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

San Diego Fire Rescue Air Facility

[Insert Permit Application Number]

Project Number - 625280

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

Engineer of Work:

BRIAN SAULL, PE– CA PE Lic. No. 85161

Provide Wet Signature and Stamp Above Line

Prepared For:

City of San Diego

1222 First Ave

San Diego, CA 92101

[Insert Applicant Phone Number]

Prepared By:

C & S Companies
2355 Northside Drive, Suite 350
San Diego, CA 92108
619 296-9373

Date:

Original: 12/13/2019; REV: 5/28/2020

Approved by: City of San Diego Date

The City of SAN DIEGO

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Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

Table of Contents

- 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:
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

85161 — PE#

03-31-20 — Expiration Date

Brian Saull

Print Name

C&S Companies

Company

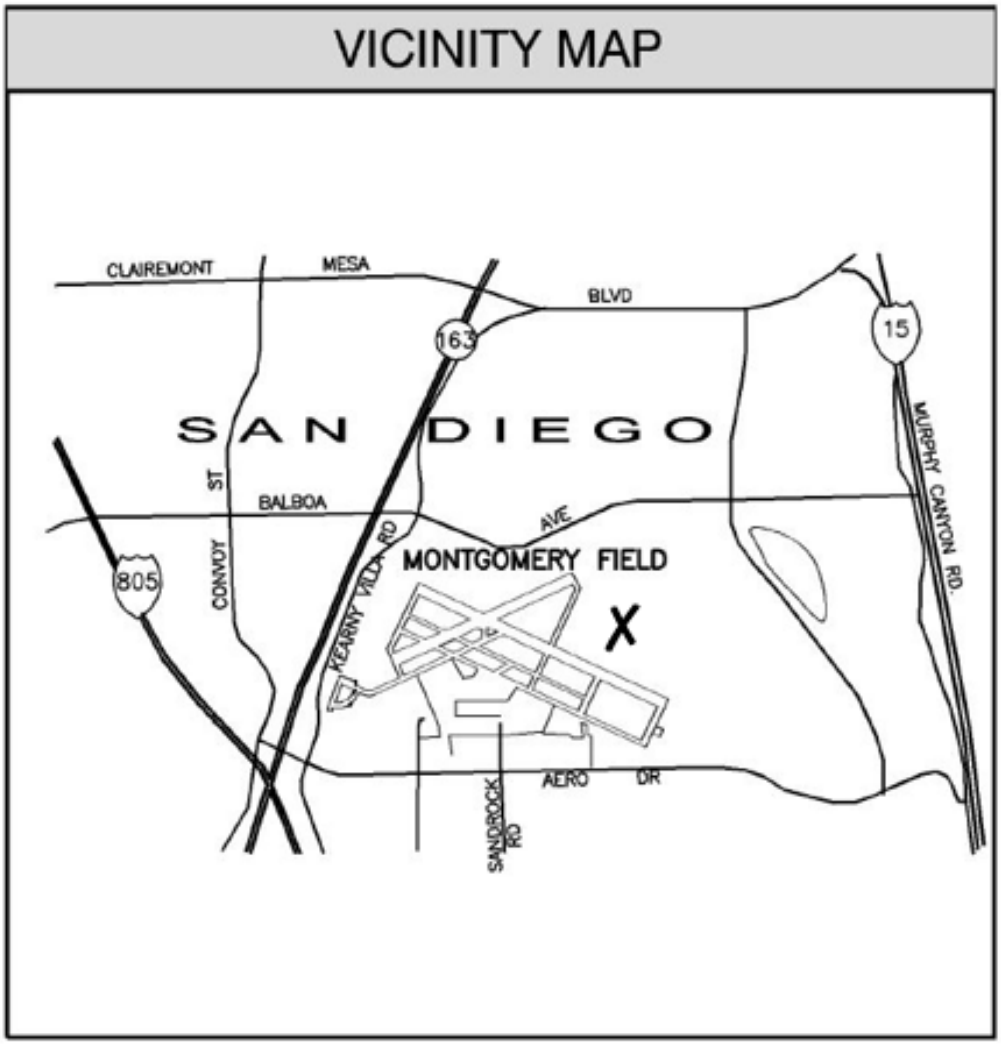
11/1/2019

Date

Engineer's Stamp

Project Vicinity Map

Project Name: San Diego Fire Rescue Air Facility - Montgomery Airport
Permit Application



Project Name: San Diego Fire Rescue Air Facility - Montgomery Airport

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	11-03-2018	☑ Preliminary Design/Planning/CEQA ☐ Final Design	Initial Submittal
2		☑ Preliminary Design/Planning/CEQA ☐ Final Design	11/05/2018
3		☑ Preliminary Design/Planning/CEQA ☐ Final Design	01/22/2019
4	11/1/2019	☑ Preliminary Design/Planning/CEQA ☐ Final Design	12/13/2019

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

Attach DS-560 form.

City of San Diego
Development Services
1222 First Ave., MS-302
San Diego, CA 92101
(619) 446-5000

Storm Water Requirements Applicability Checklist

FORM
DS-560
November 2018

Project Address:	Project Number:

SECTION 1. Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the Storm Water Standards Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP)[1] , which is administered by the State Regional Water Quality Control Board.

For all projects complete PART A: If project is required to submit a SWPPP or WPCP, continue to PART B.

PART A: Determine Construction Phase Storm Water Requirements.

1. Is the project subject to California's statewide General NPDES permit for Storm Water 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 required, skip questions 2-4 ☐ No; next question

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

   ☐ Yes; WPCP required, skip questions 3-4 ☒ No; next question

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

   ☐ Yes; WPCP required, skip question 4 ☒ No; 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, pot holing, curb and gutter replacement, and retaining wall encroachments.

   ☐ Yes; no document required

Check one of the boxes below, and continue to PART B:

☒ If you checked "Yes" for question 1, **a 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 checked "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: www.sandiego.gov/stormwater/regulations/index.shtml

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 continued 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 not located in the ASBS watershed.

b. Projects that qualify as LUP Type 2 or LUP Type 3 per the CGP and 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 not located in an ASBS watershed.

c. WPCP projects (>5,000sf of ground disturbance) located within the Los Penasquitos 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. Permanent Storm Water BMP Requirements.

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

PART C: Determine if Not Subject to Permanent Storm Water Requirements.

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

If "yes" is checked for any number in Part C, proceed to Part F and check "Not Subject to Permanent Storm Water BMP Requirements".

If "no" is checked for all of 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 storm water?	☐ 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 Page 2

PART D: PDP Exempt Requirements.

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

If "yes" was checked for any questions in Part D, continue to Part F and check the box labeled "PDP Exempt."

If "no" was 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 storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;**
   - **Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;**
   - **Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Storm Water Standards manual?**

   ☐ Yes; PDP exempt requirements apply ☒ No; 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 Storm Water Standards Manual?

   ☐ Yes; PDP exempt requirements apply ☒ No; project not exempt.

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 Storm Water 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 drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC 5812), and where the land development creates and/or replace 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 Page 3

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 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 a 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 shops 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.** The project is not covered in the categories above, results in the disturbance of one or more acres of land and is expected to generate pollutants post construction, such as fertilizers and pesticides. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces. ☐ 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 STORM WATER REQUIREMENTS**. ☐
2. The project is a **STANDARD DEVELOPMENT PROJECT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐
3. The project is **PDP EXEMPT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐
4. The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control, and structural pollutant control BMP requirements apply. See the Storm Water Standards Manual for guidance on determining if project requires a hydromodification plan management ☒

Kenneth Gethers	Project Engineer
Name of Owner or Agent *(Please Print)*	Title
	11/01/2019
Signature	Date

Clear Page 4

Clear Form

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Applicability of Permanent, Post-Construction Storm Water BMP Requirements	Form I-1

Project Identification

Project Name: San Diego Fire Rescue Air Facility - Montgomery Airport

Permit Application Number: | Date: 01/22/2019

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: San Diego Fire Rescue Air Facility – Montgomery Airport

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 (not required if prior lawful approval does not apply):		
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 not apply: All runoff created by new impervious surfaces will be first treated and stored in underground tank and hauled-off after storm event. Therefor no additional flows will be discharged into the vernal pool areas.		
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 not apply: No critical Coarse sediment yield areas exist within the project site, WMAA exhibit within attachment 2b		

HMP Exemption Exhibit

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

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

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Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

Site Information Checklist For PDPs	Form I-3B
Project Summary Information	
Project Name	San Diego Fire Rescue Air Facility - Montgomery Airp
Project Address	750 John J Montgomery Dr, San Diego, CA 92123
Assessor's Parcel Number(s) (APN(s))	760-222-32, 760-104-83, 421-030-61
Permit Application Number	
Project Watershed	Select One: ☐ San Dieguito River ☐ Penasquitos ☐ Mission Bay ☐ San Diego River ☐ San Diego Bay ☐ Tijuana River
Hydrologic subarea name with Numeric Identifier up to two decimal places (9XX.XX)	Mission San Diego , HSA - 907.11
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	502 Acres (21,867,120 Square Feet)
Area to be disturbed by the project (Project Footprint)	3.19 Acres (139,105 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	2.97 Acres (129,373 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	0.22 Acres (9,583 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	314.62 %

Form I-3B Page 2 of 11

Description of Existing Site Condition and Drainage Patterns

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

- ☑ Existing development
- ☐ Previously graded but not built out
- ☐ Agricultural or other non-impervious use
- ☐ Vacant, undeveloped/natural

Description / Additional Information:

The site is an airport facility.

Existing Land Cover Includes (select all that apply):

- ☑ Vegetative Cover
- ☐ Non-Vegetated Pervious Areas
- ☑ Impervious Areas

Description / Additional Information:

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

- ☐ NRCS Type A
- ☐ NRCS Type B
- ☐ NRCS Type C
- ☑ NRCS Type D

Approximate Depth to Groundwater:

- ☐ Groundwater Depth < 5 feet
- ☐ 5 feet < Groundwater Depth < 10 feet
- ☐ 10 feet < Groundwater Depth < 20 feet
- ☐ Groundwater Depth > 20 feet

Existing Natural Hydrologic Features (select all that apply):

- ☐ Watercourses
- ☐ Seeps
- ☐ Springs
- ☑ Wetlands
- ☐ None

Description / Additional Information:

There are existing vernal pool south of the proposed improved area but will not be impacted by proposed ground disturbance

Form I-3B Page 3 of 11

Description of Existing Site Topography and Drainage

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

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

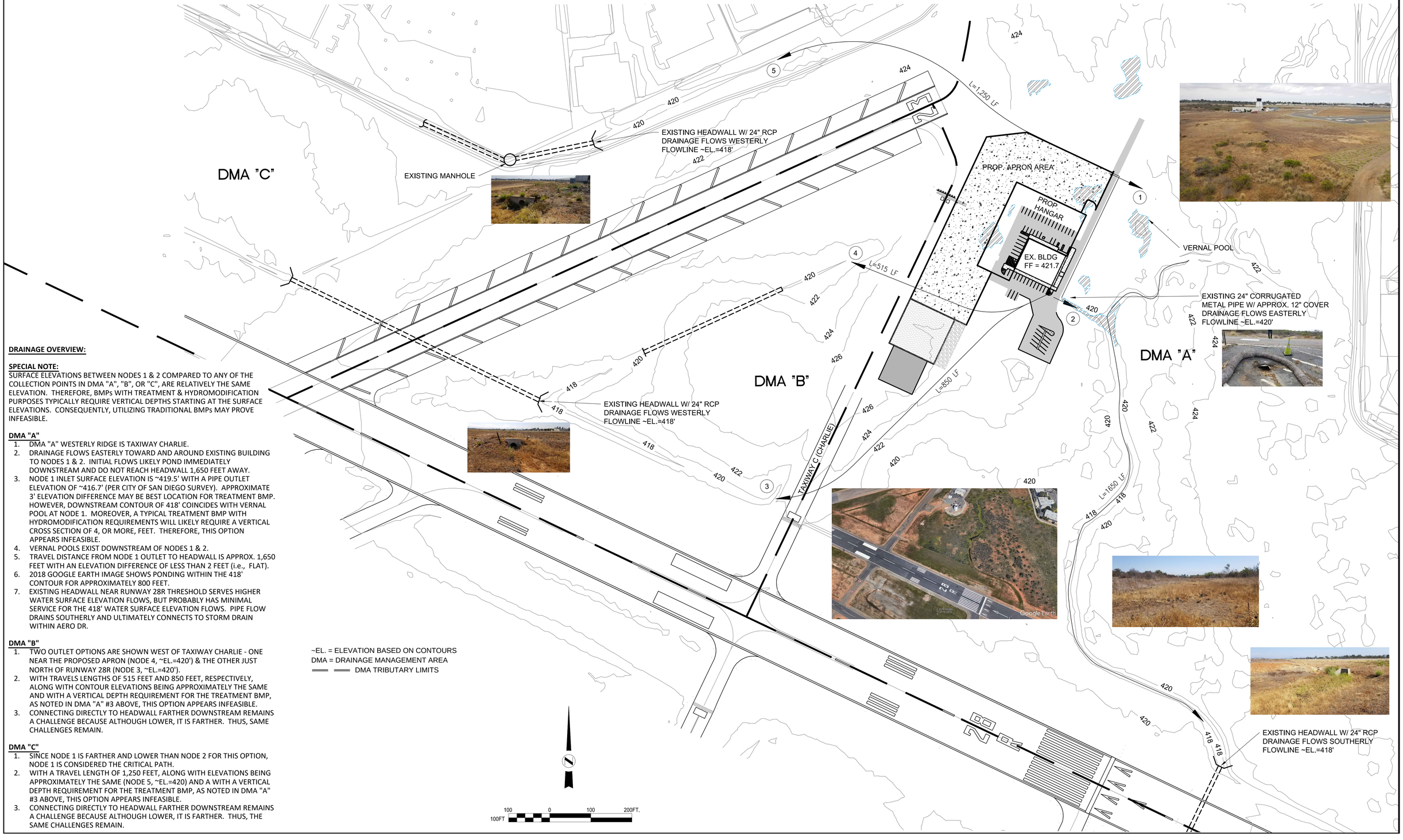
Descriptions/Additional Information

The project's runoff drains to two low points within the ground disturbance area (node 1 and node 2, of attached drainage options exhibit, next page). The southerly watershed (see hydrology map, attachment 5) drains to the northeast into an existing 24" corrugated metal pipe located in the parking lot nearby the most southeasterly corner of the existing building (node 1). This pipe conveys flows underneath the paved surface discharging flows to the east into an existing natural meandering stream that conveys flows to the southeast, to a headwall immediately north of Runway 28R, then off-site further to the south into an existing underground public system within Aero Drive. The northerly watershed drains to the east to a low point located nearby and at the most northeast corner of the existing parking lot. Flows over top the existing paved road and continue southeast into the existing stream.

Drainage options were considered, but proved infeasible regardless of the approach due to the following conditions

1. Redirecting flow from either node 1 or node 2 to node 3, 4, or 5 was not possible due to approximately the same field elevations. And since the downstream nodes are either 515 LF, 850 LF, or 1250 LF away, all downstream elevation outlets would end up below grade. Moreover, farther downstream existing structural systems have inlet elevations that are also too high relative to the upstream nodes 1 and node 2 for any connectivity to occur.

CITY OF SAN DIEGO - AIR FIRE RESCUE FACILITY
MONTGOMERY AIRPORT POST-DEVELOPMENT DRAINAGE



DRAINAGE OVERVIEW:

SPECIAL NOTE:
SURFACE ELEVATIONS BETWEEN NODES 1 & 2 COMPARED TO ANY OF THE COLLECTION POINTS IN DMA "A", "B", OR "C", ARE RELATIVELY THE SAME ELEVATION. THEREFORE, BMPs WITH TREATMENT & HYDROMODIFICATION PURPOSES TYPICALLY REQUIRE VERTICAL DEPTHS STARTING AT THE SURFACE ELEVATIONS. CONSEQUENTLY, UTILIZING TRADITIONAL BMPs MAY PROVE INFEASIBLE.

DMA "A"

1. DMA "A" WESTERLY RIDGE IS TAXIWAY CHARLIE.
2. DRAINAGE FLOWS EASTERLY TOWARD AND AROUND EXISTING BUILDING TO NODES 1 & 2. INITIAL FLOWS LIKELY POND IMMEDIATELY DOWNSTREAM AND DO NOT REACH HEADWALL 1,650 FEET AWAY.
3. NODE 1 INLET SURFACE ELEVATION IS ~419.5' WITH A PIPE OUTLET ELEVATION OF ~416.7' (PER CITY OF SAN DIEGO SURVEY). APPROXIMATE 3' ELEVATION DIFFERENCE MAY BE BEST LOCATION FOR TREATMENT BMP. HOWEVER, DOWNSTREAM CONTOUR OF 418' COINCIDES WITH VERNAL POOL AT NODE 1. MOREOVER, A TYPICAL TREATMENT BMP WITH HYDROMODIFICATION REQUIREMENTS WILL LIKELY REQUIRE A VERTICAL CROSS SECTION OF 4, OR MORE, FEET. THEREFORE, THIS OPTION APPEARS INFEASIBLE.
4. VERNAL POOLS EXIST DOWNSTREAM OF NODES 1 & 2.
5. TRAVEL DISTANCE FROM NODE 1 OUTLET TO HEADWALL IS APPROX. 1,650 FEET WITH AN ELEVATION DIFFERENCE OF LESS THAN 2 FEET (i.e., FLAT).
6. 2018 GOOGLE EARTH IMAGE SHOWS PONDING WITHIN THE 418' CONTOUR FOR APPROXIMATELY 800 FEET.
7. EXISTING HEADWALL NEAR RUNWAY 28R THRESHOLD SERVES HIGHER WATER SURFACE ELEVATION FLOWS, BUT PROBABLY HAS MINIMAL SERVICE FOR THE 418' WATER SURFACE ELEVATION FLOWS. PIPE FLOW DRAINS SOUTHERLY AND ULTIMATELY CONNECTS TO STORM DRAIN WITHIN AERO DR.

DMA "B"

1. TWO OUTLET OPTIONS ARE SHOWN WEST OF TAXIWAY CHARLIE - ONE NEAR THE PROPOSED APRON (NODE 4, ~EL.=420') & THE OTHER JUST NORTH OF RUNWAY 28R (NODE 3, ~EL.=420').
2. WITH TRAVELS LENGTHS OF 515 FEET AND 850 FEET, RESPECTIVELY, ALONG WITH CONTOUR ELEVATIONS BEING APPROXIMATELY THE SAME AND WITH A VERTICAL DEPTH REQUIREMENT FOR THE TREATMENT BMP, AS NOTED IN DMA "A" #3 ABOVE, THIS OPTION APPEARS INFEASIBLE.
3. CONNECTING DIRECTLY TO HEADWALL FARTHER DOWNSTREAM REMAINS A CHALLENGE BECAUSE ALTHOUGH LOWER, IT IS FARTHER. THUS, SAME CHALLENGES REMAIN.

DMA "C"

1. SINCE NODE 1 IS FARTHER AND LOWER THAN NODE 2 FOR THIS OPTION, NODE 1 IS CONSIDERED THE CRITICAL PATH.
2. WITH A TRAVEL LENGTH OF 1,250 FEET, ALONG WITH ELEVATIONS BEING APPROXIMATELY THE SAME (NODE 5, ~EL.=420) AND A WITH A VERTICAL DEPTH REQUIREMENT FOR THE TREATMENT BMP, AS NOTED IN DMA "A" #3 ABOVE, THIS OPTION APPEARS INFEASIBLE.
3. CONNECTING DIRECTLY TO HEADWALL FARTHER DOWNSTREAM REMAINS A CHALLENGE BECAUSE ALTHOUGH LOWER, IT IS FARTHER. THUS, THE SAME CHALLENGES REMAIN.

~EL. = ELEVATION BASED ON CONTOURS
DMA = DRAINAGE MANAGEMENT AREA
DMA TRIBUTARY LIMITS

Form I-3B Page 4 of 11

Description of Proposed Site Development and Drainage Patterns

Project Description / Proposed Land Use and/or Activities:

The project proposes to construct two hangars for helicopters, apron areas for the helicopters, fuel tender areas, and a small maintenance facility structure. The hangars will share walls with the existing FAA facility building. The FAA facility building will be renovated to function along with the proposed improvements. The project also includes the design of an underground storage vault and modular wetland systems to abide with the City's stormwater requirements. The storage vault has been designed to not only collect all the proposed runoff from the project apron areas but also to collect the adjacent helipad parking area located to the west via a new storm drain pipe, which will connect into the trench proposed in the apron

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

The project proposes two hangars and paved apron areas

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

There are large existing natural and manufactured landscaped areas surrounding the proposed improvement areas.

Does the project include grading and changes to site topography?

☐ Yes

☐ No

Description / Additional Information:

Although the site is reasonably flat, the project proposes to continue to use relatively flat grade areas for the proposed paved aprons.

Form I-3B Page 5 of 11

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 proposes to route all runoff from new impervious areas and adjacent helipad area, into a modular wetland for water quality and then into an underground storage system for detention of the 100-year peak volumes. Captured peak runoff volumes from the 6-hr, 100-yr storm event will be pumped and hauled off for discharge into an acceptable MS4 that meets the R9-2013-0001 permit, as amended by R9-2015-0001 and R9-2015-0100, NPDES CAS0109266. City of San Diego, the owner of the underground storage system, is in process of determined disposal arrangements. Prior to the installation of the Phase 2 apron the helipad, adjacent to the project area, will drain into a gravel storage shoulder, which will act as a temporary storage facility for all runoff. After the completion of Phase 2, the helipad will connect hydraulically into the proposed apron trench drain via a new storm drain.

Form I-3B Page 6 of 11

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

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

Description/Additional Information:

On-site wash racks will be required for the maintenance of the helicopters. Wash water will be properly disposed of by city personnel or their assignees.

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) Runoff from improved ares will be collected by a proposed trench drain that will then convey flows to a water quality treatment facility for treatment of the first flush, higher flows and treated flows will be conveyed into a proposed underground tank for full detention of the 6-hr, 100-yr peak flows. The runoff volume will then be will discharged into existing storm water facilities. On-site streams and culverts convey flows off-site to the south into a public underground system within Aero Drive. The public storm drain and natural canyons convey runoff from the area 2.5 miles south to discharge into the San Diego River, then flows 7.5 miles west to the Pacific Ocean.
Provide a summary of all beneficial uses of receiving waters downstream of the project discharge locations MUN, AGR, IND, PROC, REC1, REC2, WARM, COLD, WILD
Identify all ASBS (areas of special biological significance) receiving waters downstream of the project discharge locations None
Provide distance from project outfall location to impaired or sensitive receiving waters Vernal Pools exist approximately 100 feet away from the proposed ground disturbance areas but will not be impacted by the associated construction work.
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 A modular wetlands system will capture and treat the overland flow from the proposed improvements and adjacent helipad areas. Moreover, a storage tank adjacent to the modular wetlands system will capture 100% of the 6-hr 100-year storm from the proposed flows and unimproved tributary flows . Therefore, post developments improvement flows will not discharge onto the vernal pool areas.

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, Coliform, Low Dissolved Oxygen	Indicator Bacteria
	Manganese, Nitrogen,	
	Phosphorous, TDS, 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):

The project flow will be captured by a trench drain and routed to a proposed modular wetland for water quality purposes. Subsequent 0.1Q2 to Q10 flows, along with the 6-hr, 100-yr peak flows will be routed to the underground storage tank with capacity to retain all flows in order to prevent discharging onto the vernal pools located down stream. All capture runoff volumes will be pumped and hauled offsite by city-assigned personnel for discharge into an acceptable MS4 that meets the requirements of R9-2013-0001, as amended by R9-2015-0001 and R9-2015-0100, NPDES CAS0109266.

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

Critical Coarse Sediment Yield Areas*
*This Section only required if hydromodification management requirements apply

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

☐ Yes

☑ No

Discussion / Additional Information:

Form I-3B Page 10 of 11

Flow Control for Post-Project Runoff*

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

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

Not applicable, due to all flows being captured in an underground storage tank.

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:

Discussion / Additional Information: (optional)

Not applicable, due to all flows being captured in an underground storage tank.

Form I-3B Page 11 of 11

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.

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

Source Control BMP Checklist for PDPs	Form I-4B		
Source Control BMPs			
All development projects must implement source control BMPs where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of the Storm Water Standards) for information to implement source control BMPs shown in this checklist. Answer each category below pursuant to the following. • "Yes" means the project will implement the source control BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required. • "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided. • "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project has no outdoor materials storage areas). Discussion / justification may be provided.			
Source Control Requirement	**Applied?**		
4.2.1 Prevention of Illicit Discharges into the MS4	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.1 not implemented:			
4.2.2 Storm Drain Stenciling or Signage	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.2.2 not implemented:			
4.2.3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.3 not implemented:			
4.2.4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.4 not implemented:			
4.2.5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.5 not implemented:			

Project Name: San Diego Fire Rescue Air Facility - Montgomery Airport

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

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

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: Maintain existing on-site vernal pools.			
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: Large natural areas around the project site have been conserved.			

