7: Is the compact biofiltration BMP maintenance plan consistent with manufacturer guidelines and conditions of its third-party certification (i.e., maintenance activities, frequencies)?	◉ Yes, and the compact BMP is privately owned, operated and not in the public right of way.	Submit a maintenance agreement that will also include a statement that the BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification. **Stop**. The compact biofiltration BMP meets the required criteria.
	○ Yes, and the BMP is either owned or operated by the City or in the public right of way.	Approval is at the discretion of the City Engineer. The city engineer will consider maintenance requirements, cost of maintenance activities, relevant previous local experience with operation and maintenance of the BMP type, ability to continue to operate the system in event that the vending company is no longer operating as a business or other relevant factors while making the determination. **Stop**. Consult the City Engineer for a determination.
	○ No	**Stop**. Compact biofiltration BMP is not allowed.

Provide basis for Criteria 7:

Include copy of manufacturer guidelines and conditions of third-party certification in the maintenance agreement. PDP SWQMP must include a statement that the compact BMP will be maintained in accordance with manufacturer guidelines and conditions of third-party certification.

Refer to Attachment 3A for Maintenance Guidelines for the Modular Wetland System.

Compact (high rate) Biofiltration BMP Checklist	Form I-10
Section 2: Verification (For City Use Only)	
Is the proposed compact BMP accepted by the City Engineer for onsite pollutant control compliance for the DMA?	○ Yes ○ No, See explanation below
Explanation/reason if the compact BMP is not accepted by the City for onsite pollutant control compliance:	

Bio Clean

A Forterra Company

Modular Wetlands® System Linear

A Stormwater Biofiltration Solution

OVERVIEW

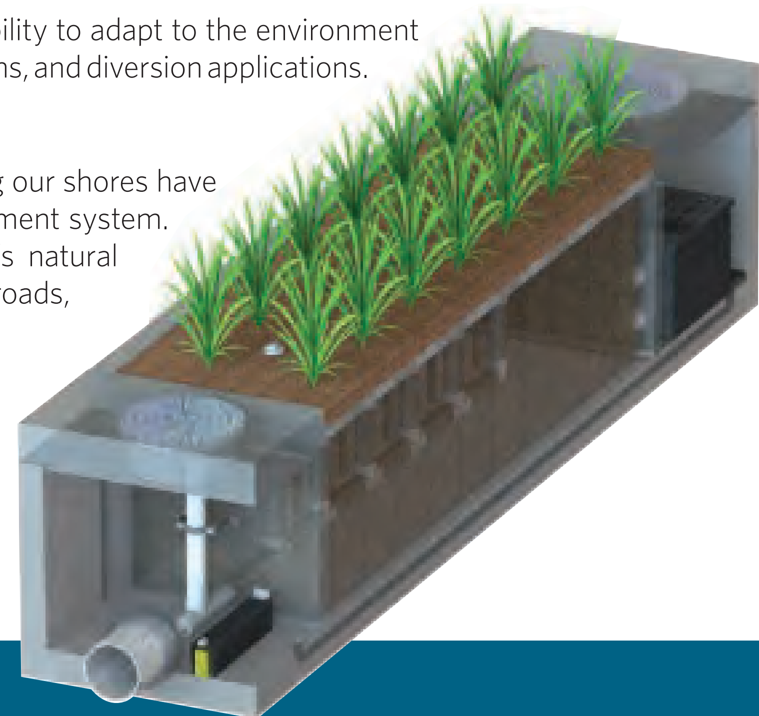
The Bio Clean Modular Wetlands® System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint, higher treatment capacity, and a wide range of versatility. While most biofilters use little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

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

The Urban Impact

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

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



PERFORMANCE

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

66% REMOVAL OF DISSOLVED ZINC	69% REMOVAL OF TOTAL ZINC	38% REMOVAL OF DISSOLVED COPPER	64% REMOVAL OF TOTAL PHOSPHORUS	
45% REMOVAL OF NITROGEN	50% REMOVAL OF TOTAL COPPER	95% REMOVAL OF MOTOR OIL	67% REMOVAL OF ORTHO PHOSPHORUS	85% REMOVAL OF TSS

APPROVALS

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

State of Washington TAPE GULD Basic Enhanced/Metals Phosphorus

Washington State Department of Ecology TAPE Approved
The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

CA

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

VA

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

MD

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

MA

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

RI

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

ADVANTAGES

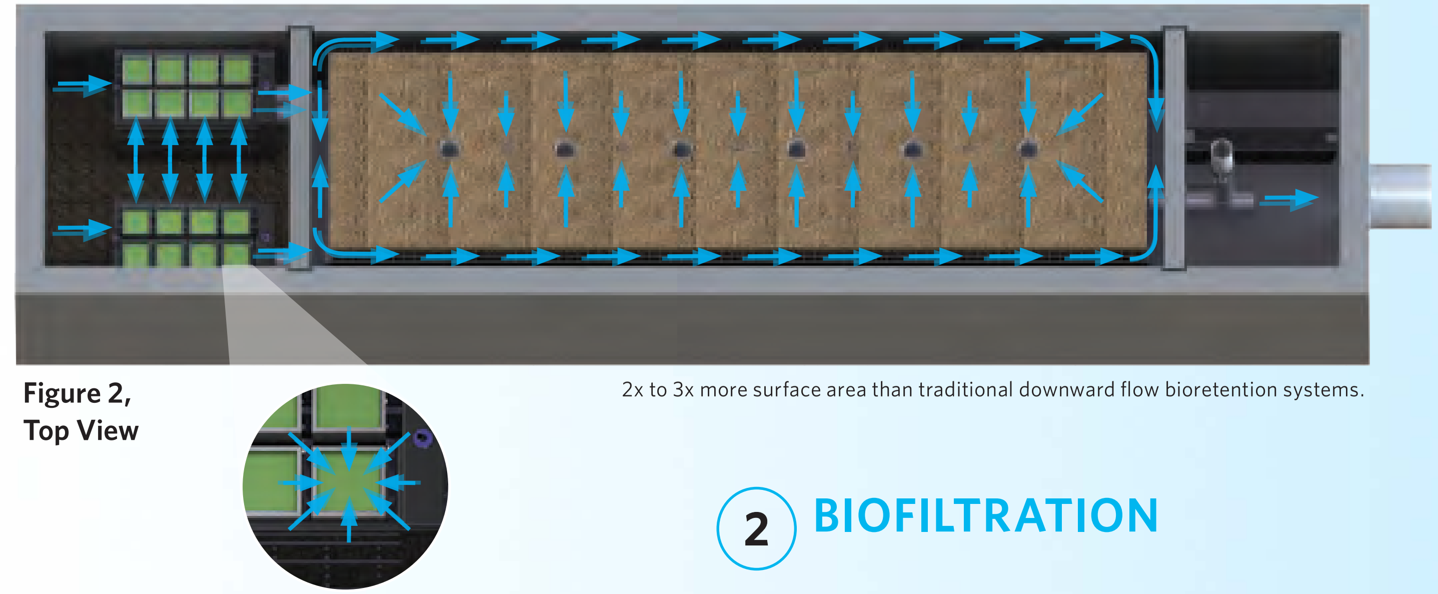
- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR

OPERATION

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

- Improves performance
- Reduces footprint
- Minimizes maintenance

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



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

Figure 2, Top View

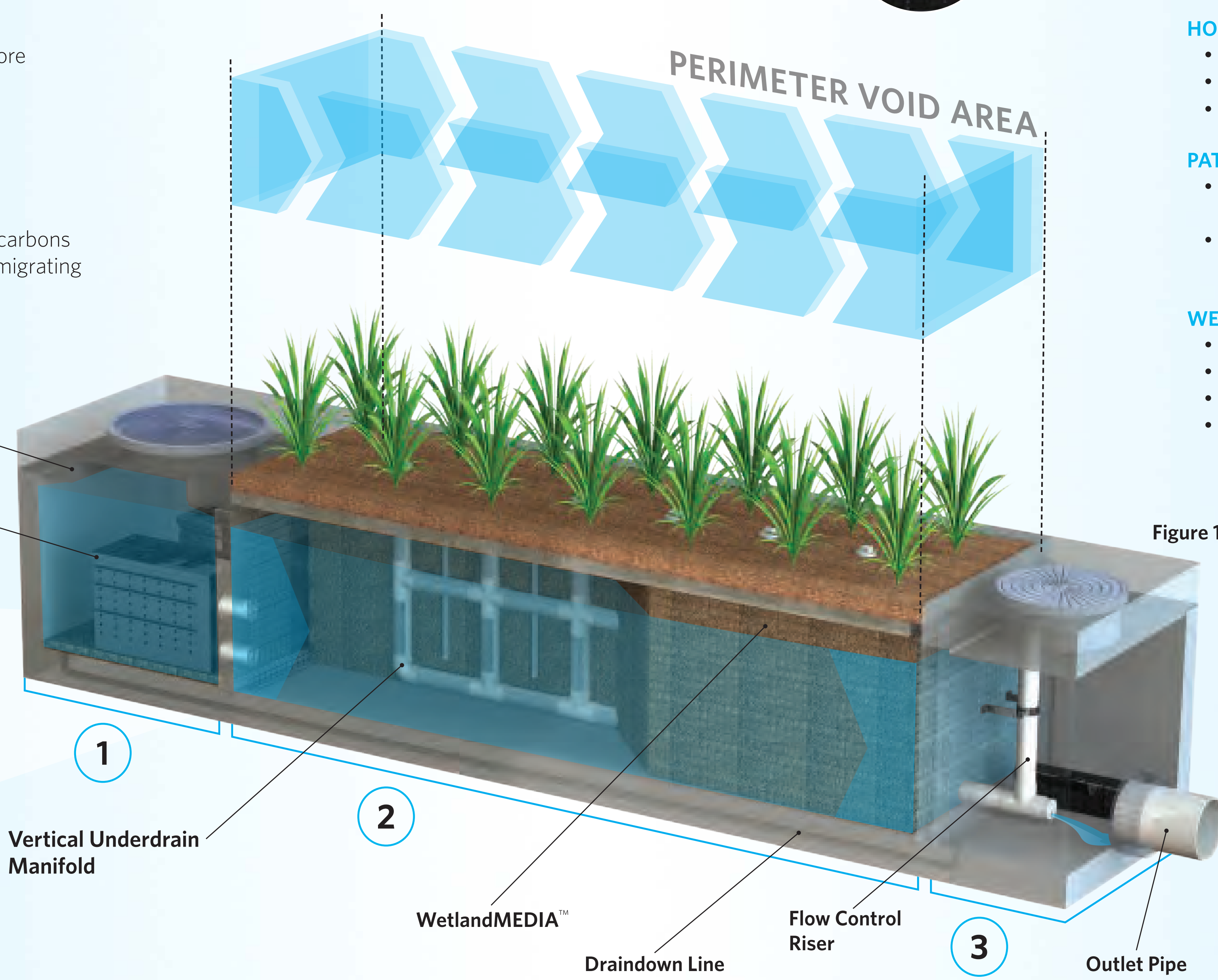
1 PRETREATMENT

SEPARATION

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

PRE-FILTER CARTRIDGES

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



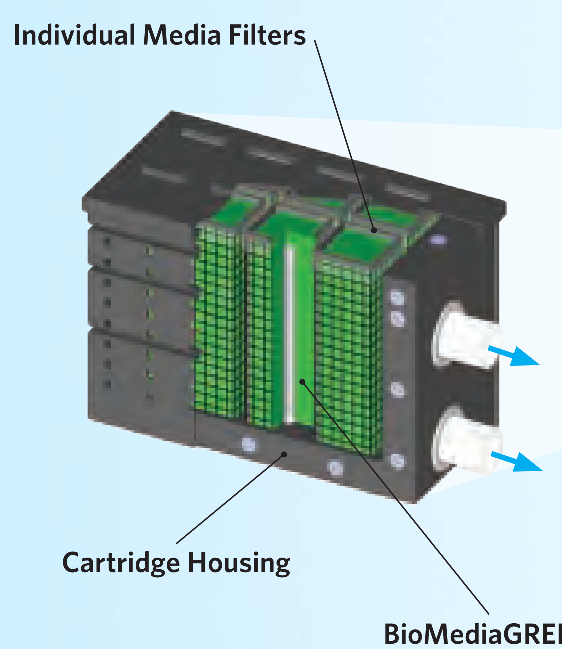


Figure 1

2 BIOFILTRATION

HORIZONTAL FLOW

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

PATENTED PERIMETER VOID AREA

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

WETLANDMEDIA

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

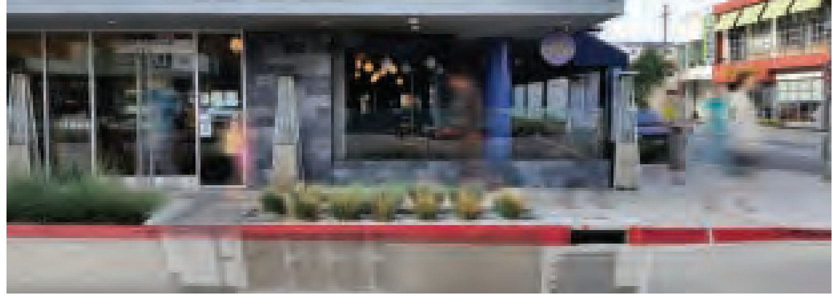
3 DISCHARGE

FLOW CONTROL

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

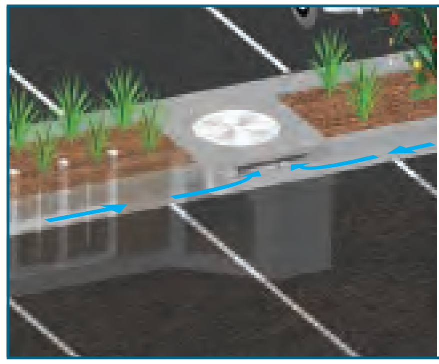
DRAINDOWN FILTER

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



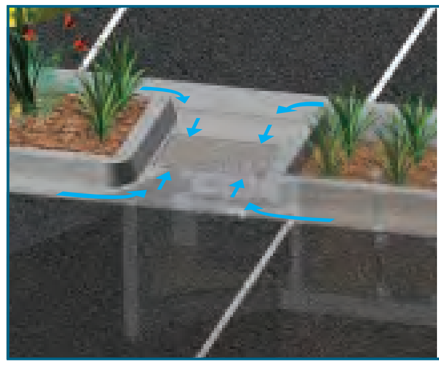
CONFIGURATIONS

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



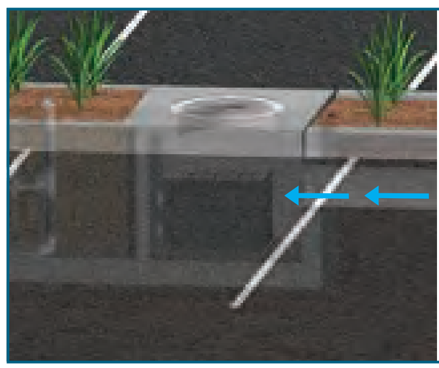
CURB TYPE

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



GRATE TYPE

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



VAULT TYPE

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

DOWNSPOUT TYPE

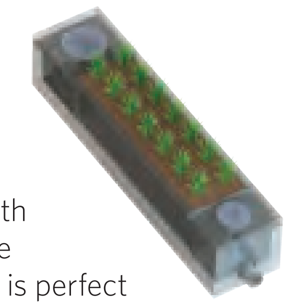
The Downspout Type is a variation of the Vault Type and is designed to accept a vertical downspout pipe from rooftop and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter, and the exterior can be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

ORIENTATIONS

SIDE-BY-SIDE

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

END-TO-END



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

BYPASS

INTERNAL BYPASS WEIR (SIDE-BY-SIDE ONLY)

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

EXTERNAL DIVERSION WEIR STRUCTURE

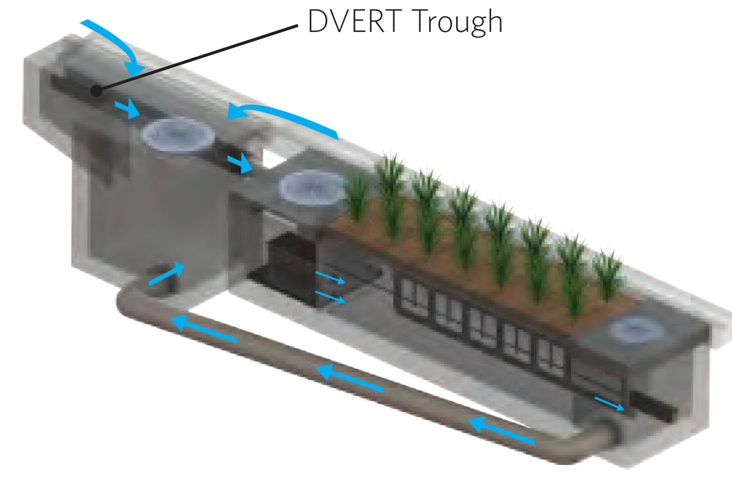
This traditional offline diversion method can be used with the Modular Wetlands® in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert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

FLOW-BY-DESIGN

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

DVERT LOW FLOW DIVERSION

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



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

SPECIFICATIONS

FLOW-BASED DESIGNS

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

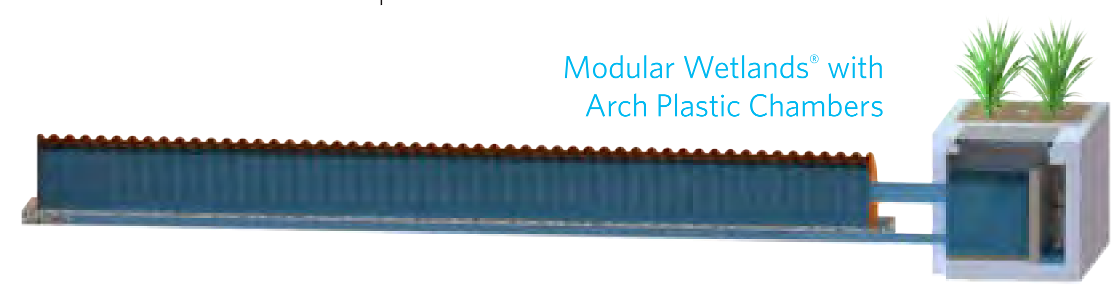
MODEL #	DIMENSIONS	WETLANDMEDIA SURFACE AREA (sq. ft.)	TREATMENT FLOW RATE (cfs)
MWS-L-4-4	4' x 4'	23	0.052
MWS-L-4-6	4' x 6'	32	0.073
MWS-L-4-8	4' x 8'	50	0.115
MWS-L-4-13	4' x 13'	63	0.144
MWS-L-4-15	4' x 15'	76	0.175
MWS-L-4-17	4' x 17'	90	0.206
MWS-L-4-19	4' x 19'	103	0.237
MWS-L-4-21	4' x 21'	117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

VOLUME-BASED DESIGNS

HORIZONTAL FLOW BIOFILTRATION ADVANTAGE

Modular Wetlands® with Box Culvert Prestorage

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



Modular Wetlands® with Arch Plastic Chambers

DESIGN SUPPORT

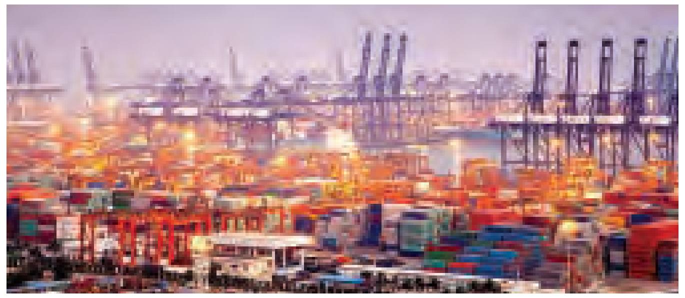
Bio Clean engineers are trained to provide you with superior support for all volume sizing configurations throughout the country. Our vast knowledge of state and local regulations allow us to quickly and efficiently size a system to maximize feasibility. Volume control and hydromodification regulations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

ADVANTAGES

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

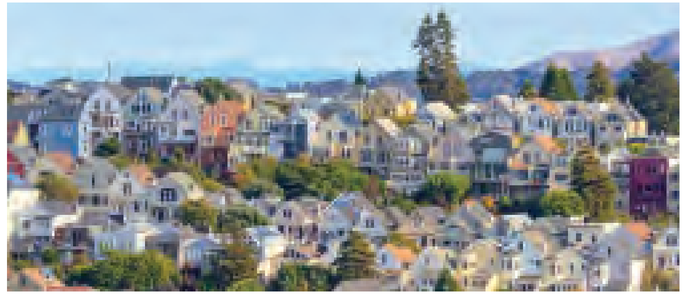
APPLICATIONS

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



INDUSTRIAL

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



RESIDENTIAL

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

STREETS

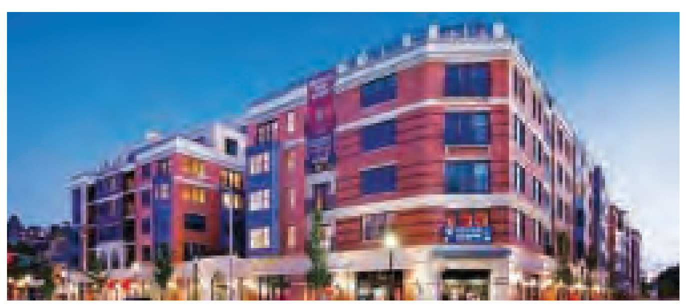
Street applications can be challenging due to limited space. The Modular Wetlands® is very adaptable, and it offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

PARKING LOTS

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

COMMERCIAL

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



MIXED USE

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

More applications include:

• Agriculture • Reuse • Low Impact Development • Waste Water

PLANT SELECTION

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

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

INSTALLATION

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

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

MAINTENANCE

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

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

Bio Clean
A Forterra Company

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biocleanenvironmental.com

010419R1A

July 2017

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

For the

MWS-Linear Modular Wetland

Ecology's Decision:

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

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

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

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

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

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

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

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

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

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

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

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

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

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

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

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

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

Application Documents:

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

Applicant's Use Level Request:

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

Applicant's Performance Claims:

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

Ecology Recommendations:

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

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

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

Field Testing

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

Issues to be addressed by the Company:

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

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

Contact Information:

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

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

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

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

Revision History

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

Biofiltration Criteria Checklist

The applicant must provide documentation of compliance with each criterion in this checklist as part of the project submittal. The right column of this checklist identifies the submittal information that is recommended to document compliance with each criterion. Biofiltration BMPs that substantially meet all aspects of Fact Sheets PR-1 or BF-1 should still use this checklist; however additional documentation (beyond what is already required for project submittal) should not be required.

1	**Biofiltration BMPs shall be allowed to be used only as described in the BMP selection process based on a documented feasibility analysis.** Intent: This manual defines a specific prioritization of pollutant treatment BMPs, where BMPs that retain water (retained includes evapotranspired, infiltrated, and/or harvested and used) must be used before considering BMPs that have a biofiltered discharge to the MS4 or surface waters. Use of a biofiltration BMP in a manner in conflict with this prioritization (i.e., without a feasibility analysis justifying its use) is not permitted, regardless of the adequacy of the sizing and design of the system.	
☐	The project applicant has demonstrated that it is not technically feasible to retain the full DCV onsite.	Document feasibility analysis and findings in the PDP SWQMP. Applicant must include harvest and use feasibility and infiltration feasibility in the PDP SWQMP
2	**Biofiltration BMPs must be sized using acceptable sizing methods.** Intent: The MS4 Permit and this manual defines specific sizing methods that must be used to size biofiltration BMPs. Sizing of biofiltration BMPs is a fundamental factor in the amount of storm water that can be treated and also influences volume and pollutant retention processes.	
☐	The project applicant has demonstrated that biofiltration BMPs are sized to meet one of the biofiltration sizing options available (Appendix B.5).	Submit sizing worksheets (Appendix B.5) or other equivalent documentation (such as results derived from continuous simulation calculations of treatment volume, retention, etc.) with the PDP SWQMP.
3	**Biofiltration BMPs must be sited and designed to achieve maximum feasible infiltration and evapotranspiration.** Intent: Various decisions about BMP placement and design influence how much water is retained via infiltration and evapotranspiration. The MS4 Permit requires that biofiltration BMPs achieve maximum feasible retention (evapotranspiration and infiltration) of storm water volume.	
☐	The biofiltration BMP is sited to allow for maximum infiltration of runoff volume based on the feasibility factors considered in site planning efforts. It is also designed to maximize evapotranspiration through the use of amended media and plants.	Document site planning and feasibility analyses in PDP SWQMP per Section 5.4.
☐	The biofiltration BMP meets the volume retention performance standard specified in Table B.5-1 in Appendix B.5.	Included documentation in the PDP SWQMP using worksheets in Appendix B.5 that show that the volume retention performance standard is met. Note, retention depth profiles that are too shallow or too deep may not be acceptable.

☐	An impermeable liner or other hydraulic restriction layer on the bottom of the BMP is only used when needed to avoid geotechnical and/or subsurface contamination issues in locations identified as "No Infiltration Condition."	If using an impermeable liner or hydraulic restriction layer, provide documentation of feasibility findings per Appendix C that recommend the use of this feature.
4	**Biofiltration BMPs must be designed with a hydraulic loading rate to maximize pollutant retention, preserve pollutant control processes, and minimize potential for pollutant washout.** Intent: Various decisions about biofiltration BMP design influence the degree to which pollutants are retained. The MS4 Permit requires that biofiltration BMPs achieve maximum feasible retention of storm water pollutants.	
☐	Media selected for the biofiltration BMP meets minimum quality and material specifications per Appendix F.3 or County LID Manual, including the maximum allowable design filtration rate and minimum thickness of media. OR Alternatively, for proprietary designs and custom media mixes not meeting the media specifications contained in Appendix F.3 or County LID Manual, field scale testing data are provided to demonstrate that proposed media meets the pollutant treatment performance criteria in Section F.1 below.	Provide documentation that media meets the specifications in Appendix F.3 or County LID Manual. Provide documentation of performance information as described in Section F.1.
☐	To the extent practicable, filtration rates are outlet controlled (e.g., via an underdrain and orifice/weir) instead of controlled by the infiltration rate of the media.	Include outlet control in designs or provide documentation of why outlet control is not practicable.
☐	Surface ponding is limited to 24 hours from the end of storm event flow to preserve plant health and promote healthy soil structure.	Include calculations to demonstrate that drawdown rate is adequate. Surface ponding drawdown time greater than 24-hours but less than 96 hours may be allowed at the discretion of the City Engineer if certified by a landscape architect or agronomist.
☐	If nutrients are a pollutant of concern, design of the biofiltration BMP follows nutrient-sensitive design criteria.	Follow specifications for nutrient sensitive design in Fact Sheet BF-2. Or provide alternative documentation that nutrient treatment is addressed and potential for nutrient release is minimized.
☐	Media gradation calculations demonstrate that migration of media between layers will be prevented and permeability will be preserved.	Follow specification for choking layer in Fact Sheet PR-1 or BF-1. Or include calculations to demonstrate that choking layer is appropriately specified.

5	**Biofiltration BMPs must be designed to promote appropriate biological activity to support and maintain treatment processes.** Intent: Biological processes are an important element of biofiltration performance and longevity.	
☐	Plants have been selected to be tolerant of project climate, design ponding depths and the treatment media composition.	Provide documentation justifying plant selection. Refer to the plant list in Appendix E.26.
☐	Plants have been selected to minimize irrigation requirements.	Provide documentation describing irrigation requirements for establishment and long term operation.
☐	Plant location and growth will not impede expected long-term media filtration rates and will enhance long term infiltration rates to the extent possible.	Provide documentation justifying plant selection. Refer to the plant list in Appendix E.26.
6	**Biofiltration BMPs must be designed with a hydraulic loading rate to prevent erosion, scour, and channeling within the BMP.** Intent: Erosion, scour, and/or channeling can disrupt treatment processes and reduce biofiltration effectiveness.	
☐	Scour protection has been provided for both sheet flow and pipe inflows to the BMP, where needed.	Provide documentation of scour protection as described in Fact Sheets PR-1 or BF-1 or approved equivalent.
☐	Where scour protection has not been provided, flows into and within the BMP are kept to non-erosive velocities.	Provide documentation of design checks for erosive velocities as described in Fact Sheets PR-1 or BF-1 or approved equivalent.
☐	For proprietary BMPs, the BMP is used in a manner consistent with manufacturer guidelines and conditions of its third-party certification[21] (i.e., maximum tributary area, maximum inflow velocities, etc., as applicable).	Provide copy of manufacturer recommendations and conditions of third-party certification.

[21]Certifications or verifications issued by the Washington Technology Acceptance Protocol-Ecology program and the New Jersey Corporation for Advanced Technology programs are typically accompanied by a set of guidelines regarding appropriate design and maintenance conditions that would be consistent with the certification/verification

7	**Biofiltration BMP must include operations and maintenance design features and planning considerations for continued effectiveness of pollutant and flow control functions.** Intent: Biofiltration BMPs require regular maintenance in order provide ongoing function as intended. Additionally, it is not possible to foresee and avoid potential issues as part of design; therefore, plans must be in place to correct issues if they arise.	
☐	The biofiltration BMP O&M plan describes specific inspection activities, regular/periodic maintenance activities and specific corrective actions relating to scour, erosion, channeling, media clogging, vegetation health, and inflow and outflow structures.	Include O&M plan with project submittal as described in Chapter 7.
☐	Adequate site area and features have been provided for BMP inspection and maintenance access.	Illustrate maintenance access routes, setbacks, maintenance features as needed on project water quality plans.
☐	For proprietary biofiltration BMPs, the BMP maintenance plan is consistent with manufacturer guidelines and conditions of its third-party certification (i.e., maintenance activities, frequencies).	Provide copy of manufacturer recommendations and conditions of third-party certification.

Modular Wetland System - Linear® Plants for Hardy Zone 10

Common Name ***Latin Name***	**Light Exposure**	**Hardy Range**	**Height**	**Flower Color**
canna, canna tropicana, canna lilly *Canna X generalis*	full sun to partial shade	USDA Zones 8-11	2.5 to 8 feet	yellow, orange, red
Lily-of-the-Nile, African Lily, African Blue Lily *Agapanthus spp*	full sun to partial shade	USDA Zones 8-11	2 to 4 feet	blue
Vetiveria zizanioides (L.) Nash Vetiver Grass	full sun	USDA Zones 5-11	2 to 8 feet	green
giant wild rye *Leymus condensatus*	full sun	USDA Zones 3-11	4 to 8 feet	brown
society garlic, pink agapanthus *Tulbaghia violacea*	full sun to full shade	USDA Zones 7-10	1.5 to 3 feet	lavender
Gulf muhlygrass, mist grass, hairawn muhly *Muhlenbergia capillaris*	full sun to partial shade	USDA Zones 5-10	2 to 3 feet	pinkish purple
Lindheimer's muhlygrass, blue muhlygrass *Muhlenbergia lindheimeri*	full sun	USDA Zones 7-11	2 to 4 feet	purple to gray
horsetail, scouring rush, E. prealtum *Equisetum hyemale*	full sun to light shade	USDA Zones 3-11	2 to 4 feet	n/a
cattail, reed-mace *Typha latifolia*	full sun	USDA Zones 2-11	3 to 9 feet	brown
papyrus, Egyptian papyrus, bulrushes *Cyperus papyrus*	full sun to partial shade	USDA Zones 9-11	2 to 10 feet	white
lavender *Lavandula L.*	sun	USDA Zones 5-10	1 to 2 feet	purple

palm sedge *Carex phyllocephala*	full sun to full shade	USDA Zones 7-10	1 to 2 feet	green
lemongrass, oil grass *Cymbopogon citratus*	full sun to partial shade	USDA Zones 10-11	4 to 6 feet	n/a
umbrella sedge, umbrella plant *Cyperus involucratus*	full sun to partial shade	USDA Zones 8-11	2 to 6 feet	green/white
feather grass, Mexican needle grass *Nassella tenuissima*	full sun to partial shade	USDA Zones 7-11	2 to 3 feet	green/brown
sea oats, Chasmanthium paniculatum *Uniola paniculata*	full sun to partial shade	USDA Zones 6-10	3 to 6 feet	golden/brown
Cape lily, Powell's crinum lily *Crinum X powellii*	full sun to partial shade	USDA Zones 6-11	3 to 4 feet	white/pink
African iris, fortnight lily, morea iris *Dietes iridioides*	full sun to partial shade	USDA Zones 8-10	2 to 4 feet	white/purple
whirling butterflies, white gaura *Gaura lindheimeri*	full sun to partial shade	USDA Zones 5-10	2 to 4 feet	white/pink
daylily *Hemerocallis hybrids*	full sun to partial shade	USDA Zones 2-10	1 to 3.5 feet	various
Adam's needle, bear grass, weak-leaf yucca *Yucca filamentosa*	full sun	USDA Zones 5-10	3 to 5 feet	white
brome hummock sedge *carex bromoides*	full sun to partial shade	USDA Zones 2-10	1 ft	green

The Modular Wetland System - Linear® standard 22' long system will require 18 to 20 plants. Different size systems will require different plant quanitities; please contact us for detailed information.

The plants listed are tolerant to drought and have deep roots to allow for ehanced pollutant removal.

These plants are subject to availability in local areas. If you would like to use a different plant please contact us. We will work with you to ensure the chosen plants work with the projects current landscape theme.

The Modular Wetland System - Linear® should be irrigated like any other planter area. The plants in the system must receive adequate irrigation to ensure plant survival during periods of drier weather. As with all landscape areas the plants within the Modular Wetland System - Linear will require more frequent watering during the establishment period.

For more information please contact at: 760-433-7640 or email: info@modularwetlands.com

E.7 SD-B Impervious Area Dispersion

Photo Credit: Orange County Technical Guidance Document

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

Description

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

Typical dispersion components include:

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

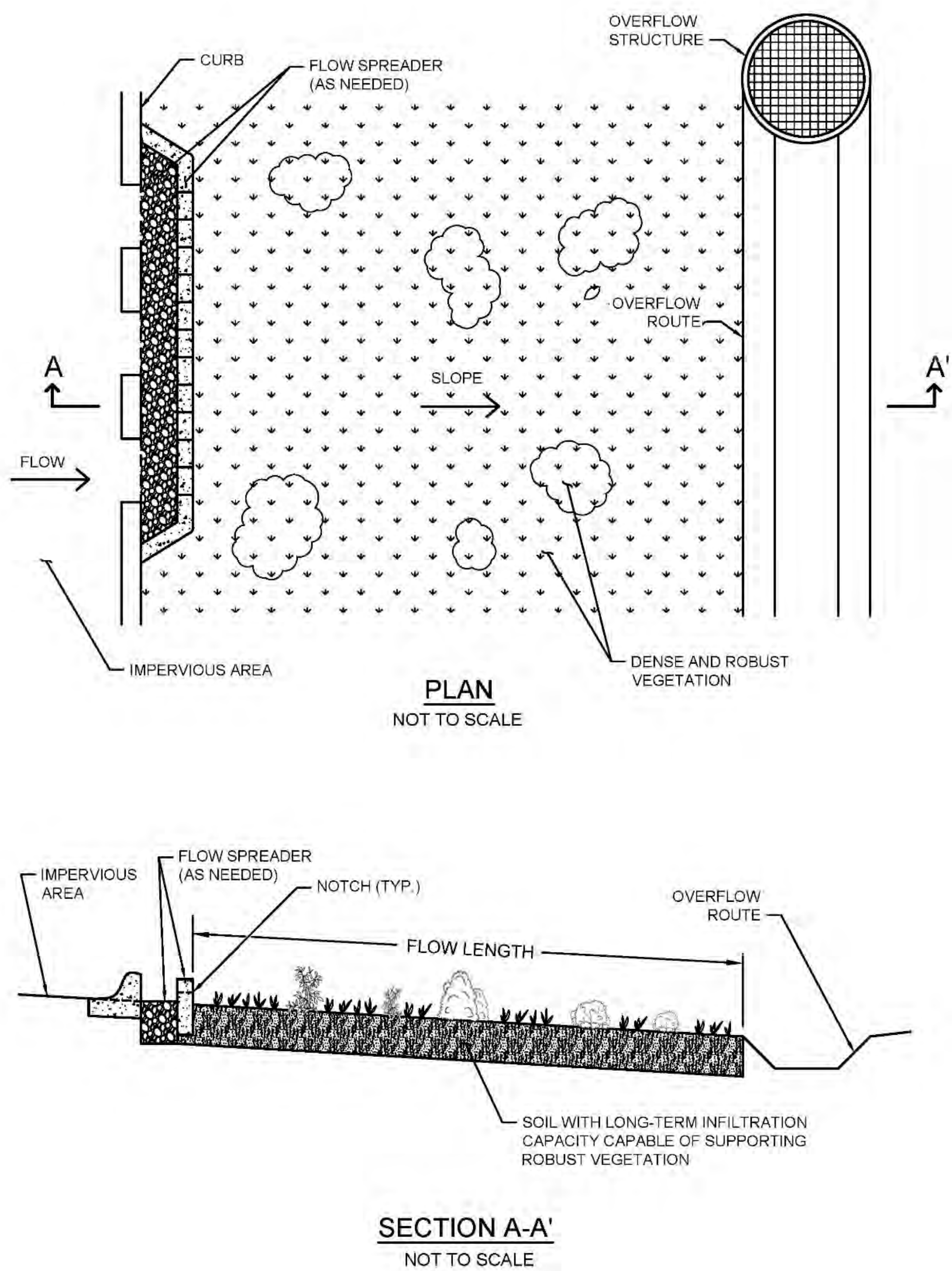


Figure E.7-1 : Typical Plan and Section view of an Impervious Area Dispersion BMP

Design Adaptations for Project Goals

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

Design Criteria and Considerations

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

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

Conceptual Design and Sizing Approach for Site Design

1. Determine the areas where dispersion can be used in the site design to reduce the DCV for pollutant control sizing.
2. Calculate the DCV for storm water pollutant control per Appendix B.2, taking into account reduced runoff from dispersion.
3. Determine if a DMA is considered "Self-retaining". DMA is self-retaining if the impervious to pervious ratio is:
   (a) 2:1 when the pervious area is composed of Hydrologic Soil Group A
   (b) 1:1 when the pervious area is composed of Hydrologic Soil Group B
4. If the top 12 inches uses amended soils in accordance with SD-F, the runoff coefficient (c-factor) for the amended area is 0.1

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

DMA is considered to meet both pollutant control and hydromodification flow control requirements if **ALL** of the following criteria are met:

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

E.11 SD-F Amended Soils

Photo Credit: Orange County Technical Guidance Document

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

Description

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

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

Design Adaptations for Project Goals

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

Important Considerations

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

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

Design Criteria and Considerations

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

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

Conceptual Design and Sizing Approach for Site Design

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

E.18 BF-1 Biofiltration


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

MS4 Permit Category	
Biofiltration	
Manual Category	
Biofiltration	
Applicable Performance Standard	
Pollutant Control Flow Control	
Primary Benefits	
Treatment Volume Reduction (Incidental) Peak Flow Attenuation (Optional)	

Description

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

Typical bioretention with underdrain components include:

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

Design Adaptations for Project Goals

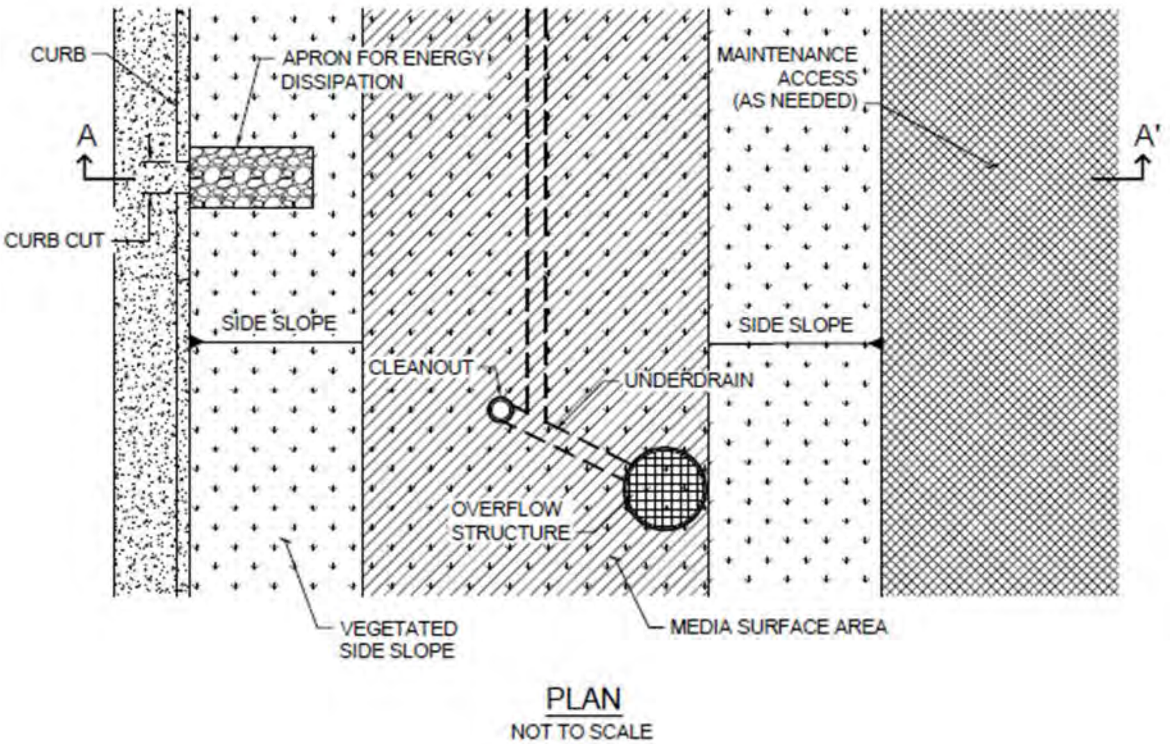
Biofiltration Treatment BMP for storm water pollutant control. The system is lined or un-lined to provide incidental infiltration, and an underdrain is provided at the bottom to carry away filtered runoff. This configuration is considered to provide biofiltration treatment via flow through the media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

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

Recommended Siting Criteria

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

Example Schematic Design – Plan and Section View



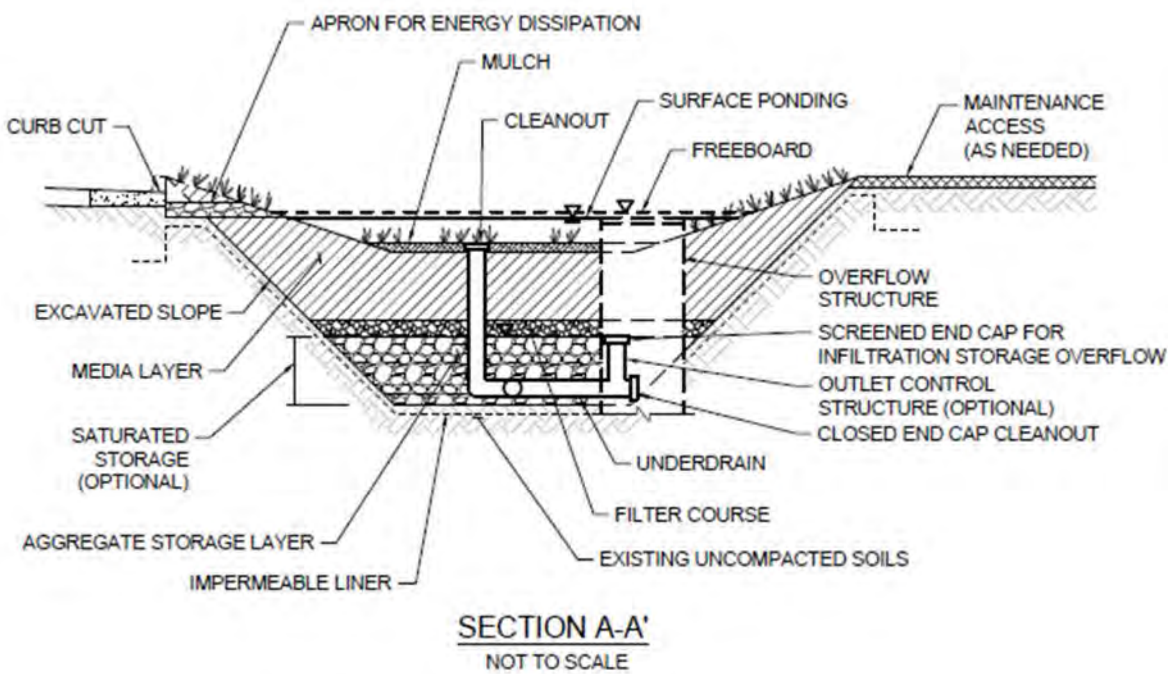


Figure E.18-1 : Typical Plan and Section View of a Biofiltration BMP

Recommended BMP Component Dimensions

BMP Component	Dimension	Intent/Rationale
Freeboard	≥ 2 inches	Freeboard provides room for head over overflow structures and minimizes risk of uncontrolled surface discharge.
Surface Ponding	≥ 6 and ≤ 12 inches	The minimum ponding depth is required so that the runoff is uniformly spread throughout the basin (minimizes the likelihood of short circuiting). Deep surface ponding raises safety concerns. When the BMP is adjoining walkways the minimum surface ponding depth can be reduced to 4 inches. Surface ponding depth greater than 12 inches (for additional pollutant control or surface outlet structures or flow-control orifices) may be allowed at the discretion of the City Engineer if the following conditions are met: 1) surface ponding depth drawdown time is less than 24 hours; and 2) safety issues and fencing requirements are considered (typically ponding greater than 18" will require a fence) and 3) potential for elevated clogging risk is evaluated (Worksheet B.5.4).
Ponding Area Side Slopes	3H:1V or shallower	Gentler side slopes are safer, less prone to erosion, able to establish vegetation more quickly and easier to maintain.
Mulch	≥ 3 inches	Mulch will suppress weeds and maintain moisture for plant growth.
Media Layer	≥ 18 inches	A deep media layer provides additional filtration and supports plants with deeper roots. Where the minimum depth of 18 inches is used, only shallow-rooted species shall be planted. A minimum 24-inch media layer shall typically be required to support vegetation, with a minimum 36-inch media layer depth required for trees.
Filter Course	6 inches	To reduce clogging potential, a two-layer filter course (aka choking stone system) is used consisting of one 3" layer of clean and washed ASTM 33 Fine Aggregate Sand overlying a 3" layer of ASTM No 8 Stone (Appendix F.4). This specification has been developed to maintain permeability while limiting the migration of media material into the stone reservoir and underdrain system.
Underdrain Diameter	≥ 8 inches	Minimum diameter required for maintenance by City crews. For privately maintained BMPs, a minimum underdrain diameter of 6 inches is allowed.
Cleanout Diameter	≥ 8 inches	Facilitates simpler cleaning, when needed. For privately maintained BMPs, cleanout diameter of 6 inches is allowed.

Deviations to the recommended BMP component dimensions may be approved at the discretion of the City Engineer if it is determined to be appropriate.

Design Criteria and Considerations

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

	Design Criteria	Intent/Rationale
Surface Ponding		
□	Surface ponding is limited to a 24-hour drawdown time.	Surface ponding limited to 24 hour for plant health. Surface ponding drawdown time greater than 24-hours but less than 96 hours may be allowed at the discretion of the City Engineer if certified by a landscape architect or agronomist.
Vegetation		
□	Plantings are suitable for the climate and expected ponding depth. A plant list to aid in selection can be found in Appendix E.26.	Plants suited to the climate and ponding depth are more likely to survive.
□	An irrigation system with a connection to water supply should be provided as needed.	Seasonal irrigation might be needed to keep plants healthy.
Mulch		
□	A minimum of 3 inches of well-aged, shredded hardwood mulch that has been stockpiled or stored for at least 12 months is provided.	Mulch will suppress weeds and maintain moisture for plant growth. Aging mulch kills pathogens and weed seeds and allows the beneficial microbes to multiply.
Media Layer		
□	Media maintains a minimum filtration rate of 5 in/hr. over lifetime of facility. Additional Criteria for media hydraulic conductivity described in the bioretention soil media model specification (Appendix F.3)	A filtration rate of at least 5 inches per hour allows soil to drain between events. The initial rate should be higher than long term target rate to account for clogging over time. However an excessively high initial rate can have a negative impact on treatment performance, therefore an upper limit is needed.

	Design Criteria	Intent/Rationale
☐	Media shall be a minimum 18 inches deep for filtration purposes, with a minimum 24-inch media layer depth typically required to support vegetation and a minimum 36-inch media layer depth required for trees. Media shall meet the following specifications. Model bioretention soil media specification provided in Appendix F.3 or County of San Diego Low Impact Development Handbook: Appendix G - Bioretention Soil Specification (June 2014, unless superseded by more recent edition). Alternatively, for proprietary designs and custom media mixes not meeting the media specifications, the media meets the pollutant treatment performance criteria in Section F.1.	A deep media layer provides additional filtration and supports plants with deeper roots. Standard specifications shall be followed. For non-standard or proprietary designs, compliance with Appendix F.1 ensures that adequate treatment performance will be provided.
☐	Media surface area is 3% of contributing area times adjusted runoff factor or greater. Unless demonstrated that the BMP surface area can be smaller than 3%.	Greater surface area to tributary area ratios: a) maximizes volume retention as required by the MS4 Permit and b) decrease loading rates per square foot and therefore increase longevity. Adjusted runoff factor is to account for site design BMPs implemented upstream of the BMP (such as rain barrels, impervious area dispersion, etc.). Refer to Appendix B.2 guidance. Refer to Appendix B.5 for guidance to support use of smaller than 3% footprint..
☐	Where receiving waters are impaired or have a TMDL for nutrients, the system is designed with nutrient sensitive media design (see fact sheet BF-2).	Potential for pollutant export is partly a function of media composition; media design must minimize potential for export of nutrients, particularly where receiving waters are impaired for nutrients.
Filter Course Layer		
☐	A filter course is used to prevent migration of fines through layers of the facility. Filter fabric is not used.	Migration of media can cause clogging of the aggregate storage layer void spaces or subgrade and can result in poor water quality performance for turbidity and suspended solids. Filter fabric is more likely to clog.
☐	Filter course is washed and free of fines.	Washing aggregate will help eliminate fines that could clog the facility and impede infiltration.
☐	To reduce clogging potential, a two-layer filter course (aka choking stone system) is used consisting of one 3" layer of clean and washed ASTM 33 Fine Aggregate Sand overlying a 3" layer of ASTM No 8 Stone (Appendix F.4).	This specification has been developed to maintain permeability while limiting the migration of media material into the stone reservoir and underdrain system.

	Design Criteria	Intent/Rationale
Aggregate Storage Layer		
☐	ASTM #57 open graded stone is used for the storage layer and a two layer filter course (detailed above) is used above this layer	This layer provides additional storage capacity. ASTM #8 stone provides an acceptable choking/bridging interface with the particles in ASTM #57 stone.
☐	The depth of aggregate provided (12-inch typical) and storage layer configuration is adequate for providing conveyance for underdrain flows to the outlet structure.	Proper storage layer configuration and underdrain placement will minimize facility drawdown time.
Inflow, Underdrain, and Outflow Structures		
☐	Inflow, underdrains and outflow structures are accessible for inspection and maintenance.	Maintenance will prevent clogging and ensure proper operation of the flow control structures.
☐	Inflow velocities are limited to 3 ft./s or less or use energy dissipation methods. (e.g., riprap, level spreader) for concentrated inflows.	High inflow velocities can cause erosion, scour and/or channeling.
☐	Curb cut inlets are at least 18 inches wide, have a 4-6 inch reveal (drop) and an apron and energy dissipation as needed.	Inlets must not restrict flow and apron prevents blockage from vegetation as it grows in. Energy dissipation prevents erosion.
☐	Underdrain outlet elevation should be a minimum of 3 inches above the bottom elevation of the aggregate storage layer.	A minimal separation from subgrade or the liner lessens the risk of fines entering the underdrain and can improve hydraulic performance by allowing perforations to remain unblocked.
☐	Minimum underdrain diameter is 8 inches.	Minimum diameter required for maintenance by City crews. For privately maintained BMPs, a minimum underdrain diameter of 6 inches is allowed.
☐	Underdrains are made of slotted, PVC pipe conforming to ASTM D 3034 or equivalent or corrugated, HDPE pipe conforming to AASHTO 252M or equivalent.	Slotted underdrains provide greater intake capacity, clog resistant drainage, and reduced entrance velocity into the pipe, thereby reducing the chances of solids migration.
☐	An underdrain cleanout with a minimum 8-inch diameter and lockable cap is placed every 50 feet as required based on underdrain length.	Properly spaced cleanouts will facilitate underdrain maintenance. For privately maintained BMPs, cleanout diameter of 6 inches is allowed.
☐	Overflow is safely conveyed to a downstream storm drain system or discharge point Size overflow structure to pass 100-year peak flow for on-line infiltration basins and water quality peak flow for off-line basins.	Planning for overflow lessens the risk of property damage due to flooding.

Conceptual Design and Sizing Approach for Storm Water Pollutant Control Only

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

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

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

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

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

E.20 BF-3 Proprietary Biofiltration Systems

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

Criteria for Use of a Proprietary BMP as a Biofiltration BMP

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

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

Guidance for Sizing a Proprietary BMP as a Biofiltration BMP

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

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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: Midway Rising

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

Attachment 3
Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

Project Name: Midway Rising

Indicate which Items are Included:

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

ATTACHMENT 3A

MAINTENANCE AGREEMENT

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

Attachment 3: For private entity operation and maintenance, Attachment 3 must include a Storm Water Management and Discharge Control Maintenance Agreement (Form DS-3247). The following information must be included in the exhibits attached to the maintenance agreement:

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

ATTACHMENT 3B

STRUCTURAL BMP MAINTENANCE THRESHOLDS AND ACTIONS

General Maintenance Information

Maintenance of Structural BMP Basins (Biofiltration, Partial Infiltration, Infiltration):

Inspection. Perform inspections monthly of the basins for sediment/trash accumulation, inlet and outlet structures, vegetation health, basin erosion, and standing water in basins.

INSPECTION ITEMS	TYPICAL MAINTENANCE INDICATOR(S)	MAINTENANCE ACTIONS
Trash and Debris	Trash and debris accumulation in area.	Remove and dispose of properly.
Sedimentation	Accumulation of sediment. (Overflow inlets should be at least 6-inches above bottom of basin.)	Remove and properly dispose of accumulated materials, without damage to the vegetation. Maintain integrity of side slopes. Do not drive heavy equipment on bottom of basins. Use ramps for staging equipment.
Vegetation	Poor vegetation establishment	Re-seed, re-plant, or re-establish vegetation per original plans. Maintain vegetation health.
	Overgrown vegetation	Mow or trim as appropriate.
	Presence of weeds	Remove weeds.
Erosion	Erosion due to concentrated irrigation flow or storm water flow.	Inspect soil and repair/re-seed/re-plant eroded areas after big storm events or as needed. Repair energy dissipation (riprap or splashblock).
Inlet and Outlet Structures	Check for clogging.	Clear obstructions. Inspect underdrain via cleanout(s) and outlet structure. Remove removable orifice place on downstream end of underdrain and cleanout underdrain and replace orifice plate.
Standing Water (beyond 96 hours after a rain event)	Inspect perforated underdrain pipe using cleanout riser and inspect downstream connection.	Make appropriate corrective measures such as adjusting irrigation system, removing obstructions of debris or invasive vegetation, unclogging perforated underdrain, loosening or replacing top soil to allow for better infiltration, or minor re-grading for proper drainage. If the issue is not corrected by restoring the BMP to the original plan and grade, the City Engineer shall be contacted prior to any additional repairs or reconstruction.

A Forterra Company

Modular Wetlands® Linear

A Stormwater Biofiltration Solution

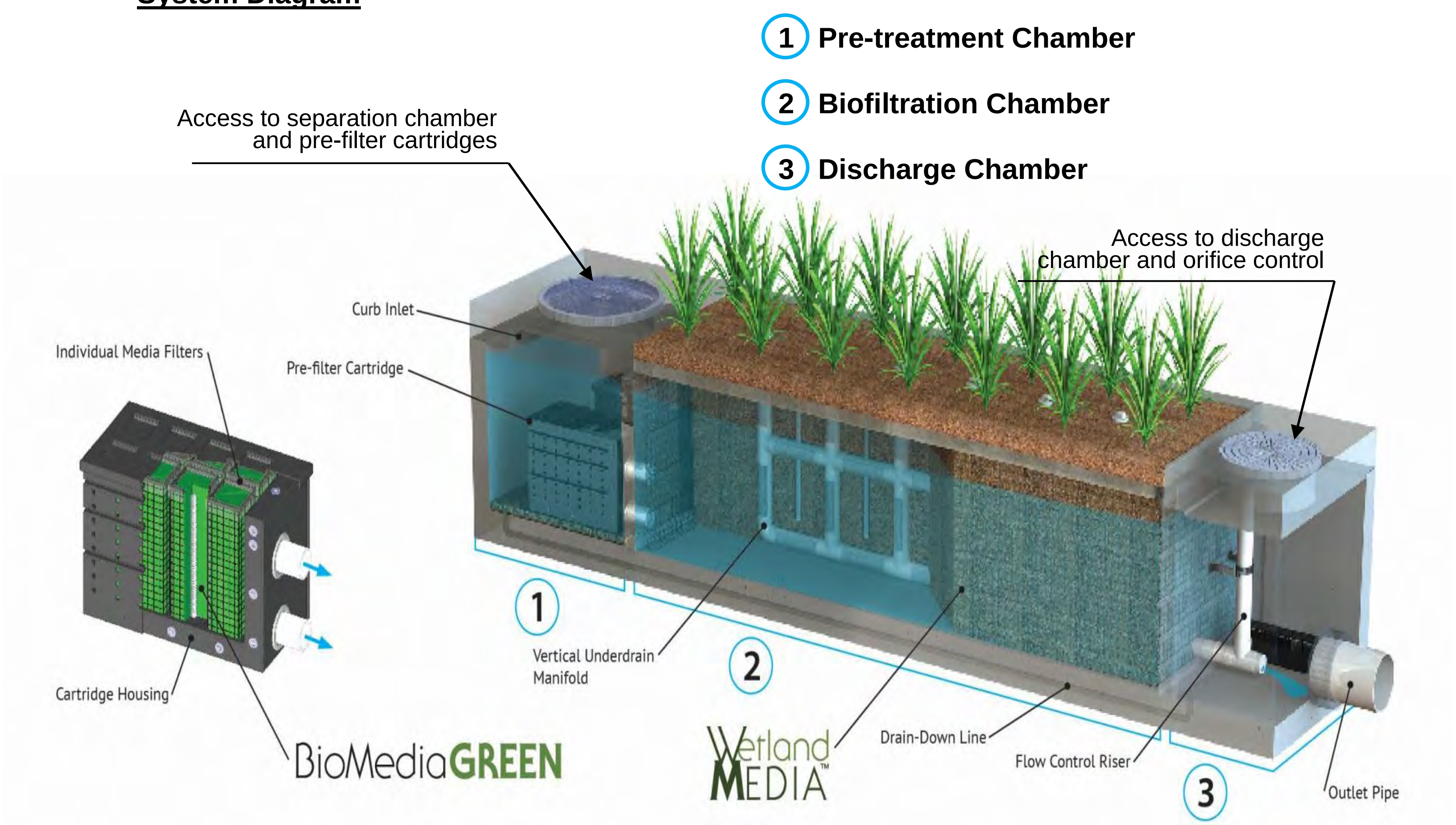
OPERATION & MAINTENANCE MANUAL

Inspection Guidelines for
Modular Wetland System - Linear

Inspection Summary

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

System Diagram



www.modularwetlands.com

Inspection Overview

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

Inspection Equipment

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

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

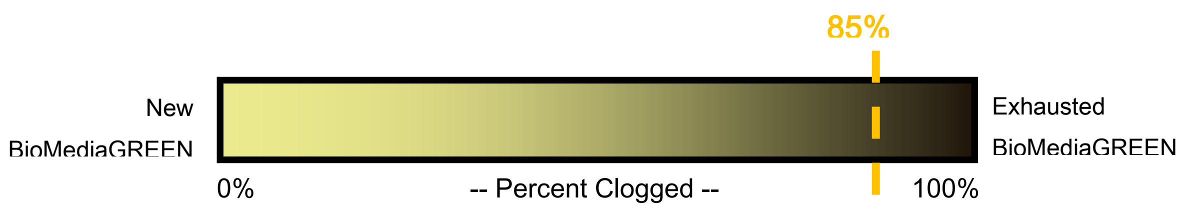
Inspection Steps

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

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

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

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



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

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

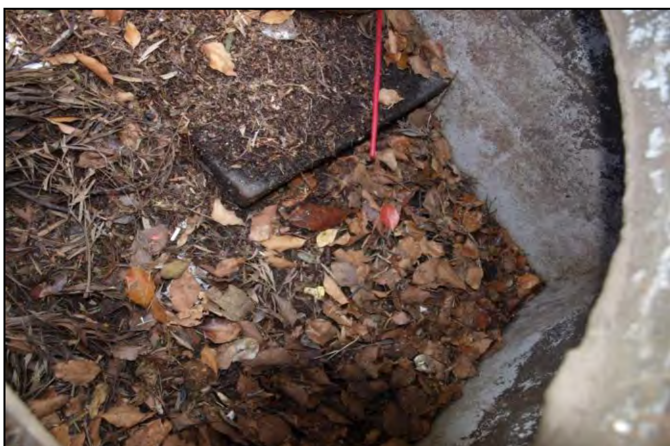
Using a permanent marker draw a 6 inch long horizontal line, as shown, at the higher water level in the MWS Linear discharge chamber.

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

Maintenance Indicators

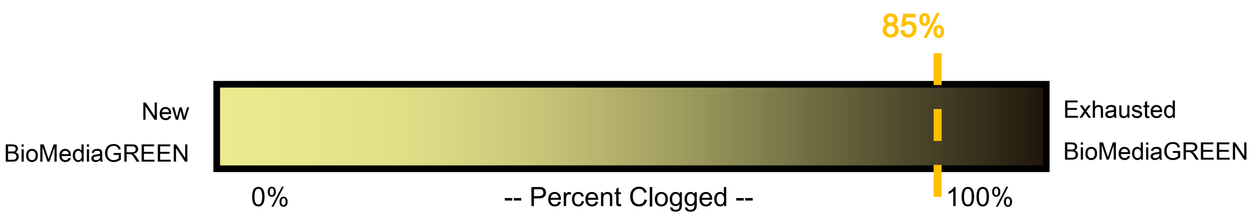
Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

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



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

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



- Excessive accumulation of sediment on the BioMediaGREEN media housed within the drain down filter. The following photos show of the condition of the BioMediaGREEN contained within the drain down filter. When media is more than 85% clogged replacement is required.

- Overgrown vegetation.

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

Inspection Notes

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

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

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

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

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

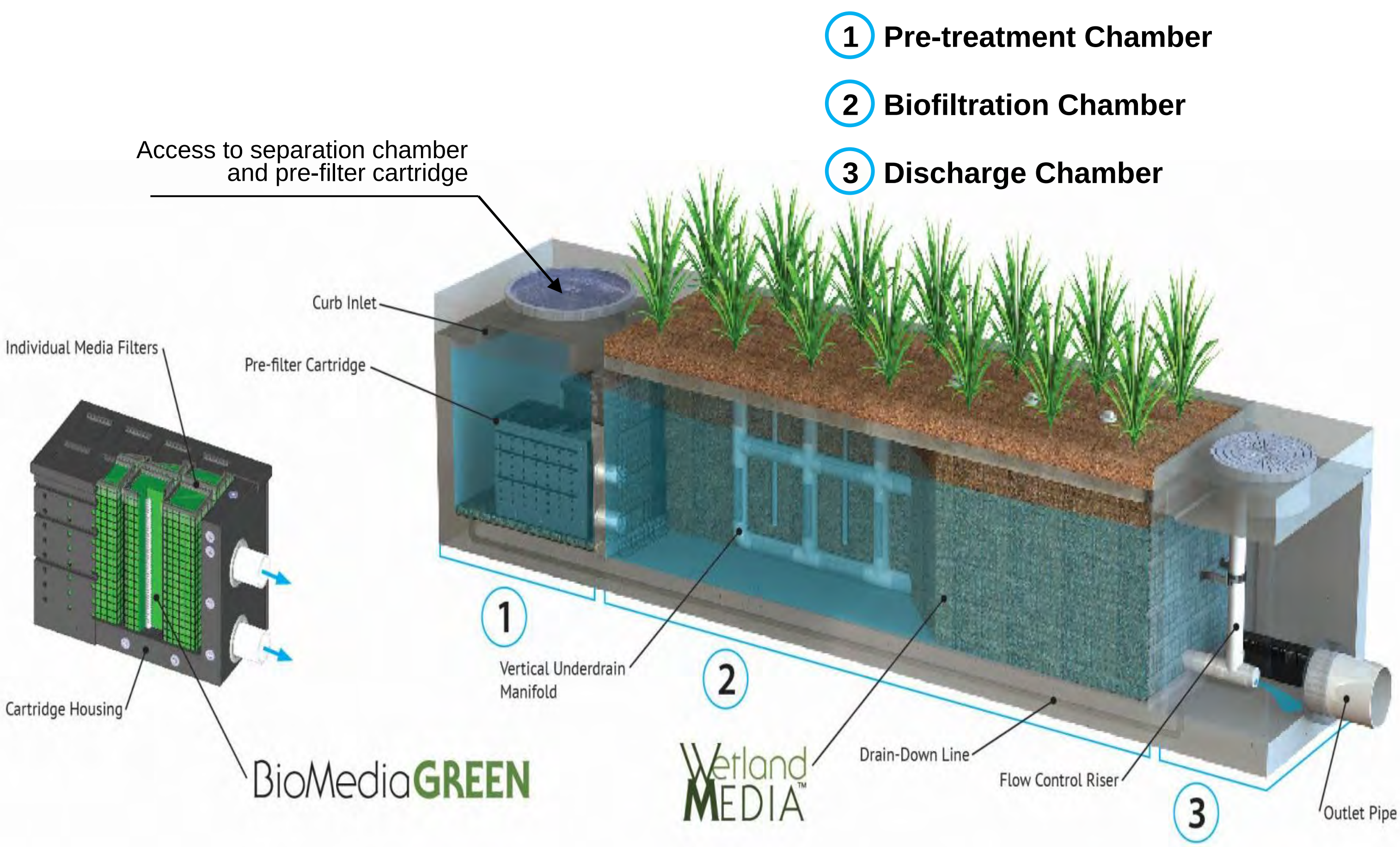
6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may not require irrigation after initial establishment.

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

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

System Diagram



www.modularwetlands.com

Maintenance Overview

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

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

Maintenance Equipment

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

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

Maintenance Steps

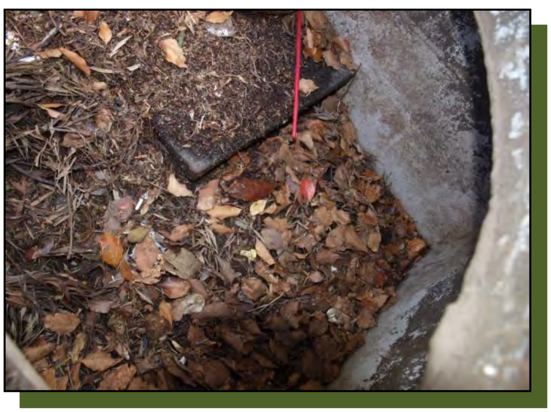
1. Pre-treatment Chamber (bottom of chamber)

   A. Remove access hatch or manhole cover over pre-treatment chamber and position vacuum truck accordingly.

   B. With a pressure washer spray down pollutants accumulated on walls and pre-filter cartridges.

   C. Vacuum out Pre-Treatment Chamber and remove all accumulated pollutants including trash, debris and sediments. Be sure to vacuum the floor until pervious pavers are visible and clean.

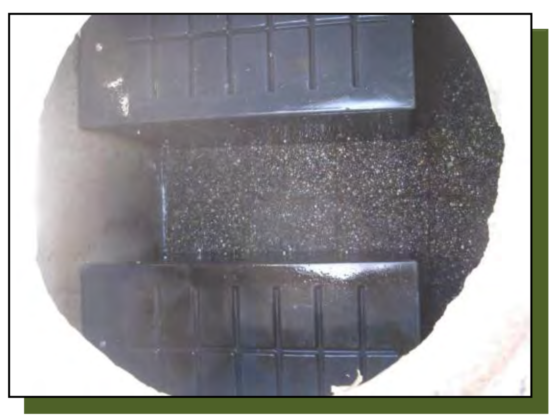
   D. If Pre-Filter Cartridges require media replacement move onto step 2. If not, replace access hatch or manhole cover.



Removal of access hatch to gain access below.

Insertion of vacuum hose into separation chamber.

Removal of trash, sediment and debris.



Fully cleaned separation chamber.

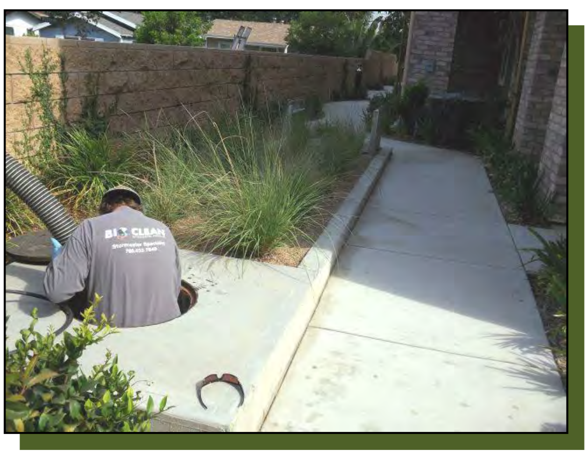
2. Pre-Filter Cartridges (attached to wall of pre-treatment chamber)

   A. After finishing step 1 enter pre-treatment chamber.
   B. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.

Pre-filter cartridges with tops on.

Inside cartridges showing media filters ready for replacement.

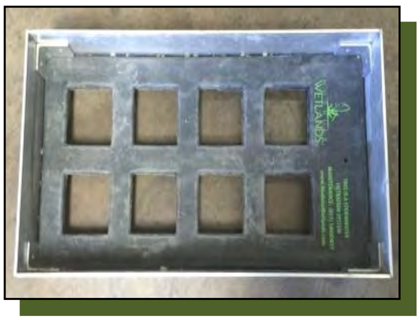
   C. Place the vacuum hose over each individual media filter to suck out filter media.



Vacuuming out of media filters.

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

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



Refilling trey for media replacement.

Refilling trey on cartridge with bulk media.

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

3. Biofiltration Chamber (middle vegetated chamber)

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

4. <u>Discharge Chamber (contains drain down cartridge & connected to pipe)</u>

A. Remove access hatch or manhole cover over discharge chamber.
B. Enter chamber to gain access to the drain down filter. Unlock the locking mechanism and left up drain down filter housing to remove used BioMediaGREEN filter block as shown below:

C. Insert new BioMediaGREEN filter block and lock drain down filter housing back in place. Replace access hatch or manhole cover over discharge chamber.

Inspection Notes

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

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

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

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

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

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

Inspection Form

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

www.modularwetlands.com

Maintenance Report

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

www.modularwetlands.com

Attachment 4
Copy of Plan Sheets Showing Permanent Storm Water BMPs

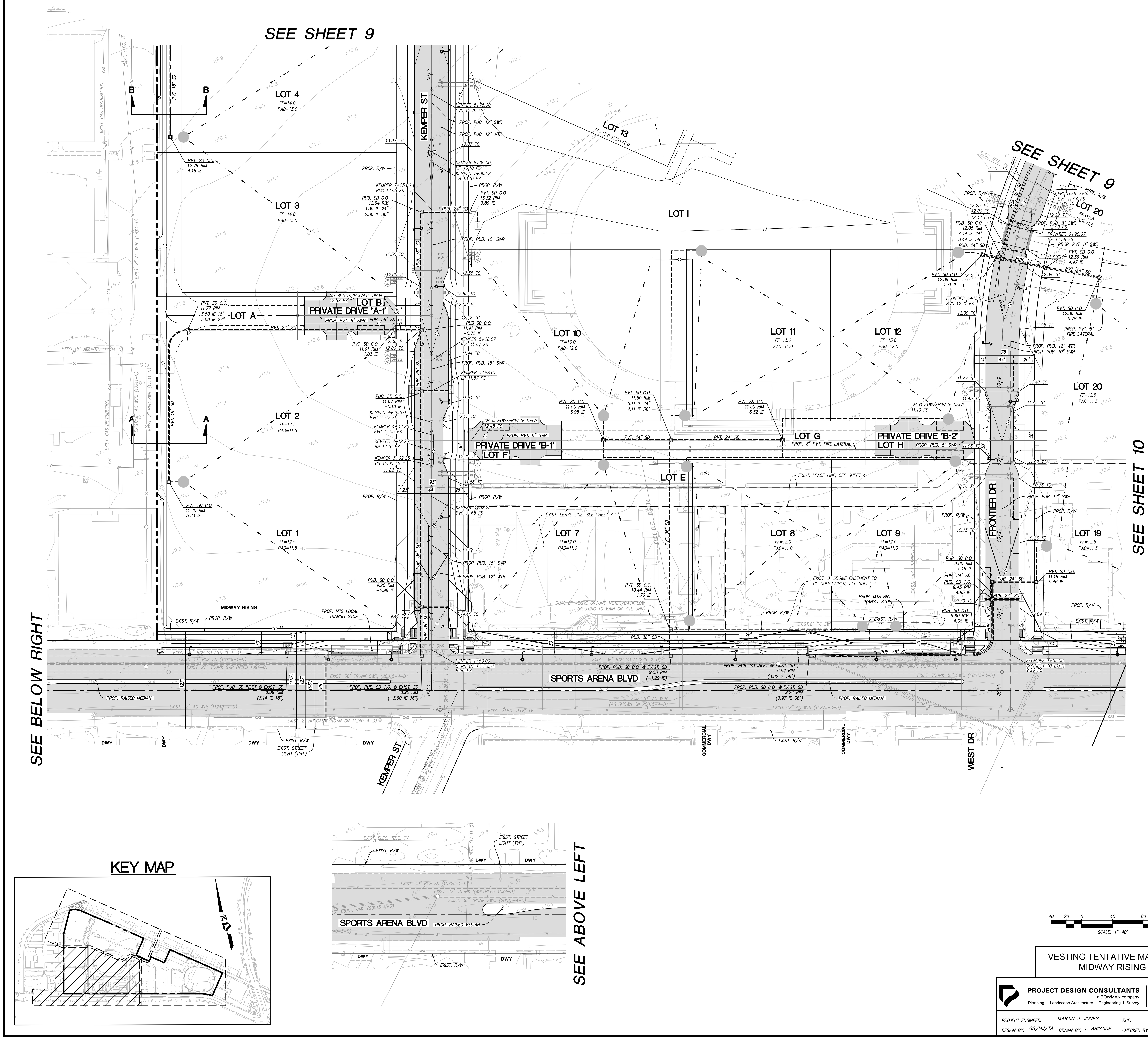
This is the cover sheet for Attachment 4.

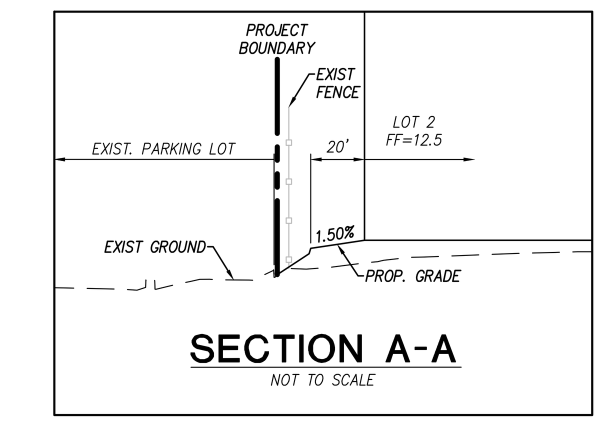
Project Name: Midway Rising

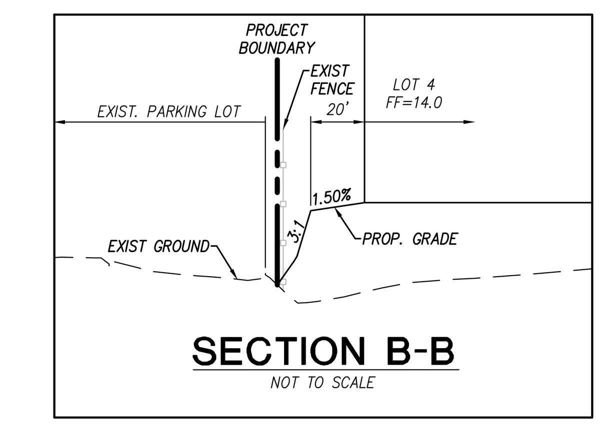
Use this checklist to ensure the required information has been included on the plans:

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.







LEGEND

DESCRIPTION	SYMBOL
PROJECT BOUNDARY	
PROP. RIGHT OF WAY	
EXIST. FIRE HYDRANT	
PROP. FIRE HYDRANT	
PROP. FIRE SERVICE AND BACKFLOW PREVENTER	BFP F
PROP. DOMESTICE WATER SERVICE, METER AND BACKFLOW PREVENTER	MTR BFP W
PROP. MODULAR WETLAND UNIT	MWU
PROP. STORM DRAIN CLEAN-OUT	
PROP. STORM DRAIN INLET	
PROP. STORM DRAIN	
PROP. PRIVATE STORM DRAIN	
PROP. SEWER MANHOLE	
PROP. SEWER MAIN	
PROP. WATER MAIN	
PROP. STREET LIGHT	
PROP. PEDESTRIAN RAMP	
BIKE BUFFER, HARDSCAPE	
FOUND MONUMENT	
PROP. COMMERCIAL DRIVEWAY	
TRUNCATED DOMES (DETECTABLE WARNING)	
PROP. PRIVATE BIO-FILTRATION (DETAIL ON SHEET 9)	
BUS STOP SLAB	
PROPOSED MODIFICATION OF EXISTING TRAFFIC SIGNAL	

SCALE: 1"=40'

VESTING TENTATIVE MAP FOR MIDWAY RISING

PROJECT DESIGN CONSULTANTS
a BOWMAN company
Planning | Landscape Architecture | Engineering | Survey
701 B Street, Suite 800
San Diego, CA 92101
619.235.6471 Tel
619.234.0349 Fax

PROJECT ENGINEER: MARTIN J. JONES RCE: 78492
DESIGN BY: GS/MJ/TA DRAWN BY: T. ARISTIDE CHECKED BY: M. JONES

Prepared By:
Name: PROJECT DESIGN CONSULTANTS
Address: 701 B STREET, SUITE 800
SAN DIEGO, CA 92101
Phone #: (619) 235-6471 Fax #: (619) 234-0349

Project Address:
3500 SPORTS ARENA BLVD
SAN DIEGO, CA 92110

Project Name:
MIDWAY RISING
TENTATIVE MAP NO. 3258589
LAND USE PLAN NO. 3258590

Sheet Title:
GRADING, DRAINAGE, & BMP PLAN

Revision 10:
Revision 9:
Revision 8:
Revision 7:
Revision 6:
Revision 5:
Revision 4:
Revision 3:
Revision 2:
Revision 1: DRAFT 5/21/24

Original Date: 10/27/2023

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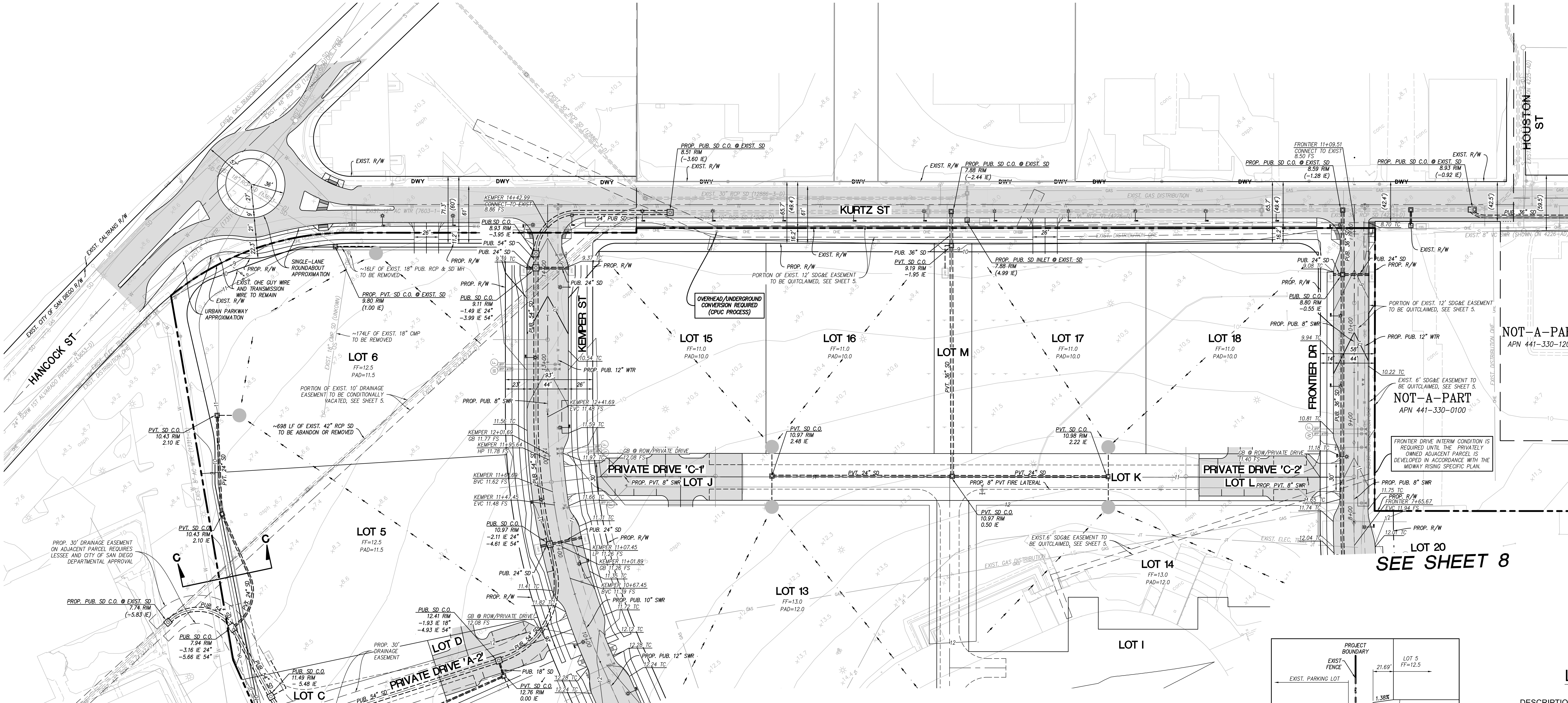
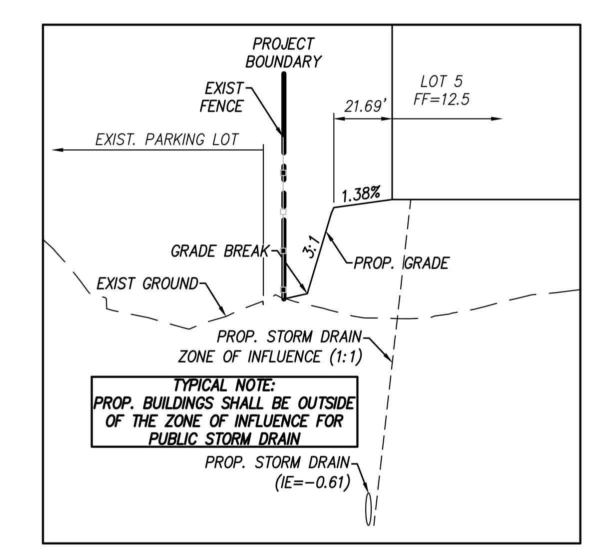
PTS #

1856-6266 CCS83 COORDINATES
214-1701 LAMBERT COORDINATES





SECTION C-C
NOT TO SCALE

LEGEND

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PROP. FIRE HYDRANT	
PROP. FIRE SERVICE AND BACKFLOW PREVENTER	BFP F
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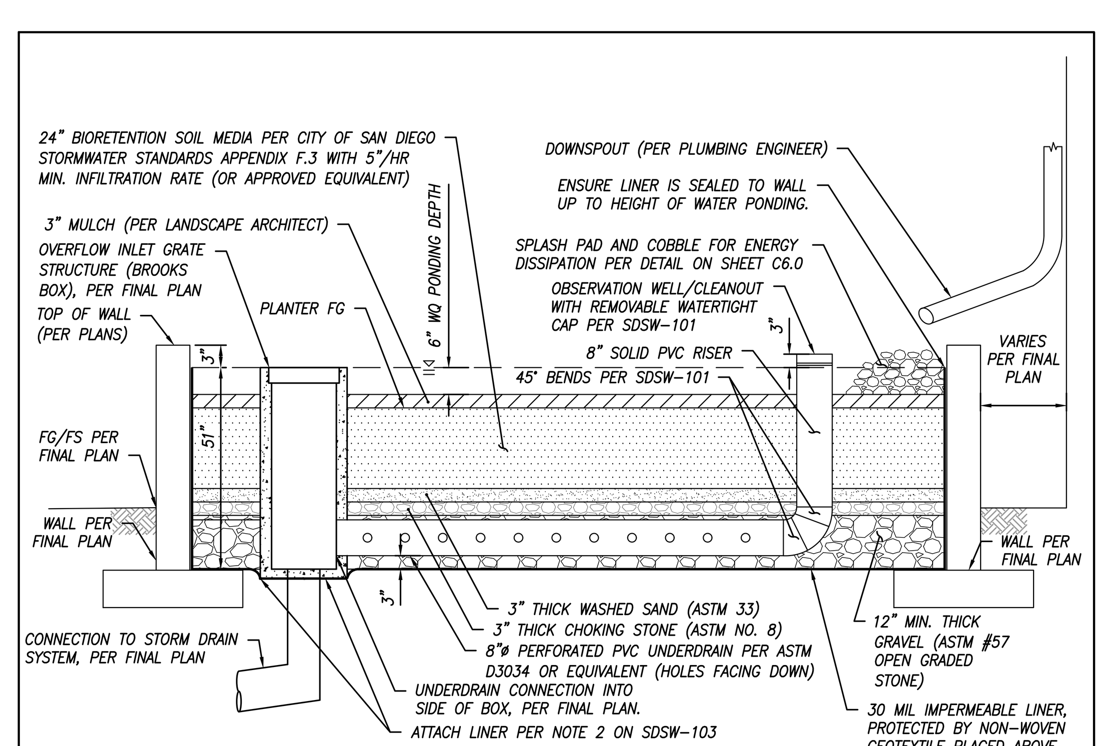
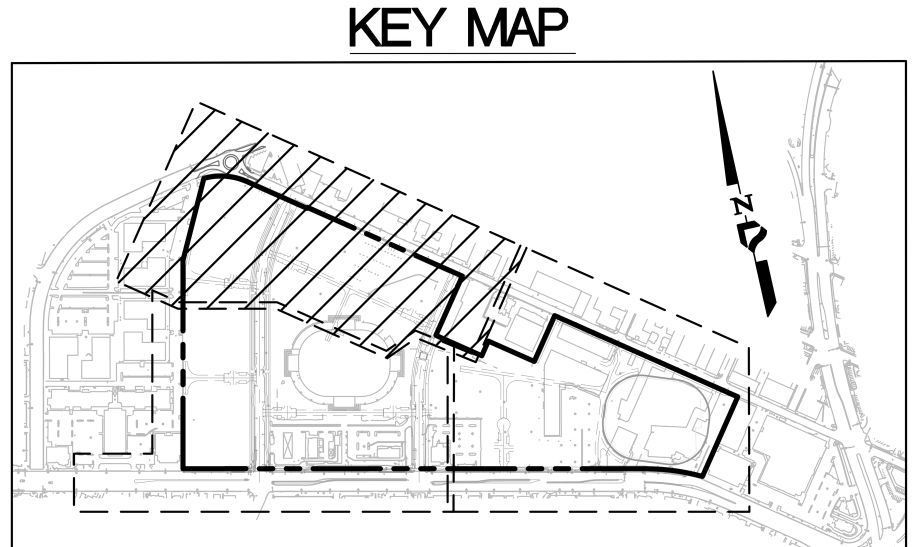


OFFSET BIOFILTRATION PLANTER TYPICAL CROSS SECTION DETAIL
NOT TO SCALE



KEY MAP

SCALE: 1"=40' (0, 20, 40, 80, 120)

VESTING TENTATIVE MAP FOR MIDWAY RISING

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1856-6266 CCS83 COORDINATES
214-1701 LAMBERT COORDINATES

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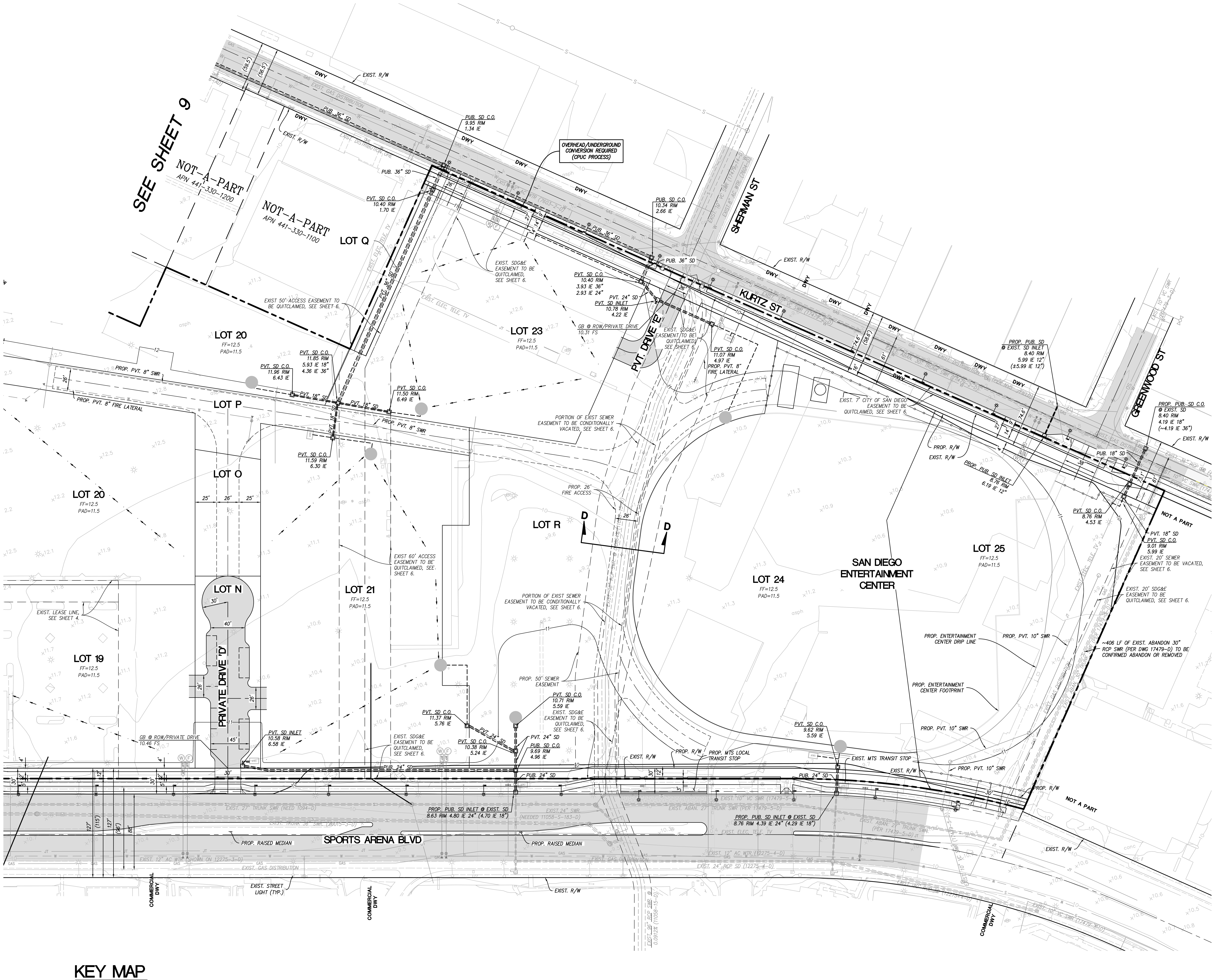

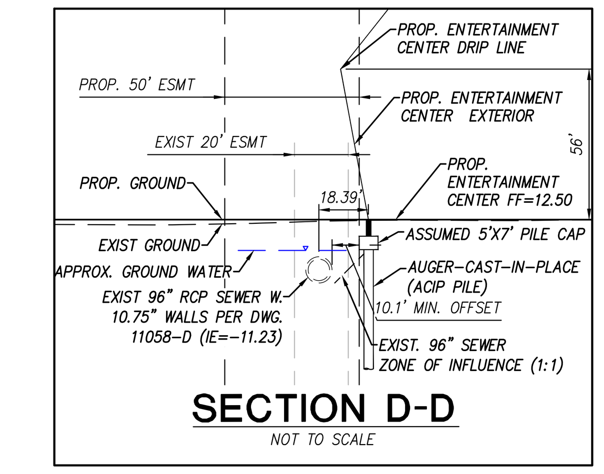

SECTION D-D

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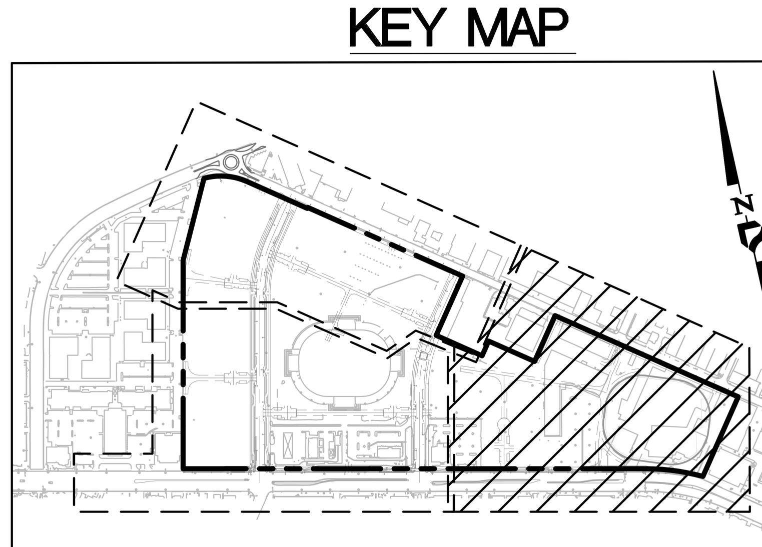

40 20 0 40 80 120
SCALE: 1"=40'

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Attachment 5
Drainage Report

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

PRELIMINARY
DRAINAGE REPORT

MIDWAY RISING

City of San Diego, CA
December 19, 2024
TM PRJ #1106734

APN #: 441-590-04
Project Address: 3500 Sports Arena Blvd San Diego, CA 92110
Legal Description: PARCEL 2 OF PARCEL MAP NO. 21332

Prepared For:

Midway Rising LLC
700 Second Street
Encinitas, CA 92024

Prepared By:

PROJECT DESIGN CONSULTANTS
a Bowman company
701 B Street, Suite 800
San Diego, CA 92101
619.235.6471

PDC Job No. 4443.10

Prepared by: J. Novoa, PE
Under the supervision of

Chelisa Pack, PE RCE 71026
Registration Expires 06/30/25

TABLE OF CONTENTS

TABLES

APPENDICES

1. INTRODUCTION

This preliminary drainage report has been prepared in support of the Tentative Map (TM) package associated with the proposed Midway Rising development project (Project). The Midway Rising Project is a re-development project consisting of a new sports/entertainment arena and mixed-use development with residential including affordable housing and commercial uses. Additional construction includes restaurants, a hotel, multi-acre urban park space and plazas throughout the project. Total Project area within the Tentative Map boundary is 49.23 acres that is currently an existing sports/entertainment arena, surrounding parking lot, a gas station and two restaurants. The project is located south of Interstate 8 and west of Interstate 5, and is bounded on the south by Sports Arena Boulevard, on the northeast by Kurtz Street. The Tentative Map project proposes ~4,250 new housing units with ~2,000 of them being affordable housing units. Refer to the Vicinity Map below: Figure 1 for the Project location.