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

Form I-5B Page 2 of 4			
Site Design Requirement	**Applied?**		
4.3.3 Minimize Impervious Area	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.3.3 not implemented:			
4.3.4 Minimize Soil Compaction	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.3.4 not implemented:			
4.3.5 Impervious Area Dispersion	☐ Yes	☑ No	☐ N/A
Discussion / justification if 4.3.5 not implemented: There are no pervious areas down stream, within the proposed improvements. All flows within proposed improvements sheet flow to a trench drain which conveys flows to the proposed modular wetland for water quality purposes.			
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

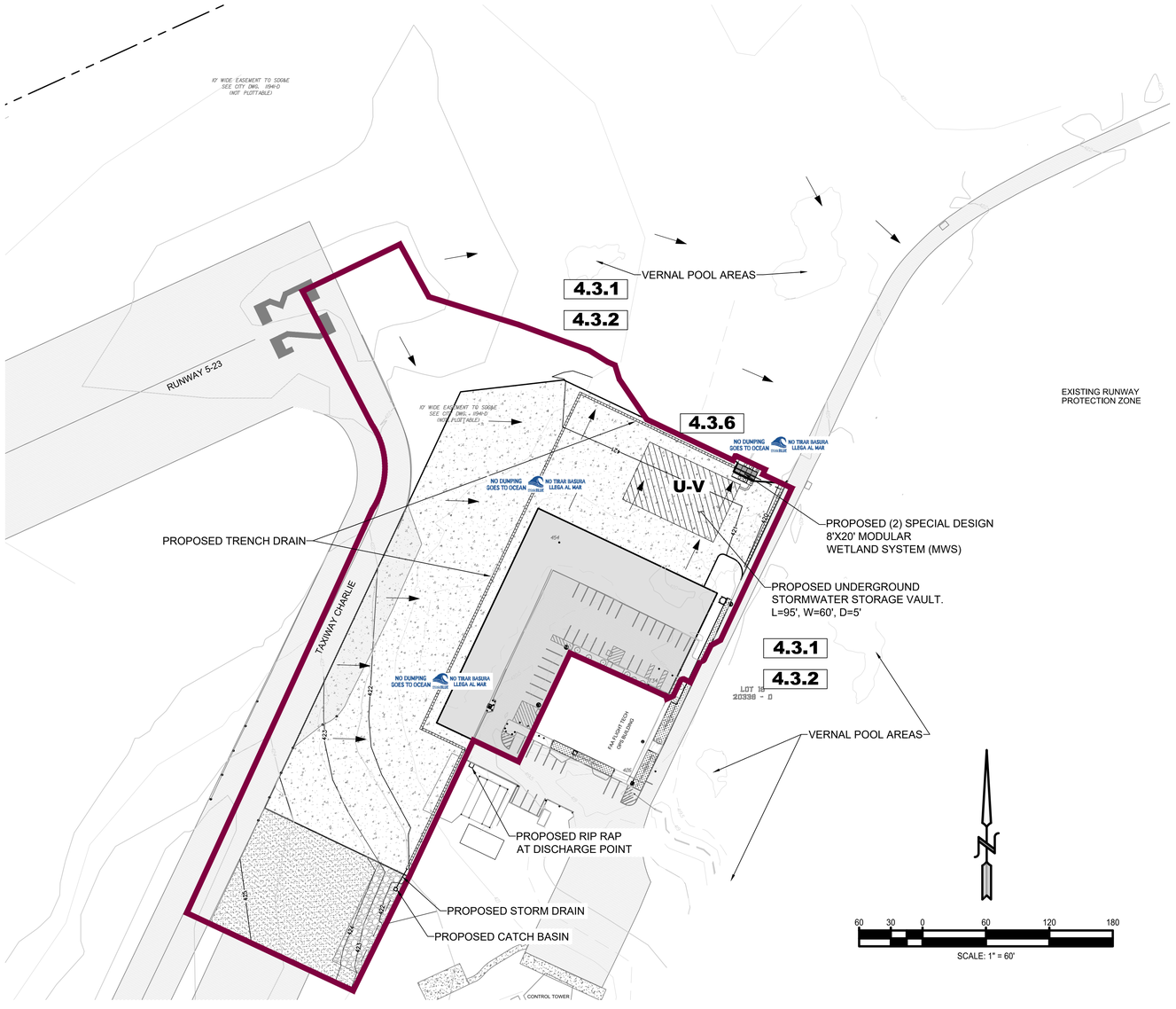
Project Name: San Diego Fire Rescue Air Facility - Montgomery Airport

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: Due to FAA minimum design requirements for proper, and safe, movement and placement of helicopters, the impervious surfaces footprint cannot be made any smaller. And the following "No" responses is in response to the requirements for this design to meet FAA guidelines.			
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: There is no new landscaping proposed.			
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

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

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

AIR FIRE RESCUE FACILITY
SITE / BMP MAP



ENGINEERING PERMIT NO:_____

DISCRETIONARY PERMIT NO:_____

PRIVATE CONTRACT

SITE / BMP MAP

AIR FIRE RESCUE FACILITY

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 1 OF 1 SHEETS

PROJECT NO._____

V.T.M._____

FOR CITY ENGINEER _____ DATE _____

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

XXXX-XXXX
NAD83 COORDINATES

XXX-XXXX
LAMBERT COORDINATES

CONTRACTOR_____ DATE STARTED_____

INSPECTOR_____ DATE COMPLETED_____

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO

PUBLIC WORKS DEPARTMENT

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

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.

Existing flows are from northwest to southeast. Southeast of the proposed BMP exists vernal pools. Due to proposed improvements, discharge will no longer be allowed to flow onto the vernal pools. Moreover, due to the treatment BMP requirement of being at or below grade of the upstream flows, the proposed modular wetlands system cannot connect to any existing MS4. The nearest MS4 is on Ponderosa Ave, over 1,200 feet away with a depth of only approximately 4 feet. As a result, the project proposes to drain all runoff from new impervious areas and existing helipad impervious areas onto a modular wetlands system for water quality for treatment of the Design Capture Volume. The additional flows will then flow into an underground storage system for detention of the 100-year peak volumes. 100% of the captured runoff volumes will then be pumped and hauled offsite by city-assigned personnel for discharge into an acceptable MS4 that meets the requirements of R9-2013-0001, as amended by R9-2015-0001 and R9-2015-0100, NPDES CAS0109266. Prior to the installation of the Phase 2 apron the helipad, adjacent to the project area, will drain into a gravel storage shoulder, which will act as a temporary storage facility for all runoff. After the completion of Phase 2, the helipad will connect hydraulically into the proposed apron trench drain via a new storm drain.

(Continue on page 2 as necessary.)

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

Form I-6 Page 2 of 2

(Continued from page 1)

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

Form I-6 Page 1 of 2 (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP-1	
Construction Plan Sheet No. Current entitlement review C-1	
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	Kenneth Gethers C&S Companies
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

Form I-6 Page 2 of 2 (Copy as many as needed)
Structural BMP ID No. BMP-1
Construction Plan Sheet No. Current entitlement review C-1
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs): The project proposes to use a modular wetland for pollutant control only.

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Attachment 1
Backup For PDP Pollutant Control BMPs

This is the cover sheet for Attachment 1.

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Project Name: San Diego Fire Rescue Air Facility - Montgomery Airport

Indicate which Items are Included:

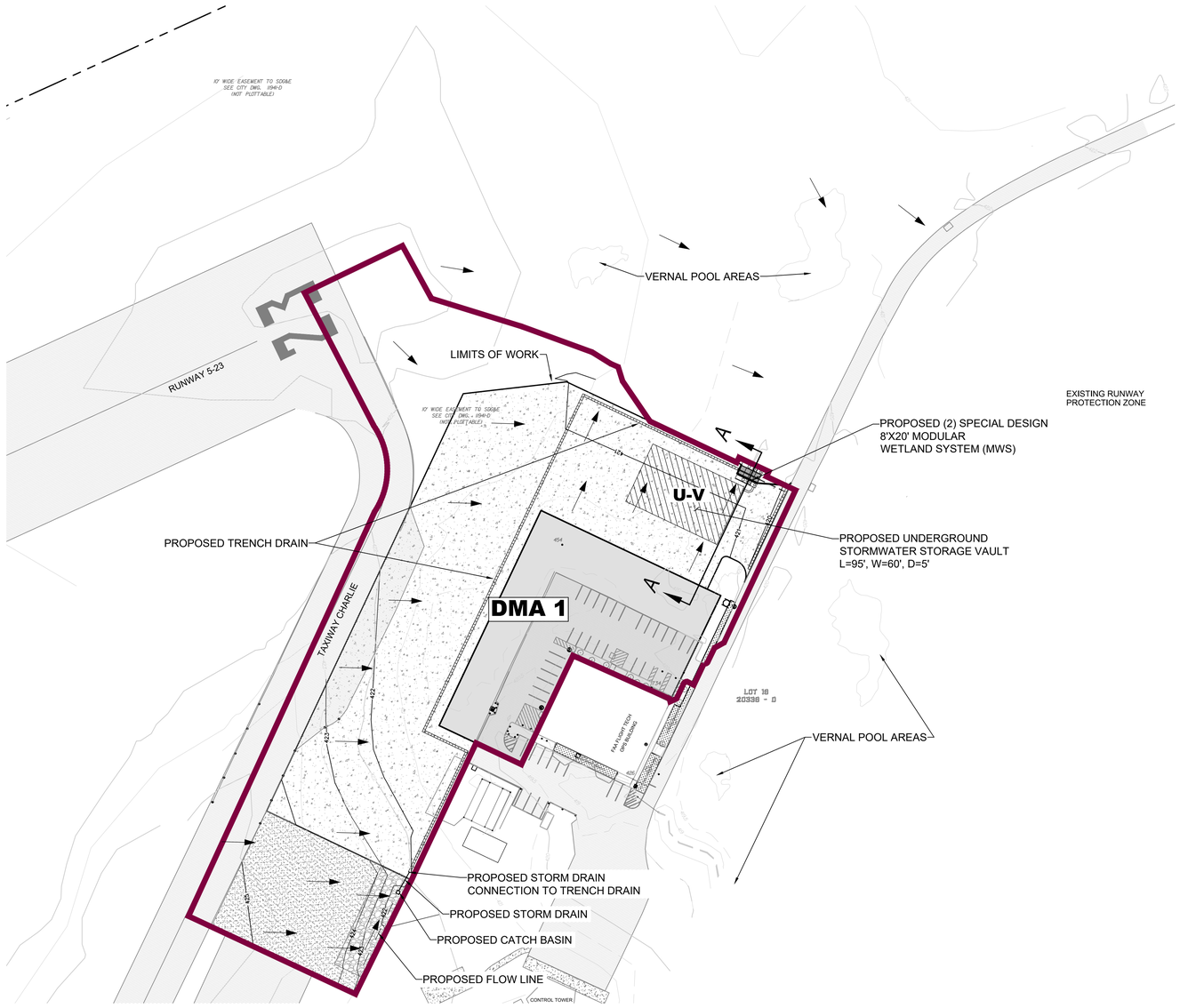
Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	☑ Included
Attachment 1b	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☑ Included on DMA Exhibit in Attachment 1a ☐ Included as Attachment 1b, separate from DMA Exhibit
Attachment 1c	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	☑ Included ☐ Not included because the entire project will use infiltration BMPs
Attachment 1d	Infiltration Feasibility Information. Contents of Attachment 1d depend on the infiltration condition: • No Infiltration Condition: ○ Infiltration Feasibility Condition Letter (***Note: must be stamped and signed by licensed geotechnical engineer***) ○ Form I-8A (optional) ○ Form I-8B (optional) • Partial Infiltration Condition: ○ Infiltration Feasibility Condition Letter (***Note: must be stamped and signed by licensed geotechnical engineer***) ○ Form I-8A ○ Form I-8B • Full Infiltration Condition: ○ Form I-8A ○ Form I-8B ○ Worksheet C.4-3 ○ Form I-9 Refer to Appendices C and D of the BMP Design Manual for guidance.	No infiltration due to geological instability, See geotechnical report for feasibility letter ☐ Included ☑ Not included because infiltration not allowed due to geological instability
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

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

The DMA Exhibit must identify:

- [x] Underlying hydrologic soil group
- [x] Approximate depth to groundwater
- [x] Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- [ ] Critical coarse sediment yield areas to be protected
- [x] Existing topography and impervious areas
- [x] Existing and proposed site drainage network and connections to drainage offsite
- [x] Proposed grading
- [x] Proposed impervious features
- [x] Proposed design features and surface treatments used to minimize imperviousness
- [x] 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)
- [x] Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
- [x] Structural BMPs (identify location, type of BMP, size/detail, and include cross-section)

AIR FIRE RESCUE FACILITY
DMA MAP



LEGEND

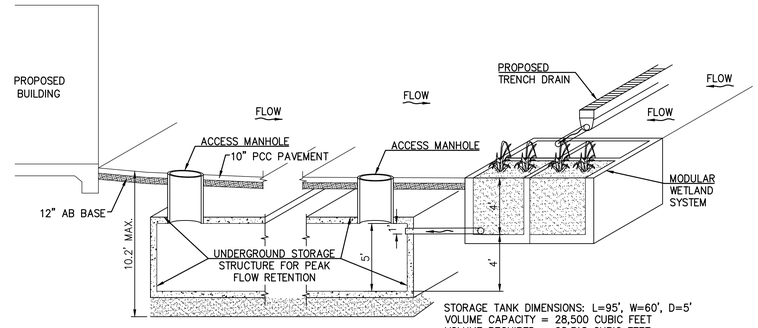
- DRAINAGE MANAGEMENT AREA (DMA)
- FLOW DIRECTION
- DMA 1 — DMA ID NUMBER
- MODULAR WETLAND SYSTEM
- U-V — STORMWATER STORAGE TANK

NOTES:

1. THE UNDERLYING SOIL TYPE GROUP IS "D" FOR THE ENTIRE PROPERTY AND SURROUNDING PARCELS
2. THE APPROXIMATE DEPTH TO GROUND WATER IS EXPECTED TO BE MORE THAN 10 FEET
3. NO CRITICAL COARSE SEDIMENT YIELD AREAS EXIST ON SITE
4. THE SITE CONTAINS VERNAL POOLS BUT NONE WILL BE IMPACTED.

DRAINAGE MANAGEMENT AREAS

DMA	TRIBUTARY AREA (SF)	IMPERVIOUS AREAS (SF)	PERVIOUS AREAS (SF)	% IMPERVIOUS	HYDROLOGIC SOIL TYPE	DRAINS TO
1	173,321	133,530	39,791	77.04	D	MWS



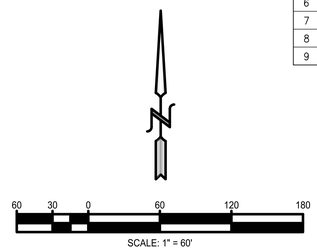
STORAGE TANK DIMENSIONS: L=95', W=60', D=5'
VOLUME CAPACITY = 28,500 CUBIC FEET
VOLUME REQUIRED = 28,318 CUBIC FEET

TYPICAL SECTION A-A
NO SCALE

1	DCV	DCV	7,754	cubic-feet
2	DCV RETAINED	DCV RETAINED	0	cubic-feet
3	DCV BIOFILTERED	DCV BIOFILTERED	0	cubic-feet
4	DCV REQUIRED FLOW-TRU (LINE 1 – LINE 2 – 0.67 X LINE 3	DCV FLOW-THRU	7,754	cubic-feet
5	ADJUSTED FACTOR (LINE 4/ LINE 1)	AF=	1	unitless
6	DESIGN RAINFALL INTENSITY	i=	0.2	in/hr
7	AREA TRIBUTARY TO BMP	A=	4.0	acres
8	RUNOFF FACTOR	C=	0.89	unitless
9	CALCULATE FLOW RATE = AF x (C x i x A)	Q=	0.712	cfs

DESIGN FLOW RATE = 0.712 X 1.5 = 1.07 CFS

(2) special design Modular Wetlands System 8' X 20' with a combined flow treatment rate of 1.154 cfs which exceeds the treatment flow rate calculated above is being proposed



ENGINEERING PERMIT NO:_____
DISCRETIONARY PERMIT NO:_____
PRIVATE CONTRACT

DMA MAP

AIR FIRE RESCUE FACILITY

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 1 OF 1 SHEETS

PROJECT NO._____
V.T.M._____

FOR CITY ENGINEER _____ DATE _____

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	XXX			
AS-BUILTS				

XXXX-XXXX NAD83 COORDINATES
XXX-XXXX LAMBERT COORDINATES

CONTRACTOR_____ DATE STARTED_____
INSPECTOR_____ DATE COMPLETED_____

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO
DEVELOPMENT SERVICES DEPARTMENT

SAVE DATE: 12/13/2019 ~ PLOT DATE: 12/17/2019 ~ FILE NAME: F:\Project\074 - City of San Diego\074001002- Air Fire Rescue Facility\Planning-Study\Provided by Others\from HWL\Phase 2 (6-20-2019)\20190620_Phase 2\18301 PDP Phase 2 - Standard\SWQMP\Mont_DMA MAP_Phase 2-updated.dwg

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:_____

No demand for harvest water. No landscaping proposed

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]

N.A.

3. Calculate the DCV using worksheet B-2.1.
DCV = _____ (cubic feet)
[Provide a summary of calculations here]

N.A.

3a. Is the 36-hour demand greater than or equal to the DCV?	3b. Is the 36-hour demand greater than 0.25DCV but less than the full DCV?	3c. Is the 36-hour demand less than 0.25DCV?
☐ Yes / ☐ No ⇨ ⇩ No Demand	☐ Yes / ☐ No ⇨ ⇩ No Demand	☐ Yes ⇩ No Demand
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.

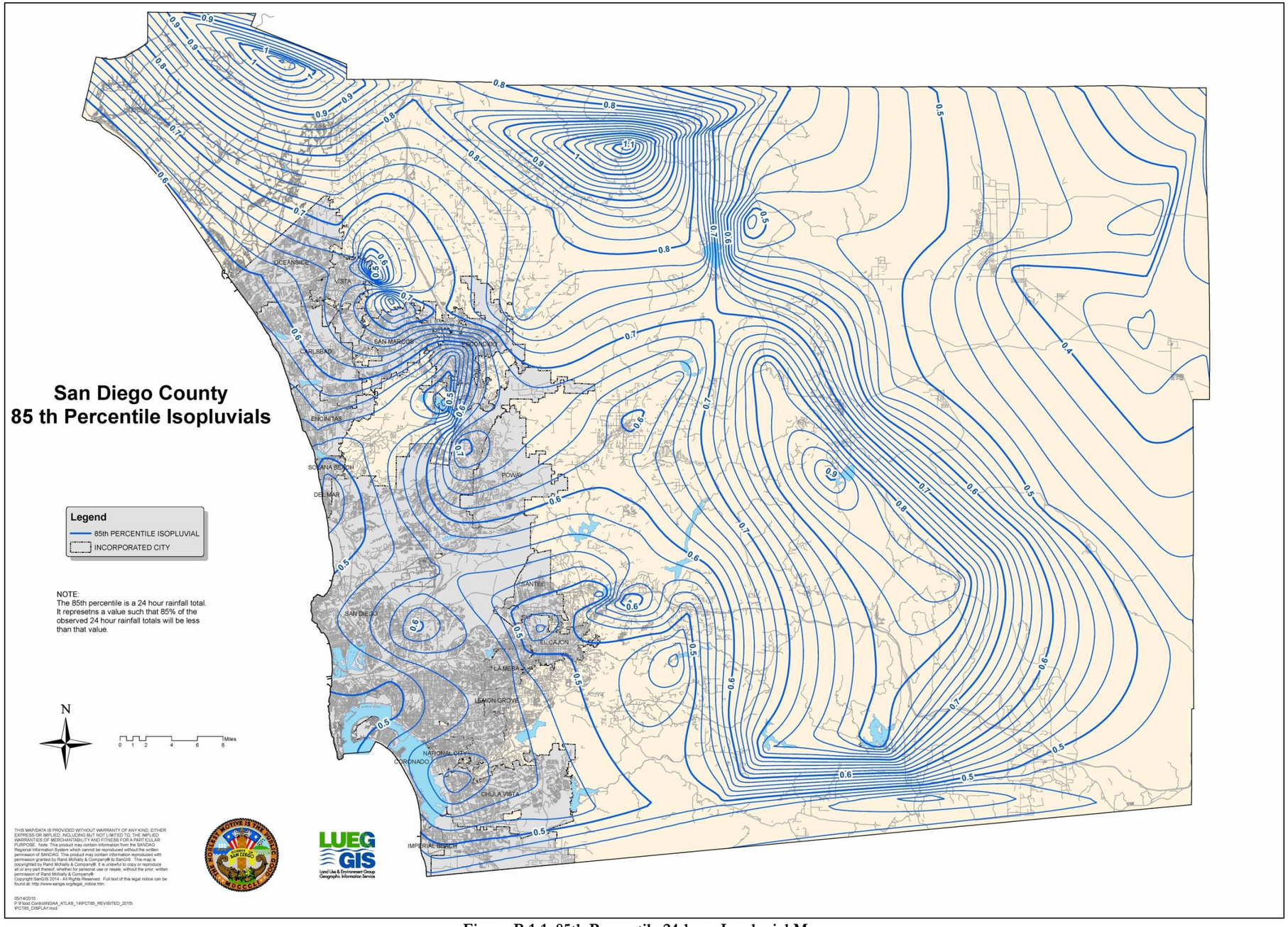


Figure B.1-1: 85th Percentile 24-hour Isopluvial Map

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.

Volume retention/reduction is not applicable, since 100% of runoff from new impervious surfaces will be detain and hauled-off to an assigned discharge location

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.

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).

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 attached documentation

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.

See attached documentation

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).

See attached documentation

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.

See attached documentation

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:	

Flow-thru Design Flows		Worksheet B.6-1		
1	DCV	DCV	7,754	cubic-feet
2	DCV retained	$DCV_{retained}$	0	cubic-feet
3	DCV biofiltered	$DCV_{biofiltered}$	0	cubic-feet
4	DCV requiring flow-thru (Line 1 – Line 2 – 0.67*Line 3)	$DCV_{flow-thru}$	7,754	cubic-feet
5	Adjustment factor (Line 4 / Line 1)	AF=	1.0	unitless
6	Design rainfall intensity	i=	0.20	in/hr.
7	Area tributary to BMP (s)	A=	4.0	acres
8	Area-weighted runoff factor (estimate using Appendix B.2)	C=	0.89	unitless
9	Calculate Flow Rate = AF x (C x i x A)	Q=	0.712	cfs

1. Adjustment factor shall be estimated considering only retention and biofiltration BMPs located upstream of flow-thru BMPs. That is, if the flow-thru BMP is upstream of the project's retention and biofiltration BMPs then the flow-thru BMP shall be sized using an adjustment factor of 1.
2. Volume based (e.g., dry extended detention basin) flow-thru treatment control BMPs shall be sized to the volume in Line 4 and flow based (e.g., vegetated swales) shall be sized to flow rate in Line 9. Sand filter and media filter can be designed either by volume in Line 4 or flow rate in Line 9.
3. Proprietary BMPs, if used, shall provide certified treatment capacity equal to or greater than the calculated flow rate in Line 9; certified treatment capacity per unit shall be consistent with third party certifications.

Design flow rate = 0.712 * 1.5 = **1.07 cfs**

(2) special design Modular Wetlands System 8' X 20' with a combined flow treatment rate of 1.154 cfs which exceeds the treatment flow rate calculated above is being proposed

April 20th, 2016

Project: All Related

Subject: MWS Linear BMP Classification Per San Diego Manual

To Whom It May Concern:

It is the intention of this document to use the MWS Linear as a biofiltration BMP. Based upon definitions of Biofiltration as found in Section 2.2.1 and Appendix F of the manual the MWS Linear meets the criteria to be classified as biofiltration and therefore is not flow through treatment and thus does not trigger the need for alternative compliance. The MWS Linear has GULD approval for basic, phosphorus and enhanced treatment under the TAPE approval. The system is certified under the TAPE approval at a loading rate of 1 gpm/sq ft for all three pollutant categories. This is consistent with the performance criteria related to the performance of Appendix F.