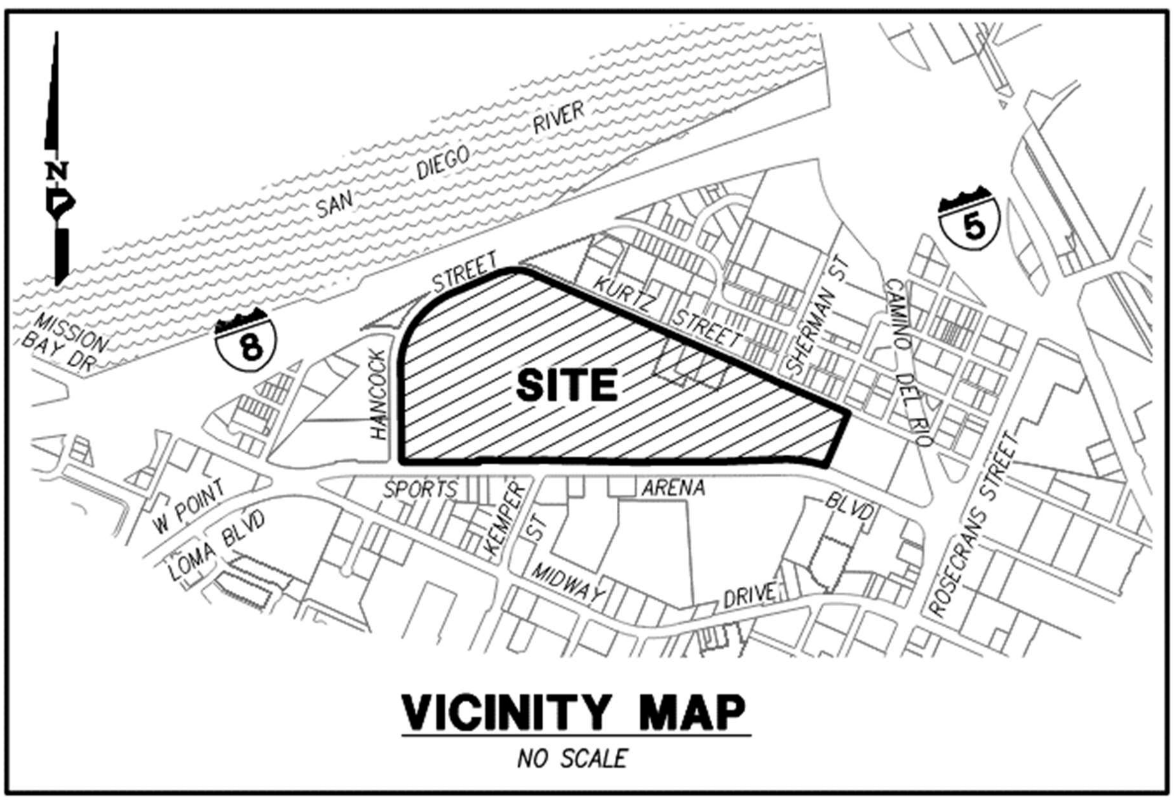


Figure 1: Vicinity Map

Presently runoff flows across the site in three main directions which mostly sheet flows to the surrounding streets and then enters the public storm drain system connecting to the downstream San Diego River channel. The proposed project will continue to send all runoff to these points with a proposed upgraded storm drain that will be constructed to convey water from the site to the connection points downstream. The storm drain system to which the majority of the site discharges outlets into the downstream storm drain and is then pumped into the San Diego River channel via a regional pump house (Pump Station H), located north of Interstate 8, per Drawing Number 3460-D.

The proposed buildings onsite are set at elevations higher than the existing surrounding streets due to potential existing condition flooding in the surrounding area. The surrounding area is both very flat and has low-lying elevations that drain to existing downstream storm drains that are very flat. Multiple biofiltration basins and other BMPs will be implemented to manage water quality. For water quality management concerns refer to the Storm Water Quality Management Plan (SWQMP) prepared by Project Design Consultants for the proposed project treatment BMPs.

The project is not subject to the Clean Water Act (CWA) Sections 401 and 404 as there will be no fill or dredging discharged into an aquatic environment since the project is located in urban land. The project's storm drain will tie into existing downstream storm drain systems and will not include grading in any downstream aquatic environment.

2. EXISTING AND PROPOSED DRAINAGE PATTERNS AND IMPROVEMENTS

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

2.1 Existing Drainage Patterns

There are currently on-site drainage facilities including inlets and stormdrain pipes with much of the site developed with asphalt surfacing and structures. The existing site sheet flows in three general directions, with approximately 50% of the site towards the north and into existing stormdrain in Kurtz Street. Approximately 40% of the site drains south to storm drain in Sports Arena Blvd and drains to the west. Both of these systems eventually drain to the existing pump house north of I-8 and are pumped into the San Diego River Flood Control Channel. The remaining 10% of the site area flows southeast towards Rosecrans Street which eventually outlets to the same channel as the above two areas of the site above through the existing City of San Diego Pump station D. There are three different discharge locations, but all eventually outlet to the San Diego River. The project site and the surrounding blocks are prone to flooding due to very flat street slopes and shallow and storm drain system with pipes with less than 0.5%. Offsite drainage areas surrounding the project in the northeast were delineating utilizing GIS topography and SanGIS stormdrain information to assist with the delineations as well as site visits to locate drainage inlets and existing drainage patterns. Refer to Exhibit A in Appendix 4 for the existing condition drainage map.

There are also a couple fragments of area outside the project boundary which drains onto the site, but generally there is not a significant amount of runon from the other sides of the project site.

2.2 Proposed Drainage Improvements

The site will continue to discharge to various outlet points to generally preserve the existing condition drainage patterns. The proposed drainage improvements include private storm drains collecting rooftop and surface drainage, a public storm drain in Kemper Street and Frontier Drive, biofiltrations planters and modular wetland units. As mentioned in the Existing Drainage Patterns section, the project site and multiple blocks surrounding the project are extremely flat and have shallow and storm drain pipe slopes less than 0.5%. A storm drain that drains through the northwest corner of the site is a 42” storm drain at 0.3% slope per Drawing 4227-D. Due to the proposed building at the northwest corner that conflicts with the existing storm drain alignment, the project proposes to realign the portion that cuts through the site with a replacement 54” storm drain. This realignment reduces the slope to 0.23% from 0.30%, but the increased pipe size allows for more capacity. A deviation from the City of San Diego Drainage Design Manual will be requested as there is not a feasible solution to increase the slope of the storm drain while tying into the existing system.

Frontage improvements require replacement of inlets along Sports Arena Boulevard and due the shallow groundwater conditions, all proposed storm drain systems will be built with water tight joints. Refer to Exhibit B in Appendix 4 for the proposed condition drainage map.

3. HYDROLOGY CRITERIA, METHODOLOGY, AND RESULTS

Hydrologic modeling was performed per City of San Diego Drainage Design Manual criteria to provide the design flows for storm drain design and improvements.

3.1 Hydrology Criteria

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

Table 1: Hydrology Criteria

Existing and Proposed Hydrology:	100-year storm frequency
Soil Type:	Hydrologic Soil Group D
Land Use / Runoff Coefficients:	Based on criteria presented in the 2017 City of San Diego Drainage Design Manual.
Rainfall intensity:	Based on intensity duration frequency relationships presented in the January 2017 City of San Diego Drainage Design Manual, see Appendix 1.

3.2 Hydrologic Methodology

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

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

The Civil-D Rational Method program was used to calculate onsite and offsite runoff for the 100-year storm event. The runoff coefficient for industrial land type of 0.95 was used for the existing onsite conditions while similar runoff coefficients were used in conjunction with multi-family residential development, and commercial development were used for the proposed onsite condition. Offsite hydrology runoff coefficients were based on land uses apparent from aerial photography, which includes mostly industrial/commercial development.

3.3 Description of Hydrologic Modeling Software

The Civil-D Rational Method Program was used to perform the Rational Method hydrologic calculations. This section provides a brief explanation of the computational procedure used in the computer model.

The Civil-D Modified Rational Method Hydrology Program is a computer-aided design program where the user simulates the hydrology with a link-node model. The sub-watersheds are represented by a pair of nodes and the conduits connecting them are assigned channel properties. The intensity-duration-frequency relationships are applied to each of the drainage areas in the model to yield peak flow rates at each point of interest per the methodology in the *City of San Diego Drainage Design Manual*.

3.4 Hydrology Results

The Rational Method as presented in the City of San Diego Drainage Design Manual was used to calculate the existing and proposed conditions peak storm flows. Table 2 below summarizes the Rational Method results for the comparison of the existing and proposed project site.

Table 2: Hydrology Results

	MIDWAY RISING HYDROLOGY SUMMARY							
	EXISTING CONDITION				PROPOSED CONDITION			
OUTFALL OF INTEREST	SYSTEM	AREA (ac)	TC (min)	Q100 (cfs)	SYSTEM	AREA (ac)	TC (min)	Q100 (cfs)
To Outfall 1 (Southwest Corner)	100	8.8	10.1	31.2	1000	10.7	12.6	30.3
	120	6.1	5.0	25.3	1100	6.6	8.3	18.2
	TOTAL	***14.9***		***56.5***	***TOTAL***	***17.3***		***48.5***
To Outfall 2 (Northwest Corner)	200	30.0	12.7	93.3	2000	51.3	23.4	120.4
	250	25.2	8.5	73.0	2100	1.3	5.7	5.3
	280	10.3	6.0	43.0	2200	14.7	11.0	45.9
	TOTAL	***65.5***		***209.3***	***TOTAL***	***67.3***		***171.6***
To Outfall 3 (Southeast Corner)	300	10.0	8.4	38.4	3000	4.5	5.2	11.0
	320	2.8	6.4	10.6	3100	3.9	5.0	15.2
	TOTAL	***12.8***		***49.0***	***TOTAL***	***8.4***		***26.2***
	GRAND TOTAL	**93.2**		**314.8**	**GRAND TOTAL**	**93.0**		**246.3**

The proposed 100-year flows were found to be less than pre-project 100-year flows with an increase in landscaping, park area and plazas. The project site's goal is to maintain existing flow patterns throughout the site, but minor areas were shifted to accommodate the grading of the site. In the post-project condition, less flow sheet flows to Kurtz Avenue, and runoff is directed into the larger of the two Kurtz Street storm drains, in order to minimize potential flooding due to minimal storm drain capacity. The flow rate in the proposed condition decreases due increase in landscape areas and longer time of concentrations in areas of urban park and paseos through the project.

4. HYDRAULIC CRITERIA, METHODOLOGY, AND RESULTS

4.1 Existing Hydraulic Conditions

As mentioned earlier, the project site and the surrounding blocks are prone to flooding due to very flat street slopes and storm drain system with flat slopes. Although the project will decrease peak flows compared to pre-project conditions, the site development may be affected by the surrounding undersized storm drain infrastructure. The project cannot be designed to eliminate these existing deficiencies; however, the drainage conditions onsite can be improved if the proposed site grading is elevated from surrounding grades. The project proposes to elevate the site above surrounding grades. The existing levee and downstream pump protects the site against potential sea level rise effects and backwater effects of the riverine flooding of the San Diego River. However, the downstream pumps are under capacity. Some of the downstream storm drains draining to the pump station are under capacity as well, so even if pumps are upgraded in the future as a part of the City's capital improvement plan, the regional drainage capacities may still not meet current drainage standards. It is beyond the scope of this project to provide a full hydraulic model all the way to the existing stormwater pump, since the pipes are likely surcharged during peak events and the flows are unknown. The City of San Diego Stormwater Pump Operation staff has provided some previous studies from other consultants that have been contracted with the City to study some of the regional drainage issues near the project. The project team reviewed the information from these previous studies in order to gather information about the regional drainage system. See below for a summary:

1) *Updated Hydraulic Analysis for the City of San Diego Pump Stations B,D,F,H, and L*, dated June 18, 2018, and prepared by Michael Baker International.

2) *Pump Station H Hydrologic Analysis (TO 066 FY23 Pump Station H Feasibility Study)*, dated April 21, 2023, and prepared by Tetra Tech.

The Michael Baker study summarized the existing deficiencies of Pump Station H, which collects drainage from the majority of the site and a larger regional drainage area of the Midway area. The report mentions that the current pumping capacity is approximately 147 cfs, based on information provided by the City. Michael Baker's study also summarized previous analysis work for the drainage area performed by O'Day Consultants. O'Day Consultants had estimated the Pump Station H drainage area to be 426.7 acres, and the 2-year peak flow based on the Rational Method to be 367.7 cfs and the 100-year peak flow based on the Rational Method to be 768.7 cfs. Based on this analysis, since the pump capacity is less than the 2-year peak flow rate, flooding is therefore expected to occur in this basin for all but the smallest low-intensity storm events. Refer to report excerpts in Appendix 6.

The TetraTech study also analyzed the Pump Station H drainage area and estimated it to be approximately 394 acres. The excerpts of their model and drainage exhibit are provided for reference in Appendix 6. The flow rates that they estimated for certain pipe segments are helpful in determining the expected flow amounts in various locations throughout the watershed. Because they analyzed the full drainage area to the Pump, whereas this Midway Rising drainage study only analyzed the onsite area plus some of the onsite runon, these flow values are helpful in determining the segments of pipe downstream of the project that may be undersized in the pre-project condition. For example, from Node 607 to Node 111, the 100-year flow rate per their study is 360.1 cfs. This represents a 54-inch concrete pipe with a slope of 0.3% per Drawing 3460 (Appendix 6). The full flow capacity of a 54-inch pipe at that slope is only 107.7 cfs, therefore, there is limited existing capacity, and flows are likely to surcharge and pond in low-lying areas during peak flow events.

After review of the above previous studies and existing conditions, PDC created exhibits displaying the 9- and 10-foot contours and elevations in the project vicinity. The intent was to show a conservative inundation scenario. The exhibit displays the approximate inundation limits if the surrounding areas were to pond up to the 10-foot contour elevation (NGVD29), the proposed project site would not be inundated. The project proposes to elevate onsite existing grades above surrounding grades. The hatched exhibits for both pre-project and post-project conditions are found in Appendix 4. Subsequent to preparation of this exhibit, PDC received further information from the City of San Diego Stormwater Engineering Division with documentation showing that in the January 22, 2024 storm, the wet weather water level at Pump Station H was recorded as approximately 10.4 NGVD29. For further information and explanation regarding the 10.4' elevation, see City of San Diego documentation in Attachment 6. It should be noted that during that storm, the station lost power during a portion of the storm. Additionally, photos were taken surrounding the site showing shallow ponding on surrounding streets, with some locations in areas that eventually drain to Pump Station H, and other areas that eventually drain to Pump Station D. By visual inspection of the provided photos, ponding elevations were estimated as less than elevation 10. From the understanding of the undersized pump and coordination with the City of San Diego Stormwater Pump Operations staff, it is expected that some ponding occurs in surrounding streets during large storms. The project team has been informed from the City of San Diego that a master plan regional analysis for the San Diego River watershed that may be able to provide additional information pertaining to the existing flooding conditions sometime in the future, but the work is not currently ongoing or under contract, so results may not be available anytime soon. Because the timing of the regional drainage analysis is unknown, this project proposes to refine the onsite project-specific hydraulic conditions in final engineering based on a conservative assumption of a tailwater of 10.4 surrounding the site, unless updated information becomes available prior to the start of final engineering for this project.

4.2 Proposed Hydraulic Conditions

Hydraulic analyses provided during final engineering will include inlet calculations and HGL determination in onsite storm drain pipes. During final engineering, all proposed onsite storm drain pipes will be designed to conform to the minimum requirements outlined in Chapter 4.1.7 of the City of San Diego Drainage Design Manual regarding water-tight joints. As noted in Section 4.1 above, the tailwater condition for the points of connection to surrounding existing storm drain pipes surrounding the project may have a high tailwater condition during peak events. It is proposed that a hydraulic analysis be completed during final engineering for the post-project condition to show that the combination of street capacity and/or pipe capacity is adequate to convey onsite flows to the perimeter of the site without inundating any proposed finished floors of any onsite proposed buildings. One way that this could be accomplished would be create a HEC-RAS model of the onsite streets and model the onsite flows in the street sections assuming that the onsite pipes have little or no capacity. This is a "worst case" scenario that would show that even if the onsite storm drain was affected by a high tailwater, the proposed buildings would still be protected from flooding. A detailed hydraulic analysis for the project will be performed at final engineering.

As discussed in Section 2.2 above, the project proposes to upsize and realign an existing storm drain that drains through the northwest corner of the site from a 42" storm drain with a replacement 54" storm drain.

PDC performed a Culvertmaster model for the existing and proposed conditions of the northwest corner of the project site. In the existing condition, the existing 42" stormdrain was modeled with overland flow modeled as a weir of any excess flow that is not contained within the stormdrain pipe. The proposed condition was modeled similarly, but included the upgraded 54" SD in addition to the proposed condition flows. It was observed that the starting water surface elevation of the model influenced the results, due to this, two scenarios were modeled. The first scenario was modeled utilizing the soffit elevation of where the proposed stormdrain ties into the existing 42" SD pipe (4227-D) and another scenario with the water surface elevation set at the rim of the proposed cleanout where the project ties into. This was done to simulate backflow from the pump up to this rim elevation. In the existing conditions, both scenarios indicate that the 100-year flow would surcharge the pipe and overflow in the existing parking lot. The first scenario results indicate that the proposed 100-year condition flows are contained entirely within the pipe, while the second scenario has some flow in the roadway, but less than the existing condition. Exhibits have been provided in Appendix 4 for the existing and proposed conditions of this preliminary analysis with a tabular summary of the scenarios.

5. CONCLUSION

This drainage report was prepared for the Midway Rising project. From the hydrologic calculations it is determined there is no increase of overall peak flow rate in the proposed conditions compared to the pre-project conditions.

APPENDIX 1

Supplemental Information (Intensity Duration Frequency Curve, Runoff Coefficients)

Table A-1. Runoff Coefficients for Rational Method

Land Use	Runoff Coefficient (C) Soil Type [1]
Residential:	
Single Family	0.55
Multi-Units	0.70
Mobile Homes	0.65
Rural (lots greater than ½ acre)	0.45
Commercial [2]	
80% Impervious	0.85
Industrial [2]	
90% Impervious	0.95

Note:
[1] Type D soil to be used for all areas.
[2] Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil.

Actual imperviousness = 50%
Tabulated imperviousness = 80%
Revised C = (50/80) x 0.85 = 0.53

The values in Table A–1 are typical for urban areas. However, if the basin contains rural or agricultural land use, parks, golf courses, or other types of nonurban land use that are expected to be permanent, the appropriate value should be selected based upon the soil and cover and approved by the City.

A.1.3. Rainfall Intensity

The rainfall intensity (I) is the rainfall in inches per hour (in/hr.) for a duration equal to the T_C for a selected storm frequency. Once a particular storm frequency has been selected for design and a T_C calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration-Frequency Design Chart (Figure A-1).

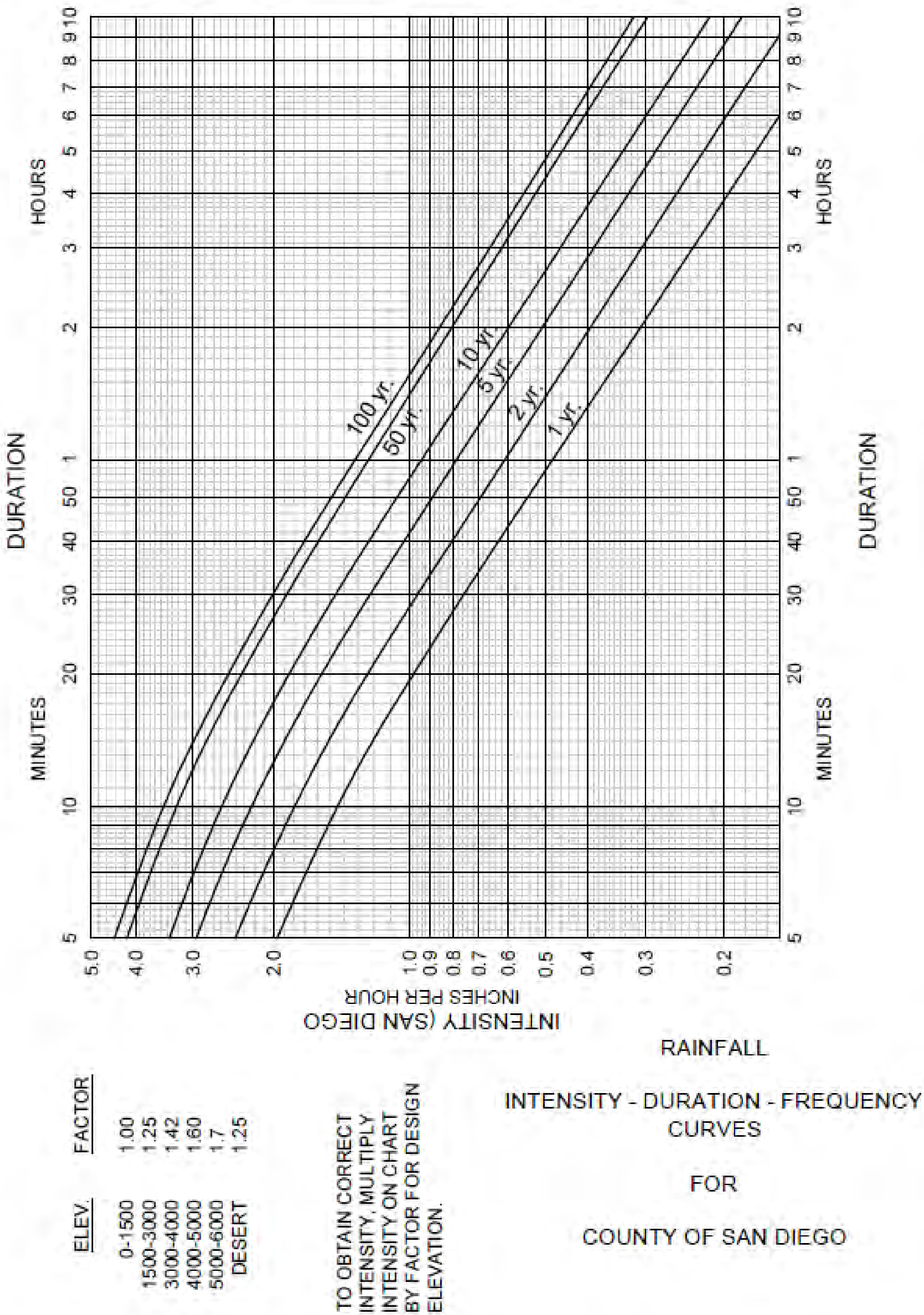


Figure A-1. Intensity-Duration-Frequency Design Chart

Map Projection:
Universal Transverse Mercator Zone 11N; North American Datum 1983;
Western Hemisphere; Vertical Datum: NAVD 88

N

1 inch = 500 feet — 1:6,000

0 250 500 750 1,000 2,000 feet

0 125 250 500 meters

EXHIBIT 7.1: ANNOTATED FIRM

VERSION NUMBER
2.3.3.3

MAP NUMBER
06073C1614H

MAP REVISED
DECEMBER 20, 2019

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

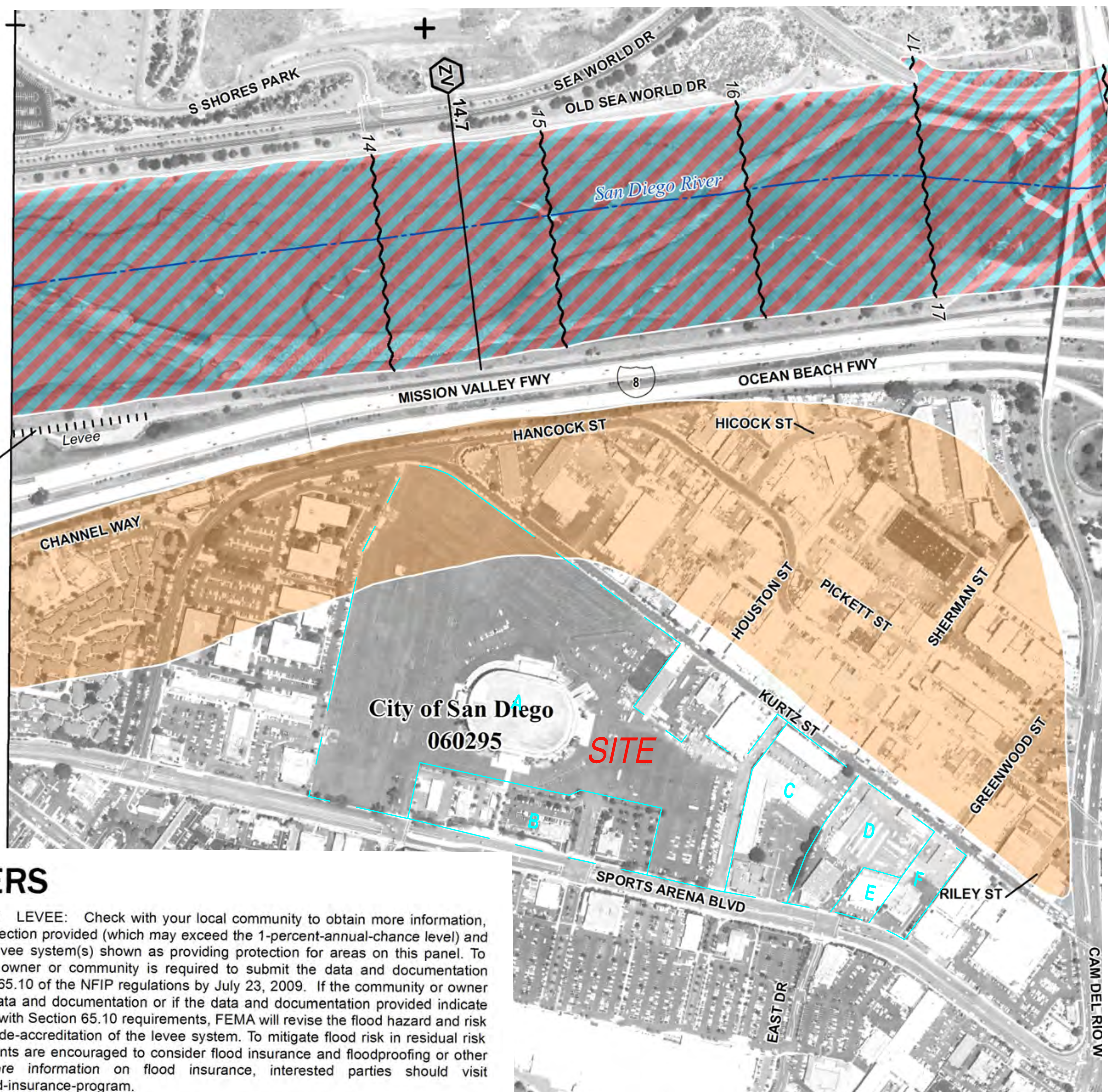
SAN DIEGO COUNTY, CALIFORNIA
and Incorporated Areas

PANEL 1614 OF 2375

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO, CITY OF	060295	1614	H



Note: This area is shown as being protected from the 1-percent-annual-chance or greater flood hazard by a levee system that has been provisionally accredited. Overtopping or failure of any levee system is possible. For additional information see the "Provisionally Accredited Levee Note" in Notes to Users.

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

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

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

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

OTHER FEATURES
- E 18.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

PROVISIONALLY ACCREDITED LEVEE: Check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection for areas on this panel. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations by July 23, 2009. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicate the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit https://www.fema.gov/national-flood-insurance-program.

APPENDIX 2

Existing Conditions Rational Method Computer Output

```
                  San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/26/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
EXISTING CONDITIONS
S100 E100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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



Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** 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                        ]
Initial subarea flow distance  =  181.000(Ft.)
Highest elevation =   16.000(Ft.)
Lowest elevation =   15.000(Ft.)
Elevation difference =    1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     4.43 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 181.000^.5)/(   0.552^(1/3)]=   4.43
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      8.089(CFS)
Total initial stream area =        1.940(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    14.700(Ft.)
```



```
Downstream point elevation =     9.000(Ft.)
Channel length thru subarea  =   400.000(Ft.)
Channel base width      =  100.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =     16.115(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     16.115(CFS)
Depth of flow =   0.076(Ft.), Average velocity =   2.096(Ft/s)
Channel flow top width =  103.029(Ft.)
Flow Velocity =    2.10(Ft/s)
Travel time  =    3.18 min.
Time of concentration =    8.18 min.
Critical depth =      0.093(Ft.)
 Adding area flow to channel
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                        ]
Rainfall intensity =      3.630(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     13.276(CFS) for    3.850(Ac.)
Total runoff =     21.365(CFS)  Total area =       5.79(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.000(Ft.)
Pipe length  =   320.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.365(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    21.365(CFS)
Normal flow depth in pipe =   22.92(In.)
Flow top width inside pipe =   25.47(In.)
Critical Depth =   18.87(In.)
Pipe flow velocity =      5.31(Ft/s)
Travel time through pipe =    1.01 min.
Time of concentration (TC) =     9.19 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     9.19 min.
Rainfall intensity =      3.480(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      3.140(CFS) for    0.950(Ac.)
Total runoff =     24.505(CFS)  Total area =       6.74(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      104.000
```

```
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.000(Ft.)
Pipe length  =   320.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    24.505(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    24.505(CFS)
Normal flow depth in pipe =   22.92(In.)
Flow top width inside pipe =   30.40(In.)
Critical Depth =   19.67(In.)
Pipe flow velocity =      5.56(Ft/s)
Travel time through pipe =    0.96 min.
Time of concentration (TC) =    10.14 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =    10.14 min.
Rainfall intensity =      3.357(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      6.665(CFS) for    2.090(Ac.)
Total runoff =     31.170(CFS)  Total area =        8.83(Ac.)
End of computations, total study area =           8.830 (Ac.)
```

```
                 San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/26/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
EXISTING CONDITIONS
S120 E100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      121.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   16.000(Ft.)
Lowest elevation =   15.000(Ft.)
Elevation difference =    1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.70 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   1.000^(1/3)]=   2.70
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      2.168(CFS)
Total initial stream area =        0.520(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      121.000 to Point/Station      122.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     20.514(CFS) for    4.920(Ac.)
Total runoff =     22.683(CFS)  Total area =        5.44(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      122.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      2.627(CFS) for    0.630(Ac.)
Total runoff =     25.309(CFS)  Total area =        6.07(Ac.)
End of computations, total study area =          6.070 (Ac.)
```

```
                San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 03/01/24
------------------------------------------------------------------------
4443.10 MIDWAY RISING
EXISTING CONDITIONS
S200 E100

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 *********   Hydrology Study Control Information **********

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Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


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Process from Point/Station      200.000 to Point/Station      201.000
**** 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                       ]
Initial subarea flow distance  =  110.000(Ft.)
Highest elevation =   11.700(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.00 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 110.000^.5)/(   0.182^(1/3)]=   5.00
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.709(CFS)
Total initial stream area =        0.170(Ac.)


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Process from Point/Station      201.000 to Point/Station      202.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =     9.700(Ft.)
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End of street segment elevation =     8.000(Ft.)
Length of street segment  =   294.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      5.316(CFS)
Depth of flow =   0.312(Ft.), Average velocity =   1.943(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   1.94(Ft/s)
Travel time =    2.52 min.     TC =    7.52  min.
 Adding area flow to street
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                       ]
Rainfall intensity =      3.744(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      7.861(CFS) for    2.210(Ac.)
Total runoff =      8.569(CFS)  Total area =        2.38(Ac.)
Street flow at end of street =      8.569(CFS)
Half street flow at end of street =      8.569(CFS)
Depth of flow =   0.369(Ft.), Average velocity =   2.349(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station      203.000 to Point/Station      202.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     7.52 min.
Rainfall intensity =      3.744(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      6.794(CFS) for    1.910(Ac.)
Total runoff =     15.363(CFS)  Total area =        4.29(Ac.)


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Process from Point/Station      202.000 to Point/Station      204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.040(Ft.)
Pipe length  =   320.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.363(CFS)
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Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    15.363(CFS)
Normal flow depth in pipe =   20.13(In.)
Flow top width inside pipe =   23.52(In.)
Critical Depth =   16.39(In.)
Pipe flow velocity =      4.83(Ft/s)
Travel time through pipe =    1.10 min.
Time of concentration (TC) =     8.63 min.


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Process from Point/Station      202.000 to Point/Station      204.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.290(Ac.)
Runoff from this stream =     15.363(CFS)
Time of concentration =    8.63 min.
Rainfall intensity =     3.560(In/Hr)


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Process from Point/Station      205.000 to Point/Station      206.000
**** 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                   ]
Initial subarea flow distance  =  112.000(Ft.)
Highest elevation =   12.700(Ft.)
Lowest elevation =   12.200(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.74 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 112.000^.5)/(   0.446^(1/3)]=   3.74
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.542(CFS)
Total initial stream area =        0.130(Ac.)


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Process from Point/Station      206.000 to Point/Station      207.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    12.200(Ft.)
End of street segment elevation =     8.600(Ft.)
Length of street segment  =   615.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
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 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      9.507(CFS)
Depth of flow =   0.383(Ft.), Average velocity =   2.457(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   2.46(Ft/s)
Travel time =    4.17 min.     TC =    9.17  min.
 Adding area flow to street
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                   ]
Rainfall intensity =      3.481(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     14.221(CFS) for    4.300(Ac.)
Total runoff =     14.763(CFS)  Total area =        4.43(Ac.)
Street flow at end of street =     14.763(CFS)
Half street flow at end of street =     14.763(CFS)
Depth of flow =   0.457(Ft.), Average velocity =   2.925(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station      207.000 to Point/Station      208.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.600(Ft.)
Downstream point/station elevation =     6.500(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.763(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    14.763(CFS)
Normal flow depth in pipe =   19.88(In.)
Flow top width inside pipe =   23.80(In.)
Critical Depth =   16.05(In.)
Pipe flow velocity =      4.71(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =     9.30 min.


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Process from Point/Station      209.000 to Point/Station      208.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                   ]
Time of concentration =     9.30 min.
Rainfall intensity =      3.464(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     13.955(CFS) for    4.240(Ac.)
Total runoff =     28.718(CFS)  Total area =        8.67(Ac.)


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Process from Point/Station      208.000 to Point/Station      204.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
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Upstream point/station elevation =     6.500(Ft.)
Downstream point/station elevation =     6.000(Ft.)
Pipe length  =    62.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    28.718(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    28.718(CFS)
Normal flow depth in pipe =   23.02(In.)
Flow top width inside pipe =   19.15(In.)
Critical Depth =   22.34(In.)
Pipe flow velocity =      7.95(Ft/s)
Travel time through pipe =    0.13 min.
Time of concentration (TC) =     9.43 min.


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Process from Point/Station      208.000 to Point/Station      204.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area =      8.670(Ac.)
Runoff from this stream =     28.718(CFS)
Time of concentration =    9.43 min.
Rainfall intensity =     3.447(In/Hr)
Summary of stream data:

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


1       15.363      8.63                 3.560
2       28.718      9.43                 3.447
Qmax(1) =
           1.000 *    1.000 *    15.363) +
           1.000 *    0.915 *    28.718) + =      41.644
Qmax(2) =
           0.968 *    1.000 *    15.363) +
           1.000 *    1.000 *    28.718) + =      43.594

Total of 2 streams to confluence:
Flow rates before confluence point:
      15.363      28.718
Maximum flow rates at confluence using above data:
       41.644      43.594
Area of streams before confluence:
        4.290       8.670
Results of confluence:
Total flow rate =     43.594(CFS)
Time of concentration =     9.426 min.
Effective stream area after confluence =     12.960(Ac.)


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Process from Point/Station      204.000 to Point/Station      210.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.500(Ft.)
Pipe length  =   290.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    43.594(CFS)
Nearest computed pipe diameter  =     42.00(In.)
Calculated individual pipe flow  =    43.594(CFS)
Normal flow depth in pipe =   36.38(In.)
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Flow top width inside pipe =   28.61(In.)
Critical Depth =   24.71(In.)
Pipe flow velocity =      4.93(Ft/s)
Travel time through pipe =    0.98 min.
Time of concentration (TC) =    10.41 min.


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Process from Point/Station      204.000 to Point/Station      210.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area =     12.960(Ac.)
Runoff from this stream =     43.594(CFS)
Time of concentration =   10.41 min.
Rainfall intensity =     3.326(In/Hr)


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Process from Point/Station      211.000 to Point/Station      212.000
**** 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                        ]
Initial subarea flow distance  =  132.000(Ft.)
Highest elevation =   12.800(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    1.800(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.80 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 132.000^.5)/(   1.364^(1/3)]=   2.80
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.500(CFS)
Total initial stream area =        0.120(Ac.)


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Process from Point/Station      212.000 to Point/Station      210.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation =    11.000(Ft.)
End of street segment elevation =     9.500(Ft.)
Length of street segment  =   375.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      8.756(CFS)
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Depth of flow =   0.311(Ft.), Average velocity =   1.609(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   1.61(Ft/s)
Travel time =    3.88 min.     TC =    8.88  min.
 Adding area flow to street
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                       ]
Rainfall intensity =      3.522(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     13.250(CFS) for    3.960(Ac.)
Total runoff =     13.750(CFS)  Total area =        4.08(Ac.)
Street flow at end of street =     13.750(CFS)
Half street flow at end of street =      6.875(CFS)
Depth of flow =   0.364(Ft.), Average velocity =   1.926(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station      210.000 to Point/Station      213.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.500(Ft.)
Downstream point/station elevation =     5.400(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.750(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    13.750(CFS)
Normal flow depth in pipe =   20.70(In.)
Flow top width inside pipe =   27.75(In.)
Critical Depth =   14.98(In.)
Pipe flow velocity =      3.81(Ft/s)
Travel time through pipe =    0.26 min.
Time of concentration (TC) =     9.15 min.


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Process from Point/Station      212.000 to Point/Station      210.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.080(Ac.)
Runoff from this stream =     13.750(CFS)
Time of concentration =    9.15 min.
Rainfall intensity =     3.485(In/Hr)
Summary of stream data:

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


1       43.594     10.41                3.326
2       13.750      9.15                3.485
Qmax(1) =
           1.000 *    1.000 *    43.594) +
           0.954 *    1.000 *    13.750) + =      56.716
Qmax(2) =
           1.000 *    0.879 *    43.594) +
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           1.000 *    1.000 *    13.750) + =      52.062

Total of 2 streams to confluence:
Flow rates before confluence point:
      43.594      13.750
Maximum flow rates at confluence using above data:
       56.716       52.062
Area of streams before confluence:
       12.960       4.080
Results of confluence:
Total flow rate =     56.716(CFS)
Time of concentration =    10.407 min.
Effective stream area after confluence =     17.040(Ac.)


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Process from Point/Station      210.000 to Point/Station      213.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     17.040(Ac.)
Runoff from this stream =     56.716(CFS)
Time of concentration =   10.41 min.
Rainfall intensity =     3.326(In/Hr)
Program is now starting with Main Stream No. 2


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Process from Point/Station      214.000 to Point/Station      215.000
**** 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                       ]
Initial subarea flow distance  =  114.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.79 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 114.000^.5)/(   0.439^(1/3)]=   3.79
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.876(CFS)
Total initial stream area =        0.210(Ac.)


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Process from Point/Station      215.000 to Point/Station      216.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    11.500(Ft.)
End of street segment elevation =    10.000(Ft.)
Length of street segment  =   598.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
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Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      7.943(CFS)
Depth of flow =   0.422(Ft.), Average velocity =   1.772(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   1.77(Ft/s)
Travel time =    5.63 min.     TC =   10.63  min.
 Adding area flow to street
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                      ]
Rainfall intensity =      3.301(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     10.631(CFS) for    3.390(Ac.)
Total runoff =     11.506(CFS)  Total area =        3.60(Ac.)
Street flow at end of street =     11.506(CFS)
Half street flow at end of street =     11.506(CFS)
Depth of flow =   0.492(Ft.), Average velocity =   2.052(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station      215.000 to Point/Station      216.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      3.600(Ac.)
Runoff from this stream =     11.506(CFS)
Time of concentration =   10.63 min.
Rainfall intensity =     3.301(In/Hr)


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Process from Point/Station      223.000 to Point/Station      224.000
**** 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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   52.000(Ft.)
Lowest elevation =   12.000(Ft.)
Elevation difference =   40.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.42 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4500)*( 100.000^.5)/(  40.000^(1/3)]=   3.42
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
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Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff =      0.494(CFS)
Total initial stream area =        0.250(Ac.)


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Process from Point/Station      224.000 to Point/Station      216.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    12.000(Ft.)
Downstream point elevation =    10.000(Ft.)
Channel length thru subarea  =   848.000(Ft.)
Channel base width      =    3.000(Ft.)
Slope or 'Z' of left channel bank =   4.000
Slope or 'Z' of right channel bank =   4.000
Estimated mean flow rate at midpoint of channel =      1.787(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.787(CFS)
Depth of flow =   0.263(Ft.), Average velocity =   1.679(Ft/s)
Channel flow top width =    5.103(Ft.)
Flow Velocity =    1.68(Ft/s)
Travel time  =    8.42 min.
Time of concentration =   13.42 min.
Critical depth =      0.203(Ft.)
 Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity =      3.030(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      1.786(CFS) for    1.310(Ac.)
Total runoff =      2.280(CFS)  Total area =        1.56(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      224.000 to Point/Station      216.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.560(Ac.)
Runoff from this stream =      2.280(CFS)
Time of concentration =   13.42 min.
Rainfall intensity =     3.030(In/Hr)
Summary of stream data:

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


1       11.506     10.63                 3.301
2        2.280     13.42                 3.030
Qmax(1) =
           1.000 *    1.000 *    11.506) +
           1.000 *    0.792 *     2.280) + =      13.312
Qmax(2) =
           0.918 *    1.000 *    11.506) +
           1.000 *    1.000 *     2.280) + =      12.843

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

```
      11.506       2.280
Maximum flow rates at confluence using above data:
       13.312       12.843
Area of streams before confluence:
        3.600        1.560
Results of confluence:
Total flow rate =     13.312(CFS)
Time of concentration =    10.625 min.
Effective stream area after confluence =      5.160(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      216.000 to Point/Station      213.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.500(Ft.)
Downstream point/station elevation =     5.400(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.312(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    13.312(CFS)
Normal flow depth in pipe =   23.72(In.)
Flow top width inside pipe =   17.64(In.)
Critical Depth =   15.21(In.)
Pipe flow velocity =      3.60(Ft/s)
Travel time through pipe =    0.28 min.
Time of concentration (TC) =    10.90 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      216.000 to Point/Station      213.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      5.160(Ac.)
Runoff from this stream =     13.312(CFS)
Time of concentration =   10.90 min.
Rainfall intensity =     3.270(In/Hr)
Summary of stream data:

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


1       56.716     10.41                 3.326
2       13.312     10.90                 3.270
Qmax(1) =
           1.000 *    1.000 *    56.716) +
           1.000 *    0.955 *    13.312) + =      69.422
Qmax(2) =
           0.983 *    1.000 *    56.716) +
           1.000 *    1.000 *    13.312) + =      69.080

Total of 2 main streams to confluence:
Flow rates before confluence point:
      56.716      13.312
Maximum flow rates at confluence using above data:
       69.422       69.080
Area of streams before confluence:
       17.040        5.160
```



```
Results of confluence:
Total flow rate =     69.422(CFS)
Time of concentration =    10.407 min.
Effective stream area after confluence  =     22.200(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      213.000 to Point/Station      217.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.400(Ft.)
Downstream point/station elevation =     4.000(Ft.)
Pipe length  =   470.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    69.422(CFS)
Nearest computed pipe diameter  =     45.00(In.)
Calculated individual pipe flow  =    69.422(CFS)
Normal flow depth in pipe =   39.47(In.)
Flow top width inside pipe =   29.55(In.)
Critical Depth =   30.76(In.)
Pipe flow velocity =      6.76(Ft/s)
Travel time through pipe =    1.16 min.
Time of concentration (TC) =    11.57 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      213.000 to Point/Station      217.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     22.200(Ac.)
Runoff from this stream =     69.422(CFS)
Time of concentration =   11.57 min.
Rainfall intensity =     3.201(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      218.000 to Point/Station      219.000
**** 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                    ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   13.000(Ft.)
Lowest elevation =   12.000(Ft.)
Elevation difference =    1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.70 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   1.000^(1/3)]=   2.70
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.834(CFS)
Total initial stream area =        0.200(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      219.000 to Point/Station      220.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
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Top of street segment elevation =    12.000(Ft.)
End of street segment elevation =     8.000(Ft.)
Length of street segment  =   666.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =     10.799(CFS)
Depth of flow =   0.414(Ft.), Average velocity =   2.305(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  21.677(Ft.)
Flow velocity =   2.31(Ft/s)
Travel time =    4.81 min.     TC =    9.81  min.
 Adding area flow to street
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                    ]
Rainfall intensity =      3.397(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     15.426(CFS) for    4.780(Ac.)
Total runoff =     16.260(CFS)  Total area =        4.98(Ac.)
Street flow at end of street =     16.260(CFS)
Half street flow at end of street =     16.260(CFS)
Depth of flow =   0.481(Ft.), Average velocity =   2.605(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  24.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      221.000 to Point/Station      220.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                    ]
Time of concentration =     9.81 min.
Rainfall intensity =      3.397(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      9.133(CFS) for    2.830(Ac.)
Total runoff =     25.393(CFS)  Total area =        7.81(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      221.000 to Point/Station      217.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      7.810(Ac.)
Runoff from this stream =     25.393(CFS)
Time of concentration =    9.81 min.
```



```
Rainfall intensity =     3.397(In/Hr)
Summary of stream data:

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


1       69.422     11.57                 3.201
2       25.393      9.81                 3.397
Qmax(1) =
           1.000 *    1.000 *    69.422) +
           0.942 *    1.000 *    25.393) + =      93.349
Qmax(2) =
           1.000 *    0.849 *    69.422) +
           1.000 *    1.000 *    25.393) + =      84.306

Total of 2 streams to confluence:
Flow rates before confluence point:
      69.422      25.393
Maximum flow rates at confluence using above data:
       93.349       84.306
Area of streams before confluence:
       22.200        7.810
Results of confluence:
Total flow rate =     93.349(CFS)
Time of concentration =    11.565 min.
Effective stream area after confluence =     30.010(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      217.000 to Point/Station      222.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.000(Ft.)
Downstream point/station elevation =     2.440(Ft.)
Pipe length  =   521.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    93.349(CFS)
Nearest computed pipe diameter  =     51.00(In.)
Calculated individual pipe flow  =    93.349(CFS)
Normal flow depth in pipe =   42.28(In.)
Flow top width inside pipe =   38.40(In.)
Critical Depth =   34.58(In.)
Pipe flow velocity =     7.42(Ft/s)
Travel time through pipe =    1.17 min.
Time of concentration (TC) =    12.74 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      222.000 to Point/Station      225.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     2.440(Ft.)
Downstream point/station elevation =     0.000(Ft.)
Pipe length  =  1900.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    93.349(CFS)
Nearest computed pipe diameter  =     60.00(In.)
Calculated individual pipe flow  =    93.349(CFS)
Normal flow depth in pipe =   49.22(In.)
Flow top width inside pipe =   46.07(In.)
Critical Depth =   32.95(In.)
Pipe flow velocity =     5.42(Ft/s)
Travel time through pipe =    5.84 min.
Time of concentration (TC) =    18.58 min.
```

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End of computations, total study area =          30.010 (Ac.)
```

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                 San Diego County Rational Hydrology Program

 CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

 Rational method hydrology  program based on
 San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 12/20/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
EXISTING CONDITIONS
S250 E100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


 Program License Serial Number 4049

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

 Standard intensity of Appendix I-B used for year and
 Elevation 0 - 1500 feet
 Factor (to multiply * intensity)  =  1.000
 Only used if inside City of San Diego
 San Diego hydrology manual 'C' values used
 Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      250.000 to Point/Station      251.000
**** 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                        ]
 Initial subarea flow distance  =  110.000(Ft.)
 Highest elevation =   12.700(Ft.)
 Lowest elevation =   12.500(Ft.)
 Elevation difference =    0.200(Ft.)
 Time of concentration calculated by the urban
 areas overland flow method (App X-C) =     5.00 min.
 TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
 TC = [1.8*(1.1-0.9500)*( 110.000^.5)/(   0.182^(1/3)]=   5.00
 Setting time of concentration to 5 minutes
 Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
 Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
 Subarea runoff =      0.542(CFS)
 Total initial stream area =        0.130(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      251.000 to Point/Station      252.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
 Top of street segment elevation =    12.500(Ft.)
```



```
 End of street segment elevation =     7.600(Ft.)
 Length of street segment  =  1158.000(Ft.)
 Height of curb above gutter flowline  =    6.0(In.)
 Width of half street (curb to crown)  =  16.000(Ft.)
 Distance from crown to crossfall grade break  =  14.500(Ft.)
 Slope from gutter to grade break (v/hz) =   0.020
 Slope from grade break to crown (v/hz)  =   0.020
 Street flow is on [1] side(s) of the street
 Distance from curb to property line  =   5.000(Ft.)
 Slope from curb to property line (v/hz) =   0.020
 Gutter width =   1.500(Ft.)
 Gutter hike from flowline =  0.125(In.)
  Manning's N in gutter =  0.0150
  Manning's N from gutter to grade break =  0.0150
  Manning's N from grade break to crown =  0.0180
 Estimated mean flow rate at midpoint of street =     10.903(CFS)
 Depth of flow =   0.431(Ft.), Average velocity =   2.352(Ft/s)
 Note:  depth of flow exceeds top of street crown.
 Streetflow hydraulics at midpoint of street travel:
 Halfstreet flow width =  16.000(Ft.)
 Flow velocity =   2.35(Ft/s)
 Travel time =    8.20 min.     TC =   13.20  min.
  Adding area flow to street
 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                        ]
 Rainfall intensity =      3.049(In/Hr) for a   100.0 year storm
 Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
 Subarea runoff =     14.394(CFS) for    4.970(Ac.)
 Total runoff =     14.936(CFS)  Total area =        5.10(Ac.)
 Street flow at end of street =     14.936(CFS)
 Half street flow at end of street =     14.936(CFS)
 Depth of flow =   0.492(Ft.), Average velocity =   2.665(Ft/s)
 Note:  depth of flow exceeds top of street crown.
 Flow width (from curb towards crown)=  16.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      253.000 to Point/Station      252.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
 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                        ]
 Time of concentration =    13.20 min.
 Rainfall intensity =      3.049(In/Hr) for a   100.0 year storm
 Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
 Subarea runoff =     16.537(CFS) for    5.710(Ac.)
 Total runoff =     31.474(CFS)  Total area =       10.81(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      254.000 to Point/Station      252.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
 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                    ]
Time of concentration =    13.20 min.
Rainfall intensity =      3.049(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     11.237(CFS) for    3.880(Ac.)
Total runoff =     42.711(CFS)  Total area =      14.69(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      252.000 to Point/Station      255.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.400(Ft.)
Downstream point/station elevation =     6.200(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    42.711(CFS)
Nearest computed pipe diameter  =     36.00(In.)
Calculated individual pipe flow  =    42.711(CFS)
Normal flow depth in pipe =   25.43(In.)
Flow top width inside pipe =   32.79(In.)
Critical Depth =   25.57(In.)
Pipe flow velocity =      8.00(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =    13.28 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      256.000 to Point/Station      255.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                    ]
Time of concentration =    13.28 min.
Rainfall intensity =      3.042(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     30.290(CFS) for   10.480(Ac.)
Total runoff =     73.001(CFS)  Total area =      25.17(Ac.)
End of computations, total study area =         25.170 (Ac.)
```

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                San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/26/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
EXISTING CONDITIONS
S280 E100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      280.000 to Point/Station      281.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   16.000(Ft.)
Lowest elevation =   15.000(Ft.)
Elevation difference =    1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.70 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   1.000^(1/3)]=   2.70
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.584(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      281.000 to Point/Station      282.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
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```
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     34.149(CFS) for    8.190(Ac.)
Total runoff =     34.733(CFS)  Total area =        8.33(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      284.000 to Point/Station      282.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      8.256(CFS) for    1.980(Ac.)
Total runoff =     42.989(CFS)  Total area =       10.31(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      282.000 to Point/Station      283.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.000(Ft.)
Downstream point/station elevation =     3.000(Ft.)
Pipe length  =   352.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    42.989(CFS)
Nearest computed pipe diameter  =     39.00(In.)
Calculated individual pipe flow  =    42.989(CFS)
Normal flow depth in pipe =   31.17(In.)
Flow top width inside pipe =   31.24(In.)
Critical Depth =   25.08(In.)
Pipe flow velocity =      6.05(Ft/s)
Travel time through pipe =    0.97 min.
Time of concentration (TC) =     5.97 min.
End of computations, total study area =         10.310 (Ac.)
```

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                San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/26/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
EXISTING CONDITIONS
S300 E100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      301.000
**** 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                        ]
Initial subarea flow distance  =  189.000(Ft.)
Highest elevation =   15.000(Ft.)
Lowest elevation =   12.600(Ft.)
Elevation difference =    2.400(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.43 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 189.000^.5)/(   1.270^(1/3)]=   3.43
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      1.001(CFS)
Total initial stream area =        0.240(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     23.225(CFS) for    5.570(Ac.)
Total runoff =     24.225(CFS)  Total area =        5.81(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      304.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    10.500(Ft.)
End of street segment elevation =     8.400(Ft.)
Length of street segment  =   489.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  36.000(Ft.)
Distance from crown to crossfall grade break  =  34.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =     25.726(CFS)
Depth of flow =   0.627(Ft.), Average velocity =   2.375(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    6.34(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.318(Ft.)
Flow velocity =   2.38(Ft/s)
Travel time =    3.43 min.     TC =    8.43  min.
 Adding area flow to street
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                        ]
Rainfall intensity =      3.590(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      2.455(CFS) for    0.720(Ac.)
Total runoff =     26.681(CFS)  Total area =        6.53(Ac.)
Street flow at end of street =     26.681(CFS)
Half street flow at end of street =     26.681(CFS)
Depth of flow =   0.635(Ft.), Average velocity =   2.391(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    6.76(Ft.)
Flow width (from curb towards crown)=  32.736(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      304.000 to Point/Station      303.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      6.530(Ac.)
```

```
Runoff from this stream =     26.681(CFS)
Time of concentration =    8.43 min.
Rainfall intensity =     3.590(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      305.000 to Point/Station      306.000
**** 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                        ]
Initial subarea flow distance  =  155.900(Ft.)
Highest elevation =   13.000(Ft.)
Lowest elevation =   12.000(Ft.)
Elevation difference =    1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.91 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 155.900^.5)/(   0.641^(1/3)]=   3.91
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      1.167(CFS)
Total initial stream area =        0.280(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      306.000 to Point/Station      303.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     11.091(CFS) for    2.660(Ac.)
Total runoff =     12.259(CFS)  Total area =        2.94(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      307.000 to Point/Station      303.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      2.085(CFS) for    0.500(Ac.)
Total runoff =     14.343(CFS)  Total area =        3.44(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      307.000 to Point/Station      303.000
```



```
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.440(Ac.)
Runoff from this stream =     14.343(CFS)
Time of concentration =    5.00 min.
Rainfall intensity =     4.389(In/Hr)
Summary of stream data:

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


1       26.681      8.43                 3.590
2       14.343      5.00                 4.389
Qmax(1) =
           1.000 *    1.000 *    26.681) +
           0.818 *    1.000 *    14.343) + =      38.412
Qmax(2) =
           1.000 *    0.593 *    26.681) +
           1.000 *    1.000 *    14.343) + =      30.166

Total of 2 streams to confluence:
Flow rates before confluence point:
      26.681      14.343
Maximum flow rates at confluence using above data:
       38.412       30.166
Area of streams before confluence:
        6.530        3.440
Results of confluence:
Total flow rate =     38.412(CFS)
Time of concentration =     8.431 min.
Effective stream area after confluence =      9.970(Ac.)
End of computations, total study area =          9.970 (Ac.)
```

```
                 San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/26/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
EXISTING CONDITIONS
S320 E100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      320.000 to Point/Station      321.000
**** 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                        ]
Initial subarea flow distance  =  107.000(Ft.)
Highest elevation =   11.300(Ft.)
Lowest elevation =   10.900(Ft.)
Elevation difference =    0.400(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.88 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 107.000^.5)/(   0.374^(1/3)]=   3.88
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.876(CFS)
Total initial stream area =        0.210(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      321.000 to Point/Station      322.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    10.600(Ft.)
```



```
Downstream point elevation =     9.600(Ft.)
Channel length thru subarea  =   150.000(Ft.)
Channel base width      =   20.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =      4.378(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      4.378(CFS)
Depth of flow =   0.112(Ft.), Average velocity =   1.761(Ft/s)
Channel flow top width =   24.473(Ft.)
Flow Velocity =    1.76(Ft/s)
Travel time  =    1.42 min.
Time of concentration =    6.42 min.
Critical depth =      0.109(Ft.)
 Adding area flow to channel
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                        ]
Rainfall intensity =      3.975(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      6.344(CFS) for    1.680(Ac.)
Total runoff =      7.220(CFS)  Total area =       1.89(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      323.000 to Point/Station      322.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     6.42 min.
Rainfall intensity =      3.975(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      3.437(CFS) for    0.910(Ac.)
Total runoff =     10.656(CFS)  Total area =       2.80(Ac.)
End of computations, total study area =          2.800 (Ac.)
```

APPENDIX 3

Proposed Conditions Rational Method Computer Output

```
                  San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/27/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
PROPOSED CONDITIONS
S1000P100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1000.000 to Point/Station     1001.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   11.500(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.459(CFS)
Total initial stream area =        0.110(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1001.000 to Point/Station     1002.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      6.588(CFS) for    1.580(Ac.)
Total runoff =      7.047(CFS)  Total area =        1.69(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1002.000 to Point/Station     1003.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.500(Ft.)
Downstream point/station elevation =     5.190(Ft.)
Pipe length  =    63.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.047(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.047(CFS)
Normal flow depth in pipe =   14.09(In.)
Flow top width inside pipe =   14.85(In.)
Critical Depth =   12.33(In.)
Pipe flow velocity =      4.75(Ft/s)
Travel time through pipe =    0.22 min.
Time of concentration (TC) =     5.22 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1004.000 to Point/Station     1003.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.22 min.
Rainfall intensity =      4.312(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.369(CFS) for    0.090(Ac.)
Total runoff =      7.415(CFS)  Total area =        1.78(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1005.000 to Point/Station     1003.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.22 min.
Rainfall intensity =      4.312(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.696(CFS) for    0.170(Ac.)
Total runoff =      8.112(CFS)  Total area =        1.95(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1005.000
```

```
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.190(Ft.)
Downstream point/station elevation =     4.950(Ft.)
Pipe length  =    18.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.112(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     8.112(CFS)
Normal flow depth in pipe =   10.77(In.)
Flow top width inside pipe =   17.65(In.)
Critical Depth =   13.23(In.)
Pipe flow velocity =      7.35(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     5.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1003.000 to Point/Station     1006.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.950(Ac.)
Runoff from this stream =      8.112(CFS)
Time of concentration =    5.26 min.
Rainfall intensity =     4.299(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1007.000 to Point/Station     1008.000
**** 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                        ]
Initial subarea flow distance  =   87.000(Ft.)
Highest elevation =   12.360(Ft.)
Lowest elevation =   12.110(Ft.)
Elevation difference =    0.250(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.82 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*(  87.000^.5)/(   0.287^(1/3)]=   3.82
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.375(CFS)
Total initial stream area =        0.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1008.000 to Point/Station     1009.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    12.110(Ft.)
End of street segment elevation =     9.600(Ft.)
Length of street segment  =   386.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  20.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
```



```
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  12.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      0.435(CFS)
Depth of flow =   0.110(Ft.), Average velocity =   1.077(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   6.472(Ft.)
Flow velocity =   1.08(Ft/s)
Travel time =    5.97 min.     TC =   10.97  min.
 Adding area flow to street
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                        ]
Rainfall intensity =      3.263(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      0.887(CFS) for    0.320(Ac.)
Total runoff =      1.263(CFS)  Total area =        0.41(Ac.)
Street flow at end of street =      1.263(CFS)
Half street flow at end of street =      1.263(CFS)
Depth of flow =   0.172(Ft.), Average velocity =   1.399(Ft/s)
Flow width (from curb towards crown)=   9.576(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1010.000 to Point/Station     1006.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =    10.97 min.
Rainfall intensity =      3.263(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      2.829(CFS) for    1.020(Ac.)
Total runoff =      4.091(CFS)  Total area =        1.43(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1010.000 to Point/Station     1006.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.430(Ac.)
Runoff from this stream =      4.091(CFS)
Time of concentration =   10.97 min.
Rainfall intensity =     3.263(In/Hr)
Summary of stream data:

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


1        8.112      5.26                 4.299
2        4.091     10.97                 3.263
```

```
Qmax(1) =
          1.000 *    1.000 *     8.112) +
          1.000 *    0.480 *     4.091) + =      10.074
Qmax(2) =
          0.759 *    1.000 *     8.112) +
          1.000 *    1.000 *     4.091) + =      10.248

Total of 2 streams to confluence:
Flow rates before confluence point:
       8.112       4.091
Maximum flow rates at confluence using above data:
       10.074       10.248
Area of streams before confluence:
        1.950        1.430
Results of confluence:
Total flow rate =     10.248(CFS)
Time of concentration =    10.973 min.
Effective stream area after confluence =      3.380(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1006.000 to Point/Station     1011.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.500(Ft.)
Pipe length  =   290.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.248(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    10.248(CFS)
Normal flow depth in pipe =   18.21(In.)
Flow top width inside pipe =   25.30(In.)
Critical Depth =   13.27(In.)
Pipe flow velocity =      3.59(Ft/s)
Travel time through pipe =    1.35 min.
Time of concentration (TC) =    12.32 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1012.000 to Point/Station     1011.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =    12.32 min.
Rainfall intensity =      3.128(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.099(CFS) for    0.370(Ac.)
Total runoff =     11.347(CFS)  Total area =        3.75(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1013.000 to Point/Station     1011.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
```



```
Time of concentration =    12.32 min.
Rainfall intensity =      3.128(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.070(CFS) for    0.360(Ac.)
Total runoff =     12.417(CFS)  Total area =        4.11(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1014.000 to Point/Station     1011.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =    12.32 min.
Rainfall intensity =      3.128(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      2.437(CFS) for    0.820(Ac.)
Total runoff =     14.854(CFS)  Total area =        4.93(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1011.000 to Point/Station     1015.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.500(Ft.)
Downstream point/station elevation =     5.400(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.854(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    14.854(CFS)
Normal flow depth in pipe =   21.98(In.)
Flow top width inside pipe =   26.55(In.)
Critical Depth =   15.59(In.)
Pipe flow velocity =      3.85(Ft/s)
Travel time through pipe =    0.26 min.
Time of concentration (TC) =    12.58 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1011.000 to Point/Station     1015.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.930(Ac.)
Runoff from this stream =     14.854(CFS)
Time of concentration =   12.58 min.
Rainfall intensity =     3.104(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1016.000 to Point/Station     1017.000
**** 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                        ]
```

```
Initial subarea flow distance  =  122.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     4.01 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 122.000^.5)/(   0.410^(1/3)]=   4.01
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.709(CFS)
Total initial stream area =        0.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1017.000 to Point/Station     1018.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      4.045(CFS) for    0.970(Ac.)
Total runoff =      4.753(CFS)  Total area =        1.14(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1019.000 to Point/Station     1018.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      4.962(CFS) for    1.190(Ac.)
Total runoff =      9.715(CFS)  Total area =        2.33(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1018.000 to Point/Station     1020.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.950(Ft.)
Downstream point/station elevation =     5.110(Ft.)
Pipe length  =    83.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.715(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     9.715(CFS)
Normal flow depth in pipe =   13.64(In.)
Flow top width inside pipe =   15.42(In.)
Critical Depth =   14.44(In.)
Pipe flow velocity =      6.77(Ft/s)
Travel time through pipe =    0.21 min.
Time of concentration (TC) =     5.21 min.
```



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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1021.000 to Point/Station     1020.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.21 min.
Rainfall intensity =      4.318(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.723(CFS) for    0.420(Ac.)
Total runoff =     11.438(CFS)  Total area =        2.75(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1022.000 to Point/Station     1020.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.21 min.
Rainfall intensity =      4.318(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      3.281(CFS) for    0.800(Ac.)
Total runoff =     14.719(CFS)  Total area =        3.55(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1023.000 to Point/Station     1020.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.21 min.
Rainfall intensity =      4.318(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      2.871(CFS) for    0.700(Ac.)
Total runoff =     17.590(CFS)  Total area =        4.25(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1024.000 to Point/Station     1020.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.21 min.
Rainfall intensity =      4.318(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.313(CFS) for    0.320(Ac.)
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```
Total runoff =     18.903(CFS)  Total area =        4.57(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1024.000 to Point/Station     1020.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      4.570(Ac.)
Runoff from this stream =     18.903(CFS)
Time of concentration =    5.21 min.
Rainfall intensity =     4.318(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1026.000 to Point/Station     1027.000
**** 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
[MULTI - UNITS area type                     ]
Initial subarea flow distance  =   71.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     6.82 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(  71.000^.5)/( 0.704^(1/3)]=   6.82
Rainfall intensity (I) =      3.885(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff =      0.218(CFS)
Total initial stream area =        0.080(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1027.000 to Point/Station     1020.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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
[MULTI - UNITS area type                     ]
Time of concentration =     6.82 min.
Rainfall intensity =      3.885(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.700
Subarea runoff =      2.230(CFS) for    0.820(Ac.)
Total runoff =      2.447(CFS)  Total area =        0.90(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1027.000 to Point/Station     1020.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     7.000(Ft.)
Downstream point/station elevation =     5.110(Ft.)
Pipe length  =   175.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.447(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.447(CFS)
```



```
Normal flow depth in pipe =    7.13(In.)
Flow top width inside pipe =   11.79(In.)
Critical Depth =    8.03(In.)
Pipe flow velocity =      5.04(Ft/s)
Travel time through pipe =    0.58 min.
Time of concentration (TC) =     7.40 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1027.000 to Point/Station     1020.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.900(Ac.)
Runoff from this stream =      2.447(CFS)
Time of concentration =    7.40 min.
Rainfall intensity =     3.767(In/Hr)
Summary of stream data:

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


1       18.903      5.21                 4.318
2        2.447      7.40                 3.767
Qmax(1) =
           1.000 *    1.000 *    18.903) +
           1.000 *    0.704 *     2.447) + =      20.625
Qmax(2) =
           0.873 *    1.000 *    18.903) +
           1.000 *    1.000 *     2.447) + =      18.941

Total of 2 streams to confluence:
Flow rates before confluence point:
      18.903       2.447
Maximum flow rates at confluence using above data:
       20.625       18.941
Area of streams before confluence:
        4.570        0.900
Results of confluence:
Total flow rate =     20.625(CFS)
Time of concentration =     5.206 min.
Effective stream area after confluence =      5.470(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1020.000 to Point/Station     1025.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.110(Ft.)
Downstream point/station elevation =     1.700(Ft.)
Pipe length  =   241.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    20.625(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    20.625(CFS)
Normal flow depth in pipe =   18.00(In.)
Flow top width inside pipe =   20.78(In.)
Critical Depth =   19.54(In.)
Pipe flow velocity =      8.15(Ft/s)
Travel time through pipe =    0.49 min.
Time of concentration (TC) =     5.70 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1028.000 to Point/Station     1025.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.70 min.
Rainfall intensity =      4.164(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.108(CFS) for    0.280(Ac.)
Total runoff =     21.733(CFS)  Total area =        5.75(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1025.000 to Point/Station     1015.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.700(Ft.)
Downstream point/station elevation =     1.300(Ft.)
Pipe length  =    28.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.733(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    21.733(CFS)
Normal flow depth in pipe =   16.41(In.)
Flow top width inside pipe =   22.32(In.)
Critical Depth =   20.01(In.)
Pipe flow velocity =      9.50(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     5.75 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1025.000 to Point/Station     1015.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      5.750(Ac.)
Runoff from this stream =     21.733(CFS)
Time of concentration =    5.75 min.
Rainfall intensity =     4.150(In/Hr)
Summary of stream data:

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


1       14.854     12.58                 3.104
2       21.733      5.75                 4.150
Qmax(1) =
           1.000 *    1.000 *    14.854) +
           0.748 *    1.000 *    21.733) + =      31.110
Qmax(2) =
           1.000 *    0.457 *    14.854) +
           1.000 *    1.000 *    21.733) + =      28.522

Total of 2 main streams to confluence:
Flow rates before confluence point:
      14.854      21.733
Maximum flow rates at confluence using above data:
```



```
       31.110       28.522
Area of streams before confluence:
        4.930        5.750


Results of confluence:
Total flow rate =     31.110(CFS)
Time of concentration =    12.579 min.
Effective stream area after confluence  =     10.680(Ac.)
End of computations, total study area =          10.680 (Ac.)
```

```
                San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/26/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
PROPOSED CONDITIONS
S1100P100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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



Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1100.000 to Point/Station     1101.000
**** 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                         ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   11.500(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.709(CFS)
Total initial stream area =        0.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1101.000 to Point/Station     1102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
```



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Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                         ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      4.503(CFS) for    1.080(Ac.)
Total runoff =      5.212(CFS)  Total area =        1.25(Ac.)


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Process from Point/Station     1102.000 to Point/Station     1103.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.230(Ft.)
Downstream point/station elevation =     3.070(Ft.)
Pipe length  =   213.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.212(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     5.212(CFS)
Normal flow depth in pipe =   10.16(In.)
Flow top width inside pipe =   14.02(In.)
Critical Depth =   11.10(In.)
Pipe flow velocity =      5.89(Ft/s)
Travel time through pipe =    0.60 min.
Time of concentration (TC) =     5.60 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1104.000 to Point/Station     1103.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                         ]
Time of concentration =     5.60 min.
Rainfall intensity =      4.192(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      4.700(CFS) for    1.180(Ac.)
Total runoff =      9.912(CFS)  Total area =        2.43(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1103.000 to Point/Station     1105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     3.070(Ft.)
Downstream point/station elevation =     1.030(Ft.)
Pipe length  =   270.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.912(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     9.912(CFS)
Normal flow depth in pipe =   13.20(In.)
Flow top width inside pipe =   20.30(In.)
Critical Depth =   14.06(In.)
Pipe flow velocity =      6.23(Ft/s)
Travel time through pipe =    0.72 min.
Time of concentration (TC) =     6.32 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1106.000 to Point/Station     1105.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Time of concentration =     6.32 min.
Rainfall intensity =      3.998(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      1.241(CFS) for    0.690(Ac.)
Total runoff =     11.153(CFS)  Total area =        3.12(Ac.)


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Process from Point/Station     1105.000 to Point/Station     1107.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.030(Ft.)
Downstream point/station elevation =     0.750(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.153(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    11.153(CFS)
Normal flow depth in pipe =   14.04(In.)
Flow top width inside pipe =   19.77(In.)
Critical Depth =   14.95(In.)
Pipe flow velocity =      6.53(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     6.41 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1105.000 to Point/Station     1107.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.120(Ac.)
Runoff from this stream =     11.153(CFS)
Time of concentration =    6.41 min.
Rainfall intensity =     3.977(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1108.000 to Point/Station     1109.000
**** 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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Initial subarea flow distance  =   76.000(Ft.)
Highest elevation =   13.300(Ft.)
Lowest elevation =   12.600(Ft.)
Elevation difference =    0.700(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =    10.48 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4500)*(  76.000^.5)/( 0.921^(1/3)]=  10.48
Rainfall intensity (I) =      3.317(In/Hr) for a   100.0 year storm
```



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Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff =      0.134(CFS)
Total initial stream area =        0.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1109.000 to Point/Station     1110.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    12.600(Ft.)
Downstream point elevation =    12.000(Ft.)
Channel length thru subarea  =   191.000(Ft.)
Channel base width      =   20.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =      0.851(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      0.851(CFS)
Depth of flow =   0.096(Ft.), Average velocity =   0.423(Ft/s)
Channel flow top width =   21.918(Ft.)
Flow Velocity =    0.42(Ft/s)
Travel time  =    7.52 min.
Time of concentration =   18.00 min.
Critical depth =      0.038(Ft.)
 Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity =      2.700(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      1.166(CFS) for    0.960(Ac.)
Total runoff =      1.301(CFS)  Total area =        1.05(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1110.000 to Point/Station     1111.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     3.930(Ft.)
Downstream point/station elevation =     3.300(Ft.)
Pipe length  =    63.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.301(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.301(CFS)
Normal flow depth in pipe =    6.01(In.)
Flow top width inside pipe =    8.48(In.)
Critical Depth =    6.31(In.)
Pipe flow velocity =      4.15(Ft/s)
Travel time through pipe =    0.25 min.
Time of concentration (TC) =    18.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1111.000 to Point/Station     1107.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     3.300(Ft.)
Downstream point/station elevation =     2.000(Ft.)
Pipe length  =   146.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.301(CFS)
```

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Nearest computed pipe diameter  =     9.00(In.)
Calculated individual pipe flow  =    1.301(CFS)
Normal flow depth in pipe =    6.28(In.)
Flow top width inside pipe =    8.26(In.)
Critical Depth =    6.31(In.)
Pipe flow velocity =      3.95(Ft/s)
Travel time through pipe =    0.62 min.
Time of concentration (TC) =    18.87 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1111.000 to Point/Station     1107.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.050(Ac.)
Runoff from this stream =      1.301(CFS)
Time of concentration =   18.87 min.
Rainfall intensity =     2.647(In/Hr)
Summary of stream data:

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


1       11.153      6.41                 3.977
2        1.301     18.87                 2.647
Qmax(1) =
           1.000 *    1.000 *    11.153) +
           1.000 *    0.340 *     1.301) + =      11.595
Qmax(2) =
           0.666 *    1.000 *    11.153) +
           1.000 *    1.000 *     1.301) + =       8.724

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.153       1.301
Maximum flow rates at confluence using above data:
       11.595        8.724
Area of streams before confluence:
        3.120        1.050
Results of confluence:
Total flow rate =     11.595(CFS)
Time of concentration =     6.414 min.
Effective stream area after confluence =      4.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1107.000 to Point/Station     1112.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     2.000(Ft.)
Downstream point/station elevation =     1.500(Ft.)
Pipe length  =    76.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.595(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    11.595(CFS)
Normal flow depth in pipe =   15.61(In.)
Flow top width inside pipe =   18.35(In.)
Critical Depth =   15.24(In.)
Pipe flow velocity =      6.05(Ft/s)
Travel time through pipe =    0.21 min.
Time of concentration (TC) =     6.62 min.
```



```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1107.000 to Point/Station     1112.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.170(Ac.)
Runoff from this stream =     11.595(CFS)
Time of concentration =    6.62 min.
Rainfall intensity =     3.928(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1113.000 to Point/Station     1114.000
**** 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                        ]
Initial subarea flow distance  =   58.000(Ft.)
Highest elevation =   13.000(Ft.)
Lowest elevation =   12.700(Ft.)
Elevation difference =    0.300(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     4.27 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8500)*(  58.000^.5)/(   0.517^(1/3)]=   4.27
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =      0.224(CFS)
Total initial stream area =        0.060(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1114.000 to Point/Station     1112.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    12.700(Ft.)
End of street segment elevation =    12.000(Ft.)
Length of street segment  =   251.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  20.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      0.262(CFS)
Depth of flow =   0.106(Ft.), Average velocity =   0.691(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   6.275(Ft.)
Flow velocity =   0.69(Ft/s)
Travel time =    6.06 min.     TC =   11.06  min.
```

```
 Adding area flow to street
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                    ]
Rainfall intensity =      3.254(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      0.940(CFS) for    0.340(Ac.)
Total runoff =      1.164(CFS)  Total area =        0.40(Ac.)
Street flow at end of street =      1.164(CFS)
Half street flow at end of street =      1.164(CFS)
Depth of flow =   0.198(Ft.), Average velocity =   0.997(Ft/s)
Flow width (from curb towards crown)=  10.875(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1115.000 to Point/Station     1112.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                    ]
Note: user entry of impervious value, Ap = 0.900
Time of concentration =    11.06 min.
Rainfall intensity =      3.254(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.956
Subarea runoff =      1.431(CFS) for    0.460(Ac.)
Total runoff =      2.595(CFS)  Total area =        0.86(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1115.000 to Point/Station     1112.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.860(Ac.)
Runoff from this stream =      2.595(CFS)
Time of concentration =   11.06 min.
Rainfall intensity =     3.254(In/Hr)
Summary of stream data:

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


1       11.595      6.62                 3.928
2        2.595     11.06                 3.254
Qmax(1) =
           1.000 *    1.000 *    11.595) +
           1.000 *    0.599 *     2.595) + =      13.150
Qmax(2) =
           0.828 *    1.000 *    11.595) +
           1.000 *    1.000 *     2.595) + =      12.200

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.595       2.595
Maximum flow rates at confluence using above data:
       13.150       12.200
Area of streams before confluence:
```



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        4.170        0.860
Results of confluence:
Total flow rate =     13.150(CFS)
Time of concentration =     6.623 min.
Effective stream area after confluence =      5.030(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1112.000 to Point/Station     1116.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     2.000(Ft.)
Downstream point/station elevation =     1.200(Ft.)
Pipe length  =   280.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.150(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    13.150(CFS)
Normal flow depth in pipe =   18.16(In.)
Flow top width inside pipe =   25.34(In.)
Critical Depth =   15.12(In.)
Pipe flow velocity =      4.62(Ft/s)
Travel time through pipe =    1.01 min.
Time of concentration (TC) =     7.63 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     1117.000 to Point/Station     1116.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                    ]
Time of concentration =     7.63 min.
Rainfall intensity =      3.724(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      0.760(CFS) for    0.240(Ac.)
Total runoff =     13.909(CFS)  Total area =        5.27(Ac.)


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Process from Point/Station     1118.000 to Point/Station     1116.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                    ]
Time of concentration =     7.63 min.
Rainfall intensity =      3.724(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      2.405(CFS) for    0.680(Ac.)
Total runoff =     16.315(CFS)  Total area =        5.95(Ac.)


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Process from Point/Station     1116.000 to Point/Station     1119.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.200(Ft.)
Downstream point/station elevation =     0.300(Ft.)
```

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Pipe length  =   232.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    16.315(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    16.315(CFS)
Normal flow depth in pipe =   19.05(In.)
Flow top width inside pipe =   24.61(In.)
Critical Depth =   16.90(In.)
Pipe flow velocity =      5.44(Ft/s)
Travel time through pipe =    0.71 min.
Time of concentration (TC) =     8.34 min.


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Process from Point/Station     1120.000 to Point/Station     1119.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     8.34 min.
Rainfall intensity =      3.603(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      1.930(CFS) for    0.630(Ac.)
Total runoff =     18.245(CFS)  Total area =        6.58(Ac.)
End of computations, total study area =           6.580 (Ac.)
```

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                 San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 06/10/24
------------------------------------------------------------------------
4443.10 MIDWAY RISING
PROPOSED CONDITIONS
S2000P100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2000.000 to Point/Station     2001.000
**** 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                        ]
Initial subarea flow distance  =  110.000(Ft.)
Highest elevation =   11.700(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.00 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 110.000^.5)/(   0.182^(1/3)]=   5.00
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.709(CFS)
Total initial stream area =        0.170(Ac.)


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Process from Point/Station     2001.000 to Point/Station     2002.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    11.200(Ft.)
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```
End of street segment elevation =     9.000(Ft.)
Length of street segment  =   294.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      5.254(CFS)
Depth of flow =   0.298(Ft.), Average velocity =   2.096(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  15.879(Ft.)
Flow velocity =   2.10(Ft/s)
Travel time =    2.34 min.     TC =    7.34  min.
 Adding area flow to street
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                        ]
Rainfall intensity =      3.779(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      7.826(CFS) for    2.180(Ac.)
Total runoff =      8.535(CFS)  Total area =        2.35(Ac.)
Street flow at end of street =      8.535(CFS)
Half street flow at end of street =      8.535(CFS)
Depth of flow =   0.352(Ft.), Average velocity =   2.534(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2003.000 to Point/Station     2002.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     7.34 min.
Rainfall intensity =      3.779(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      6.857(CFS) for    1.910(Ac.)
Total runoff =     15.392(CFS)  Total area =        4.26(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2003.000 to Point/Station     2004.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.040(Ft.)
Pipe length  =   320.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.392(CFS)
Nearest computed pipe diameter  =     27.00(In.)
```

```
Calculated individual pipe flow  =    15.392(CFS)
Normal flow depth in pipe =   20.16(In.)
Flow top width inside pipe =   23.49(In.)
Critical Depth =   16.39(In.)
Pipe flow velocity =      4.83(Ft/s)
Travel time through pipe =    1.10 min.
Time of concentration (TC) =     8.44 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2003.000 to Point/Station     2004.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.260(Ac.)
Runoff from this stream =     15.392(CFS)
Time of concentration =    8.44 min.
Rainfall intensity =     3.588(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2005.000 to Point/Station     2006.000
**** 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                         ]
Initial subarea flow distance  =   80.000(Ft.)
Highest elevation =   11.300(Ft.)
Lowest elevation =   10.800(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.82 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*(  80.000^.5)/(   0.625^(1/3)]=   2.82
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.584(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2006.000 to Point/Station     2007.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    10.800(Ft.)
Downstream point elevation =     9.700(Ft.)
Channel length thru subarea  =    90.000(Ft.)
Channel base width      =   20.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =      1.334(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      1.334(CFS)
Depth of flow =   0.046(Ft.), Average velocity =   1.374(Ft/s)
Channel flow top width =   21.856(Ft.)
Flow Velocity =    1.37(Ft/s)
Travel time  =    1.09 min.
Time of concentration =    6.09 min.
```



```
Critical depth =      0.051(Ft.)
 Adding area flow to channel
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                         ]
Rainfall intensity =      4.057(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.387(CFS) for    0.360(Ac.)
Total runoff =      1.971(CFS)  Total area =        0.50(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2007.000 to Point/Station     2004.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.990(Ft.)
Downstream point/station elevation =     4.190(Ft.)
Pipe length  =    65.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.971(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.971(CFS)
Normal flow depth in pipe =    5.64(In.)
Flow top width inside pipe =    8.71(In.)
Critical Depth =    7.66(In.)
Pipe flow velocity =      6.78(Ft/s)
Travel time through pipe =    0.16 min.
Time of concentration (TC) =     6.25 min.


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Process from Point/Station     2007.000 to Point/Station     2004.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.500(Ac.)
Runoff from this stream =      1.971(CFS)
Time of concentration =    6.25 min.
Rainfall intensity =     4.016(In/Hr)
Summary of stream data:

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


1       15.392      8.44                 3.588
2        1.971      6.25                 4.016
Qmax(1) =
           1.000 *    1.000 *    15.392) +
           0.893 *    1.000 *     1.971) + =      17.153
Qmax(2) =
           1.000 *    0.741 *    15.392) +
           1.000 *    1.000 *     1.971) + =      13.370

Total of 2 streams to confluence:
Flow rates before confluence point:
      15.392       1.971
Maximum flow rates at confluence using above data:
       17.153       13.370
Area of streams before confluence:
        4.260        0.500
Results of confluence:
```

```
Total flow rate =     17.153(CFS)
Time of concentration =     8.442 min.
Effective stream area after confluence =      4.760(Ac.)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2004.000 to Point/Station     2008.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.190(Ft.)
Downstream point/station elevation =     4.000(Ft.)
Pipe length  =    66.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    17.153(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    17.153(CFS)
Normal flow depth in pipe =   23.02(In.)
Flow top width inside pipe =   19.15(In.)
Critical Depth =   17.36(In.)
Pipe flow velocity =      4.75(Ft/s)
Travel time through pipe =    0.23 min.
Time of concentration (TC) =     8.67 min.


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2004.000 to Point/Station     2008.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.760(Ac.)
Runoff from this stream =     17.153(CFS)
Time of concentration =    8.67 min.
Rainfall intensity =     3.553(In/Hr)


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Process from Point/Station     2009.000 to Point/Station     2010.000
**** 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                         ]
Initial subarea flow distance  =   75.000(Ft.)
Highest elevation =   10.600(Ft.)
Lowest elevation =   10.500(Ft.)
Elevation difference =    0.100(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     7.63 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8500)*(  75.000^.5)/( 0.133^(1/3)]=   7.63
Rainfall intensity (I) =      3.725(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =      1.773(CFS)
Total initial stream area =        0.560(Ac.)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2010.000 to Point/Station     2011.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    10.500(Ft.)
End of street segment elevation =     8.700(Ft.)
```



```
Length of street segment  =   491.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  20.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  12.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      2.659(CFS)
Depth of flow =   0.262(Ft.), Average velocity =   1.354(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.065(Ft.)
Flow velocity =   1.35(Ft/s)
Travel time =    6.04 min.     TC =   13.67  min.
 Adding area flow to street
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                         ]
Rainfall intensity =      3.009(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      1.432(CFS) for    0.560(Ac.)
Total runoff =      3.205(CFS)  Total area =        1.12(Ac.)
Street flow at end of street =      3.205(CFS)
Half street flow at end of street =      3.205(CFS)
Depth of flow =   0.282(Ft.), Average velocity =   1.418(Ft/s)
Flow width (from curb towards crown)=  15.083(Ft.)


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Process from Point/Station     2011.000 to Point/Station     2013.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.190(Ft.)
Downstream point/station elevation =     6.000(Ft.)
Pipe length  =    36.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.205(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     3.205(CFS)
Normal flow depth in pipe =    9.09(In.)
Flow top width inside pipe =   14.66(In.)
Critical Depth =    8.66(In.)
Pipe flow velocity =      4.12(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =    13.82 min.


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2013.000 to Point/Station     2012.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                         ]
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Time of concentration =    13.82 min.
Rainfall intensity =      2.997(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     12.074(CFS) for    4.240(Ac.)
Total runoff =     15.279(CFS)  Total area =        5.36(Ac.)


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Process from Point/Station     2012.000 to Point/Station     2008.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.500(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.279(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    15.279(CFS)
Normal flow depth in pipe =   15.35(In.)
Flow top width inside pipe =   23.04(In.)
Critical Depth =   16.89(In.)
Pipe flow velocity =      7.19(Ft/s)
Travel time through pipe =    0.14 min.
Time of concentration (TC) =    13.96 min.


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Process from Point/Station     2012.000 to Point/Station     2008.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      5.360(Ac.)
Runoff from this stream =     15.279(CFS)
Time of concentration =   13.96 min.
Rainfall intensity =     2.986(In/Hr)
Summary of stream data:

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


1       17.153      8.67                 3.553
2       15.279     13.96                 2.986
Qmax(1) =
           1.000 *    1.000 *    17.153) +
           1.000 *    0.621 *    15.279) + =      26.648
Qmax(2) =
           0.840 *    1.000 *    17.153) +
           1.000 *    1.000 *    15.279) + =      29.695

Total of 2 streams to confluence:
Flow rates before confluence point:
      17.153      15.279
Maximum flow rates at confluence using above data:
       26.648       29.695
Area of streams before confluence:
        4.760        5.360
Results of confluence:
Total flow rate =     29.695(CFS)
Time of concentration =    13.956 min.
Effective stream area after confluence =     10.120(Ac.)


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Process from Point/Station     2008.000 to Point/Station     2014.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.000(Ft.)
Downstream point/station elevation =     5.500(Ft.)
Pipe length  =   290.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    29.695(CFS)
Nearest computed pipe diameter  =     39.00(In.)
Calculated individual pipe flow  =    29.695(CFS)
Normal flow depth in pipe =   28.03(In.)
Flow top width inside pipe =   35.07(In.)
Critical Depth =   20.66(In.)
Pipe flow velocity =      4.65(Ft/s)
Travel time through pipe =    1.04 min.
Time of concentration (TC) =    14.99 min.


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Process from Point/Station     2008.000 to Point/Station     2014.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     10.120(Ac.)
Runoff from this stream =     29.695(CFS)
Time of concentration =   14.99 min.
Rainfall intensity =     2.905(In/Hr)


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Process from Point/Station     2015.000 to Point/Station     2016.000
**** 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                    ]
Initial subarea flow distance  =  132.000(Ft.)
Highest elevation =   12.800(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    1.800(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.80 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 132.000^.5)/(   1.364^(1/3)]=   2.80
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.500(CFS)
Total initial stream area =        0.120(Ac.)


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Process from Point/Station     2016.000 to Point/Station     2014.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    11.000(Ft.)
End of street segment elevation =     9.500(Ft.)
Length of street segment  =   275.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
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Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      8.756(CFS)
Depth of flow =   0.295(Ft.), Average velocity =   1.779(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  15.735(Ft.)
Flow velocity =   1.78(Ft/s)
Travel time =    2.58 min.     TC =    7.58  min.
 Adding area flow to street
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                        ]
Rainfall intensity =      3.734(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     14.047(CFS) for    3.960(Ac.)
Total runoff =     14.548(CFS)  Total area =        4.08(Ac.)
Street flow at end of street =     14.548(CFS)
Half street flow at end of street =      7.274(CFS)
Depth of flow =   0.352(Ft.), Average velocity =   2.162(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station     2016.000 to Point/Station     2014.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.080(Ac.)
Runoff from this stream =     14.548(CFS)
Time of concentration =    7.58 min.
Rainfall intensity =     3.734(In/Hr)
Summary of stream data:

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


1       29.695     14.99                 2.905
2       14.548      7.58                 3.734
Qmax(1) =
           1.000 *    1.000 *    29.695) +
           0.778 *    1.000 *    14.548) + =      41.015
Qmax(2) =
           1.000 *    0.505 *    29.695) +
           1.000 *    1.000 *    14.548) + =      29.553

Total of 2 streams to confluence:
Flow rates before confluence point:
      29.695     14.548
Maximum flow rates at confluence using above data:
       41.015       29.553
Area of streams before confluence:
       10.120        4.080
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Results of confluence:
Total flow rate =     41.015(CFS)
Time of concentration =    14.995 min.
Effective stream area after confluence =     14.200(Ac.)


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Process from Point/Station     2014.000 to Point/Station     2017.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.500(Ft.)
Downstream point/station elevation =     5.400(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    41.015(CFS)
Nearest computed pipe diameter  =     42.00(In.)
Calculated individual pipe flow  =    41.015(CFS)
Normal flow depth in pipe =   34.41(In.)
Flow top width inside pipe =   32.33(In.)
Critical Depth =   23.92(In.)
Pipe flow velocity =      4.87(Ft/s)
Travel time through pipe =    0.21 min.
Time of concentration (TC) =    15.20 min.


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Process from Point/Station     2014.000 to Point/Station     2017.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     14.200(Ac.)
Runoff from this stream =     41.015(CFS)
Time of concentration =   15.20 min.
Rainfall intensity =     2.890(In/Hr)
Program is now starting with Main Stream No. 2


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Process from Point/Station     2018.000 to Point/Station     2019.000
**** 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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Initial subarea flow distance  =  114.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =    16.44 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4500)*( 114.000^.5)/( 0.439^(1/3)]=  16.44
Rainfall intensity (I) =      2.802(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff =      0.265(CFS)
Total initial stream area =        0.210(Ac.)


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Process from Point/Station     2019.000 to Point/Station     2020.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
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____________________________________________________________________
Top of street segment elevation =    11.500(Ft.)
End of street segment elevation =    10.000(Ft.)
Length of street segment  =   598.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      2.402(CFS)
Depth of flow =   0.271(Ft.), Average velocity =   1.145(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.536(Ft.)
Flow velocity =   1.14(Ft/s)
Travel time =    8.71 min.     TC =   25.15  min.
 Adding area flow to street
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                    ]
Rainfall intensity =      2.313(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      7.449(CFS) for    3.390(Ac.)
Total runoff =      7.714(CFS)  Total area =        3.60(Ac.)
Street flow at end of street =      7.714(CFS)
Half street flow at end of street =      7.714(CFS)
Depth of flow =   0.417(Ft.), Average velocity =   1.751(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station     2019.000 to Point/Station     2020.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      3.600(Ac.)
Runoff from this stream =      7.714(CFS)
Time of concentration =   25.15 min.
Rainfall intensity =     2.313(In/Hr)


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Process from Point/Station     2021.000 to Point/Station     2022.000
**** 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
[MULTI - UNITS area type                 ]
Initial subarea flow distance  =  112.000(Ft.)
Highest elevation =   52.000(Ft.)
Lowest elevation =   12.000(Ft.)
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Elevation difference =   40.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =      2.31 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*( 112.000^.5)/(  35.714^(1/3)]=   2.31
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff =      0.768(CFS)
Total initial stream area =        0.250(Ac.)


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Process from Point/Station     2022.000 to Point/Station     2020.000
**** IMPROVED CHANNEL TRAVEL TIME ****
____________________________________________________________________
Upstream point elevation =    12.000(Ft.)
Downstream point elevation =    10.000(Ft.)
Channel length thru subarea  =   848.000(Ft.)
Channel base width      =    4.000(Ft.)
Slope or 'Z' of left channel bank =   4.000
Slope or 'Z' of right channel bank =   4.000
Estimated mean flow rate at midpoint of channel =      2.780(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    4.000(Ft.)
Flow(q) thru subarea =      2.780(CFS)
Depth of flow =   0.293(Ft.), Average velocity =   1.837(Ft/s)
Channel flow top width =    6.342(Ft.)
Flow Velocity =    1.84(Ft/s)
Travel time  =    7.69 min.
Time of concentration =   12.69 min.
Critical depth =      0.227(Ft.)
 Adding area flow to channel
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
[MULTI - UNITS area type                 ]
Rainfall intensity =      3.094(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.700
Subarea runoff =      2.837(CFS) for    1.310(Ac.)
Total runoff =      3.605(CFS)  Total area =        1.56(Ac.)


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Process from Point/Station     2022.000 to Point/Station     2020.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.560(Ac.)
Runoff from this stream =      3.605(CFS)
Time of concentration =   12.69 min.
Rainfall intensity =     3.094(In/Hr)
Summary of stream data:

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


1        7.714     25.15                2.313
2        3.605     12.69                3.094
Qmax(1) =
           1.000 *    1.000 *     7.714) +
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           0.748 *    1.000 *     3.605) + =      10.409
Qmax(2) =
           1.000 *    0.505 *     7.714) +
           1.000 *    1.000 *     3.605) + =       7.499

Total of 2 streams to confluence:
Flow rates before confluence point:
      7.714       3.605
Maximum flow rates at confluence using above data:
      10.409       7.499
Area of streams before confluence:
        3.600        1.560
Results of confluence:
Total flow rate =     10.409(CFS)
Time of concentration =    25.148 min.
Effective stream area after confluence =      5.160(Ac.)


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Process from Point/Station     2020.000 to Point/Station     2017.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.500(Ft.)
Downstream point/station elevation =     5.400(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.409(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    10.409(CFS)
Normal flow depth in pipe =   18.66(In.)
Flow top width inside pipe =   24.95(In.)
Critical Depth =   13.35(In.)
Pipe flow velocity =      3.55(Ft/s)
Travel time through pipe =    0.28 min.
Time of concentration (TC) =    25.43 min.


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Process from Point/Station     2020.000 to Point/Station     2017.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      5.160(Ac.)
Runoff from this stream =     10.409(CFS)
Time of concentration =   25.43 min.
Rainfall intensity =     2.300(In/Hr)
Summary of stream data:

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


1       41.015     15.20                 2.890
2       10.409     25.43                 2.300
Qmax(1) =
           1.000 *    1.000 *    41.015) +
           1.000 *    0.598 *    10.409) + =      47.237
Qmax(2) =
           0.796 *    1.000 *    41.015) +
           1.000 *    1.000 *    10.409) + =      43.047

Total of 2 main streams to confluence:
Flow rates before confluence point:
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      41.015      10.409
Maximum flow rates at confluence using above data:
       47.237       43.047
Area of streams before confluence:
       14.200        5.160


Results of confluence:
Total flow rate =     47.237(CFS)
Time of concentration =    15.200 min.
Effective stream area after confluence  =     19.360(Ac.)


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Process from Point/Station     2017.000 to Point/Station     2023.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.400(Ft.)
Downstream point/station elevation =     4.000(Ft.)
Pipe length  =   470.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    47.237(CFS)
Nearest computed pipe diameter  =     39.00(In.)
Calculated individual pipe flow  =    47.237(CFS)
Normal flow depth in pipe =   33.94(In.)
Flow top width inside pipe =   26.22(In.)
Critical Depth =   26.29(In.)
Pipe flow velocity =      6.16(Ft/s)
Travel time through pipe =    1.27 min.
Time of concentration (TC) =    16.47 min.


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Process from Point/Station     2017.000 to Point/Station     2023.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     19.360(Ac.)
Runoff from this stream =     47.237(CFS)
Time of concentration =   16.47 min.
Rainfall intensity =     2.800(In/Hr)


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Process from Point/Station     2024.000 to Point/Station     2025.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   13.000(Ft.)
Lowest elevation =   12.000(Ft.)
Elevation difference =    1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.70 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   1.000^(1/3)]=   2.70
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.834(CFS)
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Total initial stream area =        0.200(Ac.)


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Process from Point/Station     2025.000 to Point/Station     2026.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    12.000(Ft.)
End of street segment elevation =     8.000(Ft.)
Length of street segment  =   666.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =     10.799(CFS)
Depth of flow =   0.414(Ft.), Average velocity =   2.305(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  21.677(Ft.)
Flow velocity =   2.31(Ft/s)
Travel time =    4.81 min.     TC =    9.81  min.
 Adding area flow to street
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                       ]
Rainfall intensity =      3.397(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      15.426(CFS) for    4.780(Ac.)
Total runoff =     16.260(CFS)  Total area =        4.98(Ac.)
Street flow at end of street =     16.260(CFS)
Half street flow at end of street =     16.260(CFS)
Depth of flow =   0.481(Ft.), Average velocity =   2.605(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  24.000(Ft.)


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Process from Point/Station     2027.000 to Point/Station     2026.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     9.81 min.
Rainfall intensity =      3.397(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      9.133(CFS) for    2.830(Ac.)
Total runoff =     25.393(CFS)  Total area =        7.81(Ac.)


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Process from Point/Station     2026.000 to Point/Station     2023.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.300(Ft.)
Downstream point/station elevation =     4.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.393(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    25.393(CFS)
Normal flow depth in pipe =   18.61(In.)
Flow top width inside pipe =   24.99(In.)
Critical Depth =   21.11(In.)
Pipe flow velocity =     8.69(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     9.87 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2026.000 to Point/Station     2023.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      7.810(Ac.)
Runoff from this stream =     25.393(CFS)
Time of concentration =    9.87 min.
Rainfall intensity =     3.390(In/Hr)
Summary of stream data:

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


1       47.237     16.47                 2.800
2       25.393      9.87                 3.390
Qmax(1) =
           1.000 *    1.000 *    47.237) +
           0.826 *    1.000 *    25.393) + =      68.211
Qmax(2) =
           1.000 *    0.599 *    47.237) +
           1.000 *    1.000 *    25.393) + =      53.703

Total of 2 streams to confluence:
Flow rates before confluence point:
      47.237      25.393
Maximum flow rates at confluence using above data:
       68.211       53.703
Area of streams before confluence:
       19.360        7.810
Results of confluence:
Total flow rate =     68.211(CFS)
Time of concentration =    16.472 min.
Effective stream area after confluence =     27.170(Ac.)


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Process from Point/Station     2023.000 to Point/Station     2028.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.000(Ft.)
Downstream point/station elevation =     1.150(Ft.)
Pipe length  =   950.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    68.211(CFS)
Nearest computed pipe diameter  =     45.00(In.)
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```
Calculated individual pipe flow  =    68.211(CFS)
Normal flow depth in pipe =   38.25(In.)
Flow top width inside pipe =   32.14(In.)
Critical Depth =   30.48(In.)
Pipe flow velocity =      6.82(Ft/s)
Travel time through pipe =    2.32 min.
Time of concentration (TC) =    18.79 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2023.000 to Point/Station     2028.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     27.170(Ac.)
Runoff from this stream =     68.211(CFS)
Time of concentration =   18.79 min.
Rainfall intensity =     2.651(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2029.000 to Point/Station     2030.000
**** 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
[MULTI - UNITS area type                     ]
Initial subarea flow distance  =   75.000(Ft.)
Highest elevation =   11.500(Ft.)
Lowest elevation =   11.200(Ft.)
Elevation difference =    0.300(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     8.46 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(  75.000^.5)/( 0.400^(1/3)]=   8.46
Rainfall intensity (I) =      3.585(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff =      0.251(CFS)
Total initial stream area =        0.100(Ac.)


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Process from Point/Station     2030.000 to Point/Station     2031.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    11.200(Ft.)
End of street segment elevation =    10.800(Ft.)
Length of street segment  =   283.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  12.000(Ft.)
Distance from crown to crossfall grade break  =  10.500(Ft.)
Slope from gutter to grade break (v/hz) =    0.020
Slope from grade break to crown (v/hz)  =    0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =    0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
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 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      0.878(CFS)
Depth of flow =   0.152(Ft.), Average velocity =   0.607(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   8.591(Ft.)
Flow velocity =   0.61(Ft/s)
Travel time =    7.77 min.     TC =   16.23  min.
 Adding area flow to street
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
[MULTI - UNITS area type                     ]
Rainfall intensity =      2.816(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.700
Subarea runoff =      0.986(CFS) for    0.500(Ac.)
Total runoff =      1.237(CFS)  Total area =        0.60(Ac.)
Street flow at end of street =      1.237(CFS)
Half street flow at end of street =      0.618(CFS)
Depth of flow =   0.175(Ft.), Average velocity =   0.660(Ft/s)
Flow width (from curb towards crown)=   9.753(Ft.)


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Process from Point/Station     2030.000 to Point/Station     2031.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.600(Ac.)
Runoff from this stream =      1.237(CFS)
Time of concentration =   16.23 min.
Rainfall intensity =     2.816(In/Hr)


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Process from Point/Station     2032.000 to Point/Station     2033.000
**** 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                        ]
Initial subarea flow distance  =  110.000(Ft.)
Highest elevation =   11.500(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.68 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 110.000^.5)/(   0.455^(1/3)]=   3.68
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.584(CFS)
Total initial stream area =        0.140(Ac.)


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Process from Point/Station     2033.000 to Point/Station     2034.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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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                       ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      6.338(CFS) for    1.520(Ac.)
Total runoff =      6.922(CFS)  Total area =       1.66(Ac.)


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Process from Point/Station     2033.000 to Point/Station     2034.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     8.000(Ft.)
Downstream point/station elevation =     6.000(Ft.)
Pipe length  =   114.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.922(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     6.922(CFS)
Normal flow depth in pipe =   10.23(In.)
Flow top width inside pipe =   13.97(In.)
Critical Depth =   12.67(In.)
Pipe flow velocity =      7.76(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =     5.24 min.


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Process from Point/Station     2035.000 to Point/Station     2034.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     5.24 min.
Rainfall intensity =      4.305(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      2.634(CFS) for    0.720(Ac.)
Total runoff =      9.556(CFS)  Total area =       2.38(Ac.)


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Process from Point/Station     2034.000 to Point/Station     2031.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.970(Ft.)
Downstream point/station elevation =     4.220(Ft.)
Pipe length  =    64.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.556(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     9.556(CFS)
Normal flow depth in pipe =   12.63(In.)
Flow top width inside pipe =   16.47(In.)
Critical Depth =   14.33(In.)
Pipe flow velocity =      7.21(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =     5.39 min.
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Process from Point/Station     2034.000 to Point/Station     2031.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      2.380(Ac.)
Runoff from this stream =      9.556(CFS)
Time of concentration =    5.39 min.
Rainfall intensity =     4.257(In/Hr)
Summary of stream data:

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


1        1.237     16.23                  2.816
2        9.556      5.39                  4.257
Qmax(1) =
           1.000 *    1.000 *     1.237) +
           0.662 *    1.000 *     9.556) + =       7.559
Qmax(2) =
           1.000 *    0.332 *     1.237) +
           1.000 *    1.000 *     9.556) + =       9.967

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.237       9.556
Maximum flow rates at confluence using above data:
        7.559       9.967
Area of streams before confluence:
        0.600       2.380
Results of confluence:
Total flow rate =      9.967(CFS)
Time of concentration =     5.393 min.
Effective stream area after confluence =      2.980(Ac.)


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Process from Point/Station     2031.000 to Point/Station     2036.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.220(Ft.)
Downstream point/station elevation =     2.660(Ft.)
Pipe length  =    60.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.967(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     9.967(CFS)
Normal flow depth in pipe =   11.74(In.)
Flow top width inside pipe =   12.37(In.)
Critical Depth =   14.19(In.)
Pipe flow velocity =      9.66(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     5.50 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2036.000 to Point/Station     2037.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     2.660(Ft.)
Downstream point/station elevation =     1.340(Ft.)
Pipe length  =   260.00(Ft.)   Manning's N = 0.013
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No. of pipes = 1  Required pipe flow  =     9.967(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     9.967(CFS)
Normal flow depth in pipe =   15.33(In.)
Flow top width inside pipe =   18.65(In.)
Critical Depth =   14.11(In.)
Pipe flow velocity =      5.30(Ft/s)
Travel time through pipe =    0.82 min.
Time of concentration (TC) =     6.31 min.


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Process from Point/Station     2036.000 to Point/Station     2037.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      2.980(Ac.)
Runoff from this stream =      9.967(CFS)
Time of concentration =    6.31 min.
Rainfall intensity =     4.001(In/Hr)


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Process from Point/Station     2038.000 to Point/Station     2039.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.417(CFS)
Total initial stream area =        0.100(Ac.)


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Process from Point/Station     2039.000 to Point/Station     2040.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.501(CFS) for    0.360(Ac.)
Total runoff =      1.918(CFS)  Total area =        0.46(Ac.)


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Process from Point/Station     2040.000 to Point/Station     2041.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.430(Ft.)
Downstream point/station elevation =     5.930(Ft.)
Pipe length  =    50.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.918(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     1.918(CFS)
Normal flow depth in pipe =    6.27(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    7.08(In.)
Pipe flow velocity =      4.62(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     5.18 min.


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Process from Point/Station     2042.000 to Point/Station     2041.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.18 min.
Rainfall intensity =      4.326(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      2.425(CFS) for    0.590(Ac.)
Total runoff =      4.343(CFS)  Total area =        1.05(Ac.)


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Process from Point/Station     2043.000 to Point/Station     2041.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.18 min.
Rainfall intensity =      4.326(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      5.672(CFS) for    1.380(Ac.)
Total runoff =     10.014(CFS)  Total area =        2.43(Ac.)


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Process from Point/Station     2044.000 to Point/Station     2041.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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
[SINGLE FAMILY area type                     ]
Time of concentration =     5.18 min.
Rainfall intensity =      4.326(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      1.261(CFS) for    0.530(Ac.)
Total runoff =     11.275(CFS)  Total area =        2.96(Ac.)
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Process from Point/Station     2041.000 to Point/Station     2037.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.900(Ft.)
Downstream point/station elevation =     1.300(Ft.)
Pipe length  =   296.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.275(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    11.275(CFS)
Normal flow depth in pipe =   12.88(In.)
Flow top width inside pipe =   16.24(In.)
Critical Depth =   15.40(In.)
Pipe flow velocity =      8.33(Ft/s)
Travel time through pipe =    0.59 min.
Time of concentration (TC) =     5.77 min.


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Process from Point/Station     2046.000 to Point/Station     2037.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     5.77 min.
Rainfall intensity =      4.143(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.551(CFS) for    0.140(Ac.)
Total runoff =     11.827(CFS)  Total area =        3.10(Ac.)


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Process from Point/Station     2046.000 to Point/Station     2037.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      3.100(Ac.)
Runoff from this stream =     11.827(CFS)
Time of concentration =    5.77 min.
Rainfall intensity =     4.143(In/Hr)
Summary of stream data:

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


1        9.967      6.31                 4.001
2       11.827      5.77                 4.143
Qmax(1) =
           1.000 *    1.000 *     9.967) +
           0.966 *    1.000 *    11.827) + =      21.387
Qmax(2) =
           1.000 *    0.914 *     9.967) +
           1.000 *    1.000 *    11.827) + =      20.938

Total of 2 streams to confluence:
Flow rates before confluence point:
       9.967      11.827
```



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Maximum flow rates at confluence using above data:
       21.387       20.938
Area of streams before confluence:
        2.980        3.100
Results of confluence:
Total flow rate =     21.387(CFS)
Time of concentration =     6.314 min.
Effective stream area after confluence =      6.080(Ac.)


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Process from Point/Station     2037.000 to Point/Station     2028.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.340(Ft.)
Downstream point/station elevation =     0.500(Ft.)
Pipe length  =   377.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.387(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    21.387(CFS)
Normal flow depth in pipe =   23.53(In.)
Flow top width inside pipe =   29.85(In.)
Critical Depth =   18.33(In.)
Pipe flow velocity =      4.72(Ft/s)
Travel time through pipe =    1.33 min.
Time of concentration (TC) =     7.64 min.


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Process from Point/Station     2037.000 to Point/Station     2028.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      6.080(Ac.)
Runoff from this stream =     21.387(CFS)
Time of concentration =    7.64 min.
Rainfall intensity =     3.722(In/Hr)
Summary of stream data:

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


1       68.211     18.79                 2.651
2       21.387      7.64                 3.722
Qmax(1) =
           1.000 *    1.000 *    68.211) +
           0.712 *    1.000 *    21.387) + =      83.446
Qmax(2) =
           1.000 *    0.407 *    68.211) +
           1.000 *    1.000 *    21.387) + =      49.131

Total of 2 main streams to confluence:
Flow rates before confluence point:
      68.211      21.387
Maximum flow rates at confluence using above data:
       83.446       49.131
Area of streams before confluence:
       27.170        6.080


Results of confluence:
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```
Total flow rate =     83.446(CFS)
Time of concentration =    18.793 min.
Effective stream area after confluence  =     33.250(Ac.)


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Process from Point/Station     2028.000 to Point/Station     2047.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     0.500(Ft.)
Downstream point/station elevation =     0.350(Ft.)
Pipe length  =   130.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    83.446(CFS)
Nearest computed pipe diameter  =     60.00(In.)
Calculated individual pipe flow  =    83.446(CFS)
Normal flow depth in pipe =   46.41(In.)
Flow top width inside pipe =   50.23(In.)
Critical Depth =   31.08(In.)
Pipe flow velocity =      5.12(Ft/s)
Travel time through pipe =    0.42 min.
Time of concentration (TC) =    19.22 min.


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Process from Point/Station     2028.000 to Point/Station     2047.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     33.250(Ac.)
Runoff from this stream =     83.446(CFS)
Time of concentration =   19.22 min.
Rainfall intensity =     2.626(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2048.000 to Point/Station     2049.000
**** 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                         ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.500(CFS)
Total initial stream area =        0.120(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2049.000 to Point/Station     2050.000
**** SUBAREA FLOW ADDITION ****
```



```
______________________________________________________________________
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                         ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.792(CFS) for    0.190(Ac.)
Total runoff =      1.293(CFS)  Total area =        0.31(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2045.000 to Point/Station     2050.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                         ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      4.670(CFS) for    1.120(Ac.)
Total runoff =      5.963(CFS)  Total area =        1.43(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2051.000 to Point/Station     2050.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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
[SINGLE FAMILY area type                      ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      0.869(CFS) for    0.360(Ac.)
Total runoff =      6.832(CFS)  Total area =        1.79(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2050.000 to Point/Station     2052.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.800(Ft.)
Downstream point/station elevation =     4.400(Ft.)
Pipe length  =   123.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.832(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     6.832(CFS)
Normal flow depth in pipe =   12.19(In.)
Flow top width inside pipe =   11.71(In.)
Critical Depth =   12.60(In.)
Pipe flow velocity =      6.40(Ft/s)
Travel time through pipe =    0.32 min.
Time of concentration (TC) =     5.32 min.
```

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Process from Point/Station     2055.000 to Point/Station     2052.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.790(Ac.)
Runoff from this stream =      6.832(CFS)
Time of concentration =    5.32 min.
Rainfall intensity =     4.280(In/Hr)


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Process from Point/Station     2053.000 to Point/Station     2054.000
**** 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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Initial subarea flow distance  =  110.000(Ft.)
Highest elevation =   13.000(Ft.)
Lowest elevation =   12.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =    15.96 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4500)*( 110.000^.5)/( 0.455^(1/3)]=  15.96
Rainfall intensity (I) =      2.835(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.450
Subarea runoff =      0.179(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2054.000 to Point/Station     2055.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    12.500(Ft.)
Downstream point elevation =    12.000(Ft.)
Channel length thru subarea  =   357.000(Ft.)
Channel base width      =   20.000(Ft.)
Slope or 'Z' of left channel bank =  10.000
Slope or 'Z' of right channel bank =  10.000
Estimated mean flow rate at midpoint of channel =      0.874(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      0.874(CFS)
Depth of flow =   0.124(Ft.), Average velocity =   0.332(Ft/s)
Channel flow top width =   22.476(Ft.)
Flow Velocity =    0.33(Ft/s)
Travel time  =   17.90 min.
Time of concentration =   33.86 min.
Critical depth =      0.039(Ft.)
 Adding area flow to channel
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
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity =      1.953(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      0.958(CFS) for    1.090(Ac.)
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Total runoff =      1.137(CFS)  Total area =        1.23(Ac.)


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Process from Point/Station     2056.000 to Point/Station     2055.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =    33.86 min.
Rainfall intensity =      1.953(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.299(CFS) for    0.700(Ac.)
Total runoff =      2.436(CFS)  Total area =        1.93(Ac.)


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Process from Point/Station     2055.000 to Point/Station     2052.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.700(Ft.)
Downstream point/station elevation =     4.440(Ft.)
Pipe length  =    12.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.436(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.436(CFS)
Normal flow depth in pipe =    5.81(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    8.02(In.)
Pipe flow velocity =      6.45(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    33.89 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2056.000 to Point/Station     2052.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      1.930(Ac.)
Runoff from this stream =      2.436(CFS)
Time of concentration =   33.89 min.
Rainfall intensity =     1.952(In/Hr)
Summary of stream data:

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


1        6.832      5.32                 4.280
2        2.436     33.89                 1.952
Qmax(1) =
           1.000 *    1.000 *     6.832) +
           1.000 *    0.157 *     2.436) + =       7.214
Qmax(2) =
           0.456 *    1.000 *     6.832) +
           1.000 *    1.000 *     2.436) + =       5.552

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

```
      6.832       2.436
Maximum flow rates at confluence using above data:
       7.214        5.552
Area of streams before confluence:
       1.790        1.930
Results of confluence:
Total flow rate =      7.214(CFS)
Time of concentration =     5.320 min.
Effective stream area after confluence =      3.720(Ac.)


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Process from Point/Station     2052.000 to Point/Station     2057.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.400(Ft.)
Downstream point/station elevation =     1.500(Ft.)
Pipe length  =   393.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.214(CFS)
Nearest computed pipe diameter  =    18.00(In.)
Calculated individual pipe flow  =     7.214(CFS)
Normal flow depth in pipe =   12.16(In.)
Flow top width inside pipe =   16.85(In.)
Critical Depth =   12.47(In.)
Pipe flow velocity =      5.67(Ft/s)
Travel time through pipe =    1.15 min.
Time of concentration (TC) =     6.48 min.


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Process from Point/Station     2052.000 to Point/Station     2057.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      3.720(Ac.)
Runoff from this stream =      7.214(CFS)
Time of concentration =    6.48 min.
Rainfall intensity =     3.962(In/Hr)


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Process from Point/Station     2058.000 to Point/Station     2059.000
**** 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                        ]
Initial subarea flow distance  =   75.000(Ft.)
Highest elevation =   12.400(Ft.)
Lowest elevation =   12.100(Ft.)
Elevation difference =    0.300(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.29 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8500)*(  75.000^.5)/( 0.400^(1/3)]=   5.29
Rainfall intensity (I) =      4.290(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =      0.219(CFS)
Total initial stream area =       0.060(Ac.)
```



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Process from Point/Station     2059.000 to Point/Station     2060.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    12.100(Ft.)
End of street segment elevation =     9.000(Ft.)
Length of street segment  =   284.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  20.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      0.247(CFS)
Depth of flow =   0.077(Ft.), Average velocity =   1.139(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   4.815(Ft.)
Flow velocity =   1.14(Ft/s)
Travel time =    4.16 min.     TC =    9.45  min.
 Adding area flow to street
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                        ]
Note: user entry of impervious value, Ap = 0.900
Rainfall intensity =      3.444(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.956
Subarea runoff =      0.856(CFS) for    0.260(Ac.)
Total runoff =      1.075(CFS)  Total area =        0.32(Ac.)
Street flow at end of street =      1.075(CFS)
Half street flow at end of street =      1.075(CFS)
Depth of flow =   0.144(Ft.), Average velocity =   1.635(Ft/s)
Flow width (from curb towards crown)=   8.199(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2060.000 to Point/Station     2057.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.500(Ft.)
Downstream point/station elevation =     1.200(Ft.)
Pipe length  =    13.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.075(CFS)
Nearest computed pipe diameter  =     9.00(In.)
Calculated individual pipe flow  =     1.075(CFS)
Normal flow depth in pipe =    4.11(In.)
Flow top width inside pipe =    8.97(In.)
Critical Depth =    5.72(In.)
Pipe flow velocity =      5.47(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     9.49 min.


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Process from Point/Station     2061.000 to Point/Station     2057.000
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**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                    ]
Time of concentration =     9.49 min.
Rainfall intensity =      3.439(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      0.877(CFS) for    0.300(Ac.)
Total runoff =      1.952(CFS)  Total area =       0.62(Ac.)


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Process from Point/Station     2061.000 to Point/Station     2057.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.620(Ac.)
Runoff from this stream =      1.952(CFS)
Time of concentration =    9.49 min.
Rainfall intensity =     3.439(In/Hr)
Summary of stream data:

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


1        7.214      6.48                 3.962
2        1.952      9.49                 3.439
Qmax(1) =
           1.000 *    1.000 *     7.214) +
           1.000 *    0.683 *     1.952) + =       8.547
Qmax(2) =
           0.868 *    1.000 *     7.214) +
           1.000 *    1.000 *     1.952) + =       8.214

Total of 2 streams to confluence:
Flow rates before confluence point:
       7.214       1.952
Maximum flow rates at confluence using above data:
        8.547       8.214
Area of streams before confluence:
        3.720       0.620
Results of confluence:
Total flow rate =      8.547(CFS)
Time of concentration =     6.475 min.
Effective stream area after confluence =      4.340(Ac.)


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Process from Point/Station     2057.000 to Point/Station     2047.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.500(Ft.)
Downstream point/station elevation =     1.000(Ft.)
Pipe length  =    64.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.547(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     8.547(CFS)
Normal flow depth in pipe =   13.62(In.)
Flow top width inside pipe =   15.45(In.)
```



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Critical Depth =   13.58(In.)
Pipe flow velocity =      5.96(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     6.65 min.


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Process from Point/Station     2057.000 to Point/Station     2047.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.340(Ac.)
Runoff from this stream =      8.547(CFS)
Time of concentration =    6.65 min.
Rainfall intensity =     3.921(In/Hr)
Summary of stream data:

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


1       83.446     19.22                 2.626
2        8.547      6.65                 3.921
Qmax(1) =
           1.000 *    1.000 *    83.446) +
           0.670 *    1.000 *     8.547) + =      89.170
Qmax(2) =
           1.000 *    0.346 *    83.446) +
           1.000 *    1.000 *     8.547) + =      37.442

Total of 2 main streams to confluence:
Flow rates before confluence point:
      83.446       8.547
Maximum flow rates at confluence using above data:
       89.170       37.442
Area of streams before confluence:
       33.250        4.340


Results of confluence:
Total flow rate =     89.170(CFS)
Time of concentration =    19.216 min.
Effective stream area after confluence  =     37.590(Ac.)


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Process from Point/Station     2047.000 to Point/Station     2062.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.500(Ft.)
Downstream point/station elevation =     0.500(Ft.)
Pipe length  =   411.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    89.170(CFS)
Nearest computed pipe diameter  =     54.00(In.)
Calculated individual pipe flow  =    89.170(CFS)
Normal flow depth in pipe =   40.78(In.)
Flow top width inside pipe =   46.44(In.)
Critical Depth =   33.20(In.)
Pipe flow velocity =      6.92(Ft/s)
Travel time through pipe =    0.99 min.
Time of concentration (TC) =    20.21 min.
```

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Process from Point/Station     2047.000 to Point/Station     2062.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     37.590(Ac.)
Runoff from this stream =     89.170(CFS)
Time of concentration =   20.21 min.
Rainfall intensity =     2.569(In/Hr)


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Process from Point/Station     2063.000 to Point/Station     2064.000
**** 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                       ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.500(CFS)
Total initial stream area =       0.120(Ac.)


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Process from Point/Station     2064.000 to Point/Station     2065.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      5.837(CFS) for    1.400(Ac.)
Total runoff =      6.338(CFS)  Total area =       1.52(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2066.000 to Point/Station     2065.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
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Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      7.547(CFS) for    1.810(Ac.)
Total runoff =     13.885(CFS)  Total area =       3.33(Ac.)


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Process from Point/Station     2065.000 to Point/Station     2067.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     2.500(Ft.)
Downstream point/station elevation =     2.000(Ft.)
Pipe length  =   191.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.885(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    13.885(CFS)
Normal flow depth in pipe =   19.59(In.)
Flow top width inside pipe =   24.09(In.)
Critical Depth =   15.55(In.)
Pipe flow velocity =      4.49(Ft/s)
Travel time through pipe =    0.71 min.
Time of concentration (TC) =     5.71 min.


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Process from Point/Station     2068.000 to Point/Station     2067.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     5.71 min.
Rainfall intensity =      4.161(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      3.835(CFS) for    0.970(Ac.)
Total runoff =     17.719(CFS)  Total area =       4.30(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2069.000 to Point/Station     2067.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                       ]
Time of concentration =     5.71 min.
Rainfall intensity =      4.161(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      5.851(CFS) for    1.480(Ac.)
Total runoff =     23.570(CFS)  Total area =       5.78(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2070.000 to Point/Station     2067.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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
```

```
[SINGLE FAMILY area type                    ]
Time of concentration =     5.71 min.
Rainfall intensity =      4.161(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      3.387(CFS) for    1.480(Ac.)
Total runoff =     26.958(CFS)  Total area =        7.26(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2067.000 to Point/Station     2062.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     2.000(Ft.)
Downstream point/station elevation =     1.000(Ft.)
Pipe length  =   280.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.958(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    26.958(CFS)
Normal flow depth in pipe =   23.44(In.)
Flow top width inside pipe =   29.94(In.)
Critical Depth =   20.68(In.)
Pipe flow velocity =      5.98(Ft/s)
Travel time through pipe =    0.78 min.
Time of concentration (TC) =     6.49 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2067.000 to Point/Station     2062.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      7.260(Ac.)
Runoff from this stream =     26.958(CFS)
Time of concentration =    6.49 min.
Rainfall intensity =     3.959(In/Hr)
Summary of stream data:

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


1       89.170     20.21                 2.569
2       26.958      6.49                 3.959
Qmax(1) =
           1.000 *    1.000 *    89.170) +
           0.649 *    1.000 *    26.958) + =     106.662
Qmax(2) =
           1.000 *    0.321 *    89.170) +
           1.000 *    1.000 *    26.958) + =      55.594

Total of 2 streams to confluence:
Flow rates before confluence point:
      89.170      26.958
Maximum flow rates at confluence using above data:
      106.662       55.594
Area of streams before confluence:
       37.590        7.260
Results of confluence:
Total flow rate =    106.662(CFS)
Time of concentration =    20.206 min.
Effective stream area after confluence =     44.850(Ac.)
```


S2000P100.out

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2062.000 to Point/Station     2072.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.500(Ft.)
Downstream point/station elevation =     0.500(Ft.)
Pipe length  =   478.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   106.662(CFS)
Nearest computed pipe diameter  =     57.00(In.)
Calculated individual pipe flow  =   106.662(CFS)
Normal flow depth in pipe =   48.19(In.)
Flow top width inside pipe =   41.21(In.)
Critical Depth =   35.85(In.)
Pipe flow velocity =      6.67(Ft/s)
Travel time through pipe =    1.19 min.
Time of concentration (TC) =    21.40 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2062.000 to Point/Station     2072.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     44.850(Ac.)
Runoff from this stream =    106.662(CFS)
Time of concentration =   21.40 min.
Rainfall intensity =     2.503(In/Hr)


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Process from Point/Station     2073.000 to Point/Station     2074.000
**** 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                        ]
Initial subarea flow distance  =   62.000(Ft.)
Highest elevation =   12.000(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    1.000(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.02 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8500)*(  62.000^.5)/(   1.613^(1/3)]=   3.02
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =      0.261(CFS)
Total initial stream area =        0.070(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2074.000 to Point/Station     2075.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    11.000(Ft.)
End of street segment elevation =     9.000(Ft.)
Length of street segment  =   137.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  20.500(Ft.)
```

```
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      0.286(CFS)
Depth of flow =   0.077(Ft.), Average velocity =   1.317(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   4.815(Ft.)
Flow velocity =   1.32(Ft/s)
Travel time =    1.73 min.     TC =    6.73  min.
 Adding area flow to street
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                   ]
Rainfall intensity =      3.903(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      0.630(CFS) for    0.190(Ac.)
Total runoff =      0.892(CFS)  Total area =        0.26(Ac.)
Street flow at end of street =      0.892(CFS)
Half street flow at end of street =      0.892(CFS)
Depth of flow =   0.126(Ft.), Average velocity =   1.743(Ft/s)
Flow width (from curb towards crown)=   7.254(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2075.000 to Point/Station     2072.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.500(Ft.)
Downstream point/station elevation =     1.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.892(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.892(CFS)
Normal flow depth in pipe =    4.05(In.)
Flow top width inside pipe =    8.96(In.)
Critical Depth =    5.18(In.)
Pipe flow velocity =      4.62(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     6.84 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2075.000 to Point/Station     2072.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.260(Ac.)
Runoff from this stream =      0.892(CFS)
Time of concentration =    6.84 min.
Rainfall intensity =     3.880(In/Hr)
Summary of stream data:

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



```
1      106.662     21.40                2.503
2        0.892      6.84                3.880
Qmax(1) =
           1.000 *    1.000 *   106.662) +
           0.645 *    1.000 *     0.892) + =     107.237
Qmax(2) =
           1.000 *    0.320 *   106.662) +
           1.000 *    1.000 *     0.892) + =      34.994

Total of 2 streams to confluence:
Flow rates before confluence point:
     106.662       0.892
Maximum flow rates at confluence using above data:
      107.237      34.994
Area of streams before confluence:
       44.850       0.260
Results of confluence:
Total flow rate =    107.237(CFS)
Time of concentration =    21.400 min.
Effective stream area after confluence =     45.110(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2072.000 to Point/Station     2077.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.000(Ft.)
Downstream point/station elevation =     0.500(Ft.)
Pipe length  =   270.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   107.237(CFS)
Nearest computed pipe diameter  =     60.00(In.)
Calculated individual pipe flow  =   107.237(CFS)
Normal flow depth in pipe =   46.97(In.)
Flow top width inside pipe =   49.48(In.)
Critical Depth =   35.39(In.)
Pipe flow velocity =      6.50(Ft/s)
Travel time through pipe =    0.69 min.
Time of concentration (TC) =    22.09 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2078.000 to Point/Station     2077.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                   ]
Time of concentration =    22.09 min.
Rainfall intensity =      2.466(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      0.901(CFS) for    0.430(Ac.)
Total runoff =    108.138(CFS)  Total area =       45.54(Ac.)


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Process from Point/Station     2079.000 to Point/Station     2077.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
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Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                    ]
Time of concentration =    22.09 min.
Rainfall intensity =      2.466(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      0.985(CFS) for    0.470(Ac.)
Total runoff =    109.123(CFS)  Total area =       46.01(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2077.000 to Point/Station     2080.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     0.500(Ft.)
Downstream point/station elevation =     0.400(Ft.)
Pipe length  =   140.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   109.123(CFS)
Nearest computed pipe diameter  =     72.00(In.)
Calculated individual pipe flow  =   109.123(CFS)
Normal flow depth in pipe =   56.81(In.)
Flow top width inside pipe =   58.75(In.)
Critical Depth =   33.81(In.)
Pipe flow velocity =      4.56(Ft/s)
Travel time through pipe =    0.51 min.
Time of concentration (TC) =    22.60 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2077.000 to Point/Station     2080.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     46.010(Ac.)
Runoff from this stream =    109.123(CFS)
Time of concentration =   22.60 min.
Rainfall intensity =     2.439(In/Hr)


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Process from Point/Station     2081.000 to Point/Station     2082.000
**** 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                    ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   13.000(Ft.)
Lowest elevation =   12.500(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.709(CFS)
Total initial stream area =       0.170(Ac.)
```



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Process from Point/Station     2082.000 to Point/Station     2083.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                    ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      9.215(CFS) for    2.210(Ac.)
Total runoff =      9.924(CFS)  Total area =        2.38(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2083.000 to Point/Station     2080.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.000(Ft.)
Downstream point/station elevation =     0.200(Ft.)
Pipe length  =   430.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.924(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     9.924(CFS)
Normal flow depth in pipe =   14.84(In.)
Flow top width inside pipe =   13.70(In.)
Critical Depth =   14.58(In.)
Pipe flow velocity =      6.37(Ft/s)
Travel time through pipe =    1.13 min.
Time of concentration (TC) =     6.13 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2084.000 to Point/Station     2080.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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
[SINGLE FAMILY area type                 ]
Time of concentration =     6.13 min.
Rainfall intensity =      4.048(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      3.295(CFS) for    1.480(Ac.)
Total runoff =     13.219(CFS)  Total area =        3.86(Ac.)


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Process from Point/Station     2084.000 to Point/Station     2080.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.860(Ac.)
Runoff from this stream =     13.219(CFS)
Time of concentration =    6.13 min.
Rainfall intensity =     4.048(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
```

```
 No.       (CFS)       (min)                 (In/Hr)


1      109.123     22.60                 2.439
2       13.219      6.13                 4.048
Qmax(1) =
           1.000 *    1.000 *   109.123) +
           0.603 *    1.000 *    13.219) + =     117.087
Qmax(2) =
           1.000 *    0.271 *   109.123) +
           1.000 *    1.000 *    13.219) + =      42.788

Total of 2 streams to confluence:
Flow rates before confluence point:
     109.123      13.219
Maximum flow rates at confluence using above data:
      117.087       42.788
Area of streams before confluence:
       46.010        3.860
Results of confluence:
Total flow rate =    117.087(CFS)
Time of concentration =    22.604 min.
Effective stream area after confluence =     49.870(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2080.000 to Point/Station     2085.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     1.500(Ft.)
Downstream point/station elevation =     0.200(Ft.)
Pipe length  =   341.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   117.087(CFS)
Nearest computed pipe diameter  =     54.00(In.)
Calculated individual pipe flow  =   117.087(CFS)
Normal flow depth in pipe =   42.66(In.)
Flow top width inside pipe =   43.99(In.)
Critical Depth =   38.22(In.)
Pipe flow velocity =      8.70(Ft/s)
Travel time through pipe =    0.65 min.
Time of concentration (TC) =    23.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2086.000 to Point/Station     2085.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =    50.000(Ft.)
Downstream point/station elevation =     1.000(Ft.)
Pipe length  =     1.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   117.087(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =   117.087(CFS)
Normal flow depth in pipe =    5.78(In.)
Flow top width inside pipe =   11.99(In.)
Critical depth could not be calculated.
Pipe flow velocity =    312.54(Ft/s)
Travel time through pipe =    0.00 min.
Time of concentration (TC) =    23.26 min.


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Process from Point/Station     2086.000 to Point/Station     2085.000
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**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =    23.26 min.
Rainfall intensity =      2.406(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      3.291(CFS) for    1.440(Ac.)
Total runoff =    120.378(CFS)  Total area =       51.31(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2085.000 to Point/Station     2087.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     0.200(Ft.)
Downstream point/station elevation =     0.000(Ft.)
Pipe length  =    70.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   120.378(CFS)
Nearest computed pipe diameter  =     57.00(In.)
Calculated individual pipe flow  =   120.378(CFS)
Normal flow depth in pipe =   46.31(In.)
Flow top width inside pipe =   44.50(In.)
Critical Depth =   38.16(In.)
Pipe flow velocity =      7.81(Ft/s)
Travel time through pipe =    0.15 min.
Time of concentration (TC) =    23.41 min.
End of computations, total study area =         51.310 (Ac.)
```

```
                    San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 06/10/24
------------------------------------------------------------------------
4443.10 MIDWAY RISING
PROPOSED CONDITIONS
S2200P100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


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Process from Point/Station     2200.000 to Point/Station     2201.000
**** 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                        ]
Initial subarea flow distance  =  110.000(Ft.)
Highest elevation =   12.300(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    1.300(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.68 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 110.000^.5)/(   1.182^(1/3)]=   2.68
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.584(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2201.000 to Point/Station     2202.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    11.000(Ft.)
```


S2200P100.out

```
End of street segment elevation =     8.000(Ft.)
Length of street segment  =   759.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      9.173(CFS)
Depth of flow =   0.408(Ft.), Average velocity =   2.152(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   2.15(Ft/s)
Travel time =    5.88 min.     TC =   10.88  min.
 Adding area flow to street
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                        ]
Rainfall intensity =      3.273(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     12.810(CFS) for    4.120(Ac.)
Total runoff =     13.394(CFS)  Total area =        4.26(Ac.)
Street flow at end of street =     13.394(CFS)
Half street flow at end of street =     13.394(CFS)
Depth of flow =   0.476(Ft.), Average velocity =   2.500(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2202.000 to Point/Station     2203.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.400(Ft.)
Downstream point/station elevation =     6.200(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    13.394(CFS)
Nearest computed pipe diameter  =    24.00(In.)
Calculated individual pipe flow  =    13.394(CFS)
Normal flow depth in pipe =   15.98(In.)
Flow top width inside pipe =   22.64(In.)
Critical Depth =   15.81(In.)
Pipe flow velocity =      6.02(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =    10.98 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     2204.000 to Point/Station     2203.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =    10.98 min.
Rainfall intensity =      3.262(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =     32.480(CFS) for   10.480(Ac.)
Total runoff =     45.873(CFS)  Total area =       14.74(Ac.)
End of computations, total study area =          14.740 (Ac.)
```

```
                 San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/27/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
PROPOSED CONDITIONS
S3000P100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3000.000 to Point/Station     3001.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   11.500(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.500(CFS)
Total initial stream area =        0.120(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3001.000 to Point/Station     3002.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      4.503(CFS) for    1.080(Ac.)
Total runoff =      5.004(CFS)  Total area =        1.20(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3002.000 to Point/Station     3003.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.760(Ft.)
Downstream point/station elevation =     5.240(Ft.)
Pipe length  =    58.40(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.004(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     5.004(CFS)
Normal flow depth in pipe =   10.35(In.)
Flow top width inside pipe =   13.88(In.)
Critical Depth =   10.89(In.)
Pipe flow velocity =      5.54(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     5.18 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3002.000 to Point/Station     3003.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.200(Ac.)
Runoff from this stream =      5.004(CFS)
Time of concentration =    5.18 min.
Rainfall intensity =     4.328(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3004.000 to Point/Station     3005.000
**** 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
[SINGLE FAMILY area type                     ]
Initial subarea flow distance  =   97.000(Ft.)
Highest elevation =   11.700(Ft.)
Lowest elevation =   11.200(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =    12.16 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5500)*(  97.000^.5)/( 0.515^(1/3)]=  12.16
Rainfall intensity (I) =      3.143(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.550
Subarea runoff =      0.173(CFS)
Total initial stream area =        0.100(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3005.000 to Point/Station     3003.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =    11.200(Ft.)
Downstream point elevation =    10.500(Ft.)
Channel length thru subarea  =   228.000(Ft.)
Channel base width      =   20.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =      1.366(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      1.366(CFS)
Depth of flow =   0.071(Ft.), Average velocity =   0.900(Ft/s)
Channel flow top width =   22.833(Ft.)
Flow Velocity =    0.90(Ft/s)
Travel time  =    4.22 min.
Time of concentration =   16.38 min.
Critical depth =      0.052(Ft.)
 Adding area flow to channel
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
[SINGLE FAMILY area type                     ]
Rainfall intensity =      2.806(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      2.130(CFS) for    1.380(Ac.)
Total runoff =      2.303(CFS)  Total area =       1.48(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3005.000 to Point/Station     3003.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.480(Ac.)
Runoff from this stream =      2.303(CFS)
Time of concentration =   16.38 min.
Rainfall intensity =     2.806(In/Hr)
Summary of stream data:

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


1        5.004      5.18                  4.328
2        2.303     16.38                  2.806
Qmax(1) =
           1.000 *    1.000 *     5.004) +
           1.000 *    0.316 *     2.303) + =       5.731
Qmax(2) =
           0.648 *    1.000 *     5.004) +
           1.000 *    1.000 *     2.303) + =       5.547

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.004       2.303
Maximum flow rates at confluence using above data:
        5.731       5.547
Area of streams before confluence:
        1.200       1.480
```



```
Results of confluence:
Total flow rate =      5.731(CFS)
Time of concentration =     5.176 min.
Effective stream area after confluence =      2.680(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3003.000 to Point/Station     3006.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     5.240(Ft.)
Downstream point/station elevation =     4.800(Ft.)
Pipe length  =    12.50(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.731(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     5.731(CFS)
Normal flow depth in pipe =    8.55(In.)
Flow top width inside pipe =   10.86(In.)
Critical Depth =   11.37(In.)
Pipe flow velocity =      9.57(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =     5.20 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3003.000 to Point/Station     3006.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.680(Ac.)
Runoff from this stream =      5.731(CFS)
Time of concentration =    5.20 min.
Rainfall intensity =     4.320(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3007.000 to Point/Station     3008.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   11.800(Ft.)
Lowest elevation =   11.300(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.67 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8500)*( 100.000^.5)/( 0.500^(1/3)]=   5.67
Rainfall intensity (I) =      4.173(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.850
Subarea runoff =      0.851(CFS)
Total initial stream area =        0.240(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3008.000 to Point/Station     3009.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =    11.300(Ft.)
```

```
End of street segment elevation =    10.500(Ft.)
Length of street segment  =   183.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  22.000(Ft.)
Distance from crown to crossfall grade break  =  20.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =   5.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  0.125(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      1.844(CFS)
Depth of flow =   0.164(Ft.), Average velocity =   1.115(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   9.174(Ft.)
Flow velocity =   1.12(Ft/s)
Travel time =    2.74 min.     TC =    8.40  min.
 Adding area flow to street
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                         ]
Rainfall intensity =      3.594(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      1.711(CFS) for    0.560(Ac.)
Total runoff =      2.562(CFS)  Total area =        0.80(Ac.)
Street flow at end of street =      2.562(CFS)
Half street flow at end of street =      1.281(CFS)
Depth of flow =   0.188(Ft.), Average velocity =   1.209(Ft/s)
Flow width (from curb towards crown)=  10.365(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3009.000 to Point/Station     3006.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     6.580(Ft.)
Downstream point/station elevation =     4.960(Ft.)
Pipe length  =   318.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.562(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     2.562(CFS)
Normal flow depth in pipe =    7.99(In.)
Flow top width inside pipe =   14.97(In.)
Critical Depth =    7.70(In.)
Pipe flow velocity =      3.86(Ft/s)
Travel time through pipe =    1.37 min.
Time of concentration (TC) =     9.78 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3009.000 to Point/Station     3006.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.800(Ac.)
Runoff from this stream =      2.562(CFS)
Time of concentration =    9.78 min.
```



```
Rainfall intensity =     3.402(In/Hr)
Summary of stream data:

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


1        5.731      5.20                4.320
2        2.562      9.78                3.402
Qmax(1) =
           1.000 *    1.000 *     5.731) +
           1.000 *    0.531 *     2.562) + =       7.093
Qmax(2) =
           0.787 *    1.000 *     5.731) +
           1.000 *    1.000 *     2.562) + =       7.074

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.731       2.562
Maximum flow rates at confluence using above data:
        7.093        7.074
Area of streams before confluence:
        2.680        0.800
Results of confluence:
Total flow rate =      7.093(CFS)
Time of concentration =     5.197 min.
Effective stream area after confluence =      3.480(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3006.000 to Point/Station     3010.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     4.960(Ft.)
Downstream point/station elevation =     4.800(Ft.)
Pipe length  =    13.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.093(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     7.093(CFS)
Normal flow depth in pipe =   12.16(In.)
Flow top width inside pipe =   11.75(In.)
Critical Depth =   12.79(In.)
Pipe flow velocity =      6.66(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     5.23 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3011.000 to Point/Station     3010.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                         ]
Time of concentration =     5.23 min.
Rainfall intensity =      4.310(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      3.883(CFS) for    1.060(Ac.)
Total runoff =     10.976(CFS)  Total area =        4.54(Ac.)
End of computations, total study area =           4.540 (Ac.)
```

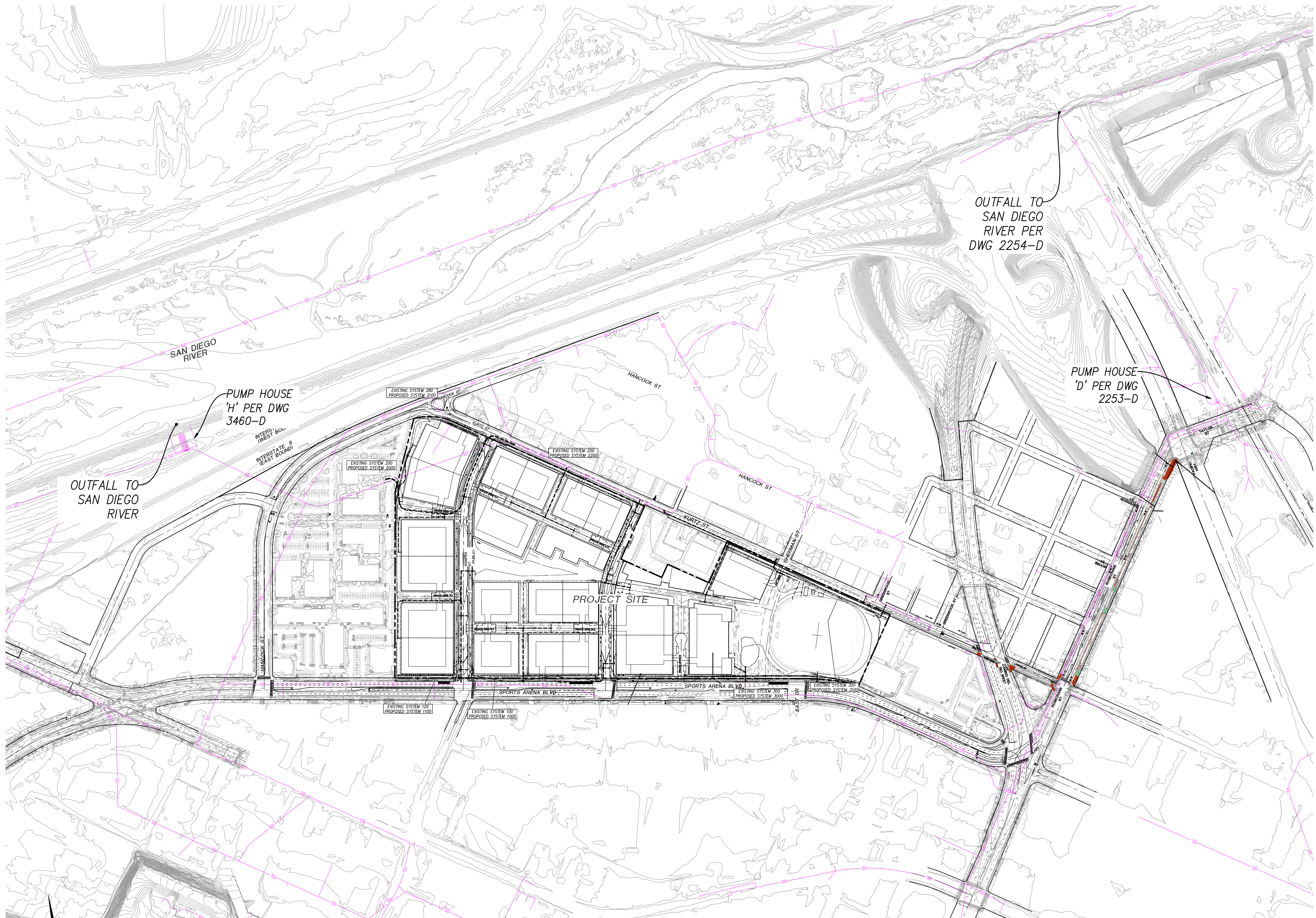
```
                San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2003 Version 6.3

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
        Rational Hydrology Study        Date: 10/26/23
------------------------------------------------------------------------
4443.10 MIDWAY RISING
PROPOSED CONDITIONS
S3100P100