Let us first address the comment regarding the MWS (referring to the Modular Wetland System Linear) being flow through treatment. To do so let us look at the definition of biofiltration as provided by the Design Manual which states:

> *"For situations where onsite retention of the 85th percentile storm volume is not feasible, biofiltration must be provided to satisfy specific "biofiltration standards" i.e. a set of selection, sizing, design and operation and maintenance (O&M) criteria that must be met for a BMP to be considered a "biofiltration BMP" – see Section 2.2.1 and Appendix F."*

If we look at section 2.2.2 Storm Water Pollutant Control Performance Standard it states:

> *"(i) If it is not technically feasible to implement retention BMPs for the full DCV onsite for a PDP, then the PDP shall utilize biofiltration BMPs for the remaining volume not reliably retained. Biofiltration BMPs must be designed as described in Appendix F to have an appropriate hydraulic loading rate to maximize storm water retention and pollutant removal, as well as to prevent erosion, scour, and channeling within the BMP, and must be sized to:*
>
> > *[a]. Treat 1.5 times the DCV not reliably retained onsite, OR*
> >
> > *[b]. Treat the DCV not reliably retained onsite with a flow-thru design that has a total volume, including pore spaces and pre-filter detention volume, sized to hold at least 0.75 times the portion of the DCV not reliably retained onsite."*

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As the manual states Biofiltration BMPs must be designed as described in Appendix F which states:

> *"A project applicant must be able to affirmatively demonstrate that a given BMP is designed and sized in a manner consistent with this definition to be considered as a "biofiltration BMP" as part of a compliant storm water management plan."*
>
> *"This appendix contains a checklist of the key underlying criteria that must be met for a BMP to be considered a biofiltration BMP. The purpose of this checklist is to facilitate consistent review and approval of biofiltration BMPs that meet the "biofiltration standard" defined by the MS4 Permit."*
>
> *"This checklist includes specific design criteria that are essential to defining a system as a biofiltration BMP; however it does not present a complete design basis. This checklist was used to develop BMP Fact Sheets for PR-1 biofiltration with partial retention and BF-1 biofiltration, which do present a complete design basis. Therefore, biofiltration BMPs that substantially meet all aspects of the Fact sheets PR-1 or BF-1 should be able to complete this checklist without additional documentation beyond what would already be required for a project submittal."*
>
> *"Other biofiltration BMP designs (including both non-proprietary and proprietary designs) may also meet the underlying MS4 Permit requirements to be considered biofiltration BMPs. These BMPs may be classified as biofiltration BMPs if they (1) meet the minimum design criteria listed in this appendix, including the pollutant treatment performance standard in Appendix F.1, (2) are designed and maintained in a manner consistent with their performance certifications (See explanation in Appendix F.2), if applicable, and (3) are acceptable at the discretion of the [City Engineer]. The applicant may be required to provide additional studies and/or required to meet additional design criteria beyond the scope of this document in order to demonstrate that these criteria are met."*

As stated the Biofiltration BMP must meet three objectives. The following outlines how the Modular Wetland System Linear meets these criteria.

Minimum Design Criteria

1. Biofiltration BMPs shall be allowed only as described in the BMP selection process in this manual (i.e., retention feasibility hierarchy).

    a. The Modular Wetland System Linear (MWS Linear) is only being proposed on plans when retention via infiltration or reuse is proven infeasible. Conditions such as soils with little to no infiltration rate or sites in which insufficient landscaping warrant to successful implementation of reuse systems.

2. Biofiltration BMPs must be sized using acceptable sizing methods described in this manual.

    a. Section B.5.2 Basis for Minimum Sizing Factor for Biofiltration BMPs states:

    "The MS4 Permit describes conceptual performance goals for biofiltration BMPs and specifies numeric criteria for sizing biofiltration BMPs (See Section 2.2.1 of this Manual). However, the MS4 Permit does not define a specific footprint sizing factor or design profile that must be provided for the BMP to be considered "biofiltration."

    "Additionally, it does not apply to alternative biofiltration designs that utilize the checklist in Appendix F (Biofiltration Standard and Checklist). Acceptable alternative designs (such as proprietary systems meeting Appendix F criteria) typically include design features intended to allow acceptable performance with a smaller footprint and have undergone field scale testing to evaluate performance and required O&M frequency."

    As stated in the Manual alternative biofiltration designs are allowed. The MWS Linear therefore qualifies as a biofiltration BMP under this definition as it has both undergone field scale testing (TAPE tested and approved with a GULD) and provides requirements on O&M frequency. In addition, the MWS Linear can be sized to treat either 1.5 times the DCV not reliably retained onsite OR 1.0 times the portion of the DCV not reliably retained onsite; and additionally check that the system has a total static (i.e. non-routed) storage volume, including pore spaces and pre-filter detention volume to at least 0.75 times the portion of the DCV not reliably retained onsite.

3. Biofiltration BMPs must be sited and designed to achieve maximum feasible infiltration and evapotranspiration.

    a. The MWS Linear is utilized and placed in the same manner as other types of biofiltration systems. As with other biofiltration systems the MWS Linear includes and underdrain for the remaining portion of the DCV that is not retained via incidental infiltration (as biofiltration if infiltration is not feasible due to poor soils) and evapotranspiration. The MWS Linear can be designed with an open bottom to maximize this incidental infiltration. The only exception to this, as with other biofiltration BMPs, is when the geotechnical consultant recommends an impervious liner be used due to specific soil conditions such as expansive clays. Additionally, the MWS Linear utilizes an amended media that is much more porous than the standard prescribed biofiltration media which is a mix of sand and compost. 100% of the media used in the MWS Linear has interparticle voids of 48% plus and 24% internal void space for each media particle. This is much greater than the sand which has interparticle voids of 35% and internal voids of 0%. As such, the MWS Linear retains greater moisture which allows for greater volume retention and ultimately evapotranspiration via respiration of the contained vegetation.

4. Biofiltration BMPs must be designed with a hydraulic loading rate to maximize pollutant retention, preserve pollutant control/sequestration processes, and minimize potential for pollutant washout.

    a. The manual states:

    "Alternatively, for proprietary designs and custom media mixes not meeting the media specifications contained in the City 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."

    The MWS Linear has been tested under the Washington State TAPE protocol which is full scale field testing and has received General Use Level Designation under that protocol. Table F.1-1, as shown below, requires a biofiltration BMP to have Basic Treatment, Phosphorus Treatment, and Enhanced Treatment under this protocol. The MWS Linear has GULD approval for all three and therefore meets this minimum requirement 4. A copy of the TAPE approval has been attached to this document.

Table F.1-1: Required Technology Acceptance Protocol-Ecology Certifications for Polltuants of Concern for Biofiltration Performance Standard

Project Pollutant of Concern	Required Technology Acceptance Protocol-Ecology Certification for Biofiltration Performance Standard
Trash	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Sediments	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Oil and Grease	Basic Treatment, Phosphorus Treatment, Enhanced Treatment
Nutrients	Phosphorus Treatment[1]
Metals	Enhanced Treatment
Pesticides	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment
Organics	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment
Bacteria and Viruses	Basic Treatment (including bacteria removal processes)[3] , Phosphorus Treatment, Enhanced Treatment
Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment	Basic Treatment (including filtration)[2] Phosphorus Treatment, Enhanced Treatment

5. Biofiltration BMPs must be designed to promote appropriate biological activity to support and maintain treatment processes.

    a. The MWS Linear an advanced vegetated biofiltration promotes biological processes found in both upland bioretention systems and wetlands. The system utilizes an advanced horizontal flow design to ensure maximum contact with the vegetation root mass. Bacterial growth, supported by the root system in the wetland chamber, performs a number of treatment processes. These vary as a function of moisture, temperature, pH, salinity, and pollutant concentrations. Biologically available forms of nitrogen, phosphorus, and carbon are actively taken into the cells of vegetation and bacteria, and used for metabolic processes (i.e., energy production and growth). Nitrogen and phosphorus are actively taken up as nutrients that are vital for a number of cell functions, growth, and energy production. These processes remove metabolites from the media during and between storm events, making the media available to capture more nutrients from subsequent storms.

    b. Soil organisms in the wetland chamber can break down a wide array of organic compounds into less toxic forms or completely break them down into carbon dioxide and water (Means and Hinchee 1994). Bacteria can also cause metals to precipitate out as salts, bind them within organic material, and accumulate metals in nodules within the cells. Finally, plant growth may metabolize many pollutants, sequester them or rendering them less toxic (Reeves and Baker 2000).

    c. Following are pictures from the plants pulled from a MWS Linear after only 14 months of growth. The media used in the system is designed to maximize biological activity:

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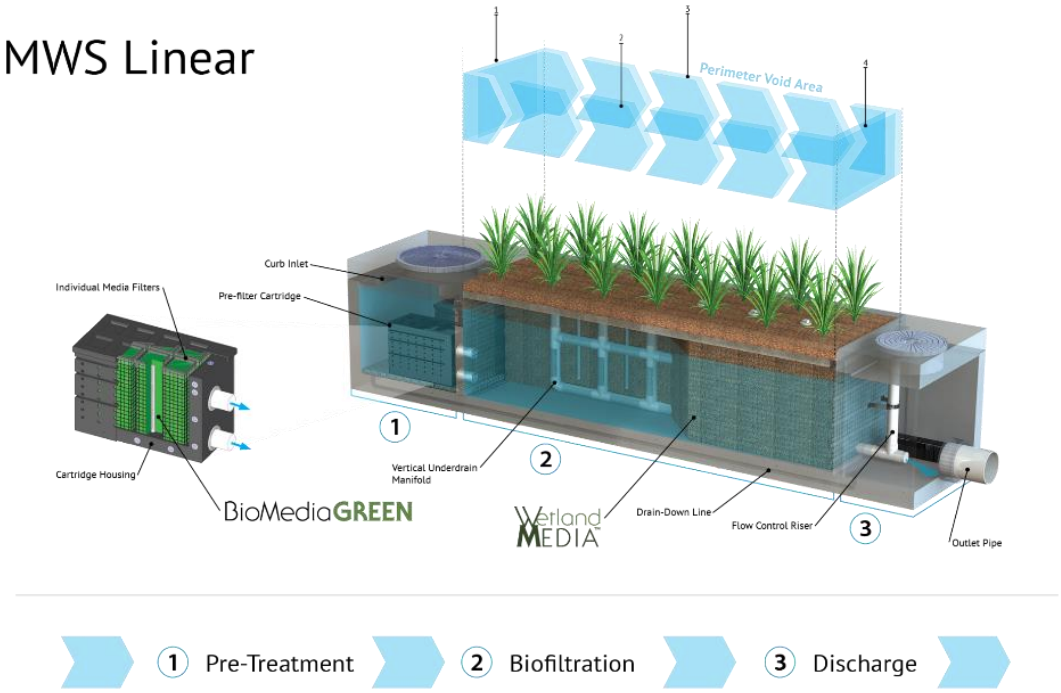
6. Biofiltration BMPs must be designed to prevent erosion, scour, and channeling within the BMP.

    a. The MWS Linear is a self-contained system with a pre-treatment chamber. Unlike other biofiltration BMPs erosion, scour, and channeling with in the BMP is not an issue. Following is a diagram of the BMP. The system pre-treatment chamber prevent any erosion or scour. The system downstream orifice control prevents channeling of the media:



7. Biofiltration BMP must include operations and maintenance design features and planning considerations to provide for continued effectiveness of pollutant and flow control functions.

    a. The MWS Linear provides activation along with the first year of maintenance and inspection free on all installation in the county of San Diego. Unlike other biofiltration BMPs the City and Co-permitees can be assured the system is being properly installed and maintained. The first year of inspections is used to gauge the amount of loading in the system and this information is used to set appropriate maintenance interval for subsequent years. Attached is a copy of the maintenance manual for the MWS Linear.

Designed & Maintained Consistent with their Performance Certifications

We are in agreement that all BMPs should be designed in a manner consistent with the TAPE certification. The MWS Linear is sized in accordance with the TAPE GULD approval which provides certification at a loading rate of 1 gpm/sq ft (100 in/hr) for Basic, Phosphorus and Enhanced treatment. In addition, as stated previously, Modular Wetland System, Inc. provide activation of all system installed in San Diego County along with the first year of inspections and maintenance to ensure appropriate function. As previously stated, a copy of the TAPE GULD approval is attached to support this claim.

Additionally, it should be noted that the manual allows for biofiltration BMPs to be sized in either volume based (DCV) or flow based design. The manual states in section F.2.2 Sizing of Flow-Based Biofiltration *BMPs:*

> *"This sizing method is only available when the BMP meets the pollutant treatment performance standard in Appendix F.1."*
>
> *"Proprietary biofiltration BMPs are typically designed as a flow-based BMPs (i.e., a constant treatment capacity with negligible storage volume). Additionally, proprietary biofiltration is only acceptable if no infiltration is feasible and where site-specific documentation demonstrates that the use of larger footprint biofiltration BMPs would be infeasible. The applicable sizing method for biofiltration is therefore reduced to: Treat 1.5 times the DCV."*
>
> *"The following steps should be followed to demonstrate that the system is sized to treat 1.5 times the DCV."*
>
> > *1. Calculate the flow rate required to meet the pollutant treatment performance standard without scaling for the 1.5 factor. Options include either:*
> >
> > - *Calculate the runoff flow rate from a 0.2 inch per hour uniform intensity precipitation event (See methodology Appendix B.6.3), or*
> >
> > - *Conduct a continuous simulation analysis to compute the size required to capture and treat 80 percent of average annual runoff; for small catchments, 5-minute precipitation data should be used to account for short time of concentration. Nearest rain gage with 5-minute precipitation data is allowed for this analysis.*

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2. Multiply the flow rate from Step 1 by 1.5 to compute the design flow rate for the biofiltration system.

3. Based on the conditions of certification/verification (discussed above), establish the design capacity, as a flow rate, of a given sized unit.

4. Demonstrates that an appropriate unit size and number of units is provided to provide a flow rate that meets the required flow rate from Step 2.

In conclusion, we have closely followed the process and protocol for showing the MWS Linear meets all the criteria to be accepted as Biofiltration as found in Appendix F.

If you have any questions please feel free to contact us directly.

Sincerely,

Zachariha J. Kent

Director of Engineering

Bio Clean Environmental Services, Inc.

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

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 monitoring for 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. 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:

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P.O. Box 869
Oceanside, CA 92054
gkent@biocleanenvironmental.net

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

TAPE PERFORMANCE SUMMARY

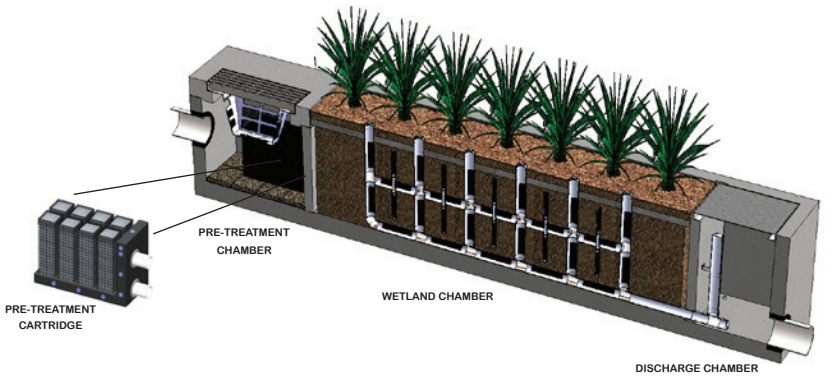
MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

Modular Wetland System Linear 2.0 (MWS-L 2.0) is an advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff. Superior pollutant removal efficiencies are achieved by treating runoff through a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is transferred to the biofiltration chamber which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms and uptakes pollutants through an array of physical, chemical, and biological mechanisms.

MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.



TAPE PERFORMANCE

Modular Wetland System Linear 2.0 (MWS-L 2.0) completed its TAPE field testing in the spring of 2013. The Washington DOE has approved the system under the TAPE protocol. The MWS-Linear has met the performance benchmarks for the three major pollutant categories as defined by TAPE: Basic Treatment (TSS), Phosphorus and Enhanced (dissolved zinc and copper). It is the first system tested under the protocol to meet the benchmarks for all three categories.

Pollutant	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Total Suspended Solids	75.0	15.7	85%	Summary of all data meeting TAPE parameters pertaining to this pollutant. Mean of 8 microns.
Total Phosphorus	0.227	0.074	64%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Ortho Phosphorus	0.093	0.031	67%	Summary of all data meeting TAPE parameters for total phosphorus.
Nitrogen	1.40	0.77	45%	Utilizing the Kjeldahl method (Total Kjeldahl nitrogen). Summary of all data during testing.
Dissolved Zinc	0.062	0.024	66%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Dissolved Copper	0.0086	0.0059	38%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Total Zinc	0.120	0.038	69%	Summary of all data during testing.
Total Copper	0.017	0.009	50%	Summary of all data during testing.
Motor Oil	24.157	1.133	95%	Summary of all data during testing.

NOTES:
1. The MWS-Linear was proven effective at infiltration rates of up to 121 in/hr.
2. A minimum of 10 aliquots were collected for each event.
3. Sampling was targeted to capture at least 75 percent of the hydrograph.

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PERFORMANCE SUMMARY

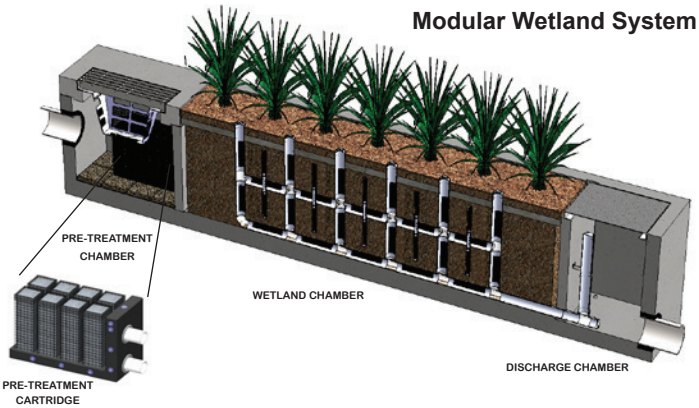
MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

Modular Wetland System Linear 2.0 (MWS-L 2.0) is an advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff. Superior pollutant removal efficiencies are achieved by treating runoff through a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is transferred to the biofiltration chamber which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms and uptakes pollutants through an array of physical, chemical, and biological mechanisms.

MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.



Modular Wetland System Linear 2.0 (MWS-L 2.0) has been independently tested in laboratory and field conditions since 2008.

Oceanside Test Site

Portland Test Site

HEAVY METALS: Copper / Zinc

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	.76 / .95	.06 / .19	92% / 80%	Majority Dissolved Fraction
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.04 / .24	< .02 / < .05	>50% / >79%	Effluent Concentrations Below Detectable Limits
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	.058 / .425	.032 / .061	44% / 86%	Test Unit 2
TAPE Field Testing / Portland, OR 2011/2012	Field	.017/ .120	.009 / .038	50% / 69%	Total Metals

TOTAL SUSPENDED SOLIDS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	270	3	99%	Sil-co-sil 106 - 20 micron mean particle size
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	45.67	8.24	82%	Mean Particle Size by Count < 8 Microns
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	676	39	94%	Test Unit 2
TAPE Field Testing / Portland, OR 2011/2012	Field	75.0	15.7	85%	Means particle size of 8 microns

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PERFORMANCE SUMMARY

MWS-LINEAR 2.0

PHOSPHORUS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
TAPE Field Testing / Portland, OR 2011/2012	Field	.227	.074	64%	TOTAL P
TAPE Field Testing / Portland, OR 2011/2012	Field	.093	.031	67%	ORTHO P

BACTERIA:

Description	Type	Avg. Influent (MPN)	Avg. Effluent (MPN)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	1600 / 1600	535 / 637	67% / 60%	Fecal / E. Coli
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	31666 / 6280	8667 / 1058	73% / 83%	Fecal / E. Coli

LEAD:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	.54	.10	82%	Total
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	.01 / .043	.004 / .014	60% / 68%	Both Test Units
TAPE Field Testing / Portland, OR 2011/2012	Field	.011	.003	70%	Total

NITROGEN:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.85	.21	75%	NITRATE
TAPE Field Testing / Portland, OR 2011/2012	Field	1.40	0.77	45%	TKN

HYDROCARBONS:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	10	1.625	84%	Oils & Grease
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	.83	0	100%	TPH Motor Oil
TAPE Field Testing / Portland, OR 2011/2012	Field	24.157	1.133	95%	Motor Oil

TURBIDITY:

Description	Type	Avg. Influent (NTU)	Avg. Effluent (NTU)	Removal Efficiency	Notes
Waves Environmental - 1/4 Scale Lab Testing - 2007	Lab	21	1.575	93%	Field Measurement
City of Oceanside Boat Wash / Waves Environmental - 2008	Field	21	6	71%	Field Measurement

COD:

Description	Type	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Recycling Facility, Kileen, TX / CERL - 2011-2012	Field	516 / 1450	90 / 356	83% / 75%	Both Test Units

All removal efficiencies and concentrations rounded up for easy viewing. Please call us for more information, including full copies of the reports reference above.

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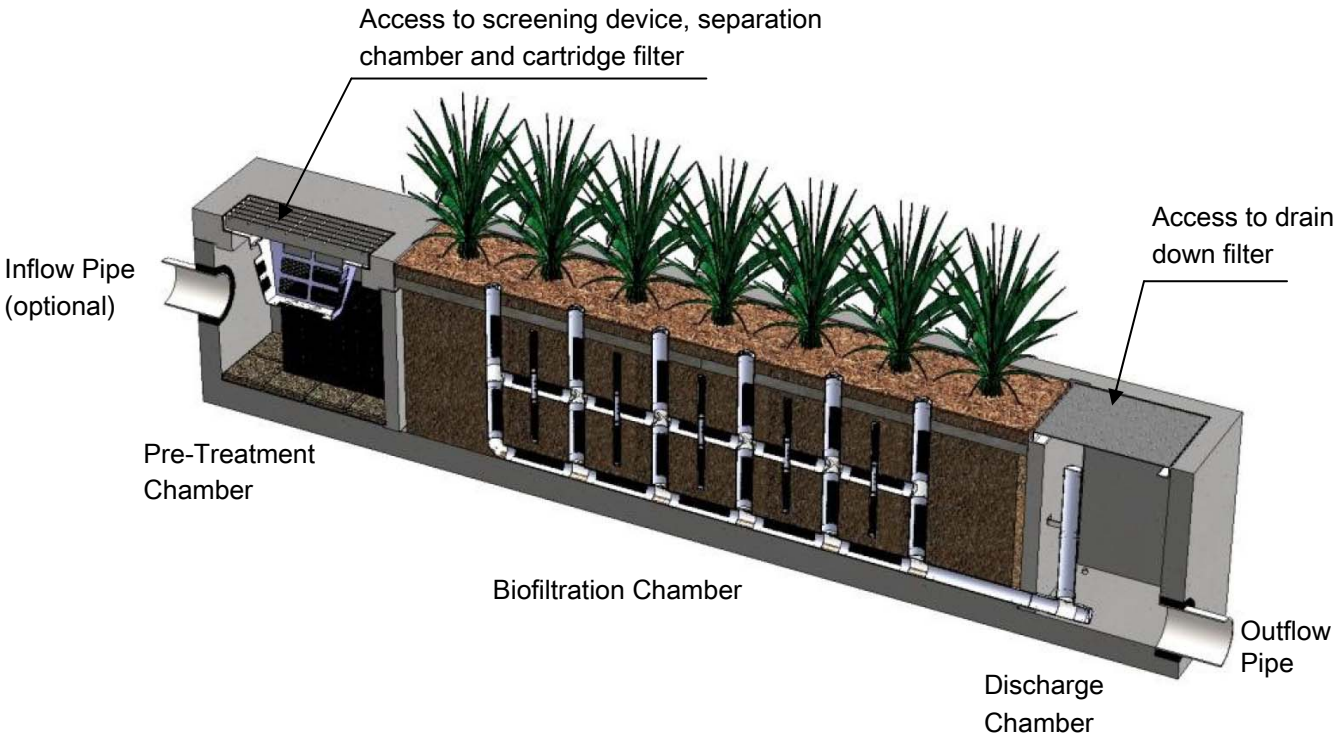
Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance 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 require irrigation.

Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.

Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

Modular Wetland System, Inc.
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E. Info@modularwetlands.com

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

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

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

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

Weather Condition _____ Additional Notes _____

Inspection Checklist

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

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

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

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

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes:

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Maintenance Report

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Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

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

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

Weather Condition _____ Additional Notes _____

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

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

Comments:

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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: San Diego Fire Rescue Air Facility - Montgomery Airport

Indicate which Items are Included:

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

Project Name: San Diego Fire Rescue Air Facility – Montgomery Airport

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

The Hydromodification Management Exhibit must identify:

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

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REACH ID	NAME
1	Santa Margarita River
2	San Luis Rey River
3	Buena Vista Creek
4	Agua Hedionda Creek
5	San Marcos Creek
6	Encinitas Creek
7	Cottonwood Creek (Carlsbad WMA)
8	Escondido Creek
9	San Dieguito Creek - Reach 1
10	San Dieguito Creek - Reach 2
11	Lusardi Creek
12	Los Penasquitos / Poway Creek
13	Rattlesnake Creek
14	Carroll Canyon Creek
15	Rose Creek
16	San Diego River
17	Sycamore Creek
18	Woodglen Vista Creek
19	San Vicente Creek
20	Forester Creek
21	Chollas Creek
22	Sweetwater River - Reach 1
23	Sweetwater River - Reach 2
24	Otay River
25	Jamul / Dulzura Creek
26	Tijuana River
27	Cottonwood Creek (Tijuana WMA)

Legend

- Regional WMAA Streams
- Watershed Boundaries
- Municipal Boundaries
- Rivers & Streams
- Potential Critical Coarse Sediment Yield Areas

Aerial Imagery Source: DigitalGlobe, 06/2012

Miles 0 5 10 15

Potential Critical Coarse Sediment Yield Areas

Regional San Diego County Watersheds

Exhibit Date: Sept. 8, 2014

Geosyntec consultants

RICK ENGINEERING COMPANY

Attachment 3
Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

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Project Name: San Diego Fire Rescue Air Facility - Montgomery Airport

Indicate which Items are Included:

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

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).

MAINTENANCE

MWS – Linear

Hybrid Stormwater Filtration System

Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92049

www.modularwetlands.com
P 760-433-7640
F 760-433-3179

MAINTENANCE

Maintenance Summary –

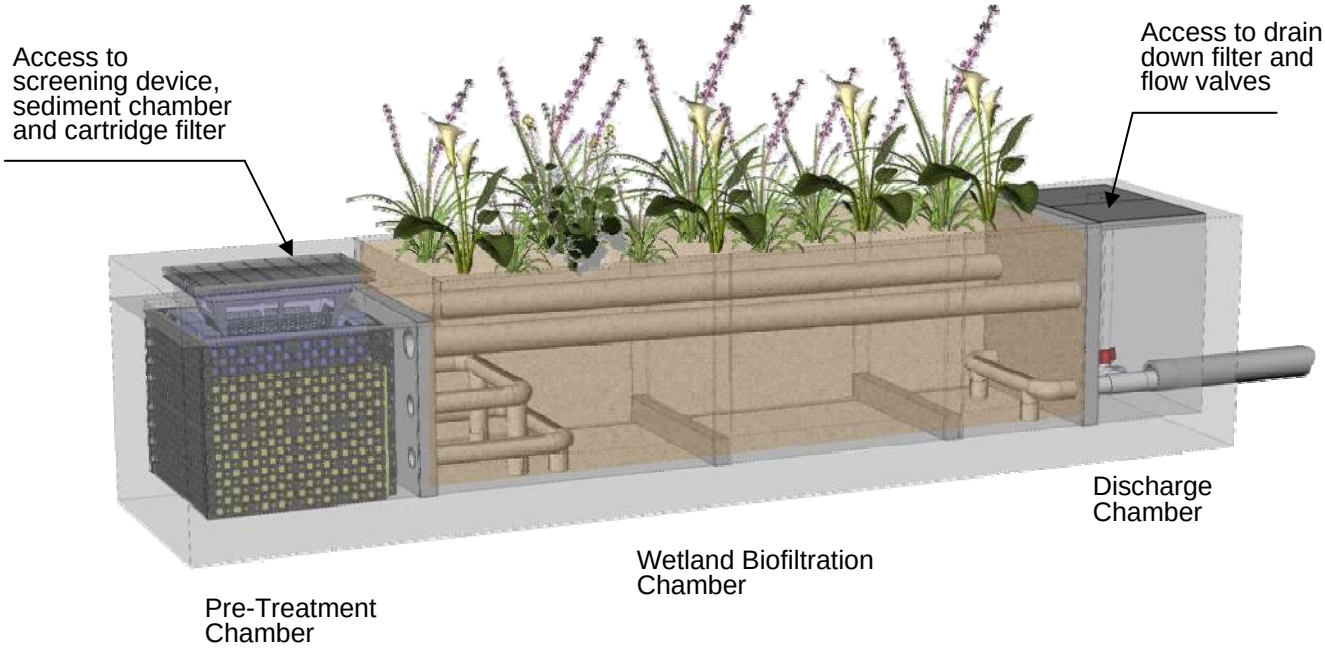
- **<u>Clean Bio Clean® Catch Basin Filter</u> – average maintenance interval is 3 to 6 months.**
  - **(*15 minute service time*).**
- **<u>Clean Separation (sediment) Chamber</u> – average maintenance interval is 6 to 18 months.**
  - **(*30 minute service time*).**
- **<u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – average maintenance interval 6 – 12 months.**
  - **(*45 minute service time*).**
- **<u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – average maintenance interval is 6 to 12 months.**
  - **(*5 minute service time*).**
- **<u>Trim Vegetations</u> – average maintenance interval is 3 to 6 months.**
  - **(*15 minute service time*).**
- **<u>Evaluate Wetland Media Flow Hydraulic Conductivity</u> – average inspection interval is once per year.**
  - ***(5 minute inspection time).***
- **<u>Wetland Media Replacement</u> – average maintenance interval is 5 to 20 years.**
  - **(*6 hours*).**

For more information on maintenance procedures, to order replacement media or find an authorized service company please contact:

Modular Wetland Systems, Inc
2972 San Luis Rey Road
Oceanside, CA 92058

Phone: 760-433-7640
Fax: 760-433-3176
Email: info@modularwetlands.com

System Diagram –



Maintenance Overview –

A. Every installed MWS – Linear unit is to be maintained by the Supplier, or a Supplier approved contractor. The cost of this service varies among providers.

B. The MWS – Linear is a multi-stage self-contained treatment train for stormwater treatment. Each stage protects subsequent stages from clogging. Stages include: screening, separation, cartridge media filtration, and biofiltration. The biofiltration stage contains various types of vegetation which will require annual evaluation and trimming.

1. <u>Clean Bio Clean® Catch Basin Filter</u> – Screening is provided by well proven catch basin filter. The filter has a trash and sediment capacity of 2 (curb type) and 4 (grate type) cubic feet. The filter removes gross solids, including litter, and sediments greater than 200 microns. This procedure is easily done by hand or with a small industrial vacuum device. This filter is located directly under the manhole or grate access cover.

2. <u>Clean Separation (sediment) Chamber</u> – separation occurs in the pre-treatment chamber located directly under the curb or grated inlet. This chamber has a capacity of approximately 21 cubic feet for trash, debris and sediments. This chamber targets TSS, and particulate metals and nutrients. This procedure can be performed with a standard vacuum truck. This chamber is located directly under the manhole or grate access cover.

3. <u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – Primary filtration is provided by a horizontal flow cartridge filter utilizing BioMediaGREEN blocks. Each cartridge has a media surface area of 35 square feet. The large surface area will insure long term operation without clogging. The cartridge filter with BioMediaGREEN targets fine TSS, metals, nutrients, hydrocarbons, turbidity and bacteria. Media life depends on local loading conditions and can easily be replaced and disposed of without any equipment. The filters are located in the pre-treatment chamber. Entry into chamber required to replace BioMediaGREEN blocks. Each cartridge contain 14 pieces of 20" tall BioMediaGREEN.

4. <u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – A drain down filter, similar in function to the perimeter filter is located in the discharge chamber. This filter allows standing water to be drained and filtered out of the separation chamber. This addresses any vector issues, by eliminating all standing water within this system. Replacement of media takes approximately 5 minutes and is performed without any equipment.

5. <u>Trim Vegetations</u> – The system utilizes multiple plants in the biofiltration chamber to provide enhanced treatment for dissolved pollutants including nutrients and metals. The vegetation will need to be maintained (trimmed) as needed. This can be done as part of the project normal landscape maintenance. **NO FERTILIZER SHALL BE USED IN THIS CHAMBER.**

<u>6. Evaluate Wetland Media Flow Hydraulic Conductivity</u> – The systems flow can be assessed from the discharge chamber. This should be done during a rain event. By viewing into the discharge chamber the flow out of the system can be observed. If little to know flow is observed from the lower valve or orifice plate this is a sign of potential wetland media (biofiltration) maintenance needs.

<u>7. Wetland Media Replacement</u> – biofiltration is provided by an advance horizontal flow vegetated wetland. This natural filter contains a mix of sorptive media that supports abundant plant life. This biofilter targets the finest TSS, dissolved nutrients, dissolved metals, organics, pesticides, oxygen demanding substances and bacteria. This filter provides the final polishing step of treatment. If prior treatment stages are properly maintained, the life of this media can be up to 20 years. Replacement of the media is simple. Removal of spent media can be done with a shovel of a vacuum truck.

C. The MWS – Linear catch basin filter, separation chamber, cartridge filter media and wetland media are designed to allow for the use of vacuum removal of captured pollutants and spent filter media by centrifugal compressor vacuum units without causing damage to the filter or during normal cleaning and maintenance. Filter and chambers can be cleaned from finish surface through standard manhole or grate access.

Maintenance Procedures –

1. <u>Clean Bio Clean® Catch Basin Filter</u> – Modular Wetland Systems, Inc. recommends the **catch basin filter** be inspected and cleaned a minimum of once every six months and replacement of hydrocarbon booms once a year. The procedure is easily done with the use of any standard vacuum truck. *This procedure takes approximately 15 minutes.*

1. Remove grate or manhole to gain access to catch basin filter insert. Remove the deflector shield (grate type only) with the hydrocarbon boom attached. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
2. Remove all trash, debris, organics, and sediments collected by the inlet filter insert. Removal of the trash and debris can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screen of the filter.
3. Evaluation of the hydrocarbon boom shall be performed at each cleaning. If the boom is filled with hydrocarbons and oils it should be replaced. Attach new boom to basket with plastic ties through pre-drilled holes in basket. Place the deflector shield (grate type only) back into the filter.
4. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
5. The hydrocarbon boom may be classified as hazardous material and will have to be picked up and disposed of as hazardous waste. Hazardous material can only be handled by a certified hazardous waste trained person (minimum 24-hour hazwoper).

2. <u>Clean Separation (sediment) Chamber</u> – Modular Wetland Systems, Inc. recommends the **separation chamber** be inspected and cleaned a minimum of once a year. The procedure is easily done with the use of any standard vacuum truck. *This procedure takes approximately 30 minutes.*

1. Remove grate or manhole to gain access to the catch basin filter.
2. Remove catch basin filter. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
3. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
4. Vacuum out separation chamber and remove all accumulated debris and sediments.
5. Replace catch basin filter, replace grate or manhole cover.
6. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

3. <u>Replace Cartridge Filter Media (BioMediaGREEN™)</u> – Modular Wetland Systems, Inc. recommends the **cartridge filters** media be inspected and cleaned a minimum of once a year. The procedure will require prior maintenance of separation chamber. *Replacement of media takes approximately 45 minutes.*

1. Remove grate or manhole to gain access to the catch basin filter.
2. Remove catch basin filter. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
3. Enter separation chamber.
4. Unscrew the two ½" diameter bolts holding the lid on each cartridge filter and remove lid and place outside of unit.
5. Remove each of the 14 BioMediaGREEN filter blocks in each cartridge and remove from chamber for disposal.
6. Spray down the outside and inside of the cartridge filter to remove any accumulated sediments.
7. Replace with new BioMediaGREEN filter blocks insuring the blocks are properly lined up and seated in the bottom.
8. Replace the lid and tighten down bolts.
9. Replace catch basin filter, replace grate or manhole cover.
10. Transport all debris, trash, organics, spent media and sediments to approved facility for disposal in accordance with local and state requirements.

4. <u>Replace Drain Down Filter Media (BioMediaGREEN™)</u> – Modular Wetland Systems, Inc. recommends the **drain down filter** be inspected and maintained a minimum of once a year. *Replacement of media takes approximately 5 minutes.*

1. Open hatch of discharge chamber
2. Enter chamber, unlatch drain down filter cover.
3. Remove BioMediaGREEN filter block
4. Replace with new block, replace and latch cover.
5. Exit chamber, close and lock down the hatch.
6. Transport spent media to approved facility for disposal in accordance with local and state requirements.

5. <u>Trim Vegetations</u> – Modular Wetland Systems, Inc. recommends the plants/vegetation be inspected and maintained a minimum of once a year. It is also recommended that the plants receive the same care as other landscaped areas. **Note: No fertilizer is to be used on this area.** *Trimming of vegetation takes approximately 15 minutes.*

<u>6. Evaluate Wetland Media Flow Hydraulic Conductivity</u> – Modular Wetland Systems, Inc. recommends system flow be inspected and observed a minimum of once a year. This needs to be done during a rain event. *Inspection and Observation takes approximately 5 minutes.*

1. Open hatch of discharge chamber
2. Observe the level of flow from the bottom valve or orifice plate.
3. If flow is steady and high the system is operating normally.

4. If little or no flow is observed exiting the valve possible maintenance to the biofiltration wetland chamber may be needed. Contact Modular Wetlands for further assistance.
5. Exit chamber, close and lock down the hatch.

7. Wetland Media Replacement – Modular Wetland Systems, Inc. recommends the wetland media be replaced a minimum of one every 20 years. *Inspection takes approximately 15 minutes. Replacement of rock media takes approximately 6 hours and requires a vacuum truck.*

1. Remove plants from the wetland chamber.
2. Use a vacuum truck or shovel to remove all wetland media.
3. Spray down the walls and floor of the chamber and vacuum out any accumulated pollutants.
4. Spray down perforated piping and netting of flow matrix and the inflow and outflow end to remove any accumulated pollutants.
5. Vacuum out any standing water from the media removal and insure the chamber is cleaning.
6. Use a small backhoe to fill chamber with new media. Call Modular Wetland Systems, Inc. for media delivery information.
7. Install BioMediaGREEN filter blocks across over the entire filter bed. Fill with media until 9” from top. The install filter blocks which are 3” thick. Fill the top 6” inches with wetland media.
8. Plant new vegetation in the same configuration and quantity as old vegetation. Dig down until the BioMediaGREEN is exposed. Cut out a small circle of the BioMediaGREEN. Remove plant from container including soil ball and place in the whole cut out of the BioMediaGREEN. Cover up with wetland media.
9. Spray down the plants and media with water to saturate.
10. Continue supplemental irrigation (spray or drip) for at lest 90 days.

7. Other Maintenance Notes –

1. Following maintenance and/or inspection, the maintenance operator shall prepare a maintenance/inspection record. The record shall include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanism. .
2. The owner shall retain the maintenance/inspection record for a minimum of five years from the date of maintenance. These records shall be made available to the governing municipality for inspection upon request at any time.
3. Any person performing maintenance activities must have completed a minimum of OSHA 24-hour hazardous waste worker (hazwoper) training.
4. Remove access manhole lid or grate to gain access to filter screens and sediment chambers. Where possible the maintenance should be performed from the ground surface. Note: entry into an underground stormwater vault such as an inlet vault requires certification in confined space training.
5. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
6. The hydrocarbon boom is classified as hazardous material and will have to be picked up and disposed of as hazardous waste. Hazardous material can only be handled by a certified hazardous waste trained person (minimum 24-hour hazwoper).

Maintenance Sequence –

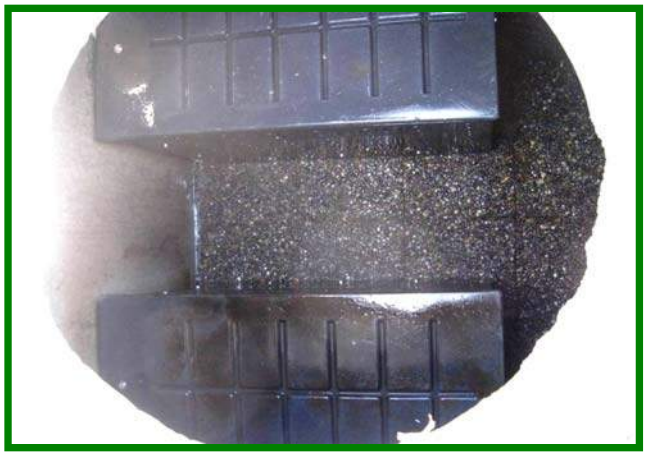
Access Pre-Treatment Chamber by Removing Manhole or Grate Cover

Assess Pollutant Loading in Catch Basin Filter and Sediment Chamber

Vacuum Catch Basin Filter

Remove Catch Basin Filter

Vacuum out the Sediment Chamber



Enter Chamber Remove Lids of Cartridge Filters

Remove Spent BioMediaGREEN Filter Blocks

Spray Down and Clean Cartridge Filter Housing

Replace with New BioMediaGREEN Filter Blocks and Replace Lid, then Catch Basin Filter and Replace Manhole or Grate

Open Discharge Chamber Lid to Asses Wetland Media Flow Rate and Replace Drain Down Filter Near Bottom

Evaluate Vegetation and Trim if Needed. Maintenance Complete.

Please Contact Modular Wetland Systems, Inc. for More Information:

760-433-7640

info@modularwetlands.com

Stormwater Management Fact Sheet: Bioretention

Description

Bioretention areas are landscaping features adapted to treat stormwater runoff on the development site. They are commonly located in parking lot islands or within small pockets in residential land uses. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed to incorporate many of the pollutant removal mechanisms that operate in forested ecosystems. During storms, runoff ponds above the mulch and soil in the system. Runoff from larger storms is generally diverted past the facility to the storm drain system. The remaining runoff filters through the mulch and prepared soil mix. Typically, the filtered runoff is collected in a perforated underdrain and returned to the storm drain system. For more information see *Bioretention as a Water Quality Best Management Practice*, Article 110 in the Practice of Watershed Protection.

Applicability

Bioretention systems are generally applied to small sites, but can be applied to a wide range of development. Bioretention can be applied in many climate and geologic situations, with some minor design modifications.

Regional Applicability
Bioretention systems are applicable almost everywhere in the United States. In arid or cold climates, however, some minor design modifications may be needed.

Ultra Urban Areas
Ultra urban areas are densely developed urban areas in which little pervious surface exists. Bioretention facilities are ideally suited to many ultra urban areas, such as parking lots. While they consume a fairly large amount of space (approximately 5% of the area that drains to them), they can fit into existing parking lot islands or other landscaped areas.

Stormwater Hotspots
Stormwater hotspots are areas where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater. A typical example is a gas station or convenience store parking lot. Bioretention areas can be used to treat stormwater hotspots as long as an impermeable liner is used at the bottom of the filter bed.

Stormwater Retrofit
A stormwater retrofit is a stormwater management practice (usually structural) put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other objectives. Bioretention can be used as a stormwater retrofit, by modifying existing landscaped areas, or if a parking lot is being resurfaced. In highly urban watersheds, they are one of the few retrofit options that can be employed. However, it is very expensive to retrofit an entire watershed using bioretention areas since they treat small sites.

Cold Water (Trout) Streams
The species in cold water streams, notably trout, are extremely sensitive to changes in temperature. In order to protect these resources, designers should avoid treatment practices that increase the temperature of the stormwater runoff they treat. Bioretention is a good option in cold water streams because water ponds in them for only a short time, decreasing the potential for stream warming.

Siting and Design Considerations

Designers need to consider conditions at the site level and must incorporate design features to improve the longevity and performance of the practice, while minimizing the maintenance burden.

Siting
Some considerations selecting a stormwater treatment practice are the drainage area the practice will need to treat, the slopes both at the location of the practice and draining to it, soil and subsurface conditions, and the depth of the seasonably high groundwater table. Bioretention can be applied on many sites, with its primary restriction being the need to apply the practice on small sites.

Drainage Area

Bioretention areas should usually be used on small sites (i.e., five acres or less). When used to treat larger areas, they tend to clog. In addition, it is difficult to convey flow from a large area to a bioretention area.

Slope

Bioretention areas are best applied to relatively shallow slopes (usually about 5%). Sufficient slope is needed at the site to ensure that the runoff that enters a bioretention area can be connected with the storm drain system. It is important to note, however, that these bioretention areas are most often applied to parking lots or residential landscaped areas, which generally have gentle slopes.

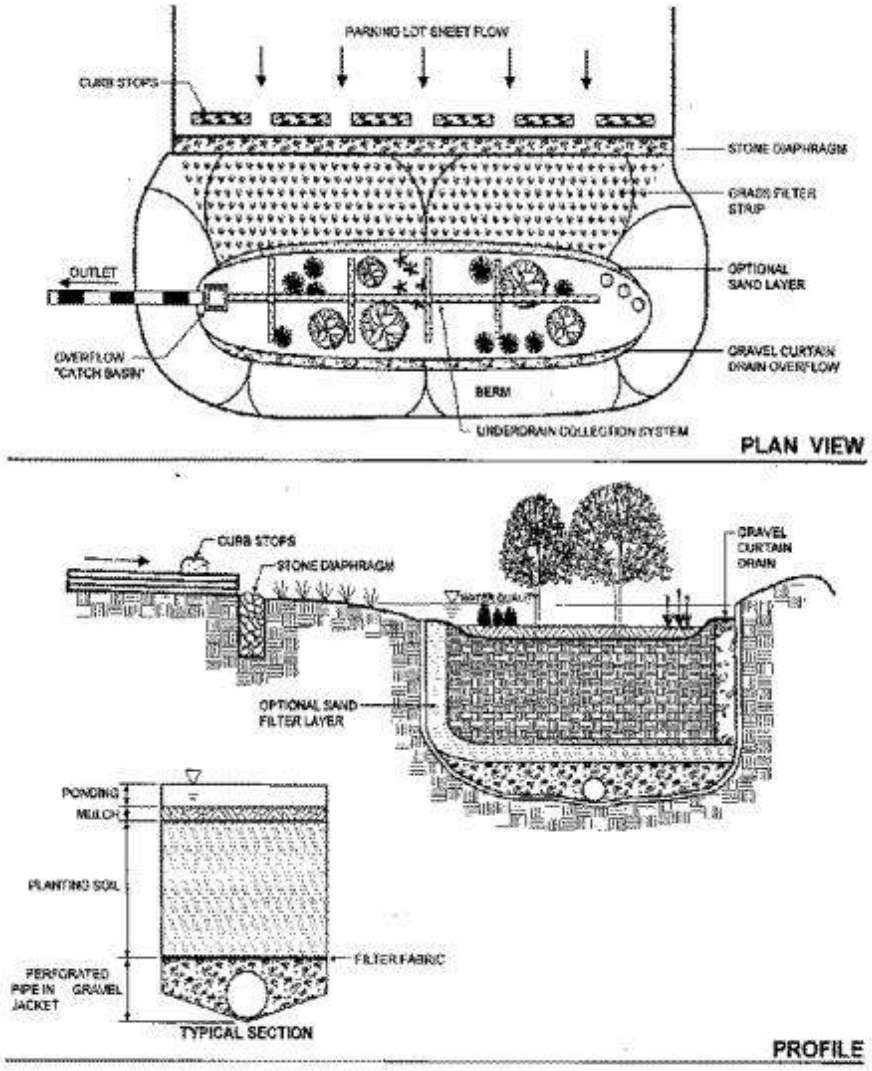
Soils /Topography

Bioretention areas can be applied in almost any soils or topography, since runoff percolates through a made soil bed, and is returned to the stormwater system.

Groundwater

Bioretention should be separated from the watertable to ensure that the groundwater never intersects with the bottom of the bioretention area, which prevents possible groundwater contamination and practice failure.

Design Considerations
Specific designs may vary considerably, depending on site constraints or preferences of the designer or community, but some features, should be incorporated into all bioretention areas. These design features can be divided into five basic categories: *pretreatment, treatment*, *conveyance*, *maintenance reduction*, and *landscaping (*for more information see the Manual Builder Category) (see Figure 1).



Pretreatment

Pretreatment refers to features of a bioretention area that capture and remove coarse sediment particles. Incorporating pretreatment helps to reduce the maintenance burden of bioretention, and reduces the likelihood that the soil bed will clog over time. Several different mechanisms are used to provide pretreatment in bioretention areas. Runoff can be directed to a grass channel or filter strip to settle out coarse sediments before the runoff flows into the filter bed of the bioretention area. Other features may include a pea gravel diaphragm, which acts to spread flow evenly and drop out larger particles.

Treatment

Treatment features enhance the ability of a stormwater treatment practice to remove pollutants. Several basic features should be incorporated into bioretention areas to enhance their pollutant removal rates. The bioretention system should be sized be between 5% and 10% of the impervious area draining to it. The practice should be designed with a soil bed that is a sand/ soil matrix with a mulch layer above the soil bed. The bioretention area should be designed to pond a small depth of water (6" to 9") above the filter bed.

Conveyance

Conveyance of stormwater runoff into and through a stormwater practice is a critical component of any stormwater treatment practice. Stormwater should be conveyed to and from the practice safely and minimize erosion potential.

Bioretention areas are designed with an underdrain system to collect filtered runoff at the bottom of the filter bed and direct it to the storm drain system. An underdrain is a perforated pipe in a gravel bed, installed along the bottom of filter bed. Stormwater management practices, and used to collect and remove filtered runoff. Designers should also provide an overflow structure to convey flow from large storms (that are not treated by the bioretention area) to the storm drain system.

Maintenance Reduction

In addition to regular maintenance, bioretention areas should incorporate design features to reduce the long term maintenance of a bioretention area. Designers should ensure that the bioretention area is easily accessible for maintenance.

Landscaping

Landscaping is critical to the function and appearance of bioretention areas. It is preferred that native vegetation is used for landscaping, where possible. Plants should be selected that can withstand the hydrologic regime they will experience (i.e., plants that tolerate both wet and dry conditions). At the edges, which will remain primarily dry, upland species will be the most resilient. Finally, it is best to select a combination of trees, shrubs, and herbaceous materials.

Design Variations

One design alternative to bioretention areas is the use of a "partial exfiltration" system, which promotes greater groundwater recharge (see below).

Partial Exfiltration

In this design variation, the underdrain of a bioretention area only is only installed on part of the bottom of the system. This design allows for greater infiltration of stormwater runoff, with the underdrain acting as more of an overflow. This system can be applied only when the soils and other characteristics are appropriate for infiltration (for more information see the Infiltration Trench and Infiltration Basin Fact Sheet in the Fact Sheet Category).

Arid Climates

In arid climates, bioretention areas should be landscaped with drought tolerant plant species.

Cold Climates

In cold climates, bioretention areas can be used as a snow storage area. When used for this purpose, or if used to treat parking lot runoff, the bioretention area should be planted with salt tolerant, and non-woody plant species.

Limitations

Bioretention areas have a few limitations. Bioretention areas cannot be used to treat large drainage areas, limiting their usefulness for some sites. Although bioretention areas do not consume a large amount of space, incorporating bioretention into a parking lot design may reduce the number of parking spaces available. Finally, the construction cost of bioretention areas relatively high compared with other stormwater treatment practices. (See *Cost Considerations* for a more detailed explanation).