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4049

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

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3100.000 to Point/Station     3100.000
**** 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                        ]
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =   11.500(Ft.)
Lowest elevation =   11.000(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     3.40 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9500)*( 100.000^.5)/(   0.500^(1/3)]=   3.40
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.950
Subarea runoff =      0.584(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3101.000 to Point/Station     3102.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.00 min.
Rainfall intensity =      4.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      7.297(CFS) for    1.750(Ac.)
Total runoff =      7.881(CFS)  Total area =        1.89(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3102.000 to Point/Station     3103.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =     7.000(Ft.)
Downstream point/station elevation =     5.590(Ft.)
Pipe length  =    21.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.881(CFS)
Nearest computed pipe diameter  =    12.00(In.)
Calculated individual pipe flow  =     7.881(CFS)
Normal flow depth in pipe =    8.53(In.)
Flow top width inside pipe =   10.88(In.)
Critical depth could not be calculated.
Pipe flow velocity =     13.20(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     5.03 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3104.000 to Point/Station     3103.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.03 min.
Rainfall intensity =      4.380(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      3.499(CFS) for    0.940(Ac.)
Total runoff =     11.380(CFS)  Total area =        2.83(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     3105.000 to Point/Station     3103.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
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                        ]
Time of concentration =     5.03 min.
Rainfall intensity =      4.380(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.850
Subarea runoff =      3.834(CFS) for    1.030(Ac.)
Total runoff =     15.214(CFS)  Total area =        3.86(Ac.)
End of computations, total study area =          3.860 (Ac.)
```

APPENDIX 4

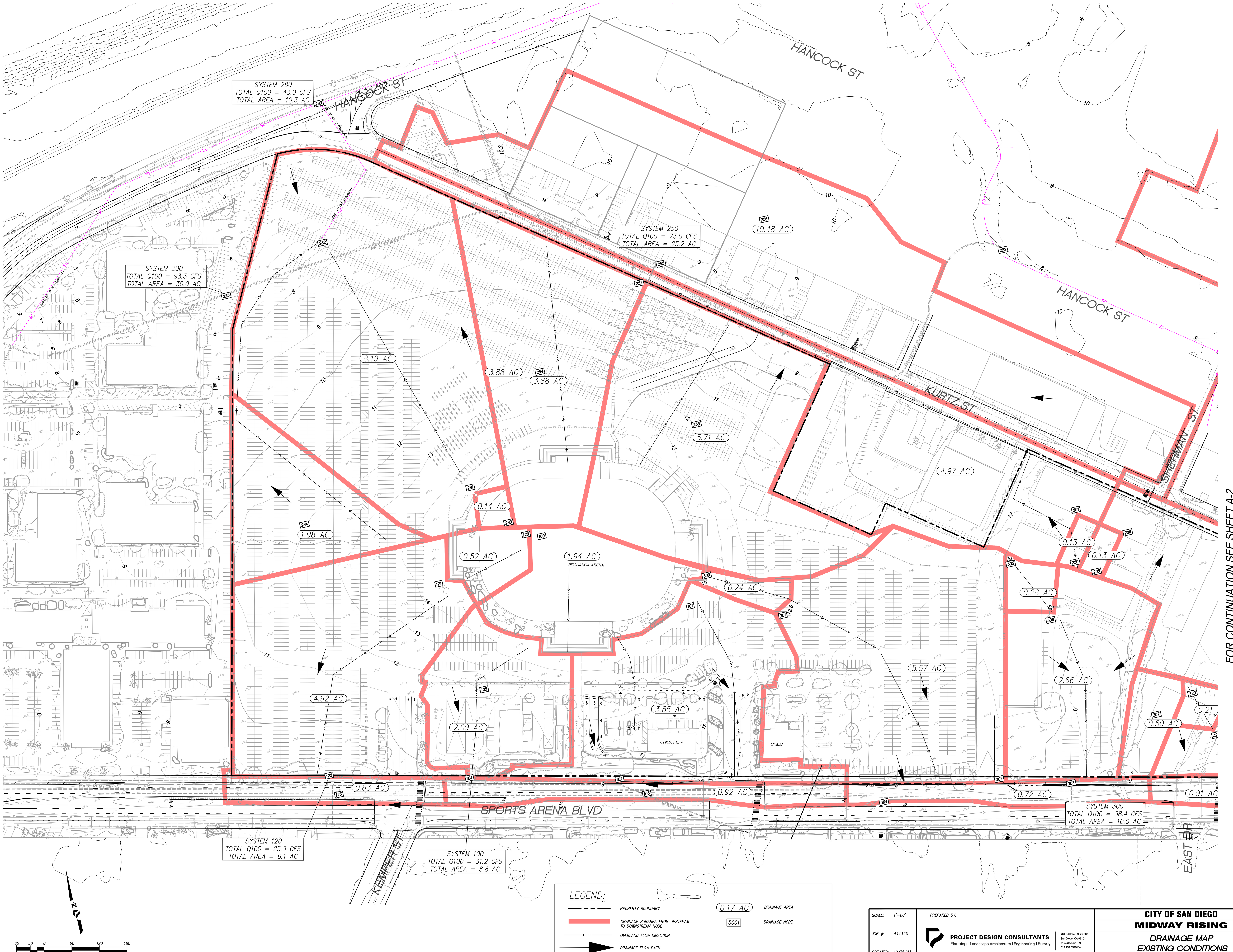
Drainage Exhibits



SCALE: 1"=150'
JOB #: 4443.10
CREATED: 8/10/23

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

CITY OF SAN DIEGO
MIDWAY RISING
REGIONAL DRAINAGE MAP



SCALE: 1"=60'
JOB #: 4443.10
CREATED: 10/18/23

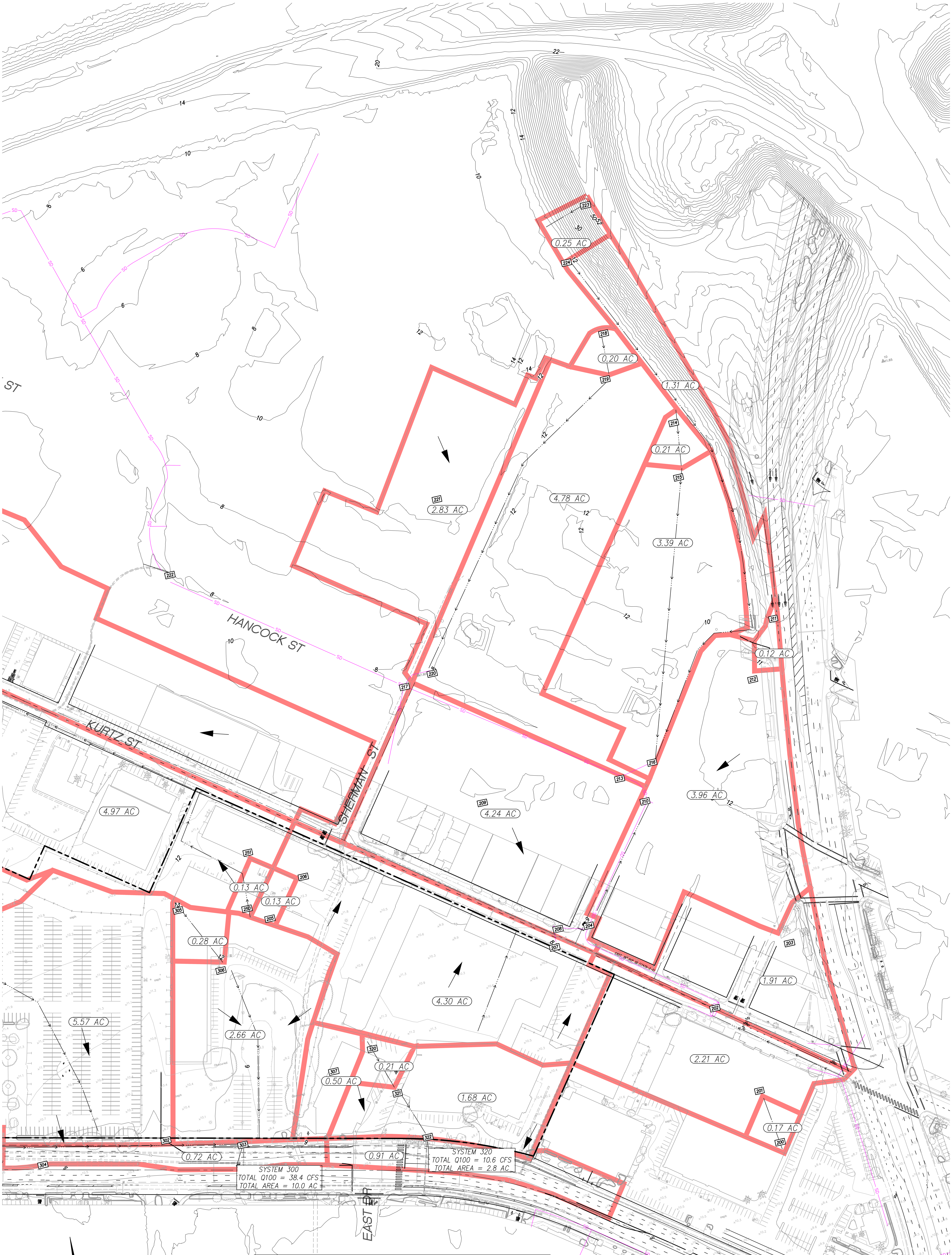
PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

CITY OF SAN DIEGO

MIDWAY RISING

DRAINAGE MAP
EXISTING CONDITIONS
EXHIBIT A-1



LEGEND:

PROPERTY BOUNDARY	
DRAINAGE SUBAREA FROM UPSTREAM TO DOWNSTREAM NODE	
OVERLAND FLOW DIRECTION	
DRAINAGE FLOW PATH	
0.17 AC	DRAINAGE AREA
5001	DRAINAGE NODE

SCALE: 1"=60'

SCALE: 1"=60'
JOB #: 4443.10
CREATED: 8/10/23

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

CITY OF SAN DIEGO
MIDWAY RISING
DRAINAGE MAP
EXISTING CONDITIONS
EXHIBIT A-2

100 50 0 100 200 300

SCALE: 1"=100'

LEGEND:

PROPERTY BOUNDARY	
DRAINAGE SUBAREA FROM UPSTREAM TO DOWNSTREAM NODE	
OVERLAND FLOW DIRECTION	
DRAINAGE FLOW PATH	
0.17 AC	DRAINAGE AREA
5001	DRAINAGE NODE

SCALE: 1"=100'
JOB #: 4443.10
CREATED: 8/10/23

PREPARED BY:

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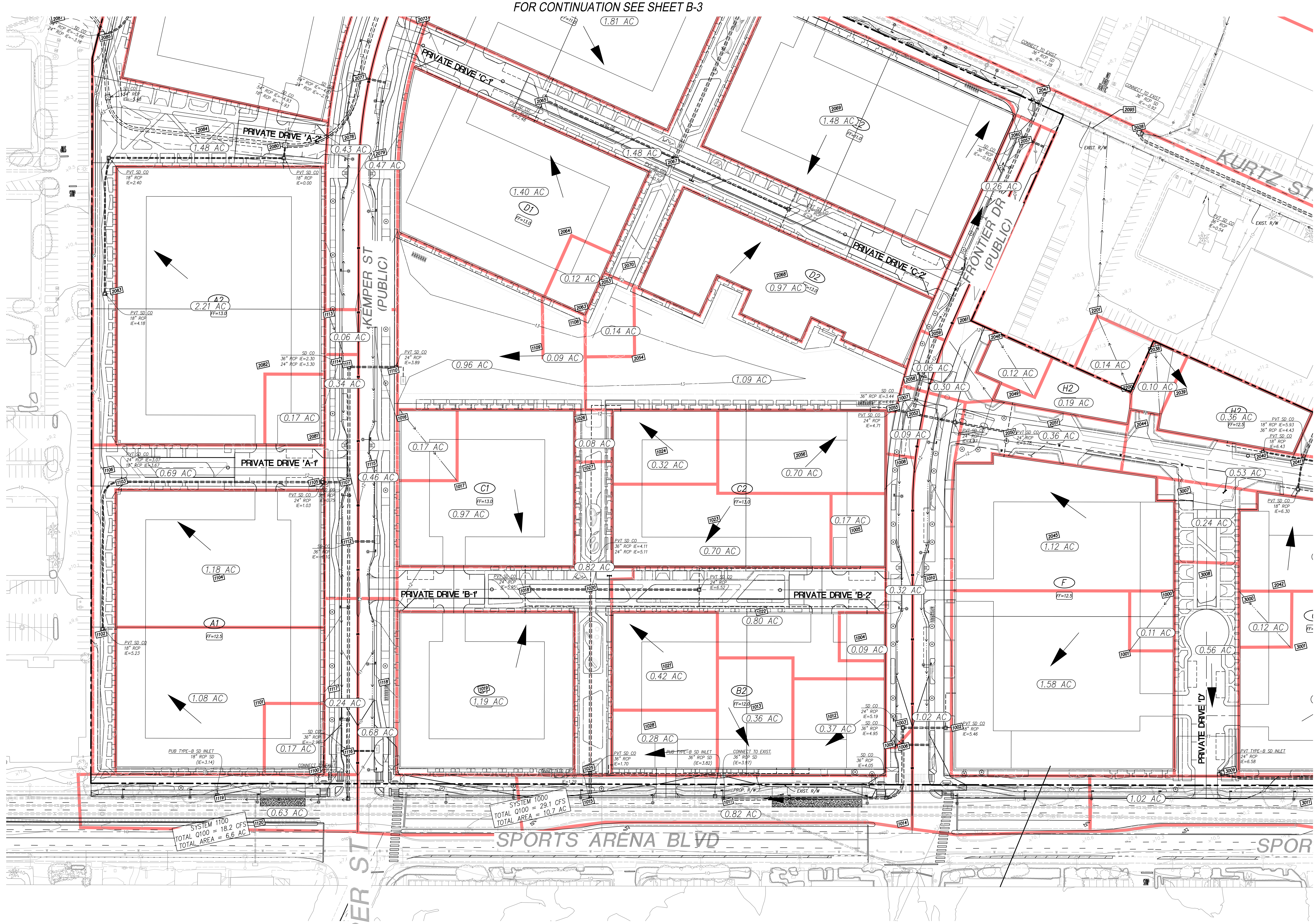
San Diego, CA 92101
619.235.6471 Tel
619.234.0349 Fax

CITY OF SAN DIEGO

MIDWAY RISING

DRAINAGE MAP-KEY MAP
PROPOSED CONDITIONS
EXHIBIT B-1

FOR CONTINUATION SEE SHEET B-3



FOR CONTINUATION SEE SHEET B-4

LEGEND:

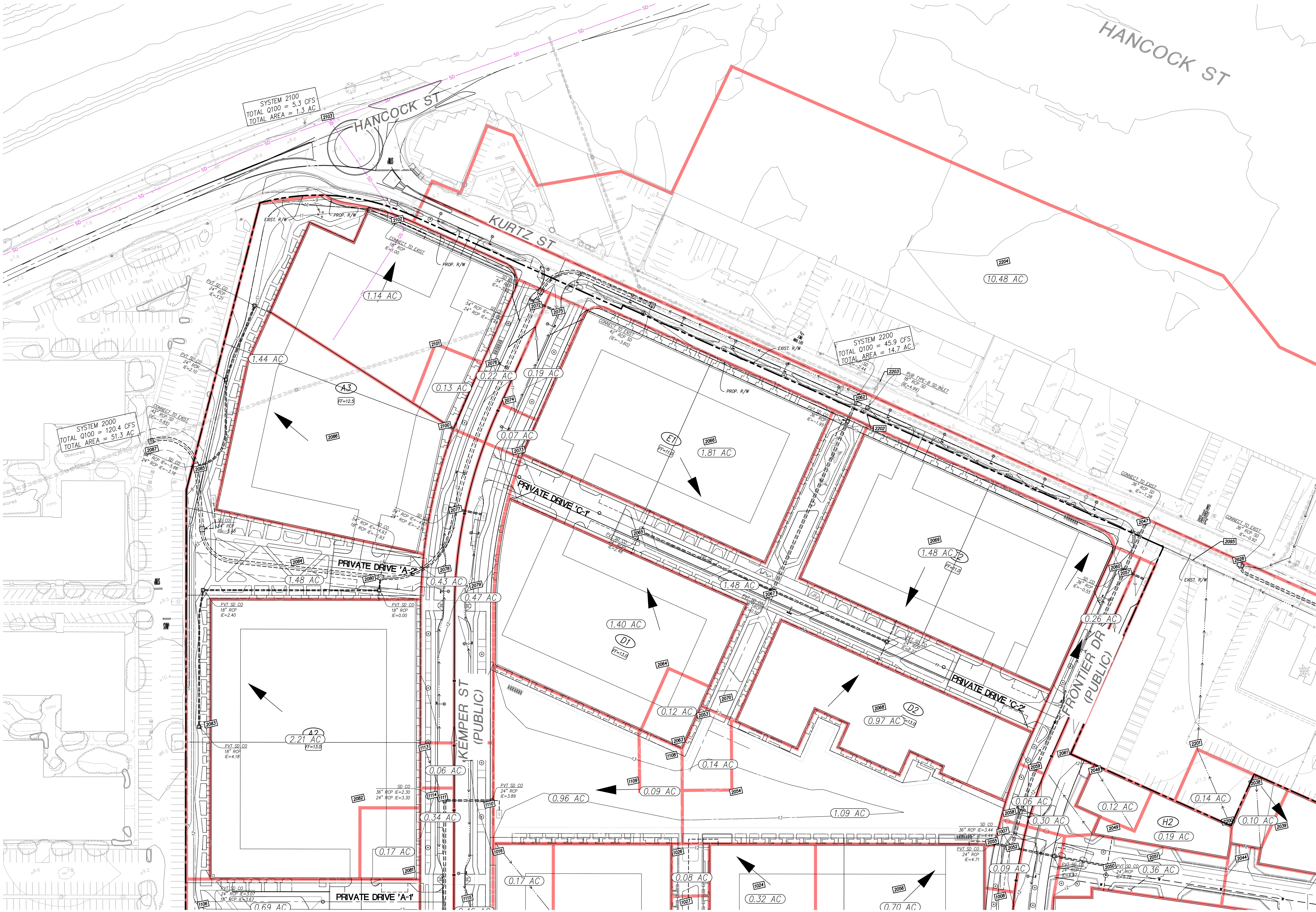
— · —	PROPERTY BOUNDARY
(red line)	DRAINAGE SUBAREA FROM UPSTREAM TO DOWNSTREAM NODE
→	OVERLAND FLOW DIRECTION
▶	DRAINAGE FLOW PATH
(0.17 AC)	DRAINAGE AREA
5001	DRAINAGE NODE

SCALE: 1"=40'

SCALE: 1"=40'
JOB #: 4443.10
CREATED: 8/10/23

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

CITY OF SAN DIEGO
MIDWAY RISING
DRAINAGE MAP
PROPOSED CONDITIONS
EXHIBIT B-2



FOR CONTINUATION SEE SHEET B-4

FOR CONTINUATION SEE SHEET B-2

LEGEND:

- PROPERTY BOUNDARY
- DRAINAGE SUBAREA FROM UPSTREAM TO DOWNSTREAM NODE
- OVERLAND FLOW DIRECTION
- DRAINAGE FLOW PATH
- 0.17 AC — DRAINAGE AREA
- 5001 — DRAINAGE NODE

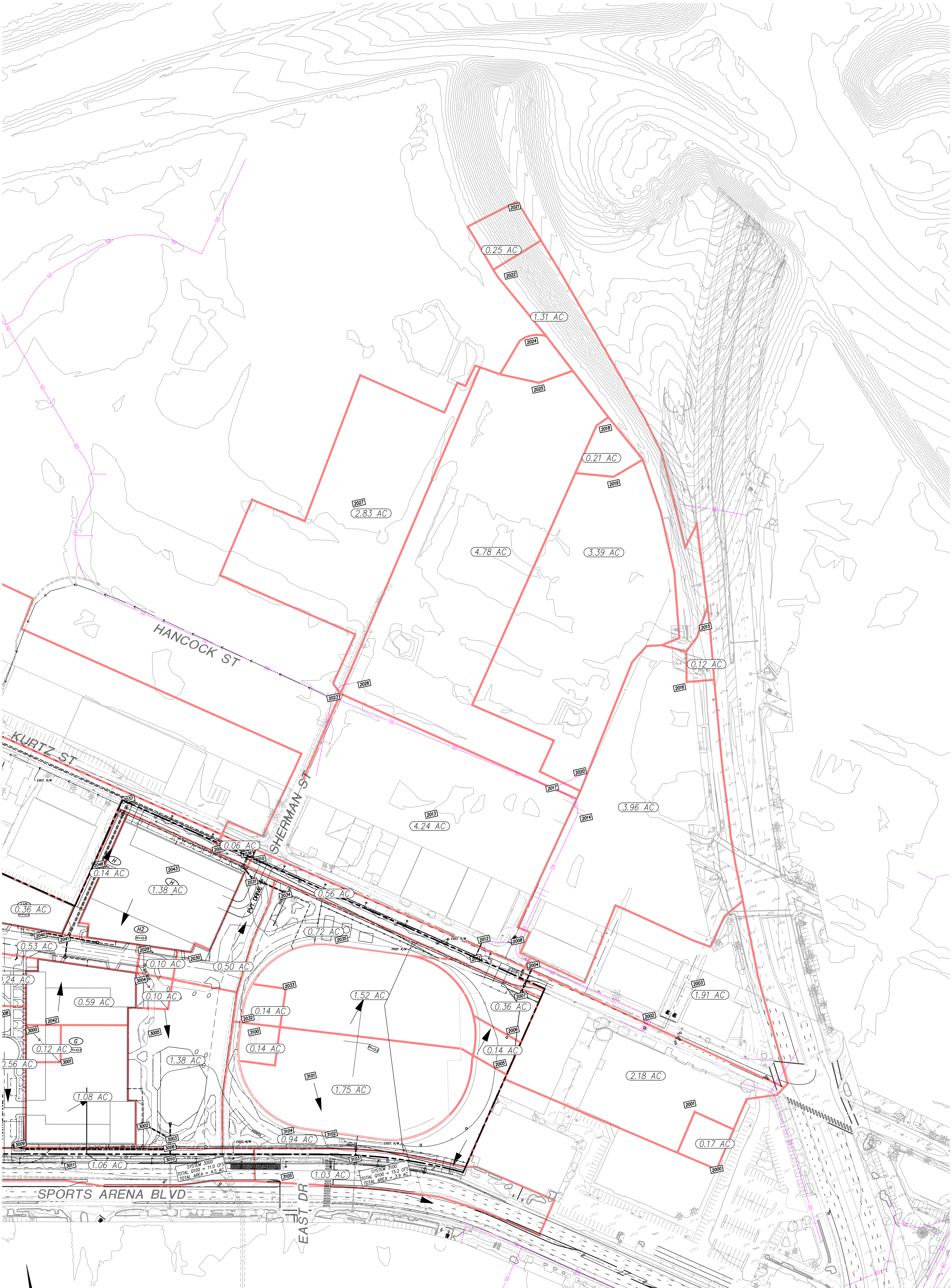
SCALE: 1"=40'

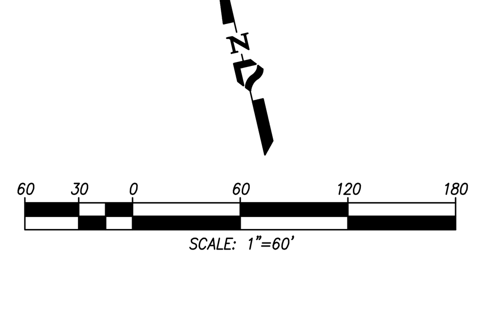
SCALE: 1"=40'
JOB #: 4443.10
CREATED: 8/10/23

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

CITY OF SAN DIEGO
MIDWAY RISING
DRAINAGE MAP
PROPOSED CONDITIONS
EXHIBIT B-3

FOR CONTINUATION SEE SHEETS B-2 & B-3





LEGEND:

PROPERTY BOUNDARY	
DRAINAGE SUBAREA FROM UPSTREAM TO DOWNSTREAM NODE	
OVERLAND FLOW DIRECTION	
DRAINAGE FLOW PATH	
0.17 AC	DRAINAGE AREA
5001	DRAINAGE NODE

SCALE: 1"=60'
JOB #: 4443.10
CREATED: 8/10/23

PREPARED BY:
PROJECT DESIGN CONSULTANTS
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619.234.0349 Fax

CITY OF SAN DIEGO
MIDWAY RISING
DRAINAGE MAP
PROPOSED CONDITIONS
EXHIBIT B-4

EXISTING/PROPOSED COMPARISON					
EXISTING CONDITION			PROPOSED CONDITION		
TAILWATER	SOFFIT (-2.33')	CLEANOUT RIM (7.8')	TAILWATER	SOFFIT (-2.33')	CLEANOUT RIM (7.8')
42" PIPE FLOW (CFS)	83.5	28.1	54" PIPE FLOW (CFS)	120.4	81
WEIR (CFS)	37	92	WEIR (CFS)	0	39.5
HEADWATER ELEV	8.9'	9.1'	HEADWATER ELEV	2.9'	10.1'

SCALE: 1"=60'

JOB #: 4443.10

CREATED: 12/6/23

PREPARED BY:

PROJECT DESIGN CONSULTANTS
Planning | Landscape Architecture | Engineering | Survey

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619.234.0349 Fax

CITY OF SAN DIEGO

MIDWAY RISING

IRREGULAR WEIR DRAINAGE ANALYSIS
EXISTING CONDITIONS

P:\4443.10\Engr\Reports\Drainage-TM\EXH\4443.10 MR-Existing Condition Exhibit-Weir.dwg 3/1/2024 11:37:17 AM

EXISTING/PROPOSED COMPARISON					
EXISTING CONDITION			PROPOSED CONDITION		
TAILWATER	SOFFIT	CLEANOUT RIM	TAILWATER	SOFFIT	CLEANOUT RIM
42" PIPE FLOW (CFS)	83.4	27.9	54" PIPE FLOW (CFS)	120.4	81.0
WEIR (CFS)	32.7	87.9	WEIR (CFS)	0	39.5
HEADWATER ELEV	8.9'	9.1'	HEADWATER ELEV	2.9'	10.1'

SCALE: 1"=40'
JOB #: 4443.10
CREATED: 12/6/23

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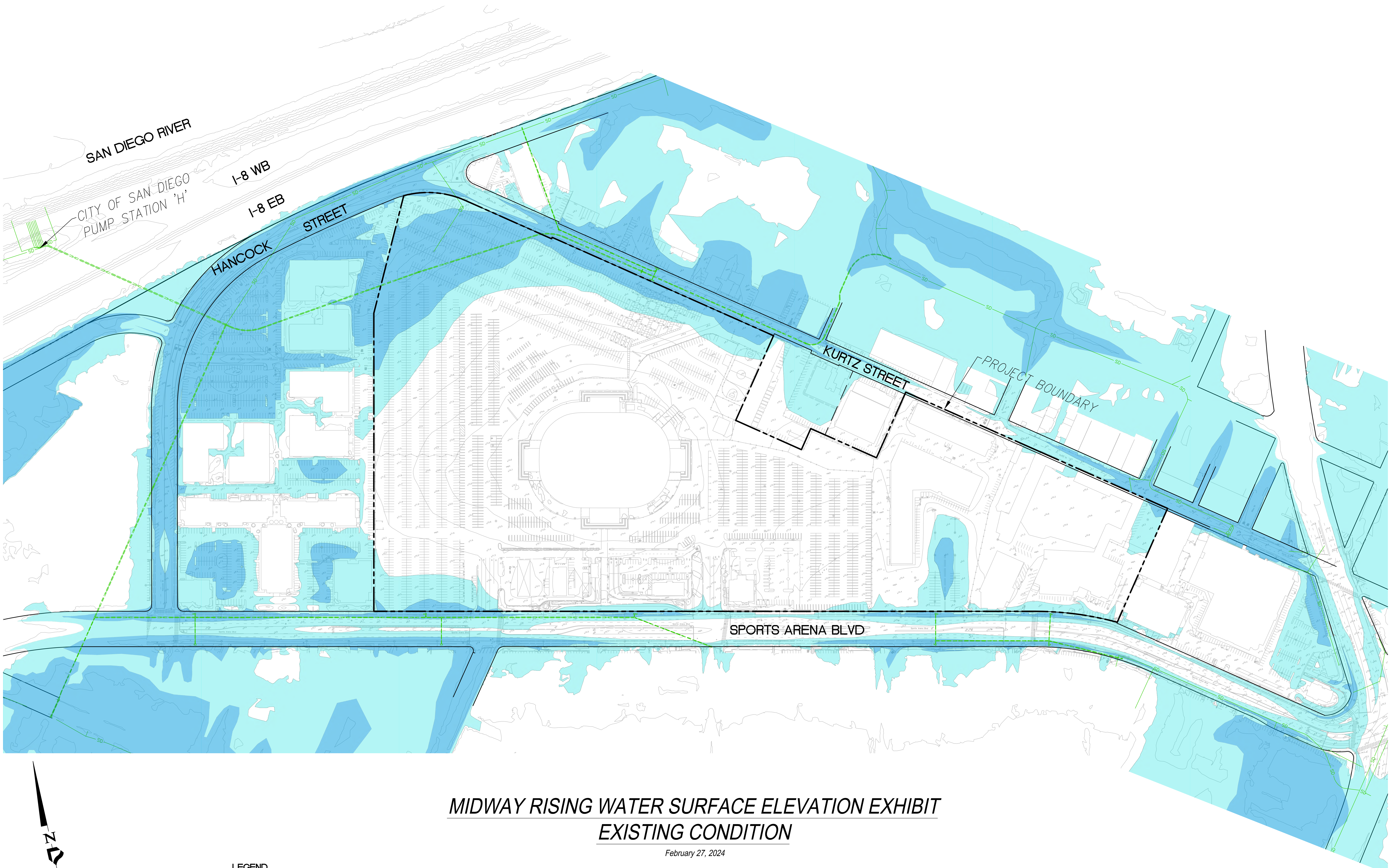
San Diego, CA 92101
619.235.6471 Tel
619.234.0349 Fax

CITY OF SAN DIEGO
MIDWAY RISING
IRREGULAR WEIR DRAINAGE ANALYSIS PROPOSED CONDITIONS



MIDWAY RISING WATER SURFACE ELEVATION EXHIBIT

EXISTING CONDITION

February 27, 2024

LEGEND

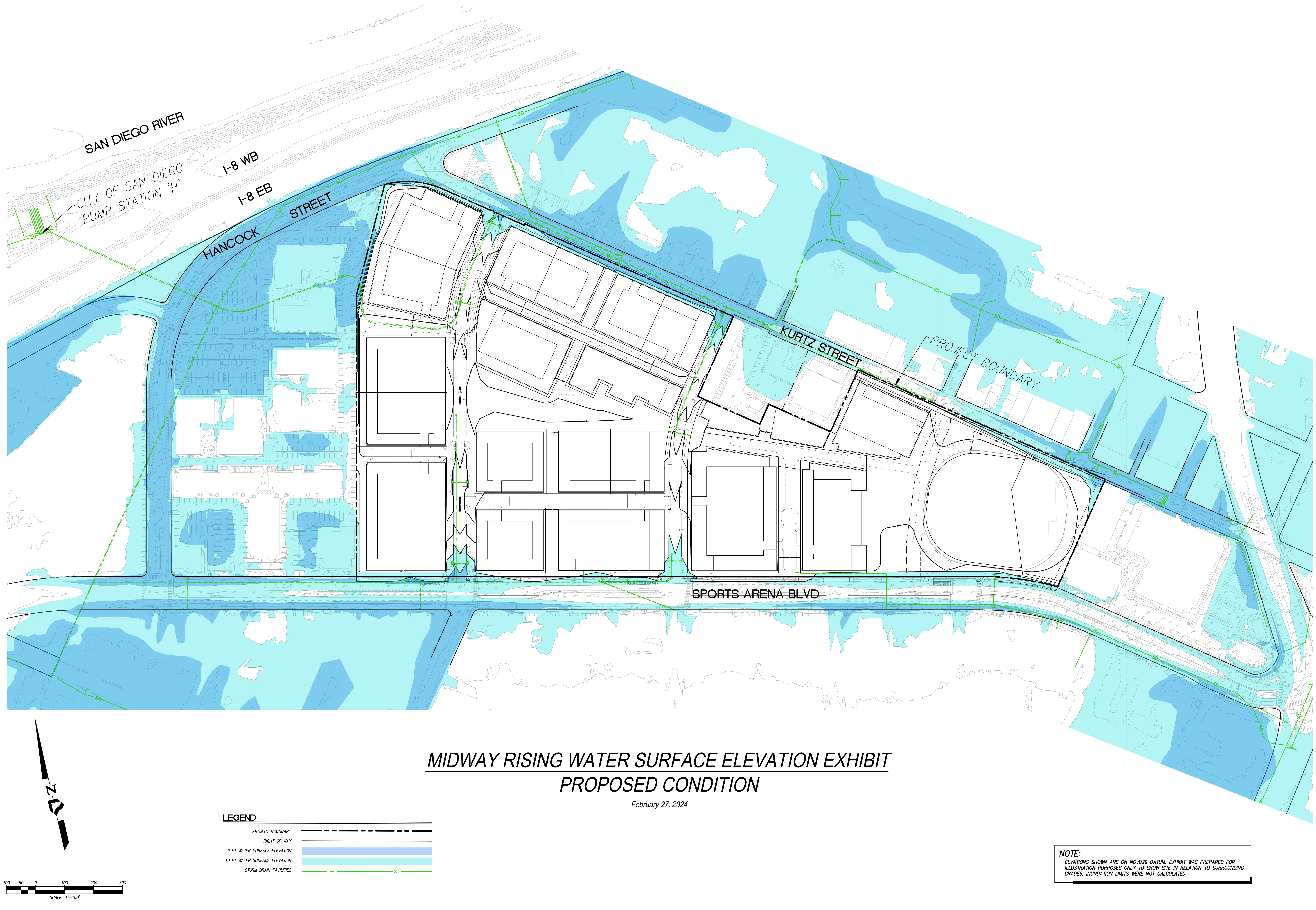
- PROJECT BOUNDARY
- RIGHT OF WAY
- 9 FT WATER SURFACE ELEVATION
- 10 FT WATER SURFACE ELEVATION
- STORM DRAIN FACILITIES (SD)

100 50 0 100 200 300

SCALE: 1"=100'

NOTE:

ELVATIONS SHOWN ARE ON NGVD29 DATUM. EXHIBIT WAS PREPARED FOR ILLUSTRATION PURPOSES ONLY TO SHOW SITE IN RELATION TO SURROUNDING GRADES. INUNDATION LIMITS WERE NOT CALCULATED.



MIDWAY RISING WATER SURFACE ELEVATION EXHIBIT
PROPOSED CONDITION

February 27, 2024

NOTE:
ELEVATIONS SHOWN ARE ON NGVD29 DATUM. EXHIBIT WAS PREPARED FOR ILLUSTRATION PURPOSES ONLY TO SHOW SITE IN RELATION TO SURROUNDING GRADES. INUNDATION LIMITS WERE NOT CALCULATED.

APPENDIX 5

Hydraulic Calculations

Culvert Analysis Report
Existing Condition 42" EX Alignment Tailwater- CO Rim Elev

Analysis Component			
Storm Event	Design	Discharge	120.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	120.40 cfs	Check Discharge	120.40 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	7.80 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-42 inch Circular	28.01 cfs	9.06 ft	2.91 ft/s
Weir	Roadway	92.18 cfs	9.06 ft	N/A
Total	----------------	120.19 cfs	9.06 ft	N/A

Culvert Analysis Report
Existing Condition 42" EX Alignment Tailwater- CO Rim Elev

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	9.06	ft	Discharge	28.01	cfs
Inlet Control HW Elev.	7.80	ft	Tailwater Elevation	7.80	ft
Outlet Control HW Elev.	9.06	ft	Control Type	Outlet Control	
Headwater Depth/Height	3.45				

Grades					
Upstream Invert	-3.00	ft	Downstream Invert	-7.38	ft
Length	1,426.92	ft	Constructed Slope	0.003070	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	15.18	ft
Slope Type	N/A		Normal Depth	1.76	ft
Flow Regime	N/A		Critical Depth	1.63	ft
Velocity Downstream	2.91	ft/s	Critical Slope	0.003938	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.50	ft
Section Size	42 inch		Rise	3.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	9.06	ft	Upstream Velocity Head	0.13	ft
Ke	0.20		Entrance Loss	0.03	ft

Inlet Control Properties					
Inlet Control HW Elev.	7.80	ft	Flow Control	Unsubmerged	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	9.6	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Analysis Report
Existing Condition 42" EX Alignment Tailwater- CO Rim Elev

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	92.18	cfs	Allowable HW Elevation	9.06	ft
Roadway Width	708.60	ft	Overtopping Coefficient	2.92	US
Low Point	8.52	ft	Headwater Elevation	9.06	ft
Discharge Coefficient (Cr)	2.92		Submergence Factor (Kt)	1.00	
Tailwater Elevation	7.80	ft			

Sta (ft)	Elev. (ft)
0.00	12.18
10.41	11.98
26.29	11.73
45.74	11.69
85.72	11.52
125.34	11.20
152.67	10.88
167.47	10.74
179.35	10.63
252.44	9.83
288.96	9.59
305.19	9.49
353.62	9.18
402.20	8.96
446.07	8.76
512.85	8.52
528.83	8.70
551.20	8.86
577.15	9.19
579.25	9.14
590.72	9.23
593.54	9.25
605.51	9.37
619.67	9.44
630.33	8.97
630.37	8.97
630.44	9.12
630.52	9.26
631.42	8.98
636.75	9.26
637.33	9.29
656.96	9.88
669.67	9.70
672.53	9.99
675.76	10.15
689.93	10.94
703.63	11.00
708.60	10.88

Culvert Analysis Report
Existing Condition 42" EX Alignment Tailwater-Pipe Soffit

Analysis Component			
Storm Event	Design	Discharge	120.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	120.40 cfs	Check Discharge	116.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	-2.33 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-42 inch Circular	83.48 cfs	8.90 ft	8.68 ft/s
Weir	Roadway	37.03 cfs	8.90 ft	N/A
Total	----------------	120.50 cfs	8.90 ft	N/A

Culvert Analysis Report
Existing Condition 42" EX Alignment Tailwater-Pipe Soffit

Component:Culvert-1

Culvert Summary

Computed Headwater Elevation	8.90 ft	Discharge	83.48 cfs
Inlet Control HW Elev.	1.73 ft	Tailwater Elevation	-2.33 ft
Outlet Control HW Elev.	8.90 ft	Control Type	Outlet Control
Headwater Depth/Height	3.40		

Grades

Upstream Invert	-3.00 ft	Downstream Invert	-7.38 ft
Length	1,426.92 ft	Constructed Slope	0.003070 ft/ft

Hydraulic Profile

Profile	PressureProfile	Depth, Downstream	5.05 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	2.85 ft
Velocity Downstream	8.68 ft/s	Critical Slope	0.006971 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	8.90 ft	Upstream Velocity Head	1.17 ft
Ke	0.20	Entrance Loss	0.23 ft

Inlet Control Properties

Inlet Control HW Elev.	1.73 ft	Flow Control	Submerged
Inlet Type	Beveled ring, 33.7° bevels	Area Full	9.6 ft²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Analysis Report
Existing Condition 42" EX Alignment Tailwater-Pipe Soffit

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	37.03	cfs	Allowable HW Elevation	8.90	ft
Roadway Width	708.60	ft	Overtopping Coefficient	2.91	US
Low Point	8.52	ft	Headwater Elevation	8.90	ft
Discharge Coefficient (Cr)	2.91		Submergence Factor (Kt)	1.00	
Tailwater Elevation	-2.33	ft			

Sta (ft)	Elev. (ft)
0.00	12.18
10.41	11.98
26.29	11.73
45.74	11.69
85.72	11.52
125.34	11.20
152.67	10.88
167.47	10.74
179.35	10.63
252.44	9.83
288.96	9.59
305.19	9.49
353.62	9.18
402.20	8.96
446.07	8.76
512.85	8.52
528.83	8.70
551.20	8.86
577.15	9.19
579.25	9.14
590.72	9.23
593.54	9.25
605.51	9.37
619.67	9.44
630.33	8.97
630.37	8.97
630.44	9.12
630.52	9.26
631.42	8.98
636.75	9.26
637.33	9.29
656.96	9.88
669.67	9.70
672.53	9.99
675.76	10.15
689.93	10.94
703.63	11.00
708.60	10.88

Culvert Analysis Report
Proposed 54" SD Alignment Tailwater- CO Rim Elev

Analysis Component			
Storm Event	Design	Discharge	120.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	120.40 cfs	Check Discharge	120.40 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	7.80 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-2	1-54 inch Circular	81.00 cfs	10.07 ft	5.09 ft/s
Weir	Roadway	39.47 cfs	10.07 ft	N/A
Total	----------------	120.47 cfs	10.07 ft	N/A

Culvert Analysis Report
Proposed 54" SD Alignment Tailwater- CO Rim Elev

Component:Culvert-2

Culvert Summary					
Computed Headwater Elevation	10.07	ft	Discharge	81.00	cfs
Inlet Control HW Elev.	7.80	ft	Tailwater Elevation	7.80	ft
Outlet Control HW Elev.	10.07	ft	Control Type	Outlet Control	
Headwater Depth/Height	3.04				

Grades					
Upstream Invert	-3.60	ft	Downstream Invert	-5.83	ft
Length	1,050.67	ft	Constructed Slope	0.002122	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	13.63	ft
Slope Type	N/A		Normal Depth	3.32	ft
Flow Regime	N/A		Critical Depth	2.63	ft
Velocity Downstream	5.09	ft/s	Critical Slope	0.004060	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	4.50	ft
Section Size	54 inch		Rise	4.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	10.07	ft	Upstream Velocity Head	0.40	ft
Ke	0.20		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	7.80	ft	Flow Control	N/A	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	15.9	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Analysis Report
Proposed 54" SD Alignment Tailwater- CO Rim Elev

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	39.47	cfs	Allowable HW Elevation	10.07	ft
Roadway Width	862.00	ft	Overtopping Coefficient	2.94	US
Low Point	9.20	ft	Headwater Elevation	10.07	ft
Discharge Coefficient (Cr)	2.94		Submergence Factor (Kt)	1.00	
Tailwater Elevation	7.80	ft			

Sta (ft)	Elev. (ft)
0.00	13.00
100.00	13.00
200.00	12.00
250.00	12.00
272.00	12.00
310.00	12.50
754.00	12.50
784.00	9.70
786.00	9.20
824.00	10.00
862.00	10.50

Culvert Analysis Report
Proposed 54" SD Alignment Tailwater- Pipe Soffit

Analysis Component			
Storm Event	Design	Discharge	120.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	120.40 cfs	Check Discharge	128.50 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	-2.33 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-2	1-54 inch Circular	120.41 cfs	2.93 ft	9.07 ft/s
Weir	Roadway	0.00 cfs	2.93 ft	N/A
Total	----------------	120.41 cfs	2.93 ft	N/A

Culvert Analysis Report
Proposed 54" SD Alignment Tailwater- Pipe Soffit

Component:Culvert-2

Culvert Summary

Computed Headwater Elevation	2.93 ft	Discharge	120.41 cfs
Inlet Control HW Elev.	1.35 ft	Tailwater Elevation	-2.33 ft
Outlet Control HW Elev.	2.93 ft	Control Type	Outlet Control
Headwater Depth/Height	1.45		

Grades

Upstream Invert	-3.60 ft	Downstream Invert	-5.83 ft
Length	1,050.67 ft	Constructed Slope	0.002122 ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile	Depth, Downstream	3.50 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	3.23 ft
Velocity Downstream	9.07 ft/s	Critical Slope	0.005013 ft/ft

Section

Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	4.50 ft
Section Size	54 inch	Rise	4.50 ft
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	2.93 ft	Upstream Velocity Head	0.89 ft
Ke	0.20	Entrance Loss	0.18 ft

Inlet Control Properties

Inlet Control HW Elev.	1.35 ft	Flow Control	Transition
Inlet Type	Beveled ring, 33.7° bevels	Area Full	15.9 ft²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Analysis Report
Proposed 54" SD Alignment Tailwater- Pipe Soffit

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	0.00	cfs	Allowable HW Elevation	2.93	ft
Roadway Width	862.00	ft	Overtopping Coefficient	2.90	US
Low Point	9.20	ft	Headwater Elevation	N/A	ft
Discharge Coefficient (Cr)	2.90		Submergence Factor (Kt)	1.00	
Tailwater Elevation	-2.33	ft			

Sta (ft)	Elev. (ft)
0.00	13.00
100.00	13.00
200.00	13.00
250.00	12.00
272.00	12.00
310.00	12.50
754.00	12.50
784.00	9.70
786.00	9.20
824.00	10.00
862.00	10.50

APPENDIX 6

Supplemental Information for Downstream Storm Drain Capacity

Profile of 18' Roadway
Scale: Horiz. 1" = 50' Vert. 1" = 6'
Profile of Line "B"
Scale: Horiz. 1" = 50' Vert. 1" = 6'
Profile of Line "A"
Scale: Horiz. 1" = 50' Vert. 1" = 6'
SAN DIEGO RIVER FLOOD CHANNEL
Bar Grate in end each pipe See Detail Below.
Existing 1.5' stone face
Portland Cement Concrete Apron
Note: Use 5° beveled joints at all bends.
Profile of Discharge Lines
Scale: Horiz. 1" = 20' Vert. 1" = 6'
℄ of 6" C.I. pipe at same grade as ℄ of these 3-18" conc. pipes
Profile of 48" Storm Drain
Scale: Horiz. 1" = 50' Vert. 1" = 6'
48" Concrete Pipe (1750-D) with double rubber gasket joints
Crusher run rock bedding (See detail)
591'
PUMP HOUSE
Test Hole No. 1
City Datum
Current FG=6.4 NGVD29
=-16.5 OLD CITY STAFF DATUM +6.12=-10.38 NGVD29
=-14.5 OLD CITY STAFF DATUM +6.12=-8.38 NGVD29
PDC - VERTICAL DATUM SHIFT OF +6.12 PER MARCH 1963 DATUM CHANGE
Profile of 54" Storm Drain
Scale: Horiz. 1" = 50" Vert. 1" = 6"
54" Concrete Pipe with double rubber gasket joints
Crusher run rock bedding (See Detail)
663.99'
591'-48" concrete pipe with double rubber gasket joints (1750-D) and crusher run rock bedding.
597'-54" concrete pipe with double rubber gasket joints (1500-D) and crusher run rock bedding (See Detail)
NASHVILLE ST.
LAPWAI ST.
KING ST.
KNOXVILLE ST.
ALLEY Block A
ALLEY Block D
PACIFIC VIEW Map No. 1497
DRUCKER'S ADDITION Map No. 1584
P. L. 259
Scale: 1" = 50'
Typical Cross-Section of Roadways
Detail of Crusher Run Rock Bedding
Scale: 1/2" = 1'-0"
Detail of Bars at Outlet
Typical 6 places
Scale: 1 1/2" = 1'-0"
FRONTIER DRAINAGE PUMP STATION
CITY OF SAN DIEGO
ENGINEERING DEPARTMENT
SHEET 2 OF 6 SHEETS
W.O. NO. 20936
CONTR. Castillo & Thibodo INSP. Waddel
FIELD BOOK 2328-46
6-26-56 DATE STARTED
4-26-57 DATE COMPLETED
3460-D

UPDATED HYDRAULIC ANALYSIS

FOR THE

CITY OF SAN DIEGO PUMP STATIONS B, D, F, H, AND L

MBI JN 163401

June 18, 2018

Revised Final Report

Prepared by:

Michael Baker INTERNATIONAL

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858.614.5001 Fax

Project Contact:

Joel E. Bowdan III, PE, RCE 71693
Aharon Weintraub, EIT

Signature: ______________________   Date: *June 18, 2018*

Baker 163401

on record drawings and field investigation, PS-F is a reinforced concrete structure having a main floor and building above grade for the dry well and a lower wet which extends approximately 12-feet below ground. 15-inch and 24-inch drainage sewers enter the influent channel of the wet well. The influent channel is separate by a 6-inch thick, 12-foot tall weir wall. The weir wall contains an integral bar screen to allow flow directly from the influent channel to the larger wet well area; therefore the volumes of the influent channel and wet well are considered together.

The facility once accommodated cantilevered submersible, drive-shaft driven pumps with motors located on the main floor. However, the original pumps have been removed and replaced with submersible pumps and motors. With a total of three (3) pumping units, PS-F consists of the following pumps and capacities:

- One (1) 4-inch Barnes Submersible Non-Clog Pump, rated at 450 gpm @ 22' TDH, 7.5HP
- Two (2) 6-inch Barnes Submersible Non-Clog Pump, each rated at 1,250 gpm @ 20' TDH, 18HP
- One (1) recently installed 6-inch Barnes Submersible Non-Clog Pump with discharge hose, rated at 1,000 gpm @ 20' TDH, 18HP

The flow from each of the three (3) 6-inch submersible pumps discharges directly via separate 8-inch discharge piping and discharge hosing to a drainage box. The drainage box drains by gravity through a 24-inch storm drain outfall into Mission Bay. The smaller 4-inch submersible pump, which is used primarily for dewatering and dry weather flows, currently discharges to the drainage box via a 4-inch pump hose. For the purpose of this study, all four pumps are included in the hydraulic analysis.

2.1.4 Pump Station H

The official address for Pump Station H is 3930 King Street in San Diego. However, King Street no longer exists. The location of PS-H can be more accurately described as the south bank of the San Diego River levee, north of I-8, just south of the pedestrian walkway/bikeway approximately 1,900 feet east of the Sports Arena Blvd overpass. PS-H was constructed in 1956 and is responsible for servicing approximately 426 acres in the Sports Arena and Loma Portal area south of I-8. Based on record drawings and field investigation, PS-H is a 20-feet x 22-feet rectangular reinforced concrete structure having a main floor and building above grade for the dry well and a lower wet which extends approximately 23-feet below ground. The main influent drainage sewers into the structure include the following:

- 54-inch drainage sewer from east
- 48-inch drainage sewer from the west

Based on information from the City of San Diego, this station has a current pumping capacity of approximately 66,000 gpm. With a total of six (6) main pumping units and one (1) dry weather flow pump, PS-H consists of the following pumps:

~147 cfs

- One (1) 4-inch Barnes Submersible Pump, rated at 750 gpm @ 30' TDH, 15HP

Drainage Study

For:

Pump Stations B, L, D, F, H

Prepared for:
City of San Diego
Public Works Department
Engineering & Capital Projects
525 B Street, Ste 700
San Diego, CA 92101

Prepared by:

O'Day Consultants, Inc.
2710 Loker Avenue West, Suite 100
Carlsbad, CA 92010
(760) 931-7700

March 30, 2016

George O'Day **RCE 32014**

Section 4.1

APPENDIX A

Pump Station H Hydrologic Calculations

Basin	C	Area (ac)	% of Total	C x % of Total
Commercial	0.85	322.6	0.76	0.64
Single Family Residential	0.55	104.1	0.24	0.13
	Total Area	426.7	C	0.78

Initial area travel path = 0.29 mi

H = 74 ft

Time of Concentration = $T_c = (11.9L^3/H)^{.385}$

Add 10 minutes

Initial Time of Concentration =	17.11	minutes
Tc = Ti + 5 mins (time through pipe)=	22.11	minutes
(Drainage Design Manual) I (100yr) =	2.30	in/hr
(Drainage Design Manual) I (2yr) =	1.10	in/hr
Q (100yr) =	CIA	
A =	426.70	ac
1 ac =	43,560	ft^2
1 hr =	3,600	secs
Q =	**768.72**	**ft^3/sec**

Q (2yr) =	CIA	
A =	426.70	ac
1 ac =	43,560	ft^2
1 hr =	3,600	secs
Q =	**367.65**	**ft^3/sec**

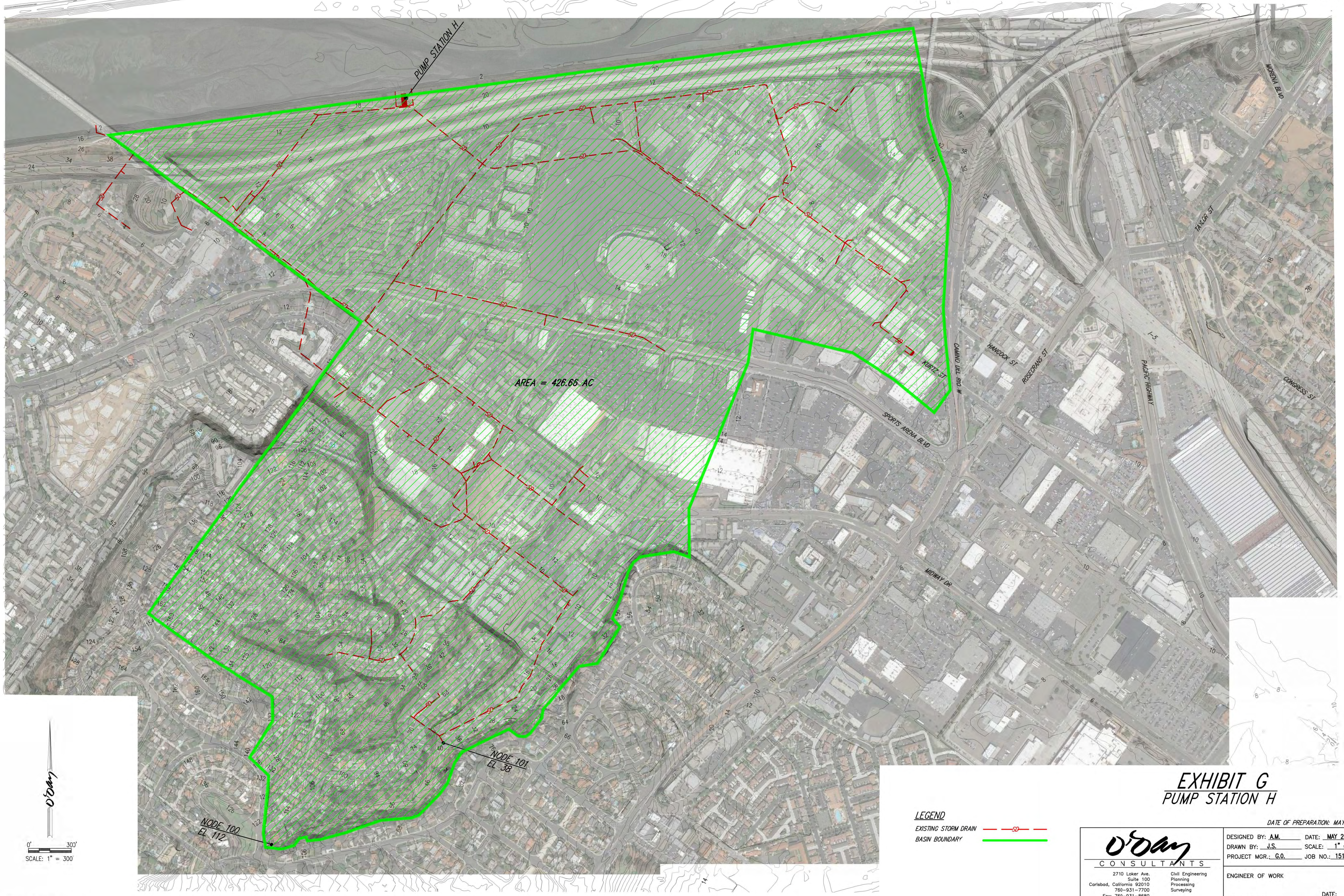


EXHIBIT G
PUMP STATION H

LEGEND

EXISTING STORM DRAIN
BASIN BOUNDARY

DATE OF PREPARATION: MAY 20, 2016

O'Day CONSULTANTS
2710 Loker Ave. Suite 100
Carlsbad, California 92010
760-931-7700
Fax: 760-931-8680
ODayConsultants.com
Civil Engineering
Planning
Processing
Surveying

DESIGNED BY: A.M.	DATE: MAY 2016
DRAWN BY: J.S.	SCALE: 1" = 300'
PROJECT MGR.: G.O.	JOB NO.: 151033
ENGINEER OF WORK	
	DATE:
GEORGE O'DAY	RCE: 32014

MEMO

Date:	April 21, 2023
To:	Sara Dastgheibi, P.E., CFM, Senior Civil Engineer, City of San Diego
From:	Ben Whitehead, P.E., Project Manager
Author:	Steve Parker, Project Manager | Chung-Cheng Yen, P.E., Ph.D.
Project:	TO 066 FY23 Pump Station H Feasibility Study
Project Number:	DIV 100-T39294.066.23 / IEW 200-012917-22013
Subject:	Pump Station H Hydrologic Analysis

1.0 INTRODUCTION

The City of San Diego is conducting assessments of its pump station facilities and looking for preliminary design concepts for potential system upgrades that meet their design standards. This memo details the hydrology and flow analysis, methodology and results, for the Pump Station H watershed. This analysis assumes that drainage facilities within and outside the watershed are maintained to City design standards to handle flows as appropriate, thus the analysis does not include any existing storm drain facility (pipe or inlet) capacity analyses.

The City will be considering climate change impacts in all future pump station infrastructure projects. Changing climate is projected to result in sea level rise and changing precipitation patterns. Findings from a review of several climate change studies are summarized in Attachment B – Pump Station Climate Change Considerations.

2.0 MBI 2018 REPORT AND MODEL REVIEW

This section is a review of existing analyses for Pump Station H, specifically a review of the Michael Baker International (MBI) report titled “Hydraulic Analysis for the City of San Diego Pump Stations B, D, F, H, and L”, dated June 18, 2018.

2.1 PUMP STATION H OVERVIEW

Pump Station H is located on the south bank of the San Diego River Levee, 2 miles from the River’s outlet at the Pacific Ocean. It is between the levee and the Interstate 8 freeway, 2000-ft upstream of the Mission Bay Drive/Sports Arena Boulevard bridge. See **Figure 1** for the location map. The site accumulates flow from storm drains to the south and east, in a low-lying area between Loma Portal and Midway District. The Pump Station H watershed is 394 acres.

Tetra Tech, Inc.
9444 Balboa Ave Suite 215, San Diego, CA, 92123
Tel 517.316.3930 Fax 517.484.8140 tetratech.com

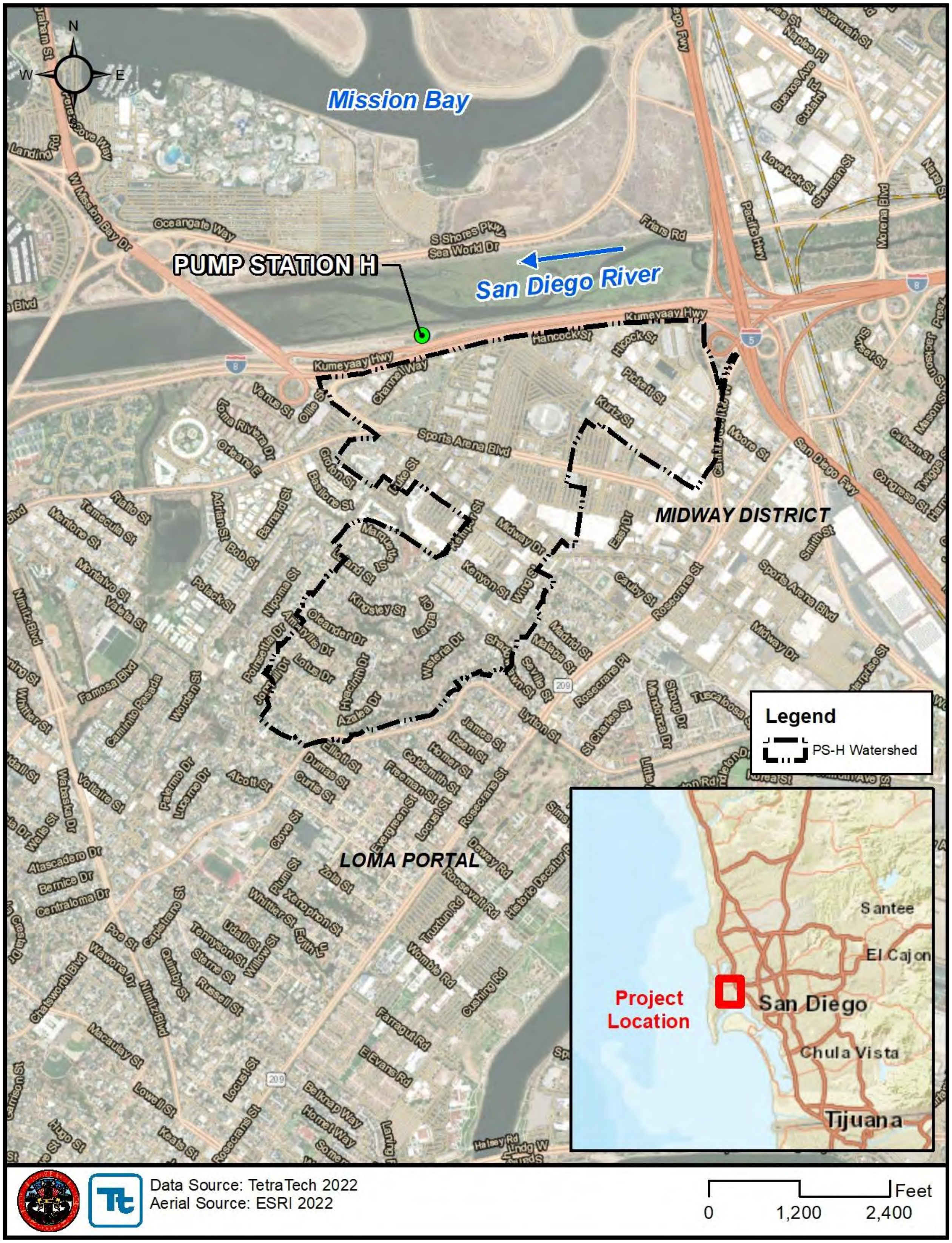


Figure 1. Project Overview Map

This value is different from the MBI report of approximately 426 acres as this analysis has found some areas south of Midway Drive, south of Sports Arena Boulevard and south of the I-8 interchange flow to a gravity outlet just west of the bridge.

Flows received from the watershed are discharged into the San Diego River. A cursory review of the outlet structure provides an elevation of approximately 15-ft, which is higher than the 13-14 foot 100-year base flood elevation of San Diego River per FEMAs National Flood Hazard Layer. Due to the outlet inverts likely being higher than the 100-year River elevation, no joint probability analysis should be required for sizing pumps. The outlet elevation however should be confirmed before final design of the pump station.

2.2 MODELING APPROACH

The 2018 Study by Michael Baker utilized a regional model used for water quality studies called the San Diego Hydrology Model, developed by Clear Creek Solutions Inc. It is a pre-packaged model with data and is described as “a tool for analyzing the hydromodification effects of land development projects and sizing solutions to mitigate the increased runoff from these projects”, geared toward addressing requirements by the California Regional Water Quality Control Board (RWQCB) that address increases in runoff rate and volume from new developments. The model is based on a tool adapted from another model, the Western Washington Hydrology Model.

The San Diego Hydrology Model uses historical rainfall data rather than design rainfall data such as that found in the San Diego County Hydrology Manual or the City of San Diego Design manual. As such, getting the model to adhere to local design guidance is difficult as the historical rainfall data does not correlate cleanly with the design rainfalls and routing methodology.

2.3 STORM SELECTION

As noted in the approach, aligning the San Diego Hydrology Model (SDMH) with local methodology is difficult. The SDHM manual states the model is primed to generate 2-year through 10-year flood frequency results. In this particular study, MBI selected rainfall events from the model database of historical storm events and associated them to represent corresponding frequencies per below:

- 100yr-1hr, 50yr-3hr (December 10, 1965)
- 10yr-3hr (January 31, 1979)
- 5yr-1hr (February 23, 1998)
- 15yr-12hr (January 14, 1978)

None of these events line up with the City Design manual which generates 10, 25, and 100-year events of 6-hr and 24-hr durations. Additionally, the hydrographs that are generated in the SDHM do not align with the City Design approach which specifies utilization of the Natural Resources Conservation Service (NRCS) Method.

2.4 RESULTS & ANALYSIS

2.4.1 Storm Selection Issues

The primary concern with the MBI approach, though useful for a quick analysis, is that the SDHM computed values are not readily compatible with the peak flows based on the hydrologic procedures outlined in the City of San Diego Drainage Design Manual (2017).

Though the SDHM is supposed to only generate 2- to 10- year flood frequency, the MBI report does not indicate how the 15-, 50-, and 100-year flood frequency values were estimated or generated. There were no detailed basis procedures to relate the storm events selected to the frequency and duration (it is not clear why the December 10, 1965 event is assigned as the 100-year 1-hr as well as 50-year-3hr event)

Lastly, there is no association of the events and results with the City of San Diego Drainage Design Manual procedures. It is unclear if the peak flows for the five selected events are compatible to the results based on the City’s procedures. The report does not detail this.

2.4.2 Comparison

To highlight potential differences in the SDHM approach, versus the Rational Method approach in the City's Design Manual, a single analysis was performed to compare the peak flow rates as follows:

- Drainage area, A = 426 ac (per MBI 2018 report)
- Runoff coefficient, C = 0.78 (per MBI 2018 report)
- Time of concentration assumed to be between 20 and 30 minutes for flat ground slope
- Rainfall Intensity, I (in/hr) obtained from Figure A-1 of City of San Diego Drainage Design Manual (2017)

The computed Rational Method peak flow rates and MBI peak flow rates are listed in the following table for comparison.

Table 1. Companion of Peak Flow Rates

T-year	C	Tc (min)	I (in/hr)	A (ac)	Q = CIA (cfs)	MBI Q(cfs)
5	0.78	20	1.56	426	518.4	225.3
	0.78	30	1.25	426	415.4	
15	0.78	20	1.93	426	641.3	108.2
	0.78	30	1.56	426	518.4	

As can be seen, the SDHM methodology results in discharges significantly less than the expected similar results used in a Rational Method approach like that in the City's Design Manual.

To conclude, the SDHM methodology was appropriate as a screening tool to evaluate a large number of pump stations against each other in order to prioritize development of solutions for those pump stations that may require the most attention to resolve capacity or other issues. However, for design purposes, using the City's Design Manual is the appropriate approach for design solutions. This not only provides for more robust design criteria in terms of runoff estimates, but it also aligns future results with all other facilities designed to handle the City's flood control requirements.

3.0 PUMP STATION H: CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL HYDROLOGY

For the determination of runoff for given rainfall events within the interior drainage watershed of Pump Station H, the watershed of Pump Station H, being less than 1 square mile, was analyzed with the Rational Method approach per the City of San Diego Drainage Design Manual to estimate the time of concentration (Tc) and determine peak flow values for the 10-, 25-, and 100- year storm events.

To generate a hydrograph for the pump station analysis, an additional methodology was required per the design manual. The NRCS Method was utilized to generate a hydrograph that could be scaled to have its peak match the results of the Rational Method approach. The input parameters for the models were developed using the City's Drainage Design Manual (City of San Diego, 2017).

3.1 DRAINAGE AREA

The first step in the interior hydrology analysis was to delineate the watershed boundaries and pipe connections to determine sub-areas. The drainage area for Pump Station H was determined using a combination of LiDAR data from the USGS National Map LiDAR in 2005. Boundaries were refined with parcel data, storm drain network data, and guided by aerial imagery observations and the total drainage area is approximately 394 acres. The primary watershed was subsequently sub-delineated into sub-basins based on flow paths to the pump station.

The longest watershed course for each basin was determined, as well as additional flow paths from other areas of the watershed to the pump station. This was used to guide the delineation of sub-basins and to determine additional flow paths for the analysis. Pump Station H exhibited a few convoluted flow paths as a pair of pipe systems diverted flow down to confluences while bypassing picking up additional flow area. This was noted where drainage area 1000/1100 are directed to the downstream end of 600, bypassing picking up the 800 subareas. The storm drain system GIS data was highly scrutinized and compared to street view imagery of inlet structures and manholes to construct the system. Lastly, the creation of the sub-basins and flow paths allowed the creation of the model concentration point nodes and elevations at those nodes from the LiDAR data. The watershed boundaries, flow paths, and nodes are found in **Figure 2** and **Figure 3**.

3.2 SOILS & LAND USE

In the process to transform rainfall into effective rainfall for the Rational Method model, GIS data for land use were processed within each sub-basin, then associated with curve numbers and permeability by land use type classified by the SD Hydrology Manual parameters. Table 2 lists the SANDAG land use categories (SANDAG 2020) in the SANDAG Land Use GIS spatial data (shapefile) and their associated hydrology land cover (per the City Design Manual), soil permeability, and curve numbers. Per available soil data and Design Manual guidelines, all soil types in the watershed were soil class D. Figure 4 show the Land Use Cover used within each watershed.

A large area of City owned property between Kurtz Street and Sports Arena Blvd is proposed to be redeveloped. The property currently includes commercial offices and parking to the west, the San Diego Pechanga Sports arena and associated parking, and additional commercial and/or light industrial use to the east. The Pump Station H watershed does not include the eastern portion of the property where the topography and adjacent drainage systems take discharges south to San Diego Bay (see Figure 5). The area identified in Figure 5 as potential additional drainage area represents a 1.7% increase in the watershed area and potential additional flow would not exceed that increase to the peak flow estimate of this memo's evaluation. Overall, the sports arena city owned property has proposed re-development initiatives that currently suggest much of the sports arena parking will be developed primarily into multiple-unit housing with a central urban park as well as other mixed uses such as an entertainment, arts, and culture district, while upgrading the arena itself. The current parking lot and arena splits runoff to the north and south drains that lead to Pump Station H.

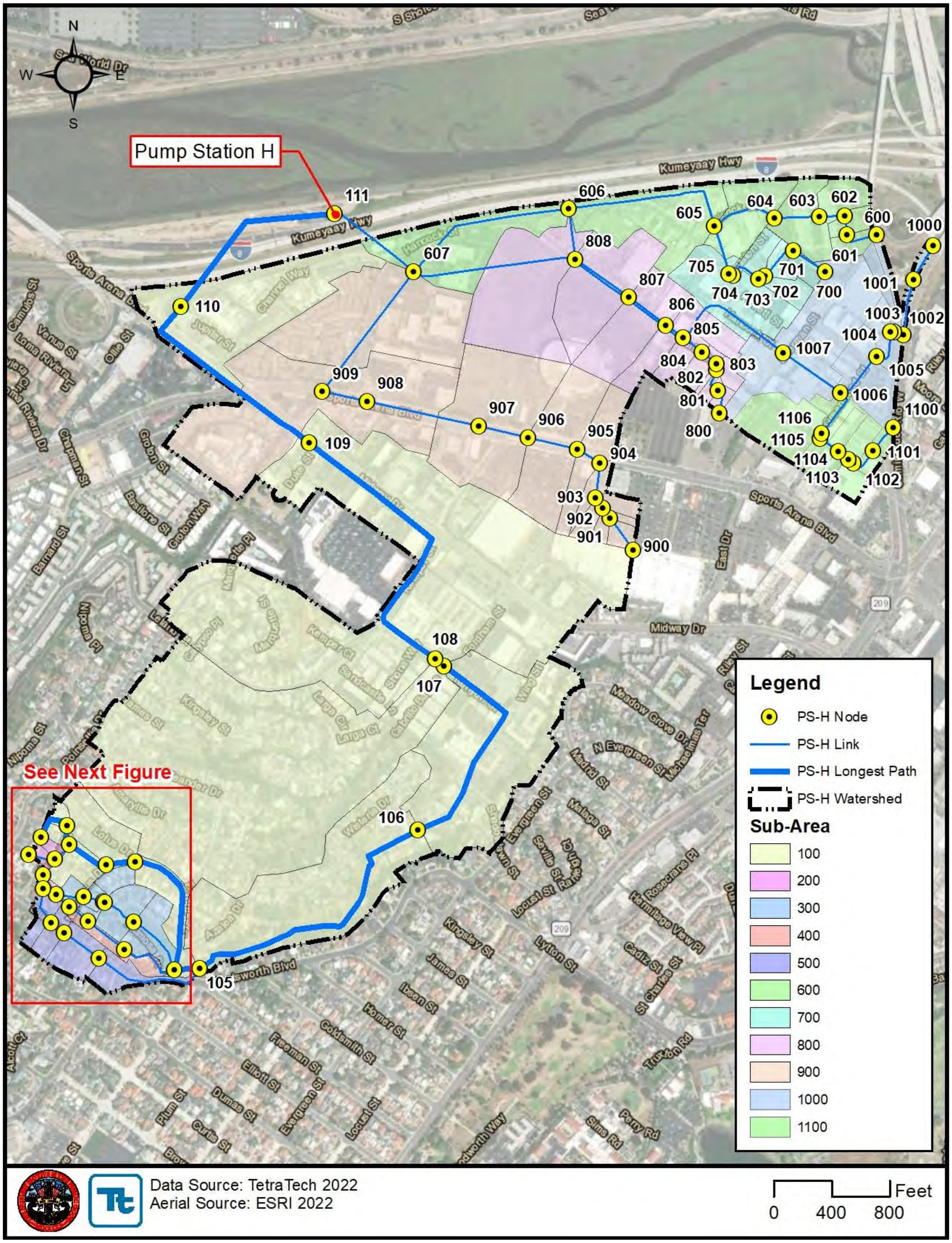


Figure 2. Pump Station H Watershed

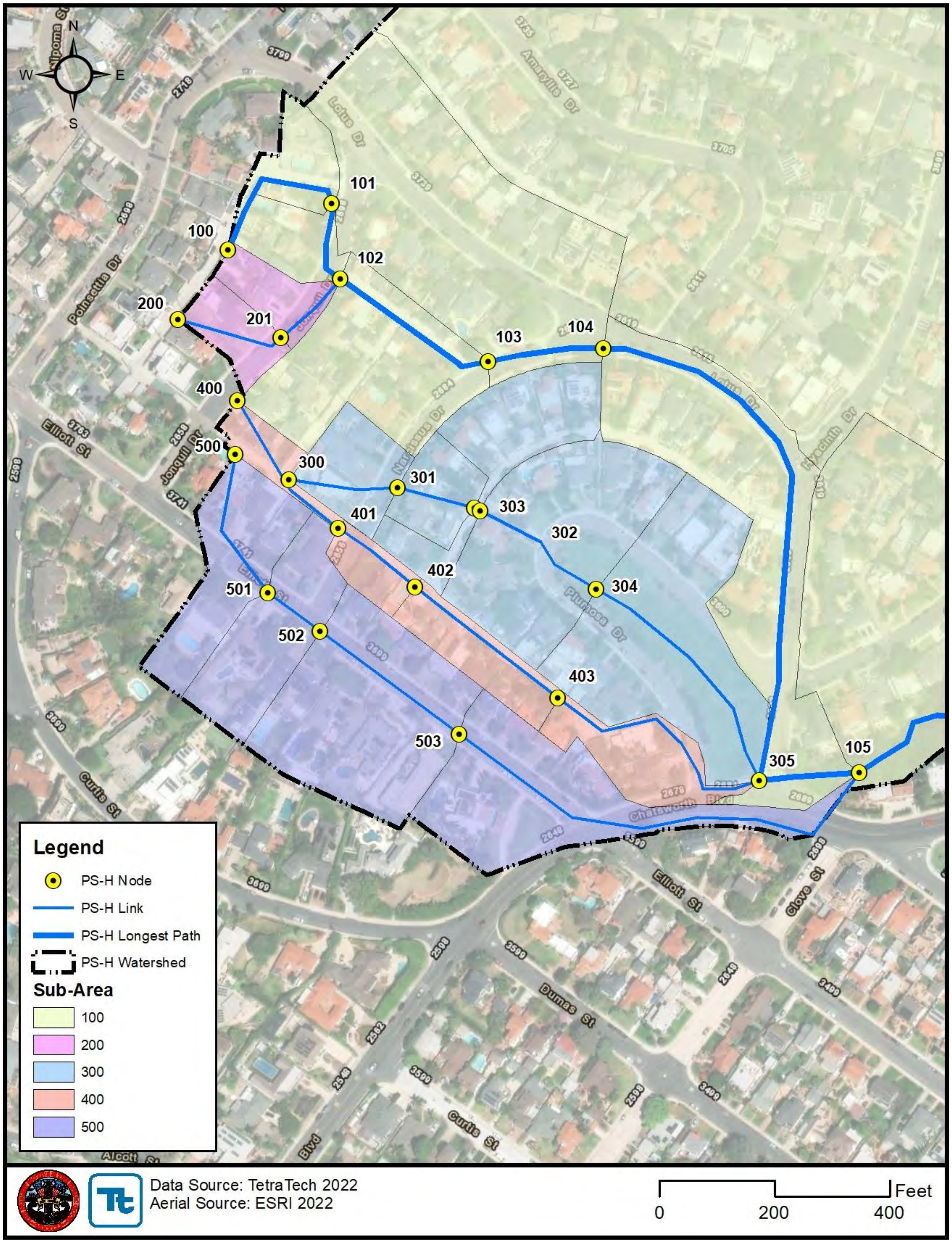


Figure 3. Pump Station H Upper Watershed

Q = CIA

C - runoff coefficient
I - rainfall intensity in in/hr as a function of Tc
A - drainage area in acres

Frequency Event: 10 Year

U/S Node	D/S Node	Area #	Acre	∑ A	"C"	CA	∑ CA	Ti (min)	Tt (min)	Tc = Ti + Tt	I (Tc)	Q =(∑CA)I
100	101	101	0.49	0.49	0.68	0.33	0.33	8.15		8.15	2.80	0.93
101	102	102	0.45	0.94	0.65	0.29	0.63		1.30	9.44	2.63	1.65
200	201	201	0.40	0.40	0.67	0.27	0.27	6.41		6.41	3.07	0.83
201	102	202	0.40	0.79	0.69	0.27	0.54		0.96	7.37	2.91	1.58
Confluence Analysis												
100	102			0.94			0.63			9.44		3.08
200	102			0.79			0.54			7.37		2.87
102	**102**			**1.74**			**1.17**			**9.44**		**3.08**
102	103	103	1.80	3.54	0.66	1.18	2.35		1.14	10.58	2.50	5.87
103	104	104	3.80	7.33	0.68	2.57	4.92		1.01	11.59	2.40	11.80
104	305	105	3.11	10.44	0.75	2.33	7.25		3.23	14.83	2.12	15.36
300	301	301	0.61	0.61	0.68	0.41	0.41	6.34		6.34	3.08	1.27
301	302	302	0.47	1.07	0.56	0.26	0.67		0.42	6.76	3.01	2.03
302	303	303	1.09	2.16	0.62	0.67	1.35		0.09	6.85	3.00	4.04
303	304	304	2.10	4.26	0.62	1.29	2.64		0.81	7.66	2.86	7.56
304	305	305	2.52	6.79	0.64	1.61	4.25		2.08	9.74	2.60	11.04
400	401	401	0.31	0.31	0.71	0.22	0.22	7.48		7.48	2.89	0.64
401	402	402	0.31	0.62	0.73	0.22	0.45		0.79	8.27	2.78	1.24
402	403	403	0.59	1.21	0.63	0.37	0.82		1.38	9.65	2.61	2.13
403	305	404	0.73	1.94	0.70	0.51	1.33		1.75	11.39	2.42	3.23
Confluence Analysis												
104	305			10.44			7.25			14.83		27.20

300	305			6.79			4.25			9.74		23.89
400	305			1.94			1.33			9.65		22.01
305	**305**			**19.17**			**12.83**			**14.83**		**27.20**
305	105			19.17			12.83		0.13	14.96	2.11	27.10
500	501	501	1.09	1.09	0.62	0.68	0.68	12.00		12.00	2.36	1.60
501	502	502	1.08	2.18	0.64	0.70	1.38		0.79	12.80	2.29	3.15
502	503	503	2.18	4.35	0.63	1.36	2.74		1.38	14.17	2.17	5.95
503	105	504	1.94	6.29	0.73	1.41	4.15		1.75	15.92	2.05	8.50
Confluence Analysis												
305	105			19.17			12.83			14.96		35.08
503	105			6.29			4.15			15.92		34.79
105	**105**			**25.46**			**16.98**			**14.96**		**35.08**
105	106	106	23.30	48.77	0.62	14.34	31.32		2.09	17.05	1.98	61.86
106	107	107	22.80	71.56	0.71	16.09	47.41		2.31	19.36	1.84	87.30
107	108	108	58.53	130.09	0.63	36.75	84.16		0.21	19.57	1.83	153.97
108	109	109	70.24	200.33	0.79	55.43	139.59		5.06	24.63	1.62	225.50
109	110	110	15.68	216.01	0.85	13.33	152.92		3.27	27.89	1.50	228.92
110	111			216.01			152.92		2.79	30.68	1.41	216.16
600	601	601	1.00	1.00	0.87	0.87	0.87	5.00		5.00	3.35	2.92
601	602	602	0.97	1.97	0.88	0.85	1.72		0.88	5.88	3.17	5.44
602	603	603	1.92	3.88	0.87	1.66	3.38		1.45	7.33	2.92	9.87
603	604	604	3.63	7.51	0.85	3.09	6.47		2.37	9.70	2.60	16.83
604	605	605	4.45	11.96	0.94	4.16	10.64		1.84	11.54	2.41	25.59
700	701	701	0.86	0.86	0.95	0.81	0.81	6.58		6.58	3.04	2.47
701	702	702	0.85	1.70	0.95	0.80	1.62		2.95	9.53	2.62	4.23
702	703	703	1.09	2.80	0.95	1.04	2.66		0.52	10.06	2.56	6.81
703	704	704	1.25	4.05	0.95	1.18	3.84		1.39	11.45	2.42	9.28
704	705	705	6.72	10.76	0.93	6.27	10.11		0.14	11.59	2.40	24.28
705	605			10.76			10.11			11.59	2.28	23.08

Confluence Analysis												
600	605			11.96			10.64			11.54		48.57
700	605			10.76			10.11			11.59		47.35
605	**605**			**22.72**			**20.75**			**11.54**		**48.57**
605	606	606	8.56	31.28	0.94	8.01	28.76	11.54	3.84	15.39	2.09	59.97
800	801	801	0.42	0.42	0.85	0.36	0.42	8.57		8.57	2.74	1.15
801	802	802	0.43	0.85	0.85	0.37	0.79		1.37	9.94	2.58	2.02
802	803	803	0.82	1.67	0.91	0.74	1.53		0.30	10.24	2.54	3.89
803	804	804	1.10	2.77	0.94	1.03	2.56		1.25	11.49	2.41	6.18
804	805	805	1.41	4.18	0.88	1.25	3.81		1.34	12.83	2.28	8.71
805	806	806	4.08	8.26	0.93	3.78	7.59		1.18	14.01	2.19	16.59
806	807	807	6.18	14.44	0.84	5.21	12.80		2.27	16.28	2.02	25.89
807	808	808	8.26	22.70	0.90	7.40	20.20		1.59	17.86	1.93	38.94
808	606	809	11.90	34.60	0.86	10.22	30.42		1.38	19.25	1.85	56.21
Confluence Analysis												
605	606			31.28			28.76			15.39		104.91
800	606			34.60			30.42			19.25		109.35
606	**606**			**65.88**			**59.18**			**19.25**		**109.35**
606	607	607	8.98	74.86	0.88	7.86	67.04	19.25	1.84	11.54	1.71	114.38
900	901	901	0.74	0.74	0.85	0.63	0.74	10.00		10.00	2.57	1.91
901	902	902	0.74	1.48	0.85	0.63	1.37		0.89	10.88	2.46	3.37
902	903	903	1.46	2.94	0.85	1.24	2.61		0.84	11.72	2.39	6.23
903	904	904	1.07	4.01	0.85	0.91	3.52		1.61	13.33	2.24	7.88
904	905	905	3.93	7.94	0.86	3.37	6.89		0.87	14.20	2.17	14.95
905	906	906	8.32	16.26	0.86	7.11	14.01		1.40	15.60	2.07	29.04
906	907	907	14.21	30.47	0.86	12.19	26.20		1.17	16.77	1.99	52.18
907	908			30.47			26.20		2.35	19.12	1.86	48.59
908	909	909	24.75	55.22	0.78	19.39	45.58		0.95	20.08	1.80	82.23
909	607	910	15.88	71.10	0.79	12.58	58.16		2.76	22.83	1.68	97.66

1000	1001	1001	0.26	0.26	0.90	0.23	0.26	5.00		5.00	3.35	0.86
1001	1002	1002	0.31	0.56	0.90	0.28	0.53		1.59	6.59	3.04	1.62
1002	1003	1003	0.68	1.24	0.90	0.61	1.14		0.53	7.12	2.96	3.39
1003	1004	1004	0.88	2.13	0.90	0.79	1.94		0.05	7.17	2.95	5.72
1004	1005	1005	1.74	3.87	0.92	1.59	3.53		1.66	8.83	2.71	9.56
1005	1006	1006	4.04	7.90	0.87	3.50	7.04		1.66	10.49	2.51	17.66
1100	1101	1101	0.52	0.52	0.89	0.46	0.52	5.69		5.69	3.21	1.66
1101	1102	1102	0.51	1.02	0.88	0.44	0.96		2.16	7.85	2.83	2.72
1102	1103	1103	1.08	2.11	0.86	0.93	1.89		0.26	8.11	2.80	5.29
1103	1104	1104	1.50	3.60	0.90	1.34	3.23		0.46	8.57	2.74	8.87
1104	1105	1105	1.73	5.33	0.89	1.54	4.77		0.71	9.28	2.65	12.65
1105	1106	1106	4.46	9.79	0.88	3.93	8.70		0.16	9.44	2.63	22.88
1106	1006	1107	1.29	11.08	0.91	1.17	9.87		1.31	10.75	2.48	24.46
Confluence Analysis												
1000	1006			7.90			7.04			10.49		41.55
1100	1006			11.08			9.87			10.75		41.90
1006	**1006**			**18.98**			**16.91**			**10.75**		**41.90**
1006	1007	1007	12.56	31.55	0.91	11.40	28.31	10.75	1.50	12.25	2.34	66.19
1007	607			31.55			28.31		8.49	20.74	1.77	50.15
Confluence Analysis												
606	607			74.86			67.04			11.54		191.66
909	607			71.10			58.16			22.83		173.10
1007	607			31.55			28.31			20.74		257.66
607	**607**			**177.50**			**153.51**			**20.74**		**257.66**
607	111			177.50			153.51	20.74	1.38	22.12	1.71	262.74
Confluence Analysis												
110	111			216.01			152.92			30.68		433.14
607	111			177.50			153.51			22.12		418.61
111	**111**			**393.51**			**306.42**			**30.68**		**433.14**
								Watershed lag (0.6Tc) =		18.41		

Q = CIA

C - runoff coefficient
I - rainfall intensity in in/hr as a function of Tc
A - drainage area in acres

Frequency Event: 25 Year

U/S Node	D/S Node	Area #	Acre	∑ A	"C"	CA	∑ CA	Ti (min)	Tt (min)	Tc = Ti + Tt	I (Tc)	Q =(∑CA)I
100	101	101	0.49	0.49	0.68	0.33	0.33	8.15		8.15	3.17	1.06
101	102	102	0.45	0.94	0.65	0.29	0.63		1.26	9.41	2.99	1.88
200	201	201	0.40	0.40	0.67	0.27	0.27	6.41		6.41	3.47	0.93
201	102	202	0.40	0.79	0.69	0.27	0.54		0.98	7.39	3.29	1.79
Confluence Analysis												
100	102			0.94			0.63			9.41		3.51
200	102			0.79			0.54			7.39		3.27
102	**102**			**1.74**			**1.17**			**9.41**		**3.51**
102	103	103	1.80	3.54	0.66	1.18	2.35		1.07	10.48	2.87	6.74
103	104	104	3.80	7.33	0.68	2.57	4.92		1.01	11.49	2.75	13.54
104	305	105	3.11	10.44	0.75	2.33	7.25		3.23	14.72	2.44	17.69
300	301	301	0.61	0.61	0.68	0.41	0.41	6.34		6.34	3.48	1.44
301	302	302	0.47	1.07	0.56	0.26	0.67		0.40	6.74	3.41	2.29
302	303	303	1.09	2.16	0.62	0.67	1.35		0.09	6.83	3.40	4.57
303	304	304	2.10	4.26	0.62	1.29	2.64		0.79	7.63	3.25	8.58
304	305	305	2.52	6.79	0.64	1.61	4.25		1.97	9.60	2.97	12.62
400	401	401	0.31	0.31	0.71	0.22	0.22	7.48		7.48	3.28	0.73
401	402	402	0.31	0.62	0.73	0.22	0.45		0.75	8.23	3.16	1.41
402	403	403	0.59	1.21	0.63	0.37	0.82		1.38	9.60	2.97	2.43
403	305	404	0.73	1.94	0.70	0.51	1.33		1.71	11.31	2.78	3.70
Confluence Analysis												
104	305			10.44			7.25			14.72		31.32

300	305			6.79			4.25			9.60		27.30
400	305			1.94			1.33			9.60		25.20
305	**305**			**19.17**			**12.83**			**14.72**		**31.32**
305	105			19.17			12.83		0.13	14.85	2.43	31.20
500	501	501	1.09	1.09	0.62	0.68	0.68	12.00		12.00	2.69	1.83
501	502	502	1.08	2.18	0.64	0.70	1.38		0.75	12.75	2.62	3.61
502	503	503	2.18	4.35	0.63	1.36	2.74		1.38	14.13	2.49	6.82
503	105	504	1.94	6.29	0.73	1.41	4.15		1.71	15.84	2.35	9.76
Confluence Analysis												
305	105			19.17			12.83			14.85		40.35
503	105			6.29			4.15			15.84		39.98
105	**105**			**25.46**			**16.98**			**14.85**		**40.35**
105	106	106	23.30	48.77	0.62	14.34	31.32		2.03	16.87	2.28	71.35
106	107	107	22.80	71.56	0.71	16.09	47.41		2.24	19.12	2.13	100.87