Maintenance Considerations

Bioretention requires seasonal landscaping maintenance. In many cases, bioretention areas require intense maintenance initially to establish the plants, but less maintenance is required in the long term. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site.

Table 1. Typical Maintenance Activities for Bioretention Areas

Activity	Schedule
• Remulch void areas • Treat diseased trees and shrubs	As needed
• Water plants daily for two weeks	At project completion
• Inspect soil and repair eroded areas • Remove litter and debris	Monthly
• Remove and replace dead and diseased vegetation	Twice per year
• Add additional mulch • Replace tree stakes and wire	Once per year

Effectiveness

Structural stormwater management practices can be used to achieve four broad resource protection goals. These include: *Flood Control, Channel Protection, Groundwater Recharge,* and *Pollutant Removal*. In general, bioretention areas can only provide pollutant removal.

Groundwater Recharge
Bioretention areas do not usually recharge the groundwater, except in the case of the partial exfiltration design (see *Design Variations*).

Pollutant Removal
Little pollutant removal data has been collected on the pollutant removal effectiveness of bioretention areas. In fact only one study has been conducted (Davis *et al*., 1998). The data from this study is presented in Table 2.

Table 2. Typical Pollutant Removal Rates of Bioretention Systems

Pollutant	Pollutant Removal (%)
TSS	81
TP	29
TN	49
NOx	38
Metals	51-71
Bacteria	-58

Assuming that bioretention systems perform similarly to swales, their removal rates are relatively high (for more information, see *Comparative Pollutant Removal Capability of Stormwater Treatment Practices*, Article 64 in The Practice of Watershed Protection).

Cost Considerations

Bioretention areas are relatively expensive. The following cost equation was developed by Brown and Schueler (1997), adjusting for inflation:

$$C = 7.30\ V^{0.99}$$

Where:
C = Construction, Design and Permitting Cost ($)
V = Volume of water treated by the facility (cubic feet)
This amounts to about $6.80 per cubic foot of water storage.

An important consideration when evaluating the costs of bioretention is that it often replaces area that would likely be landscaped anyway. Thus, the true cost of the bioretention area may be less than the construction cost reported. Similarly, maintenance costs for bioretention areas are not very different from normal landscaping maintenance. Land consumed by bioretention areas is relatively high compared with other practices (about 5% of the drainage area). However, this land should not be considered lost, since it is often fits with existing setbacks and landscaping requirements.

References

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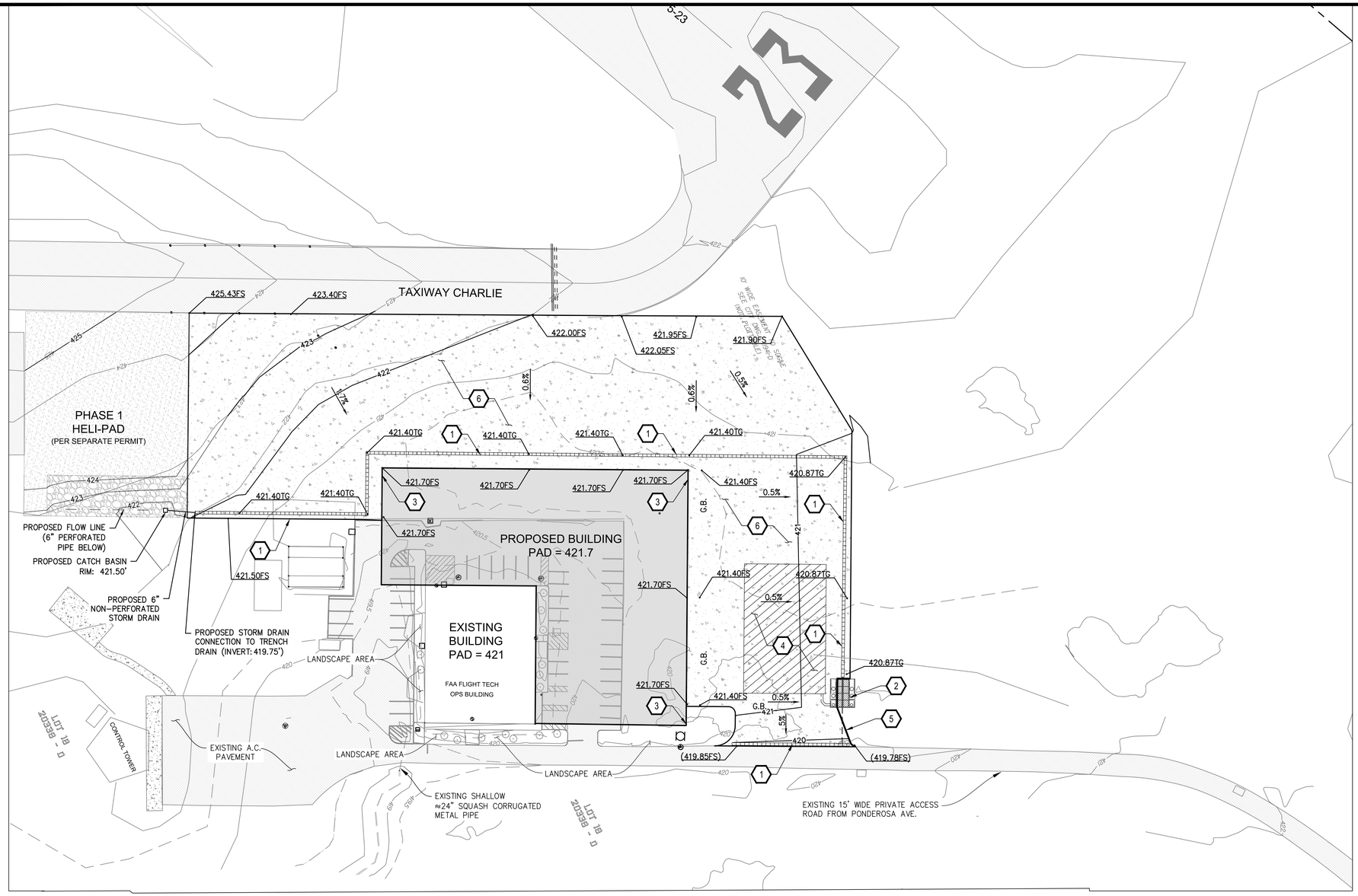
Attachment 4
Copy of Plan Sheets Showing Permanent Storm Water BMPs

This is the cover sheet for Attachment 4.

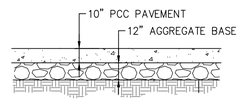


CONSTRUCTION NOTES

1. PROPOSED TRAFFIC RATED PRECAST TRENCH DRAIN.
2. PROPOSED MODULAR WETLAND SYSTEM
3. PROPOSED ROOF DOWN SPOUTS TO WQ AND HMP FACILITIES
4. PROPSOED UNDERGROUNG STORAGE FACILITY FOR 100% RETENTION OF 100 YEARS STORM FOR ALL PROPOSED IMPERVIOUS SURFACES
5. PROPOSED 6" CURB
6. PROPOSED 10" PCC PAVEMENT OVER 12" AGGREGATE BASE

SCALE: 1" = 40'

40 20 0 40 80 120



TYPICAL PAVEMENT SECTION (6)
NO SCALE

ENGINEERING PERMIT NO:_____
DISCRETIONARY PERMIT NO:_____
PRIVATE CONTRACT

PRELIMINARY GRADING PLAN FOR:

AIR OPERATION HANGERS

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 1 OF 2 SHEETS

PROJECT NO._____
V.T.M._____

FOR CITY ENGINEER _____ DATE

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	AP			
AS-BUILTS				

XXXX-XXXX
NAD83 COORDINATES

XXX-XXXX
LAMBERT COORDINATES

CONTRACTOR_____ DATE STARTED_____
INSPECTOR_____ DATE COMPLETED_____

C-1

CONSTRUCTION CHANGE TABLE

CHANGE	DATE	EFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.	PROJECT NO.

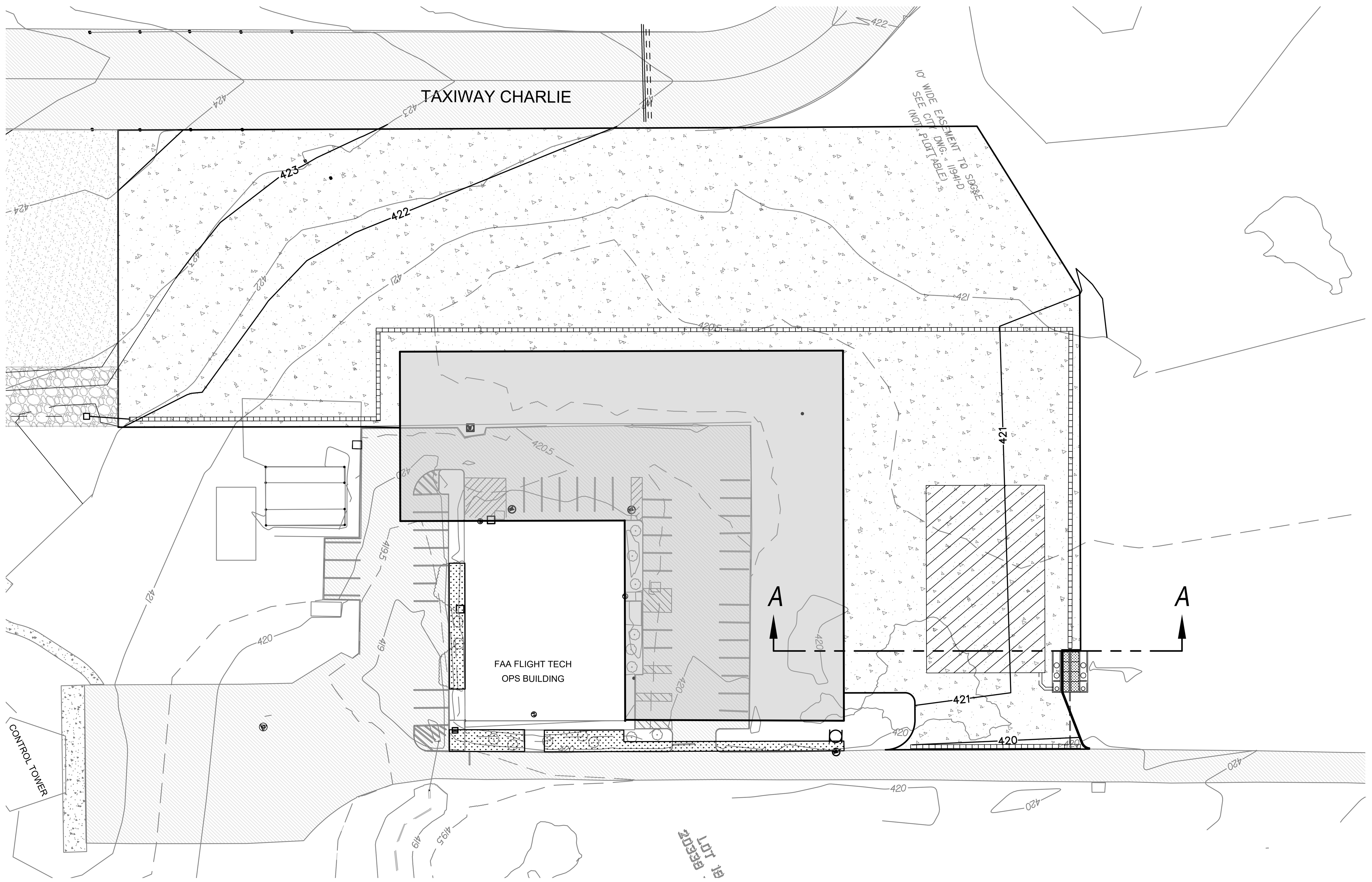
(REV 3/04/2016)

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

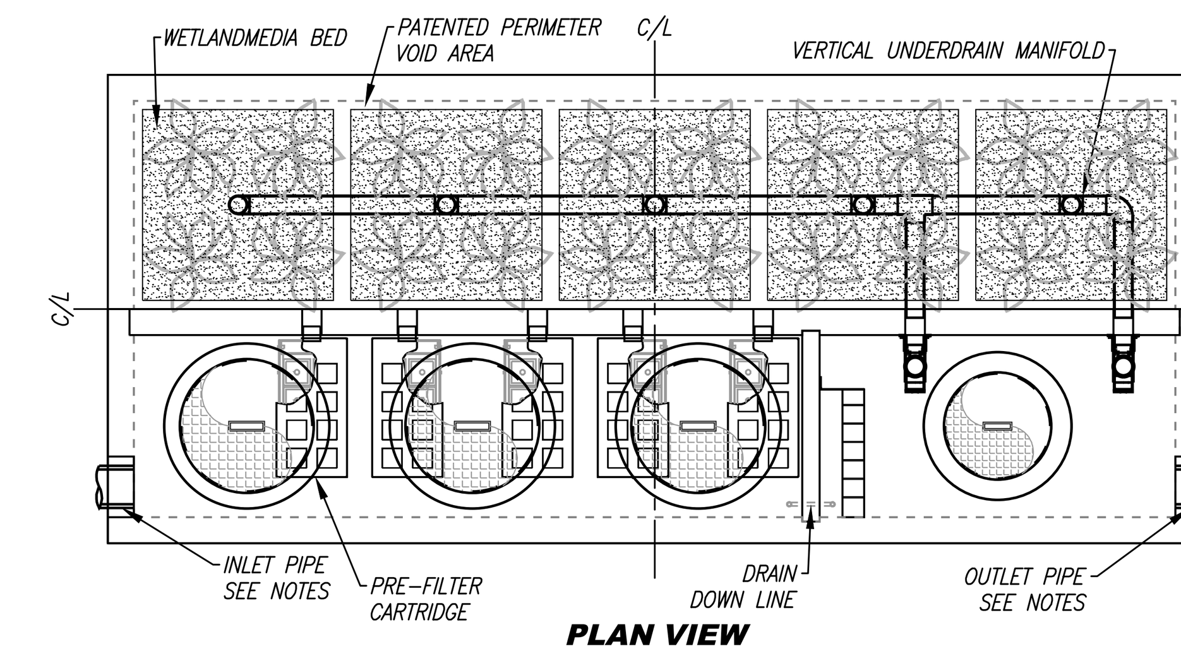
The City of SAN DIEGO
DEVELOPMENT SERVICES DEPARTMENT

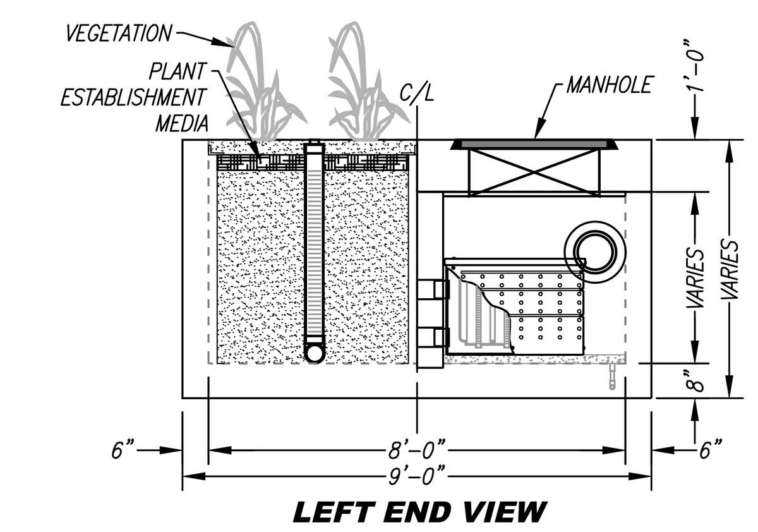
SAVE DATE: 11/4/2019 ~ PLOT DATE: 12/13/2019 ~ FILE NAME: F:\Project\Q74 – City of San Diego\Q74001002– Air Fire Rescue Facility\Design\CADD\Storm Analysis\Phase 2\18301 PGP Phase 2 (c&s).dwg



SITE SPECIFIC DATA			
PROJECT NUMBER		625280	
PROJECT NAME		Fire Rescue Air Ops Facility	
PROJECT LOCATION		Montgomery Airfield	
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.577	
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			DVERT
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	418.85'	RCP	6"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	418'	RCP	12"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	421 +/-		
SURFACE LOAD	OTHER LOADING - USER FILL		
FRAME & COVER	3EA ø30"	OPEN PLANTER	ø24"
NOTES:			

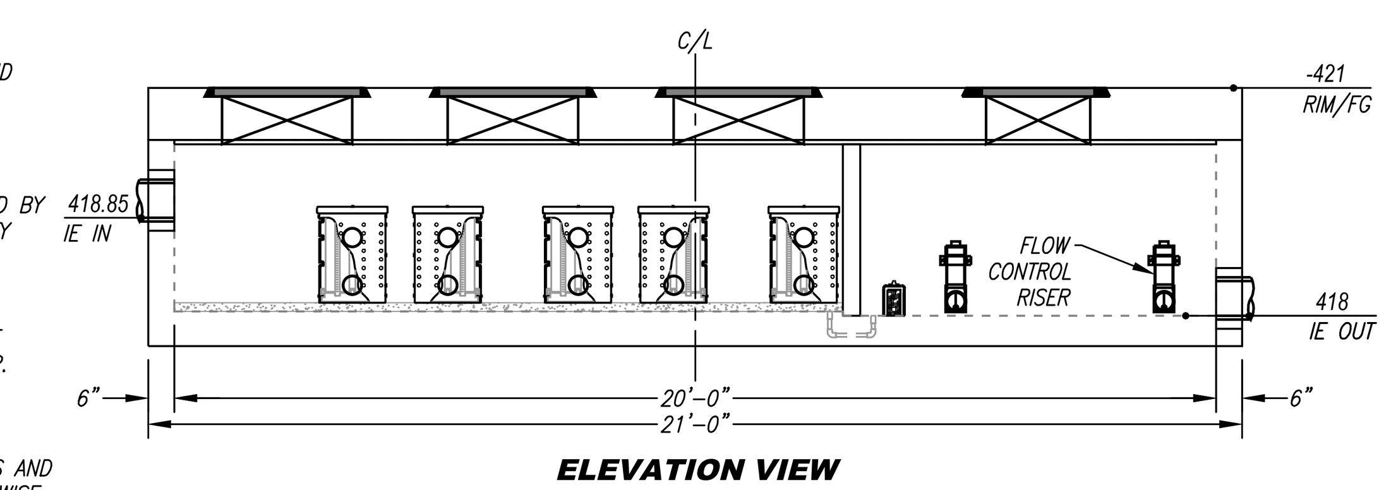
* PRELIMINARY NOT FOR CONSTRUCTION

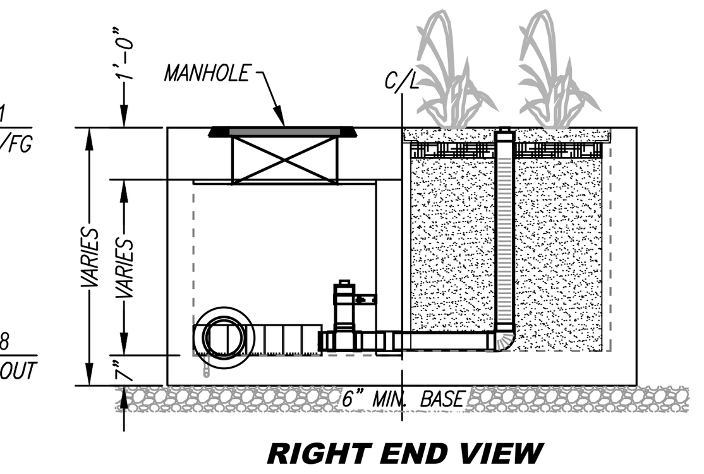




INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURERS WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.





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

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

5/23/19TOLFE

MODULAR WETLANDS

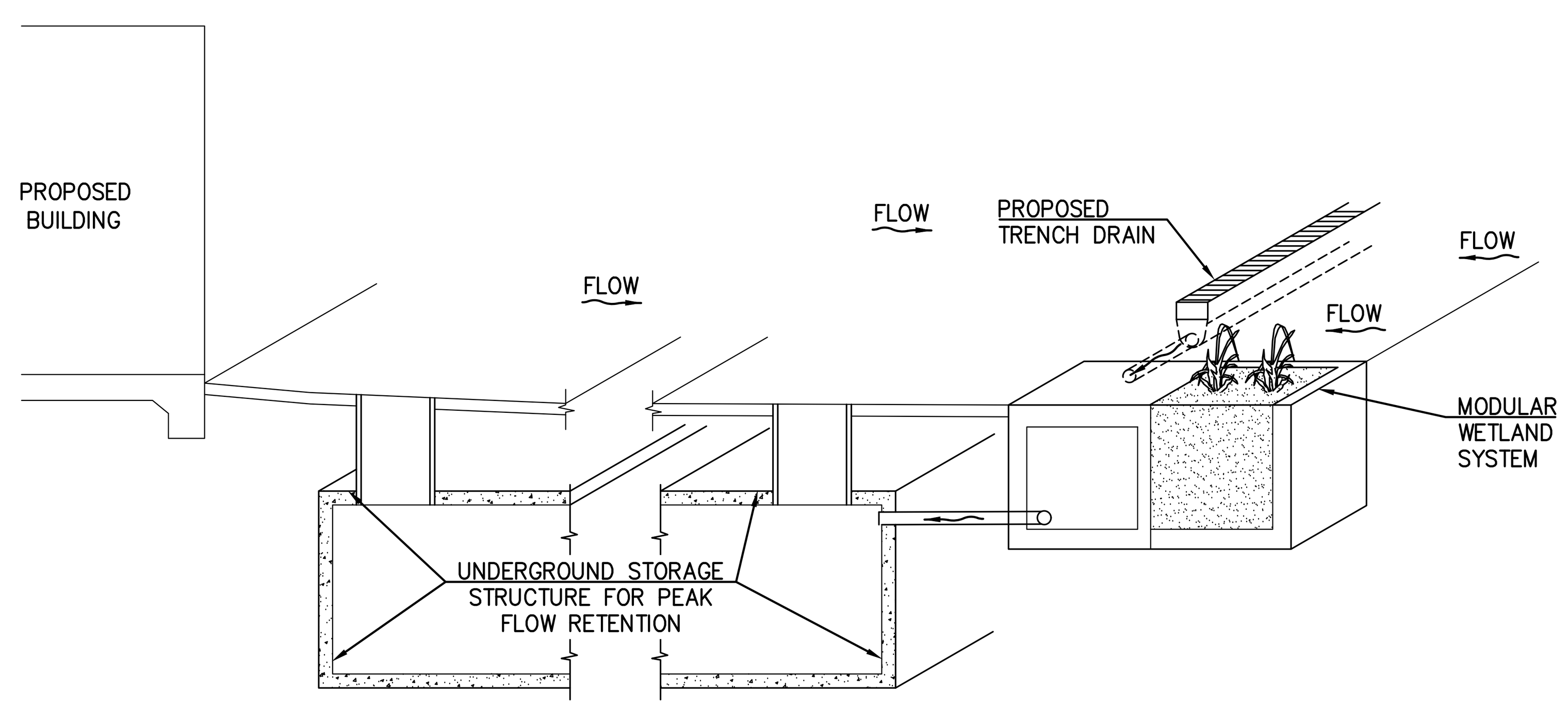
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

Bio Clean
A Forterra Company

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

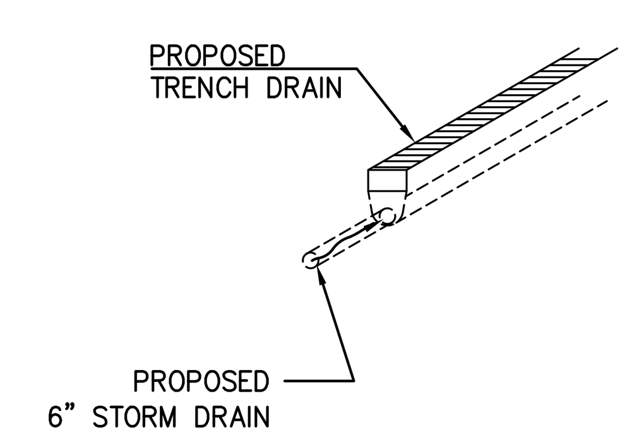
STORMWATER QUALITY NOTES / CONSTRUCTION BMP'S

1. SUFFICIENT BMPS MUST BE INSTALLED TO PREVENT SILT, MUD OR OTHER CONSTRUCTION DEBRIS FROM BEING TRACKED IN TO THE ADJACENT STREET(S) OR STORM WATER CONVEYANCE SYSTETMOS DCUOENSTRUCTIO N VEHICLES OR ANY OTHER CONSTRUCTION ACTIVITY, THE CONTRACTOR SHALL BE RESPONSIBLE FOR CLEANING ANY SUCH DEBRIS THAT MAY BE IN THE STREET AT THE END OF EACH WORK DAY AFTER A STORM EVENT THAT CAUSES A BREECH IN THE INSTALLED CONSTRUCTION BMPS.
2. ALL STOCK PILES OF UNCOMPACTED SOIL AND/OR BUILDING MATERIALS THAT ARE INTENDED TO BE LEFT UNPROTECTED FOR A PERIOD GREATER THAN SEVEN CALENDAR DAYS ARE TO BE PROVIDED WITH EROSION AND SEDIMENT CONTROLS. SUCH SOIL MUST BE PROTECTED EACH DAY WHEN THE PROBABILITY OF RAIN IS 4GOR% DATRE R.
3. A CONCRETE WASHOUT SHALL BE PROVIDED ON ALL PROJECTS WHICPHR OPOSE THE CONSTRUCTIO NOF ANY CONCRETE IMPROVEMENTS THAT ARE TO BE POURED IN PLACE ON THE SITE.
4. ALL EROSION/SEDIMENT CONTROL DEVICES SHALL BE MAINTAINED IN WORKING ORDER AT ALL TIMES.
5. ALL SLOPES THAT ARE GRADED OR DISTURBED BY CONSTRUCTION ACTIVITY MUST BE PROTECTED AGAINST EROSION AND SEDIMENT TRANSPORT AT ALL TIMES.
6. THE STORAGE OF ALL CONSTRUCTION MATERIALS AND EQUIPMENT MUST BE PROTECTED AGAINST ANY POTENTIAL RELEASE OR POLLUTANTS INTO THE ENVIRONMENT.