107	108	108	58.53	130.09	0.63	36.75	84.16		0.21	19.32	2.11	177.97
108	109	109	70.24	200.33	0.79	55.43	139.59		4.94	24.26	1.87	260.97
109	110	110	15.68	216.01	0.85	13.33	152.92		3.05	27.32	1.74	266.01
110	111			216.01			152.92		2.72	30.04	1.65	251.95
600	601	601	1.00	1.00	0.87	0.87	0.87	5.00		5.00	3.79	3.30
601	602	602	0.97	1.97	0.88	0.85	1.72		0.86	5.86	3.59	6.16
602	603	603	1.92	3.88	0.87	1.66	3.38		1.38	7.24	3.32	11.22
603	604	604	3.63	7.51	0.85	3.09	6.47		2.32	9.56	2.97	19.25
604	605	605	4.45	11.96	0.94	4.16	10.64		1.85	11.41	2.76	29.39
700	701	701	0.86	0.86	0.95	0.81	0.81	6.58		6.58	3.44	2.80
701	702	702	0.85	1.70	0.95	0.80	1.62		2.95	9.53	2.98	4.81
702	703	703	1.09	2.80	0.95	1.04	2.66		0.52	10.06	2.91	7.74
703	704	704	1.25	4.05	0.95	1.18	3.84		1.32	11.38	2.77	10.63
704	705	705	6.72	10.76	0.93	6.27	10.11		0.14	11.52	2.75	27.80
705	605			10.76			10.11			11.52	2.63	26.55

Confluence Analysis												
600	605			11.96			10.64			11.41		55.69
700	605			10.76			10.11			11.52		54.48
605	**605**			**22.72**			**20.75**			**11.41**		**55.69**
605	606	606	8.56	31.28	0.94	8.01	28.76	11.41	3.56	14.97	2.42	69.62
800	801	801	0.42	0.42	0.85	0.36	0.42	8.57		8.57	3.11	1.30
801	802	802	0.43	0.85	0.85	0.37	0.79		1.37	9.94	2.93	2.30
802	803	803	0.82	1.67	0.91	0.74	1.53		0.29	10.23	2.90	4.43
803	804	804	1.10	2.77	0.94	1.03	2.56		1.21	11.45	2.76	7.07
804	805	805	1.41	4.18	0.88	1.25	3.81		1.34	12.78	2.62	9.99
805	806	806	4.08	8.26	0.93	3.78	7.59		1.13	13.91	2.51	19.07
806	807	807	6.18	14.44	0.84	5.21	12.80		2.18	16.09	2.33	29.87
807	808	808	8.26	22.70	0.90	7.40	20.20		1.57	17.65	2.22	44.87
808	606	809	11.90	34.60	0.86	10.22	30.42		1.38	19.04	2.13	64.88
Confluence Analysis												
605	606			31.28			28.76			14.97		120.64
800	606			34.60			30.42			19.04		126.21
606	**606**			**65.88**			**59.18**			**19.04**		**126.21**
606	607	607	8.98	74.86	0.88	7.86	67.04	19.04	1.85	11.41	1.97	131.97
900	901	901	0.74	0.74	0.85	0.63	0.74	10.00		10.00	2.92	2.17
901	902	902	0.74	1.48	0.85	0.63	1.37		0.86	10.86	2.82	3.86
902	903	903	1.46	2.94	0.85	1.24	2.61		0.84	11.70	2.73	7.12
903	904	904	1.07	4.01	0.85	0.91	3.52		1.61	13.30	2.56	9.04
904	905	905	3.93	7.94	0.86	3.37	6.89		0.85	14.15	2.49	17.16
905	906	906	8.32	16.26	0.86	7.11	14.01		1.37	15.52	2.38	33.31
906	907	907	14.21	30.47	0.86	12.19	26.20		1.16	16.68	2.29	60.00
907	908			30.47			26.20		2.26	18.94	2.14	56.03
908	909	909	24.75	55.22	0.78	19.39	45.58		0.92	19.86	2.08	94.96
909	607	910	15.88	71.10	0.79	12.58	58.16		2.66	22.52	1.95	113.14

1000	1001	1001	0.26	0.26	0.90	0.23	0.26	5.00		5.00	3.79	0.98
1001	1002	1002	0.31	0.56	0.90	0.28	0.53		1.63	6.63	3.43	1.83
1002	1003	1003	0.68	1.24	0.90	0.61	1.14		0.53	7.16	3.33	3.82
1003	1004	1004	0.88	2.13	0.90	0.79	1.94		0.05	7.21	3.32	6.45
1004	1005	1005	1.74	3.87	0.92	1.59	3.53		1.54	8.76	3.08	10.89
1005	1006	1006	4.04	7.90	0.87	3.50	7.04		1.58	10.33	2.89	20.32
1100	1101	1101	0.52	0.52	0.89	0.46	0.52	5.69		5.69	3.62	1.87
1101	1102	1102	0.51	1.02	0.88	0.44	0.96		2.16	7.85	3.21	3.09
1102	1103	1103	1.08	2.11	0.86	0.93	1.89		0.25	8.11	3.17	5.99
1103	1104	1104	1.50	3.60	0.90	1.34	3.23		0.44	8.55	3.11	10.06
1104	1105	1105	1.73	5.33	0.89	1.54	4.77		0.70	9.24	3.02	14.40
1105	1106	1106	4.46	9.79	0.88	3.93	8.70		0.16	9.41	2.99	26.06
1106	1006	1107	1.29	11.08	0.91	1.17	9.87		1.25	10.65	2.84	28.07
Confluence Analysis												
1000	1006			7.90			7.04			10.33		47.54
1100	1006			11.08			9.87			10.65		48.08
1006	**1006**			**18.98**			**16.91**			**10.65**		**48.08**
1006	1007	1007	12.56	31.55	0.91	11.40	28.31	10.65	1.52	12.18	2.67	75.70
1007	607			31.55			28.31		8.14	20.32	2.06	58.32
Confluence Analysis												
606	607			74.86			67.04			11.41		222.02
909	607			71.10			58.16			22.52		200.94
1007	607			31.55			28.31			20.32		298.52
607	**607**			**177.50**			**153.51**			**20.32**		**298.52**
607	111			177.50			153.51	20.32	1.35	21.67	1.98	304.65
Confluence Analysis												
110	111			216.01			152.92			30.04		504.87
607	111			177.50			153.51			21.67		486.40
111	**111**			**393.51**			**306.42**			**30.04**		**504.87**
								Watershed lag (0.6Tc) =		18.02		

$Q = CIA$

C - runoff coefficient
I - rainfall intensity in in/hr as a function of Tc
A - drainage area in acres

Frequency Event: 100 Year

U/S Node	D/S Node	Area #	Acre	∑ A	"C"	CA	∑ CA	Ti (min)	Tt (min)	Tc = Ti + Tt	I (Tc)	Q =(∑CA)I
100	101	101	0.49	0.49	0.68	0.33	0.33	8.15		8.15	3.73	1.24
101	102	102	0.45	0.94	0.65	0.29	0.63		1.26	9.41	3.52	2.21
200	201	201	0.40	0.40	0.67	0.27	0.27	6.41		6.41	4.05	1.09
201	102	202	0.40	0.79	0.69	0.27	0.54		0.98	7.39	3.87	2.10
Confluence Analysis												
100	102			0.94			0.63			9.41		4.12
200	102			0.79			0.54			7.39		3.84
102	**102**			**1.74**			**1.17**			**9.41**		**4.12**
102	103	103	1.80	3.54	0.66	1.18	2.35		1.14	10.55	3.36	7.90
103	104	104	3.80	7.33	0.68	2.57	4.92		0.93	11.48	3.25	16.00
104	305	105	3.11	10.44	0.75	2.33	7.25		3.17	14.64	2.89	20.95
300	301	301	0.61	0.61	0.68	0.41	0.41	6.34		6.34	4.07	1.68
301	302	302	0.47	1.07	0.56	0.26	0.67		0.42	6.76	3.97	2.67
302	303	303	1.09	2.16	0.62	0.67	1.35		0.09	6.85	3.96	5.33
303	304	304	2.10	4.26	0.62	1.29	2.64		0.81	7.66	3.81	10.06
304	305	305	2.52	6.79	0.64	1.61	4.25		1.97	9.63	3.49	14.84
400	401	401	0.31	0.31	0.71	0.22	0.22	7.48		7.48	3.85	0.85
401	402	402	0.31	0.62	0.73	0.22	0.45		0.79	8.27	3.70	1.65
402	403	403	0.59	1.21	0.63	0.37	0.82		1.38	9.65	3.49	2.86
403	305	404	0.73	1.94	0.70	0.51	1.33		1.71	11.35	3.27	4.36
Confluence Analysis												
104	305			10.44			7.25			14.64		37.09

300	305			6.79			4.25			9.63		32.31
400	305			1.94			1.33			9.65		29.76
305	**305**			**19.17**			**12.83**			**14.64**		**37.09**
305	105			19.17			12.83		0.12	14.76	2.88	37.00
500	501	501	1.09	1.09	0.62	0.68	0.68	12.00		12.00	3.19	2.17
501	502	502	1.08	2.18	0.64	0.70	1.38		0.79	12.80	3.09	4.26
502	503	503	2.18	4.35	0.63	1.36	2.74		1.38	14.17	2.94	8.04
503	105	504	1.94	6.29	0.73	1.41	4.15		1.71	15.88	2.78	11.51
Confluence Analysis												
305	105			19.17			12.83			14.76		47.70
503	105			6.29			4.15			15.88		47.13
105	**105**			**25.46**			**16.98**			**14.76**		**47.70**
105	106	106	23.30	48.77	0.62	14.34	31.32		1.96	16.72	2.70	84.60
106	107	107	22.80	71.56	0.71	16.09	47.41		2.20	18.92	2.54	120.38
107	108	108	58.53	130.09	0.63	36.75	84.16		0.20	19.12	2.52	212.38
108	109	109	70.24	200.33	0.79	55.43	139.59		4.64	23.75	2.25	313.46
109	110	110	15.68	216.01	0.85	13.33	152.92		2.91	26.67	2.11	323.22
110	111			216.01			152.92		2.60	29.26	2.00	305.17
600	601	601	1.00	1.00	0.87	0.87	0.87	5.00		5.00	4.44	3.86
601	602	602	0.97	1.97	0.88	0.85	1.72		0.85	5.85	4.19	7.20
602	603	603	1.92	3.88	0.87	1.66	3.38		1.31	7.16	3.90	13.17
603	604	604	3.63	7.51	0.85	3.09	6.47		2.32	9.48	3.51	22.71
604	605	605	4.45	11.96	0.94	4.16	10.64		1.72	11.20	3.29	34.96
700	701	701	0.86	0.86	0.95	0.81	0.81	6.58		6.58	4.01	3.26
701	702	702	0.85	1.70	0.95	0.80	1.62		2.95	9.53	3.50	5.66
702	703	703	1.09	2.80	0.95	1.04	2.66		0.52	10.06	3.42	9.10
703	704	704	1.25	4.05	0.95	1.18	3.84		1.24	11.29	3.28	12.58
704	705	705	6.72	10.76	0.93	6.27	10.11		0.13	11.42	3.26	32.97
705	605			10.76			10.11			11.42	3.13	31.61

Confluence Analysis												
600	605			11.96			10.64			11.20		65.96
700	605			10.76			10.11			11.42		64.85
605	**605**			**22.72**			**20.75**			**11.20**		**65.96**
605	606	606	8.56	31.28	0.94	8.01	28.76	11.20	3.41	14.62	2.89	83.15
800	801	801	0.42	0.42	0.85	0.36	0.42	8.57		8.57	3.64	1.52
801	802	802	0.43	0.85	0.85	0.37	0.79		1.31	9.88	3.45	2.72
802	803	803	0.82	1.67	0.91	0.74	1.53		0.29	10.17	3.41	5.21
803	804	804	1.10	2.77	0.94	1.03	2.56		1.21	11.39	3.26	8.36
804	805	805	1.41	4.18	0.88	1.25	3.81		1.30	12.69	3.11	11.85
805	806	806	4.08	8.26	0.93	3.78	7.59		1.13	13.81	2.98	22.58
806	807	807	6.18	14.44	0.84	5.21	12.80		2.13	15.95	2.77	35.46
807	808	808	8.26	22.70	0.90	7.40	20.20		1.49	17.44	2.65	53.57
808	606	809	11.90	34.60	0.86	10.22	30.42		1.29	18.73	2.56	77.81
Confluence Analysis												
605	606			31.28			28.76			14.62		143.88
800	606			34.60			30.42			18.73		151.36
606	**606**			**65.88**			**59.18**			**18.73**		**151.36**
606	607	607	8.98	74.86	0.88	7.86	67.04	18.73	1.72	11.20	2.37	159.03
900	901	901	0.74	0.74	0.85	0.63	0.74	10.00		10.00	3.43	2.55
901	902	902	0.74	1.48	0.85	0.63	1.37		0.68	10.67	3.36	4.59
902	903	903	1.46	2.94	0.85	1.24	2.61		0.79	11.47	3.25	8.50
903	904	904	1.07	4.01	0.85	0.91	3.52		1.55	13.01	3.07	10.81
904	905	905	3.93	7.94	0.86	3.37	6.89		0.85	13.87	2.97	20.46
905	906	906	8.32	16.26	0.86	7.11	14.01		1.30	15.17	2.85	39.94
906	907	907	14.21	30.47	0.86	12.19	26.20		1.10	16.27	2.74	71.82
907	908			30.47			26.20		2.17	18.44	2.59	67.78
908	909	909	24.75	55.22	0.78	19.39	45.58		0.88	19.31	2.51	114.38
909	607	910	15.88	71.10	0.79	12.58	58.16		2.56	21.88	2.35	136.90

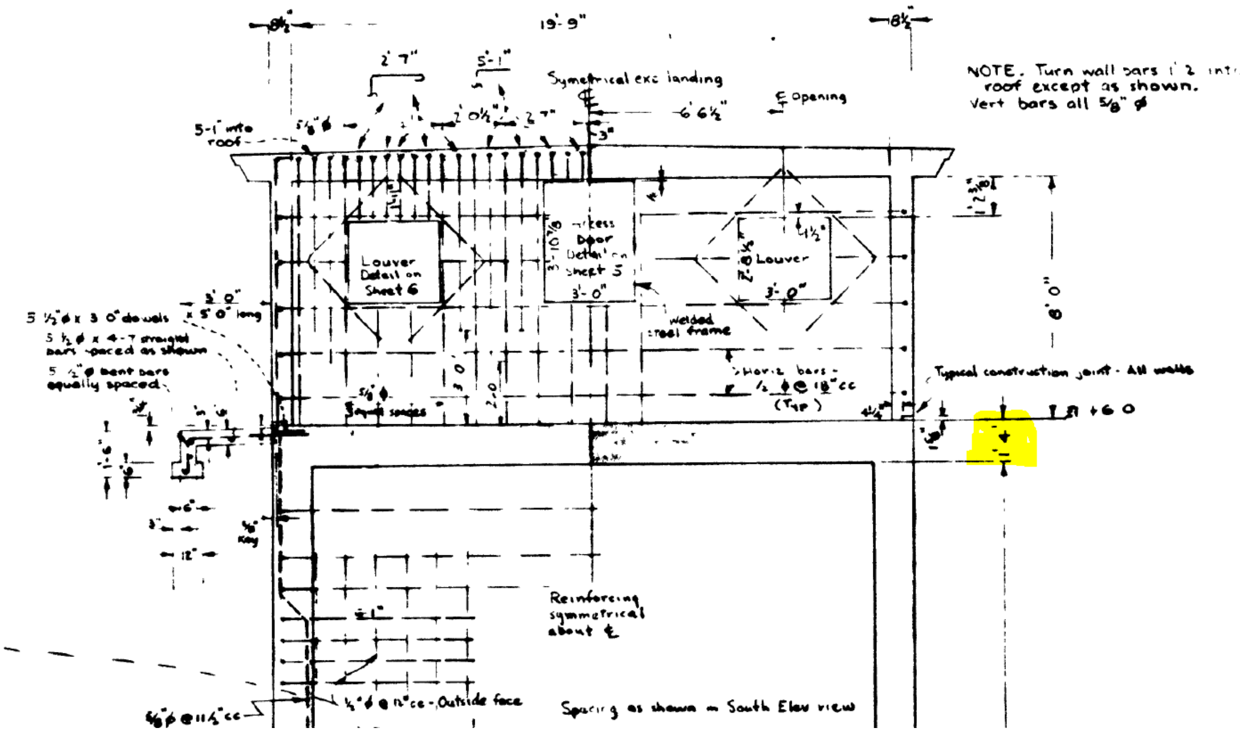
1000	1001	1001	0.26	0.26	0.90	0.23	0.26	5.00		5.00	4.44	1.14	
1001	1002	1002	0.31	0.56	0.90	0.28	0.53		1.55	6.55	4.01	2.14	
1002	1003	1003	0.68	1.24	0.90	0.61	1.14		0.49	7.05	3.92	4.49	
1003	1004	1004	0.88	2.13	0.90	0.79	1.94		0.05	7.10	3.90	7.57	
1004	1005	1005	1.74	3.87	0.92	1.59	3.53		1.54	8.64	3.63	12.83	
1005	1006	1006	4.04	7.90	0.87	3.50	7.04		1.54	10.18	3.40	23.95	
1100	1101	1101	0.52	0.52	0.89	0.46	0.52	5.69		5.69	4.25	2.19	
1101	1102	1102	0.51	1.02	0.88	0.44	0.96		2.16	7.85	3.78	3.63	
1102	1103	1103	1.08	2.11	0.86	0.93	1.89		0.24	8.10	3.74	7.05	
1103	1104	1104	1.50	3.60	0.90	1.34	3.23		0.43	8.52	3.65	11.81	
1104	1105	1105	1.73	5.33	0.89	1.54	4.77		0.65	9.18	3.55	16.94	
1105	1106	1106	4.46	9.79	0.88	3.93	8.70		0.15	9.33	3.53	30.70	
1106	1006	1107	1.29	11.08	0.91	1.17	9.87		1.23	10.56	3.36	33.20	
Confluence Analysis													
1000	1006			7.90			7.04			10.18		55.94	
1100	1006			11.08			9.87			10.56		56.86	
1006	**1006**			**18.98**			**16.91**			**10.56**		**56.86**	
1006	1007	1007	12.56	31.55	0.91	11.40	28.31	10.56	1.44	12.01	3.19	90.28	
1007	607			31.55			28.31		7.85	19.85	2.47	70.03	
Confluence Analysis													
606	607			74.86			67.04			11.20		268.67	
909	607			71.10			58.16			21.88		243.04	
1007	607			31.55			28.31			19.85		360.12	
607	**607**			**177.50**			**153.51**			**19.85**		**360.12**	← Q100
607	111			177.50			153.51	19.85	1.29	21.15	2.40	368.30	
Confluence Analysis													
110	111			216.01			152.92			29.26		611.51	
607	111			177.50			153.51			21.15		588.83	
111	**111**			**393.51**			**306.42**			**29.26**		**611.51**	
								Watershed lag (0.6Tc) =		17.56			

Supporting calculations provided 11/21/24 from City of San Diego for Pump Station H Depth

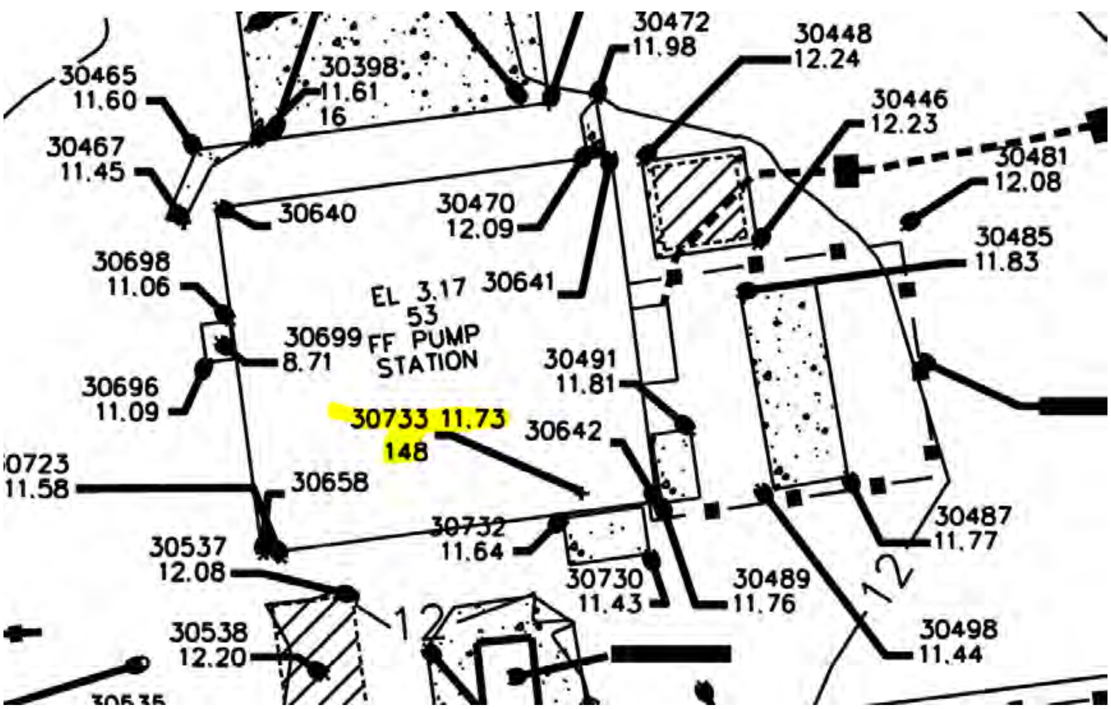
Pump Station H

Wetwell Depth Calculations During January 22nd Storm

Item 1 – Original 1956 PS-H As-Builts (3461-D) – Slab thickness is shown to be 1’4”(16”) thick.



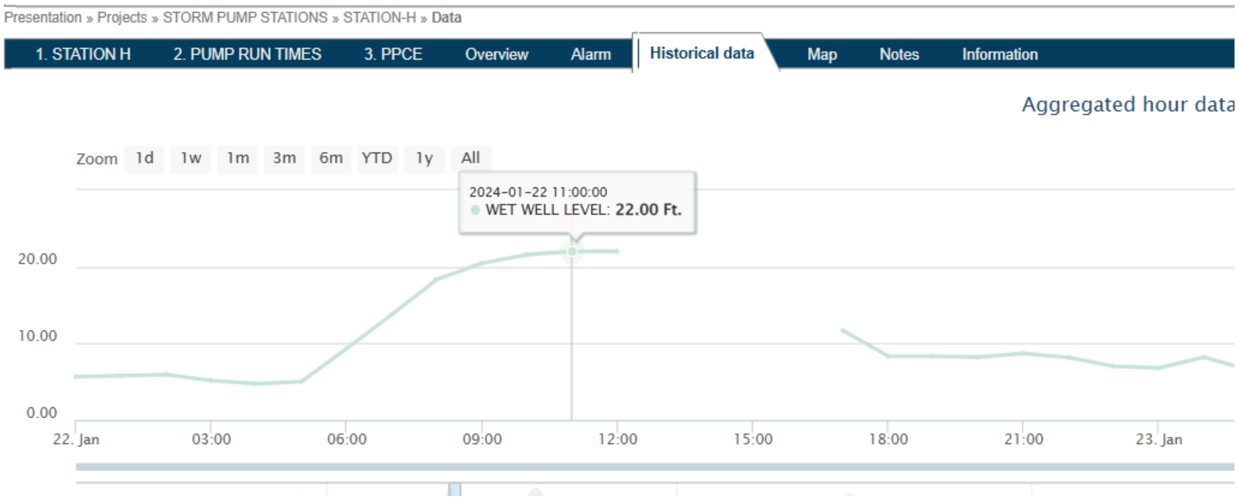
Item 2 – Nov 2022 PS-H site survey produced by O’Day Consultants. Shows FF to be 11.73’ (NGVD29)



Items 3 & 4 – Photos taken of the front entrance of PS-H showing the FF

Item 5 – Photo taken from inside wetwell. Paint markings on wall are in one foot increments measured from the bottom of the wetwell. These markings were used to calibrate the wetwell sensor. The top of the yellow painted slab is the FF of the station (station's motor room floor slab).

Items 6 & 7 – Wetwell Levels January 22nd taken from Netbiter program in graphical and direct export.



Time	Wetwell Level
1/22/2024 6:00	9.325
1/22/2024 7:00	13.766667
1/22/2024 8:00	18.333333
1/22/2024 9:00	20.466667
1/22/2024 10:00	21.583333
1/22/2024 11:00	22
1/22/2024 12:00	22
1/22/2024 17:00	11.683333
1/22/2024 18:00	8.333333
1/22/2024 19:00	8.316667

Calculations:

FF per NGVD29 O'day Survey = 11.73'

Max Depth of Water per Netbiter data = 22' (Top of wetwell/Bottom of motor room floor slab)

Thickness of slab = 1.33'

11.73' – 1.33' = 10.40' (NGVD29) approximate maximum water depth observed.

Notes:

On Jan 22nd, field crews reported that wetwell water level was reaching the bottom of the station's motor room floor slab. Wetwell level data recorded via the ultrasonic sensor from our Netbiter SCADA system confirms this claim.

However, please note that at the max wetwell depth of 22 ft, the sensor can no longer record data due to it being submerged at this point. There were no reports of the water breaching into the pump station motor room but it is still possible that the water levels exceeded the 22 ft. For these calculations, we assumed the max wetwell depth of 22 ft.

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.

PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT
MIDWAY RISING SPORTS ARENA COMPLEX
3220, 3240, 3250, AND 3500 SPORTS ARENA BOULEVARD
SAN DIEGO, CALIFORNIA 92110

Prepared for

Midway Rising LLC C/O
Zephyr Partners
700 Second Street
Encinitas, California 92024

Prepared by

GROUP DELTA CONSULTANTS, INC.
9245 Activity Road, Suite 103
San Diego, California 92126

Project No. SD760
January 17, 2024

January 17, 2024

Midway Rising LLC C/O
Zephyr Partners
700 Second Street
Encinitas, California 92024

Attention: Ryan Herrell, Executive Vice President

SUBJECT: PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT
Midway Rising Sports Arena Complex
3220, 3240, 3250, and 3500 Sports Arena Boulevard
San Diego, California 92110

Mr. Herrell:

Group Delta Consultants, Inc. (Group Delta) is submitting this Preliminary Geotechnical Investigation Report to support the preparation of the California Environmental Quality Act documentation and to provide preliminary recommendations for design and construction. Group Delta prepared this report per the referenced proposal (Group Delta, 2022). This report is a final version for the Specific Plan and Tentative Map submittal.

We appreciate the opportunity to support this project. Please contact us with questions or comments, or if you need anything else.

GROUP DELTA CONSULTANTS

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EXECUTIVE SUMMARY

Group Delta Consultants, Inc. (Group Delta) is submitting this report to support the initial phases of the redevelopment of the 50-acre Pechanga Sports Arena site. Midway Rising LLC proposes a new arena, entertainment plaza, hotel, six blocks of residential housing, and park space. The redevelopment plans to raise portions of the site up to three feet.

Group Delta managed advancing eight borings and eight cone penetration tests to depths ranging from 20 to 120 feet with laboratory testing of soil samples collected from the borings. Group Delta interpreted the field and laboratory data, and then conducted engineering analyses to prepare this report with our findings, conclusions, and recommendations.

Geologically young, loose, and soft soils associated with the changing coastline and the growth of the San Diego River Delta underlie the site. Undocumented fill underlain by paralic estuarine deposits extend from the ground surface to depths ranging from about 100 to 105 feet. Due to an abrupt change in apparent density and soil type at depths of about 60 feet, these deposits are subdivided into *upper* and *lower* paralic estuarine deposits. Sandstone and conglomerate mapped as old paralic deposits occur below the paralic estuarine deposits.

Groundwater depths range from 6 to 16 feet and fluctuate from tidal influences. Underground obstructions consist of the piles supporting the Pechanga Arena, utilities, remnant building foundations, and a historic dump site.

The fill and upper paralic estuarine deposit soils are highly compressible and possess a low shear strength. The observed presence of mica, organics, and/or seashells can adversely influence the geotechnical engineering characteristics of these deposits. The lower paralic estuarine deposit soils are less compressible and gain shear strength with depth. The sandstone and conglomerate old paralic deposits possess a very high shear strength and a very low compressibility.

The primary geologic hazard is liquefaction of the upper paralic estuarine deposit soils during an earthquake. The most likely secondary effect of liquefaction is settlement. Liquefaction requires site response analyses to incorporate the amplification of ground motions into the seismic design of structures. Liquefaction also creates large downdrag loads on piled foundations.

Design and construction of the redevelopment will need to mitigate the potential for soil liquefaction, consider the high compressibility and low shear strength of the underlying soils, and manage a shallow groundwater level. Since the proposed buildings have high structural loads, they will require, individually or combined, ground improvement and/or deep foundations to provide satisfactory long-term performance. New underground utilities and existing underground utilities that will remain will need to consider the settlement caused from fill placement and the settlement caused by liquefaction. This report provides preliminary recommendations for design and construction and discusses geotechnical-related construction considerations known at this time.

1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical investigation by Group Delta Consultants, Inc. (Group Delta) for the redevelopment that Midway Rising LLC (Midway Rising) is proposing for the Pechanga Arena site located at 3220, 3240, 3250, and 3500 Sports Arena Boulevard in the City of San Diego, California. Figure 1, Site Location Map, shows the regional location of the project site.

The purposes of this report are to: 1) provide geologic and geotechnical information to support the preparation of the California Environmental Quality Act (CEQA) documentation, 2) provide preliminary geotechnical recommendations for design and construction, and 3) discuss the geotechnical-related construction considerations known at this time. Revisions may be needed for changes to the redevelopment, the detailed design phase, and changes in expected construction processes and/or subsurface conditions exposed during construction.

Group Delta developed the recommendations using information from a previous geotechnical desktop study report (Group Delta, 2023), recent subsurface exploration and laboratory testing, geotechnical engineering interpretation and analyses, and our previous experience.

1.1 Scope of Services

Group Delta prepared this report per the referenced proposal (Group Delta, 2022). We provided the following scope of services.

- A field investigation consisting of eight borings and eight cone penetrometer tests to depths ranging from 20 to 120 feet. Figure 2 shows the approximate locations of these explorations. Appendix A provides relevant information.
- Geotechnical laboratory testing of soil samples collected from the borings. Appendix B provides the test results.
- Interpretation of the field and laboratory data and engineering analyses. Appendix C provides additional information.
- Preparation of this report with our findings, conclusions, and recommendations.

1.2 Site Description

The 50-acre site is located north of Sports Arena Boulevard and south of Kurtz Street in the Midway District of the City of San Diego. The existing Pechanga Arena and surrounding surface parking occupies most of the site. Low rise retail and commercial buildings occupy the eastern and western portions of the site. Interstate 8 and the San Diego River levees are north of the site. The sides of the levee channel are armored with riprap with fill embankments ranging from 16 to 18 feet high (Group Delta, 2015).

The elevation of the site ranges from about 7.5 feet to 15 feet, NGVD 29 (Project Design Consultants, 2023). The highest elevations surround the existing Pechanga Arena. The lowest elevations are in the northwest area of the site.

1.3 Project Description

Midway Rising proposes to redevelop the site with a new arena, entertainment plaza, hotel, and six blocks of residential housing. The blocks of housing will be residential over parking, residential over retail and parking, and residential over retail that will surround parking. The redevelopment will include several types of parks. We have based our understanding of the redevelopment on the Midway Rising Specific Plan (City Thinkers, Safdie Rabines, OJB and PDC/Bowman; 2023), the Tentative Map for Midway Rising (PDC, 2023), and the information described below.

The redevelopment earthwork proposes a minimum building pad elevation of 10 feet, NGVD 29 to accommodate flooding (Project Design Consultants, 2023). Project Design Consultants estimate this earthwork could require 20,000 to 30,000 cubic yards of fill to raise portions of the site up to three feet to achieve the proposed building pad elevation.

The residential housing may be 8 to 12 story structures consisting of five stories of wood framing over three stories of cast-in-place reinforced concrete with column loads of 750 kilopounds (kips) or twelve stories of post-tensioned concrete with column loads of 1,700 kips (KPFF, 2023). We understand from preliminary communication with Walter P. Moore the new sports arena could have column loads ranging from 100 to 1,000 kips. Basements and below grade parking are not proposed as part of the development.

1.4 Prior Geotechnical Studies

Several geotechnical engineering investigations have been completed at the site and nearby. Group Delta reviewed these studies and prepared a Geotechnical Desktop Study Report (Group Delta, 2023). We have incorporated relevant information into the findings presented in this report.

2.0 FIELD AND LABORATORY INVESTIGATION

The field investigation included a site reconnaissance and eight hollow stem/mud rotary borings and eight Cone Penetration Tests (CPT) to depths ranging from 20 to 120 feet. These explorations were completed during February and March 2023. Figure 2, Exploration Locations shows their approximate locations. Figure 2 also shows the locations of cross-sections A-A' and B-B', Figures 3A and 3B, that depict an interpretation of the subsurface conditions. Appendix A provides the exploration records and other relevant information. The scope of the field investigation complies with the recommendation for subsurface exploration provided in the Additional Geotechnical Engineering Services of the referenced Geotechnical Desktop Study Report (Group Delta, 2023).

Soil samples were collected from the borings for laboratory testing. The testing program included sieve analyses and plasticity index testing to classify the soil using the Unified Soil Classification

System and to provide data to evaluate the potential for liquefaction. Other index-type tests were completed to evaluate the soil expansion potential and corrosivity. Consolidation tests were conducted to help evaluate static settlement. Direct shear and unconfined compressive strength tests were completed to evaluate soil shear strength. The Exploration Records in Appendix A and Appendix B provide the laboratory test results.

3.0 GEOLOGY AND SUBSURFACE CONDITIONS

Geologically young, loose, and soft soils associated with the changing coastline and the growth of the San Diego River Delta underlie the site. These soils occur as fill from land reclamation and as alluvial/estuarine sediments deposited from the ancient San Diego River Delta. Old paralic deposits comprising sandstone and conglomerate underlie these soils (Kennedy and Tan, 2008). Figure 4, Geologic Map, shows the mapped limits of these geologic units relative to the site.

Prior subsurface explorations conducted at the site and nearby (Group Delta, 1999, 2019, and 2020) and the current subsurface explorations encountered undocumented fill[1] over paralic estuarine deposits. Some of these explorations encountered old paralic deposits below these soils. The following paragraphs describe these materials. Cross-sections A-A' and B-B', Figures 3A and 3B, depict an interpretation of the subsurface conditions.

3.1 Undocumented Fill

Undocumented fill soils (fill) were observed in all the exploratory borings. The soils were interpreted to range from 7 to 13 feet in thickness. The fill soils were observed to consist of clayey sand (Unified Soil Classification System - SC) and silty sand (SM) and poorly graded sand (SP). Gravel and cobbles, and construction debris were frequently observed in the upper portions of the fill. The apparent density based on drive sampler resistance was very loose to medium dense.

3.2 Paralic Estuarine Deposits

Paralic estuarine deposits were observed below the fill to elevations ranging from 3.0 to -1.0 feet NGVD 29. The soils were interpreted to extend to depths of about 100 to 105 feet. Due to an abrupt change in apparent density/consistency and soil type, these deposits were subdivided into two units referred to as the *upper* and *lower* paralic estuarine deposits described below.

3.2.1 Upper Paralic Estuarine Deposits

Upper paralic estuarine deposits were interpreted to extend to elevations ranging from about -40 to -50 feet NGVD 29, resulting in a thickness ranging from about 40 to 55 feet. These soils were observed to mostly consist of silty sand (SM), sand (SP-SM), and non-plastic sandy silts (ML) that mostly occur in 5-foot thick or less layers. An approximately 10-foot-thick layer of fat clay (CH) was

1. **Undocumented fill** is soil that has been placed and compacted with no documentation of observation and compaction testing by a geotechnical engineer.

observed from elevations -27 to -37 feet NGVD 29 within the western portion of the site.
The upper paralic deposit soils were typically observed to be dark gray to grayish black and to have mica and seashells. The soils often had a light organic odor. The apparent density and consistency based on drive sampler resistance was very loose to medium dense, and soft to stiff.

3.2.2 Lower Paralic Estuarine Deposits

Lower paralic estuarine deposits were interpreted to extend to elevations ranging from about -89 to -97 feet NGVD 29, resulting in a thickness below the upper paralic deposits ranging from about 40 to 55 feet. These soils were observed to consist mostly of silty sand (SM), sand (SP-SM, SP), and sandy silt (ML). The apparent density based on drive sampler resistance was medium dense to very dense. These soils were typically observed to be medium to dark grey and to have some mica.

3.3 Old Paralic Deposits

Old paralic deposits were observed below the paralic estuarine deposits to the maximum depth of exploration of 120 feet. When disturbed by drilling, the old paralic deposits were observed to consist of poorly graded sand with gravel (SP) and poorly graded gravel with sand (GP). The explorations terminated in a layer of gravel and cobbles that was initially encountered at elevations ranging from -89 to -97 feet NGVD 29. The relative density based on drive sampler resistance was very dense.

3.4 Groundwater

Groundwater levels are closely related to the water surface elevation within the San Diego River and subject to tidal influences. Groundwater was measured in the various subsurface explorations at depths ranging from 6 to 16 feet that correspond to elevations of 3.0 to -4.0 feet NGVD 29. The most direct measurement of groundwater occurred in a temporary monitoring well installed in Boring A-23-013, where groundwater was measured at a depth of 7 feet that corresponds to an elevation of approximately 2 feet NGVD 29. Appendix A provides a summary of the groundwater measurements.

Groundwater levels will fluctuate from tidal influences. Daily tidal fluctuations recently measured at the nearby Quivira Basin recording station ranged from about 0.0 to 8.0 feet NGVD 29 (NOAA, 2023). The porosity of the soil should attenuate tidal fluctuations.

3.5 Underground Obstructions

In addition to the piles supporting the Pechanga Arena (Group Delta, 2023), underground utilities, remnant building foundations, and the historic dump site (Group Delta, 1999), there may be other types of underground obstructions. Typical environmental assessments, along with surface geophysical studies, potholing, and research by cultural resources specialists, such as an architectural historian, should help to locate obstructions prior to construction.

4.0 GEOLOGIC HAZARDS

The primary geologic hazard at the site requiring mitigation is liquefaction. The City of San Diego Seismic Safety Element map indicates the site lies within the "Liquefaction, High Potential – shallow groundwater, major drainages, hydraulic fills" geologic hazard category. Figure 5 reproduces this map with an outline of the site. Listed below are the geologic hazards that could affect the project followed by discussions that elaborate on these hazards.

- Strong Ground Motion
- Earthquake Surface Fault Rupture
- Liquefaction and Secondary Effects
- Seismic Compaction
- Tsunamis

4.1 Strong Ground Motion

The site could be subjected to moderate to strong ground motion from a nearby or more distant, large magnitude earthquake occurring during the expected life span of the project. Numerous regional and local faults can produce large earthquakes with magnitudes (M) 6.0 or greater. Figure 6, Regional Faults and Earthquakes Map, presents the locations of these faults and the historical earthquake epicenters recorded on them. This hazard is managed by structural design using the latest edition of the California Building Code. This report provides preliminary recommendations.

4.2 Earthquake Surface Fault Rupture Hazard

The potential for surface fault rupture is very low. No active or potentially active faults project towards the site. Surface fault rupture is displacement on a fault that occurs at the ground surface because of tectonic forces. Based on the findings from this geotechnical investigation, prior geotechnical investigations in the area, and the City of San Diego and the State of California geologic hazard mapping, the site is not underlain by an active or a potentially active fault, per the City of San Diego definitions of fault activity[2] in their Guidelines for Geotechnical Reports (City of San Diego, 2018). We have based this assessment on the following specific information.

- The California Geological Survey (CGS, 2021) maps the trace of the active Rose Canyon Fault Zone (RCFZ) approximately 4,000 feet east of the western perimeter of the site. The RCFZ is a complex system of northwest-trending, right-lateral strike-slip, steeply dipping, parallel to subparallel faults. Figure 7, Earthquake Zones of Required Investigation, La Jolla outlines the site on the CGS map of the same title relative to the RCFZ. Figure 5, San Diego Seismic Element also shows the location of the RCFZ relative to the site.

2. **Active Faults** – this class of fault has had demonstrable surface displacement during Holocene time (past 11,700 years). **Potentially Active Faults** - faults with Quaternary (2.6 million years ago) displacement, but Holocene surface displacement is indeterminate. **Inactive Faults** – pre-Quaternary faults.

- The City of San Diego Seismic Safety Element maps the trace of the Point Loma Fault approximately 1,800 feet southwest of the southwest corner of the site. This map also indicates the trace of a short unnamed fault is located approximately 1,100 feet southwest of the southwest corner of the site. The City of San Diego Seismic Safety Element map indicates these faults are "Potentially Active, Inactive, Presumed Inactive or Activity Unknown." Figure 5, San Diego Seismic Safety Element shows the locations of these faults.

4.3 Liquefaction and Secondary Effects

Liquefiable soils underlie the site. Liquefaction is the sudden loss of soil shear strength within saturated, loose to medium dense, sands, and non-plastic silts. Liquefaction is caused by the build-up of soil pore water pressure from strong ground motion during an earthquake. The secondary effects of liquefaction are sand boils, settlement, lateral spreading, and overall instability and/or permanent horizontal deformations within sloping ground. Of these, settlement should be the most likely to occur given the site surface and subsurface conditions. Liquefaction-induced settlement can cause adverse vertical deformation of the ground surface and the soils supporting shallow foundations, and it can create large downdrag loads on piles.

4.3.1.1 Liquefaction

An assessment of the potential for liquefaction triggering and an estimate of the liquefaction-induced settlement interprets the following:

- Potentially liquefiable soils occur at the design groundwater level (+3 feet NGVD 29) and extends to about 60 feet below existing grades (-50 feet NGVD 29). The liquefiable soils are predominantly silty sand (USCS Symbol SM), sand (SP-SM), and non-plastic sandy silts (ML). In the upper 40 feet below existing grades (-30 feet NGVD 29), liquefiable materials generally occur as a thick, continuous layer that is occasionally interrupted by thin layers of non-liquefiable materials less than about three feet in thickness. Below a depth of 40 feet, liquefiable materials occur in relatively thin layers (about 5-foot thick or less) that are separated by non-liquefiable materials that range from about two to ten feet in thickness.
- Estimated settlements range from 7 to 10 inches in our calculations. Differential settlement over the common 30- to 40-foot column spacing is typically estimated to be one-half to two-thirds of the total settlement. Actual settlements realized in the field following a seismic event can vary significantly from calculations. Accordingly, design total and differential liquefaction induced settlements are provided in a table in Appendix C to account for the potential variability of actual liquefaction induced settlements compared to those that were calculated as a part of this evaluation.

Appendix C summarizes the methods used to assess liquefaction triggering and estimate liquefaction-induced settlement and provides a summary of the results of the analyses.

4.3.1.2 Lateral Spreading

The potential for lateral spreading should be low because an unprotected face does not exist along the San Diego River near the site since there is a flood control levee maintained by the City of San Diego (PDC, 2023). The sides of the levee channel are armored with riprap (Group Delta, 2015). Lateral spreading is the relatively rapid, fluid-like movement that can cause large horizontal deformations within the gently sloping ground near the shoreline with an unprotected face.

4.4 Seismic Compaction

The potential for seismic compaction-induced settlement should be low. Soils prone to seismic compaction should be removed by typical site preparation earthwork. Seismic compaction is the densification from strong ground motion of loose granular soil that exist above groundwater.

4.5 Tsunamis

The potential for large waves from a tsunami to affect the site should be low. The State of California Tsunami Inundation Map (California Emergency Management Agency, 2009) indicates the site does not lie within a tsunami inundation area. Tsunamis are sea waves created by the sudden uplift of the sea floor during an earthquake. Figure 8, Tsunami Inundation Map, reproduces this map with the outline of the site shown.

The California Tsunami Inundation map indicates the existing San Diego River levees north of the site would channel a tsunami up the San Diego River channel beyond the project site. Group Delta summarized a prior geotechnical evaluation of these levees near the West Mission Bay Bridge (Group Delta, 2023).

5.0 GEOTECHNICAL ENGINEERING CHARACTERISTICS

The primary geotechnical engineering characteristics that will influence design and construction are the high compressibility and the low shear strength of the fill and upper paralic estuarine deposits. These soils extend to depths ranging from about 50 to 60 feet. The lower paralic estuarine deposits below these soils gain shear strength and become less compressible. Sandstones and conglomerate old paralic deposits underlay these materials at depths ranging from about 100 to 105 feet. The geotechnical engineering characteristics of these materials should be similar to very dense sands.

The presence of mica, organics, and/or seashells observed in the estuary environment of the site can influence the geotechnical engineering characteristics of the fill and upper paralic estuarine deposits. In particular, the presence of mica flakes in sands has been shown to reduce shear strength and alter volume change characteristics (Hight, 2002; Mundegar, 1998).

5.1 Compressible Soils

The loads imposed on the existing fill and upper paralic deposits soils from placing additional fill and using shallow foundations could generate adverse static settlement. Static settlement is the combination of short-term elastic and long-term consolidation vertical deformations. Coarse grained soils, such as sand, should settle elastically with the application of load. Fine-grained soils, such as clay, should continue to settle after the load is fully applied. Provided below are preliminary estimates:

- The total static settlement from the placement of about 3 feet of fill is estimated to range from about 1.5 to 2.5 inches. The duration for this settlement to be substantially complete is estimated to range from 2 months, to up to 12 months, after the completion of the fill placement. This substantial variability stems from a thick fat clay layer that underlies the western portion of the site, which is estimated to take significantly longer to reach substantial completion than the eastern portion of the site. A test fill as described in the *Construction Considerations* section of the report should be considered in this area.
- The total static settlement from a 10- by 10-foot spread footing designed using an allowable bearing pressure of 1,000 pounds per square foot (psf) is estimated to be one inch or less. Differential settlement could range from one-half to two-thirds of the estimated total settlement over a typical horizontal column spacing of 30 to 40 feet. The duration for this settlement to be substantially complete is estimated to be one month or less from the initial loading.

Appendix C summarizes the methods used to estimate settlement and provides a summary of results of the analyses.

5.2 Soil Shear Strength

Direct measurement and typical geotechnical correlations indicate the fill and upper paralic deposits possess relatively low shear strength. This low shear strength precludes using shallow foundations except where a structure can be economically designed using a relatively low allowable bearing pressure and it can accommodate the settlement estimated from static loads and liquefaction per ASCE 7-16. Appendix C provides plots of soil shear strength versus elevation.

5.3 Expansive Soils

Expansive soils are clays that are prone to shrinking or swelling with decreases or increases in moisture content. Near surface soil samples exhibited a “very low” to ‘low” potential for expansion when tested per ASTM D4829. Construction may encounter expansive soils in the fill due to the uncontrolled method of placement. Appendix B provides the laboratory test data.

5.4 Corrosive Soils

A screening level qualitative assessment of the general degree of corrosivity to underground ferrous metals and concrete using the results of laboratory tests on soil samples indicates the potential for increased corrosivity below groundwater because of the influence of seawater. Findings from the pH, resistivity, sulfate, and chloride laboratory test results are summarized below. Appendix B provides the test results.

GENERAL DEGREE OF CORROSIVITY

Soil Condition	pH	Resistivity	Chloride	Sulfate
Above Groundwater [1]	Negligible	Moderate	Negligible	Negligible
Below Groundwater	Negligible	Severe	Severe	Severe

1. May vary considerably due to the uncontrolled nature of the placement of fill.

The above assessment refers to commonly published guidance such as Caltrans (2022) and NACE International (1989). A corrosion consultant should be contacted for specific recommendations.

6.0 CONCLUSIONS

The project site is geotechnically suitable for the proposed redevelopment. The proposed redevelopment should not adversely affect adjacent properties and right-of-way. These conclusions consider that design and construction will need to mitigate the potential for soil liquefaction, consider the high compressibility and low shear strength of the underlying soils, and manage a shallow groundwater level. The primary geotechnical conclusions are provided below.

- Undocumented fill that is underlain by upper paralic estuarine deposits extend from the ground surface to a depth of about 60 feet. These soils were observed to consist mostly of silty sand (USCS Symbol SM), sand (SP-SM), and non-plastic sandy silt (ML). An approximately 10-foot-thick layer of fat clay (CH) was observed at depths of about 40 to 50 feet within the western portion of the site.
- The fill and upper paralic estuarine deposit soils are highly compressible and possess a low shear strength. The observed presence of mica, organics, and/or seashells can also influence the geotechnical engineering characteristics of these deposits. These soils are liquefiable. The liquefaction-induced settlement was estimated to be from 7 to 10 inches.
- Below the upper paralic estuarine deposits are soils referred to as lower paralic estuarine deposits that extend from the ground surface to depths of about 100 to 105 feet. These soils were observed to consist of silty sand (SM), sand (SP-SM, SP) and sandy silt (ML).
- The apparent density of the lower paralic estuarine deposits soils increases and therefore they become less compressible, gain shear strength, and are not considered liquefiable.
- Sandstone and conglomerate old paralic deposits occur below the paralic estuarine deposits. The disturbed old paralic deposits were observed to consist of poorly graded sand with gravel (SP) and poorly graded gravel with sand (GP). The apparent density of these material is very dense. They have very high shear strength and very low compressibility.
- Observed groundwater levels range from 6 to 16 feet below the existing ground surface. Groundwater levels fluctuate from tidal influences.
- Underground obstructions consist of the piles supporting the Pechanga Area (Group Delta, 2023), utilities, remnant building foundations, and a historic dump site (Group Delta, 1999).
- The buildings proposed for the redevelopment have high structural loads that will require, individually or combined, ground improvement and/or deep foundations to provide satisfactory long-term performance. Settlement of the fill placed to raise the site will influence design and construction of the infrastructure, such as underground utilities.

The remainder of this report presents recommendations for civil and structural design and earthwork construction. These recommendations are based on empirical and analytical methods typical of the standards of practice in southern California and San Diego area construction methods. They consider our current understanding of the project design. Revisions may be needed for changes to the redevelopment, the detailed design phase, and changes in expected construction processes and/or subsurface conditions exposed during construction. If these recommendations do not address a specific feature Group Delta can prepare revisions.

7.0 GROUND IMPROVEMENT AND EARTHWORK CONSTRUCTION RECOMENDATIONS

7.1 Ground Improvement

Considering prior projects nearby, Vibro-Replacement Stone Columns and Deep Soil Mixing should be the most likely types of ground improvement to allow for conventional shallow foundations (Group Delta, 2023). The purposes of ground improvement are to:

- Mitigate soil liquefaction and secondary effects, such as settlement and pile downdrag.
- Increase the Site Class for seismic design to reduce seismic demands on the structures.
- Increase the allowable bearing pressure and reduce the static settlement.

Geotechnical and Structural Engineers should develop performance objectives for the ground improvement. A Ground Improvement Specialty Contractor should select the type of ground improvement and design it to meet the performance objectives considering the soil and groundwater conditions and the potential for soil liquefaction. A pilot study is often an early construction activity to confirm the final design. The Geotechnical Engineer should develop a project-specific specification with vetting by the project team to procure the design and construction of ground improvement.

For preliminary planning purposes, the ground improvement needed to fully mitigate soil liquefaction and secondary effects and increase the Site Class for seismic design would extend to a depth of about 60 feet below existing grades (-50 feet NGVD 29) and be installed at least 20 feet horizontally outside of the plan limits of the structure to be protected from liquefaction.

7.2 Earthwork

Earthwork should consist of demolition and removal of existing structures and abandoned utilities, removal of existing soils as recommended in this report, replacement and recompaction of the removed existing soils with soils that are suitable for reuse as recommended in this report, and the placement and compaction of new fill to raise the site. Earthwork should also consist of importing soils needed to raise the site, installing new underground utilities, and excavating and exporting soils generated from ground improvement and piling that will mostly occur below groundwater.

Earthwork should be conducted per the current applicable requirements of the City of San Diego, the California Building Code, and the project specifications (that will be prepared). This report provides recommendations for specific aspects of the earthwork, which may need to be revised based on the conditions observed during construction.

7.2.1 General Site Preparation

General site preparation should begin with the removal of deleterious materials, such as landscaping and topsoil; demolition debris, such as existing structures, foundations, concrete slabs, and asphalt concrete that are not recycled as new construction materials; and expansive soils

(Expansive Index greater than 50). Areas disturbed by demolition should be restored with a subgrade that is stabilized to the satisfaction of the Geotechnical Engineer.

Piles below the existing Pechanga stadium should be cut down at least 5 feet below the lowest planned excavation for utilities or other infrastructure requiring excavation. In areas where no excavations are planned, the piles should be cut down at least 5 feet below finish grade. The cut off portion of the pile should be disposed of offsite.

Existing subsurface utilities that will be abandoned should be removed and the excavations backfilled and compacted as recommended in this report. Alternatively, abandoned pipes may be grouted using a two-sack sand-cement slurry under the observation of the Geotechnical Engineer.

Areas to receive fill should be scarified 12 inches and recompacted to 90 percent or more of the maximum dry density based on ASTM D1557. In areas of saturated or “pumping” subgrade, a bi- or tri-axial geogrid may be placed directly on the excavation bottom, and then covered with at least 12 inches of ¾-inch aggregate base. Once the subgrade is firm enough to attain compaction in the aggregate base, the remainder of the excavation may be backfilled. It may be necessary to place additional aggregate base to stabilize the subgrade sufficiently to place fill. The placement of the geogrid and aggregate base should also follow the specific installation guidelines from the manufacturer of the geogrid. Note that it may be necessary to use crushed rock (¾-inch) completely wrapped in filter fabric (Mirafi 140N, or approved equivalent) where stabilization occurs at elevations where groundwater may rise to in the future (tidally or long term).

7.2.2 Remedial Earthwork

Remedial earthwork that requires removing existing soils and replacing them with properly processed and recompacted soils is recommended prior to placing new fill, structures, slabs-on-grade, roadways, and exterior surface improvements. The purposes of remedial earthwork are to:

1. Provide a uniform surface to place fill or to construct new surface improvements due to the uncontrolled nature of the existing fill soils.
2. Allow for observation of unsuitable soils (clayey, wet, loose) in the exposed subgrade.
3. Reestablish subgrades that are disturbed by the ground improvement operations (if adopted).

The soils removed from remedial earthwork may be recompacted provided it is processed as recommended in the *On-Site Soils and Materials Management* section of this report. The existing soils should be removed and replaced with compacted fill to a depth that is three feet below:

1. The existing surface levels (following removal of existing hardscaped surfaces) in proposed fill areas or in areas where minimal grade changes are proposed.
2. The proposed subgrade levels in cut areas.
3. The grade from which ground improvement has been performed.

The recommendation does not consider the following factors that could increase the depth of soil removal:

- Some areas may require additional soil removal considering the disturbance caused by demolition or removal of contaminated soils.
- The undocumented fill soils may possess increased physical variability and consequently increase the need for deeper removal.
- The variability inherent in native subgrades where there may be loose and/or soft areas.
- The findings from additional subsurface exploration and/or observations by the Geotechnical Engineer during earthwork.
- Planned hardscape, graded paths, pavements, concrete slabs, and structural improvements in the park sites could require additional removal for subgrade preparation.

The level of groundwater during remedial earthwork may hinder the ability to achieve the recommended depth of soil removal. The Geotechnical Engineer can provide specific guidance, if and where this condition occurs.

7.2.3 Fill Placement and Compaction

All fill and backfill should be placed at slightly above optimum moisture content using equipment that can produce a uniformly compacted product. The loose lift thickness should be 8 inches, unless performance observed and testing during earthwork indicates a thinner loose lift is needed, or a thicker loose lift is possible, up to a loose lift thickness of 12 inches. The recommended relative compaction is 90 percent or more, or 95 percent or more as specified in Table 1, of the maximum dry density based on ASTM D1557.

A two-sack sand and cement slurry may also be used for structural fill as an alternative to compacted soil. Slurry is often useful in confined areas that may be difficult to access with typical compaction equipment. Samples of the slurry should be fabricated and tested for compressive strength during construction. A 28-day compressive strength of 100 pounds per square inch (psi) or more is recommended for the sand and cement slurry. Crushed rock (¾-inch) completely wrapped in filter fabric (Mirafi 140N, or approved equivalent) may also be used as backfill in confined areas.

7.2.4 On-Site Soils and Materials Management

The following existing soils and materials are available for processing and reuse.

- Soil
- Asphalt Concrete (AC)
- Portland Cement Concrete (PCC)

The following sections provide recommendations for processing and reuse as fill. During earthwork, soil types may be encountered by the Contractor that do not conform to those discussed within this report. The Geotechnical Engineer should evaluate the suitability of these soils for their proposed use.

7.2.4.1 Soil - Geotechnical

Most of the existing soils above groundwater should be suitable for reuse from a geotechnical standpoint. Table 1 provides material requirements for on-site soils to be used as fill. Soil excavated from below groundwater may not be suitable for reuse. Earthwork contractors may not want to use these soils due to the extra handling and processing needed to dry them for placement and compaction.

7.2.4.2 Asphalt Concrete

Existing asphalt concrete should be crushed to less than 3 inches in maximum dimension and blended with approved fill soils provided this is considered acceptable by the project environmental consultant. Existing asphalt concrete can also be recycled, reprocessed, and reused as a base course for new asphalt concrete paving. Alternatively, properly crushed asphalt concrete that is combined with crushed Portland Cement Concrete will often meet the gradation and quality criteria from Section 200-2.5 of the Standard Specifications for Public Works Construction for use as Processed Miscellaneous Base (PMB). Paving fabric could preclude reusing asphalt concrete. We did not observe this fabric in the limited opportunity for observation provided by drilling.

7.2.4.3 Portland Cement Concrete

Concrete may be crushed to less than 3 inches in maximum dimension for use as fill. It should be added to other soils to create a well graded fill material. Reinforcing steel should be removed prior to crushing the concrete. Properly crushed concrete will often meet the gradation and quality criteria from Section 200-2.4 of the Standard Specifications for Public Works Construction for use as Crushed Miscellaneous Base (CMB).

7.2.5 Import Soil

Import sources should be observed and tested by the Geotechnical Engineer prior to hauling onto the site to determine the suitability of the soils for use. For each proposed fill source, the Contractor should provide a submittal to the Geotechnical Engineer demonstrating the proposed site and materials meet the geotechnical guidelines for import and use as indicated in Table 1. The following screening tests should be performed for every 1,000 cubic yards of import, with a minimum of two sets of screening tests for each import site:

- Particle Size Distribution (ASTM D6913)
- Maximum Density (ASTM D1557)
- Expansion Index (ASTM D4829)
- Sulfate Content (ASTM D516)
- Chloride Content (ASTM D512)
- pH & Resistivity (CT 643)

The import soil testing frequency may be reduced by the Geotechnical Engineer if a long-term, steady source of import soils are used that consistently meets the requirements in Table 1.

8.0 STRUCTURAL DESIGN RECOMMENDATIONS

8.1 Seismic Design

The site classification for seismic design is Site Class F because the soils are susceptible to liquefaction and the potential for liquefaction triggering is widespread. The 2022 California Building Code and ASCE 7-16 require developing site-specific ground motions using site response analyses for Site Class F soils to capture the impact of liquefaction on the ground shaking, with one exception: relatively stiff structures with a fundamental period of 0.5-seconds or less. Structures meeting this exception may be classified as they would in the absence of liquefaction, which would be Site Class D considering the average shear wave velocity measured in the upper 100 feet at this site (602 ft/s to 688 ft/s). Site Class D may be adopted if ground improvement is completed over the entire building area to mitigate the potential for liquefaction.

For preliminary design purposes, assuming either ground improvement is performed or the exception for structures with fundamental periods of 0.5-seconds or less is met, the mapped values listed in the table below may be used for Site Class D. These are provided using the exception listed in Section 11.4.8 of Supplement 3 of ASCE 7-16, which states for structures on "Site Class D site with S_1 greater than or equal to 0.2" that a ground motion hazard analysis is not required where the mapped value of S_{M1} is increased by 50%. The parameters tabulated below were developed using the referenced ASCE 7 Hazard Tool online (ASCE, 2023).

MAPPED SEISMIC DESIGN ACCELERATION PARAMETERS (ASCE 7-16)

Design Parameters	Mapped Value
Site Latitude	32.75345
Site Longitude	-117.20699
S_S (g)	1.465
S_1 (g)	0.503
Site Class	D
F_a	1.0
F_V	1.797
T_S (sec)	0.925 [1]
T_L (sec)	8
S_{MS} (g)	1.465
S_{M1} (g)	1.356 [1]
S_{DS} (g)	0.977
S_{D1} (g)	0.904[1]

1: S_{M1} has been increased by 50% per ASCE 7-16 Supplement 3, which also impacts the value of T_S. F_V is based on Table 11.4-2.

In addition, although requirements for site response analyses at liquefiable sites remain the same in future codes (such as ASCE 7-22 and the future 2025 CBC) the general Site Classes for seismic design will change. Based on measured shear wave velocities, the site would be Site Class DE ($V_{S,30}$ between 500 and 700 ft/s) per ASCE 7-22 (ASCE, 2023). As some of the proposed structures may not be designed for some time, we are providing these values for future consideration. Note the same limitations apply – these values are only valid assuming that the structures have fundamental periods less than 0.5 seconds, or that ground improvement is completed to mitigate liquefaction. The parameters below were obtained from the ASCE 7 Hazard Tool online (ASCE, 2023).

MAPPED SEISMIC DESIGN ACCELERATION PARAMETERS(ASCE 7-22)

Design Parameters	Mapped Value
Site Latitude	32.75345
Site Longitude	-117.20699
S_S (g)	1.62
S_1 (g)	0.50
Site Class	DE
T_L (sec)	8
S_{MS} (g)	1.54
S_{M1} (g)	1.47
S_{DS} (g)	1.03
S_{D1} (g)	0.98

8.2 Shallow Foundations

Continuous strip and isolated pad footings may be used for lightly loaded buildings and other similar appurtenances where: 1) they can satisfactorily tolerate the estimated static and liquefaction-induced settlement per ASCE 7-16, or 2) it is acceptable to repair the damage caused by the settlement, and 3) they are not needed for primary ingress/egress or other essential functionality. The above recommendations assume that at least two feet below the bottom of the footing have been removed and recompacted. Strip and pad footings may be designed using the following parameters and recommendations.

- Allowable vertical bearing capacity of 1,000 pounds per square foot (psf). This parameter considers controlling static differential settlement within horizontal distances of 30 to 40 feet to ½-inch or less.
- Allowable lateral bearing capacity using an equivalent fluid weight of 250 pounds per cubic foot for footings above groundwater that are poured neat against properly compacted fill. The upper 12 inches of material in areas that are not covered with concrete slabs or pavements should not be included in the estimation of allowable lateral bearing.

- Bearing capacity and passive pressure may be increased by one-third for short term seismic and wind loads.
- Footing embedment and width as shown in Figure 9, Shallow Foundation Dimension Details.

8.3 Deep Foundations

Deep foundations use piles to transmit structure loads through the fill and upper paralic estuarine deposits that have a very low soil shear strength to the lower paralic estuarine deposits and old paralic deposits that have a high enough soil shear strength to provide geotechnical resistance. Based on the type of piles recently adopted at prior nearby projects (Group Delta, 2023), Appendix C provides preliminary recommendations for 18- and 24-inch diameter Drilled Displacement Piles (DDP). It may be necessary to adopt Auger-Cast-In-Place (ACIP) piles if larger diameters are needed to resist lateral loads.

DDP piles use a drill tool that is proprietary to the piling contractor to advance the hole and displace the soil into the ground. They do not generate significant amounts of spoil. ACIP piles use a continuous flight auger to advance the hole and remove the soil.

Driven precast concrete piles are also suitable. We have not considered them further because of the noise associated with driving and the current piling contracting industry's more prevalent use of DDP and ACIP piles.

8.3.1 Axial Capacity

The piles derive axial capacity from shaft resistance and end bearing within the lower paralic deposits and old paralic deposits. Per ASCE 7-16, no capacity is derived from the fill and the upper paralic deposits due to the potential for liquefaction. Appendix C provides downward and upward pile capacities versus embedment and the assumptions used to estimate these capacities.

8.3.2 Static Settlement

Single isolated piles loaded to the allowable axial capacities should experience less than ½ inch of total settlement. Settlement should occur when building loads are applied.

8.3.3 Downdrag

Downdrag is the downward load resulting from friction along the soil-pile interface that is generated from settlement of the soils surrounding the pile. ASCE 7-16 Section 12.13.9.3.1 states the following regarding liquefaction-induced downdrag (ASCE, 2017):

Design of piles shall incorporate the effects of downdrag caused by liquefaction. For geotechnical design, the liquefaction-induced downdrag shall be determined as the downward skin friction on the pile within and above the liquefied zone(s). The net geotechnical ultimate capacity of the pile shall be the ultimate geotechnical capacity of the below the liquefiable layer(s) reduced by the downdrag *load. For structural design, downdrag load induced by liquefaction shall be treated as a seismic load and factored accordingly.*

The Structural Engineer should include liquefaction settlement induced downdrag loads at the pile head. Piles that support buildings where fill will be placed should be installed after settlement of the underlying soils is substantially complete to avoid additional static settlement-induced downdrag loads on the piles. Appendix C provides a summary table with the recommended downdrag loads as well as downward ultimate pile capacities versus embedment that have been adjusted to account for the liquefaction induced downdrag loads.

8.3.4 Lateral Capacity

Resistance to lateral loads can be estimated using the passive soil pressure against the pile caps and grade beams above the design groundwater level and the bending resistance of the piles. The passive pressure at the pile caps and grade beams is dependent on the depth of these foundations, the allowable deflection of the structure, and the geotechnical engineering properties of the soil against these foundations. The bending resistance of a pile depends on its length, stiffness in the direction of loading, proximity to other piles, the degree of fixity at the head, the allowable deflection at the pile head, and the geotechnical engineering properties of the soil surrounding the pile. Specific recommendations and preliminary design parameters are provided in Appendix C. *Group Delta should be contacted for revised recommendations if the pile caps are deeper than stated in Appendix C. The lateral capacity is highly influenced by the depth of the pile cap relative to the depth of the potentially liquefiable soils.*

8.4 Interior Reinforced Concrete Slabs

A slab-on-grade may be adopted with: 1) confirmation of the estimated static settlement and duration using the settlement monitoring discussed in the *Construction on Compressible Soils* section of this report, 2) the removal and recompaction recommended in the *Remedial Earthwork* section of this report, and 3) the acceptance of the potential for some local repairs to the slab-on-grade from liquefaction-induced settlement discussed in the *Liquefaction and Secondary Effects* section of this report. A structural slab that does not rely on the support of the underlying soil subgrade should be adopted where all three of the above conditions cannot be met.

8.4.1 Soil Subgrade

The subgrade should be prepared as recommended in the *Remedial Earthwork* section of this report. Where expansive soils are encountered in the upper 24 inches of subgrade, which are soils with an Expansion Index greater than 20, we recommend removing and replacing them with properly compacted non-expansive soils (Expansion Index less than 20).

8.4.2 Thickness and Reinforcement

There are several chart solutions (ACI, 2006) to complete analyses to develop the slab-on-grade thickness and reinforcement. These charts use a modulus of subgrade reaction (k). We recommend using 150 pounds per cubic inch (pci) assuming the slab is underlain with compacted fill prepared as recommended in this report. Where software is used, the Geotechnical Engineer should review the specific input parameter needed and how it is applied in the software used by the Structural Engineer. A Structural Engineer should design the slab thickness, control joints, and reinforcement considering the type of support (structural or subgrade) and should conform to the requirements of the California Building Code.

8.4.3 Moisture Protection for Interior Slabs

The requirements for moisture protection should consider that the design groundwater level may be near the finished slab-on-grade/structural slab elevation. Moisture protection should comply with the requirements of the current California Building Code, American Concrete Institute (ACI 302.1R-15), and the desired functionality of the interior ground level spaces. The Architect typically specifies an appropriate level of moisture protection considering allowable moisture transmission rates for the flooring or other functionality considerations.

Moisture protection may be a “Vapor Retarder” or “Vapor Barrier” that use membranes with a thickness of 10 and 15 mil or more. ACI 302.1R-15 provides a flow chart to determine when and where these membranes should be used. Note the CBC specifies a Capillary Break, as defined and installed per the California Green Building Standards, with a Vapor Retarder.

9.0 CIVIL DESIGN RECOMMENDATIONS

9.1 Surface Drainage

Foundation and slab performance depend on how well surface runoff drains from the site. The ground surface should be graded so that water flows rapidly away from the structures and tops of slopes without ponding. The surface gradient needed to achieve this may depend on the planned landscaping. Planters and landscaped areas should be built so that water does not seep into the foundation, slab, or pavement areas. If roof drains are used, the drainage should be channeled by pipe to storm drains or discharged 10 feet or more from buildings. Irrigation should be limited to that needed to sustain landscaping. Excessive irrigation, surface water, water line breaks, or rainfall may cause perched groundwater to develop within the underlying soil.

9.2 Design Groundwater Elevation

The recommended design groundwater elevation is + 3 feet NGVD 29. This elevation may differ from groundwater levels that could be encountered during construction.

9.3 Storm Water Infiltration

Our preliminary recommendation is a “no infiltration” condition. The design groundwater elevation recommended in this report will be near to the bottom of the infiltration surface of the storm water Best Management Practices, and the site is underlain by more than 5 feet of fill, which would preclude using infiltration.

9.4 New Underground Utilities

The redevelopment will include new sewer, storm drain, water and fireline, and dry utilities. The following sections provide preliminary geotechnical recommendations.

9.4.1 Soil Loads

A soil unit weight of 130 and 68 pounds per cubic foot may be used to evaluate soil loads on pipes that are above and below the design groundwater elevation.

9.4.2 Uplift Pressures

Pipes and structures installed below groundwater will be subject to uplift pressures. Figure 10, Uplift Pressures for Underground Structures provides recommendations for calculating the groundwater uplift pressure and soil resistance to uplift for structures embedded below groundwater. The recommended factor of safety against uplift is 1.5 or more. Soil above the structure and the self-weight of the structure may be used as resistance against uplift.

9.4.3 Thrust Blocks

The passive soil pressure for the design of thrust blocks may be estimated using an equivalent fluid weight of 250 and 125 pounds per cubic foot for the portions of the thrust block that are above and below the design groundwater elevation. These passive pressures are allowable and assume a factor of safety of 1.5. The pressures are for static loading and level ground surface conditions. The upper 12 inches of material in areas without concrete slabs or pavement should not be included in the estimation of passive resistance.

9.4.4 Modulus of Soil Reaction

The modulus of soil reaction (E') characterizes the stiffness of soil backfill placed along the sides of buried flexible pipelines. To evaluate deflection due to the load associated with trench backfill over the pipe, we recommend using 600 pounds per square inch (psi) assuming granular bedding material is placed around the pipe and the bedding is above groundwater (Hartley and Duncan, 1987). We can provide specific recommendations bedding materials placed below groundwater.

9.4.5 Pipe Bedding

Typical pipe bedding as specified in the Standard Specifications for Public Works Construction or City of San Diego Standard Drawings may be used. We recommend using a filter fabric separator (such as Mirafi 140N or an approved similar product) to completely envelope the open graded rock used for bedding and/or backfill where: 1) the alignment is within roadways or near settlement sensitive improvements (e.g., structures, flatwork), 2) the bedding material is below the design groundwater elevation, or 3) the pipe diameter is larger than 18 inches. The Geotechnical Engineer may waive the filter fabric separator based on the soil conditions observed in the trench.

9.5 Existing Utilities

The permissible depth of cover and settlement tolerances should be evaluated where new fill will be placed over underground utilities that will remain. The permissible depth of cover and settlement tolerances for construction traffic and equipment loads should also be evaluated.

9.6 Settlement of Utilities

The design and construction of new underground utilities, and existing underground utilities that will remain, will need to consider the static settlement caused from fill placement and the settlement caused by liquefaction, as discussed in the following sections. These utilities may also need to consider the potential for the differential settlement that could occur between different subgrades, such as the transition at the edge of ground improvement or between a pile supported structure and unimproved ground.

9.6.1 Static Settlement

New and existing underground utilities within or below new fill will experience some time dependent settlement. For new utilities, the effect of settlement should depend on the timing of their installation following the placement of fill. The estimated long-term static settlement and their duration for substantial completion are described in the *Compressible Soils* section of this report.

The Civil Engineer should evaluate the ability of utilities to tolerate the estimated long-term settlement. Some form of mitigation will be needed if the utility cannot tolerate these settlements. Mitigation could be delaying the installation until the settlement is substantially complete, preloading the utility alignment area prior to utility installation with a fill surcharge, using lightweight fill or geofoam above the utility instead of fill soil, or using ground improvement to reduce the compressibility of the soils underlying the pipe.

9.6.2 Liquefaction-Induced Settlement

Liquefaction induced settlement could damage pipelines. Liquefaction of soils can also cause flotation where there are empty pipes (e.g., sewer and storm drains) below groundwater. *Critical* pipelines that service a large number of people or could be a substantial hazard to human life in the event of failure, and *Essential* pipelines that must remain operable at all times require mitigation to withstand the effects of liquefaction.

The Civil Engineer should identify existing and proposed pipelines that must remain in operation following a seismic event and develop mitigation. Mitigation depends on the serviceability required (e.g., Critical or Essential), pipeline function (e.g., transmission, distribution, or laterals), and pipeline materials. The Seismic Guidelines for Water Pipelines (America Lifelines Alliance, 2005) provides chart solutions that relates these factors to liquefaction-induced settlement and the type of pipeline design. To use this flow chart, differential settlement may be assumed to be in the 6 *inches < Permanent Ground Deformation (PGD) ≤ 12 inches* category.

9.7 Exterior Surface Improvements

Exterior surface improvements consist of the following types of paving surfaces:

- Asphalt concrete paving for interior streets and parking.
- Portland cement concrete paving for vehicles, fire lanes, and the truck loading areas for the arena.
- Portland cement concrete paving for pedestrian sidewalks and enhanced pedestrian concrete, such as an exposed aggregate finish.

The recommendations below apply to the above exterior surface improvements, which is followed by recommendations that are specific to each type of improvement.

- The upper 24-inches of the subgrade should consist of soils with a “Very Low” potential expansion (Expansion Index less than 20).
- The upper 12 inches of all paving subgrades should be scarified immediately prior to constructing the paving, brought to slightly above optimum moisture content, and compacted to 95 percent or more of the maximum dry density per ASTM D1557.
- Aggregate Base, where specified, should also be brought to slightly above optimum moisture content and compacted to 95 percent of the maximum dry density. Imported aggregate base should conform to Section 200-2.2, Crushed Aggregate Base (Public Works Standards, Inc., 2021). Where onsite concrete and/or asphalt are crushed to produce aggregate base for exterior surface improvements, the base should conform to Section 200-2.4, Crushed Miscellaneous Base, or Section 200-2.5, Processed Miscellaneous Base, meeting the fine grading in Table 2001-2.4.2 (Public Works Standards, Inc., 2021).
- An R-Value of 10 has been assumed for the preliminary assessment of paving surfaces (where it is part of the design methodology). Based on our review of the geotechnical data, the subgrade R-Value within the upper 36 inches of subgrade could range from 10 to 30 assuming selective placement of fill near the finished subgrade. The design subgrade R-Value should be confirmed by R-Value testing of the subgrade soils during precise grading.

9.7.1 Asphalt Concrete Pavements

Preliminary pavement sections designed in accordance with the Caltrans Design Method, Topic 633.1 (Caltrans, 2018b) are summarized in the table below. A 20-year pavement design life was assumed for the analyses.

PRELIMINARY ASPHALT CONCRETE PAVEMENT SECTIONS

Traffic Index	Asphalt Section	Base Section
5.0	3 inches	9 inches
6.0	3 inches	13 inches
7.0	4 inches	15 inches
8.0	5 inches	16 inches
9.0	6 inches	18 inches
10.0	6 inches	22 inches

Asphalt concrete should conform to Section 203-6 and should be compacted to 91 and 97 percent of the Rice density per ASTM D2041 (Public Works Standards, Inc., 2021).

9.7.2 Portland Cement Concrete Paving

9.7.2.1 Vehicular Paving

Preliminary concrete pavement sections are provided below using the simplified design procedure of the Portland Cement Association, the Caltrans Highway Design Manual, and typical sections from the City of San Diego Standard Drawings as guidelines (Caltrans, 2018; City of San Diego, 2019; PCA, 1984). The methodologies generally adopt a 20-year design life. It was assumed that aggregate interlock would be used for load transfer across control joints. The subgrade materials were assumed to provide relatively “low” support. Vehicular PCC pavements should have a minimum flexural strength (modulus of rupture) of 600 psi. Based on the assumed Traffic Index, we recommend the following preliminary vehicular PCC pavement sections.

PRELIMINARY VEHICULAR PORTLAND CEMENT CONCRETE PAVEMENT SECTIONS

Traffic Index	Concrete Section	Base Section
5.0	6 inches	6 inches
6.0 to 7.0	7 inches	6 inches
8.0	8 inches	6 inches
9.0	8.5 inches	6 inches
10.0	9 Inches	6 inches

Crack control joints should be constructed for vehicular PCC pavements on a maximum spacing of 10 feet, each way. Concentrated truck traffic areas, such as trash truck aprons and loading docks, should be reinforced with a minimum No. 4 bars on 18-inch centers, each way. Reinforcing bars should be placed mid-height within the slab.

Samples of the concrete used in the new pavement areas should be collected by a qualified materials testing firm and tested for flexural strength per ASTM D78 (or CT523) to confirm that the minimum required flexural strength is achieved.

9.7.2.2 Exterior PCC Slabs and Sidewalk Paving

Exterior PCC slabs and sidewalks subjected to pedestrian and small maintenance vehicle traffic should be at least 4 inches thick and reinforced with 6x6-W2.9/W2.9 Welded Wire Fabric or rebar consisting of No. 3 bars on 18-inch centers, each way, placed securely at mid-height of the concrete section. Crack control joints should be placed on a maximum spacing of 10-foot centers, each way, for slabs, and on 5-foot centers for sidewalks. There should be adequate construction and control joints to control cracking per the latest guidance from the American Concrete Institute (ACI), Portland Cement Association or other similar guidelines. The minimum compressive strength for exterior PCC slabs and sidewalks should conform to current City of San Diego Standard Drawings or other similar guidelines.

10.0 CONSTRUCTION CONSIDERATIONS

10.1 General

Construction of the project will need to adapt to the geotechnical conditions at the site. Summarized below are the primary geotechnical-related construction considerations known at this time, followed by more comprehensive discussions of some of these considerations.

- Shallow groundwater may require soil stabilization and/or dewatering to construct the grade beams and pile caps, and underground utilities. The groundwater and soil conditions could create loose/soft sidewalls and bottom instability that could cause difficulties installing shoring and pipe bedding.
- Grade-supported heavy equipment such as cranes or drill rigs operating near the upper surface of the loose/soft and saturated fill and upper estuarine deposits may require a granular working mat to provide adequate bearing capacity during construction.
- The construction of piles will need to manage groundwater and very loose/soft soils.
- Time-dependent static settlement following placement of new fill may require a settlement waiting period prior to construction of settlement sensitive improvements, including new structures, utilities, pavements, and flatwork.
- Ground improvement pilot studies and/or pile load tests may be particularly needed to confirm the design since the presence of mica, organics, and/or seashells can influence the geotechnical engineering characteristics of the upper paralic estuarine deposits.

- A 10-foot thick fat clay layer that underlies the western portion of the site creates a potential for substantial variability in the duration for settlement to be substantially complete. A test fill should be considered in this area.

10.2 Earthwork

10.2.1 Excavation Characteristics

Trench excavation in the soil above groundwater is expected to encounter little difficulty using modern trenching machines or backhoes in good working order. Standard heavy earthmoving equipment should be able to mass excavate soil above groundwater with little difficulty. Trench and mass excavation near groundwater should be prepared to encounter loose sands and soft clay. Much of the fill soils are cohesionless and should be considered prone to caving and/or sloughing. There may be debris in the undocumented fill, which could be resistant to excavation and/or require disposal offsite.

10.2.2 Subgrade Characteristics

Subgrade stabilization may be needed where excavation near groundwater could cause yielding or "pumping" of the subgrade. The Contractor should consider using lightweight equipment when working immediately above groundwater and should anticipate the need for stabilization of the subgrade as recommended in the *General Site Preparation* section of this report.

10.3 Temporary Excavations

10.3.1 CAL/OSHA Soil Types

Temporary slopes will be needed to install shallow underground utilities and to construct footings, pile caps and grade beams. Trench boxes and shields, or timber and hydraulic shoring may be needed for deeper installations.

Based on the data interpreted from subsurface exploration, the design of these types of temporary slopes may assume Soil Type C for planning purposes. For trench boxes and shields or timber and hydraulic shoring, CAL/OSHA recommends a lateral earth pressure equal to 80H for Soil Type C (often referred to as Soil Type C-80), subject to the proprietary aspects of the system adopted. The Contractor should note the materials encountered in construction excavations could vary significantly across the site. This assessment of Soil Type is based on preliminary classifications of soils encountered in widely spaced explorations.

The design and construction of these systems along with their maintenance and monitoring during construction is the responsibility of the Contractor. The Contractor should have their Competent Person evaluate the subsurface conditions exposed during excavation to consider permissible temporary slope inclinations, loads and other measures as required by California OSHA (CAL/OSHA, 2018). A registered Civil Engineer will need to design a temporary slope that is 20 feet, or more, in height. The Competent

Person should also observe temporary excavations at regular intervals for maintenance and evidence of potential instability.

10.3.2 Dewatering

Continuous dewatering will be needed for some of the temporary excavations. Dewatering typically targets lowering the groundwater to a level that ranges from 3 to 5 feet below the planned temporary excavation bottom.

Groundwater was measured in subsurface explorations at depths ranging from 6 to 16 feet that correspond to elevations of 3.0 to -4.0 feet NGVD 29. Groundwater levels will fluctuate from tidal influence.

Widespread lowering of the groundwater level can cause settlement of the surrounding ground.

10.4 Construction on Compressible Soils

10.4.1 Settlement Waiting Period and Monitoring

Where improvements cannot tolerate the estimated long-term settlement from fill placement presented in the *Compressible Soils* section of this report, construction should be timed to begin when the settlement is substantially complete. Settlement monuments should be installed in fill areas where construction needs to be delayed. Monitoring should be completed using fluid level settlement devices or surface monument and pipe riser settlement devices and precise surveying per CTM 112 (Caltrans, 2012). Figure 11A, Settlement Monument Details–Surface Monument and Figure 11B – Settlement Monument Details–Riser Plate depict typical instrumentation. Monitoring should be completed per CTM 112 (Caltrans 2012) daily during fill placement and weekly thereafter until the settlement is substantially complete as evaluated by the Geotechnical Engineer.

10.4.2 Test Fill Embankment

A test fill embankment could be constructed and monitored to further evaluate the magnitude of settlement and the duration for it to be substantially complete. The test fill should be located in the area of large fill placement. The embankment should not be located above or near to existing utilities or other existing settlement sensitive infrastructure. Provided below are preliminary recommendations for the test fill.

- The embankment height should be one-half of the thickness of the expected fill placement or a minimum of 10 feet. More useful data will be obtained from larger test fill heights.
- The top of the embankment should be twice the width of the earthwork equipment needed for construction, but not less than 20 feet. The embankment width must permit the equipment to pass on both sides of the settlement monument riser pipe during fill placement. If needed, the top of the settlement monument riser pipe can be set back horizontally 5 to 10 feet from the crest of the embankment slope to facilitate equipment

access. More useful data will be obtained by placing the monument near the center of the embankment.

- The embankment can be constructed with side slopes inclined at 1:1 (h:v).
- The length of the embankment should be at least 100 feet.
- The configuration of the embankment should be as-built with precise surveying. The purpose of this recommendation is to calculate the embankment surcharge loading.
- The subgrade should be prepared as recommended in the *Site Preparation* section of the report. The lift thickness and compaction should be as recommended in the *Fill Placement and Compaction* section of this report. The purpose of this recommendation is to provide data to estimate the fill soil unit weight to calculate the embankment surcharge loading.
- There should be three settlement monuments. One monument should be in the center of the long axis of the embankment with the other two on either side of the center monument.
- Monitoring should be completed per CTM 112 (Caltrans, 2012). There should be daily monitoring during formation of the embankment and weekly monitoring thereafter until the settlement is substantially complete, as evaluated by the Geotechnical Engineer.

10.5 Pile Installation

10.5.1 Subsurface Conditions