TYPICAL SECTION A-A

NO SCALE



PROPOSED STORM DRAIN TRENCH DRAIN CONNECTION

NO SCALE

POST-CONSTRUCTION BMP LEGEND

MODULAR WETLAND SYSTEM

UNDERGROUND STORAGE

POST-CONSTRUCTION BMPS

THIS PROJECT PRROPOSES POST-CONSTRUCTION BEST MANAGEMENT PRACTICES AND LID MEASURES REQUIRED UNDER THE CITY OF SAN DIEGO STORM WATER MANAGEMENT AND DISCHARGE CONTROL ORDINANCE (SECTION 43.03)

SCALE: 1" = 40'

40 20 0 40 80 120

ENGINEERING PERMIT NO:________________

DISCRETIONARY PERMIT NO:________________

PRIVATE CONTRACT

PRELIMINARY GRADING PLAN FOR:

AIR OPERATION HANGERS

CITY OF SAN DIEGO, CALIFORNIA
DEVELOPMENT SERVICES DEPARTMENT
SHEET 2 OF 2 SHEETS

PROJECT NO.

FOR CITY ENGINEER | DATE

V.T.M.

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	AP			
AS-BUILTS				

XXXX-XXXX
NAD83 COORDINATES

XXX-XXXX
LAMBERT COORDINATES

CONTRACTOR ________ DATE STARTED ________

INSPECTOR ________ DATE COMPLETED ________

C-2

CONSTRUCTION CHANGE TABLE

CHANGE	DATE	EFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.	PROJECT NO.

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of SAN DIEGO

DEVELOPMENT SERVICES DEPARTMENT

(REV 3/07/2018)

SAVE DATE: 11/4/2019 ~ PLOT DATE: 12/13/2019 ~ FILE NAME: F:\Project\Q74 – City of San Diego\Q74001002– Air Fire Rescue Facility\Design\CADD\Storm Analysis\Phase 2\18301 PGP Phase 2 (c&s).dwg

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.

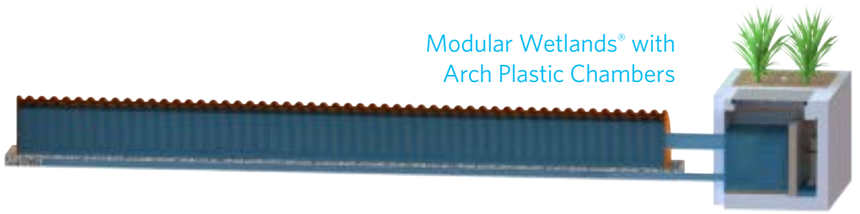
MODEL #	DIMENSIONS	WETLANDMEDIA SURFACE AREA (sq. ft.)	TREATMENT FLOW RATE (cfs)
MWS-L-4-4	4′ x 4′	23	0.052
MWS-L-4-6	4′ x 6′	32	0.073
MWS-L-4-8	4′ x 8′	50	0.115
MWS-L-4-13	4′ x 13′	63	0.144
MWS-L-4-15	4′ x 15′	76	0.175
MWS-L-4-17	4′ x 17′	90	0.206
MWS-L-4-19	4′ x 19′	103	0.237
MWS-L-4-21	4′ x 21′	117	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

Attachment 5
Drainage Report

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

DRAINAGE REPORT FOR MONTGOMERY AIRPORT AIR FIRE RESCUE FACILITY

For the City of San Diego

November 5, 2018
January 23, 2019
February 25, 2019
May 23, 2019
June 21, 2019
August 17, 2019
November 1, 2019
December 13, 2019

C&S ENGINEERS, INC.
2020 CAMINO DEL RIO NORTH, SUITE 1000
SAN DIEGO, CALIFORNIA 92108

Q74.001.002

KENNETH GETHERS - PROJECT ENGINEER

TABLE OF CONTENTS

APPENDICES

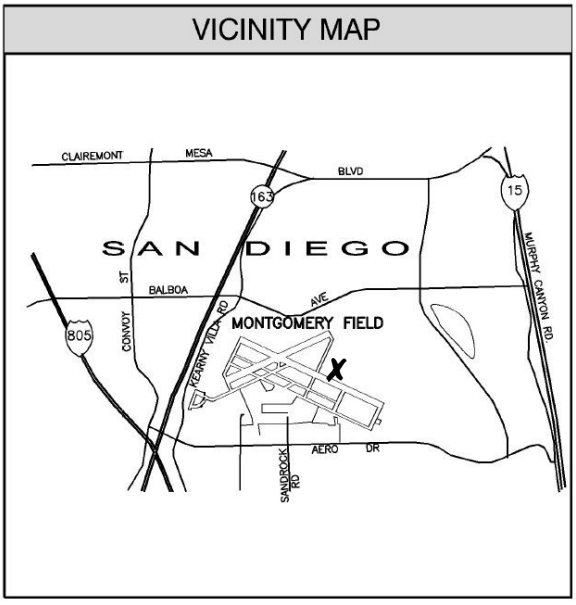
OBJECTIVE

This drainage report addresses the hydrologic and hydraulic aspects of the project. Post Construction storm water issues are discussed and addressed under the "Storm Water Quality Management Plan". The report will determine Post-Construction impact to the watershed and how additional flows will be dealt with. Additionally, due to existing vernal pools in the area, the design will show how vernal pools will not be impacted by not routing post development overland runoff flows from new impervious areas into these sensitive areas.

INTRODUCTION

This drainage report shall serve to depict existing and proposed drainage patterns for the Montgomery Airport Air Fire Rescue Facility project located north of, and adjacent to, the Montgomery Airport air traffic controller's control tower.

The site is bound by Taxiway Charlie on the west, higher natural terrain grades on the south, higher natural terrain grades on the north, and a 15-ft wide asphalt paved access road on the east. The overland drainage is comprised of two drainage areas - southerly half and a northerly half. The terrain is relatively flat, with a mild grade from west to east (Taxiway Charlie to the access road). See Appendix A for a general overview of the existing site.



The project proposes to construct two hangars for helicopters, apron areas for the helicopters, fuel tender areas, and a small maintenance facility structure. The hangars will share walls with the existing FAA facility building. The FAA facility building will be renovated to function along with the proposed improvements. See Appendix B for a general overview of the proposed site.

CONCLUSION

The table below summarize the existing flows vs. the proposed flows. The drainage boundary between Basin A and B was adjusted to treat newly created impervious areas for water quality purposes. Therefore the Post-development Q for Basin A was decreased to 2.72 CFS. Although there has been a significant increase in Q for Basin B, there will be no impact to any watersheds below our site, since all flows from Basin B will be routed and store in an underground Vault located to the northeast side of the project area, this will prevent flows from negatively impacting the vernal pools located to east of the project site. No significant impact is not anticipated because of the proposed development.

FLOWS

	C	**Tc Min**	**I In/hr**	**A (ac)**	**Q_{100} cfs**
Pre-Development					
BASIN A	0.72	10.62	3.30	1.73	4.17
BASIN B	0.62	11.25	3.23	3.20	6.49
Post-Development					
BASIN A	0.50	13.18	3.05	0.94	1.45
BASIN B	0.89	9.01	3.50	4.00	12.58

DISCUSSION

The existing site consists of impervious surfaces, such as the asphalt parking area and the building's roof top, as well as natural terrain. The runoff coefficient for the site has been developed using "The City of San Diego Drainage Design Manual" January 2017 Edition, specifically Table A-1 "Runoff Coefficient for Rational Method". Based on values shown on said table a weighted runoff coefficient was developed to accurately depict the conditions present on the site during the pre and post-development. (See Appendix C)

Per the stormwater threat assessment form DS-560, the project has been deemed a priority development project (PDP) due to large amounts of new impervious areas being proposed. Flows from Basin B will be routed, treated and stored in the proposed underground storage vault, no flows from new impervious areas and existing confluence flows are expected to leave the site via overland. Captured peak runoff volumes from the 6-hour, 100-year storm hydrograph will be pumped and hauled offsite into a nearby MS4 storm drain system.

A trench drain located on the north and west side of the building is being placed to convey the flows from the impervious areas into a modular wetland system for water quality purposed before entering the underground vault storage unit. As for the flows from the pervious areas located on the north side they will be capture by an earthen swale located on the west side on the existing access road and running in a southwesterly direction where they will capture by a catch basin that will convey them into the underground storage vault.

For compliance with the state's National Pollution Discharge Elimination System (NPDES) permit R9-2013-0001, Low Impact Development (LID) and Source Control will be implemented. For LID, due to the existing Runway 23 and Taxiway Charlie, along with the existing AC access road, the proposed hangars and apron areas are confined but will meet the minimum areas required for safe aircraft separation. And per FAA regulations, wash racks will be required for the helicopters. Wash racks will be contained and either hauled away or will be treated onsite and then hauled away. Since this hydrology study is being prepared as part of the preliminary review of the project, more information is forthcoming which will aid in the final determination on how the wash rack system will operate.

HYDROLOGIC ANALYSES

This study contains 100-year hydrologic analyses to determine the existing and proposed flows generated by the project. The City of San Diego *Drainage Design Manual, Jan. 2017 edition* criteria along with the City of San Diego Rational Method program within the *CivilDesign was utilized in calculating runoff for all basins smaller than 0.5 square miles in size.

- Drainage areas, flow lengths and elevations: For both the existing and proposed condition analyses, the grades were determined from a survey analysis prepared by the city of San Diego.

- Hydrologic soil group D was used for this study based on the requirements shown on Note 1 below Table A-1 of the City of San Diego County *Drainage Design Manual, Jan. 2017 edition.*

Due to the vernal pools and their proximity to the site, it should be noted that the access road on the east side of the site traverses the site from south to north and connects the control tower to the public road, Ponderosa Ave. More importantly, it serves as a weir for the northerly half tributary area (see Appendix B). The proposed design will continue to utilize the access road as a weir. Therefore, the overland flow will continue to concentrate west of the access road and north of the surface improvements. Additionally, an earthen swale located on the west side of the access road an running parallel to it will impede flows from leaving the site, said earthen swale will convey flows on a south westerly direction to a catch basin which will capture flows and convey them into the underground storage vault. The 6-hr. hydrograph has been developed using the CivilDesign software to determine the required storage capacity required to capture the flows. It has been determined that an underground storage vault with at storage capacity of 28,500 cubic-feet will be required said flows from Basin B.

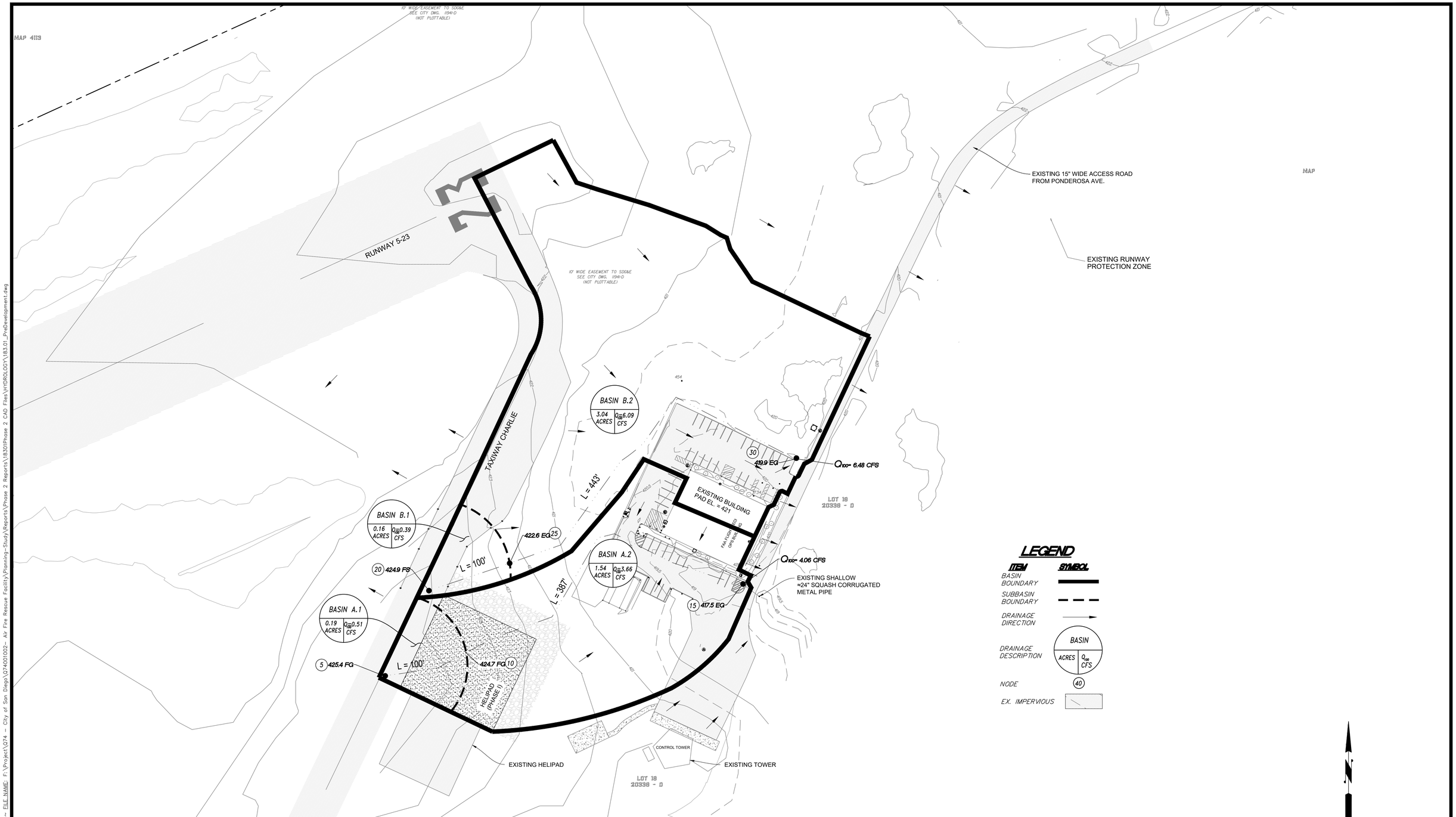
For the southerly tributary area, there is an existing squashed corrugated metal pipe, approximately 24" in diameter that lays about one foot below the AC access road (see Appendix H). Unlike the northerly tributary area, the southerly tributary area does not pond, it continues to flow to the east via the pipe. And in consideration to the vernal pools downstream of the pipe, the proposed flows are shown to be just under the existing flows (existing = 4.17 cfs, proposed = 1.45 cfs). This equates to a discharge of 2.72 cfs lower than existing.

*CivilDesign Software uses the 2003 Darinage Design Manual, however the parameters within the software still apply to the 2017 City of San Diego Drainage Design Manual.

APPENDIX A

CIVILDESIGN CALCULATIONS

PRE-DEVELOPMENT



LEGEND

ITEM	SYMBOL
BASIN BOUNDARY	
SUBBASIN BOUNDARY	
DRAINAGE DIRECTION	
DRAINAGE DESCRIPTION	BASIN: ACRES, Q_{100} CFS
NODE	40
EX. IMPERVIOUS	

N

SCALE: 1" = 50'

50 25 0 50 100 150

PRE-DEVELOPMENT HYDROLOGY EXHIBIT
AIR FIRE RESCUE FACILITY

DATE: 12/13/19

DRAWING:

SHEET 1 OF 1

SAVE DATE: 12/13/2019 ~ PLOT DATE: 12/13/2019 ~ FILE NAME: F:\Project\074 ~ City of San Diego\074001002~ Air Fire Rescue Facility\Planning-Study\Reports\Phase 2 Reports\18301Phase 2 CAD Files\HYDROLOGY\183.01_PreDevelopment.dwg

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: 12/13/19

Montgomery Air Fire Rescue Facility
Pre-Development Condition
100 Year Storm Event

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

Program License Serial Number 5017

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 5.000 to Point/Station 10.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.720 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 425.400(Ft.)
Lowest elevation = 424.700(Ft.)
Elevation difference = 0.700(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 7.70 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7200)*(100.000^.5)/(0.700^(1/3)]= 7.70
Rainfall intensity (I) = 3.711(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.720
Subarea runoff = 0.508(CFS)
Total initial stream area = 0.190(Ac.)

```
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station      10.000 to Point/Station
15.000
      **** IMPROVED CHANNEL TRAVEL TIME ****
      ____________________________________________________________________
____
      Upstream point elevation =   424.700(Ft.)
      Downstream point elevation =   417.500(Ft.)
      Channel length thru subarea  =   387.000(Ft.)
      Channel base width      =    0.000(Ft.)
      Slope or 'Z' of left channel bank =  16.000
      Slope or 'Z' of right channel bank =  16.000
      Estimated mean flow rate at midpoint of channel =      2.565(CFS)
      Manning's 'N'    = 0.025
      Maximum depth of channel  =    0.250(Ft.)
      Flow(q) thru subarea =      2.565(CFS)
      Depth of flow =   0.269(Ft.), Average velocity =   2.225(Ft/s)
      !!Warning: Water is above left or right bank elevations
      Channel flow top width =    8.000(Ft.)
      Flow Velocity =    2.23(Ft/s)
      Travel time  =    2.90 min.
      Time of concentration =   10.60 min.
      Critical depth =      0.271(Ft.)
      ERROR - Channel depth exceeds maximum allowable depth
       Adding area flow to channel
      User specified 'C' value of 0.720 given for subarea
      Rainfall intensity =      3.304(In/Hr) for a   100.0 year storm
      Runoff coefficient used for sub-area, Rational method,Q=KCIA, C =
0.720
      Subarea runoff =      3.663(CFS) for    1.540(Ac.)
      Total runoff =      4.171(CFS)      Total area =        1.73(Ac.)


      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
++++
      Process from Point/Station       15.000 to Point/Station
20.000
      **** CONFLUENCE OF MAIN STREAMS ****
      ____________________________________________________________________
____
      The following data inside Main Stream is listed:
      In Main Stream number: 1
      Stream flow area =      1.730(Ac.)
      Runoff from this stream =      4.171(CFS)
      Time of concentration =   10.60 min.
      Rainfall intensity =     3.304(In/Hr)
      Summary of stream data:

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


      1        4.171     10.60               3.304
      Qmax(1) =
                1.000 *    1.000 *     4.171) + =       4.171

      Total of 1 main streams to confluence:
      Flow rates before confluence point:
             4.171
```

Maximum flow rates at confluence using above data:
4.171
Area of streams before confluence:
1.730

Results of confluence:
Total flow rate = 4.171(CFS)
Time of concentration = 10.602 min.
Effective stream area after confluence = 1.730(Ac.)
End of computations, total study area = 1.730 (Ac.)

++
Process from Point/Station   20.000 to Point/Station   25.000
**** INITIAL AREA EVALUATION ****
_____
User specified 'C' value of 0.620 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 424.900(Ft.)
Lowest elevation = 422.600(Ft.)
Elevation difference =   2.300(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =   6.55 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.6200)*(100.000^.5)/(2.300^(1/3)]=   6.55
Rainfall intensity (I) =   3.946(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.620
Subarea runoff =   0.391(CFS)
Total initial stream area =   0.160(Ac.)

++
Process from Point/Station   25.000 to Point/Station   30.000
**** IMPROVED CHANNEL TRAVEL TIME ****
_____
Upstream point elevation =   422.600(Ft.)

```
Downstream point elevation =   419.900(Ft.)
Channel length thru subarea  =   443.000(Ft.)
Channel base width      =    3.000(Ft.)
Slope or 'Z' of left channel bank =  16.000
Slope or 'Z' of right channel bank =  16.000
Estimated mean flow rate at midpoint of channel =      4.110(CFS)
Manning's 'N'    = 0.025
Maximum depth of channel  =    0.350(Ft.)
Flow(q) thru subarea =      4.110(CFS)
Depth of flow =   0.321(Ft.), Average velocity =   1.570(Ft/s)
Channel flow top width =   13.288(Ft.)
Flow Velocity =    1.57(Ft/s)
Travel time  =    4.70 min.
Time of concentration =   11.25 min.
Critical depth =      0.254(Ft.)
 Adding area flow to channel
User specified 'C' value of 0.620 given for subarea
Rainfall intensity =      3.233(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.620
Subarea runoff =      6.094(CFS) for    3.040(Ac.)
Total runoff =      6.486(CFS)  Total area =        3.20(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       30.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      3.200(Ac.)
Runoff from this stream =      6.486(CFS)
Time of concentration =   11.25 min.
Rainfall intensity =     3.233(In/Hr)
Summary of stream data:

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


1        6.486     11.25                3.233
Qmax(1) =
           1.000 *    1.000 *     6.486) + =       6.486

Total of 1 main streams to confluence:
Flow rates before confluence point:
       6.486
Maximum flow rates at confluence using above data:
        6.486
```

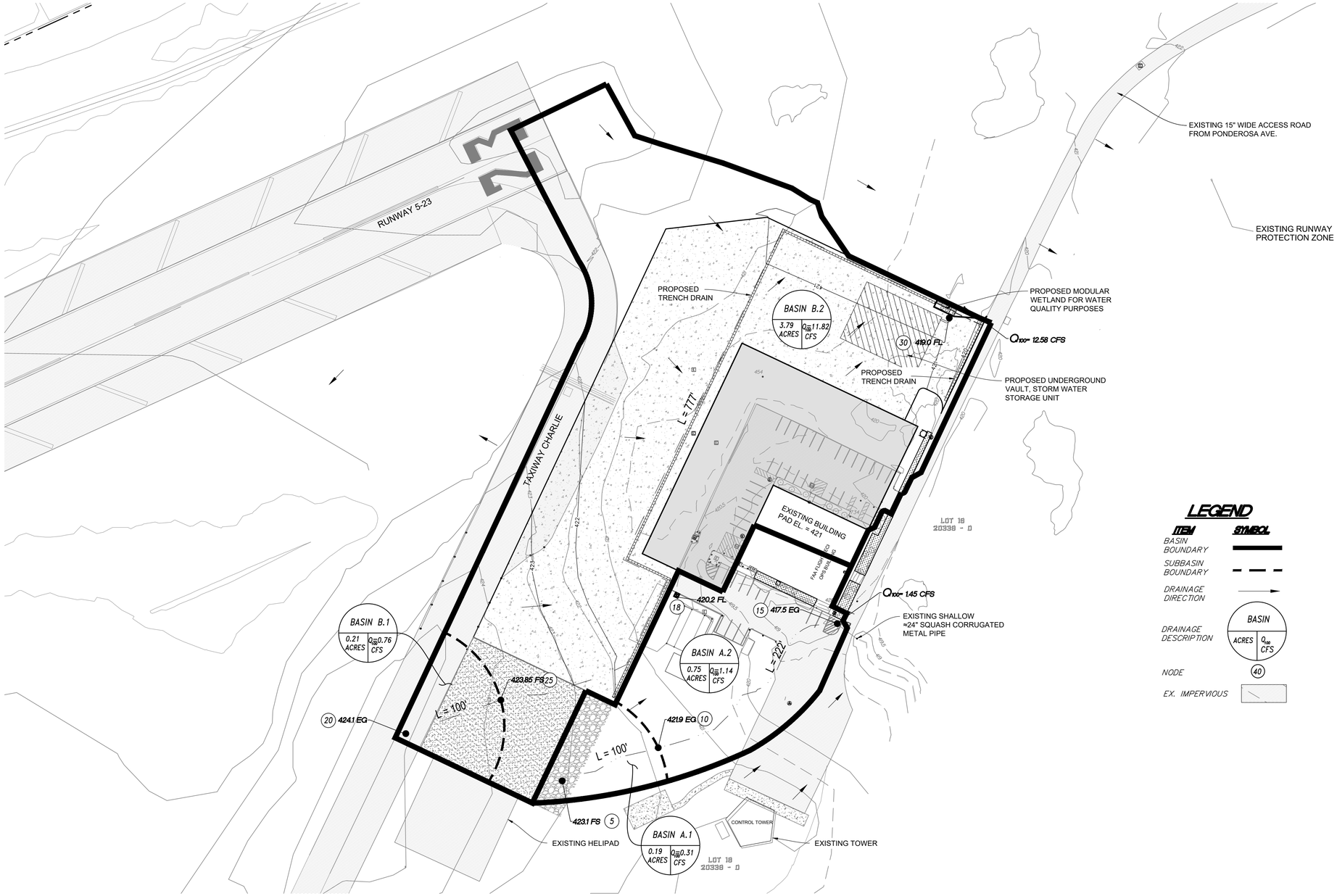
```
Area of streams before confluence:
        3.200


Results of confluence:
Total flow rate =      6.486(CFS)
Time of concentration =    11.249 min.
Effective stream area after confluence  =      3.200(Ac.)
End of computations, total study area =          3.200 (Ac.)
```

APPENDIX B

CIVILDESIGN CALCULATIONS

POST-DEVELOPMENT



LEGEND

ITEM	SYMBOL
BASIN BOUNDARY	
SUBBASIN BOUNDARY	
DRAINAGE DIRECTION	
DRAINAGE DESCRIPTION	BASIN / ACRES / Q_{100} CFS
NODE	40
EX. IMPERVIOUS	

SCALE: 1" = 50'

50 25 0 50 100 150

POST-DEVELOPMENT HYDROLOGY EXHIBIT
AIR FIRE RESCUE FACILITY

DATE: 10/31/19

DRAWING:

SHEET 1 OF 1

SAVE_DATE: 10/30/2019 ~ PLOT_DATE: 10/31/2019 ~ FILE_NAME: F:\Project\074 - City of San Diego\074001002- Air Fire Rescue Facility\Planning-Study\Reports\Phase 2 Reports\1830\Phase 2 CAD Files\HYDROLOGY\183.01_Post-Development - Rev'd RA-9-3-19.dwg

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: 10/31/19

Montgomery Air Fire Rescue Facility
Post Development Condition
100 Year Storm Event

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

Program License Serial Number 5017

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

BASIN A
++
Process from Point/Station   5.000 to Point/Station   10.000
**** INITIAL AREA EVALUATION ****
A.1____
User specified 'C' value of 0.500 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 422.800(Ft.)
Lowest elevation = 421.900(Ft.)
Elevation difference =   0.900(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =   11.19 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5000)*(100.000^.5)/(0.900^(1/3)]= 11.19

Rainfall intensity (I) = 3.240(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.500
Subarea runoff = 0.308(CFS)
Total initial stream area = 0.190(Ac.)