The Piling Contractor that will install the planned Drilled Displacement piles should adopt methods that are suitable for installation through loose and soft soils below groundwater. Coring or similar means could be needed to install piles where underground obstructions are encountered. The Piling Contractor should independently review the exploration logs in this report to assess pile installation conditions. Any surface geophysical data, pot holing, as-built plans, and other similar information should be provided to the Piling Contractor.

10.5.2 Load Testing

Pile load testing should be adopted since the capacity analyses can be highly dependent on the assumptions regarding the method of installation. Drilled Displacement piles use a drill tool that is often proprietary to the Piling Contractor. Shaft resistance can vary substantially between different drill tools and grout pressures.

An Advance Pile Load Test (APLT) program is often completed where there is a desire to obtain additional information to further assess axial pile capacities and potentially reduce pile lengths; trial the method of pile installation for specific subsurface conditions; and establish production parameters such as drilling penetration rates, torque, and downward thrust. APLTs typically include strain gauges installed at various levels to interpret shaft resistance and end bearing. The

Geotechnical Engineer can provide guidance on the depth intervals for strain gauges and the pile test load. APLTs are typically completed on sacrificial piles.

Verification Production Pile Load Tests (VPLT) should be completed on the production piles. They may be one to two test piles, or a percentage of the production piles, depending on the size and sequencing of pile construction.

Pile load tests should be completed per the latest version of ASTM Standard D1143 / D1143M, Standard Test Methods for Deep Foundations Under Static Axial Compressive Load. The pile test load should include the liquefaction-induced downdrag load and account for the shaft resistance to be neglected in the undocumented fill and upper paralic estuarine deposits. The test piles should be installed using the same methods that would be used for production piling. An automated monitoring system should be used to monitor construction of the test piles. This same monitoring system should be used on all production piles to establish that construction of the test and production piles are similar, and that production piles will achieve performance that is the same as the test piles. The latest version of ASTM Standard D4945, Standard Test Method for High-Strain Dynamic Testing of Deep Foundations may be considered for VPLTs.

10.5.3 Construction Quality Control

Construction quality control should follow typical industry guidance, such as presented in Geotechnical Engineering Circular No. 8, Design and Construction of Continuous Flight Auger Piles (FHWA, 2007). Guidance is provided for observing pile installation and maintaining construction records, materials testing, nondestructive testing to evaluate pile integrity, and the determination and treatment of unsatisfactory piles. The Contractor should submit a pile load test plan and a production pile installation plan, which should be reviewed by the Geotechnical Engineer and Structural Engineer. There should be full time observation of pile construction by the Geotechnical Engineer along with automated monitoring of drilling and grouting.

10.6 Geotechnical Services During Construction

Geotechnical services during construction are anticipated to consist of the following activities:

- Continuous onsite observation and compaction testing by a Geotechnical Technician during earthwork with associated laboratory testing (e.g., compaction curves, physical and engineering properties of engineered fill and import soils, confirming R-Value tests).
- Full- and part-time observation and compaction testing by a Geotechnical Technician as needed during the backfill of underground utility trenches, the preparation of pavement subgrade and aggregate base, and the placement of asphalt concrete. Full time observation is needed when trench excavations are too deep to safely enter for compaction testing.
- Continuous observation of ground improvement pilot studies or pile load tests, and the production installation of ground improvement and piles by a Geotechnical Engineer.

- Observation by a Geotechnical Technician to observe that remedial grading removal bottoms extend to the correct depth and bearing strata is suitable.
- Observation by a Geotechnical Technician to observe that shallow foundation excavations have the correct plan dimensions and extend to the correct depth and bearing strata is suitable.
- Evaluation of settlement monitoring data by a Geotechnical Engineer. For this activity, the Geotechnical Engineer should be provided with timely copies of all survey monitoring data.
- Consultation by the Geotechnical Engineer for unforeseen conditions, responding to Requests for Information and Submittals, and attending construction coordination meetings.
- Preparation of an As-Built Geotechnical Report.

11.0 ADDITIONAL GEOTECHNICAL SERVICES

Development of the project will require further geotechnical services that are anticipated to consist of the following tasks:

- Conducting Site-Specific Probabilistic Seismic Hazard Analysis using site response analysis per the current version of the CBC and ASCE 7 to capture the impact of liquefaction on the ground shaking.
- Installing and measuring groundwater in monitoring wells to record the impact of daily tidal fluctuations and the seasonal variations of groundwater to better inform the recommended design groundwater level for the site.
- Completing additional cone penetration tests and geotechnical borings for changes in the redevelopment layout and as needed for the final design.
- Providing geotechnical consulting during the design development, construction document and permitting phases of the project.
- Preparing a project-specific specification with the site geotechnical information and design criteria to procure the design and construction of ground improvement.
- Preparing or supporting the preparation of geotechnical-specific construction specifications (e.g., earthwork, deep foundations).
- Reviewing the civil, structural, landscaping, and architecture (waterproofing only) plans for compatibility with the recommendations provided in the geotechnical report.
- Responding to comments by the reviewing agencies.
- Updating and finalizing this geotechnical report as needed to address changes in design, to obtain permits, and/or address comments from reviewing agencies.

12.0 LIMITATIONS

The recommendations in this report are subject to revisions for changes to the design and to accommodate changes in expected construction processes and/or subsurface conditions exposed during construction. Group Delta needs to continue to be part of the project design and construction for these recommendations to remain valid. If another geotechnical consultant provides these services, they should prepare a letter indicating their intent to assume the responsibilities of the project Geotechnical Engineer-of-Record. This letter should also indicate their concurrence with the recommendations in the report or revise them as needed to assume the role of the project Geotechnical Engineer-of-Record.

This report was prepared using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in similar localities. No warranty, express or implied, is made as to the conclusions and professional opinions included in this report.

The findings of this report are valid as of the present date. However, changes in the condition of a property can occur with the passage of time, whether due to natural processes or the work of humans on this or adjacent properties. In addition, changes in applicable or appropriate standards of practice may occur from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

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TABLE 1 - GEOTECHNICAL SPECIFICATIONS FOR COMPACTED FILL

Fill Type	Location	Depth Ranges [a]	Material Recommendations [b] [Test Standard]	Minimum Compaction Recommendations [Test Standard]
General	General	All	EI ≤ 50 [ASTM D4829] Passing 6" Sieve ≥ 100% [ASTM D6913] [c,d] Passing ¾" Sieve ≥ 70% [ASTM D6913]	90% RC at or slightly above OMC [ASTM D1557]
Heave-Settlement Sensitive Improvements Subgrade	Slabs-on-Grade, Structural Slabs, Pavements, Sidewalks, Curbs, Gutters	12" to 36" below FSG	EI ≤ 20 [ASTM D4829] Passing 3" Sieve ≥ 100% [ASTM D6913] Passing ¾" Sieve ≥ 70% [ASTM D6913] Passing #200 Sieve ≤ 35% [ASTM D6913]	90% RC at or slightly above OMC [ASTM D1557]
		Upper 12" below FSG		95% RC at or slightly above OMC [ASTM D1557]
Utility Trench Backfill	Bedding (i.e., Pipe Zone)	1' above TOP to Bottom of Trench	See Geotechnical Report Text	90% RC at or slightly above OMC [ASTM D1557]
	Trench Zone	FSG to 1' above TOP	EI ≤ 50 [ASTM D4829] Passing 3" Sieve ≥ 100% [ASTM D6913] Passing ¾" Sieve ≥ 70% [ASTM D6913]	

Notes:

a = If multiple zones overlap, the most stringent of the compaction and material recommendations should apply to that zone.

b = Additional Minimum Criteria that Apply to Material Recommendations:

- Satisfactory USCS Soil Types: GW, GP, GM, GC, SW, SP, SM, and SC, or combinations of these groups [ASTM D2487]
- Unsatisfactory USCS Soil Types: CH, MH, CL, ML, OH, OL and PT, or combinations of these groups [ASTM D2487]
- Corrosion Recommendations: Sulfate Content < 0.10%; Chloride Content < 0.03%; Minimum Soil Resistivity > 1,000 ohm-cm; 5.5 < pH < 10.0 [ASTM D516, CTM 643].

c = Fill material should be placed and processed to avoid "nesting" or concentrations of rock without sufficient fines for compaction.

d = Consider using Passing 3" Sieve ≥ 100% [ASTM D6913] to facilitate footing and utility trench excavations, subgrade scarification and preparation, and backfill.

ASTM = ASTM International; BOE = Bottom of Remedial Grading Excavation; BOF = Bottom of Foundation; BOW = Bottom of Wall; CTM = Caltrans Test Method; EI = Expansion Index; FSG = Finished Subgrade; OMC = Optimum Moisture Content; RC = Relative Compaction; RDS = Remolded Direct Shear; TOP = Top of Pipe; TOW = Top of Wall; USCS = Unified Soil Classification System.

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FIGURES

REFERENCE: GOOGLE EARTH MAP, RETRIEVED ON 01-11-2023

0 1000' 2000'
1"

NOTE: SCALE, DIRECTION, AND LOCATIONS ARE APPROXIMATE

SPORTS ARENA COMPLEX MIDWAY RISING	SITE LOCATION MAP	GROUP DELTA	
		PROJECT NUMBER SD760	FIGURE NUMBER 1

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NOTE: DIRECTION, SCALE AND LOCATIONS ARE APPROXIMATE

REFERENCE: GOOGLE, INC (2023) GOOGLE EARTH PRO, AERIAL IMAGERY DATED: AUGUST 1, 2021

SPORTS ARENA COMPLEX MIDWAY RISING	EXPLORATION LOCATIONS	GROUP DELTA	
		PROJECT NUMBER	FIGURE NUMBER
		SD760	2

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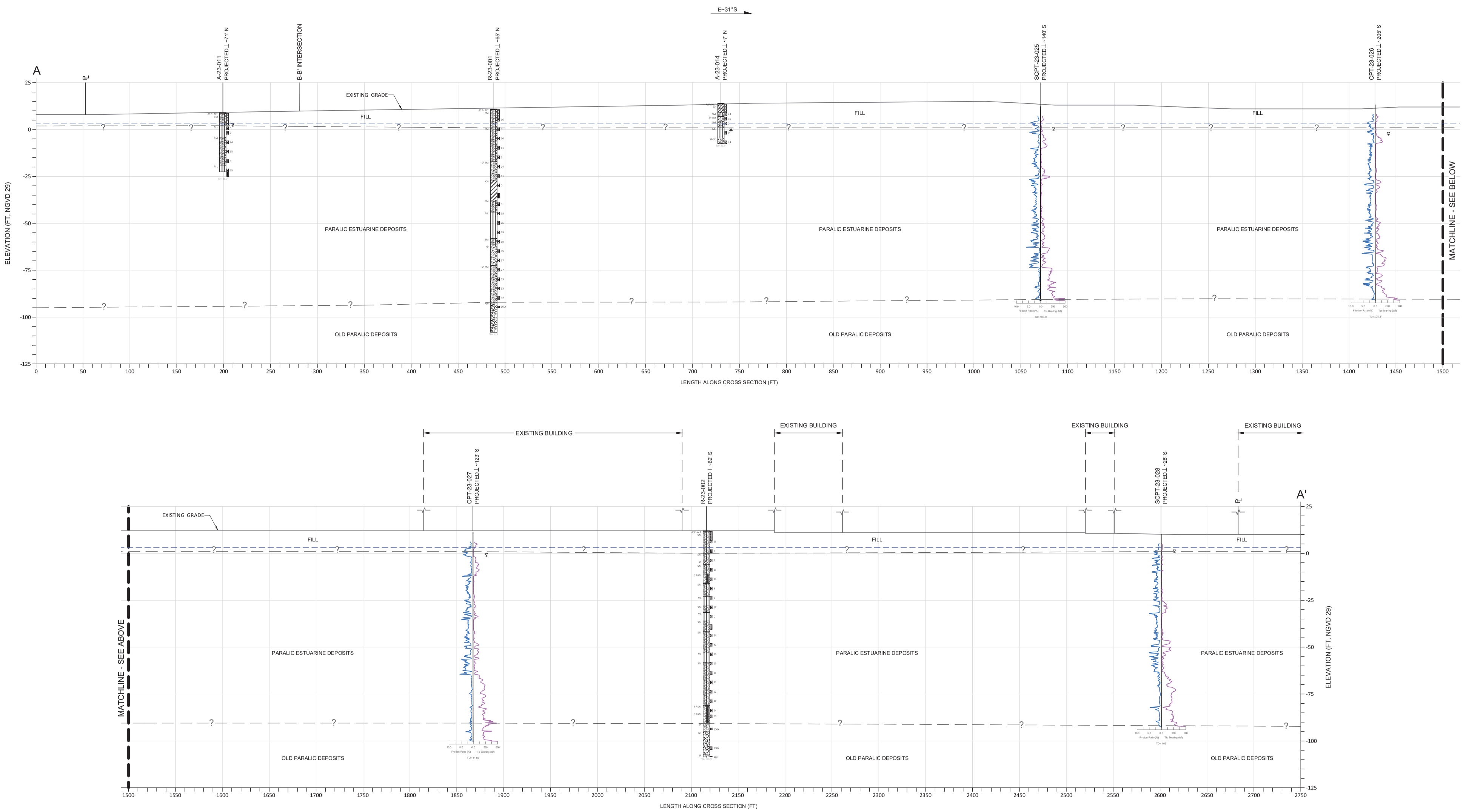


EXPLANATION

- EXISTING GRADE
- INTERPRETED GEOLOGIC CONTACT (QUERIED WHERE UNCERTAIN)
- DESIGN GROUNDWATER ELEVATION

USCS GROUP SYMBOL
USCS GRAPHIC SYMBOL (SEE BORING RECORDS LEGEND IN APPENDIX A FOR MORE INFORMATION)
SAMPLE TYPE
EQUIVALENT SPT N_{60} CORRECTED FOR HAMMER EFFICIENCY AND SAMPLER TYPE
$N_{60} = C_s * N_{FIELD/BLOWS} * ER/60$
C_s = SAMPLER TYPE CORRECTION
C_s = 1.0 (SPT) & 0.67 (MC)
ER = HAMMER EFFICIENCY (%) = 82%
REF= SAMPLER REFUSAL (UNABLE TO DRIVE SAMPLER 6" WITH 50 HAMMER BLOWS)
GROUND WATER LEVEL MEASURED OR INTERPRETED DURING EXPLORATION

SAMPLE TYPES
STANDARD PENETRATION TEST (SPT) SAMPLE
MODIFIED CALIFORNIA (MC) SAMPLE
BULK SAMPLE
SHELBY TUBE SAMPLE

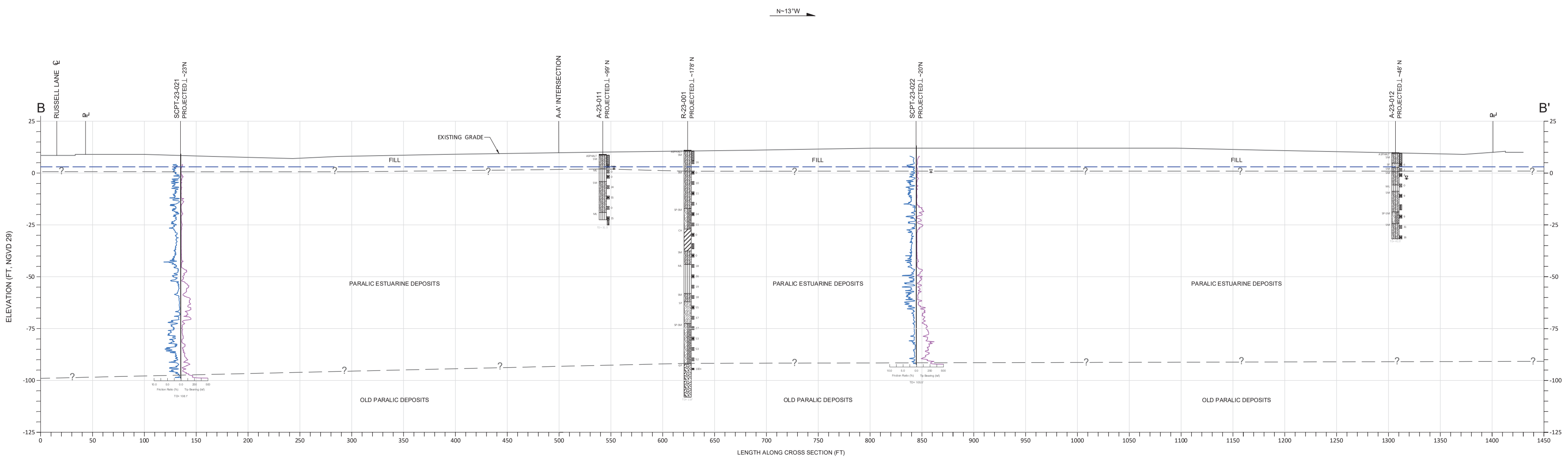
RATIO OF CPT SLEEVE FRICTION TO BEARING PRESSURE ON CONE TIP
BEARING PRESSURE AT CPT CONE TIP
GROUND WATER LEVEL MEASURED OR INTERPRETED DURING EXPLORATION
TIP BEARING GREATER THAN 500 tsf TRUNCATED AT 500 tsf MAX

NOTE:
CPT DATA PLOTTED FOR ILLUSTRATION PURPOSES ONLY. SEE APPENDIX A FOR CPT DATA PLOTS

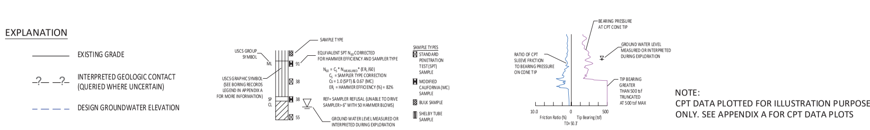
SCALE (FT): V 25' H 0' 25' 50'

NOTE: DIRECTIONS, LOCATIONS, ELEVATIONS, AND SCALE ARE APPROXIMATE
REFERENCE: PRE-EXISTING TOPOGRAPHY FROM EXISTING UTILITIES AND EASEMENTS BASE MAP, PROJECT DESIGN CONSULTANTS (02/2023)

SPORTS ARENA COMPLEX MIDWAY RISING	GEOTECHNICAL CROSS SECTION A-A'	GROUP DELTA	
		PROJECT NUMBER	FIGURE NUMBER
		SD760	3A



EXPLANATION

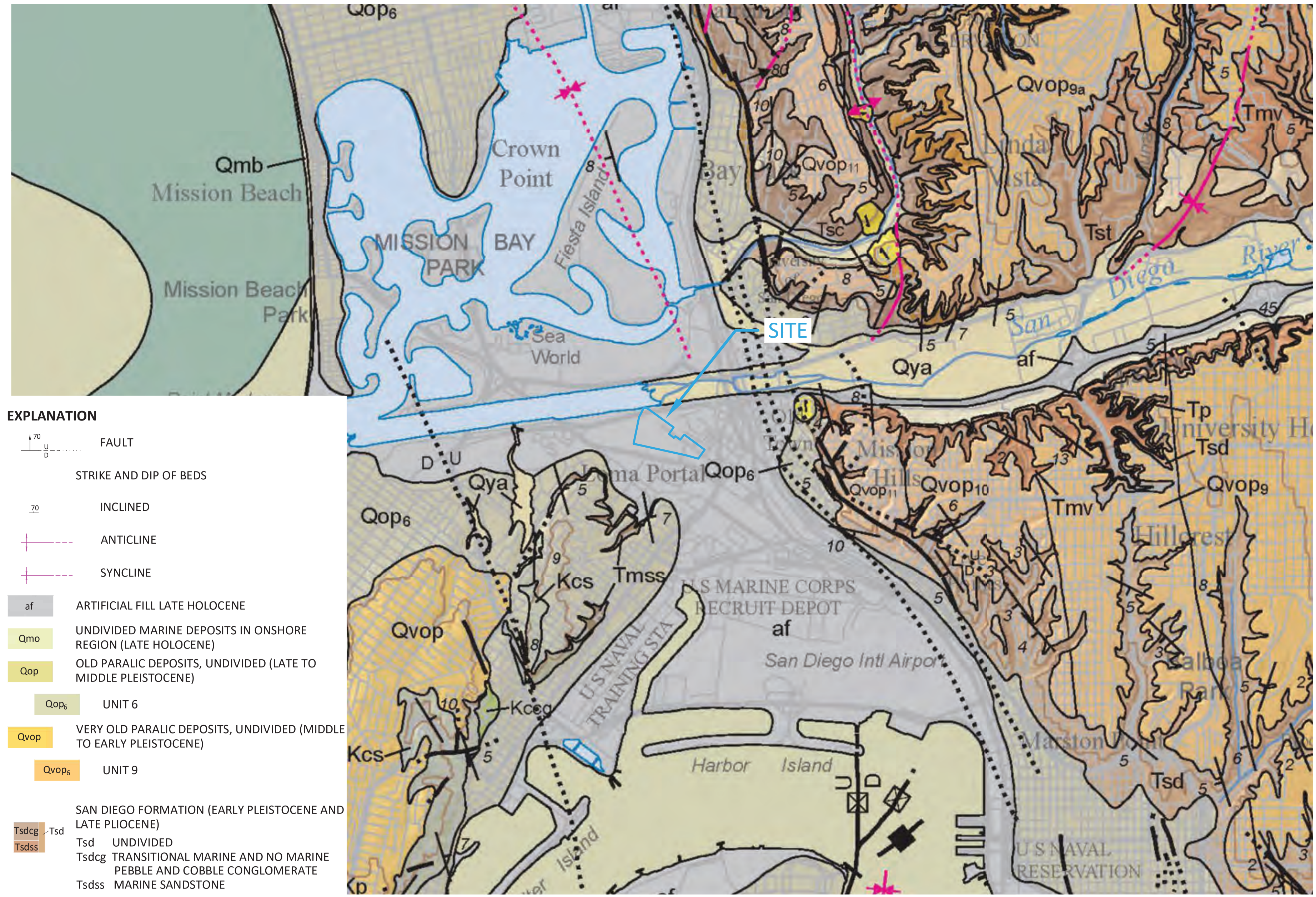


NOTE:
CPT DATA PLOTTED FOR ILLUSTRATION PURPOSES ONLY. SEE APPENDIX A FOR CPT DATA PLOTS

SCALE (FT): V 25' H 0' 25' 50'

NOTE: DIRECTIONS, LOCATIONS, ELEVATIONS, AND SCALE ARE APPROXIMATE
REFERENCE: PRE-EXISTING TOPOGRAPHY FROM EXISTING UTILITIES AND EASEMENTS BASE MAP, PROJECT DESIGN CONSULTANTS (02/2023)

SPORTS ARENA COMPLEX MIDWAY RISING	GEOTECHNICAL CROSS SECTION B-B'	GROUP DELTA	
		PROJECT NUMBER	FIGURE NUMBER
		SD760	3B



REFERENCE: GEOLOGIC MAP OF THE SAN DIEGO 30' x 60' QUADRANGLE, CALIFORNIA BY MICHAEL P. KENNEDY AND SIANGS S. TAN (2008)

SPORTS ARENA COMPLEX MIDWAY RISING	GEOLOGIC MAP	GROUP DELTA	
		PROJECT NUMBER SD760	FIGURE NUMBER 4

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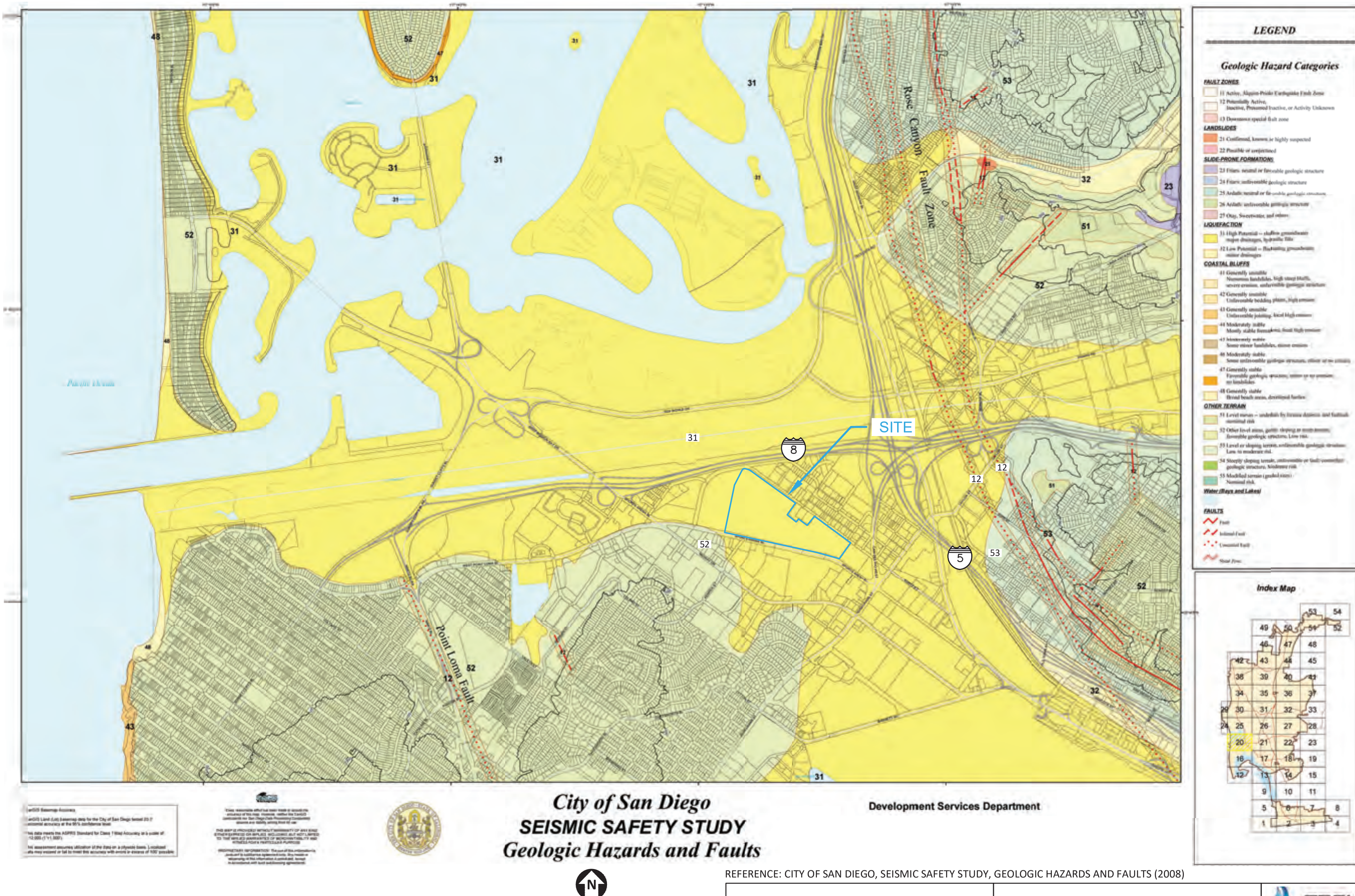
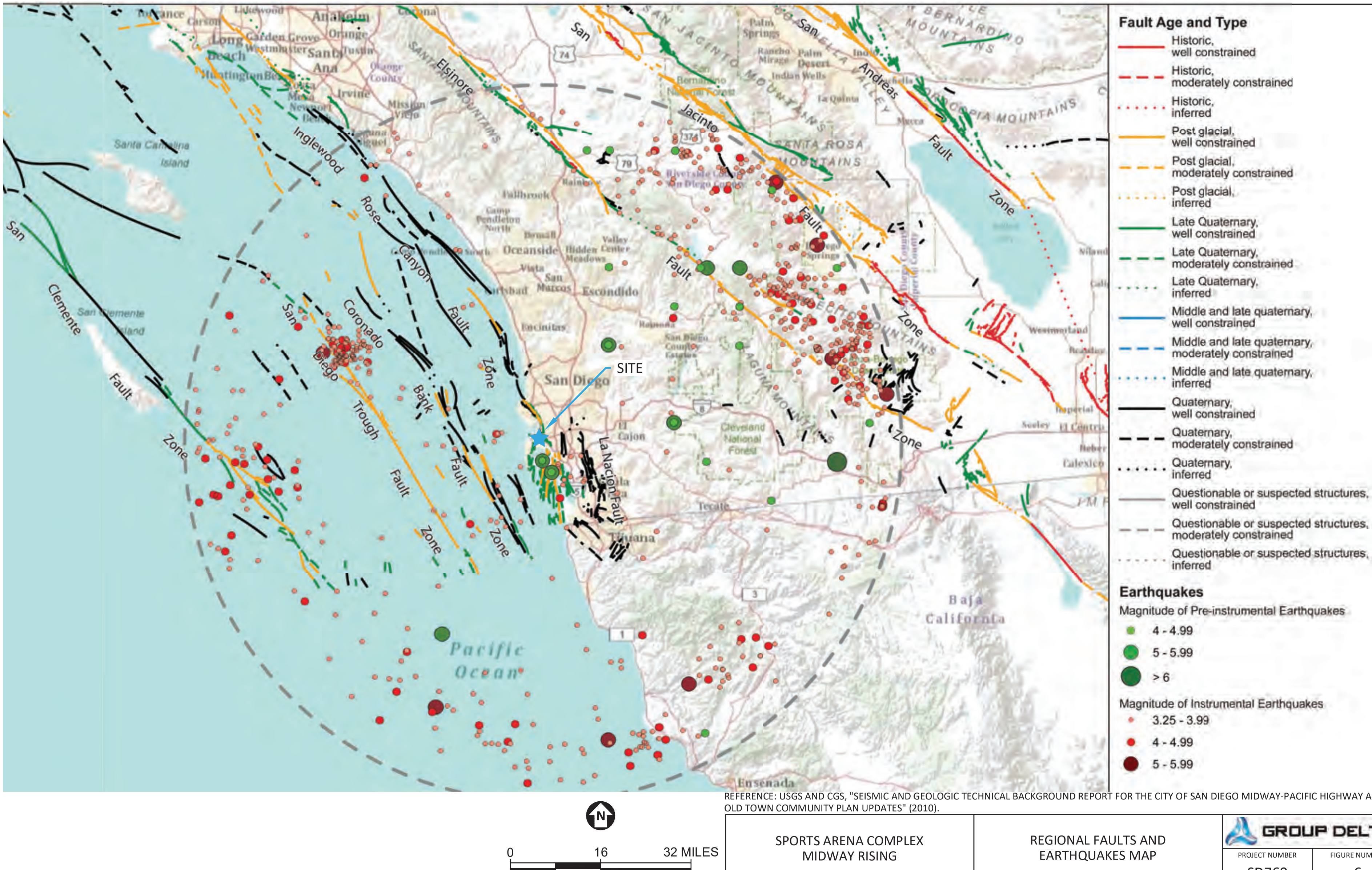


REFERENCE: CITY OF SAN DIEGO, SEISMIC SAFETY STUDY, GEOLOGIC HAZARDS AND FAULTS (2008)

SPORTS ARENA COMPLEX MIDWAY RISING	CITY OF SAN DIEGO SEISMIC SAFETY ELEMENT	GROUP DELTA	
		PROJECT NUMBER SD760	FIGURE NUMBER 5



REFERENCE: USGS AND CGS, "SEISMIC AND GEOLOGIC TECHNICAL BACKGROUND REPORT FOR THE CITY OF SAN DIEGO MIDWAY-PACIFIC HIGHWAY AND OLD TOWN COMMUNITY PLAN UPDATES" (2010).

SPORTS ARENA COMPLEX MIDWAY RISING	REGIONAL FAULTS AND EARTHQUAKES MAP	GROUP DELTA	
		PROJECT NUMBER	FIGURE NUMBER
		SD760	6

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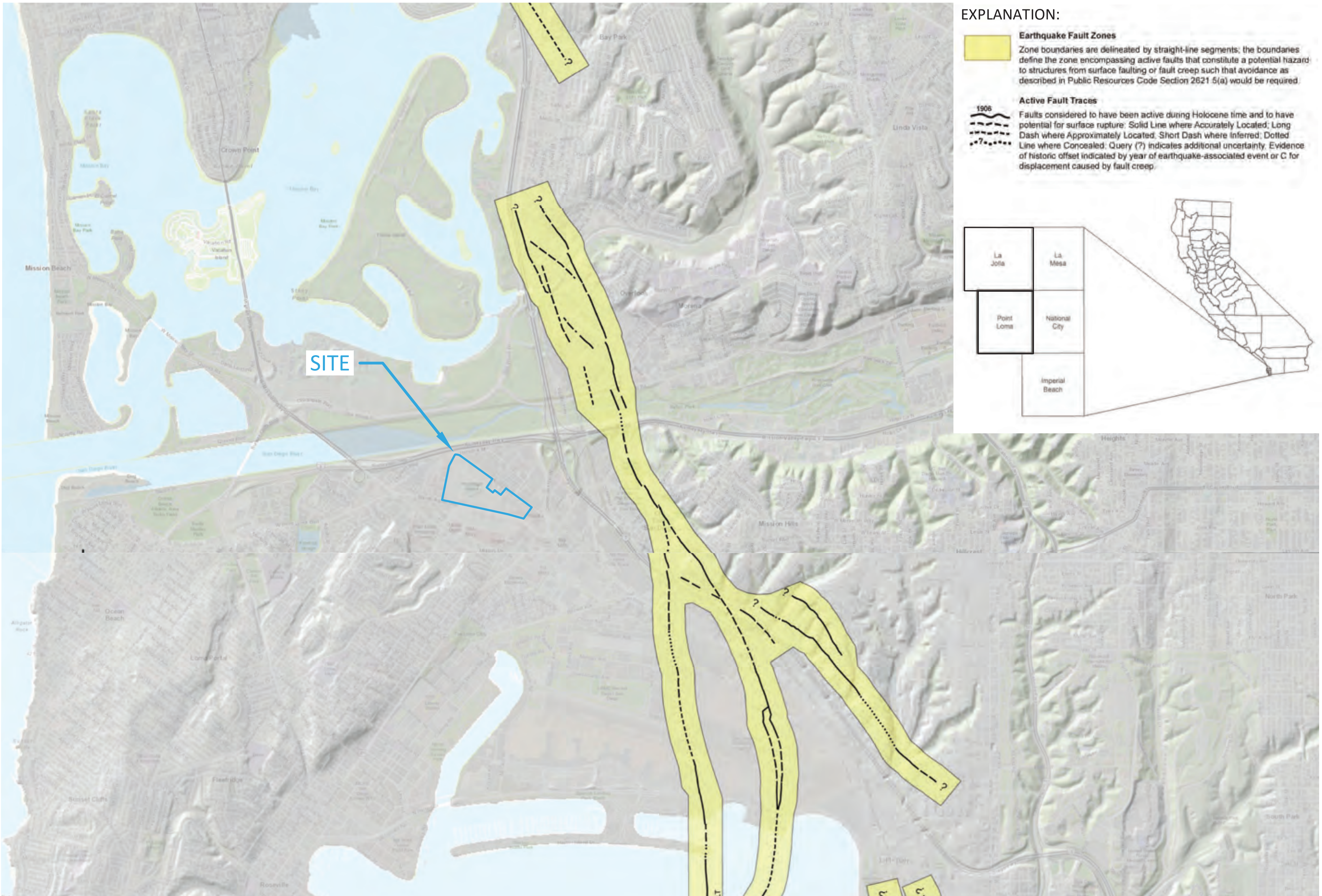

REFERENCE: CGS, SEISMIC HAZMAP LA JOLLA (2021) QUADRANGLE

0 2000' 4000'
1"
N

SPORTS ARENA COMPLEX MIDWAY RISING	EARTHQUAKE ZONE OF REQUIRED INVESTIGATION LA JOLLA QUADRANGLE	GROUP DELTA PROJECT NUMBER SD760 FIGURE NUMBER 7

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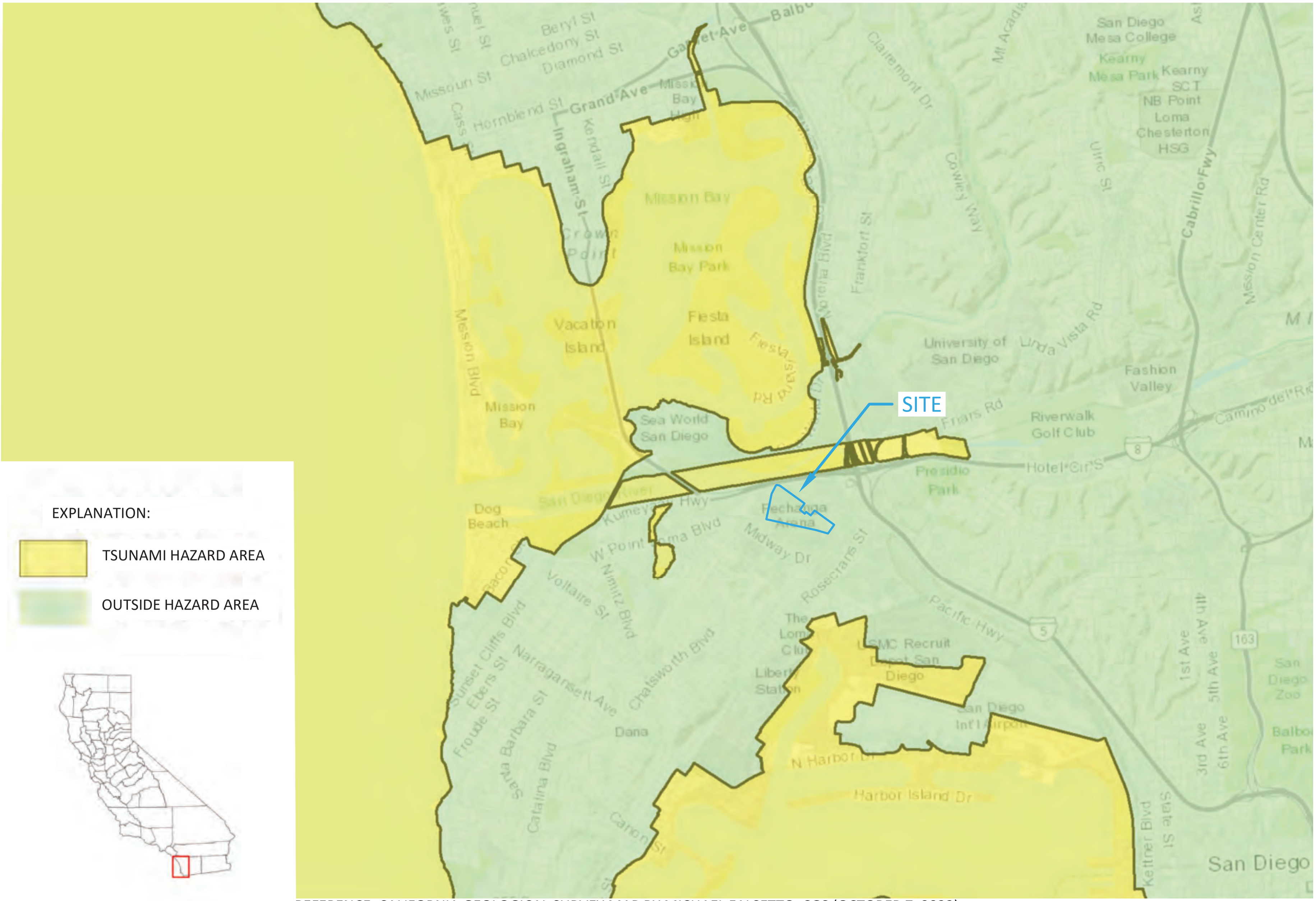

REFERENCE: CALIFORNIA GEOLOGICAL SURVEY MAP BY MICHAEL FALSETTO, CGS (OCTOBER 7, 2022)

SPORTS ARENA COMPLEX MIDWAY RISING	TSUNAMI INUNDATION MAP	GROUP DELTA PROJECT NUMBER: SD760 FIGURE NUMBER: 8

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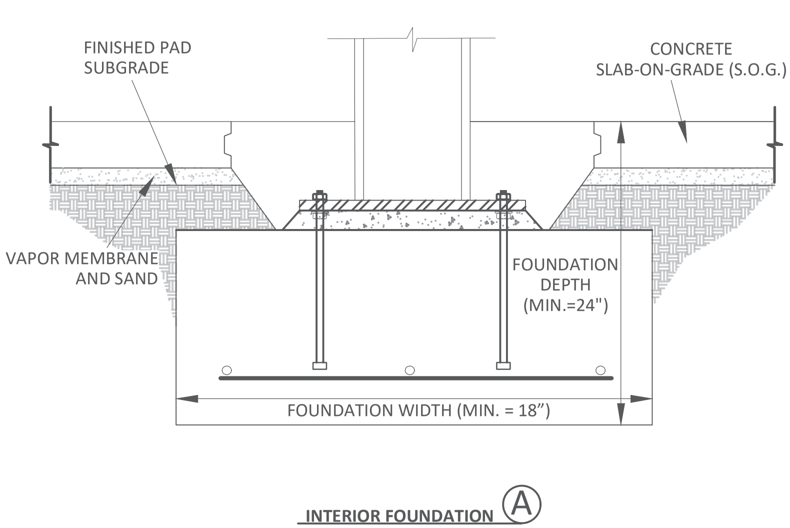
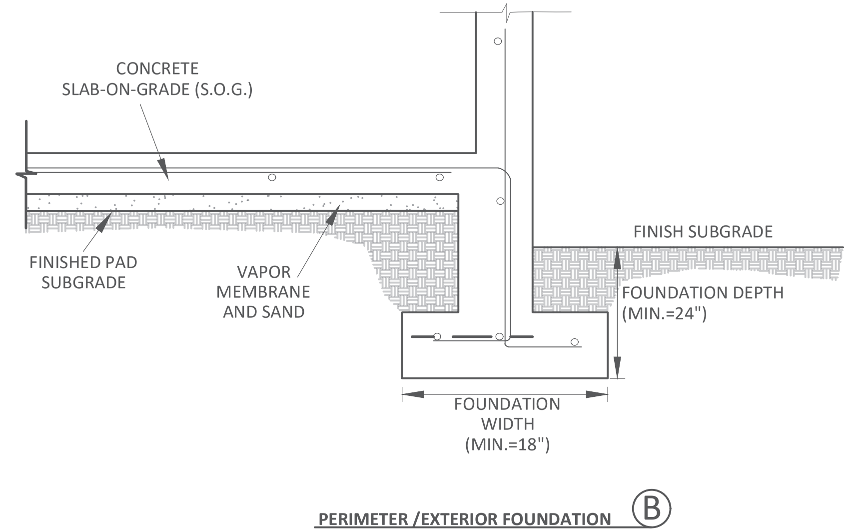
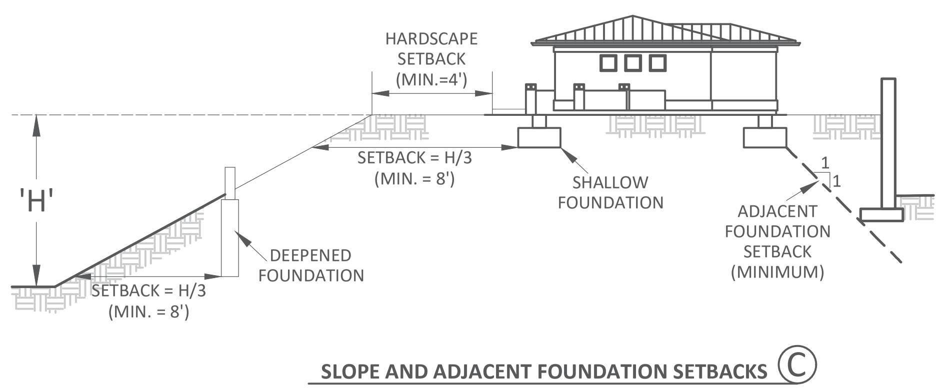


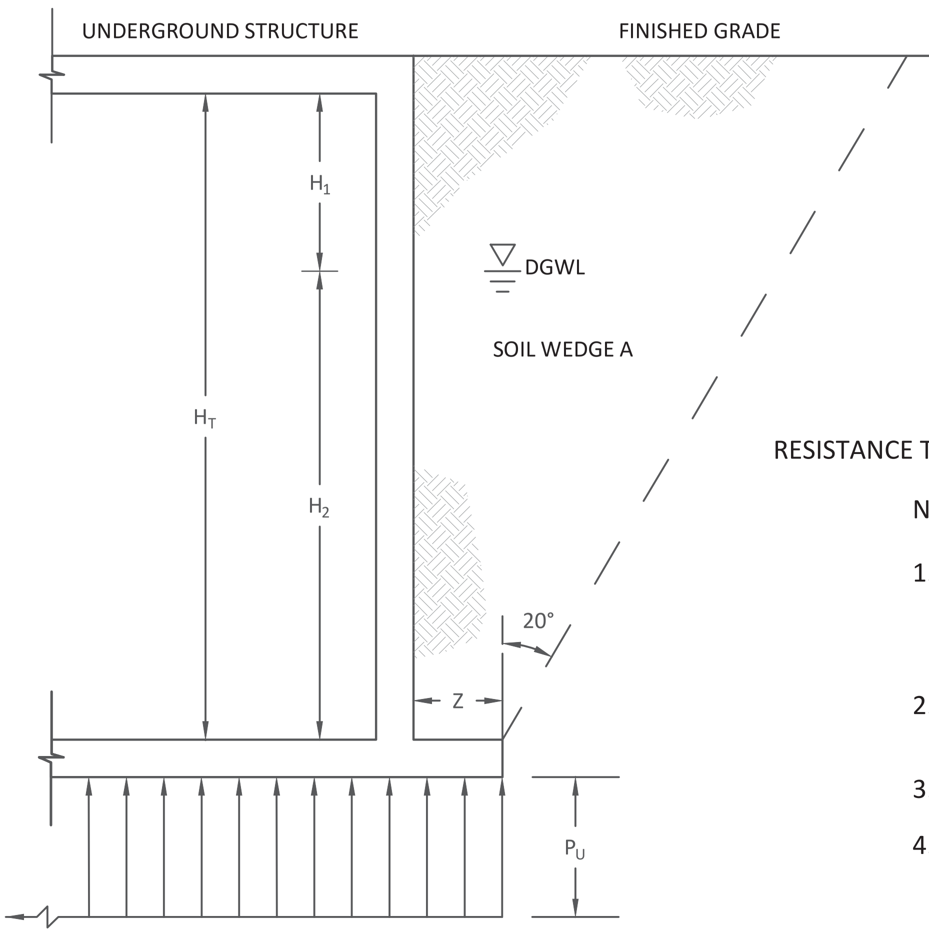




NOTES:
1) FOUNDATION REINFORCING AND SIZING PER STRUCTURAL ENGINEER. (SHOWN FOR ILLUSTRATION PURPOSES ONLY)
2) VAPOR MEMBRANE AND SAND PER ARCHITECT. (SHOWN FOR ILLUSTRATION PURPOSES ONLY)

NOT TO SCALE	SPORTS ARENA COMPLEX MIDWAY RISING	SHALLOW FOUNDATION DIMENSION DETAILS	GROUP DELTA	
			PROJECT NUMBER SD760	FIGURE NUMBER 9

FILE PATH: N:\Projects\SD\SD700\SD760 Zephyr Sports Arena Complex Redevelopment\11. Drafting\2. Geo Inv Rpt\Foundation Details.dwg PLOTTED DATE: 4/18/2023 7:53:42 PM SAVED BY: brendaa



RESISTANCE TO UPLIFT = WEIGHT OF STRUCTURE + WEIGHT OF SOIL WEDGE A

NOTES:

1. UNIT WEIGHT OF SOILS, γ OR γ_B
   γ = 120 PCF ABOVE GROUNDWATER TABLE
   γ_B = 58 PCF BELOW GROUNDWATER TABLE
2. UPLIFT PRESSURE, P_U
   $P_U = 63H_2$ PSF
3. H_T, Z, H_1 AND H_2 ARE IN FEET
4. DGWL: DESIGN GROUNDWATER LEVEL PER GEOTECHNICAL REPORT

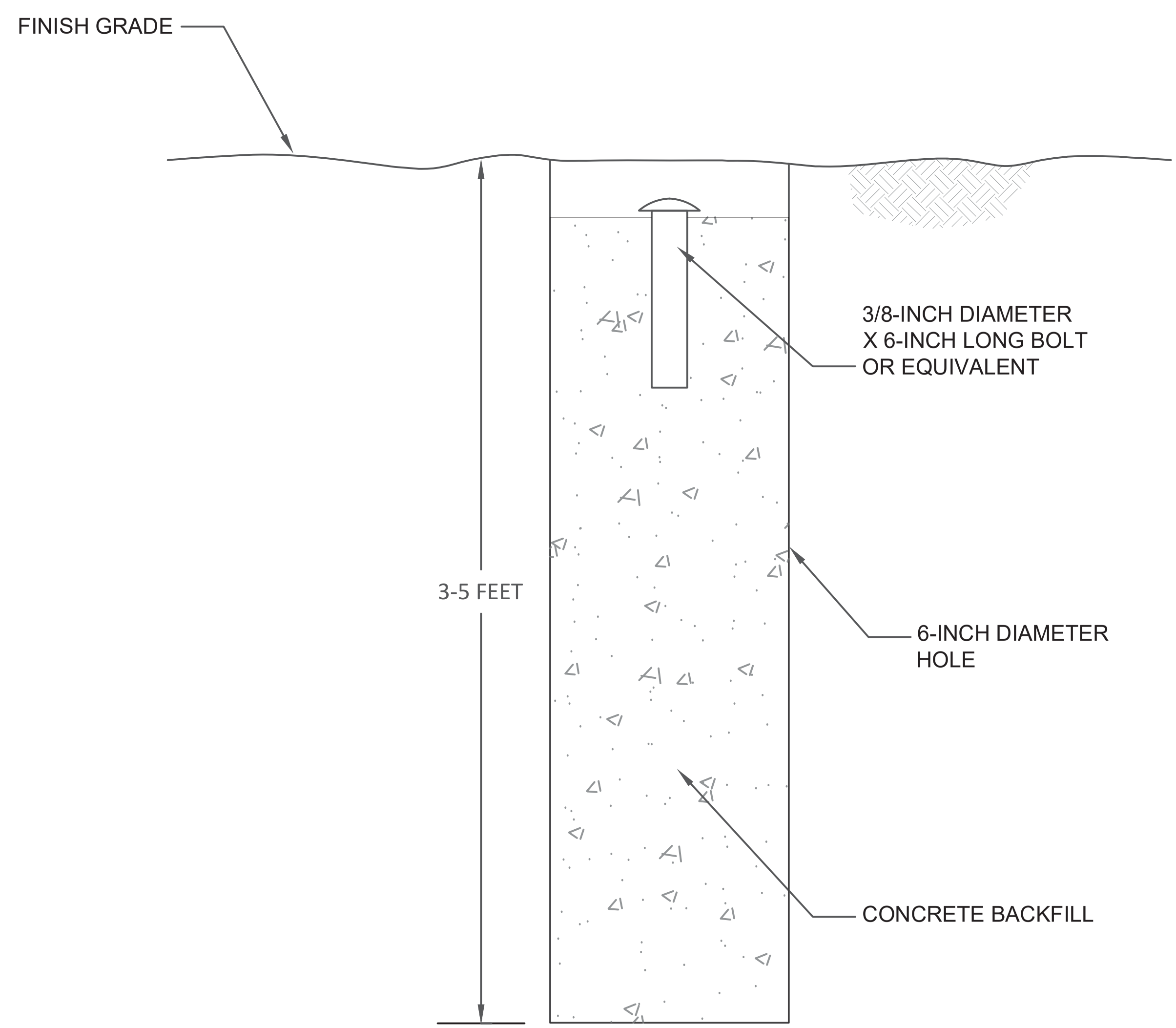
NOT TO SCALE

SPORTS ARENA COMPLEX
MIDWAY RISING

UPLIFT PRESSURES
FOR UNDERGROUND STRUCTURES

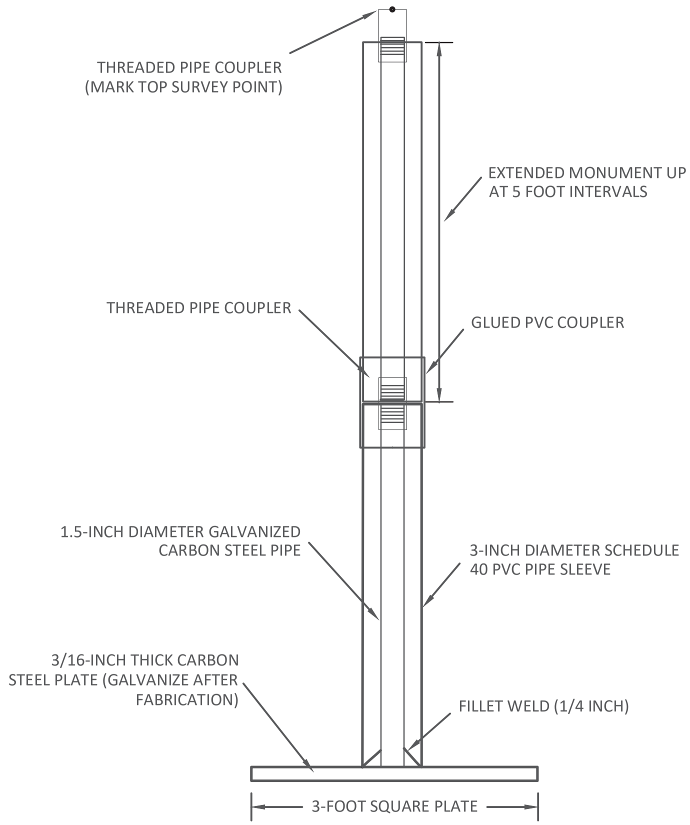
GROUP DELTA

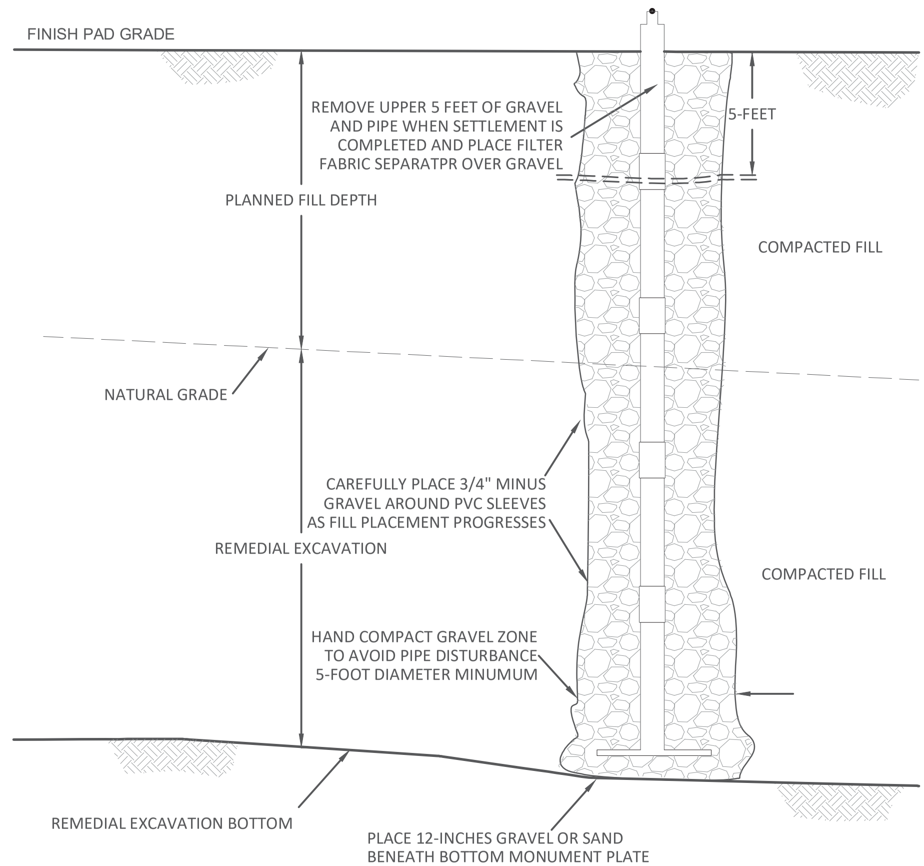
PROJECT NUMBER	FIGURE NUMBER
SD760	10



NOT TO SCALE

SPORTS ARENA COMPLEX MIDWAY RISING	SETTLEMENT MONUMENT DETAILS SURFACE MONUMENT	PROJECT NUMBER SD760	FIGURE NUMBER 11A





NOTES:

1) SETTLEMENT MONUMENTS SHOULD BE SURVEYED DAILY DURING FILL PLACEMENT, AND WEEKLY THEREAFTER BY A CALIFORNIA REGISTERED LAND SURVEYOR SURVEY DATA SHOULD BE PROVIDED WEEKLY TO GROUP DELTA CONSULTANTS FOR REVIEW UNTIL SETTLEMENT IS DEEMED SUBSTANTIALLY COMPLETED.

2) SETTLEMENT MONUMENTS SHOULD BE SURVEYED IMMEDIATELY BEFORE AND AFTER ADDING EACH 5-FOOT PIPE SECTION TO ACCOMMODATE CHANGE IN REFERENCE ELEVATION.

3) TO DESTROY MONUMENTS, UNCOUPLE AND REMOVE UPPER 5-FOOT PIPE SECTIONS, PLACE MIRAFI 140N FILTER FABRIC OVER GRAVEL, AND BACKFILL THE EXCAVATION WITH COMPACTED SOIL.

NOT TO SCALE

SPORTS ARENA COMPLEX
MIDWAY RISING

SETTLEMENT
MONUMENT DETAILS
RISER PLATE

GROUP DELTA

PROJECT NUMBER
SD760

FIGURE NUMBER
11B

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APPENDIX A
EXPLORATION RECORDS

APPENDIX A

EXPLORATION RECORDS

Field exploration included a visual reconnaissance of the site, the drilling of eight (8) hollow stem and mud rotary exploratory borings, and the advancement of eight (8) cone penetration tests (CPTs). Borings A-23-011 through R-23-002 were drilled between February 6 and February 10, 2023. SCPT-23-021 through SCPT-23-028 were advanced on February 6 and February 7, 2023, and March 15, 2023. The maximum depth of exploration was about 120.5 feet below surrounding grades. A summary of the explorations is included in Table A-1. A summary of the groundwater measurements performed at the exploration locations is included in Table A-2. The approximate exploration locations are shown in Figure 2. Logs of the explorations and plots of the CPT data and interpretations are provided in Figures A-1 through A-16, immediately after the Boring Record Legends.

HOLLOW STEM AND MUD ROTARY BORINGS

The hollow stem and mud rotary exploratory borings were advanced by Pacific Drilling using MARL M10 and MARL MTXD truck mounted drill rigs. Disturbed samples were collected from the borings using a 2-inch outside diameter unlined Standard Penetration Test (SPT) sampler. Less disturbed samples were collected using a 3-inch outside diameter ring lined sampler (a modified California sampler). Bulk samples were also collected. The samples were sealed in plastic bags, labeled, and returned to the laboratory for testing. A summary of the exploratory boring locations, elevations and depths is shown on Table A-1. Groundwater measurements from the borings, where performed, are included in Table A-2.

The drive samples were collected from the exploratory borings using automatic hammers with average Energy Transfer Ratios (ETR) of approximately 97 percent. For each sample, the 6-inch incremental blowcounts was recorded on the logs. The field blow counts (N) were normalized to approximate the standard 60 percent ETR, as shown on the logs (N_{60}). The California ring samples were also corrected for the 3-inch sampler diameter using Burmister's correction factor. Where sampler refusal was encountered (i.e., unable to drive the sampler more than the first six inches with 50 hammer blows), the blowcount is denoted as "REF".

The exploratory borings were logged using the Caltrans Soil and Rock Logging, Classification and Presentation Manual (2010) as a guideline.

APPENDIX A

EXPLORATION RECORDS (Continued)

CONE PENETRATION TESTS

The CPT soundings were advanced by Kehoe Testing and Engineering in general accordance with ASTM D5778. The CPT soundings were carried out using an integrated electronic cone system manufactured by Vertek. The soundings were advanced using a 30-ton-truck-mounted CPT rig. The cone used during the program was a 15-centimeter squared (cm^2) cone and recorded the following parameters at approximately 2.5 centimeter depth intervals:

- Cone Resistance (q_c);
- Sleeve Friction (f_s); and
- Dynamic Pore Pressure (u).

Soil Behavior Type Interpretations: The Soil Behavior Type (SBT) shown on the CPT plots is a stratigraphic interpretation based on relationships between qc, fs, and u (Robertson, 2009) that represents major soil lithologic changes. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures. However, the presence of mica, organics, and/or seashells coupled with the very low apparent density observed in the borings appears to have influenced the interpretation of SBT within the fill and upper paralic estuarine deposits. Therefore, for analysis purposes, the SBT correlated from the CPT data was adjusted to best fit the observations, classifications, and material properties of the soils observed within the borings using guidance provided by Kehoe for interpreting SBT based on their experience from prior projects with similar subsurface conditions.

Shear Wave Velocity Testing: At locations SCPT-23-021, SCPT-23-022, SCPT-23-024, SCPT-23-025 and SCPT-23-028, shear wave velocity measurements were obtained at various depths to a depth of approximately 100 feet. The shear wave was generated using an air-actuated hammer located inside the front jack of the CPT rig. The cone was equipped with a triaxial geophone, which recorded the shear wave signal generated by the air hammer. The above parameters were recorded and viewed in real time using a laptop computer. A summary of the collected shear wave measurements are presented in Figure A-17 through A-21.

Pore Pressure Dissipation Testing: Pore Pressure Dissipation (PPD) tests were performed at select CPT soundings to approximate the depth to groundwater. PPD tests consist of advancing the cone to a target depth below the suspected groundwater level and recording the dynamic pore pressure over a period of time until it stabilizes to a constant pressure. The stabilized pressure can be used to back-calculate the hydrostatic pressure, and consequently the depth to groundwater. Groundwater depths interpreted from PPD tests performed at the CPTs, where performed, are included in Table A-2.

APPENDIX A

EXPLORATION RECORDS (Continued)

Table A-1 – Explorations Summary (see Figure 2)						
Exploration ID	**Latitude [°]**	**Longitude [°]**	**Top Elevation NGVD 29 [FT]**	**Exploration Depth [FT]**	**Bottom Elevation NGVD 29 [FT]**	**Figure No.**
A-23-011	32.756717	-117.214067	9	31.5	-23	A-1
A-23-012	32.754567	-117.214333	10	41.5	-32	A-2
A-23-013	32.757233	-117.212200	9	21.5	-13	A-3
A-23-014	32.756100	-117.212383	14	21.5	-8	A-4
A-23-015	32.754817	-117.211433	14	21.5	-8	A-5
A-23-016	32.754083	-117.210400	11	41.5	-31	A-6
R-23-001	32.756317	-117.213200	11	119.0	-108	A-7
R-23-002	32.754367	-117.208317	12	120.5	-109	A-8
SCPT-23-021[1]	32.757850	-117.213583	9	108.1	-99	A-9
SCPT-23-022[1]	32.755800	-117.213850	13	105.5	-93	A-10
CPT-23-023	32.756817	-117.211517	9	108.3	-99	A-11
SCPT-23-024[1]	32.754800	-117.212933	13	106.2	-93	A-12
SCPT-23-025[1]	32.756000	-117.211167	12	103.5	-92	A-13
CPT-23-026	32.754667	-117.210700	13	104.3	-91	A-14
CPT-23-027	32.754850	-117.208917	11	111.6	-101	A-15
SCPT-23-028[1]	32.753517	-117.207133	10	103.0	-93	A-16

[1] Shear wave velocity measurements shown on Figure A-17 through A-21.

Note: The exploration locations were measured in the field using a Garmin GPSMAP 64st Global Positioning System (GPS) receiver and by visually estimating, pacing or taping distances from nearby landmarks, if available. The surface elevations were estimated by interpolation using the referenced plans provided by Project Design Consultants, *which utilizes the Northern Geodetic Vertical Datum of 1929 (NVGD 29) as the vertical datum* (see Figure 2). The locations and elevations provided should not be considered more accurate than is implied by the scale of the map and the accuracy of the equipment used to locate the explorations. The lines designating the interface between differing soil materials on the logs may be abrupt or gradational. Further, soil conditions at locations between the explorations may be substantially different from those at the specific locations we explored. The Boring Records are part of a geotechnical report which must be considered in its entirety.

APPENDIX A

EXPLORATION RECORDS (Continued)

Table A-2 – Groundwater Measurements Summary (see Figure 2)				
Exploration ID	**Groundwater Depth [FT]**	**Groundwater Elevation NGVD 29 [FT]**	**Date of Measurement**	**Type of Measurement**
A-23-011	7.0	2.0	2/06/2023	Encountered During Drilling
A-23-012	12.5	-2.5	2/07/2023	Well Sounder in Boring
A-23-013	7.3	1.7	2/06/2023 (3:00 PM)	Well Sounder in Temporary Well Casing
A-23-014	14.5	-0.5	2/06/2023	Well Sounder in Boring
A-23-015	14.0	0.0	2/07/2023	Well Sounder in Boring
A-23-016	15.0	-4.0	2/07/2023	Well Sounder in Boring
SCPT-23-022	12.6	0.4	2/06/2023	Pore Pressure Dissipation Test
CPT-23-023	6.1	2.9	2/06/2023	Pore Pressure Dissipation Test
SCPT-23-025	12.3	-0.3	2/07/2023	Pore Pressure Dissipation Test
CPT-23-026	15.8	-2.8	2/07/2023	Pore Pressure Dissipation Test
CPT-23-027	12.4	-1.4	3/15/2023	Pore Pressure Dissipation Test
SCPT-23-028	9.4	0.6	3/15/2023	Pore Pressure Dissipation Test

SOIL IDENTIFICATION AND DESCRIPTION SEQUENCE

Sequence	Identification Components	Refer to Section: Field	Refer to Section: Lab	Required	Optional
1	Group Name	2.5.2	3.2.2	●	
2	Group Symbol	2.5.2	3.2.2	●	
	Description Components				
3	Consistency of Cohesive Soil	2.5.3	3.2.3	●	
4	Apparent Density of Cohesionless Soil	2.5.4		●	
5	Color	2.5.5		●	
6	Moisture	2.5.6		●	
7	Percent or Proportion of Soil	2.5.7	3.2.4	●	◍
	Particle Size	2.5.8	2.5.8	●	◍
	Particle Angularity	2.5.9			○
	Particle Shape	2.5.10			○
8	Plasticity (for fine-grained soil)	2.5.11	3.2.5		○
9	Dry Strength (for fine-grained soil)	2.5.12			○
10	Dilatency (for fine-grained soil)	2.5.13			○
11	Toughness (for fine-grained soil)	2.5.14			○
12	Structure	2.5.15			○
13	Cementation	2.5.16		●	
14	Percent of Cobbles and Boulders	2.5.17		●	
	Description of Cobbles and Boulders	2.5.18		●	
15	Consistency Field Test Result	2.5.3		●	
16	Additional Comments	2.5.19			○

Describe the soil using descriptive terms in the order shown

Minimum Required Sequence:

USCS Group Name (Group Symbol); Consistency or Density; Color; Moisture; Percent or Proportion of Soil; Particle Size; Plasticity (optional).

◍ = optional for non-Caltrans projects

Where applicable:

Cementation; % cobbles & boulders; Description of cobbles & boulders; Consistency field test result

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

HOLE IDENTIFICATION

Holes are identified using the following convention:

H – YY – NNN

Where:

H: Hole Type Code

YY: 2-digit year

NNN: 3-digit number (001-999)

Hole Type Code and Description

Hole Type Code	Description
A	Auger boring (hollow or solid stem, bucket)
R	Rotary drilled boring (conventional)
RC	Rotary core (self-cased wire-line, continuously-sampled)
RW	Rotary core (self-cased wire-line, not continuously sampled)
P	Rotary percussion boring (Air)
HD	Hand driven (1-inch soil tube)
HA	Hand auger
D	Driven (dynamic cone penetrometer)
CPT	Cone Penetration Test
O	Other (note on LOTB)

Description Sequence Examples:

SANDY lean CLAY (CL); very stiff; yellowish brown; moist; mostly fines; some SAND, from fine to medium; few gravels; medium plasticity; PP=2.75.

Well-graded SAND with SILT and GRAVEL and COBBLES (SW-SM); dense; brown; moist; mostly SAND, from fine to coarse; some fine GRAVEL; few fines; weak cementation; 10% GRANITE COBBLES; 3 to 6 inches; hard; subrounded.

Clayey SAND (SC); medium dense, light brown; wet; mostly fine sand,; little fines; low plasticity.

GROUP DELTA

PROJECT NO. SD760

MIDWAY RISING SPORTS ARENA COMPLEX
3220, 3240, 3250, and 3500
SPORTS ARENA BOULEVARD
SAN DIEGO, CALIFORNIA

BORING RECORD LEGEND #1

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- **C** Consolidation (ASTM D 2435)
- **CL** Collapse Potential (ASTM D 5333)
- **CP** Compaction Curve (CTM 216)
- **CR** Corrosion, Sulfates, Chlorides (CTM 643; CTM 417; CTM 422)
- **CU** Consolidated Undrained Triaxial (ASTM D 4767)
- **DS** Direct Shear (ASTM D 3080)
- **EI** Expansion Index (ASTM D 4829)
- **M** Moisture Content (ASTM D 2216)
- **OC** Organic Content (ASTM D 2974)
- **P** Permeability (CTM 220)
- **PA** Particle Size Analysis (ASTM D 422)
- **PI** Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89, AASHTO T 90)
- **PL** Point Load Index (ASTM D 5731)
- **PM** Pressure Meter
- **R** R-Value (CTM 301)
- **SE** Sand Equivalent (CTM 217)
- **SG** Specific Gravity (AASHTO T 100)
- **SL** Shrinkage Limit (ASTM D 427)
- **SW** Swell Potential (ASTM D 4546)
- **UC** Unconfined Compression - Soil (ASTM D 2166) Unconfined Compression - Rock (ASTM D 2938)
- **UU** Unconsolidated Undrained Triaxial (ASTM D 2850)
- **UW** Unit Weight (ASTM D 2937)
- **WA** Percent passing the No. 200 Sieve (ASTM D 1140)

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler (2.4" ID, 3" OD)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (after drilling, date)

Definitions for Change in Material

Term	Definition	Symbol
Material Change	Change in material is observed in the sample or core and the location of change can be accurately located.	solid line
Estimated Material Change	Change in material cannot be accurately located either because the change is gradational or because of limitations of the drilling and sampling methods.	dashed line
Soil / Rock Boundary	Material changes from soil characteristics to rock characteristics.	wavy lines

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

GROUP DELTA

PROJECT NO. SD760

MIDWAY RISING SPORTS ARENA COMPLEX
3220, 3240, 3250, and 3500
SPORTS ARENA BOULEVARD
SAN DIEGO, CALIFORNIA

BORING RECORD LEGEND #2

CONSISTENCY OF COHESIVE SOILS				
Description	Shear Strength (tsf)	Pocket Penetrometer, PP Measurement (tsf)	Torvane, TV, Measurement (tsf)	Vane Shear, VS, Measurement (tsf)
Very Soft	Less than 0.12	Less than 0.25	Less than 0.12	Less than 0.12
Soft	0.12 - 0.25	0.25 - 0.5	0.12 - 0.25	0.12 - 0.25
Medium Stiff	0.25 - 0.5	0.5 - 1	0.25 - 0.5	0.25 - 0.5
Stiff	0.5 - 1	1 - 2	0.5 - 1	0.5 - 1
Very Stiff	1 - 2	2 - 4	1 - 2	1 - 2
Hard	Greater than 2	Greater than 4	Greater than 2	Greater than 2

APPARENT DENSITY OF COHESIONLESS SOILS	
Description	SPT N_{60} (blows / 12 inches)
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Greater than 50

MOISTURE	
Description	Criteria
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS	
Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 - 10%
Little	15 - 25%
Some	30 - 45%
Mostly	50 - 100%

PARTICLE SIZE		
Description		Size (in)
Boulder		Greater than 12
Cobble		3 - 12
Gravel	Coarse	3/4 - 3
	Fine	1/5 - 3/4
Sand	Coarse	1/16 - 1/5
	Medium	1/64 - 1/16
	Fine	1/300 - 1/64
Silt and Clay		Less than 1/300

CEMENTATION	
Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Plasticity

Description	Criteria
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010), with the exception of consistency of cohesive soils vs. N_{60}.

CONSISTENCY OF COHESIVE SOILS	
Description	SPT N_{60} (blows/12 inches)
Very Soft	0 - 2
Soft	2 - 4
Medium Stiff	4 - 8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	Greater than 30

Ref: Peck, Hansen, and Thornburn, 1974, "Foundation Engineering," Second Edition.

Note: Only to be used (with caution) when pocket penetrometer or other data on undrained shear strength are unavailable. Not allowed by Caltrans Soil and Rock Logging and Classification Manual, 2010.

GROUP DELTA

PROJECT NO. SD760

MIDWAY RISING SPORTS ARENA COMPLEX
3220, 3240, 3250, and 3500
SPORTS ARENA BOULEVARD
SAN DIEGO, CALIFORNIA

BORING RECORD LEGEND #3

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

BEDDING SPACING

Description	Thickness/Spacing
Massive	Greater than 10 ft
Very Thickly Bedded	3 ft - 10 ft
Thickly Bedded	1 ft - 3 ft
Moderately Bedded	4 in - 1 ft
Thinly Bedded	1 in - 4 in
Very Thinly Bedded	1/4 in - 1 in
Laminated	Less than 1/4 in

WEATHERING DESCRIPTORS FOR INTACT ROCK

	Diagnostic Features					
	Chemical Weathering-Discoloration-Oxidation		Mechanical Weathering and Grain Boundary Conditions	Texture and Leaching		
Description	Body of Rock	Fracture Surfaces		Texture	Leaching	General Characteristics
Fresh	No discoloration, not oxidized	No discoloration or oxidation	No separation, intact (tight)	No change	No leaching	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull	Minor to complete discoloration or oxidation of most surfaces	No visible separation, intact (tight)	Preserved	Minor leaching of some soluble minerals	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty"; feldspar crystals are "cloudy"	All fracture surfaces are discolored or oxidized	Partial separation of boundaries visible	Generally preserved	Soluble minerals may be mostly leached	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in situ disaggregation, grain boundary conditions	All fracture surfaces are discolored or oxidized; surfaces friable	Partial separation, rock is friable; in semi-arid conditions, granitics are disaggregated	Texture altered by chemical disintegration (hydration, argillation)	Leaching of soluble minerals may be complete	Dull sound when struck with hammer; usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures or veinlets. Rock is significantly weakened.
Decomposed	Discolored of oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay		Complete separation of grain boundaries (disaggregated)	Resembles a soil; partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes".

PERCENT CORE RECOVERY (REC)

$$\frac{\Sigma \text{ Length of the recovered core pieces (in.)}}{\text{Total length of core run (in.)}} \times 100$$

ROCK QUALITY DESIGNATION (RQD)

$$\frac{\Sigma \text{ Length of intact core pieces} \geq 4 \text{ in.}}{\text{Total length of core run (in.)}} \times 100$$

RQD* indicates soundness criteria not met.

ROCK HARDNESS

Description	Criteria
Extremely Hard	Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows
Very Hard	Cannot be scratched with a pocketknife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Can be scratched with a pocketknife or sharp pick with difficulty (heavy pressure). Breaks with heavy hammer blows.
Moderately Hard	Can be scratched with a pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows
Moderately Soft	Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily with a pocketknife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Can be readily indented, grooved or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures
Very Slightly Fractured	Core lengths greater than 3 ft.
Slightly Fractured	Core lengths mostly from 1 to 3 ft.
Moderately Fractured	Core lengths mostly 4 in. to 1 ft.
Intensely Fractured	Core lengths mostly from 1 to 4 in.
Very Intensely Fractured	Mostly chips and fragments.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

GROUP DELTA

PROJECT NO. SD760

MIDWAY RISING SPORTS ARENA COMPLEX
3220, 3240, 3250, and 3500
SPORTS ARENA BOULEVARD
SAN DIEGO, CALIFORNIA

BORING RECORD LEGEND #4

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G'#D ZĀH39J	'C'V$D (XF HB:9J	/$I#C'ĀDE# '	/$I#C'ĀFX1	#'F'D &$D(XF Ā&'(/D $F%' H.CX)/Ā=Ā-Ā(FJ	.CX)=TDĀ\ F\	F.'	IX (/DY&' HSJ	G&EĀG'F/(D E H2BJ	XDZ'& D' /D /	G&(CC(FU I'DZXG	U&$#Z(% CXU	G'/%&(#D(XFĀ$FGĀ%C$//(T(%$D(XF
			.,				,! 1-					Ā !"# "$ %& Ā$2234567 89:;<A0A,=!A6>?@:A9A4B8A9 ?4>?3:9:1
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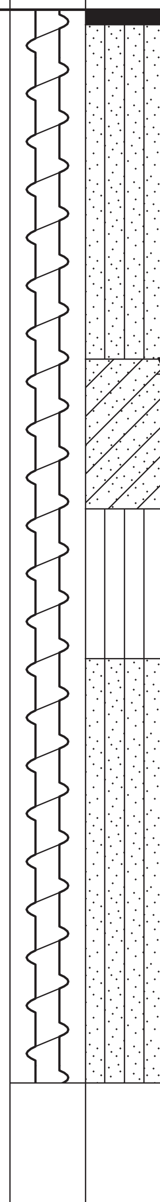

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G'#D ZĀH:B9J	'C'V$D (XF HB:9J	/$I#C'ĀDE# '	/$I#C'ĀFX1	#F'D &$D(XF Ā&'(/D $F%' H.CX)/Ā=Ā-Ā(FJ	.CX)=TDĀ\ F\	F.'	IX (/DY&' HSJ	G&EĀG'F/(D E H2BJ	XDZ'& D' /D /	G&(CC(FU I'DZXG	U&$#Z(% CXU	G'/%&(#D(XFĀ$FGĀ%C$//(T(%$D(XF
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G'#D ZĀH9J	'C'V$D (XF HB:9J	/$I#C'ĀDE# '	/$I#C'ĀFX1	#'F'D &$D(XF Ā&'(/D $F%' H.CX)/Ā=Ā-Ā(FJ	.CX)=TDĀ\ F\	F. '	IX (/DY&' HSJ	G&EĀG'F/(D E H2BJ	XDZ'& D' /D /	G&(CC(FU I'DZXG	U&$#Z(% CXU	G'/%&(#D(XFĀ$FGĀ%C$//(T(%$D(XF
												P: >94>69:A8>MA3948MA?:7:> 9A>MA?822MAC69@ P;8?N[M<M3826MĀA?9A>?3:9:1 D@6AA36>Ā&:?43MĀ6A69Ā48ĀO:49?@>6?8;Ā3429 Q@6?@ĀA9Ā Ā?4>A6M:3MĀ6>ĀA9 963:9<1 D@Ā5 2;438964>Ā:;:8964AĀ: 3 Ā:A9679:MĀP< 6>9:342;8964ĀRA6>OĀ9@:Ā3?B3Ā2;8>Ā234L6MMĀP< #34h?9ĀG:A6OĀ%4ĀR;98>9Ā@6?@ĀR96;6b:AĀ9@:ĀF43 U:4 M 96ĀV3969?ĀG9R74BĀ+! +ĀHFU VGĀ!+J8AĀ@: L: 396?8;ĀM89ĀRFA::ĀT6OR3I

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												D@Ā5 2;438964>Ā:;8964AĀ: 3 Ā:A9689:MĀP< 6>9:32;8964ĀRA6>OĀ9@:Ā3?B3MĀ2;8Ā423 4L6MMĀP< #34h?9ĀG:A6OĀ%4AR;98>9ĀQ@6?@ĀR96;6b:AĀ9@:Ā8F43 U:4 M 967ĀV3968?ĀG9R74BĀ+! +ĀHFUVGĀ!+J8AĀ@: L: 396?8;ĀM89ĀRA::ĀT6ORĀ31

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+!Ā"Ā$?968<Ā&48M]Ā/R69:Ā, 0 /8>ĀG6:O4]Ā%8;6B43>68Ā+!,!-		

Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex

Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

SCPT-23-021

Total depth: 108.14 ft, Date: 2/6/2023

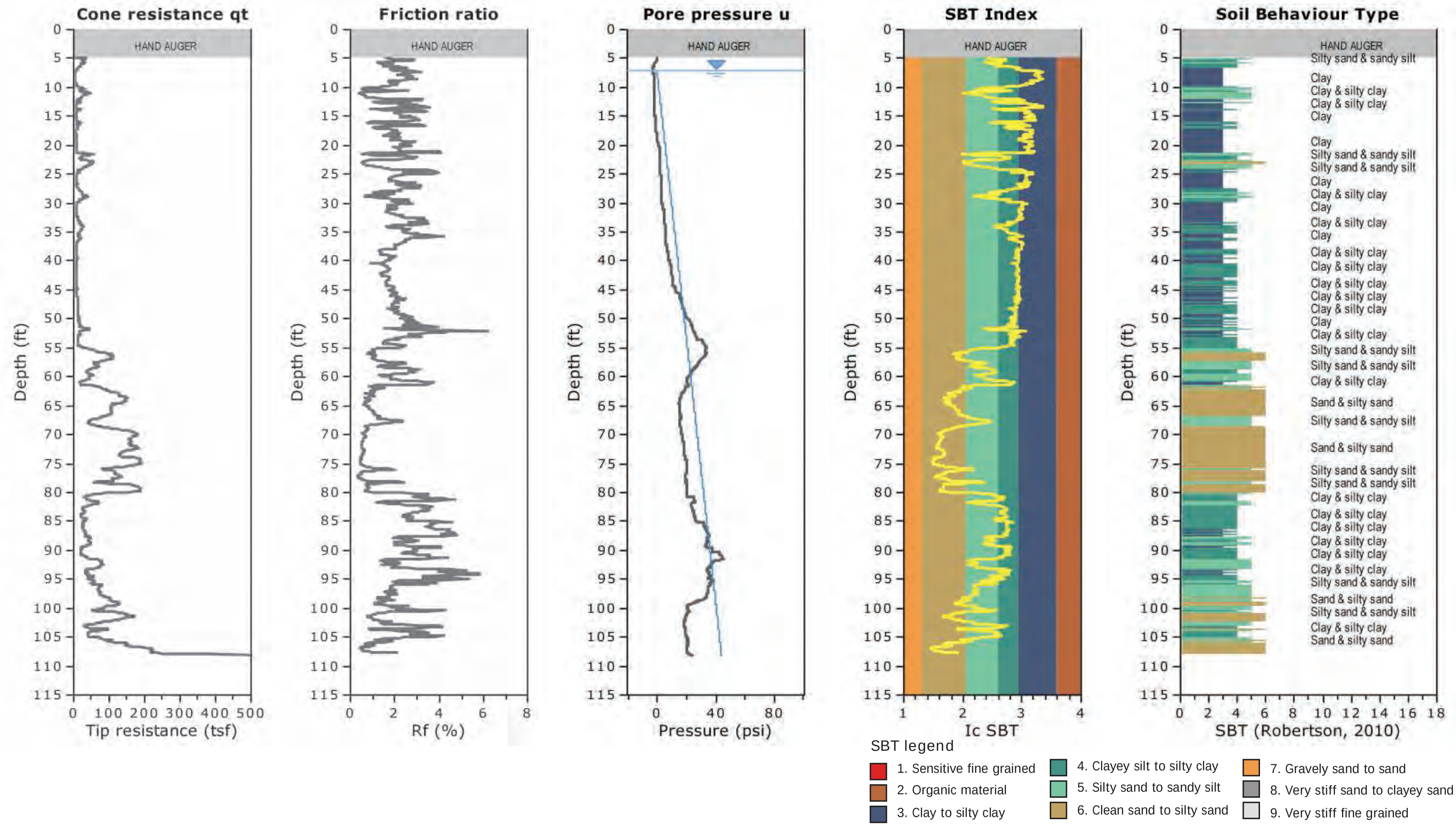


FIGURE A-9

Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex

Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

SCPT-23-022

Total depth: 105.45 ft, Date: 2/6/2023

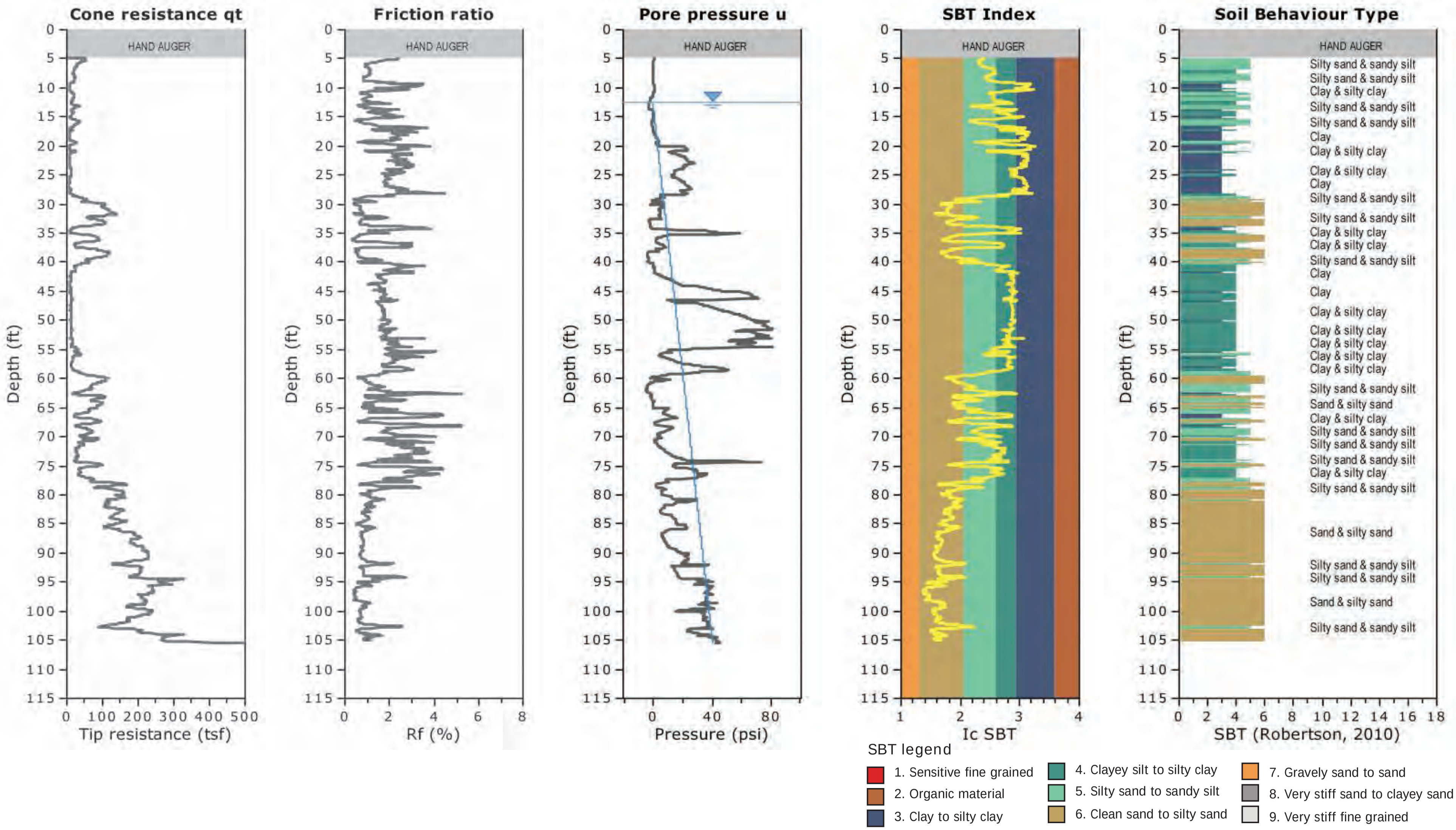


FIGURE A-10

Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex

Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

CPT-23-023

Total depth: 108.33 ft, Date: 2/6/2023

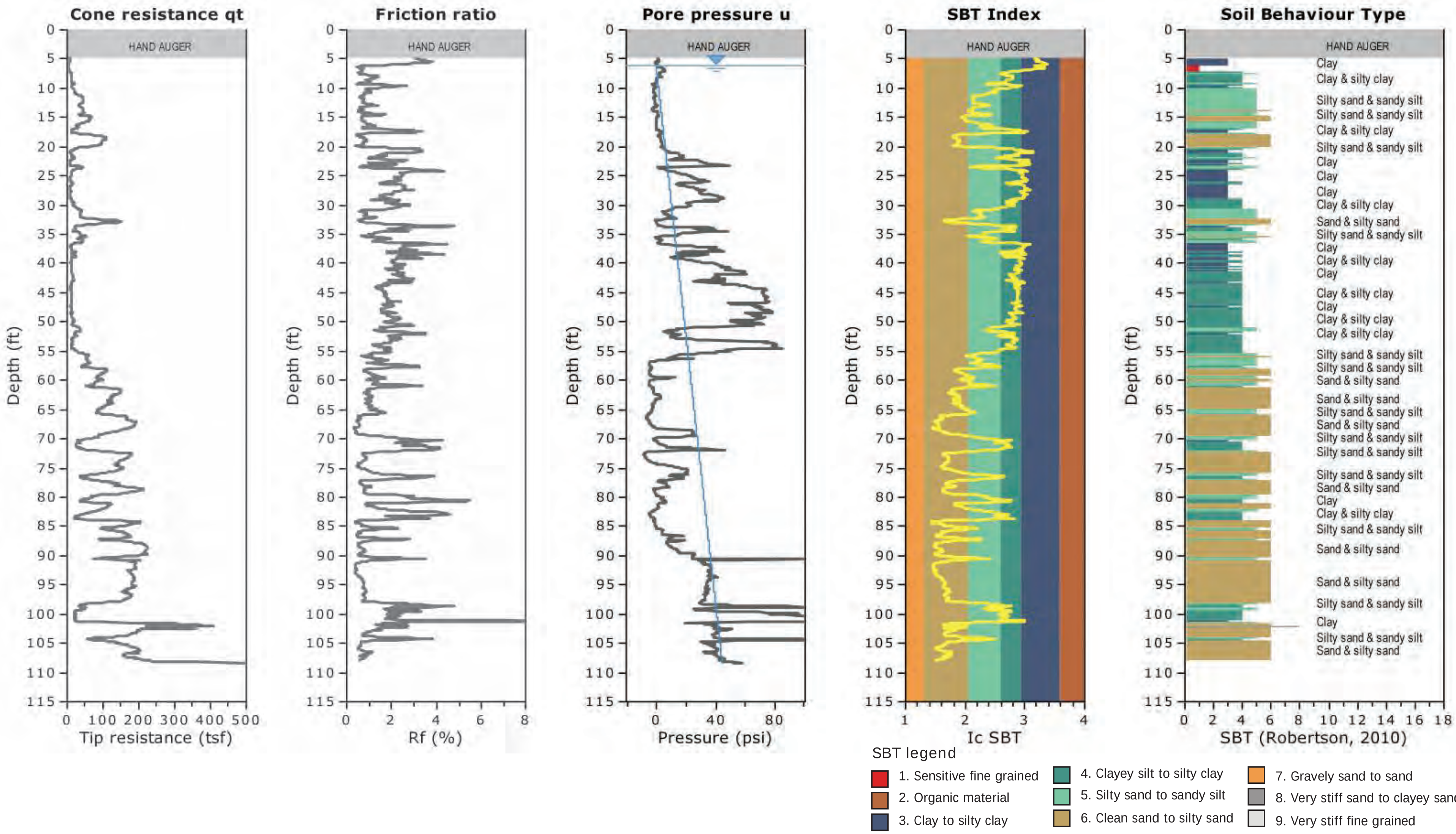


FIGURE A-11

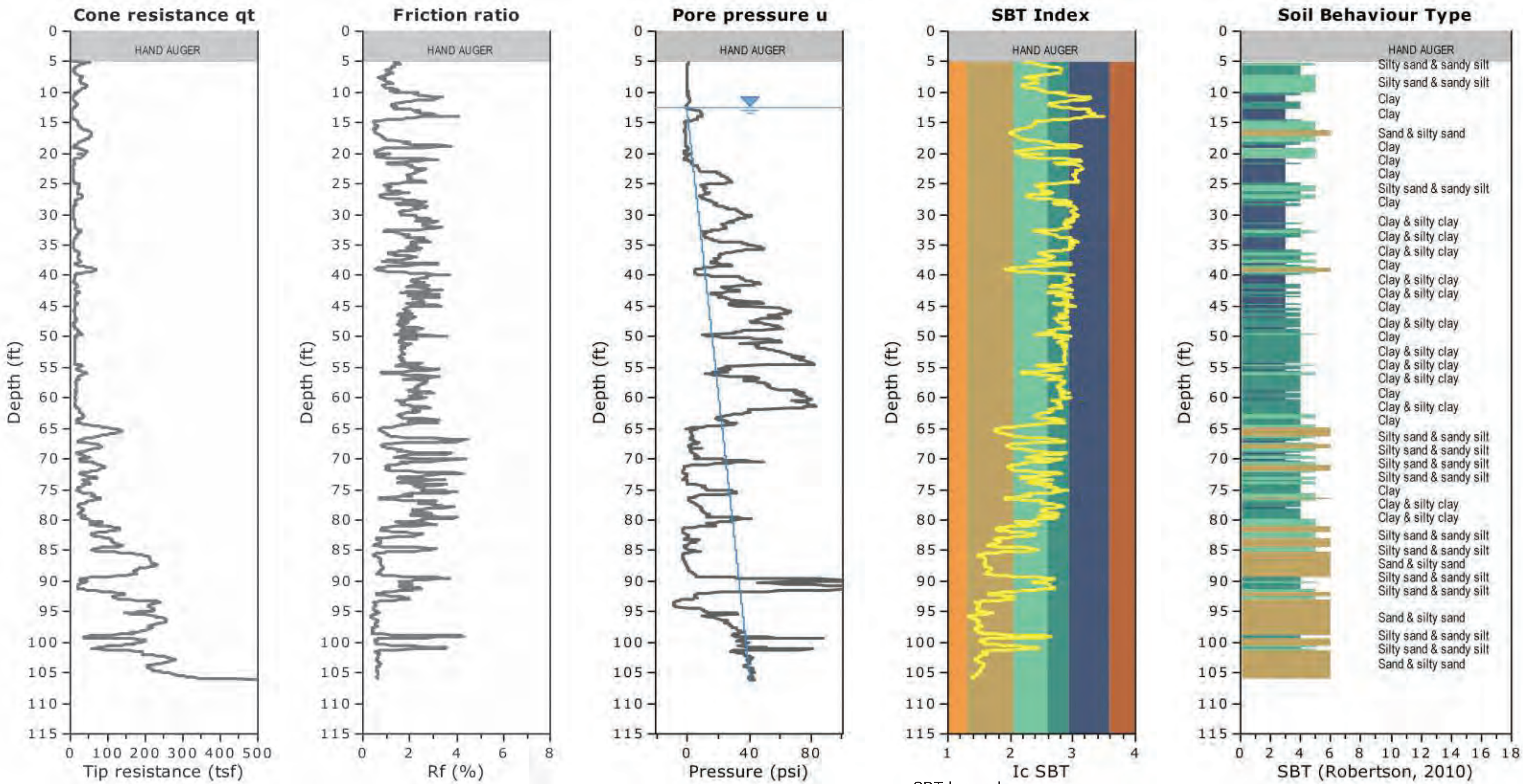
GROUP DELTA
Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex

Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

SCPT-23-024

Total depth: 106.23 ft, Date: 2/7/2023



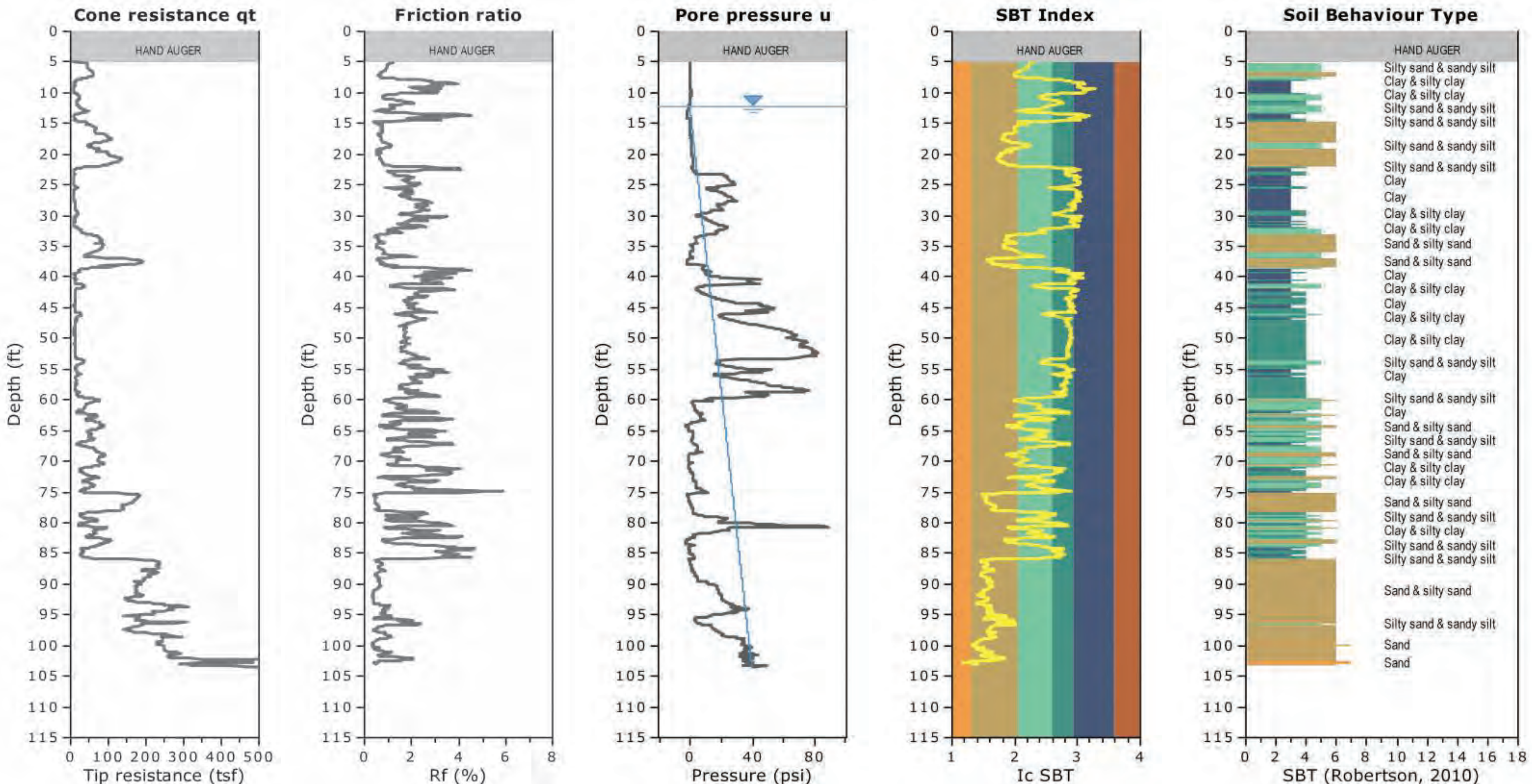
SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex
Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

SCPT-23-025
Total depth: 103.48 ft, Date: 2/7/2023



SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

FIGURE A-13

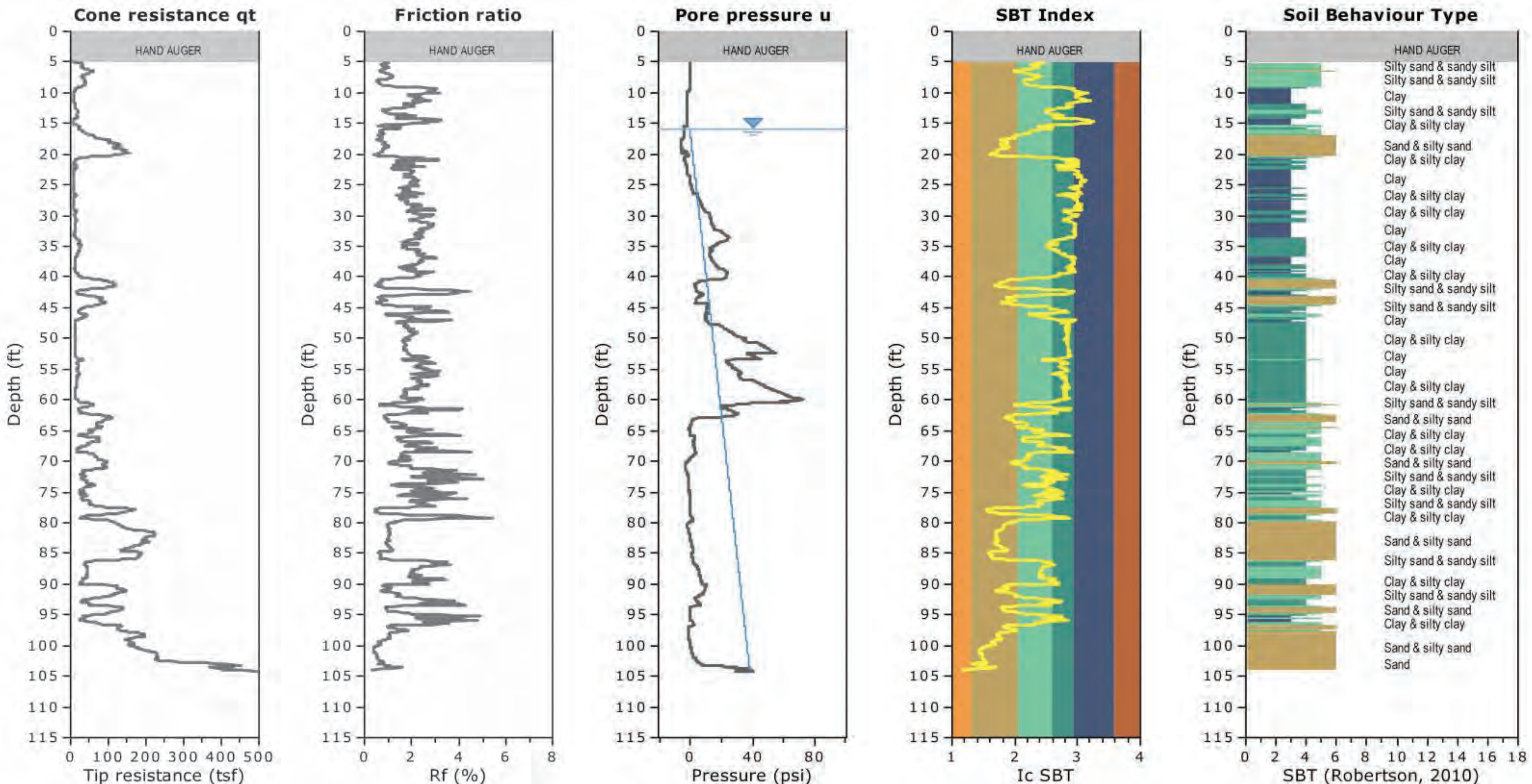
Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex

Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

CPT-23-026

Total depth: 104.27 ft, Date: 2/7/2023



SBT legend
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

CPeT-IT v.3.9.2.21 - CPTU data presentation & interpretation software - Report created on: 4/25/2023, 8:38:28 PM

FIGURE A-14

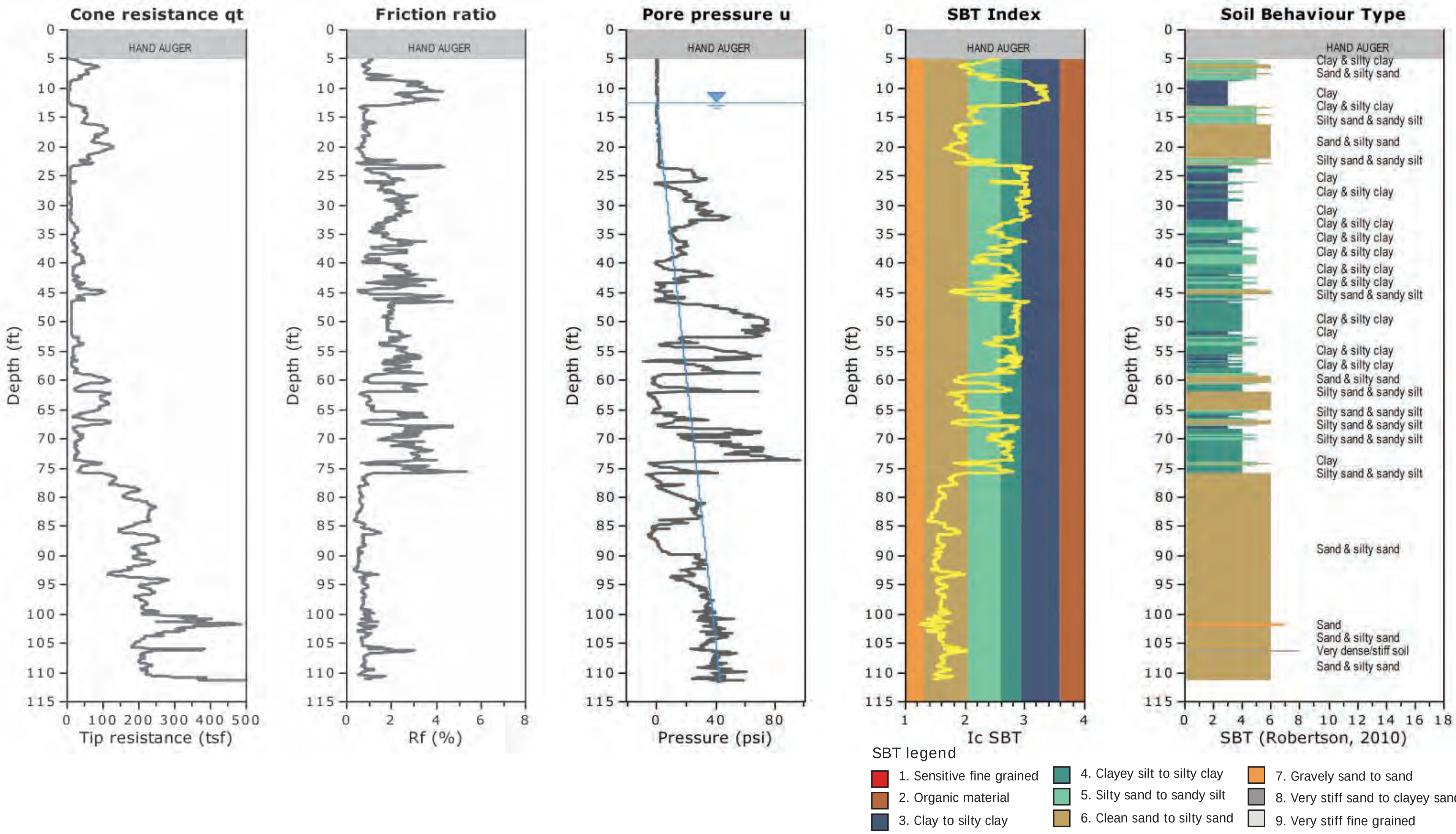
Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex

Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

CPT-23-027

Total depth: 111.56 ft, Date: 3/15/2023



CPeT-IT v.3.9.2.21 - CPTU data presentation & interpretation software - Report created on: 4/25/2023, 8:38:30 PM

FIGURE A-15

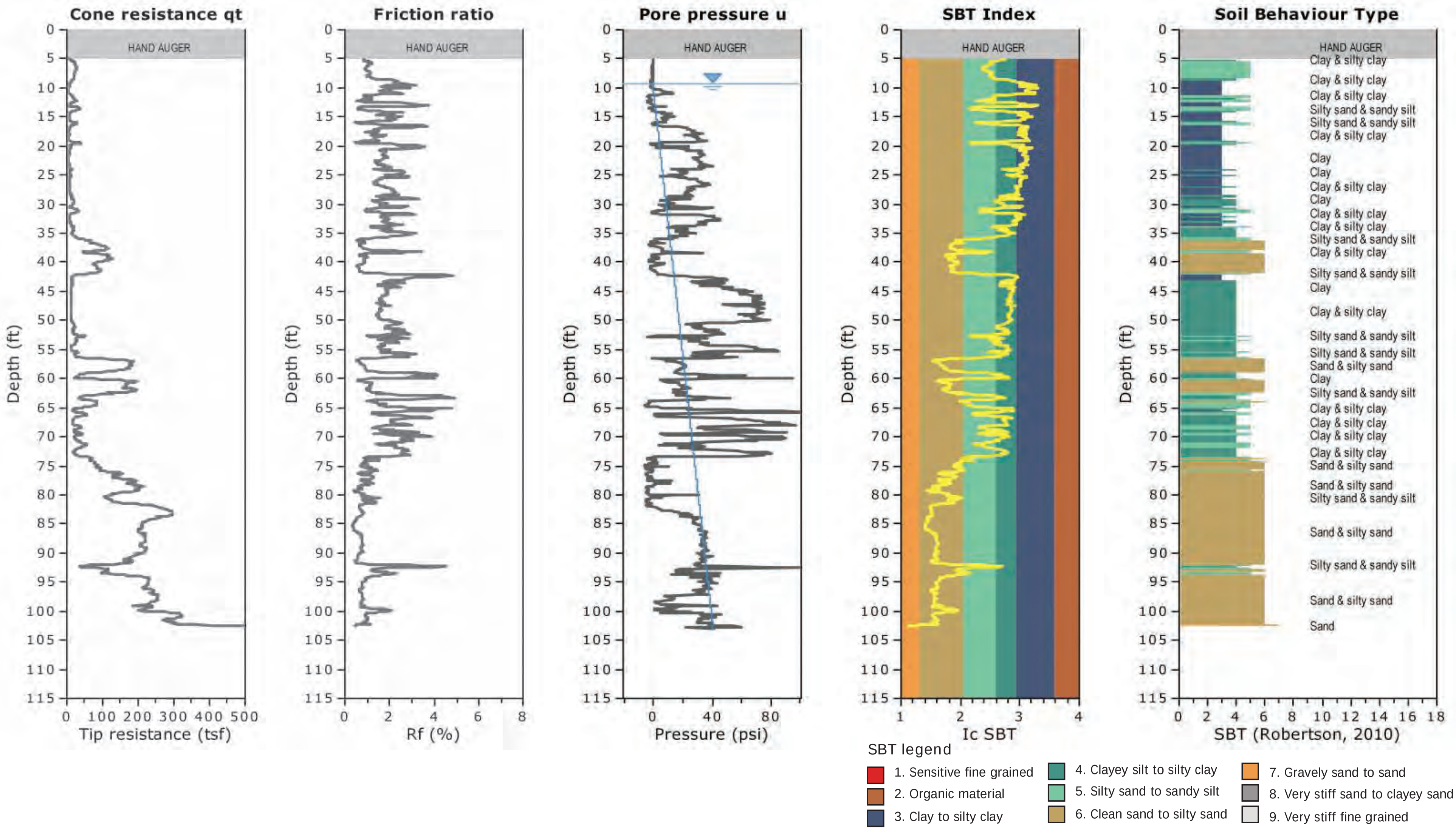
Group Delta Consultants, Inc.
9245 Activity Road, Suite 103
San Diego, California 92126
www.GroupDelta.com

Project: Midway Rising Sports Arena Complex

Location: 3220, 3240, 3250, and 3500 Sports Arena Blvd, San Diego, California

SCPT-23-028

Total depth: 102.97 ft, Date: 3/15/2023



CPeT-IT v.3.9.2.21 - CPTU data presentation & interpretation software - Report created on: 4/25/2023, 8:38:31 PM

FIGURE A-16

Midway Rising Sports Arena Complex
3220, 3240, 3250, and 3500 Sports Arena Boulevard
San Diego, California

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
SCPT-23-021	5.31	4.31	4.75	6.20	766	
	10.14	9.14	9.36	16.04	583	468
	15.06	14.06	14.20	26.44	537	466
	20.18	19.18	19.28	37.68	512	452
	25.03	24.03	24.11	49.36	489	413
	30.05	29.05	29.12	59.15	492	511
	40.65	39.65	39.70	79.00	503	533
	45.41	44.41	44.46	89.16	499	468
	50.46	49.46	49.50	98.48	503	541
	55.15	54.15	54.19	106.84	507	561
	60.30	59.30	59.33	113.48	523	775
	65.06	64.06	64.09	120.12	534	716
	69.98	68.98	69.01	126.12	547	820
	75.10	74.10	74.13	133.10	557	733
	80.05	79.05	79.08	138.72	570	880
	85.17	84.17	84.19	145.60	578	744
	90.16	89.16	89.18	152.24	586	751
	95.05	94.05	94.07	158.14	595	829
	100.03	99.03	99.05	164.44	602	790

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

Midway Rising Sports Arena Complex
3220, 3240, 3250, and 3500 Sports Arena Boulevard
San Diego, California

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
SCPT-23-022	5.02	4.02	4.49	5.88	764	
	10.27	9.27	9.48	12.06	786	808
	15.03	14.03	14.17	22.68	625	441
	20.05	19.05	19.15	32.24	594	521
	25.03	24.03	24.11	44.52	542	404
	30.09	29.09	29.16	55.76	523	449
	35.07	34.07	34.13	63.04	541	683
	40.06	39.06	39.11	70.64	554	656
	45.05	44.05	44.10	79.96	551	535
	50.00	49.00	49.04	89.92	545	497
	55.02	54.02	54.06	98.18	551	607
	60.04	59.04	59.07	106.10	557	633
	65.06	64.06	64.09	113.92	563	642
	70.05	69.05	69.08	120.32	574	779
	75.03	74.03	74.06	127.20	582	724
	80.02	79.02	79.05	134.78	586	658
	85.04	84.04	84.06	140.38	599	896
	90.03	89.03	89.05	145.16	613	1044
	95.01	94.01	94.03	149.44	629	1163
	100.00	99.00	99.02	153.96	643	1104

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

Midway Rising Sports Arena Complex
3220, 3240, 3250, and 3500 Sports Arena Boulevard
San Diego, California

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
SCPT-23-024	5.05	4.05	4.52	5.80	779	
	10.07	9.07	9.29	11.96	777	775
	15.06	14.06	14.20	22.88	621	450
	20.08	19.08	19.18	31.36	612	588
	25.07	24.07	24.15	41.42	583	494
	30.02	29.02	29.09	51.60	564	485
	35.10	34.10	34.16	60.60	564	563
	40.06	39.06	39.11	68.92	567	595
	45.11	44.11	44.16	79.10	558	495
	50.13	49.13	49.17	87.34	563	609
	55.41	54.41	54.45	96.30	565	589
	60.07	59.07	59.10	102.86	575	710
	65.06	64.06	64.09	111.36	576	587
	70.05	69.05	69.08	118.40	583	708
	75.07	74.07	74.10	124.84	594	779
	80.09	79.09	79.12	130.60	606	871
	85.10	84.10	84.12	137.40	612	737
	90.03	89.03	89.05	143.14	622	859
	95.11	94.11	94.13	149.58	629	789
	100.00	99.00	99.02	155.62	636	809

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

Midway Rising Sports Arena Complex
3220, 3240, 3250, and 3500 Sports Arena Boulevard
San Diego, California

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
SCPT-23-025	4.99	3.99	4.46	4.28	1043	
	10.04	9.04	9.26	10.92	848	722
	15.06	14.06	14.20	20.42	695	520
	20.14	19.14	19.24	28.56	674	619
	25.07	24.07	24.15	37.98	636	521
	30.05	29.05	29.12	49.24	591	441
	35.07	34.07	34.13	58.12	587	564
	40.16	39.16	39.21	65.96	594	648
	45.37	44.37	44.42	74.82	594	587
	50.07	49.07	49.11	83.84	586	521
	55.09	54.09	54.13	92.92	583	552
	60.01	59.01	59.04	101.28	583	588
	65.09	64.09	64.12	107.92	594	765
	70.11	69.11	69.14	114.76	602	734
	75.03	74.03	74.06	121.20	611	764
	80.09	79.09	79.12	126.56	625	944
	85.10	84.10	84.12	133.40	631	732
	90.09	89.09	89.11	140.48	634	705
	95.08	94.08	94.10	144.86	650	1139
	100.03	99.03	99.05	149.68	662	1027

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

Midway Rising Sports Arena Complex
3220, 3240, 3250, and 3500 Sports Arena Boulevard
San Diego, California

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
SCPT-23-028	5.02	4.02	4.49	4.26	1054	
	10.04	9.04	9.26	15.76	587	415
	15.03	14.03	14.17	26.20	541	471
	20.05	19.05	19.15	38.22	501	415
	25.07	24.07	24.15	51.28	471	383
	30.02	29.02	29.09	62.18	468	453
	35.04	34.04	34.10	71.20	479	555
	40.06	39.06	39.11	78.80	496	660
	45.05	44.05	44.10	86.40	510	656
	50.49	49.49	49.53	93.78	528	736
	55.45	54.45	54.49	101.08	539	679
	60.07	59.07	59.10	107.28	551	745
	65.09	64.09	64.12	113.38	566	823
	70.08	69.08	69.11	121.64	568	604
	75.07	74.07	74.10	128.04	579	779
	80.05	79.05	79.08	133.60	592	895
	85.04	84.04	84.06	138.52	607	1014
	90.06	89.06	89.08	144.02	619	912
	95.08	94.08	94.10	148.80	632	1050
	100.07	99.07	99.09	152.68	649	1286

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

APPENDIX B

LABORATORY TESTING

Laboratory testing was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions and in the same locality. No warranty, express or implied, is made as to the correctness or serviceability of the test results, or the conclusions derived from these tests. Where a specific laboratory test method has been referenced, such as ASTM or Caltrans, the reference only applies to the specified laboratory test method, which has been used only as a guidance document for the general performance of the test and not as a "Test Standard". A brief description of the tests follows.

Classification: Soils were visually classified according to the Unified Soil Classification System as established by the American Society of Civil Engineers per ASTM D2487. The soil classifications are shown on the boring logs in Appendix A.

Particle Size Analysis: Particle size analyses were performed in general accordance with ASTM D6913 and D1140, and were used to supplement visual classifications. The test results are summarized on the Boring Records in Appendix A and are presented in detail in Figures B-1.1 through B-1.17.

Atterberg Limits: ASTM D4318 was used to determine the liquid and plastic limits, and plasticity index of selected soil samples. The test results are presented with the associated gradation analyses in Figures B-1.1 through B-1.16 and are also summarized in Figure B-2.1 and B-2.2.

Expansion Index: The expansion potential of selected soil samples was estimated in general accordance with ASTM D4829. The test results are summarized in Figure B-3. Figure B-3 also presents common criteria for evaluating the expansion potential based on the expansion index.

pH and Resistivity: To assess the potential for reactivity with buried metals, selected soil samples were tested for pH and minimum resistivity using Caltrans test method 643. The corrosivity test results are summarized in Figure B-4.

Sulfate Content: To assess the potential for reactivity with concrete, selected soil samples were tested for water soluble sulfate. The sulfate was extracted from the soil under vacuum using a 10:1 (water to dry soil) dilution ratio. The extracted solution was tested for water soluble sulfate in general accordance with ASTM D516. The test results are also presented in Figure B-4, along with common criteria for evaluating soluble sulfate content.

Chloride Content: Soil samples were also tested for water soluble chloride. The chloride was extracted from the soil under vacuum using a 10:1 (water to dry soil) dilution ratio. The extracted solution was then tested for water soluble chloride using a calibrated ion specific electronic probe in general accordance with ASTM D512. The test results are also shown in Figure B-4.

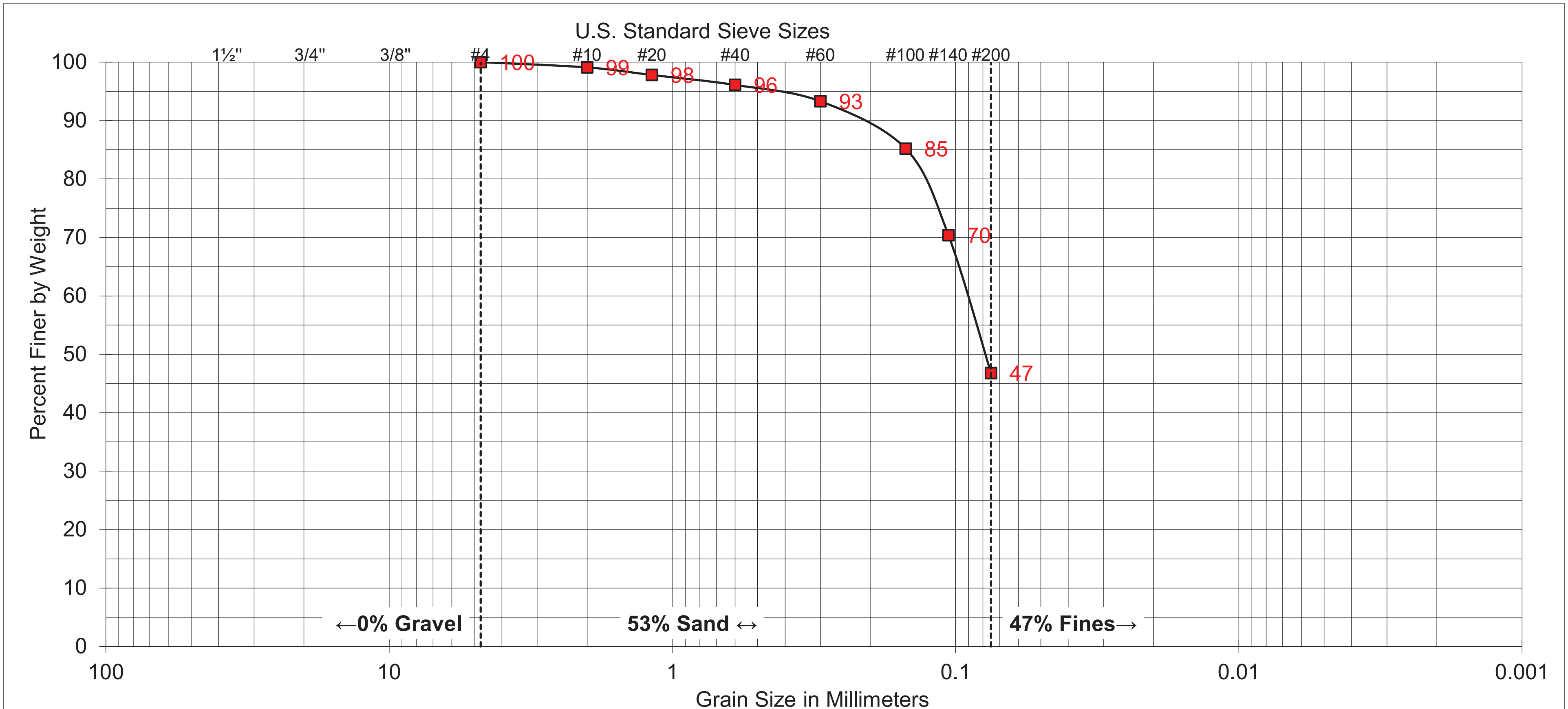
APPENDIX B

LABORATORY TESTING (Continued)

Direct Shear: The shear strength of selected partially intact samples of the soils from the site were assessed using direct shear testing performed in general accordance with ASTM D3080. The test results are shown in Figures B-5.1 through B-5.4.

Unconfined Compressive Strength: The undrained shear strength of two selected soil samples were assessed using unconfined compression testing performed in general accordance with ASTM D2166. The test results are presented in Figure B-6.1 and B-6.2. The Pocket Penetration tests conducted on clayey samples during the field investigation are shown in the Boring Records in Appendix A.

Consolidation: The one-dimensional consolidation properties of the selected samples were evaluated in general accordance with ASTM D2435. The samples were inundated with water under a nominal seating load, allowed to swell, and then subjected to controlled stress increments while restrained laterally and drained axially. The test results are presented in Figure B-7.1 through B-7.3.



GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION ID:	A-23-011
SAMPLE DEPTH:	0.5' - 5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

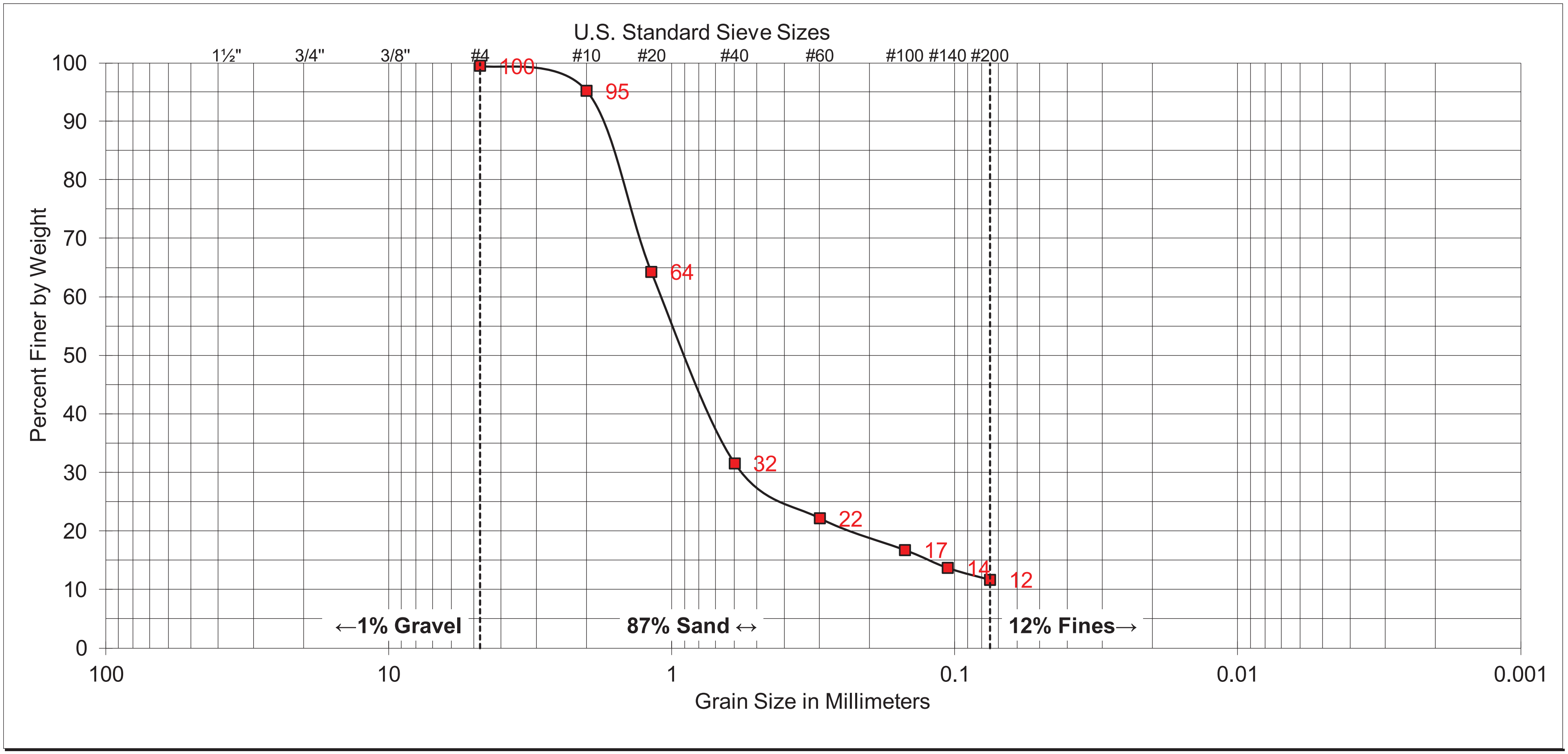
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.1



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	A-23-012
SAMPLE DEPTH:	31-31.5'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

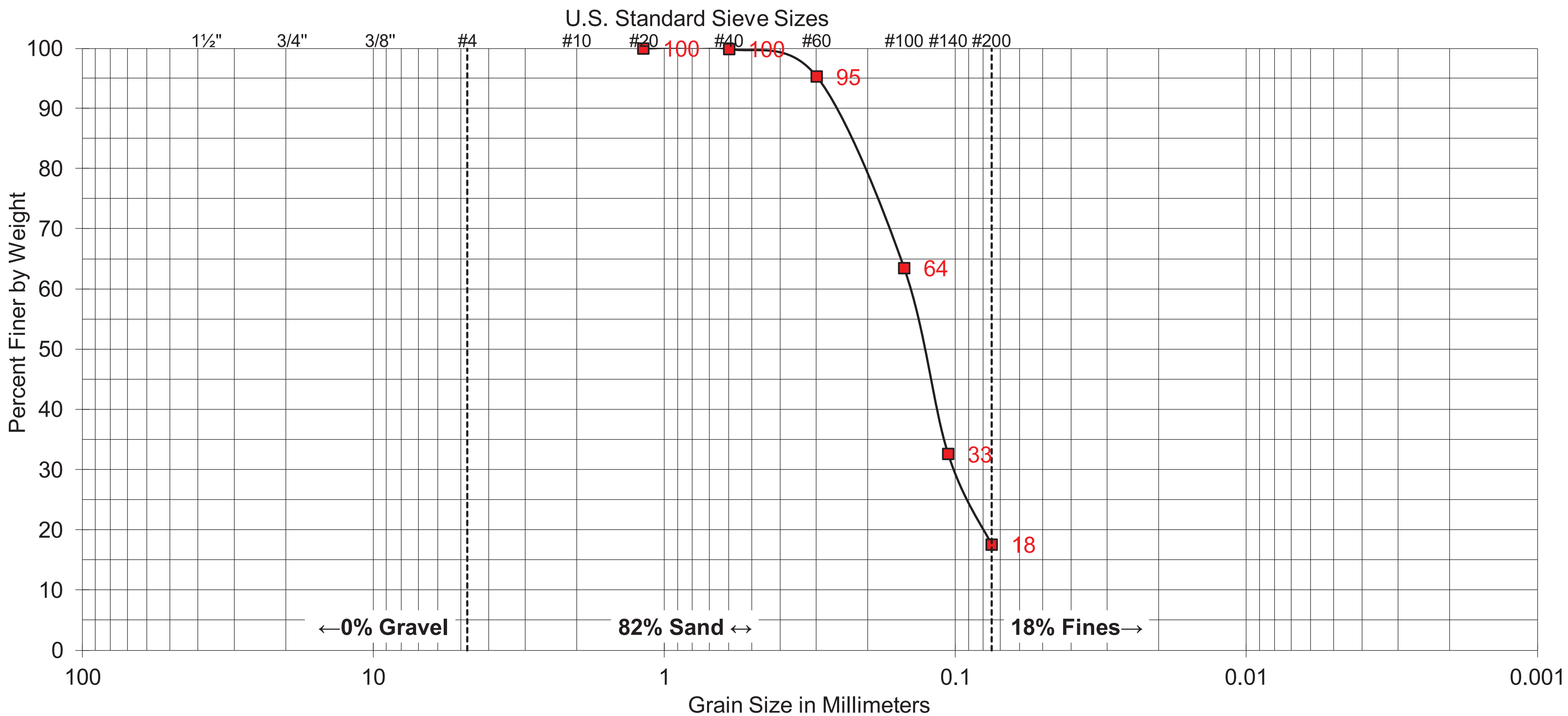
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.2



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	A-23-013
SAMPLE DEPTH:	16-16.5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

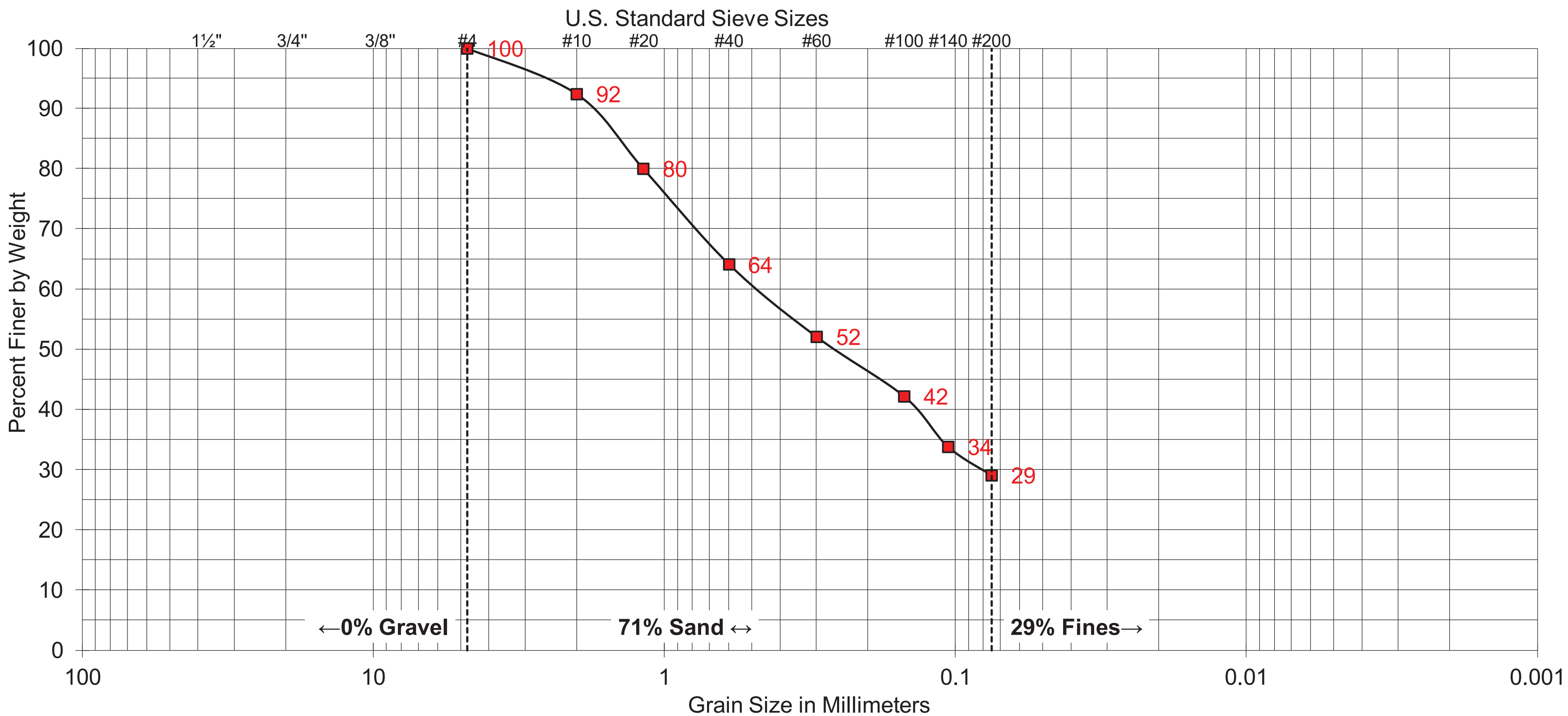
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.3



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	A-23-014
SAMPLE DEPTH:	5-6.5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

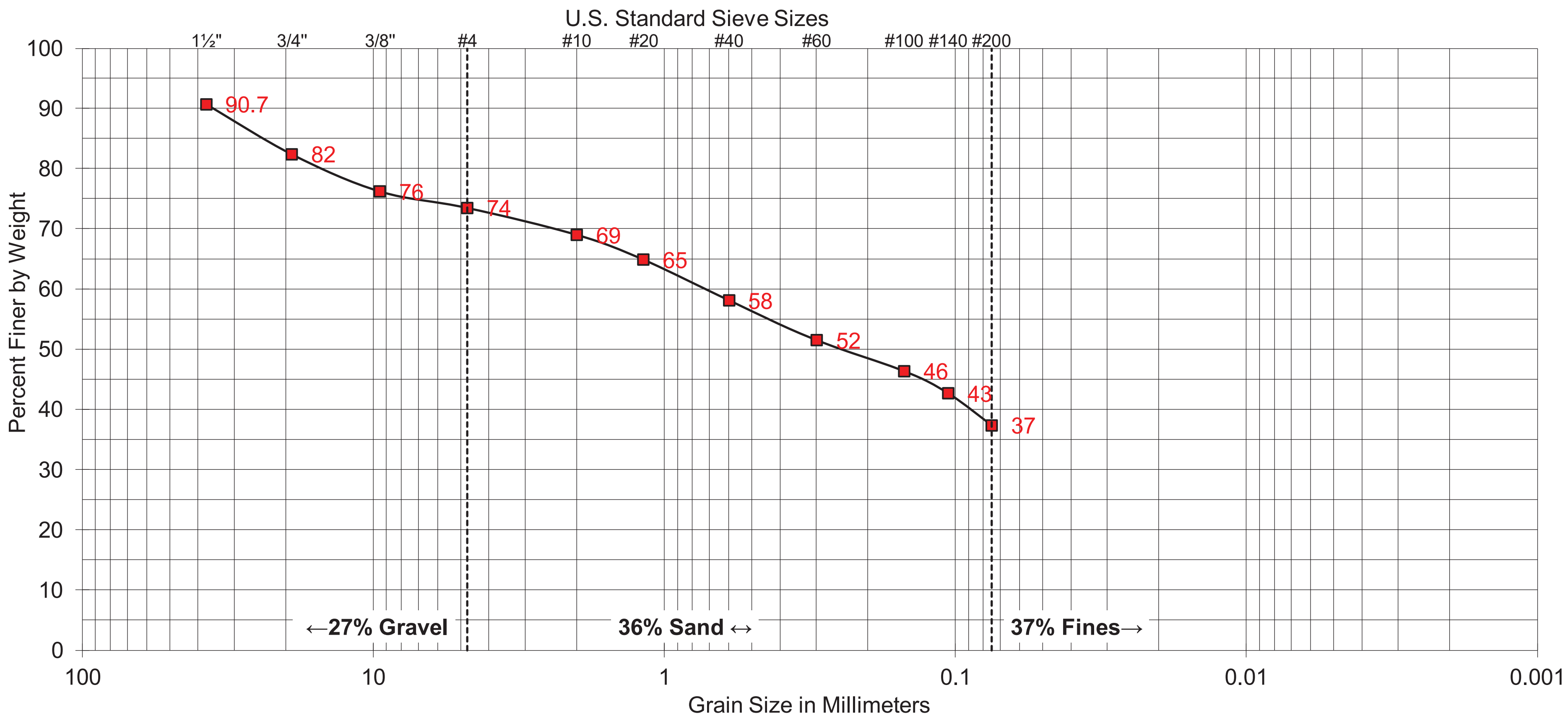
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.4



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND
GRAVEL		SAND			CLAY

SAMPLE	
EXPLORATION ID:	A-23-015
SAMPLE DEPTH:	0.5-5'

UNIFIED SOIL CLASSIFICATION: SC-SM

DESCRIPTION: CLAYEY SAND WITH GRAVEL

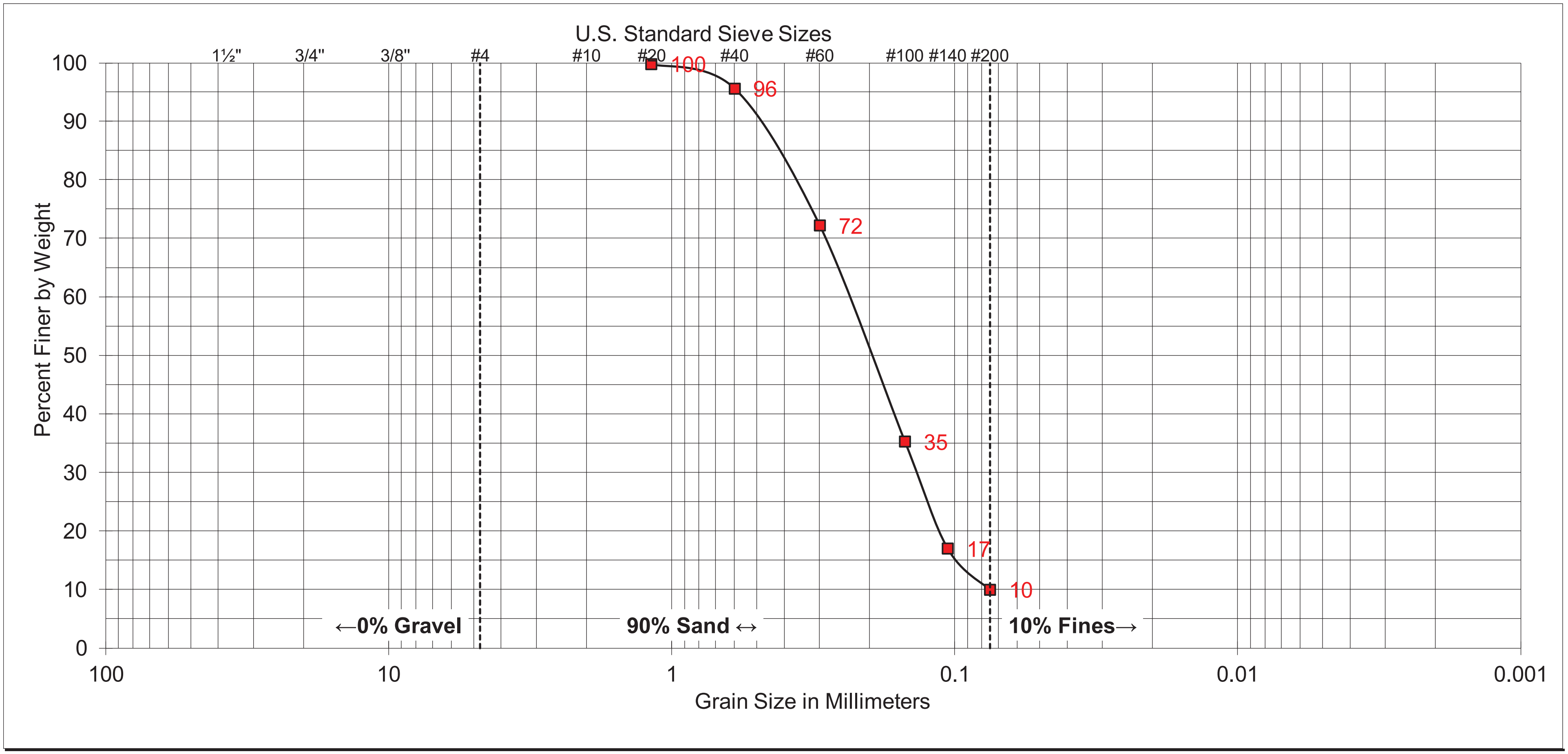
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.5



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND
GRAVEL		SAND			CLAY

SAMPLE	
EXPLORATION ID:	A-23-015
SAMPLE DEPTH:	15-16.5'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

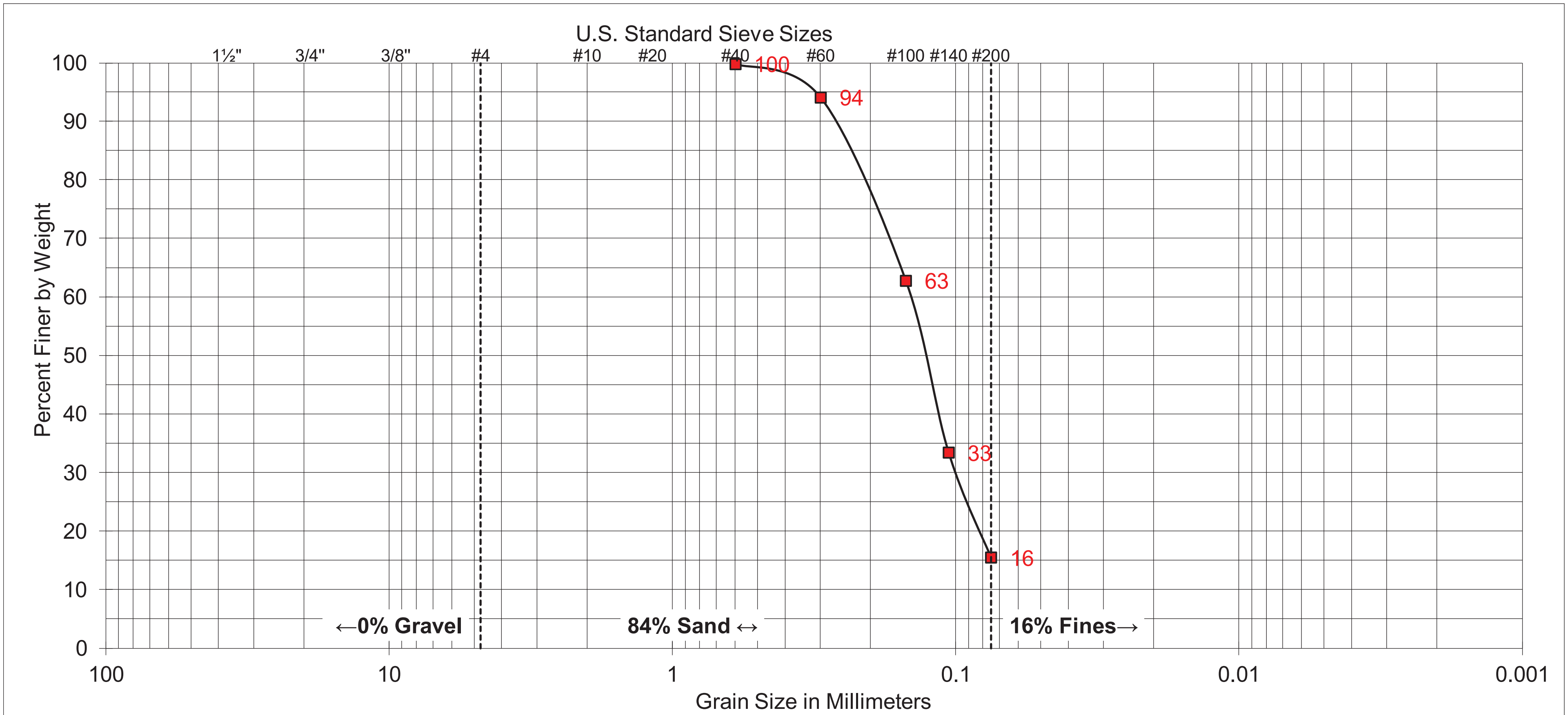
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.6



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	A-23-016
SAMPLE DEPTH:	0.5-5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

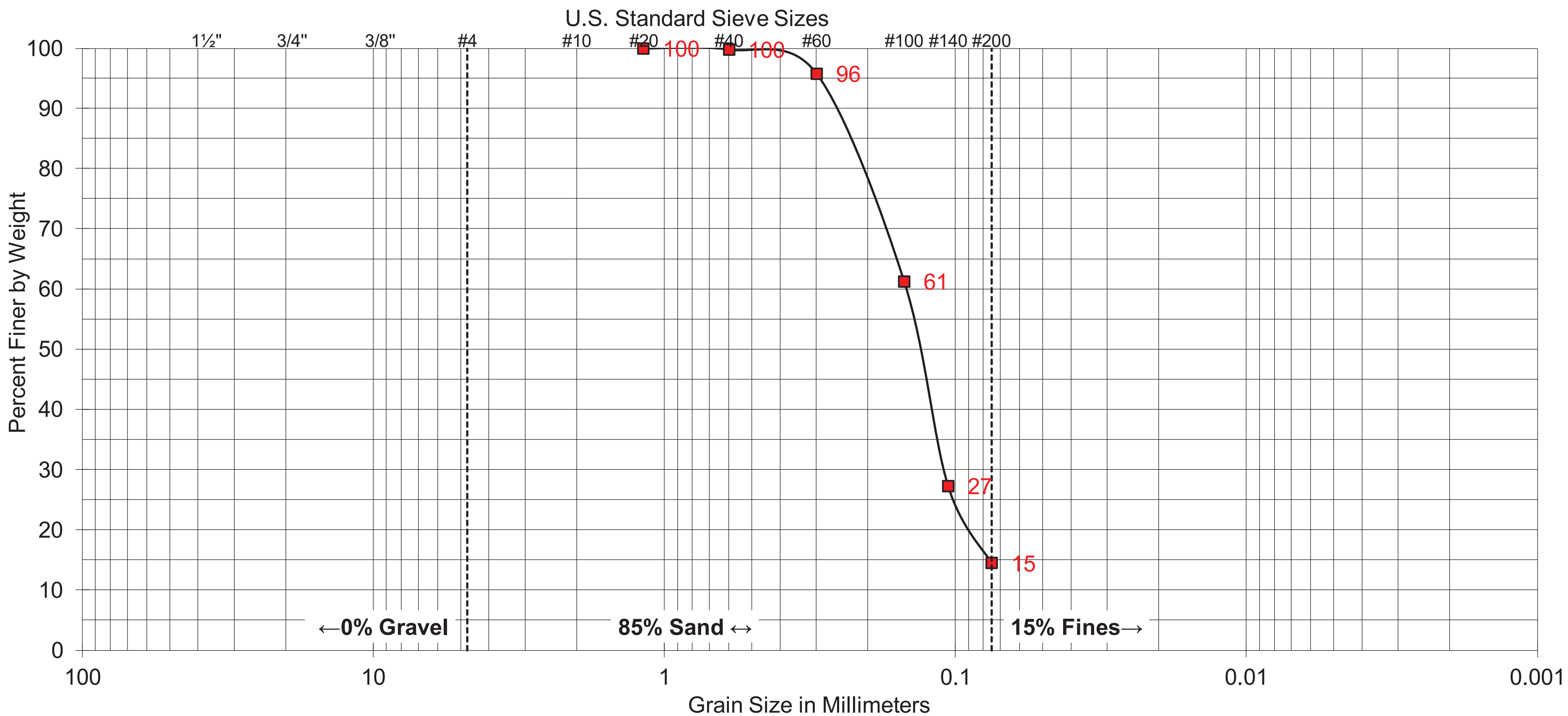
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.7



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	A-23-016
SAMPLE DEPTH:	40-41.5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

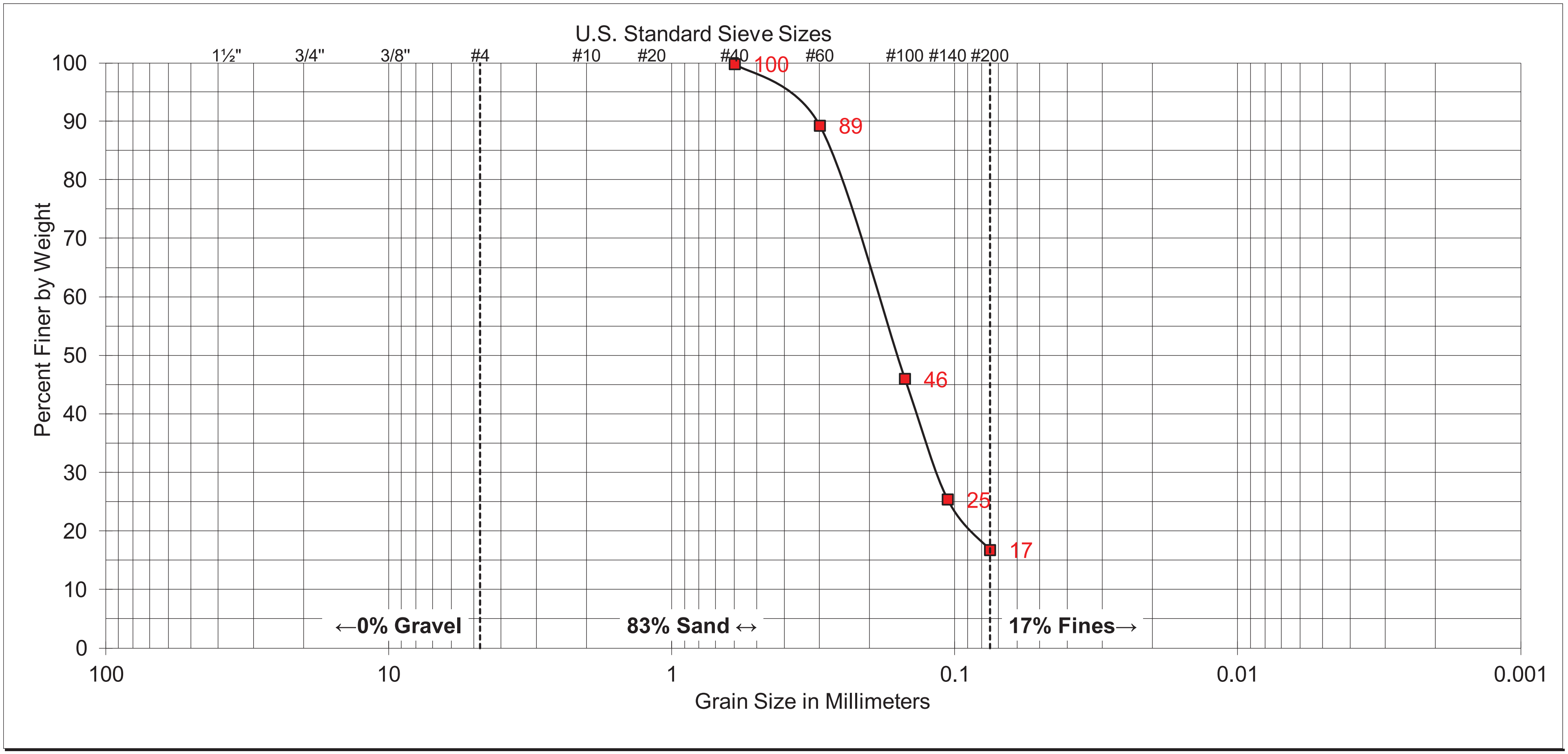
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.8



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	R-23-001
SAMPLE DEPTH:	21-21.5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

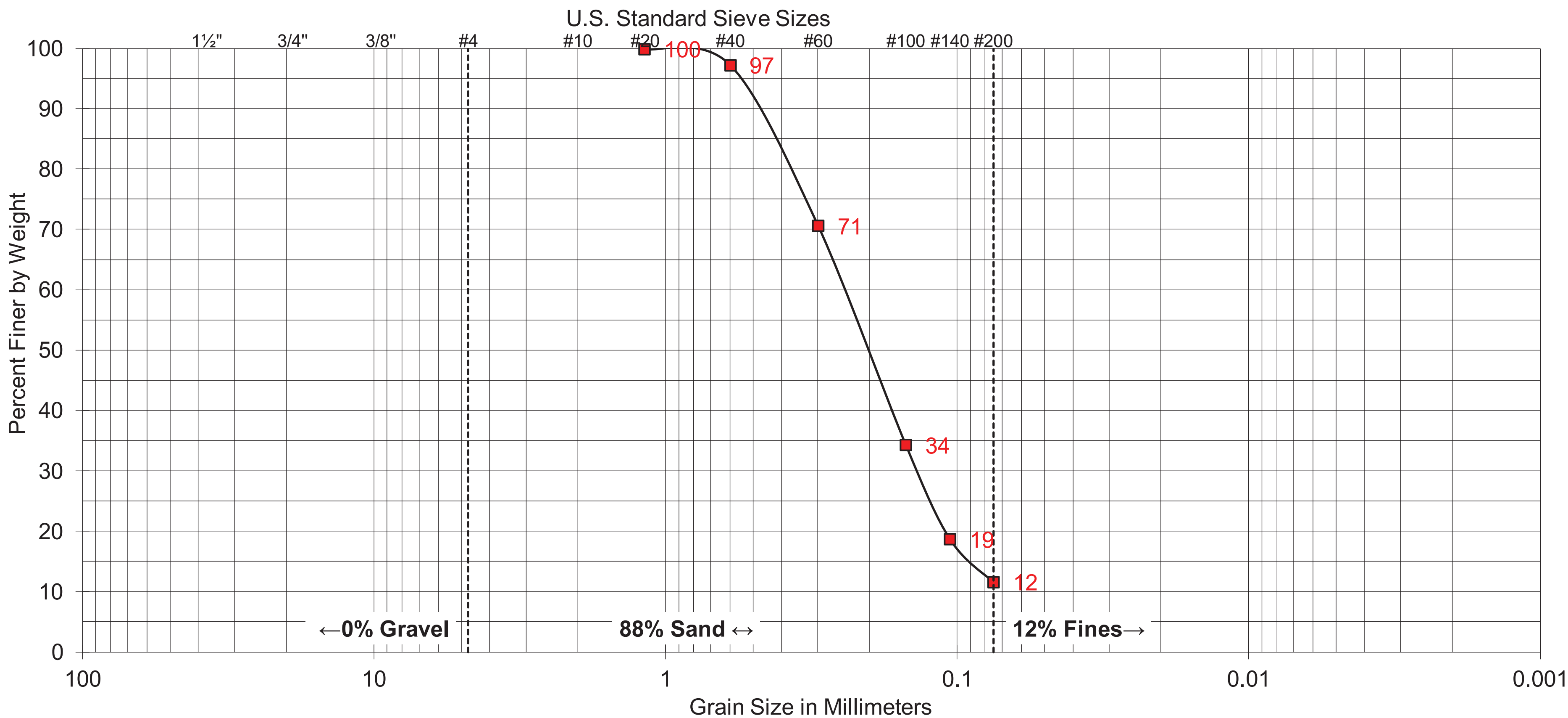
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.9



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	R-23-001
SAMPLE DEPTH:	31-31.5'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

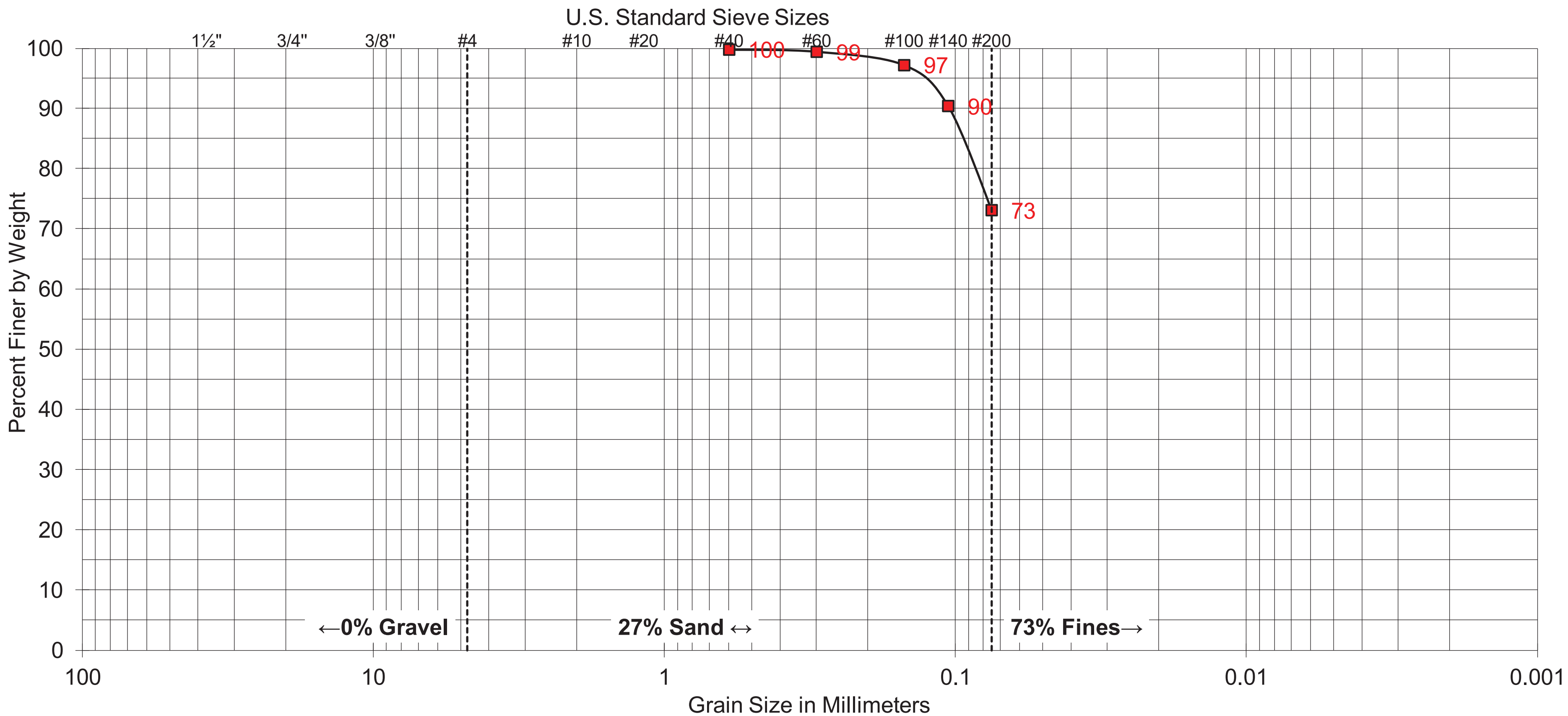
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.10



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND
GRAVEL		SAND			CLAY

SAMPLE	
EXPLORATION ID:	R-23-001
SAMPLE DEPTH:	61-61.5'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SILT WITH SAND

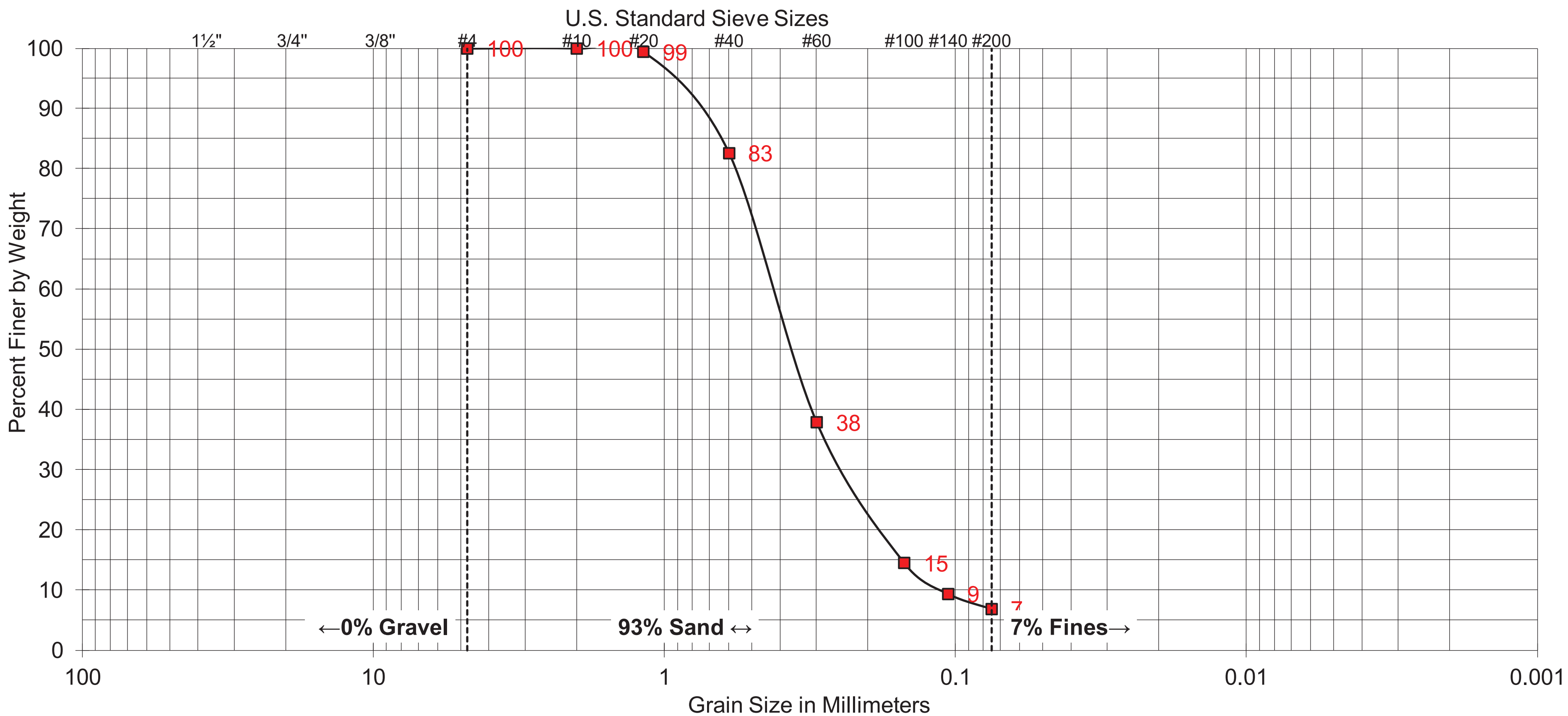
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.11



GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE	
EXPLORATION ID:	R-23-001
SAMPLE DEPTH:	91-91.5'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

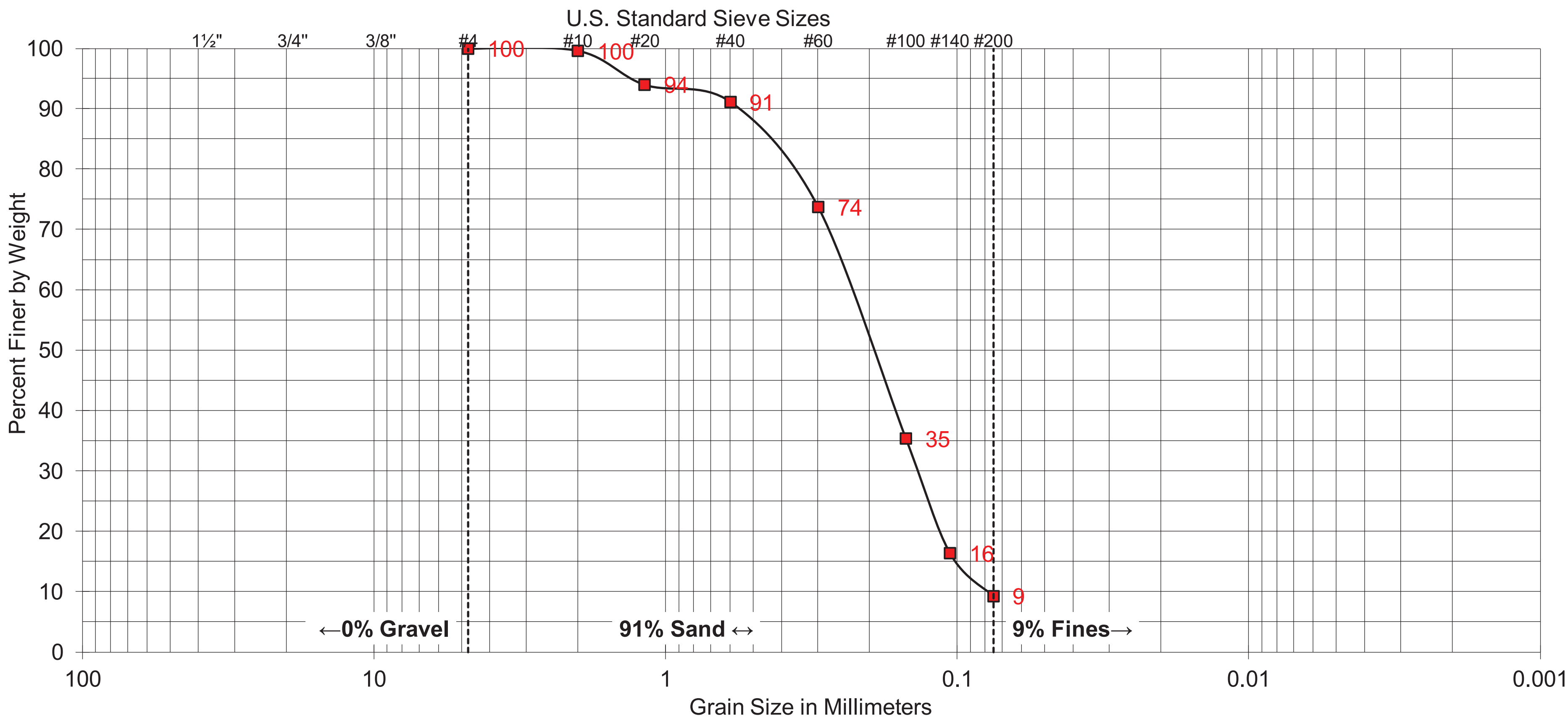
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.12



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND
GRAVEL		SAND			CLAY

SAMPLE	
EXPLORATION ID:	R-23-002
SAMPLE DEPTH:	25-26.5'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

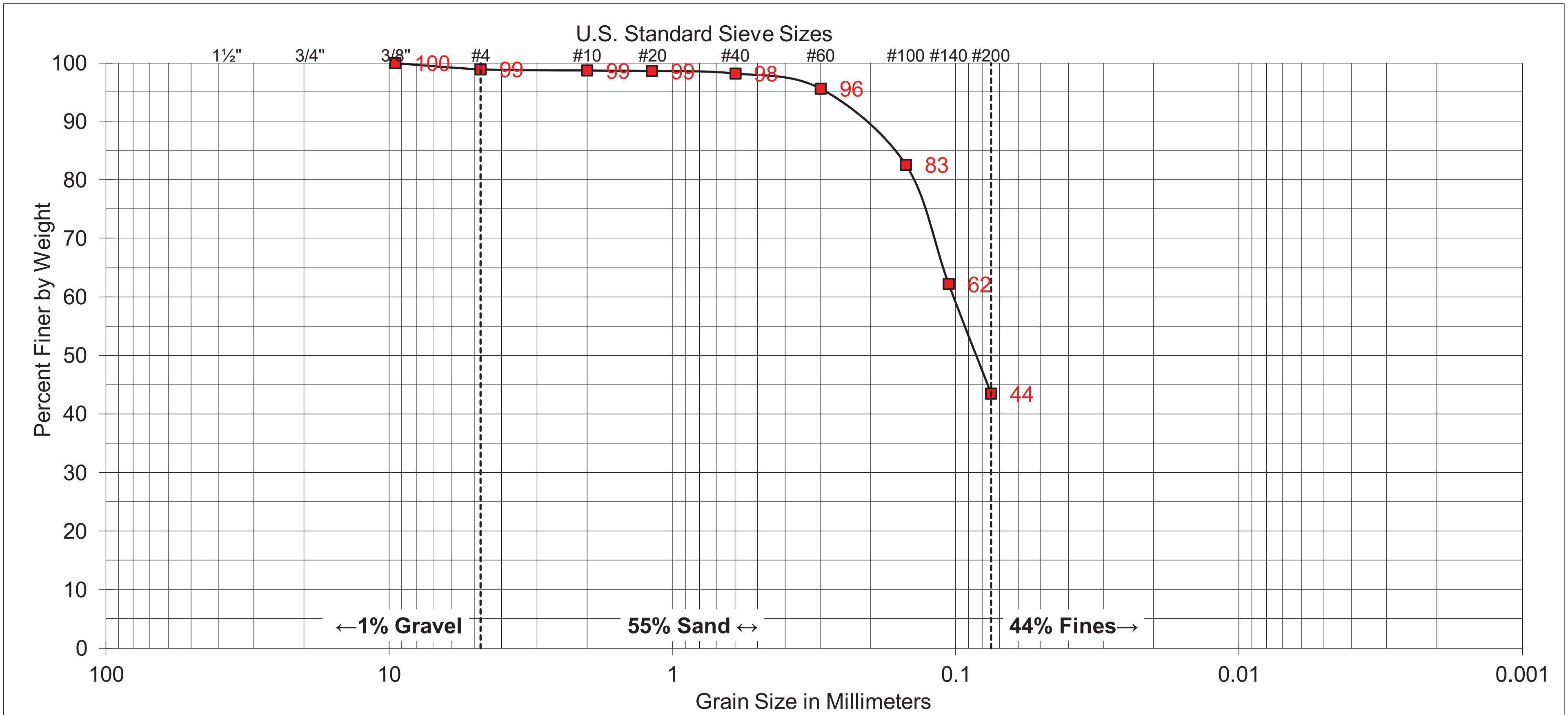
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.13



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	R-23-002
SAMPLE DEPTH:	55-56.5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

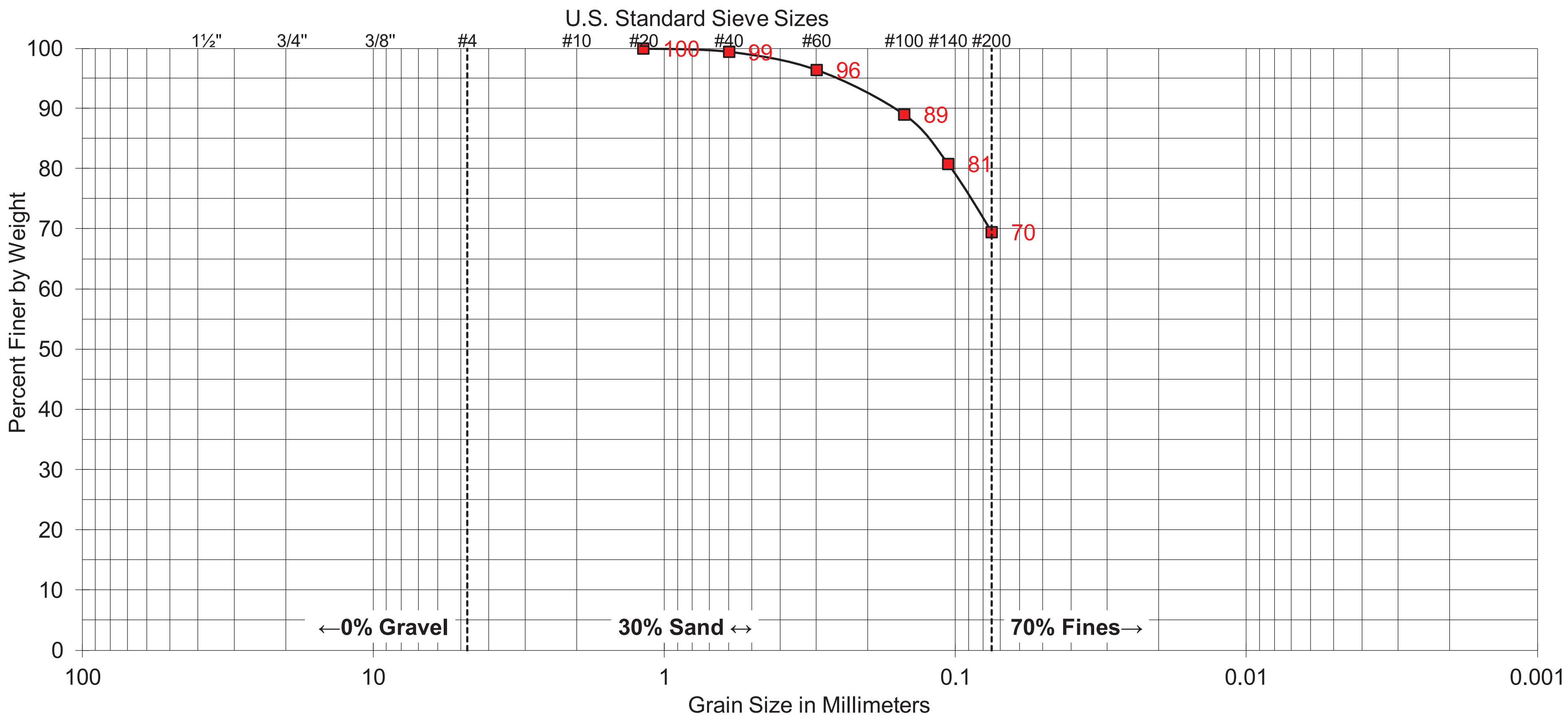
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.14



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	R-23-002
SAMPLE DEPTH:	66-66.5'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SANDY SILT

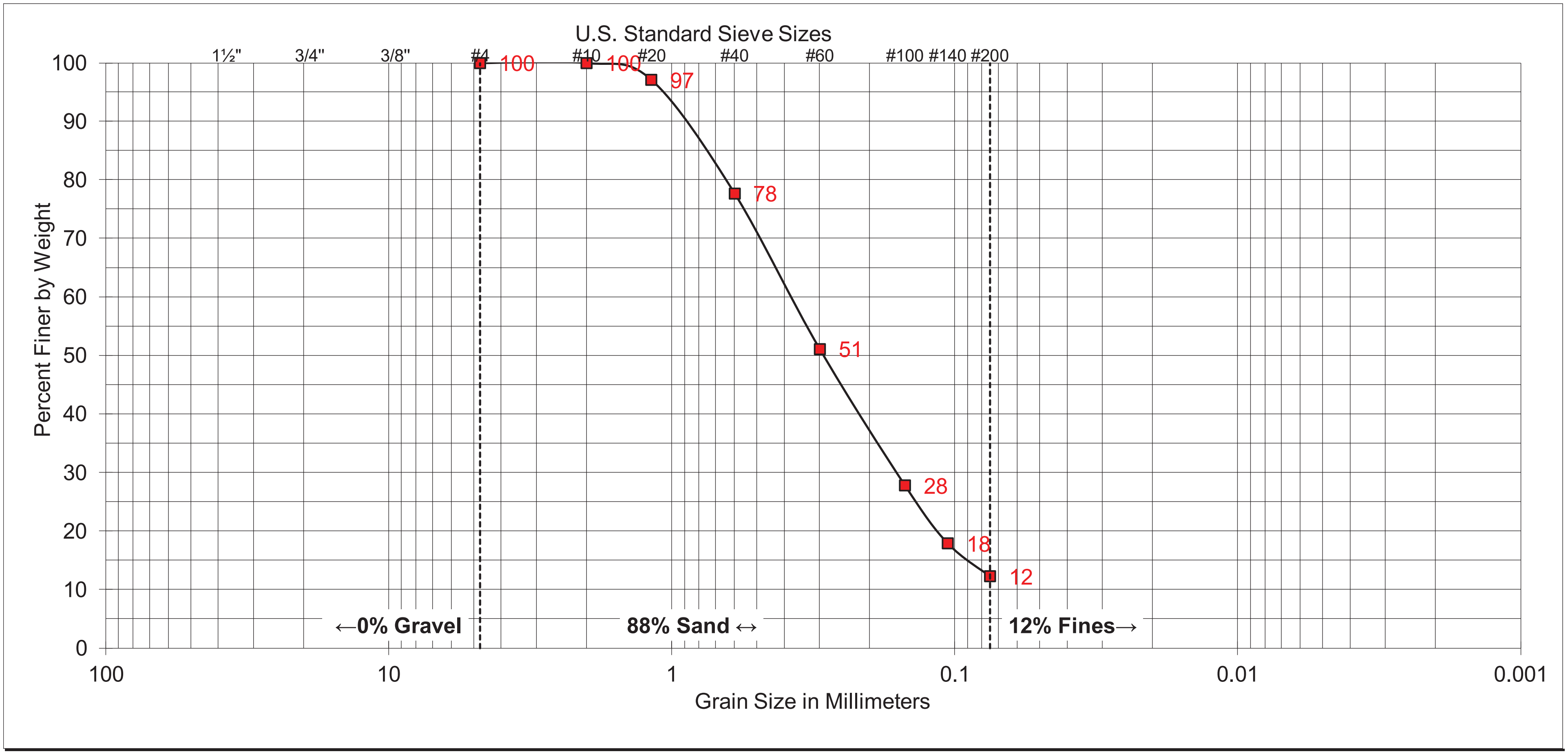
ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

Project No. SD760

FIGURE B-1.15



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	
EXPLORATION ID:	R-23-002
SAMPLE DEPTH:	81-81.5'

UNIFIED SOIL CLASSIFICATION: SM

DESCRIPTION: SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT:	--
PLASTIC LIMIT:	--
PLASTICITY INDEX:	--

GROUP DELTA

SOIL CLASSIFICATION

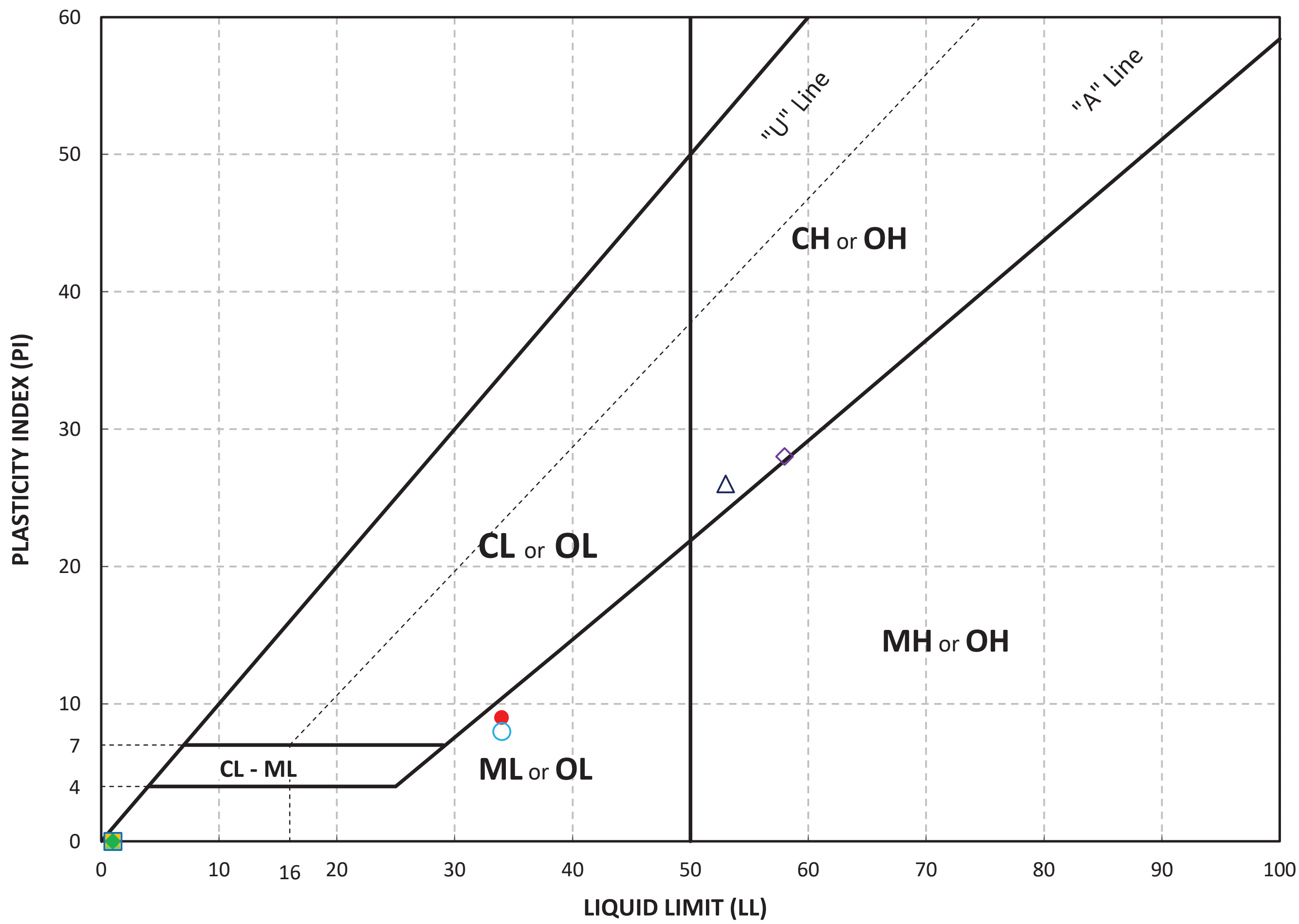
Project No. SD760

FIGURE B-1.16

PERCENT PASSING THE NO. 200 SIEVE
(ASTM D1140)

SAMPLE	DESCRIPTION	PERCENT PASSING THE NO. 200 (%)
A-23-011 @ 11' – 11.5'	SILT with SAND (ML)	73
A-23-012 @ 21' – 21.5'	SILTY SAND (SM)	38
A-23-013 @ 5' – 6.5'	SILTY SAND (SM)	13
A-23-014 @ 20' – 21.5'	Poorly Graded SAND with SILT (SP-	8
A-23-016 @ 25' – 27.5'	SANDY SILT (ML)	59
A-23-016 @ 35' – 35.5'	SANDY Lean CLAY (CL)	60
R-23-001 @ 15' – 16.5'	Poorly Graded SAND with SILT (SP-	16
R-23-001 @ 41' – 41.5'	Fat CLAY (CH)	91
R-23-001 @ 45' – 47.5'	Fat CLAY (CH)	91
R-23-001 @ 55' – 56.5'	SILT (ML)	87
R-23-002 @ 15' – 16.5'	SILTY SAND (SM)	46
R-23-002 @ 35' – 36.5'	SANDY SILT (ML)	59
R-23-002 @ 45' – 46.5'	SILT with SAND (ML)	79
R-23-002 @ 50' – 52.5'	SILTY SAND (SM)	44

ATTERBERG LIMITS
(ASTM D4318)



SYMBOL	BORING NO.	DEPTH	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION (USCS)
●	A-23-011	11' - 11.5'	34	25	9	SILT with SAND (ML)
■	A-23-012	21' - 21.5'	NP	NP	NP	SILTY SAND (SM)
▲	A-23-012	31' - 31.5'	NP	NP	NP	Poorly Graded SAND with SILT (SP-SM)
◆	A-23-014	20' - 21.5'	NP	NP	NP	Poorly Graded SAND with SILT (SP-SM)
○	A-23-016	25' - 27.5'	34	26	8	SANDY SILT (ML)
□	R-23-001	15' - 16.5'	NP	NP	NP	Poorly Graded SAND with SILT (SP-SM)
△	R-23-001	41' - 41.5'	53	27	26	Fat CLAY (CH)
◇	R-23-001	45' - 47.5'	58	30	28	Fat CLAY (CH)

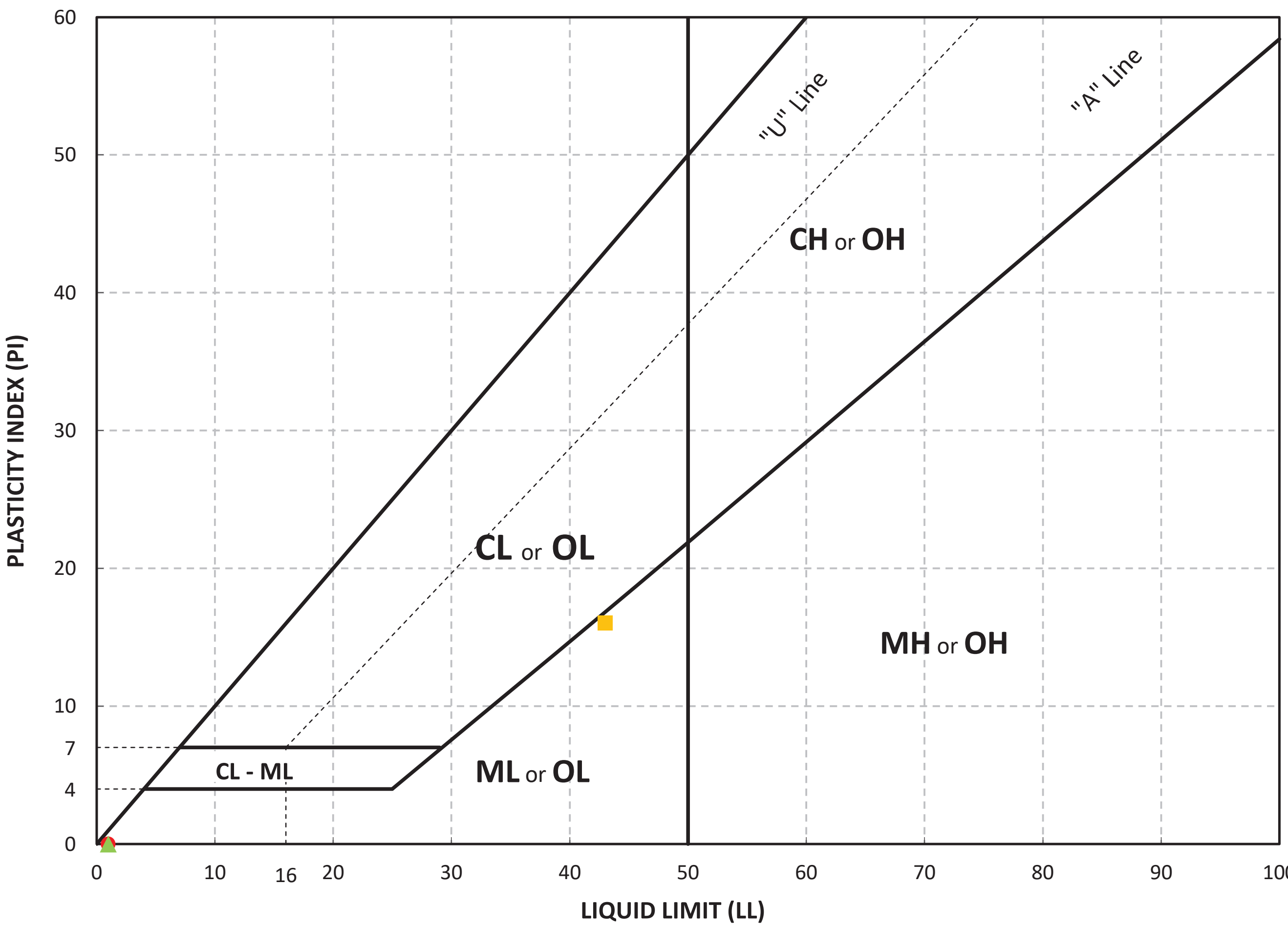
Notes: (1) Unified Soil Classification System (USCS) per ASTM D2487
(2) NP = Non-Plastic per ASTM D4318

GROUP DELTA

LABORATORY TEST RESULTS

Project No. SD760
FIGURE B-2.1

ATTERBERG LIMITS
(ASTM D4318)



SYMBOL	BORING NO.	DEPTH	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL DESCRIPTION (USCS)
●	R-23-002	35' - 36.5'	NP	NP	NP	SANDY SILT (ML)
■	R-23-002	45' - 46.5'	43	27	16	SILT with SAND (ML)
▲	R-23-002	50' - 52.5'	NP	NP	NP	SILTY SAND (SM)

Notes: (1) Unified Soil Classification System (USCS) per ASTM D2487
(2) NP = Non-Plastic per ASTM D4318

GROUP DELTA

LABORATORY TEST RESULTS

Project No. SD760
FIGURE B-2.2

EXPANSION TEST RESULTS
(ASTM D4829)

SAMPLE	DESCRIPTION	EXPANSION INDEX
A-23-011 @ 0.5' – 5'	SILTY SAND (SM)	6
A-23-014 @ 0.5' – 5'	CLAYEY SAND (SC)	13
A-23-015 @ 0.5' – 5'	CLAYEY SAND (SC)	36

EXPANSION INDEX	POTENTIAL EXPANSION
0 to 20	Very low
21 to 50	Low
51 to 90	Medium
91 to 130	High
Above 130	Very High

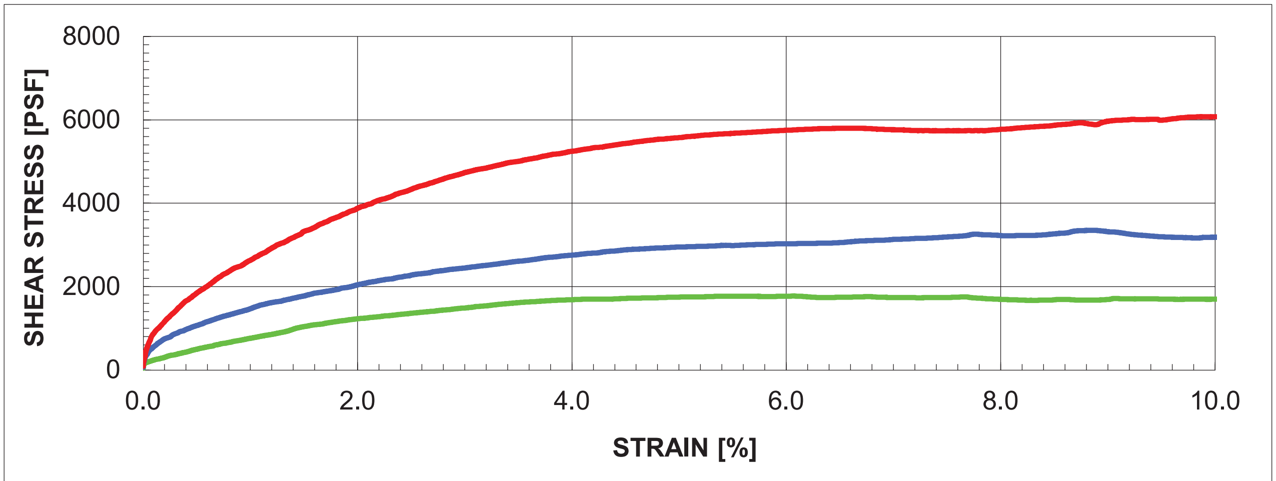
CORROSIVITY TEST RESULTS
(ASTM D516, CTM 643)

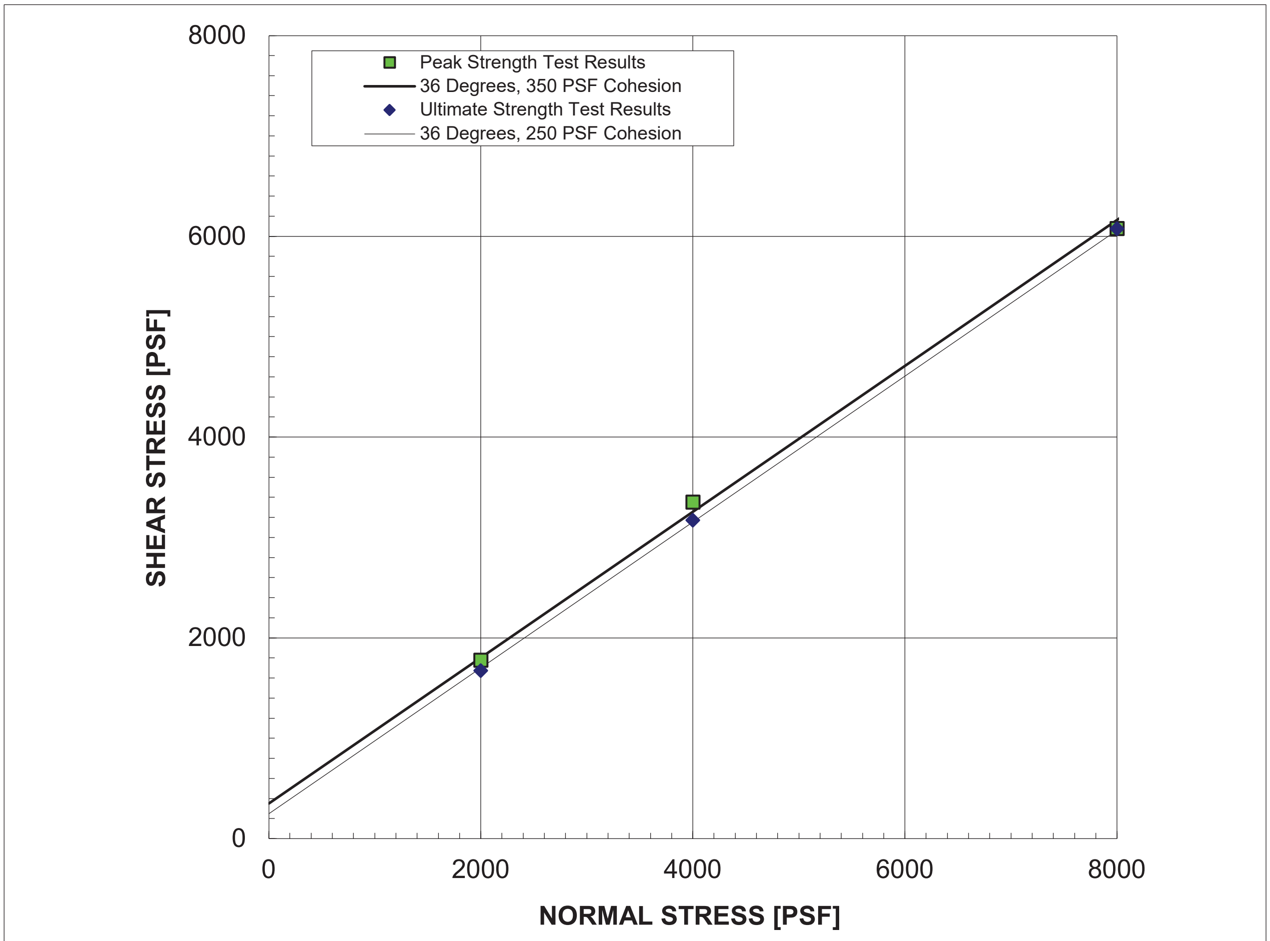
SAMPLE	pH	RESISTIVITY [OHM-CM]	SULFATE CONTENT [%]	CHLORIDE CONTENT [%]
A-23-011 @ 0.5' – 5'	8.15	7,962	<0.01	<0.01
A-23-015 @ 0.5' – 5'	8.33	1,387	0.01	<0.01
R-23-002 @ 21' – 21.5'	8.08	698	0.05	0.06

SULFATE CONTENT [%]	SULFATE EXPOSURE	CEMENT TYPE
0.00 to 0.10	Negligible	-
0.10 to 0.20	Moderate	II, IP(MS), IS(MS)
0.20 to 2.00	Severe	V
Above 2.00	Very Severe	V plus pozzolan

SOIL RESISTIVITY [OHM-CM]	GENERAL DEGREE OF CORROSIVITY TO FERROUS METALS
0 to 1,000	Very Corrosive
1,000 to 2,000	Corrosive
2,000 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
Above 10,000	Slightly Corrosive

CHLORIDE (Cl) CONTENT [%]	GENERAL DEGREE OF CORROSIVITY TO METALS
0.00 to 0.03	Negligible
0.03 to 0.15	Corrosive
Above 0.15	Severely Corrosive





SAMPLE: R-23-001 @ 61' - 61.5'

Description:
SILT with SAND (ML)

STRAIN RATE: 0.0007 IN/MIN

(Sample was consolidated and drained)

	PEAK	ULTIMATE
ϕ'	36 °	36 °
C'	350 PSF	250 PSF

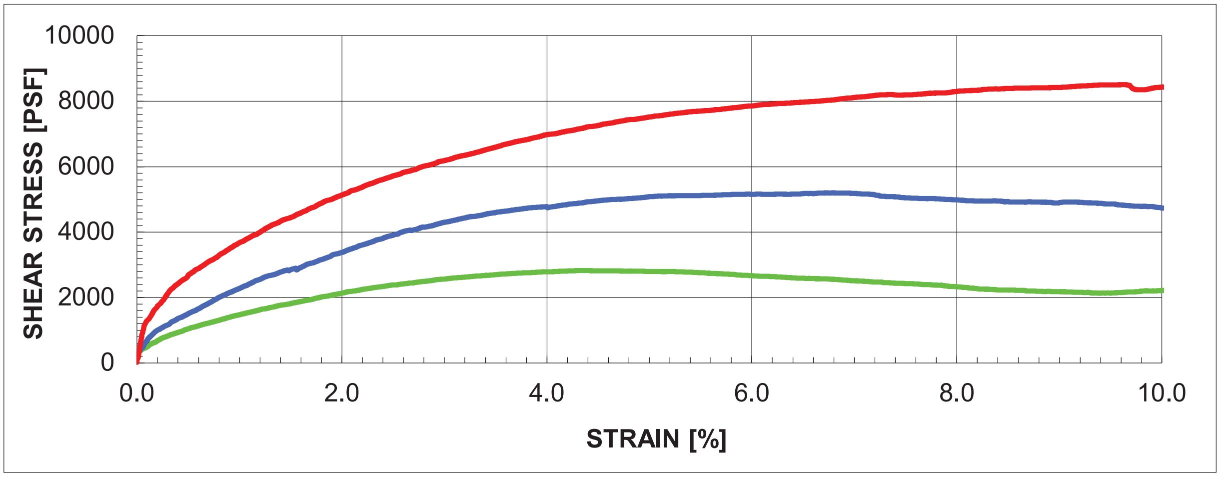
	IN-SITU	AS-TESTED
γ_d	86.7 PCF	86.7 PCF
w_c	36.2 %	35.0 %

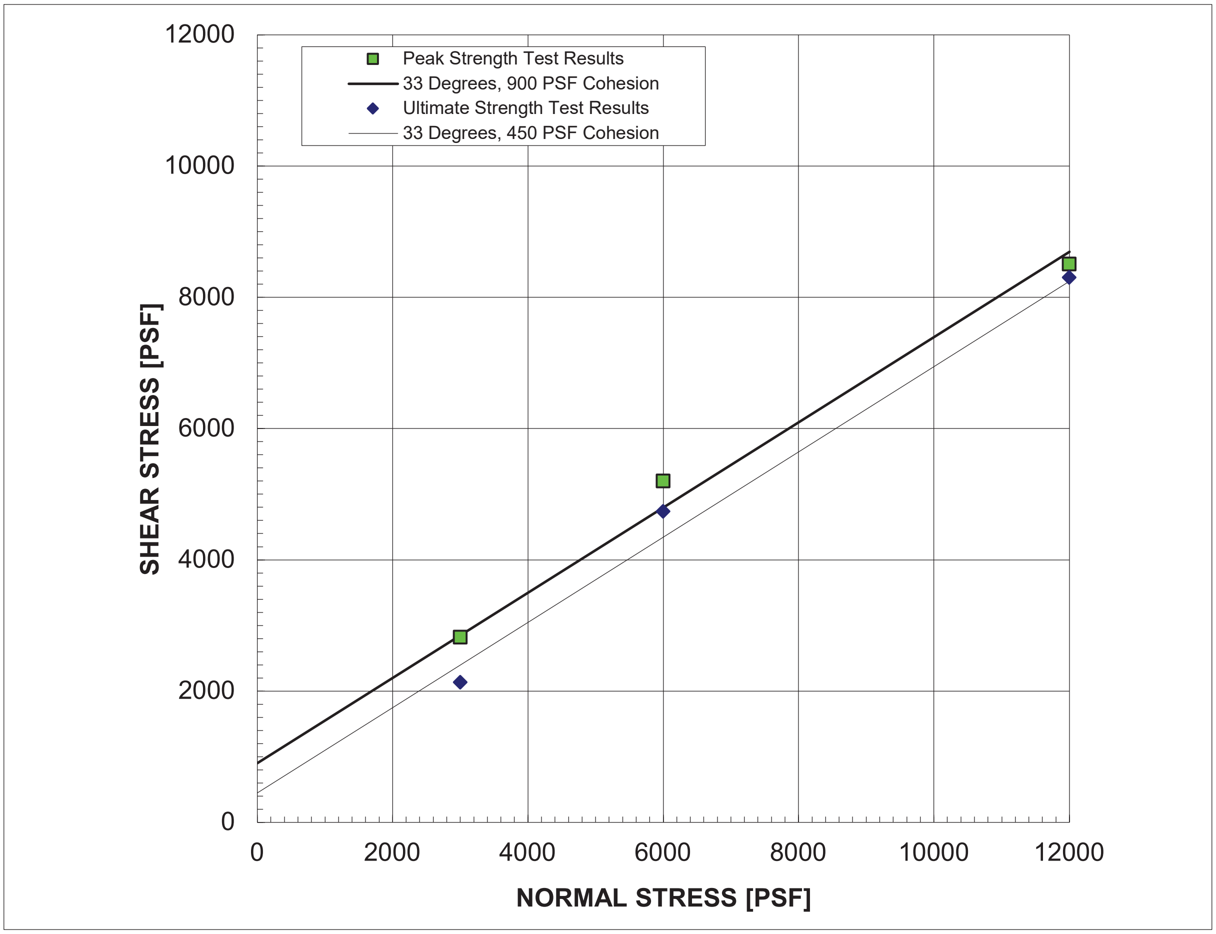
GROUP DELTA

DIRECT SHEAR TEST RESULTS

Project No. SD760

FIGURE B-5.1





SAMPLE: R-23-001 @ 91' - 91.5'

Description:
Poorly graded SAND with SILT (SP-SM)

	PEAK	ULTIMATE
ϕ'	33 °	33 °
C'	900 PSF	450 PSF

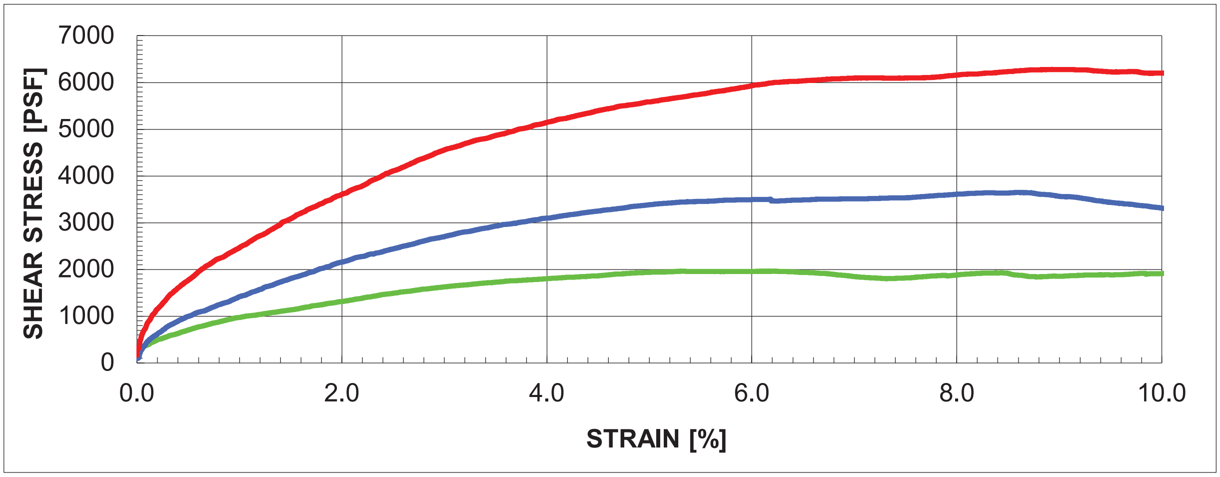
STRAIN RATE: 0.0020 IN/MIN
(Sample was consolidated and drained)

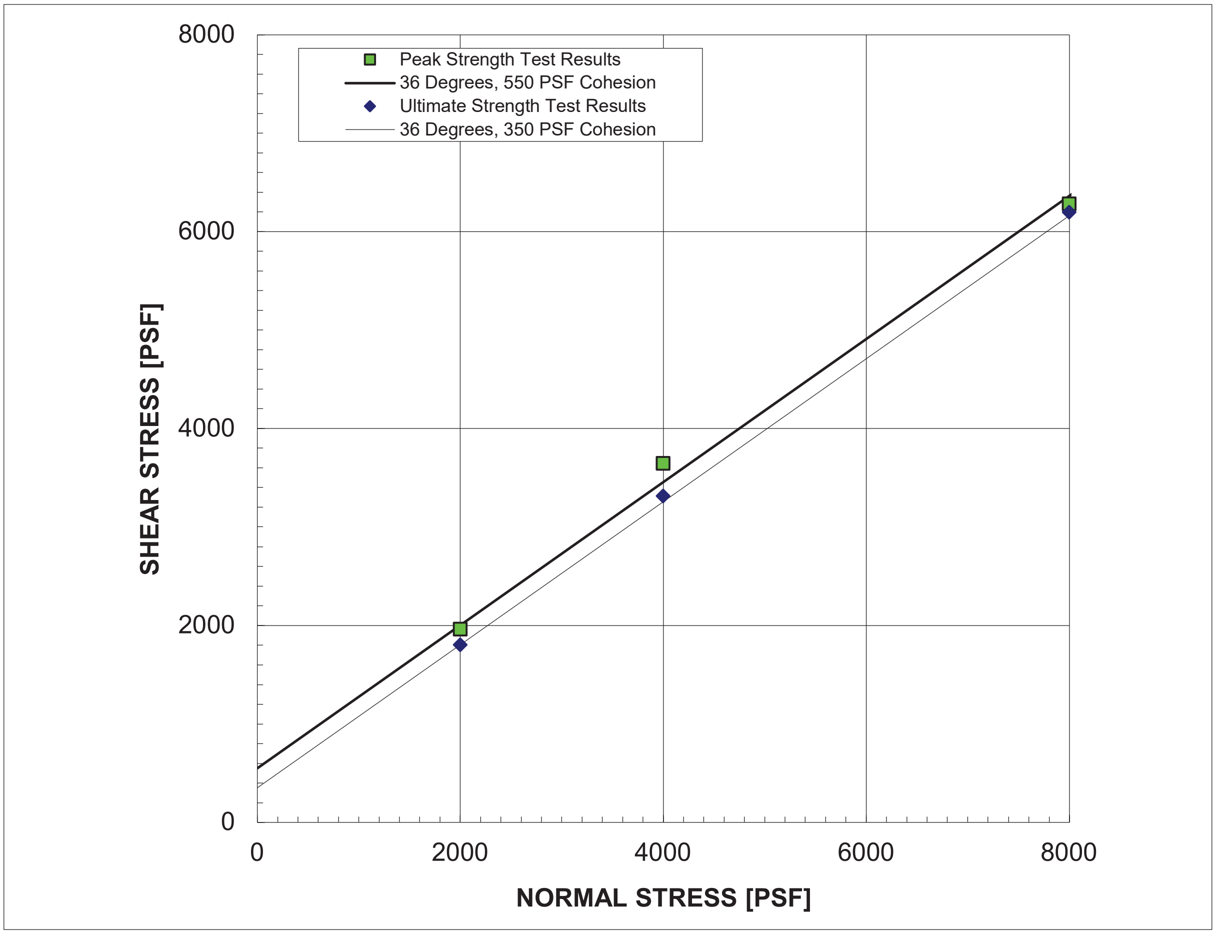
	IN-SITU	AS-TESTED
γ_d	96.3 PCF	96.3 PCF
w_c	28.5 %	26.6 %

GROUP DELTA

DIRECT SHEAR TEST RESULTS

Project No. SD760
FIGURE B-5.2





SAMPLE: R-23-002 @ 66' - 66.5'

Description: SANDY SILT (ML)

	PEAK	ULTIMATE
ϕ'	36 °	36 °
C'	550 PSF	350 PSF

STRAIN RATE: 0.0008 IN/MIN

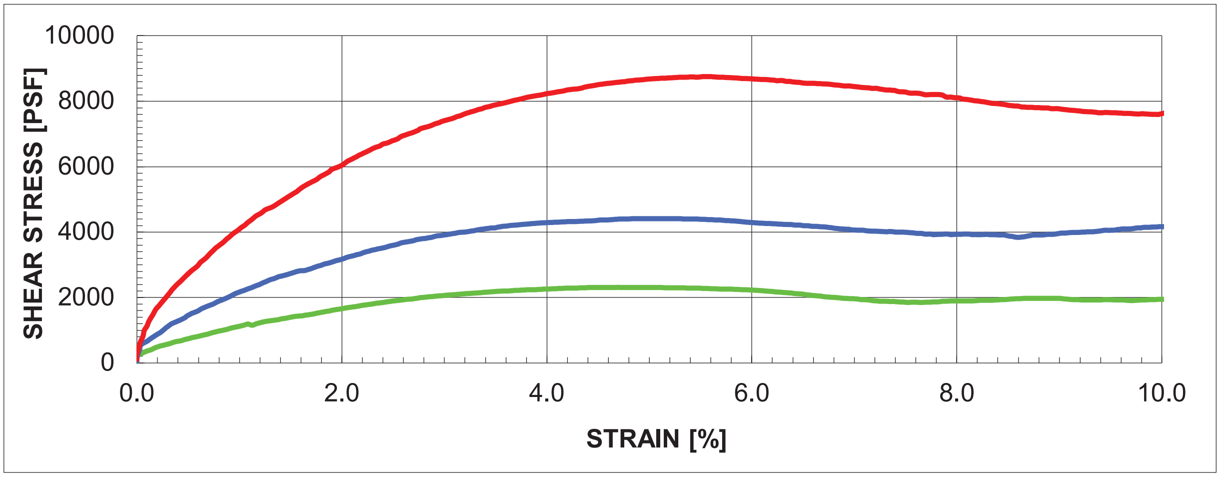
(Sample was consolidated and drained)

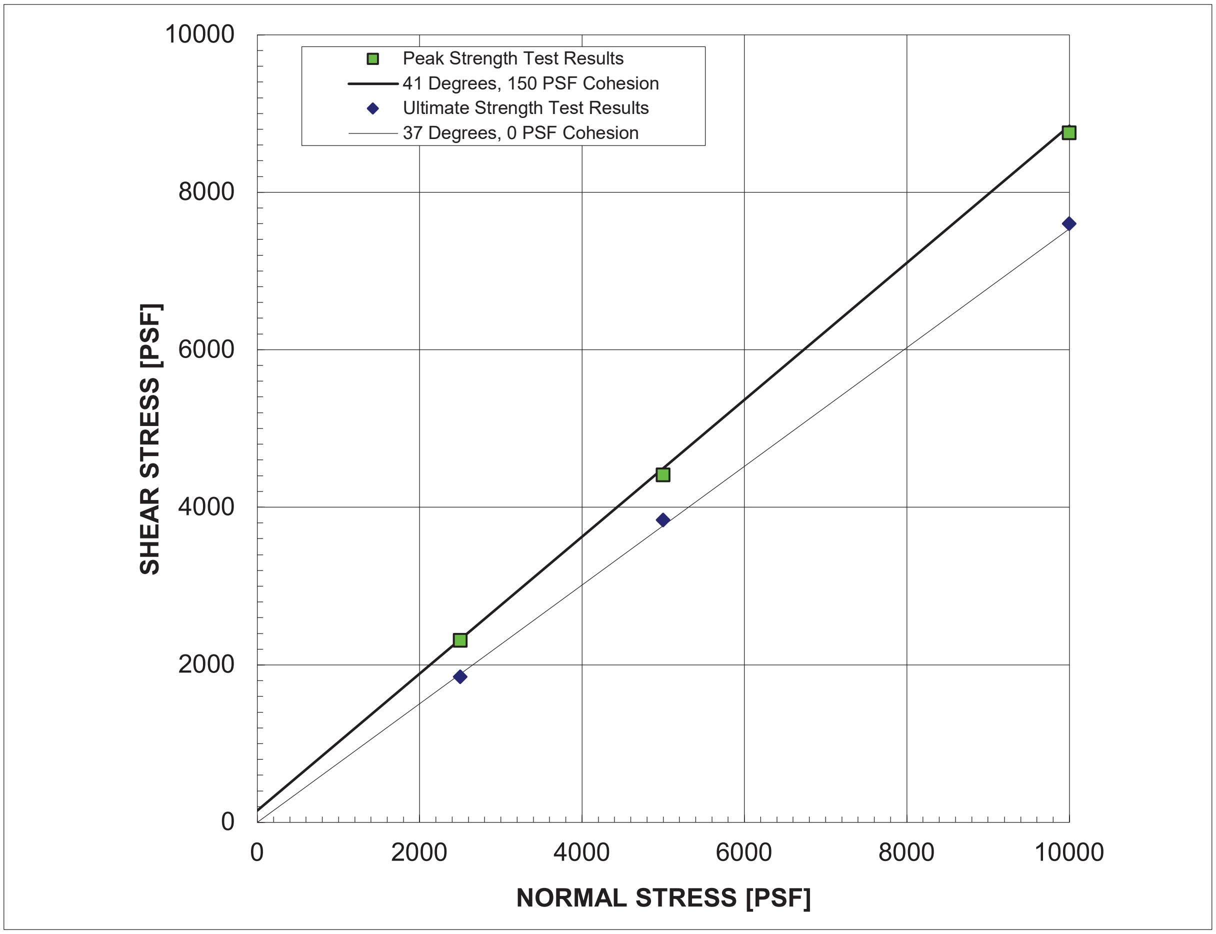
	IN-SITU	AS-TESTED
γ_d	87.5 PCF	87.5 PCF
w_c	38.5 %	29.0 %

GROUP DELTA **DIRECT SHEAR TEST RESULTS**

Project No. SD760

FIGURE B-5.3





SAMPLE: R-23-002 @ 81' - 81.5'

Description:
SILTY SAND (SM)

	PEAK	ULTIMATE
ϕ'	41 °	37 °
C'	150 PSF	0 PSF

STRAIN RATE: 0.0040 IN/MIN
(Sample was consolidated and drained)

	IN-SITU	AS-TESTED
γ_d	102.8 PCF	102.8 PCF
w_c	21.3 %	23.7 %

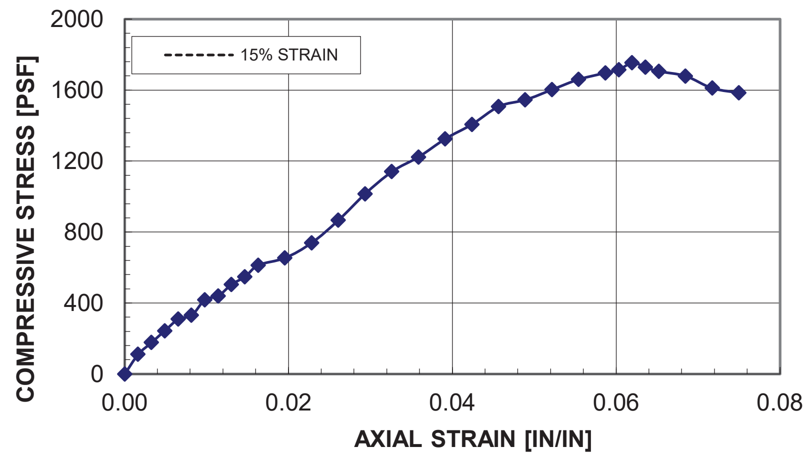
GROUP DELTA

DIRECT SHEAR TEST RESULTS

Project No. SD760
FIGURE B-5.4

PROJECT:	**Zephyr Sports Arena**	TEST METHOD:	**ASTM D2166**
SAMPLE I.D.:	**R-23-001 @ 45' - 47.5'**	TESTED BY:	**J. Krehbiel**
DESCRIPTION:	**Fat CLAY (CH)**	DATE:	**2/27/23**

TYPE OF SAMPLE	Shelby Tube	
WET WT. OF SAMPLE	1080.96	[g]
INITIAL DIAM.	2.87	[in]
INITIAL HEIGHT	6.135	[in]
INITIAL AREA	6.469	[in^2]
INITIAL VOLUME	39.69	[in^3]
WET DENSITY	103.8	[pcf]
DRY WT. OF SAMPLE	713.82	[g]
WEIGHT OF WATER	367.1	[g]
INITIAL TOTAL MOISTURE	51.4	[%]
DRY DENSITY	68.5	[pcf]
L-D RATIO	2.1:1	
STRAIN RATE	1.66	[%/min]
STRAIN AT FAILURE	10.11	[%]
STRAIN AT FAILURE	0.620	[in]
15% STRAIN	0.920	[in]
FAILURE CRITERIA:	Yield	
COMP. STRENGTH:	1754	[psf]
SHEAR STRENGTH:	877	[psf]
SPEC. GRAVITY (Assumed)	2.85	
SATURATION:	92	[%]
FAILURE MODE:	semi-plastic	



SPECIMEN AFTER FAILURE

Elapsed Time [min]	**Axial Load** [lb]	**Strain Dial** [in]	**Total Deformation** [in]	**Axial Strain** [in/in]	**Corrected Area** [in^2]	**Stress** [psf]
0.0	0.0	1.000	0.000	0.000	6.47	0.0
0.2	5.0	0.990	0.010	0.002	6.48	111.1
0.3	8.0	0.980	0.020	0.003	6.49	177.5
0.7	14.0	0.960	0.040	0.007	6.51	309.6
0.8	15.0	0.950	0.050	0.008	6.52	331.2
1.0	19.0	0.940	0.060	0.010	6.53	418.8
1.4	25.0	0.910	0.090	0.015	6.57	548.3
1.6	28.0	0.900	0.100	0.016	6.58	613.1
1.7	30.0	0.880	0.120	0.020	6.60	654.7
2.0	34.0	0.860	0.140	0.023	6.62	739.5
2.2	40.0	0.840	0.160	0.026	6.64	867.1
2.6	47.0	0.820	0.180	0.029	6.66	1015.5
2.9	53.0	0.800	0.200	0.033	6.69	1141.3
3.2	57.0	0.780	0.220	0.036	6.71	1223.3
3.5	62.0	0.760	0.240	0.039	6.73	1326.1
3.8	66.0	0.740	0.260	0.042	6.76	1406.8
4.2	71.0	0.720	0.280	0.046	6.78	1508.3
4.5	73.0	0.700	0.300	0.049	6.80	1545.5
4.9	76.0	0.680	0.320	0.052	6.83	1603.5
5.2	79.0	0.660	0.340	0.055	6.85	1661.0

GROUP DELTA

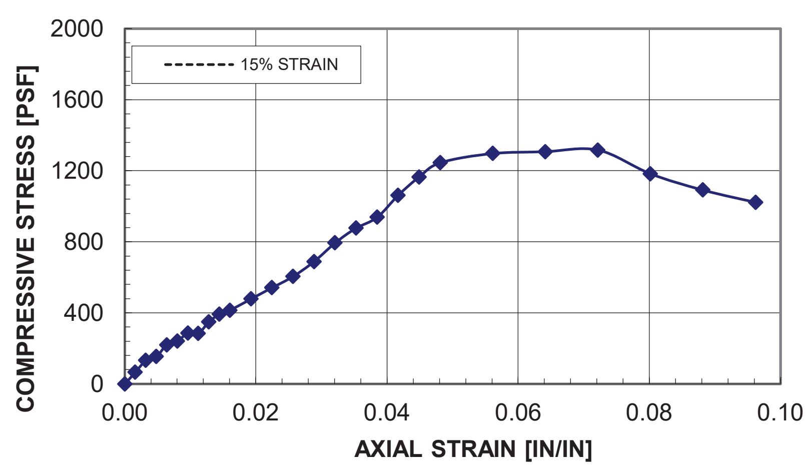
UNCONFINED COMPRESSIVE STRENGTH

Project No. SD760

FIGURE B-6.1

PROJECT:	**Zephyr Sports Arena**		TEST METHOD:	**ASTM D2166**
SAMPLE I.D.:	**R-23-002 @ 50' - 52.5'**		TESTED BY:	**J. Krehbiel**
DESCRIPTION:	**SILTY SAND (SM)**		DATE:	**2/27/23**

TYPE OF SAMPLE	Shelby Tube	
WET WT. OF SAMPLE	1195	[g]
INITIAL DIAM.	2.875	[in]
INITIAL HEIGHT	6.238	[in]
INITIAL AREA	6.492	[in^2]
INITIAL VOLUME	40.50	[in^3]
WET DENSITY	112.4	[pcf]
DRY WT. OF SAMPLE	878.58	[g]
WEIGHT OF WATER	316.4	[g]
INITIAL TOTAL MOISTURE	36.0	[%]
DRY DENSITY	82.7	[pcf]
L-D RATIO	2.2:1	
STRAIN RATE	1.62	[%/min]
STRAIN AT FAILURE	8.82	[%]
STRAIN AT FAILURE	0.550	[in]
15% STRAIN	0.936	[in]
FAILURE CRITERIA:	Yield	
COMP. STRENGTH:	1317	[psf]
SHEAR STRENGTH:	659	[psf]
SPEC. GRAVITY (Assumed)	2.85	
SATURATION:	89	[%]
FAILURE MODE:	semi-plastic	



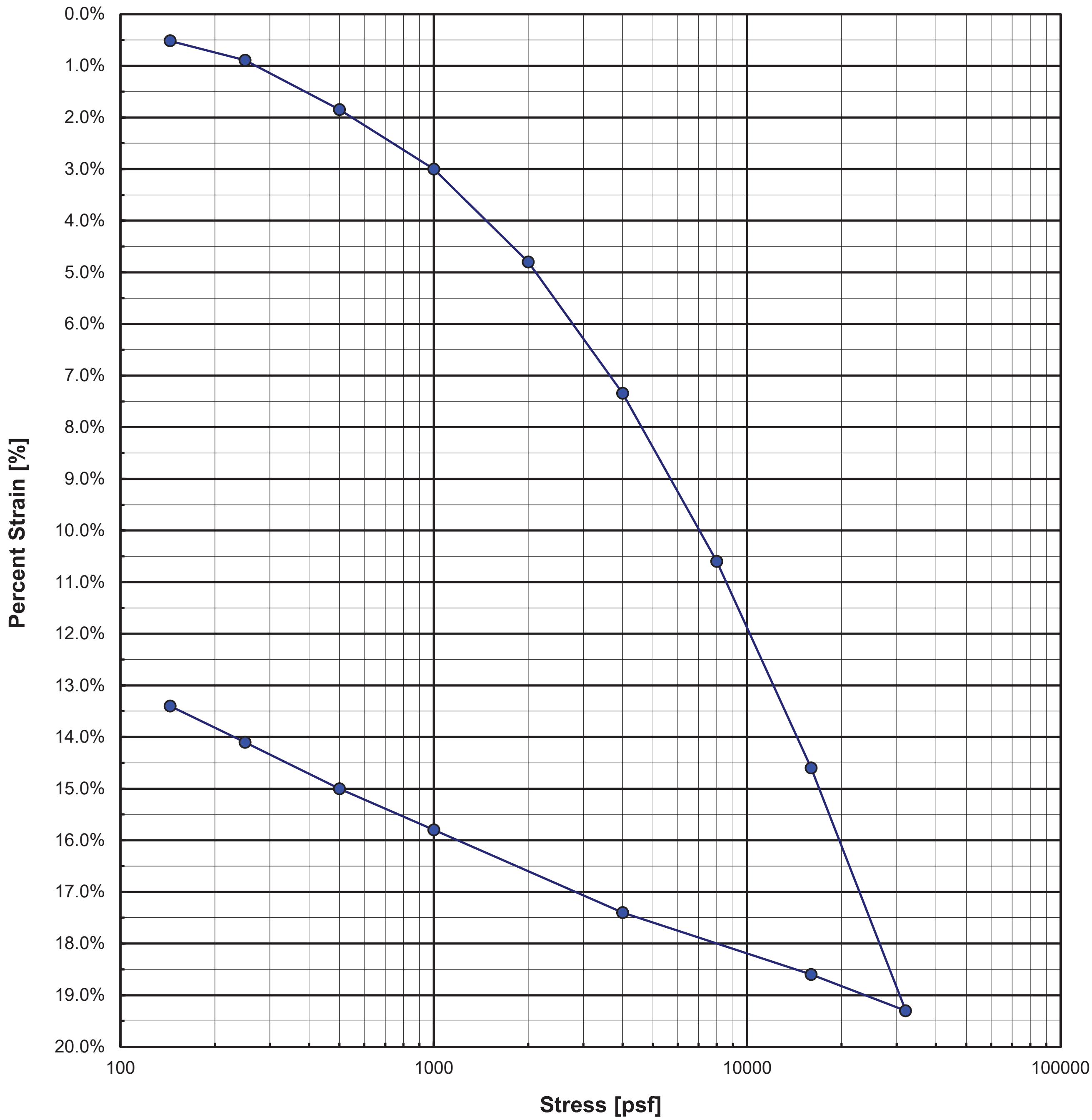
SPECIMEN AFTER FAILURE

Elapsed Time [min]	**Axial Load** [lb]	**Strain Dial** [in]	**Total Deformation** [in]	**Axial Strain** [in/in]	**Corrected Area** [in^2]	**Stress** [psf]
0.0	0.0	1.000	0.000	0.000	6.49	0.0
0.1	3.0	0.990	0.010	0.002	6.50	66.4
0.3	6.0	0.980	0.020	0.003	6.51	132.7
0.7	10.0	0.960	0.040	0.006	6.53	220.4
0.8	11.0	0.950	0.050	0.008	6.54	242.0
1.0	13.0	0.940	0.060	0.010	6.55	285.6
1.5	18.0	0.910	0.090	0.014	6.59	393.5
1.7	19.0	0.900	0.100	0.016	6.60	414.7
1.8	22.0	0.880	0.120	0.019	6.62	478.6
2.0	25.0	0.860	0.140	0.022	6.64	542.1
2.3	28.0	0.840	0.160	0.026	6.66	605.2
2.6	32.0	0.820	0.180	0.029	6.68	689.3
2.9	37.0	0.800	0.200	0.032	6.71	794.4
3.2	41.0	0.780	0.220	0.035	6.73	877.4
3.5	44.0	0.760	0.240	0.038	6.75	938.4
2.9	50.0	0.740	0.260	0.042	6.77	1062.9
4.3	55.0	0.720	0.280	0.045	6.80	1165.2
4.6	59.0	0.700	0.300	0.048	6.82	1245.8
4.9	62.0	0.650	0.350	0.056	6.88	1298.1
5.2	63.0	0.600	0.400	0.064	6.94	1307.8

GROUP DELTA

UNCONFINED COMPRESSIVE STRENGTH

Project No. SD760
FIGURE B-6.2

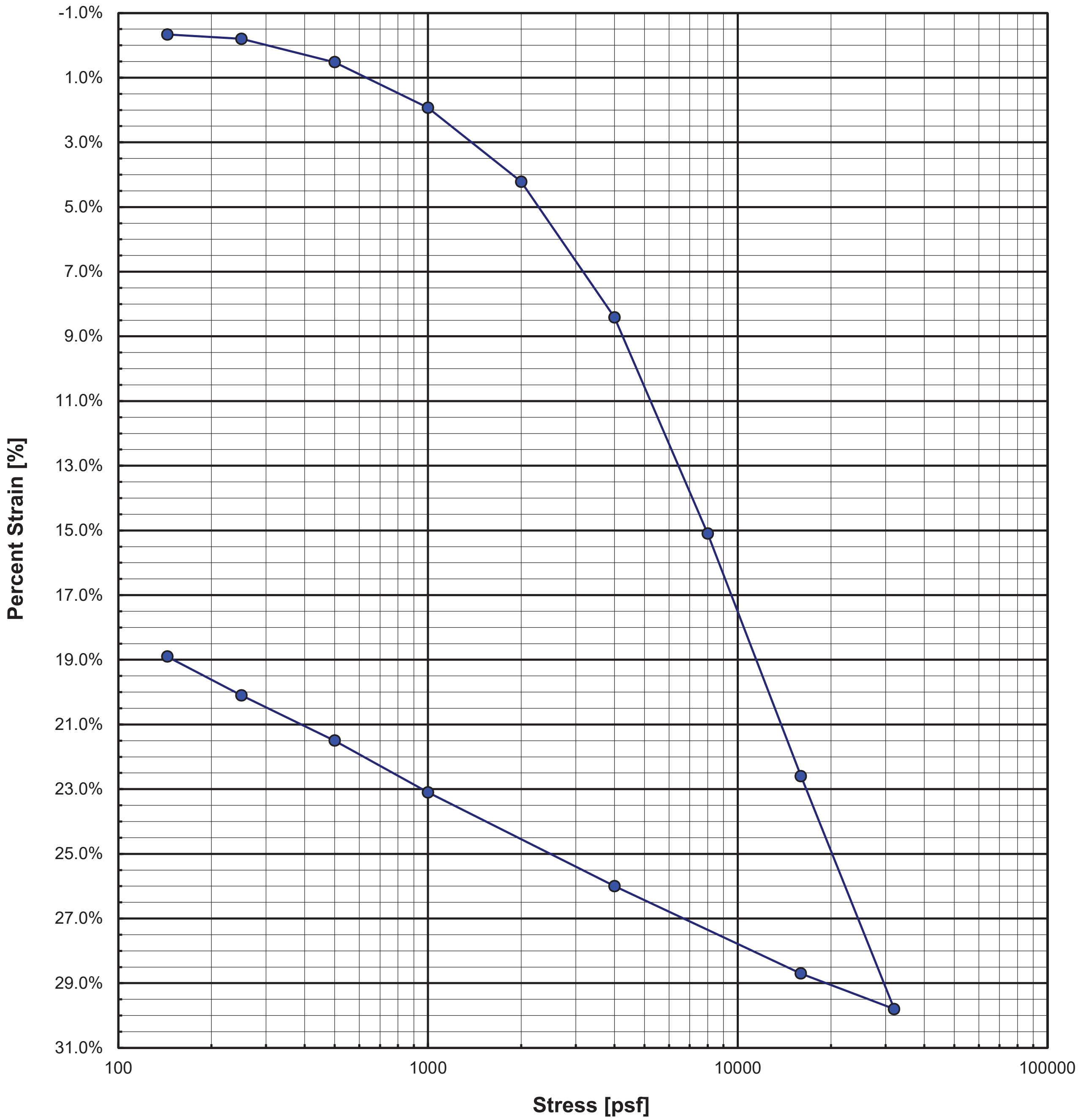


SAMPLE ID: A-23-016 @ 25' - 27.5' **DESCRIPTION:** SANDY SILT (ML)

INITIAL	FINAL	
1.0000	0.8660	SAMPLE HEIGHT [IN]
89.8	103.7	DRY DENSITY [PCF]
2.88	2.88	SPECIFIC GRAVITY (ASSUMED)
0.99	0.73	VOID RATIO (e)
33.3	25.5	WATER CONTENT [%]
96.6	100.0	DEGREE OF SATURATION [%]

GROUP DELTA **CONSOLIDATION RESULTS** Project No. SD760

FIGURE B-7.1



SAMPLE ID: R-23-001 @ 45' - 47.5' **DESCRIPTION:** Fat CLAY (CH)

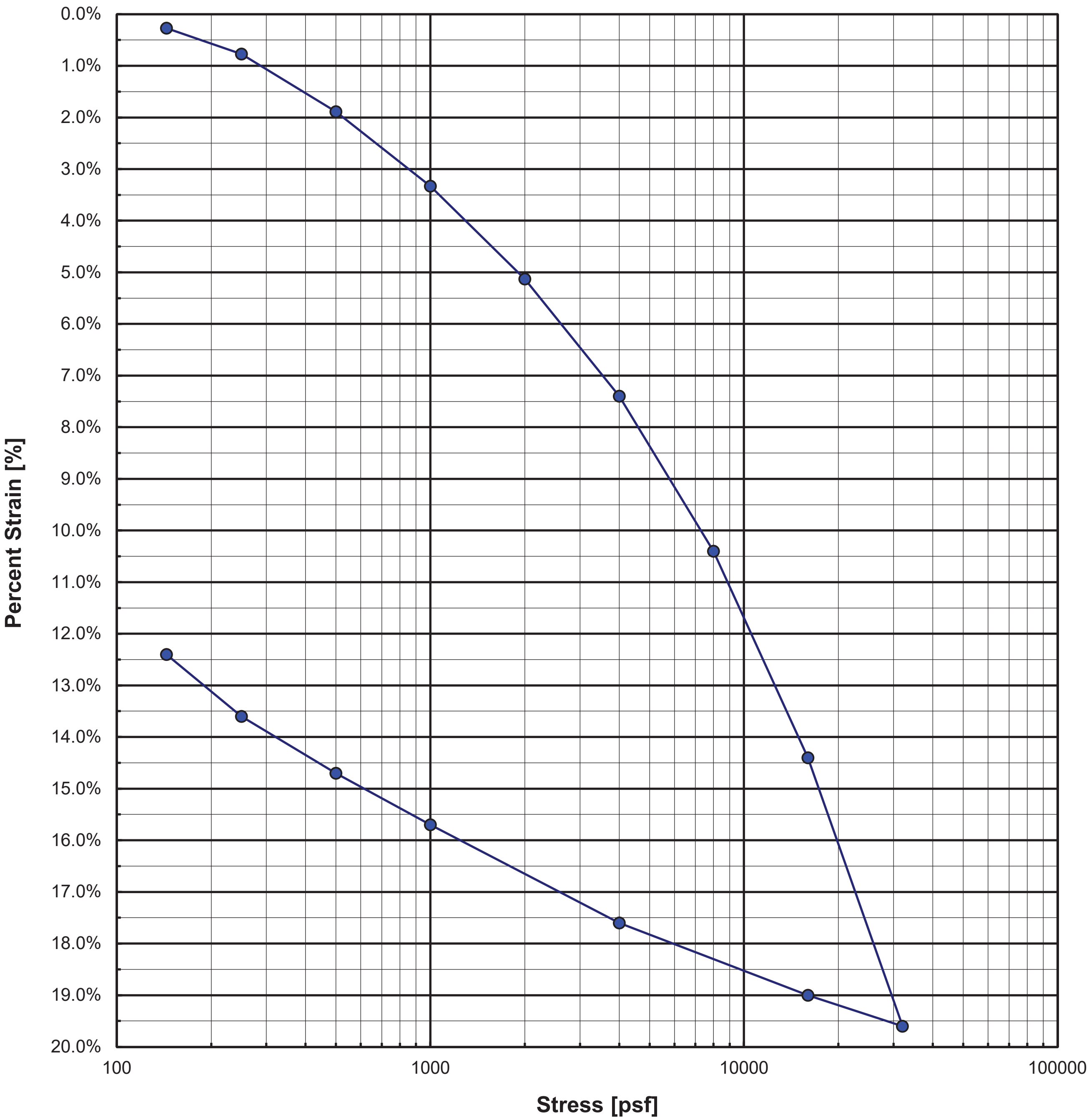
INITIAL	FINAL	
1.0000	0.8110	SAMPLE HEIGHT [IN]
65.5	80.8	DRY DENSITY [PCF]
2.86	2.86	SPECIFIC GRAVITY (ASSUMED)
1.73	1.21	VOID RATIO (e)
60.5	42.3	WATER CONTENT [%]
99.8	100.0	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

Project No. SD760

FIGURE B-7.2



SAMPLE ID: R-23-002 @ 50' - 52.5' **DESCRIPTION:** SILTY SAND (SM)

INITIAL	FINAL	
1.0000	0.8760	SAMPLE HEIGHT [IN]
77.3	88.3	DRY DENSITY [PCF]
2.85	2.85	SPECIFIC GRAVITY (ASSUMED)
1.30	1.02	VOID RATIO (e)
38.7	35.7	WATER CONTENT [%]
85.1	100.0	DEGREE OF SATURATION [%]

GROUP DELTA

CONSOLIDATION RESULTS

Project No. SD760

FIGURE B-7.3

APPENDIX C
GEOTECHNICAL ANALYSES

APPENDIX C

GEOTECHNICAL ANALYSES

SOIL PARAMETERS

Several soil parameters were interpreted from our field in-situ testing and laboratory test results. These parameters were used in the following calculations that are discussed in the later portions of this appendix. The presence of mica, organics, and/or seashells can influence the geotechnical engineering characteristics of the fill and upper paralic estuarine deposits.

Hammer Energy-Corrected Blow Count (N_{60})

The Hammer Energy-Corrected Standard Penetration Test (SPT) Blow Count (N_{60}) was interpreted from our driven samples collected from the geotechnical borings and from the Cone Penetration Test (CPT) soundings. In the geotechnical borings, N_{60} was estimated using the methods described in Appendix A. In the CPT soundings, the N_{60} was estimated using a correlation included in the referenced publication (Robertson et al., 2012). Figure C-1.1 below provides a plot of the interpreted N_{60} versus elevation.

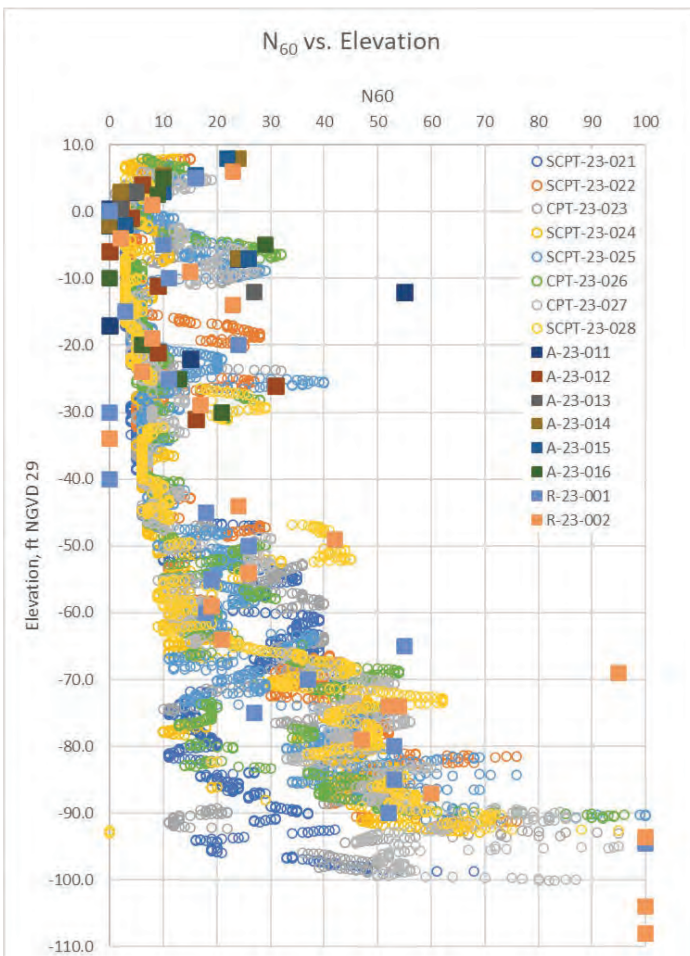


Figure C-1.1 – N_{60} versus Elevation

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

Effective Angle of Internal Friction (ϕ')

The effective angle of internal friction (ϕ'), or commonly known as friction angle, was measured in the laboratory by performing Direct Shear (DS) tests on partially intact samples collected from the geotechnical borings, as shown in Appendix B. It was also interpreted from our driven samples collected from the geotechnical borings and the Cone Penetration Test (CPT) soundings. In the geotechnical borings, ϕ' was estimated using a correlation to SPT blow count (AASHTO, 2012). In the CPT soundings, the ϕ' was estimated using a correlation included in the referenced publication (Robertson et al., 2012). Figure C-1.2 below provides a plot of the friction angle versus elevation.

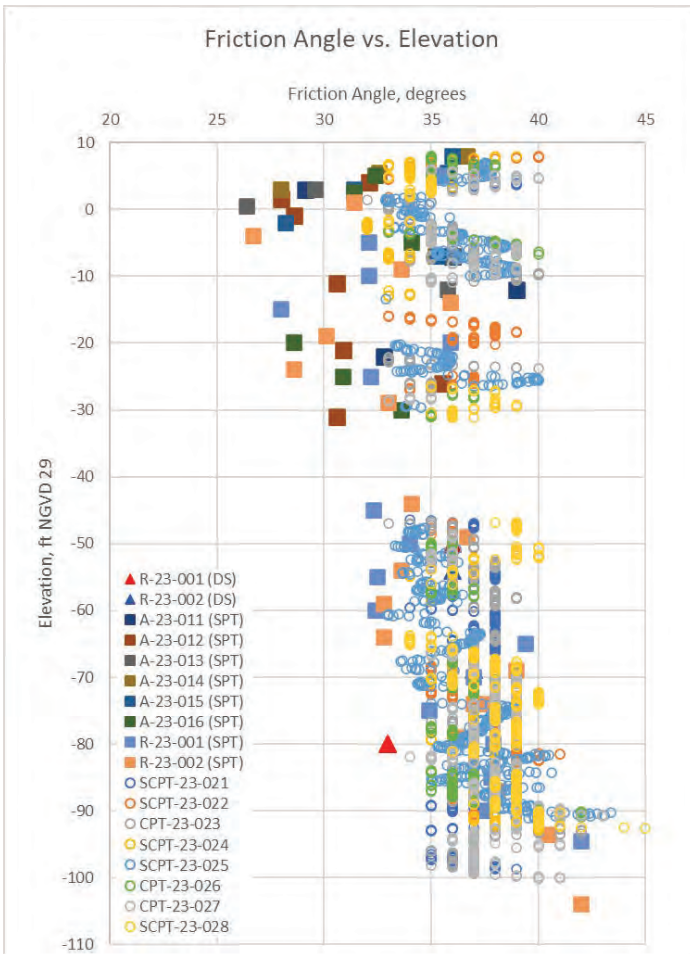


Figure C-1.2 – Friction Angle versus Elevation

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

Undrained Shear Strength (S_u)

The undrained shear strength (S_u) was measured in the laboratory by performing Unconfined Compressive (UC) strength tests on relatively undisturbed samples collected from the geotechnical borings, as shown in Appendix B. It was also interpreted from the Cone Penetration Test (CPT) soundings using a correlation included in the referenced publication and the computer program CPeT-IT (GeoLogismiki, 2023b; Robertson et al., 2012). Figure C-3 below provides a plot of the undrained shear strength versus elevation.

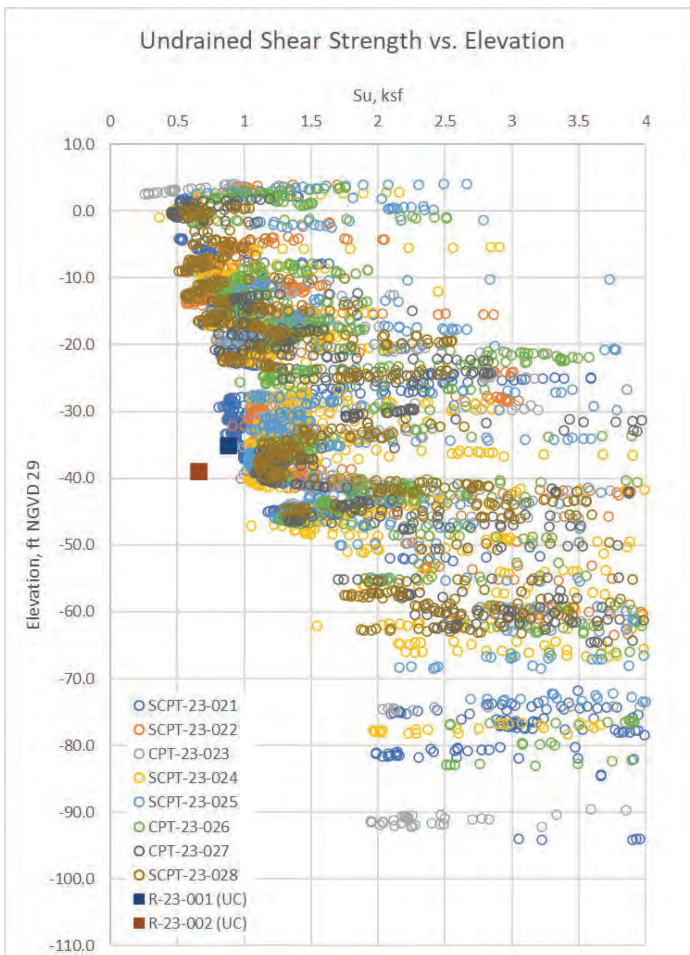


Figure C-1.3 – Undrained Shear Strength versus Elevation

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

LIQUEFACTION

The computer program CLiq (GeoLogismiki, 2023a) was used to perform liquefaction triggering calculations using several CPT-based methods, including those recommended by the NCEER Workshops (Robertson et al., 1997; Youd and Idriss, 2001) and Boulanger and Idriss (2014). CLiq also calculates the estimated free-field volumetric settlement (below groundwater) and seismic compaction (above groundwater). The analyses adopted the following input parameters:

Peak Ground Acceleration (PGA):..0.74g
Earthquake Magnitude (Mw):... 6.9
Design Groundwater Level:................................... +3 feet NGVD 29

The PGA_M was evaluated using the maximum considered earthquake geometric mean (MCE_G) peak ground acceleration adjusted for Site Class effects (PGA_M) obtained from the ASCE 7 Hazard Tool (ASCE, 2023) in accordance with ASCE 7-16 (ASCE, 2017) and the 2022 California Building Code (CBSC, 2022). The analyses preliminarily adopt a Site Class D to evaluate the PGA used for liquefaction triggering. This may need to be reviewed and updated following the completion of a ground response study for the site. The controlling magnitude used in the liquefaction evaluation was selected by reviewing deaggregation results obtained from the USGS Unified Hazard Tool (USGS, 2023). The groundwater level was adopted as recommended in the *Design Groundwater Elevation* section of this report.

The analyses were performed using data collected from the CPT soundings performed at the site. The correlated CPT parameters were compared to the results of our field and laboratory testing collected from the geotechnical borings. The Soil Behavior Type (SBT) correlated from the CPT data was adjusted to best fit the observations, classifications, and material properties of the soils observed within the borings.

In accordance with Special Publication 117A (CGS, 2008) and general geotechnical engineering practices, the liquefaction analyses were limited to a depth of 60 feet to incorporate the potentially liquefiable layers that extend to depths of approximately 60 feet.

The liquefaction settlement analyses include depth weighting proposed by Cetin et al. (2009), which consists of a linear factor that weights the volumetric strain with depth. This reduces the impact of volumetric strains at large depths. The weighting starts at one at the ground surface and reduces to zero at the weighting limit depth, selected to be the depth of analysis for this project (i.e., 60 feet).

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

Our assessment of the potential for liquefaction triggering and estimate of the liquefaction-induced settlement interprets the following:

- Potentially liquefiable soils occur at the design groundwater table (+3 feet NGVD 29) and extends to about 60 feet below existing grades (-50 feet NGVD 29). The liquefiable soils are predominantly silty sand (USCS Symbol SM), sand (SP-SM), and non-plastic sandy silts (ML). In the upper 40 feet below existing grades (-30 feet NGVD 29), liquefiable materials generally occur as a thick, continuous layer that is occasionally interrupted by thin layers of non-liquefiable materials less than about three feet in thickness. Below a depth of 40 feet, liquefiable materials occur in relatively thin layers (about 5-foot thick or less) that are separated by non-liquefiable materials that range from about two to ten feet in thickness.
- Estimated settlements range from 7.5 to 10 inches in our calculations. Differential settlement over the common 30- to 40-foot column spacing is typically estimated to be one-half to two-thirds of the total settlement. Actual settlements realized in the field following a seismic event can vary significantly from calculations. Accordingly, design total and differential liquefaction induced settlements are also provided in the table below to account for the potential variability of actual liquefaction induced settlements compared to those that were calculated as a part of this evaluation.

ESTIMATED LIQUEFACTION-INDUCED SETTLEMENT

Exploration	Calculated Total Settlement [1,2] (Inches)	Calculated Differential Settlement [3] (Inches)	Design Total Settlement [1,2] (Inches)	Design Differential Settlement [3] (Inches)
SCPT-23-021	7.5	5	5.5 – 9.5	4 – 6.5
SCPT-23-022	10	6.5	7.5 – 12.5	5 – 8.5
CPT-23-023	8.5	5.5	6.5 – 10.5	4.5 – 7
SCPT-23-024	10	6.5	7.5 – 12.5	5 – 8.5
SCPT-23-025	8	5	6 – 10	4 – 6.5
CPT-23-026	8	5	6 – 10	4 – 6.5
CPT-23-027	7	4.5	5.5 – 9	3.5 – 6
SCPT-23-028	9	6	7 – 11.5	4.5 – 7.5

[1] Settlement is the combination of liquefaction-induced and seismic compaction. Estimated magnitude of seismic compaction insignificant.
[2] Settlement is a “free-field” estimate that does not consider: a) the shear strain due to foundation loading, and b) contribution of ejecta-related settlement.
[3] Differential settlement is measured over a common 30- to 40-foot column spacing.

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

STATIC SETTLEMENT

Compressible soils underlie the site. Most of these soils are sands, silty sands, and non-plastic sandy silts that should settle elastically with the initial fill and structure loading (i.e., short-term settlement). However, there are local zones of thick fat clay and plastic silt that should experience some time dependent consolidation settlement (i.e., long-term settlement). The fat clay has a high plasticity and we interpret it to be medium stiff and normally consolidated from consolidation test, unconfined compression test, in-situ moisture contents, and Plasticity Index data. The plastic silt has medium plasticity and we interpret it to me medium stiff to stiff and slightly over consolidated from consolidation test, unconfined compression test, in-situ moisture contents, and Plasticity Index data. The in-situ moisture contents are near or are above the Liquid Limit and the Liquidity Indices range from 0.7 to 2.0, which indicate relatively soft and high compressibility soils. The total static settlement estimated at each exploration location is the sum of the long-term and short-term settlements.

Settlement analyses were conducted using the soil profiles and groundwater conditions encountered in the recent explorations and laboratory test data. The settlement magnitude and areal distribution were estimated with conventional elastic and consolidation soil mechanics methods. SPT and CPT correlations to elastic modulus were used to evaluate compressibility parameters for granular soils and non-plastic silts, and consolidation test results were used to evaluate consolidation parameters in clay and plastic silts. The analyses utilize the Boussinesq method for estimating the loading stress attenuation with depth. Settlement is neglected below the depth where the loading stress is less than 10 percent of the in-situ effective stress. The settlement parameters evaluated in these analyses do not consider increases in stiffness due to ground improvement or remedial grading and are therefore conservative in nature.

Most of the long-term settlement should occur in a relatively short time following initial loading. The zones of clay and plastic silt are usually surrounded by sand or silty sand, which should allow horizontal drainage to more quickly dissipate the excess porewater pressures that develop from loading. Estimated durations for substantial completion were not provided for the CPT locations because it is not part of the method. However, based on the interpreted thicknesses of the fine-grained layers within the CPT soundings, the settlement durations should be similar to those evaluated for the boring locations (R-23-001 and R-23-002).

The following table below provides the estimated short-term, long-term, and total static settlement and the durations of the long-term settlement assuming that a new fill thickness of three feet over a 250- by 250-foot area is placed in the vicinity of the exploration.

ESTIMATED STATIC SETTLEMENT FROM 3-FOOT-THICK FILL PLACEMENT

Exploration	Short-Term Elastic Settlement (Inches)	Long-Term Consolidation Settlement (Inches)	Total Static Settlement (Inches)	Duration for Substantial Completion [1] (Months)
SCPT-23-021	1.0	1.5	2.5	-- [2]
SCPT-23-022	0.5	1.0	1.5	-- [2]
CPT-23-023	0.5	1.0	1.5	-- [2]
SCPT-23-024	1.0	1.0	2.0	-- [2]
SCPT-23-025	0.5	1.0	1.5	-- [2]
CPT-23-026	0.5	1.0	1.5	-- [2]
CPT-23-027	0.5	1.0	1.5	-- [2]
SCPT-23-028	0.5	1.5	2.0	-- [2]
R-23-001	1.5	1.0	2.5	8 - 12
R-23-002	1.0	0.5	1.5	2 - 3

[1] Duration for substantial completion is the time to reaching 90% of the estimated long-term consolidation settlement.
[2] Duration for substantial completion is not part of the CPT-based static settlement method.

The following table below provides the estimated short-term, long-term, and total static settlement and the durations of the long-term settlement assuming a new 10-foot square shallow foundation embedded two feet below finished grade with a bearing pressure of 1,000 psf is placed in the vicinity of the exploration.

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

ESTIMATED STATIC SETTLEMENT FROM 10-FOOT SQUARE SHALLOW FOUNDATION WITH AN ALLOWABLE BEARING PRESSURE OF 1,000 PSF

Exploration	Short-Term Elastic Settlement (Inches)	Long-Term Consolidation Settlement (Inches)	Total Static Settlement (Inches)	Duration for Substantial Completion [1] (Months)
SCPT-23-021	0.5	0.5	1.0	-- [2]
SCPT-23-022	<0.5	<0.5	0.5	-- [2]
CPT-23-023	0.5	0.5	1.0	-- [2]
SCPT-23-024	0.5	0.5	1.0	-- [2]
SCPT-23-025	<0.5	<0.5	0.5	-- [2]
CPT-23-026	<0.5	<0.5	0.5	-- [2]
CPT-23-027	0.5	0.5	1.0	-- [2]
SCPT-23-028	0.5	0.5	1.0	-- [2]
R-23-001	<0.5	<0.5	0.5	<1
R-23-002	<0.5	<0.5	0.5	<1

[1] Duration for substantial completion is the time to reaching 90% of the estimated long-term consolidation settlement.
[2] Duration for substantial completion is not part of the CPT-based static settlement method.

The assessment of settlement and duration is based on engineering analyses using data obtained from widely spaced explorations, where subsurface conditions could vary significantly across the site. Due to these uncertainties, the estimated settlement and duration could vary across relatively short distances. Settlement monitoring is recommended to confirm these estimates and to plan the timing for construction of settlement sensitive improvements.

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

DEEP FOUNDATIONS

18- and 24-inch diameter Drilled Displacement Piles (DDP) were evaluated for axial and lateral capacity. DDP displace the soil using a drill tool that is often proprietary to the Piling Contractor and do not generate spoil. The DDP recommendations assume the following:

DDP Assumptions

- Finished Floor Elevation (FFE): +11 feet NGVD 29
- Typical Pile Cutoff Elevation: +7 feet NGVD 29 [4 feet below FFE]
- Pile Diameter: 18 and 24 inches
- Pile Configuration: Single

Geotechnical Conditions

- Average Existing Grade (AEG) Elevation: +10 feet NGVD 29
- Design Groundwater Elevation: +3 feet NGVD 29 [7 feet below AEG]
- Fill: +10 feet to +0 feet NGVD 29 [0 to 10 feet below AEG]
- Upper Paralic Estuarine Deposits: +0 to -50 feet NGVD 29 [10 to 60 feet below AEG]
- Lower Paralic Estuarine Deposits: -50 to -92 feet NGVD 29 [60 to 102 feet below AEG]
- Old Paralic Deposits (Qop): -92 feet NGVD 29 and deeper [102 feet below AEG and deeper]

Axial Capacity

Figures C-2.1 to C-2.4, Allowable Vertical Pile Capacity present downward and upward allowable pile capacities versus embedment depth for 18- and 24-inch diameter DDP. These allowable capacities may be increased by one-third for short-term wind and seismic loads. Figures C-2.5 to C-2.8, Ultimate Vertical Pile Capacity present downward and upward ultimate pile capacities versus embedment depth for 18- and 24-inch diameter DDP. The ultimate downward capacities are adjusted for downdrag loads, which are discussed further in the following section. The estimated capacities assume methods of pile installation that do not compromise shaft resistance and end bearing.

GEOTECHNICAL ANALYSES (Continued)

The axial pile group efficiency in compression is 1.0 assuming that piles are installed with a minimum spacing of three pile diameters (3D), center-to-center (CTC). DDP should have a minimum embedment of 25 feet into the Lower Paralic Estuarine Deposits (minimum tip elevation of -75 feet NGVD 29 corresponding to a minimum pile length of approximately 82 feet).

Seismic Settlement and Downdrag

In accordance with ASCE 7-16, the Structural Engineer should include the following liquefaction settlement-induced downdrag. Note that the Net Ultimate Vertical Pile Capacity per ASCE 7-16 is the ultimate vertical pile capacity less the corresponding downdrag load from the table below presented in Figures C-2.5 through C-2.8.

ESTIMATED LIQUEFACTION-INDUCED DOWNDRAG

Pile Diameter, inches	Downdrag Load, Kips	
	West (Residential)	East (New Sports Arena)
18	130	145
24	165	190

Lateral Capacity

Resistance to lateral loads can be estimated using the passive soil pressure against the pile caps and grade beams above groundwater and the bending resistance of the piles. We do not recommend using friction between pile caps or grade beams and the underlying soil due to the potential for long-term and liquefaction-induced settlement that may reduce the contact between the concrete and soil. The use of passive soil resistance assumes the following:

- The remedial earthwork is completed as recommended in this report.
- There is infinite level ground surrounding the foundations.
- The design groundwater elevation stated in this report.
- The pile caps and grade beams are not deeper than stated in this report.

Passive soil resistance may be estimated using an equivalent fluid weight of 250 pcf for grade beams and pile caps above groundwater that are poured neat against properly compacted fill. This passive pressure is allowable and assumes a factor of safety of 1.5. The upper 12 inches of material in areas without concrete slabs or pavement should not be included in the estimation of passive resistance.

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

If passive pressure is used in combination with the bending resistance of piles, the selected passive resistance should be compatible with the deflection of the pile or pile groups providing resistance. To evaluate the lateral displacement of a pile cap under loading, a Passive Force versus Lateral Displacement curve is presented for embedded pile caps 4 feet thick (with 3 feet of embedment) in Figure C-3.1. These recommendations assume remedial earthwork is performed as recommended in this report. Group Delta should be contacted for revised recommendations if the pile caps are deeper than stated in this report.

Lateral capacity of 18- and 24-inch diameter DDP was computed using the computer program LPILE (Ensoft, 2019) using the p-y method. LPILE analyses were performed assuming free and fixed head conditions and pile head deflections of 0.5-, 1-, and 1.5-inch. The DDP were modeled using an elastic section with a cracked moment of inertia (50 percent of the gross moment of inertia), and an axial load of 150 kips. A minimum 28-day compressive strength of 4,000 psi was assumed for the concrete, corresponding to a concrete elastic modulus of approximately 3,600 kips per square inch (ksi). The following preliminary soil parameters were adopted for the lateral pile analyses.

PRELIMINARY LPILE SOIL PARAMETERS

Elevation (ft, NGVD 29)	Depth Below Pile Head (ft)	Layer Unit Description	Liquefiable (Yes or No)	Liquefiable Layer P-Multiplier	LPILE p-y Curve Soil Type	Unit Weight [pcf]	Friction Angle [degrees]	Undrained Strength [psf]
+10 to +3	-3 to 4	Fill	No	N/A	Sand (Reese)	120	32	--
+3 to -5	4 to 12	Fill	Yes	0.05	Sand (Reese)	58	29	--
-5 to -15	12 to 22	Upper Paralic	Yes	0.15	Sand (Reese)	59	30	--
-15 to -30	22 to 37	Upper Paralic	Yes	0.12	Sand (Reese)	58	30	
-30 to -42	37 to 49	Upper Paralic	No	N/A	Stiff Clay w/ Free Water (Reese)	44	--	800
-42 to -50	49 to 57	Upper Paralic	Yes	0.15	Sand (Reese)	57	29	--
-50 to -60	57 to 67	Lower Paralic	No	N/A	Sand (Reese)	58	33	--
-60 to -92	67 to 99	Lower Paralic	No	N/A	Sand (Reese)	58	36	--
-92 and below	99 and below	Old Paralic	No	N/A	Sand (Reese)	58	40	--

APPENDIX C

GEOTECHNICAL ANALYSES (Continued)

We performed analyses using p-multipliers (p_m) of 1.0 and 0.5 to evaluate two potential pile arrangement configurations. A p_m of 1.0 assumes piles are arranged singly or are in groups that have a minimum spacing of 8D, center-to-center. A p_m of 0.5 assumes piles are arranged in groups and are spaced closer than 8D. The table below should be used to evaluate the applicable p_m for specific piles in a group based on the spacing of the piles and the number of rows in the group. To evaluate the capacity of the piles in a group, the capacity of the pile may be linearly interpolated between the values provided for a p_m of 1.0 and 0.5.

P-MULTIPLIERS

Pile CTC Spacing (in the Direction of Loading)	P-Multipliers		
	Row 1	Row 2	Row 3 or Higher
3.0*D	0.75	0.55	0.40
5.0*D	1.00	0.85	0.70
7.0*D	1.00	1.00	0.90

Deflections, maximum shear forces, and bending moments for 18- and 24-inch DDP were calculated using the parameters above for liquefied conditions (see Figures C-3.2 through C-3.9). The table below summarizes the estimated maximum shear at the pile head for each of the pile diameters, fixity conditions, pile head deflection, and p_m that were evaluated. The estimated maximum shear values are unfactored and are considered ultimate values.

ESTIMATED MAXIMUM SHEAR FORCE AT PILE HEAD – 18-INCH DIAMETER DDP

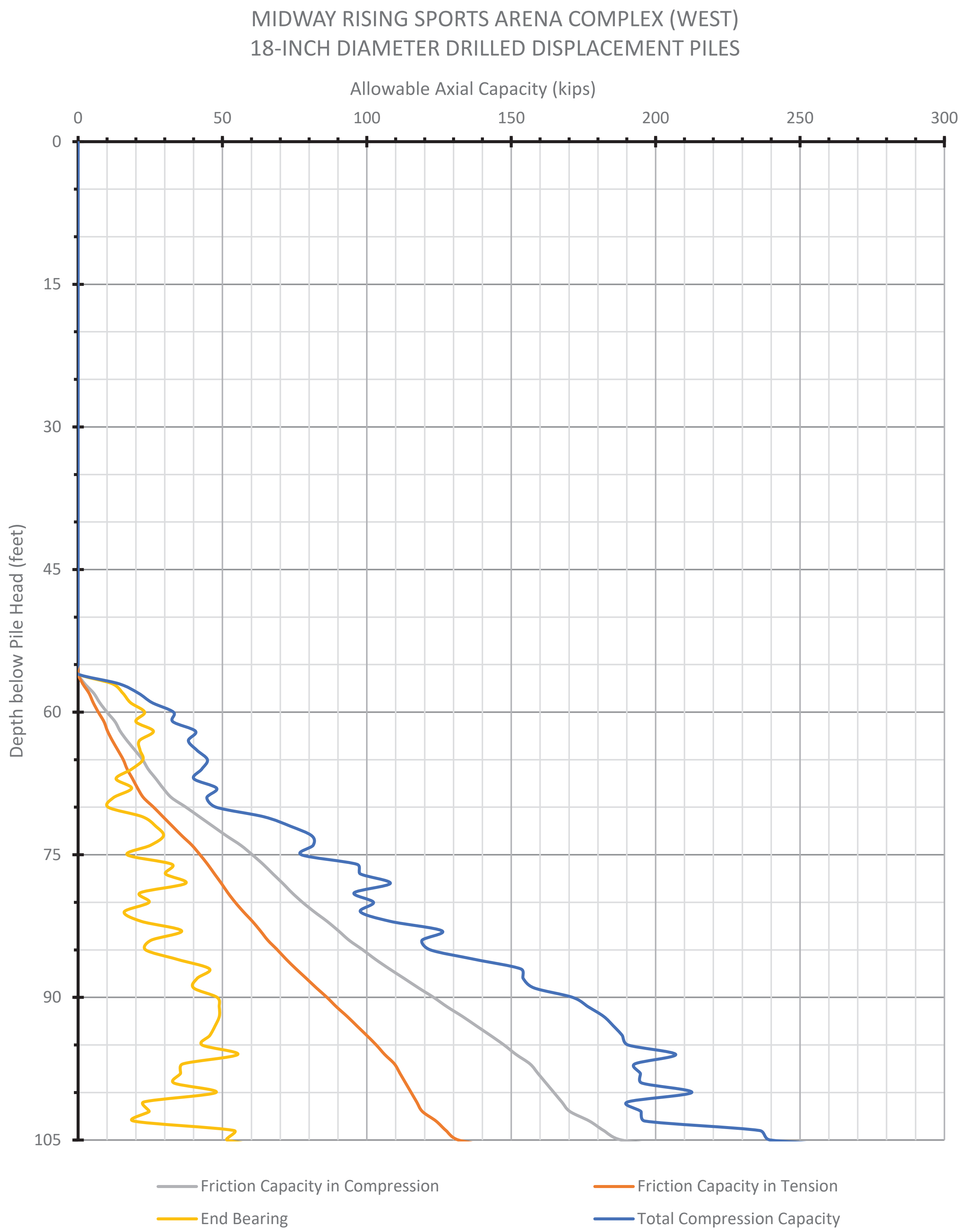
Pile Head Fixity Condition	P-Multiplier, p_m	Maximum Shear at Pile Head (kips)		
		Pile Head Deflection (inches)		
		0.5	*1.0*	*1.5*
Fixed Head	1.0	35.5	49.6	54.7
	0.5	19.8	28.1	31.7
Free Head	1.0	22.1	32.3	35.4
	0.5	12.1	17.7	19.0

APPENDIX C

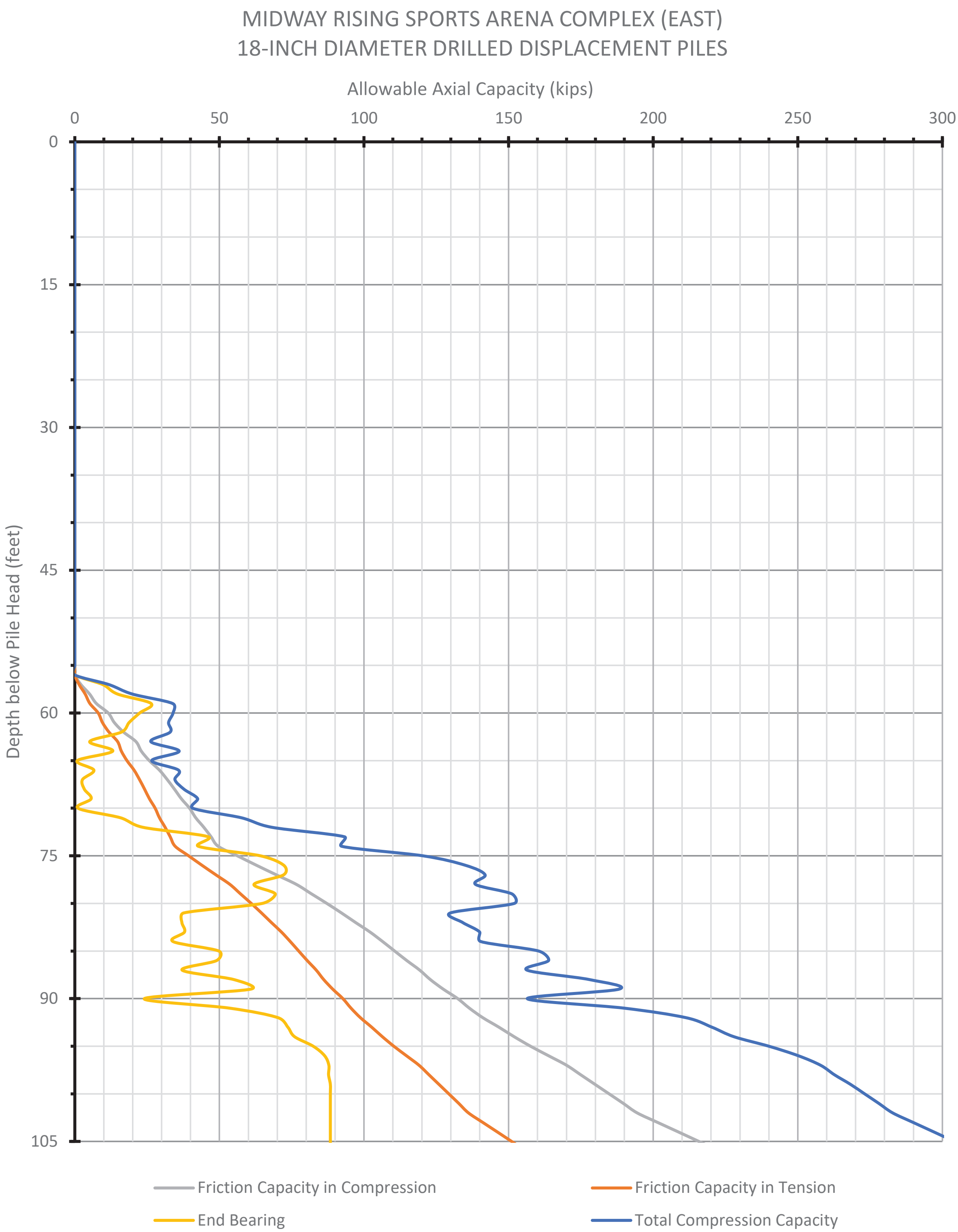
GEOTECHNICAL ANALYSES (Continued)

ESTIMATED MAXIMUM SHEAR FORCE AT PILE HEAD – 24-INCH DIAMETER DDP

Pile Head Fixity Condition	**P-Multiplier, p_m**	**Maximum Shear at Pile Head (kips)**		
		Pile Head Deflection (inches)		
		0.5	*1.0*	*1.5*
Fixed Head	1.0	49.3	73.7	83.6
	0.5	28.0	42.5	49.6
Free Head	1.0	31.9	45.8	52.4
	0.5	17.4	25.4	29.0

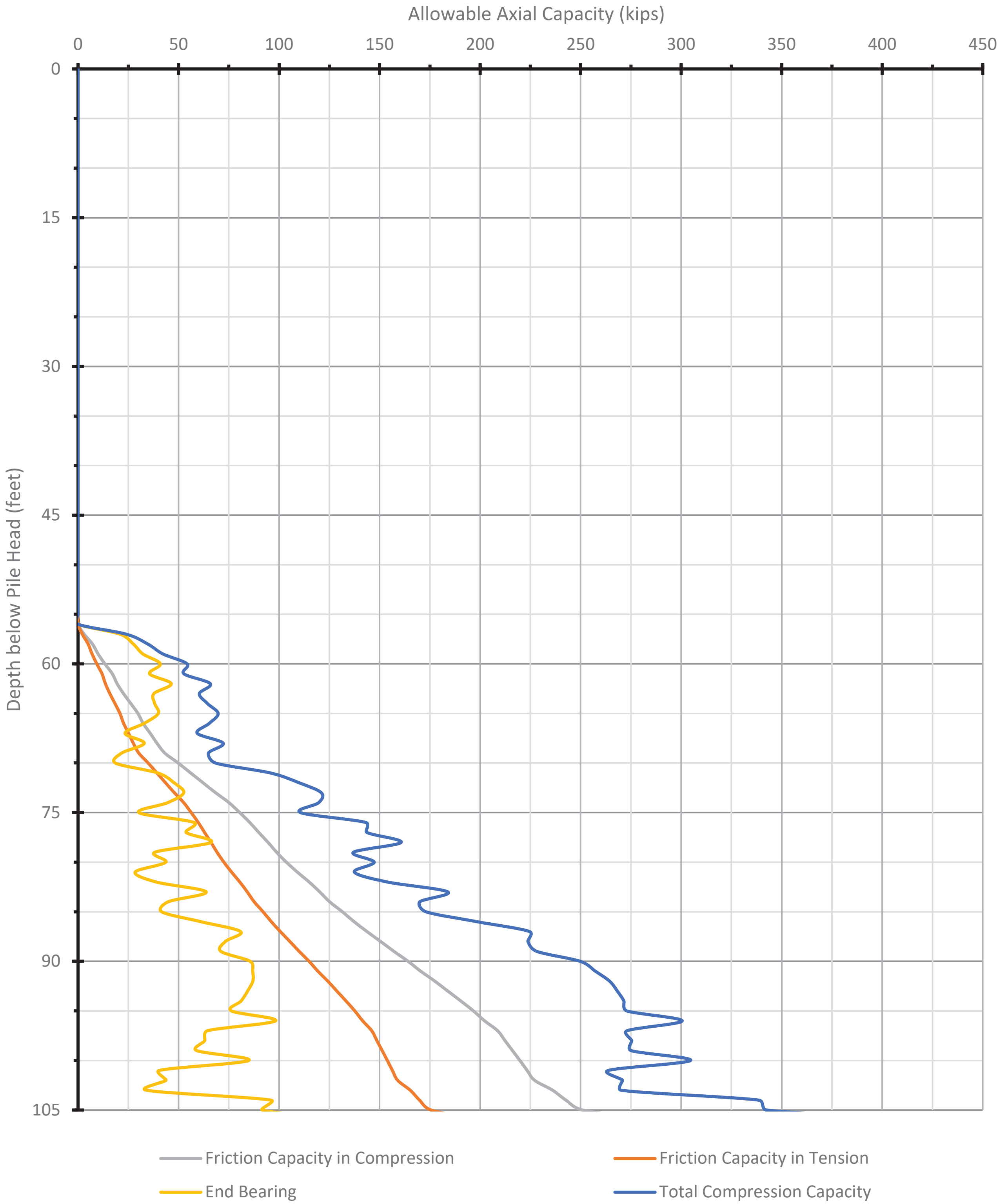


PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH - ALLOWABLE (WEST)	PROJECT NUMBER SD760	FIGURE NUMBER C-2.1

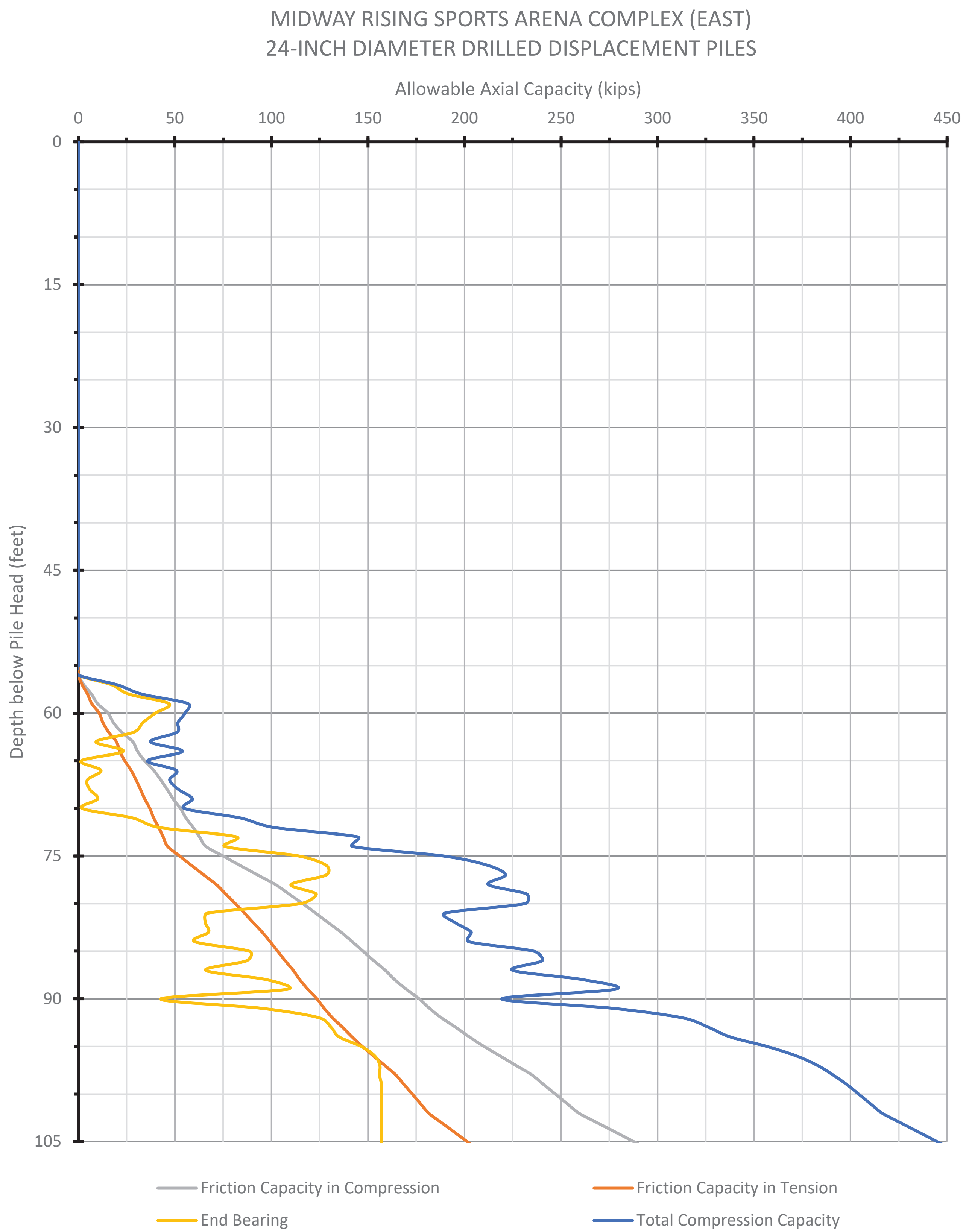


PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH - ALLOWABLE (EAST)	PROJECT NUMBER: SD760	FIGURE NUMBER: C-2.2

MIDWAY RISING SPORTS ARENA COMPLEX (WEST)
24-INCH DIAMETER DRILLED DISPLACEMENT PILES

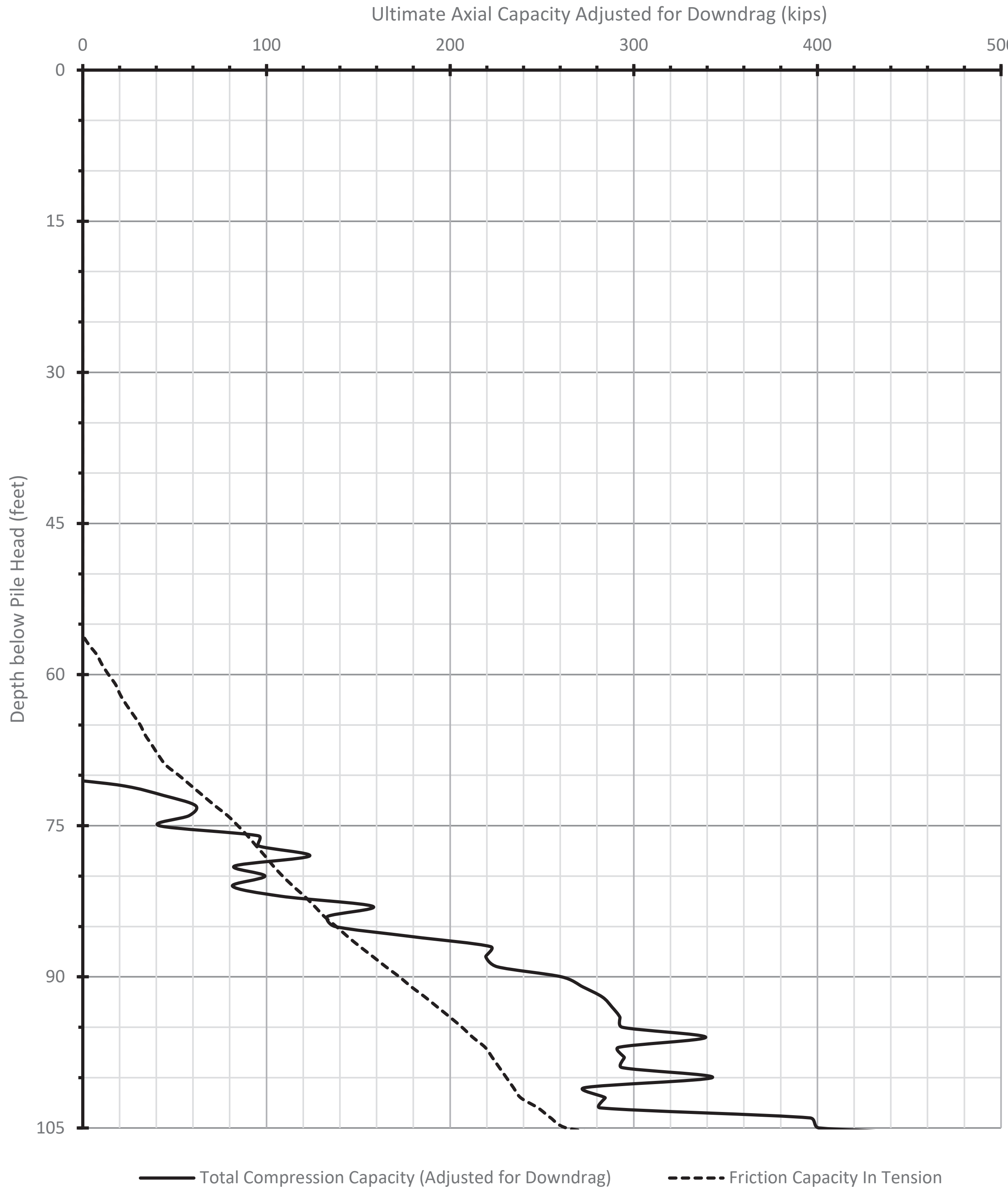


PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH - ALLOWABLE (WEST)	PROJECT NUMBER SD760	FIGURE NUMBER C-2.3



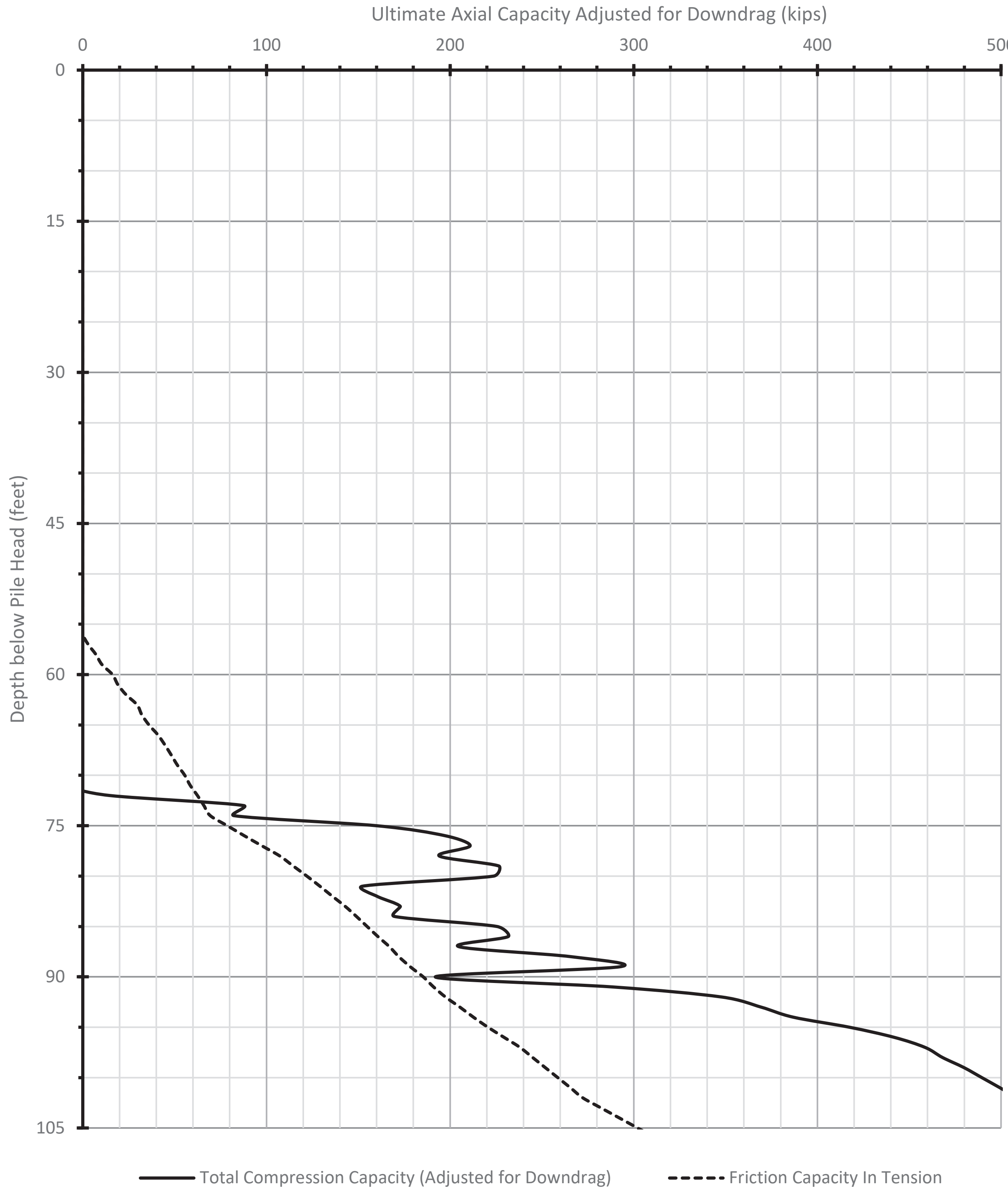
PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH - ALLOWABLE (EAST)	PROJECT NUMBER SD760	FIGURE NUMBER C-2.4

MIDWAY RISING SPORTS ARENA COMPLEX (WEST)
18-INCH DIAMETER DRILLED DISPLACEMENT PILES

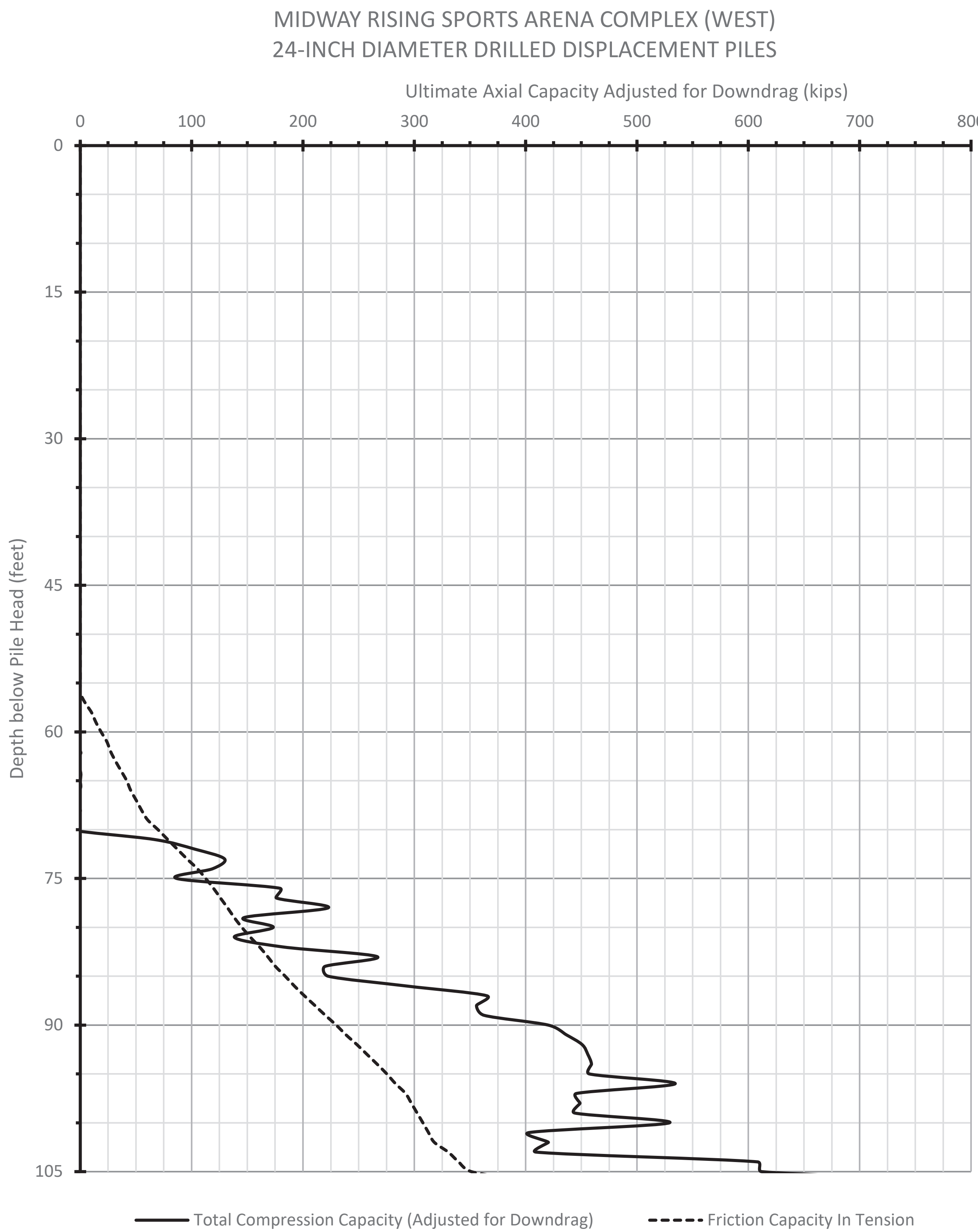


PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH - ULTIMATE (WEST)	PROJECT NUMBER SD760	FIGURE NUMBER C-2.5

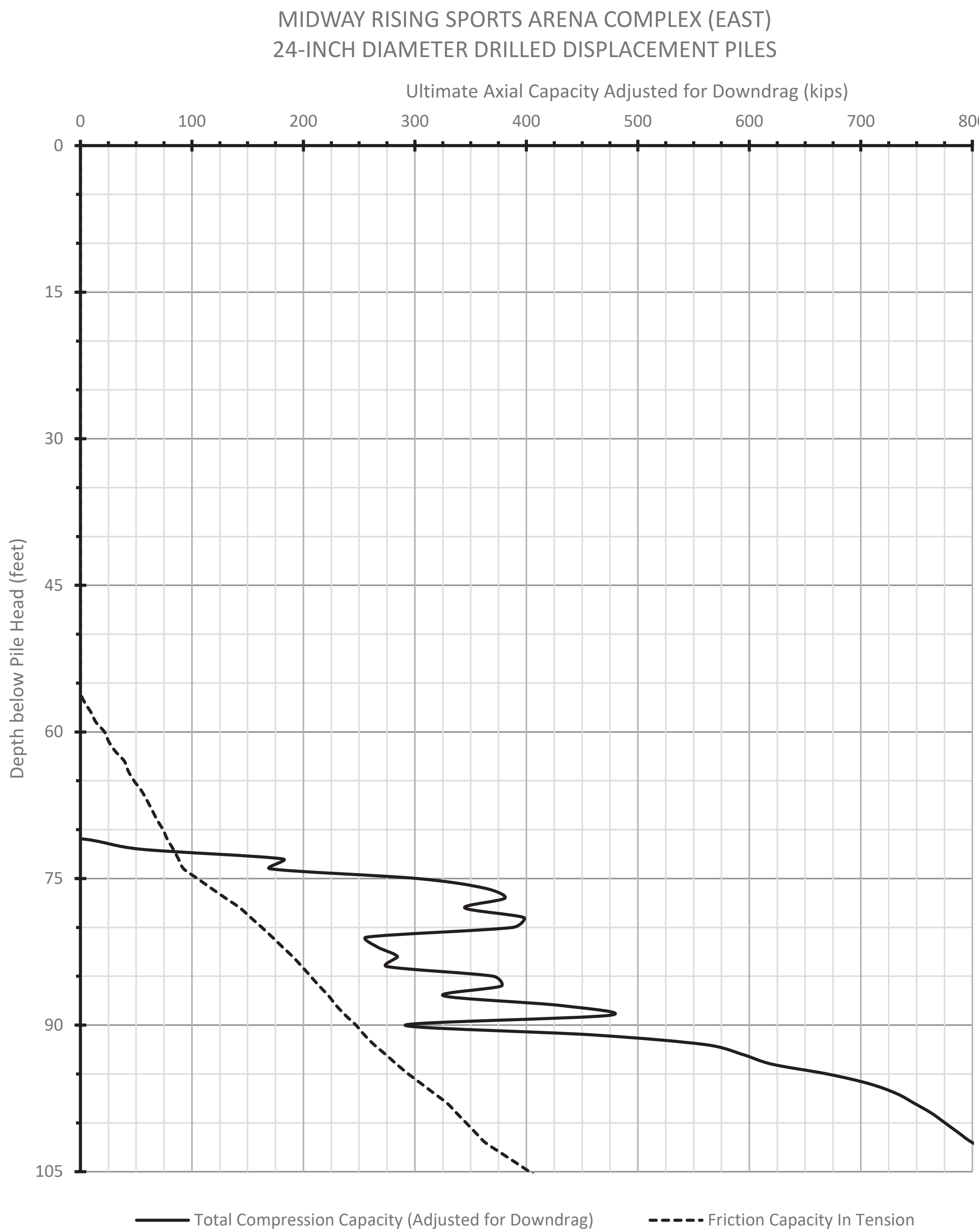
MIDWAY RISING SPORTS ARENA COMPLEX (EAST)
18-INCH DIAMETER DRILLED DISPLACEMENT PILES



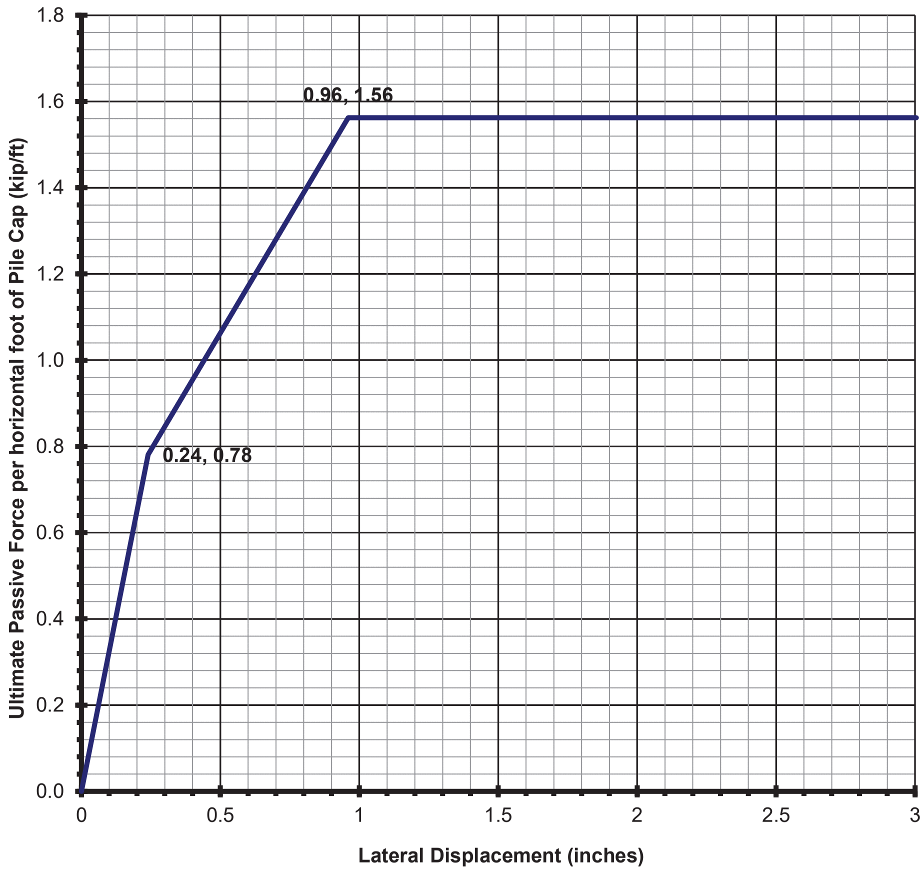
PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH - ULTIMATE (EAST)	PROJECT NUMBER: SD760	FIGURE NUMBER: C-2.6

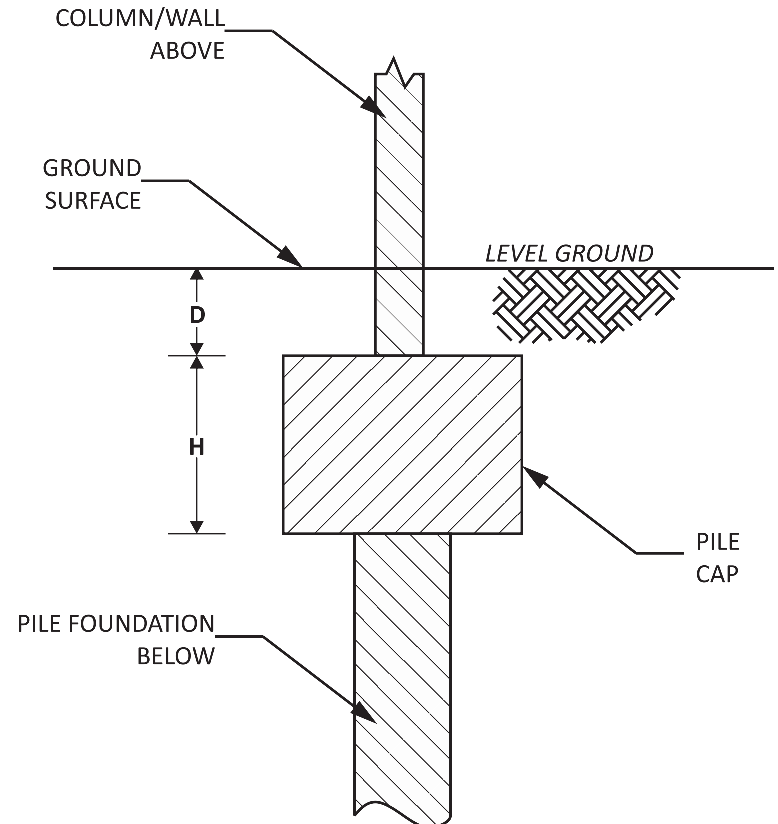


PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH - ULTIMATE (WEST)	PROJECT NUMBER SD760	FIGURE NUMBER C-2.7



PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	AXIAL PILE CAPACITY VERSUS DEPTH -ULTIMATE (EAST)	PROJECT NUMBER: SD760	FIGURE NUMBER: C-2.8





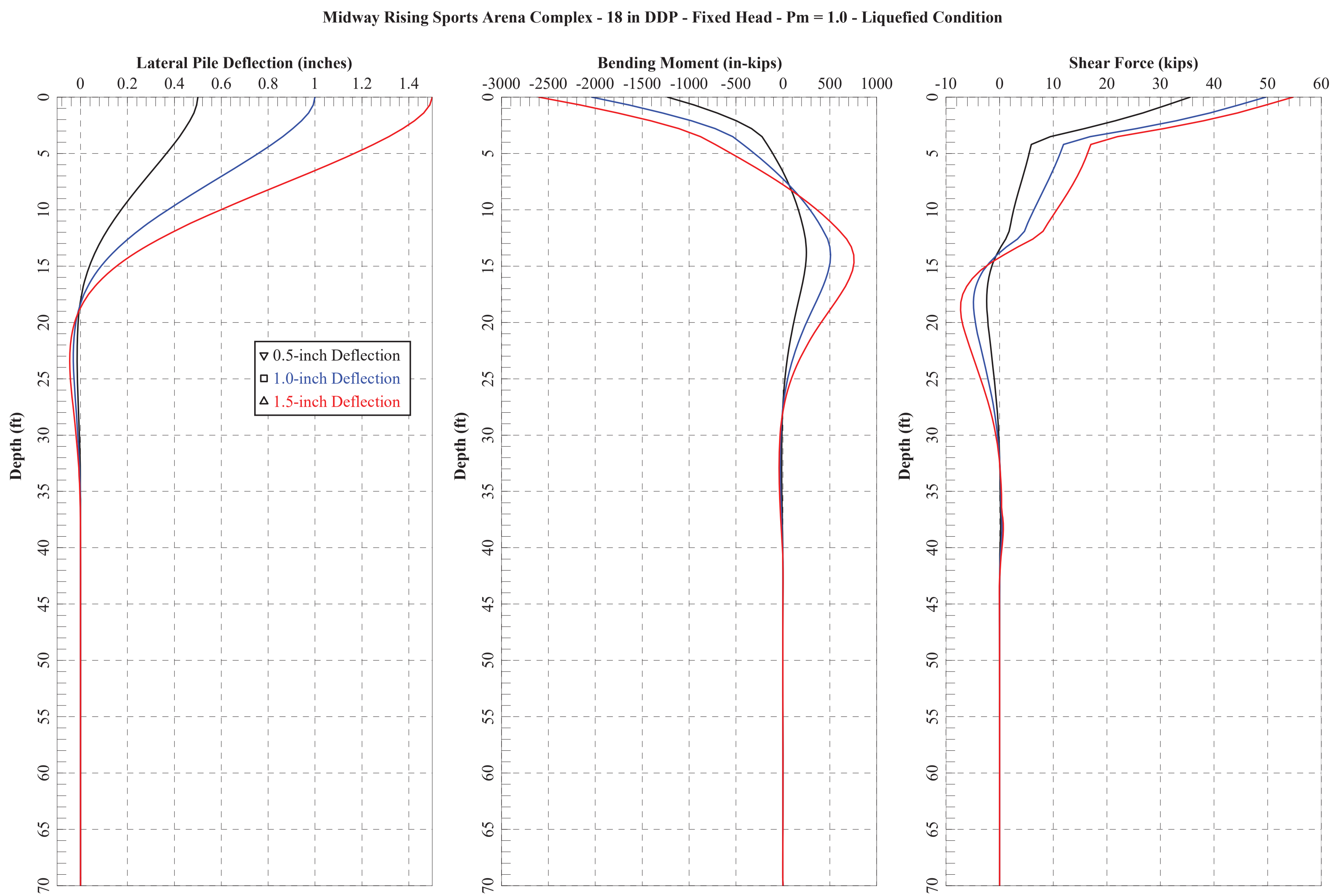
NOTES:

1. SOIL COVER DEPTH, 'D' = 1.0 FEET.
2. PILE CAP THICKNESS, 'H' = 2.0 FEET.
3. PASSIVE RESISTANCE ASSUMES GRANULAR COMPACTED FILL SOIL MATERIALS ABOVE GROUNDWATER PREPARED AS RECOMMENDED IN THE PRELIMINARY REPORT OF GEOTECHNICAL INVESTIGATION.

REFERENCES: TRILINEAR CURVE FOR IDEALIZED FORCE-DEFLECTION BEHAVIOR OF PILE CAP BASED ON CALTRANS "GUIDELINES ON FOUNDATION LOADING AND DEFORMATION DUE TO LIQUEFACTION INDUCED LATERAL SPREADING," FEBRUARY, 2011.
NAVFAC - DESIGN MANUAL 7.02, "FOUNDATIONS & EARTH STRUCTURES," REVALIDATED BY CHANGE SEPTEMBER 1, 1986, SECTION 2, FIGURE 1, PAGE 7.2-60.

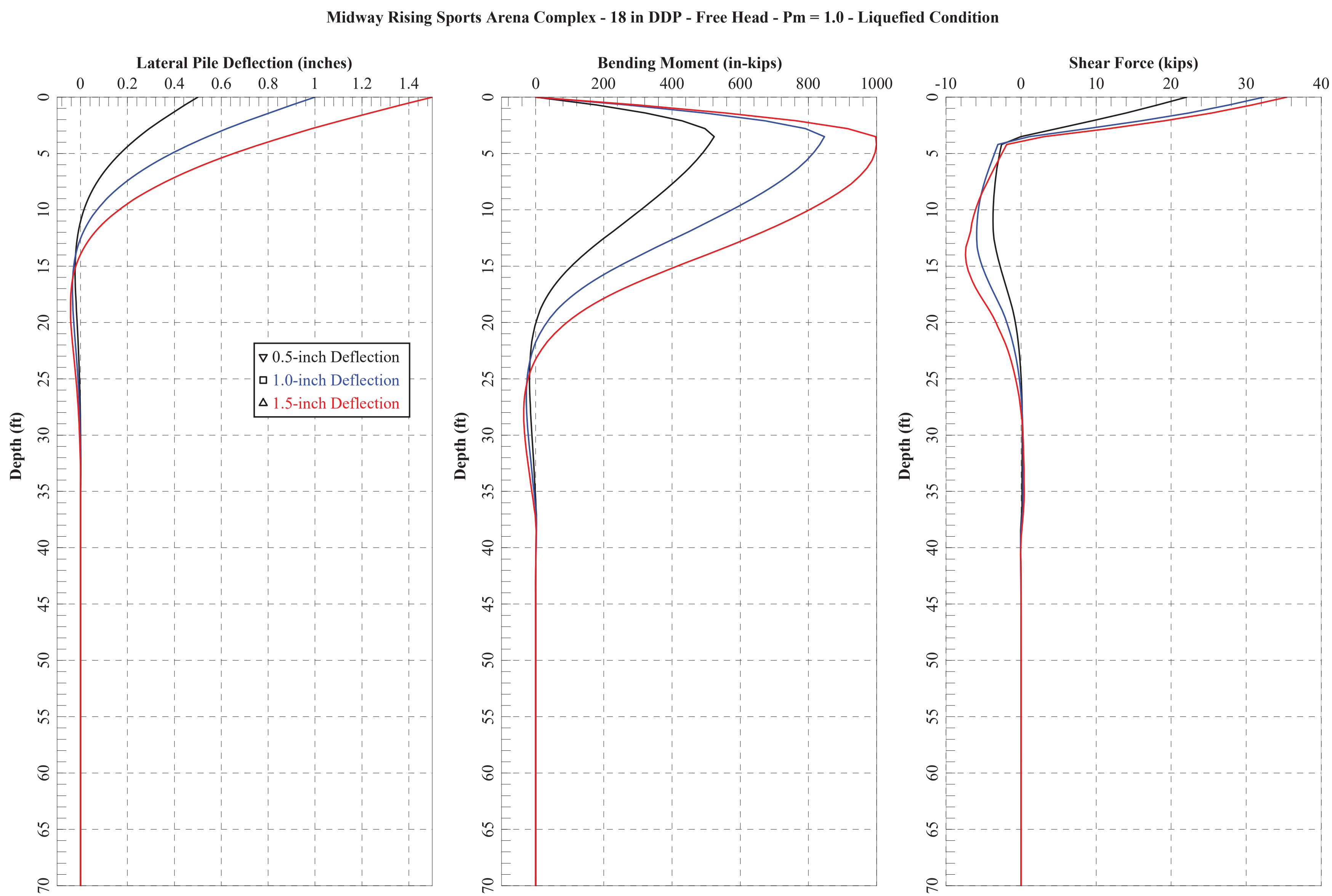
NOT TO SCALE

PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	ULTIMATE PASSIVE FORCE VERSUS LATERAL DISPLACEMENT FOR EMBEDDED PILE CAPS	PROJECT NUMBER SD760	FIGURE NUMBER C-3.1



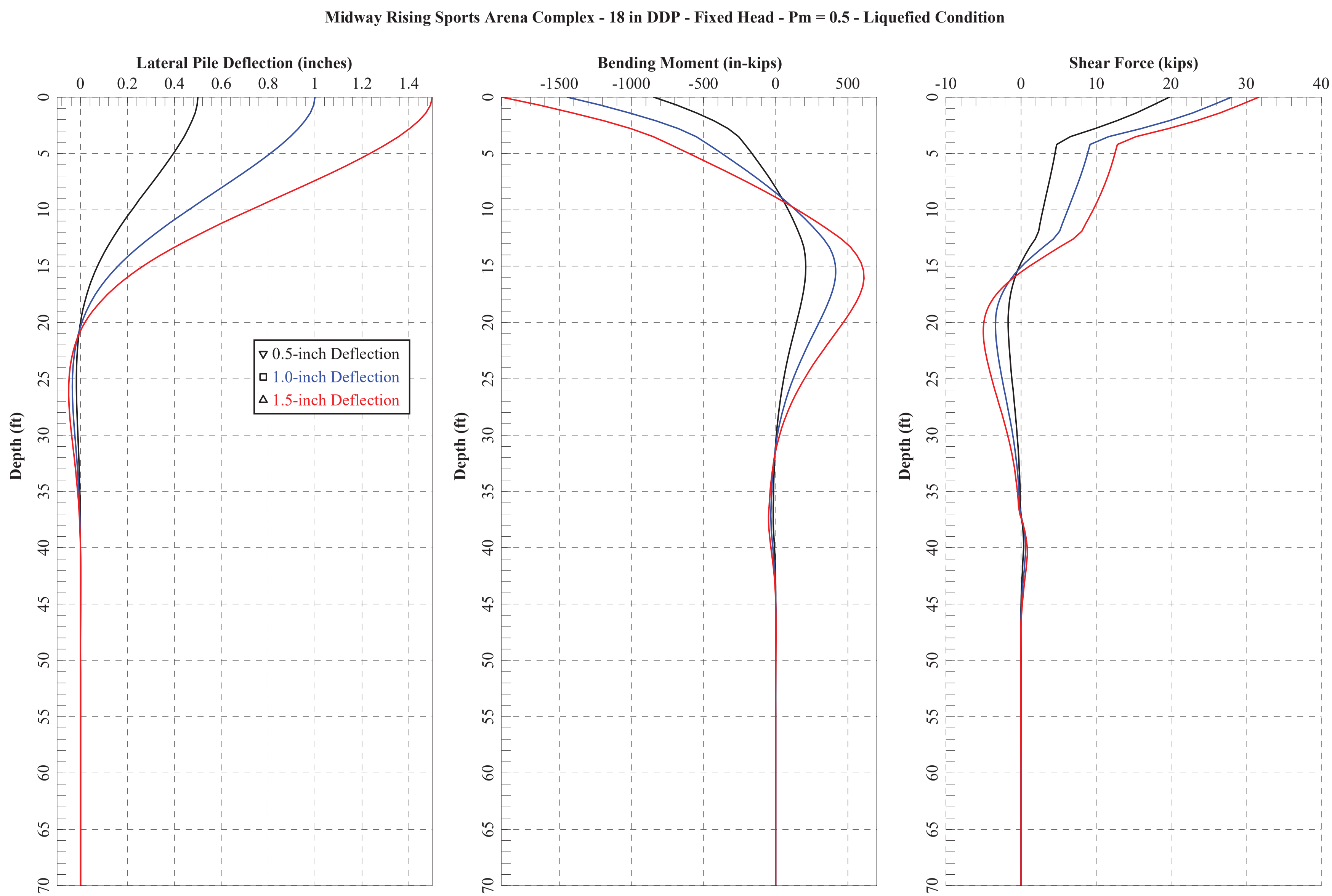
PROJECT NAME	FIGURE NAME		
SPORTS ARENA COMPLEX MIDWAY RISING	LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH	PROJECT NUMBER SD760	FIGURE NUMBER C-3.2

GROUP DELTA

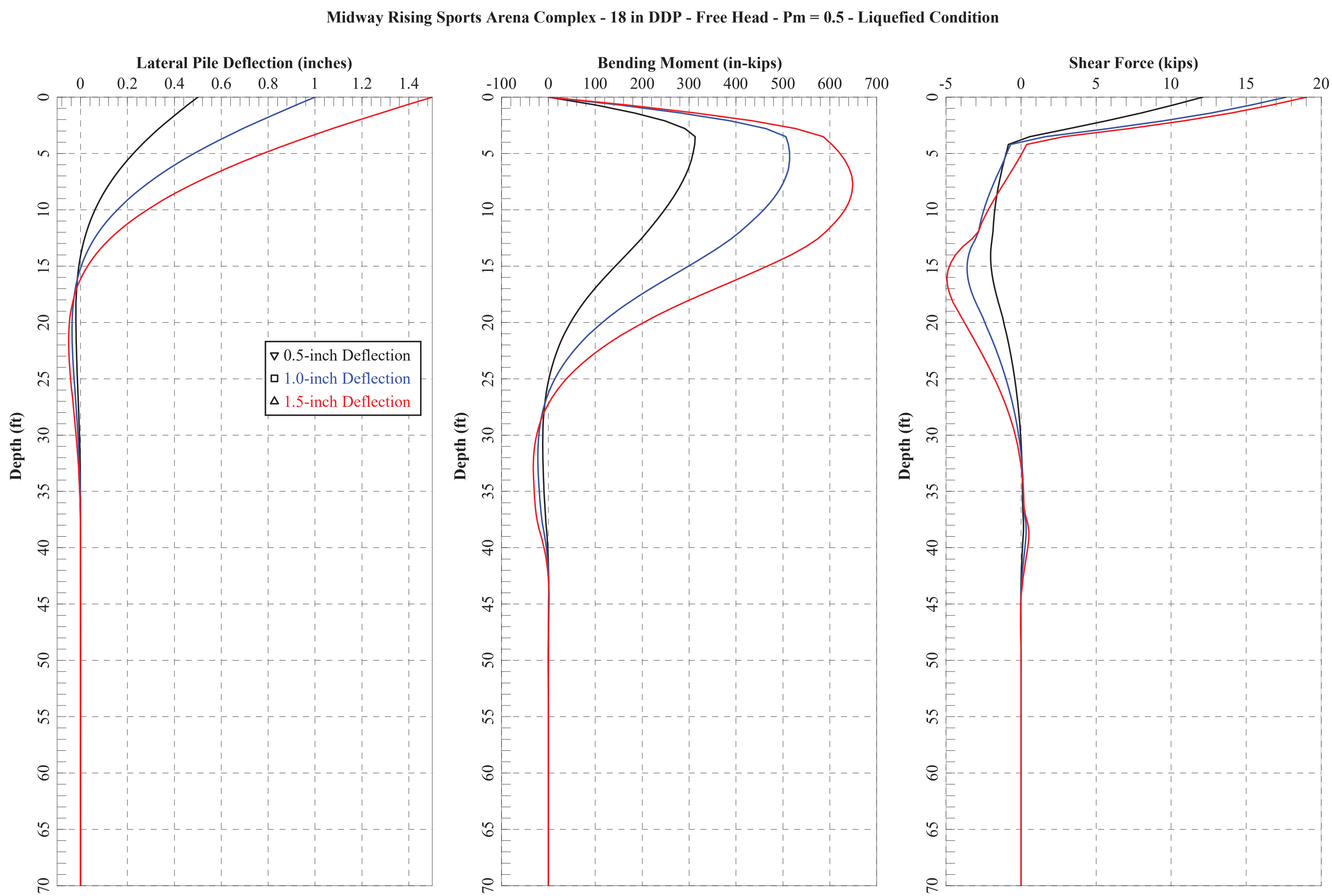


PROJECT NAME	FIGURE NAME		
SPORTS ARENA COMPLEX MIDWAY RISING	LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH	PROJECT NUMBER SD760	FIGURE NUMBER C-3.3

GROUP DELTA

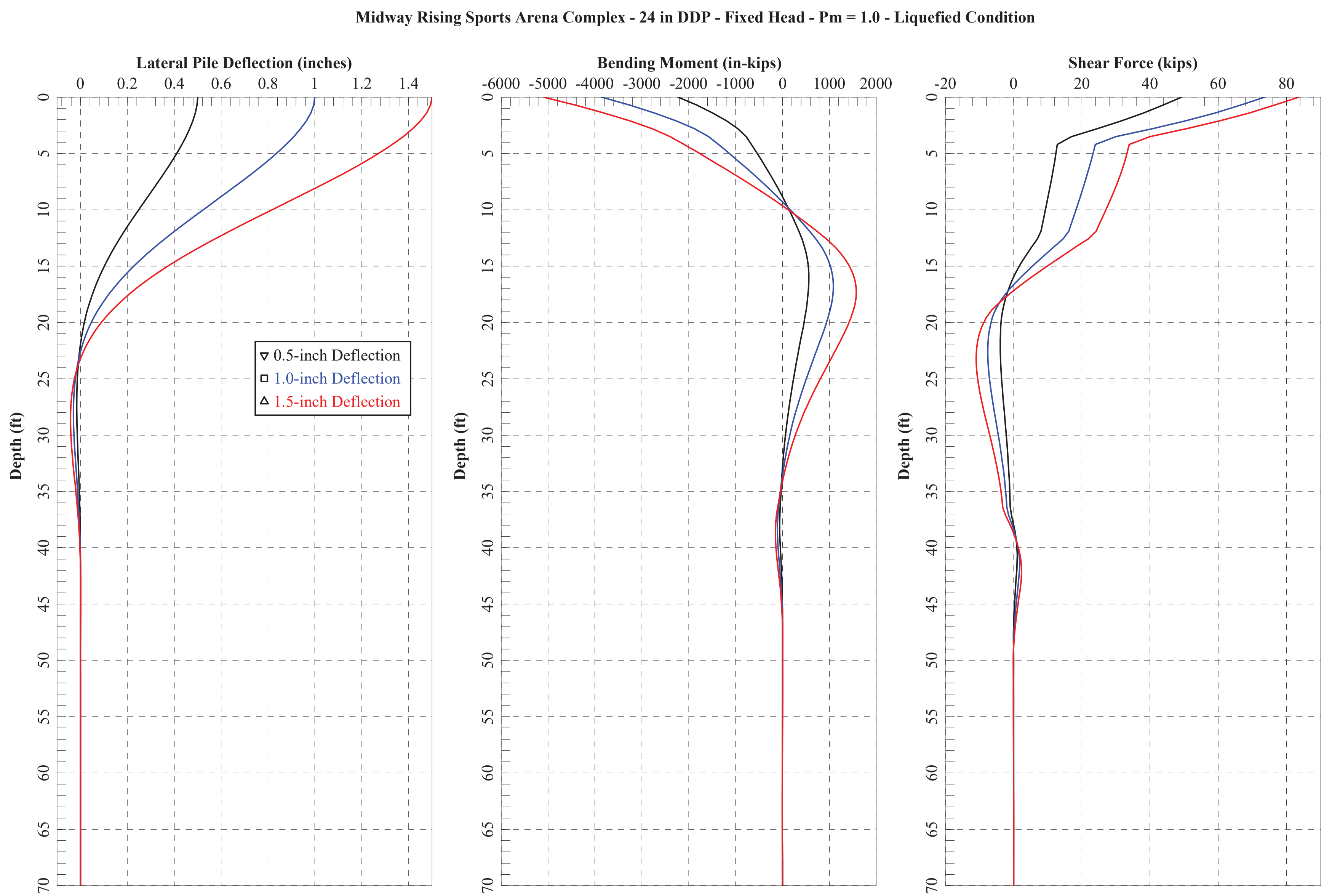


PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH	PROJECT NUMBER SD760	FIGURE NUMBER C-3.4

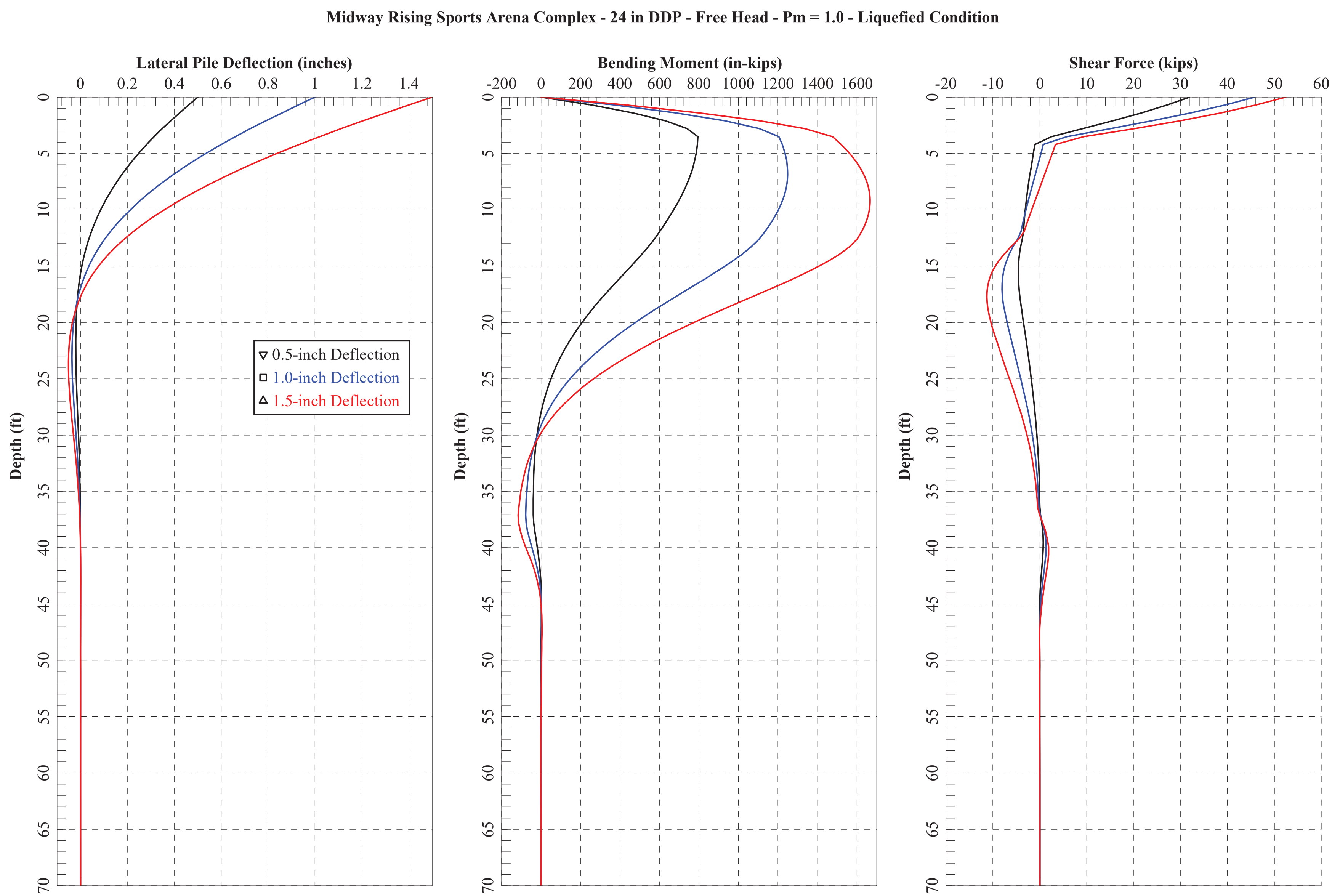


PROJECT NAME	FIGURE NAME		
SPORTS ARENA COMPLEX MIDWAY RISING	LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH	PROJECT NUMBER SD760	FIGURE NUMBER C-3.5

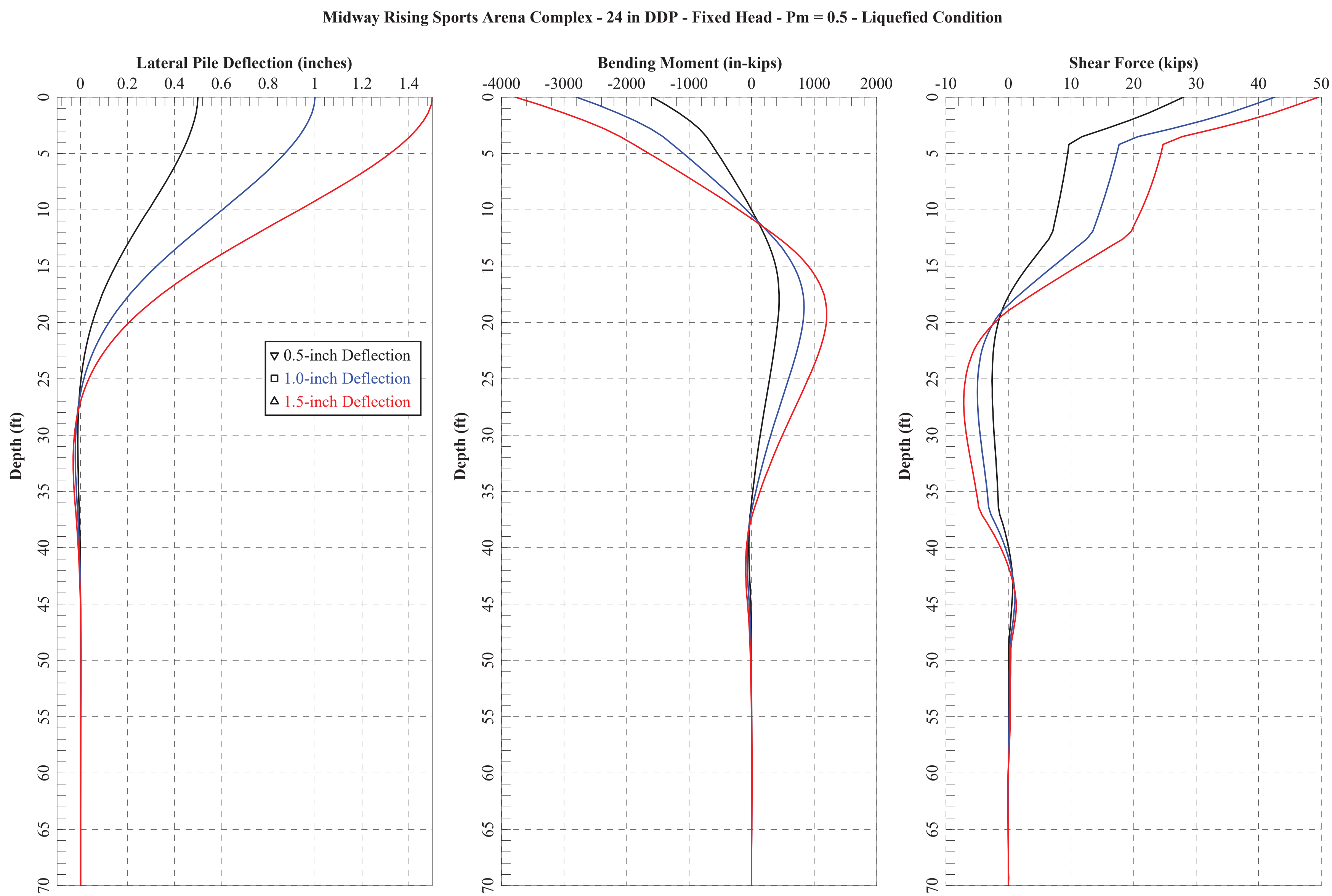
GROUP DELTA



PROJECT NAME	FIGURE NAME	GROUP DELTA	
SPORTS ARENA COMPLEX MIDWAY RISING	LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH	PROJECT NUMBER SD760	FIGURE NUMBER C-3.6



PROJECT NAME	FIGURE NAME	PROJECT NUMBER	FIGURE NUMBER
SPORTS ARENA COMPLEX MIDWAY RISING	LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH	SD760	C-3.7



PROJECT NAME

SPORTS ARENA COMPLEX
MIDWAY RISING

FIGURE NAME

LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH

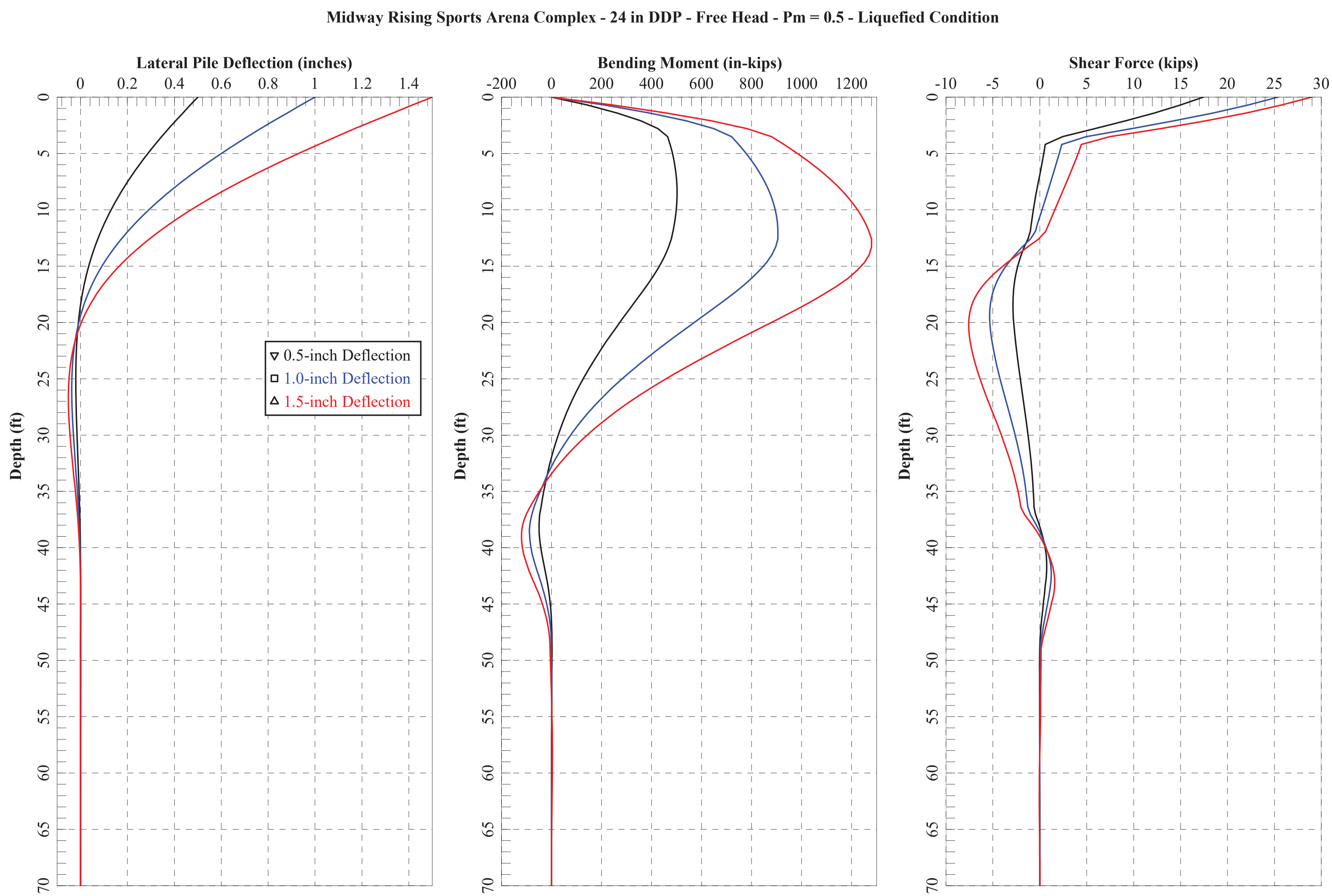
GROUP DELTA

PROJECT NUMBER

SD760

FIGURE NUMBER

C-3.8



PROJECT NAME	FIGURE NAME		
SPORTS ARENA COMPLEX MIDWAY RISING	LATERAL PILE DEFLECTION, SHEAR, AND MOMENT VERSUS DEPTH	PROJECT NUMBER SD760	FIGURE NUMBER C-3.9