++
Process from Point/Station 10.000 to Point/Station 15.000
**** IMPROVED CHANNEL TRAVEL TIME ****
A.2_____
Upstream point elevation = 421.900(Ft.)
Downstream point elevation = 417.500(Ft.)
Channel length thru subarea = 222.000(Ft.)
Channel base width = 1.500(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 = 0.915(CFS)
Manning's 'N' = 0.025
Maximum depth of channel = 0.350(Ft.)
Flow(q) thru subarea = 0.915(CFS)
Depth of flow = 0.159(Ft.), Average velocity = 1.859(Ft/s)
Channel flow top width = 4.684(Ft.)
Flow Velocity = 1.86(Ft/s)
Travel time = 1.99 min.
Time of concentration = 13.18 min.
Critical depth = 0.160(Ft.)
Adding area flow to channel
User specified 'C' value of 0.500 given for subarea
Rainfall intensity = 3.051(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.500
Subarea runoff = 1.144(CFS) for 0.750(Ac.)
Total runoff = 1.452(CFS) Total area = 0.94(Ac.)

++
Process from Point/Station 15.000 to Point/Station 15.000
**** CONFLUENCE OF MAIN STREAMS ****
_____
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 0.940(Ac.)
Runoff from this stream = 1.452(CFS)
Time of concentration = 13.18 min.
Rainfall intensity = 3.051(In/Hr)
Summary of stream data:

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

```
1        1.452     13.18                 3.051
Qmax(1) =
           1.000 *    1.000 *     1.452) + =       1.452

Total of 1 main streams to confluence:
Flow rates before confluence point:
       1.452
Maximum flow rates at confluence using above data:
        1.452
Area of streams before confluence:
        0.940


Results of confluence:
Total flow rate =      1.452(CFS)
Time of concentration =    13.176 min.
Effective stream area after confluence  =      0.940(Ac.)
End of computations, total study area =           0.940 (Ac.)

BASIN B
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       25.000
**** INITIAL AREA EVALUATION ****
B.1_____________________________________________________________________
User specified 'C' value of 0.890 given for subarea
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =  424.100(Ft.)
Lowest elevation =  423.850(Ft.)
Elevation difference =    0.250(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     6.00 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8900)*( 100.000^.5)/( 0.250^(1/3)]=   6.00
Rainfall intensity (I) =      4.081(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =      0.763(CFS)
Total initial stream area =        0.210(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       30.000
**** IMPROVED CHANNEL TRAVEL TIME ****
B.2_____________________________________________________________________
Upstream point elevation =   423.850(Ft.)
Downstream point elevation =   419.000(Ft.)
Channel length thru subarea  =   777.000(Ft.)
```

```
Channel base width      =    1.500(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      7.645(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.750(Ft.)
Flow(q) thru subarea =      7.645(CFS)
Depth of flow =   0.639(Ft.), Average velocity =   4.302(Ft/s)
Channel flow top width =    4.058(Ft.)
Flow Velocity =    4.30(Ft/s)
Travel time  =    3.01 min.
Time of concentration =    9.01 min.
Critical depth =      0.688(Ft.)
 Adding area flow to channel
User specified 'C' value of 0.890 given for subarea
Rainfall intensity =      3.504(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.890
Subarea runoff =     11.819(CFS) for    3.790(Ac.)
Total runoff =     12.582(CFS)  Total area =        4.00(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       30.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.000(Ac.)
Runoff from this stream =     12.582(CFS)
Time of concentration =    9.01 min.
Rainfall intensity =     3.504(In/Hr)
Summary of stream data:

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


1       12.582      9.01                  3.504
Qmax(1) =
           1.000 *    1.000 *    12.582) + =      12.582

Total of 1 main streams to confluence:
Flow rates before confluence point:
      12.582
Maximum flow rates at confluence using above data:
       12.582
Area of streams before confluence:
        4.000
```

```
Results of confluence:
Total flow rate =     12.582(CFS)
Time of concentration =     9.010 min.
Effective stream area after confluence  =      4.000(Ac.)
End of computations, total study area =          4.000 (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: 11/04/19

Airport 6-hr Unit Hyd

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

Program License Serial Number 5017

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   30.000 to Point/Station   30.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
_____
User specified 'C' value of 0.890 given for subarea
Rainfall intensity (I) =   3.504(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   9.01 min. Rain intensity =   3.50(In/Hr)
Total area =   4.000(Ac.) Total runoff =   12.582(CFS)

++

```
 Process from Point/Station       30.000 to Point/Station       30.000
 **** PRINT CURRENT HYDROGRAPH ****
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                  P R I N T  O F  S T O R M
               R u n o f f     H y d r o g r a p h
                                                              -------

   1-OK; 2-Change this entry; 3-Use another option] >
 [ Allowable values:         1.0000  to         3.0000 ]-------------------
 Time(h+m) Volume(Ac.Ft)   Q(CFS)  0        3.1       6.3       9.4      12.6
 ------------------------------------------------------------------------
 0+15       0.0000      0.00  Q          |          |          |          |
 0+30       0.0085      0.41  VQ         |          |          |          |
 0+45       0.0174      0.43   Q         |          |          |          |
 1+ 0       0.0265      0.44  |Q         |          |          |          |
 1+15       0.0362      0.47  |QV        |          |          |          |
 1+30       0.0463      0.49  |QV        |          |          |          |
 1+45       0.0570      0.52  |Q V       |          |          |          |
 2+ 0       0.0682      0.54  |Q  V      |          |          |          |
 2+15       0.0804      0.59  |Q  V      |          |          |          |
 2+30       0.0931      0.62  |Q   V     |          |          |          |
 2+45       0.1072      0.68  | Q   V    |          |          |          |
 3+ 0       0.1222      0.72  | Q    V   |          |          |          |
 3+15       0.1394      0.83  | Q     V  |          |          |          |
 3+30       0.1580      0.90  | Q      V |          |          |          |
 3+45       0.1807      1.10  |  Q      V|          |          |          |
 4+ 0       0.2066      1.25  |  Q        V          |          |          |
 4+15       0.2447      1.84  |    Q     |   V      |          |          |
 4+30       0.2983      2.60  |        Q |      V   |          |          |
 4+45       0.5582     12.58  |          |                    V          Q
 5+ 0       0.5887      1.48  |   Q      |          |          |   V      |
 5+15       0.6091      0.99  |  Q       |          |          |    V     |
 5+30       0.6251      0.77  | Q        |          |          |     V    |
 5+45       0.6385      0.65  | Q        |          |          |      V   |
 6+ 0       0.6501      0.56  |Q         |          |          |       V  |
 ------------------------------------------------------------------------
```

0.6501 Ac. ft * 43,560 = **28,318.4 cubic feet**

Note:

6-hr Unit Hydrograph only being provided to determine total volume needed for the vault, routing is not being performed since flows are being contained and hauled off-site after rain event. Per the 6-hr Unit Hydrograph the total volume is 28,318.4 cubic feet, an underground vault L = 95' x W = 60' x D = 5' will be required which will have a capacity of 28,500 cubic feet.

APPENDIX C

WEIGHTED RUNOFF COEFFICIENT TABLES

Pre-Project Drainage

Basin ID	Total Area (ac)	Pervious Area - Soil Type D (sq-ft)	Impervious Area - Soil Type D (sq-ft)	% Impervious	% Pervious	Sub-Basin Weighted Runoff Coeff. C:	Basin Weighted Runoff Coeff. C:
A.1	0.19	0	8276	100%	0%	0.95	
A.2	1.54	37852	29230	44%	56%	0.70	0.72
B.1	0.16	3507	3463	50%	50%	0.72	
B.2	3.04	99812	32610	25%	75%	0.61	0.62
Total	4.93		73579				

* Runoff Coefficient Table	
Soil Type	D
Impervious	0.95
Pervious	0.50

Industrial (per Table A.1 of drainage manual)

Post-Project Drainage

Basin ID	Total Area (ac)	Pervious Area - Soil Type D (sq-ft)	Impervious Area - Soil Type D (sq-ft)	% Impervious	% Pervious	Weighted Runoff Coef C:	Basin Weighted Runoff Coeff. C:
A.1	0.19	8307	0	0%	100%	0.50	
A2	0.75	16966	15867.1	49%	52%	0.72	0.50
B.1	0.21	0	9115.3	100%	0%	0.95	
B.2	3.79	21714	143295.3	87%	13%	0.89	0.89
Total	4.93		168277.7				

APPENDIX D

CITY OF SAN DIEGO FIGURES & TABLES

Appendix A

Rational Method and Modified Rational Method

A.1. Rational Method (RM)

The Rational Method (RM) is a mathematical formula used to determine the maximum runoff rate from a given rainfall. It has particular application in urban storm drainage where it is used to estimate peak runoff rates from small urban and rural watersheds for the design of storm drains and drainage structures. The RM is recommended for analyzing the runoff response from drainage areas for watersheds less than 0.5 square miles. It should not be used in instances where there is a junction of independent drainage systems or for drainage areas greater than approximately 0.5 square mile in size. In these instances, the Modified Rational Method (MRM) should be used for junctions of independent drainage systems in watersheds up to approximately 1 square mile in size (see Section A.2); or the NRCS Hydrologic Method should be used for watersheds greater than approximately 1 square mile in size (see Appendix B).

A.1.1. Rational Method Formula

The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (T_c), which is the time required for water to flow from the most remote point of the basin to the location being analyzed. The RM formula is expressed in Equation A-1.

Equation A-1. RM Formula Expression

$$Q = C\ I\ A$$

where:

Q	=	peak discharge, in cubic feet per second (cfs)
C	=	runoff coefficient expressed as that percentage of rainfall which becomes surface runoff (no units); Refer to Appendix A.1.2
I	=	average rainfall intensity for a storm duration equal to the time of concetrnatation (T_c) of the contributing draiange area, in inches per hour; Refer to Appendix A.1.3 and Appendix A.1.4
A	=	drainage area contributing to the design location, in acres

Combining the units for the expression CIA yields:

$$\left(\frac{1\,\text{acre}\times\text{inch}}{\text{hour}}\right)\left(\frac{43{,}560\,\text{ft}^2}{\text{acre}}\right)\left(\frac{1\,\text{foot}}{12\,\text{inches}}\right)\left(\frac{1\,\text{hour}}{3{,}600\,\text{seconds}}\right)\Rightarrow 1.008\,\text{cfs}$$

For practical purposes, the unit conversion coefficient difference of 0.8% can be ignored.

The RM formula is based on the assumption that for constant rainfall intensity, the peak discharge rate at a point will occur when the raindrop that falls at the most upstream point in the tributary drainage basin arrives at the point of interest.

Unlike the MRM (discussed in Appendix A.2) or the NRCS hydrologic method (discussed in Appendix B), the RM does not create hydrographs and therefore does not add separate subarea hydrographs at collection points. Instead, the RM develops peak discharges in the main line by increasing the T_c as flow travels downstream.

Characteristics of, or assumptions inherent to, the RM are listed below:

1. The discharge resulting from any I is maximum when the I lasts as long as or longer than the T_c.
2. The storm frequency of peak discharges is the same as that of I for the given T_c.
3. The fraction of rainfall that becomes runoff (or the runoff coefficient, C) is independent of I or precipitation zone number (PZN) condition (PZN Condition is discussed in the NRCS method).
4. The peak rate of runoff is the only information produced by using the RM.

A.1.2. Runoff Coefficient

The runoff coefficients are based on land use (see Table A–1). Soil type "D" is used throughout the City of San Diego for storm drain conveyance design. An appropriate runoff coefficient (C) for each type of land use in the subarea should be selected from this table and multiplied by the percentage of the total area (A) included in that class. The sum of the products for all land uses is the weighted runoff coefficient (Σ[CA]). Good engineering judgment should be used when applying the values presented in Table A–1, as adjustments to these values may be appropriate based on site-specific characteristics.

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).

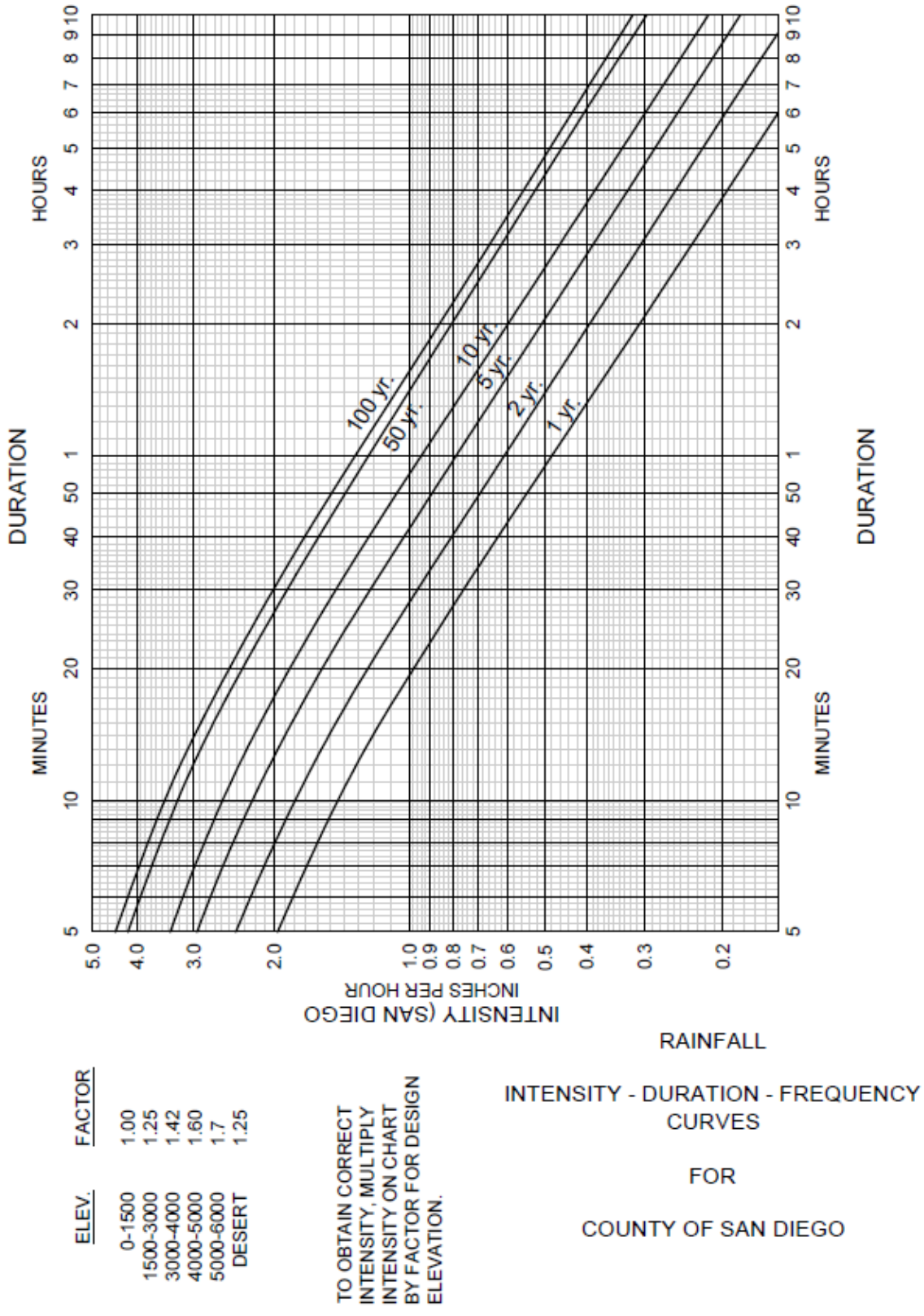


Figure A-1. Intensity-Duration-Frequency Design Chart

A.1.4. Time of Concentration

The Time of Concentration (T_c) is the time required for runoff to flow from the most remote part of the watershed to the outlet point under consideration.

Methods of calculation differ for natural watersheds (non-urbanized) and for urban drainage systems. Also, when designing storm drain systems, the designer must consider the possibility that an existing natural watershed may become urbanized during the useful life of the storm drain system. Future land uses must be used for Tc and runoff calculations, and can be determined from the Community Plans.

a. Natural watersheds: Obtain Tc from Figures A.2 and A.3

b. Urban drainage systems: In the case of urban drainage systems, the time of concentration at any point within the drainage area is given by:

   $T_c = T_i + T_t$ where

   T_i is the inlet time or the time required for the storm water to flow to the first inlet in the system. It is the sum of time in overland flow across lots and in the street gutter.

   T_t is the travel time or the time required for the storm water to flow in the storm drain from the most upstream inlet to the point in question.

   Travel Time, T_t is computed by dividing the length of storm drain by the computed flow velocity. Since the velocity normally changes at each inlet because of changes in flow rate or slope, total travel time must be computed as the sum of the travel times for each section of the storm drain.

   The overland flow component of inlet time, T_i, may be estimated by the use of the chart shown in Figure A-4. Use Figure A-5 to estimate time of travel for street gutter flow.

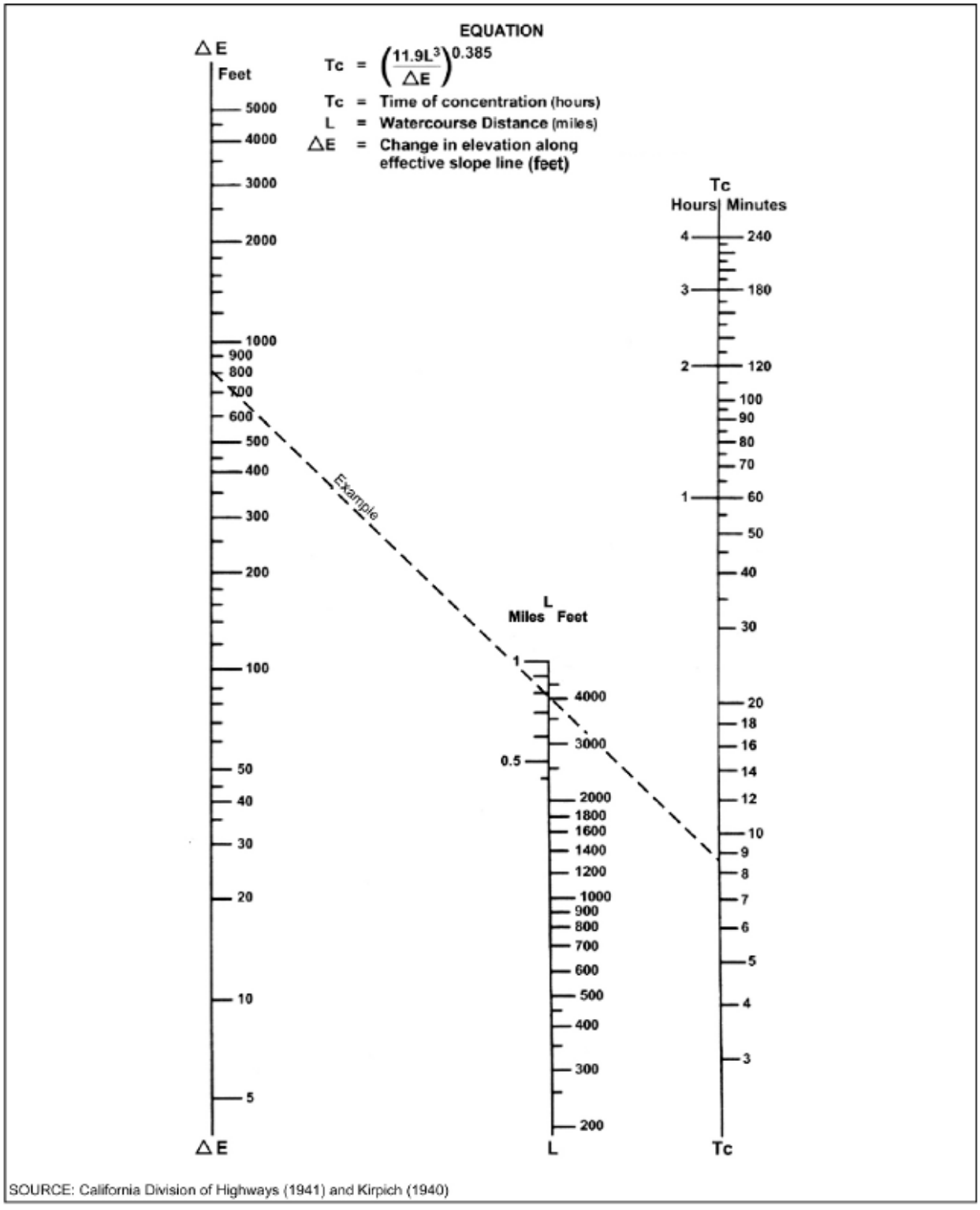


Figure A-2. Nomograph for Determination of T_c for Natural Watersheds

Note: Add ten minutes to the computed time of concentration from Figure A-2.

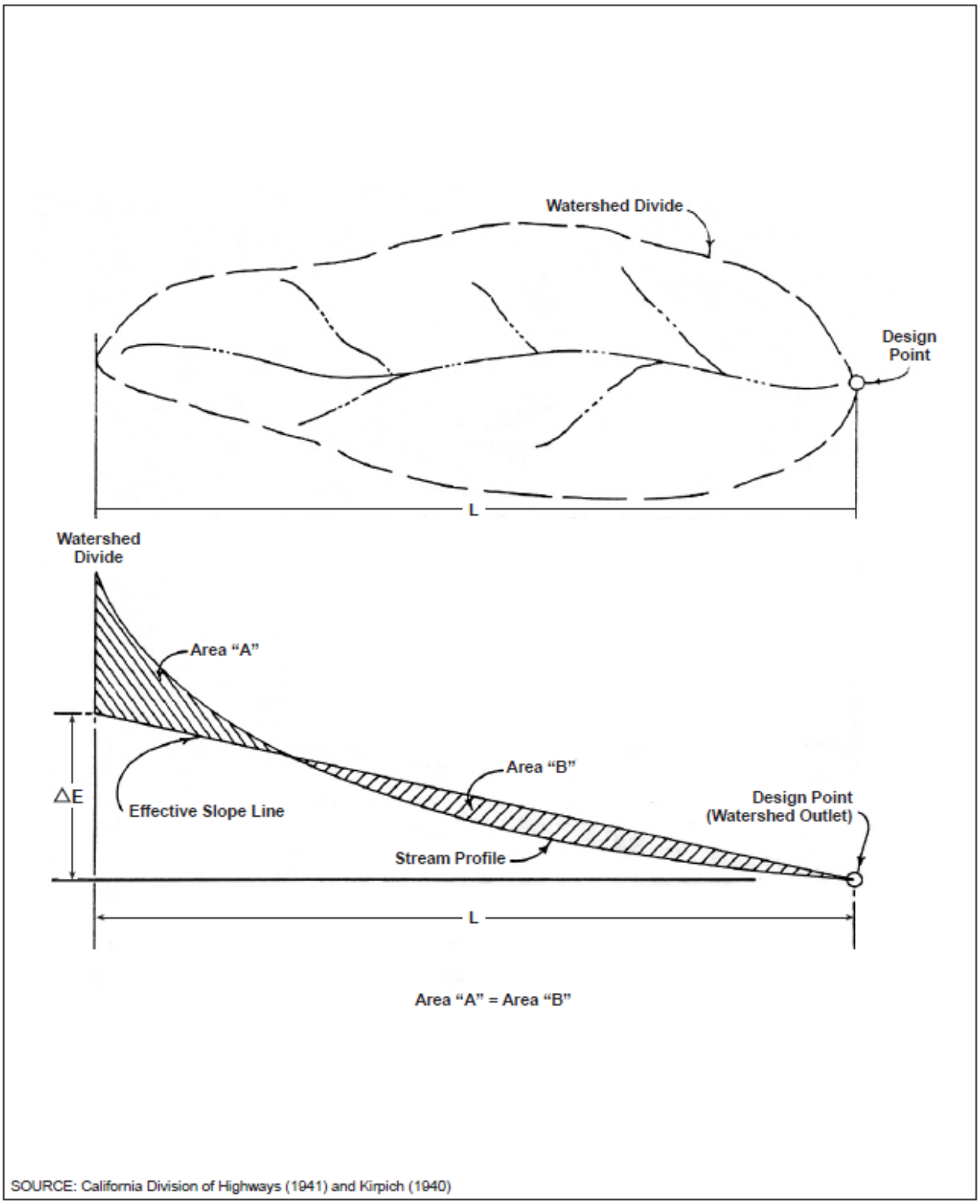


Figure A-3. Computation of Effective Slope for Natural Watersheds

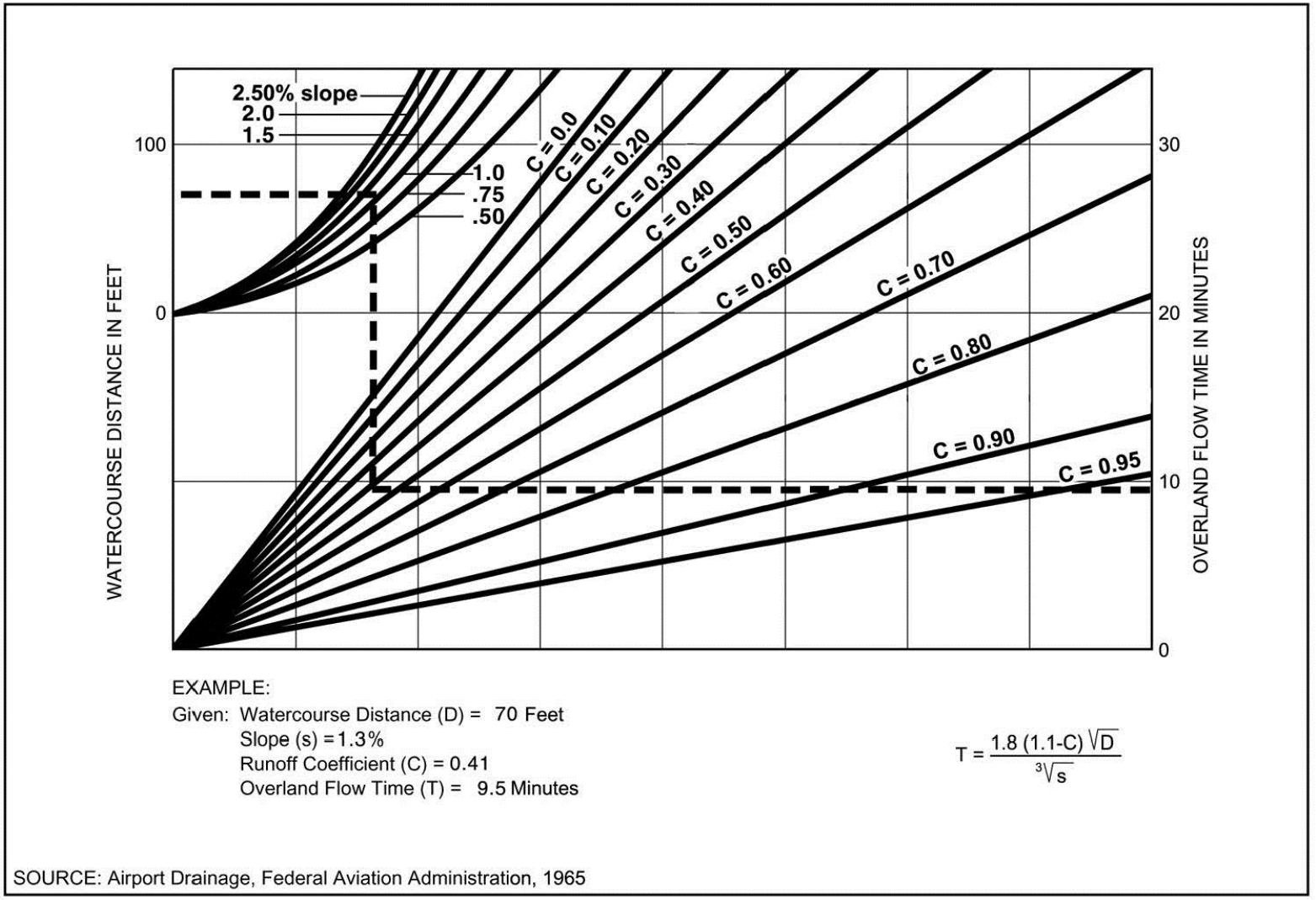


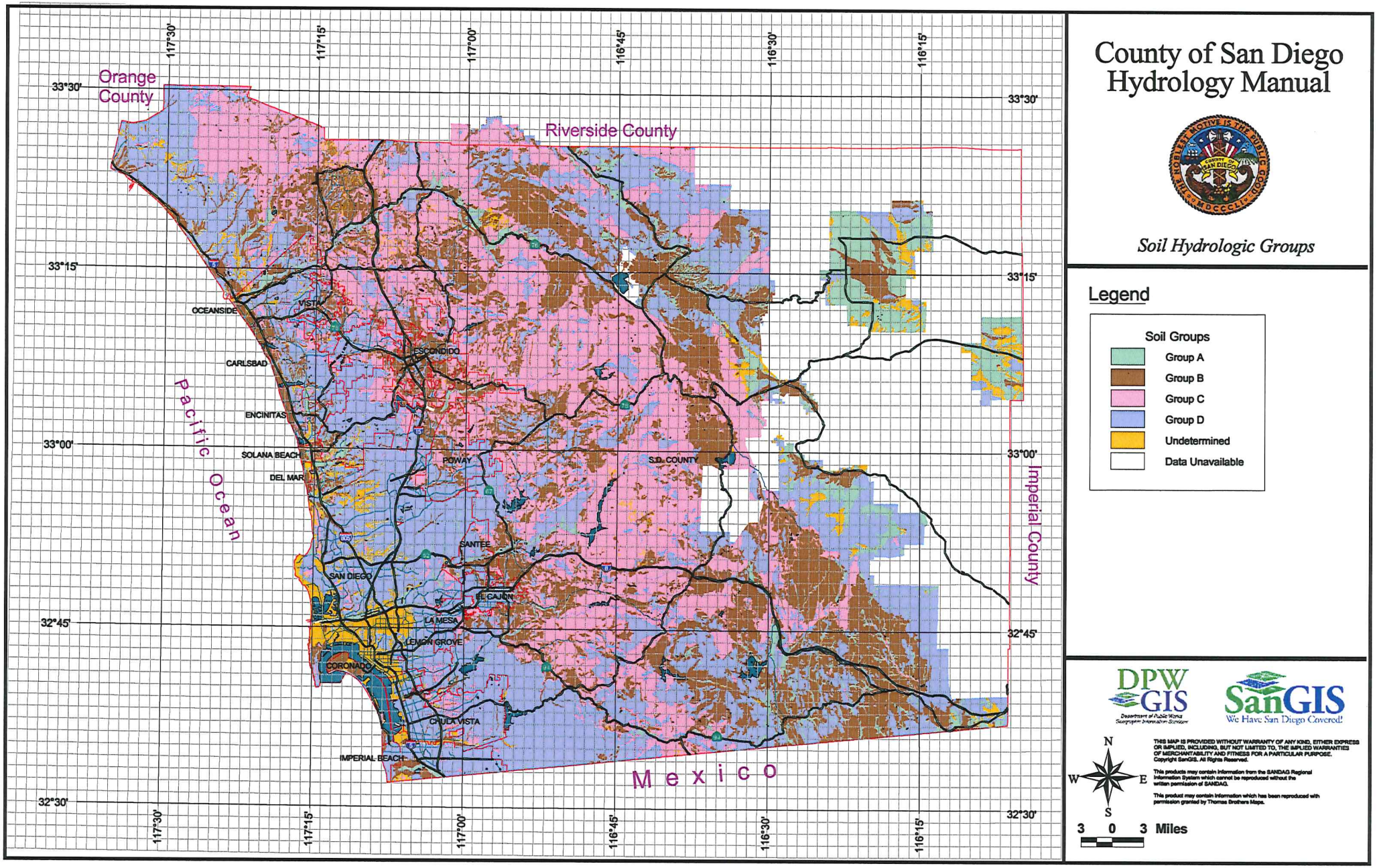
Figure A-4. Rational Formula – Overland Time of Flow Nomograph

Note: Use formula for watercourse distances in excess of 100 feet.

APPENDIX E

COUNTY COUNTY OF SAN DIEGO SOILS

HYDROLOGIC GROUPS



County of San Diego Hydrology Manual

Soil Hydrologic Groups

Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
We Have San Diego Covered!

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W E
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APPENDIX F

CITY OF SAN DIEGO RAINFALL ISOPLUVIALS

MAPS

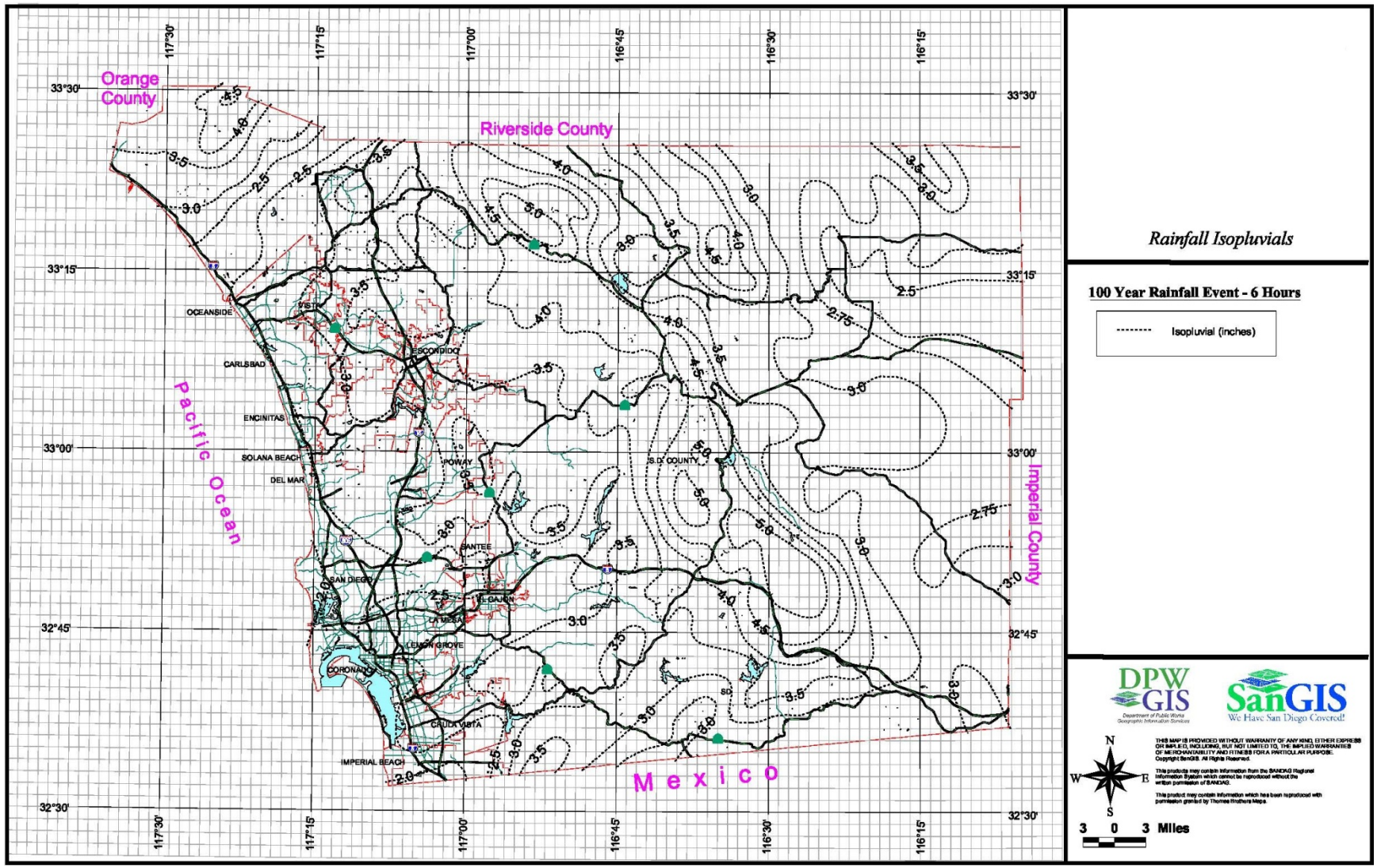


Figure B-2. 100-Year 6-Hour Isopluvials.

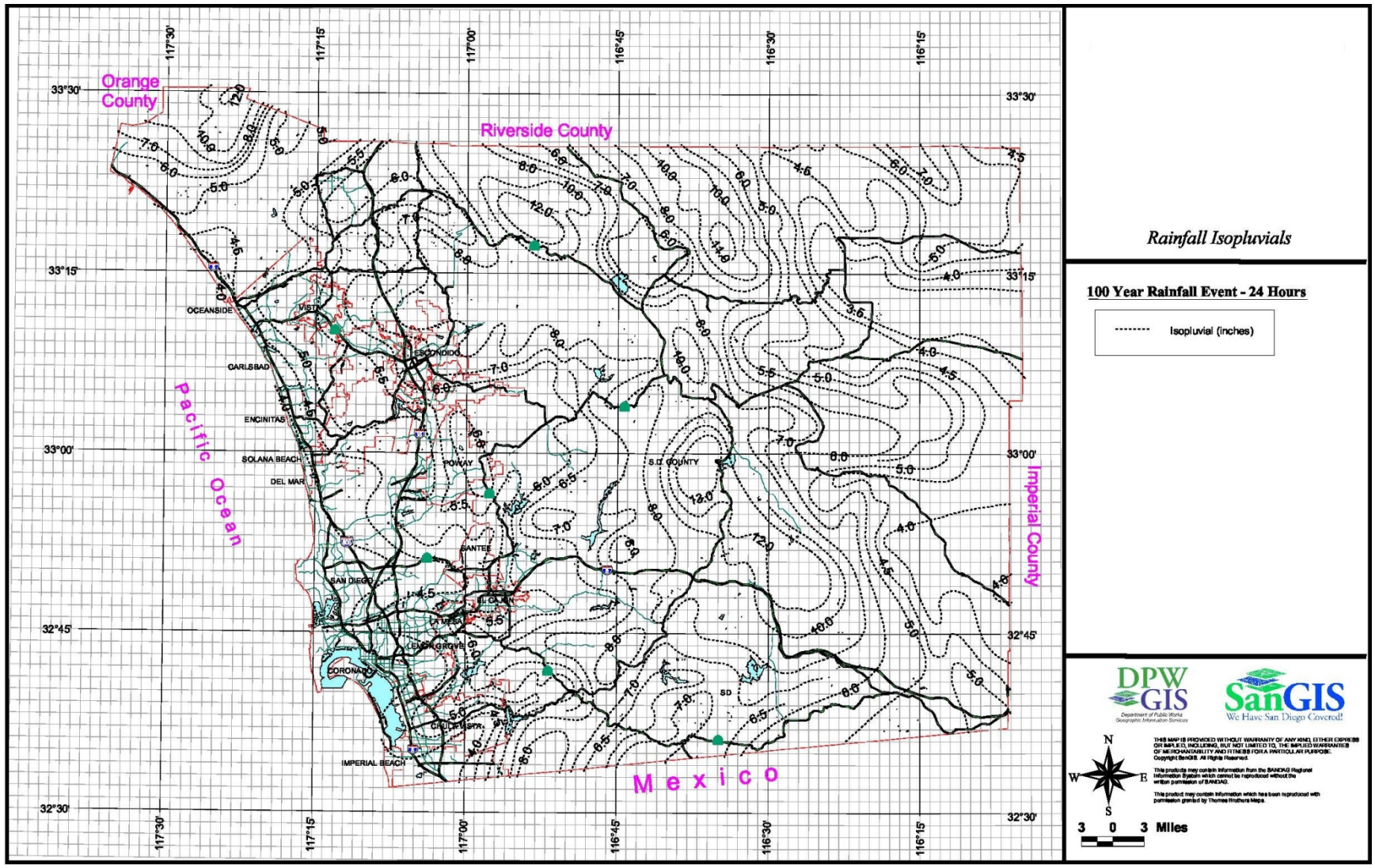


Figure B-3. 100-Year 24-Hour Isopluvials

APPENDIX G

STORM WATER REQUIREMENTS APPLICABILITY CHECKLIST (DS-560)

City of San Diego
Development Services
1222 First Ave., MS-302
San Diego, CA 92101
(619) 446-5000

Storm Water Requirements Applicability Checklist

FORM
DS-560
November 2018

Project Address:	Project Number:

SECTION 1. Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the Storm Water Standards Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP)[1] , which is administered by the State Regional Water Quality Control Board.

For all projects complete PART A: If project is required to submit a SWPPP or WPCP, continue to PART B.

PART A: Determine Construction Phase Storm Water Requirements.

1. Is the project subject to California's statewide General NPDES permit for Storm Water 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 required, skip questions 2-4 ☐ No; next question

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

   ☐ Yes; WPCP required, skip questions 3-4 ☒ No; next question

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

   ☐ Yes; WPCP required, skip question 4 ☒ No; 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, pot holing, curb and gutter replacement, and retaining wall encroachments.

   ☒ Yes; no document required

Check one of the boxes below, and continue to PART B:

☒ If you checked "Yes" for question 1, **a 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 checked "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: www.sandiego.gov/stormwater/regulations/index.shtml

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 continued 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 not located in the ASBS watershed.

b. Projects that qualify as LUP Type 2 or LUP Type 3 per the CGP and 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 not located in an ASBS watershed.

c. WPCP projects (>5,000sf of ground disturbance) located within the Los Penasquitos 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. Permanent Storm Water BMP Requirements.

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

PART C: Determine if Not Subject to Permanent Storm Water Requirements.

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

If "yes" is checked for any number in Part C, proceed to Part F and check "Not Subject to Permanent Storm Water BMP Requirements".

If "no" is checked for all of 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 storm water?	☐ 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 Page 2

PART D: PDP Exempt Requirements.

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

If "yes" was checked for any questions in Part D, continue to Part F and check the box labeled "PDP Exempt."

If "no" was 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 storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;**
   - **Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;**
   - **Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Storm Water Standards manual?**

   ☐ Yes; PDP exempt requirements apply ☒ No; 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 Storm Water Standards Manual?

   ☐ Yes; PDP exempt requirements apply ☒ No; project not exempt.

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 Storm Water 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 drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC 5812), and where the land development creates and/or replace 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 Page 3

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 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 a 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 shops 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.** The project is not covered in the categories above, results in the disturbance of one or more acres of land and is expected to generate pollutants post construction, such as fertilizers and pesticides. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces. ☐ 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 STORM WATER REQUIREMENTS**. ☐
2. The project is a **STANDARD DEVELOPMENT PROJECT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐
3. The project is **PDP EXEMPT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance. ☐
4. The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control, and structural pollutant control BMP requirements apply. See the Storm Water Standards Manual for guidance on determining if project requires a hydromodification plan management ☒

Kenneth Gethers	Project Engineer
Name of Owner or Agent *(Please Print)*	Title
	12/13/2019
Signature	Date

Clear Page 4

Clear Form

Bio Clean

A Forterra Company

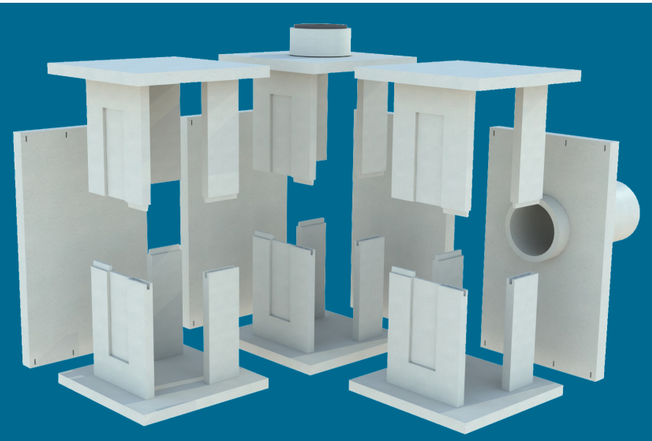
398 Via El Centro
Oceanside, CA 92058
T 760.433.7640
F 760.433.3176
bioclean_info@forterrabp.com
www.biocleanenvironmental.com

Since 1999, Bio Clean™ Environmental has been committed to providing a cleaner environment for generations to come by being the leader in stormwater technologies, solutions, research and customer care.

Ready to Talk About Your Project?
Call 760.433.7640
or email us at bioclean_info@forterrabp.com

Bio Clean's Stormwater Management Solutions

Biofiltration *Media Filters* *Separator Products* *Trash Screens*
Specialty Filters *Catch Basin Filters* *Detention, Retention and Infiltration*



UrbanPond Maintenance

UrbanPond is designed to be easily accessed and maintained from finished surface via access ports.

Modules can be modified to act as clear wells or pre-treatment chambers for capturing trash, debris and sediment to isolate maintenance requirements to only a select few modules.

Designed with multiple access points for easy maintenance. Standard manholes, hinged manholes and other access hatches are available.

UrbanPond Installation

Each module is 8 ft wide by 8 ft long (O.D.) which is the maximum width allowable on a flatbed truck without the requirement of a pilot car.

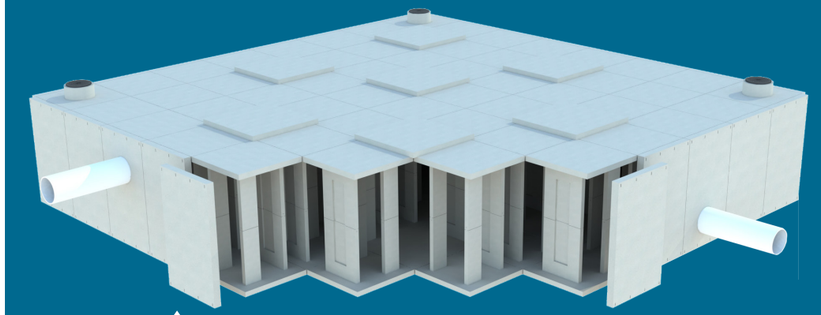
This size maximizes the space on each truck load. A 10 ft Double UrbanPond module (two pieces) weighs only 17,000 lbs total or only 8,500 lbs per piece.

At least 4 individual pieces can be delivered on a single truckload to reduce shipping costs and minimize crane requirements during install.

Most units can be installed using a simple backhoe due to low weights.

UrbanPond can be easily maintained from finished surface with a standard vacuum truck. Access points are provided, strategically, throughout the assembly for easy maintenance.

Go to biocleanenvironmental.com for complete information on UrbanPond sizing, installation, and maintenance details.



STORMWATER DETENTION SOLUTIONS

UrbanPond™

A Breakthrough System for Managing Stormwater Runoff

DETENTION

Bio Clean's UrbanPond (UP) is a technological breakthrough in underground stormwater management.

Its unique square tessellation assembly provides superior strength and material efficiency over traditional rectangular modules. Each module utilizes an offset 3 legged design with two narrow legs running parallel and one wider leg running perpendicular. This unique geometry allows for maximum strength and minimum material usage. The standard design is rated for HS-20 tandem axle live loading.

UrbanPond has high void percentages to maximize stormwater volume and its robust precast form allows systems to be buried deeper without the need for specialized backfill, increased wall thicknesses or extra rebar reinforcement.

UrbanPond is engineered specifically for:

Detention - with controlled discharge utilizing built-in outlet orifice structures

Retention - for long term retention of runoff on site to meet strict stormwater requirements

Harvesting - self-contained treatment, recycling and pumping of runoff for irrigation and grey water needs

Infiltration - capture and infiltration of runoff back into underlying native soils for recharge needs

Treatment - utilize as an underground extended detention basin or pond for advanced treatment of stormwater - integrates well with treatment train components (bio filtration, separation, etc.)

Flood Control - control of peak storm events to minimize downstream flooding and erosion

Low Impact Development - maximize land use with underground storage - construct an urban infill without a pond at grade

Bio Clean

A Forterra Company

UrbanPond Configurations

UrbanPond is a modular precast concrete structure which can be assembled from 1 to several hundred modules in various shapes and configurations to meet site specific constraints and volume requirements.

Each UrbanPond module is 8 ft wide x 8 ft long (O.D.) - specifically designed to fit on a standard flatbed truck.

UrbanPond can be configured in a combination of modules from as low as 2 ft to as high as 14 ft inside height.

Single UrbanPond

The Bio Clean Single UrbanPond module is available in heights from 2 ft to 7 ft

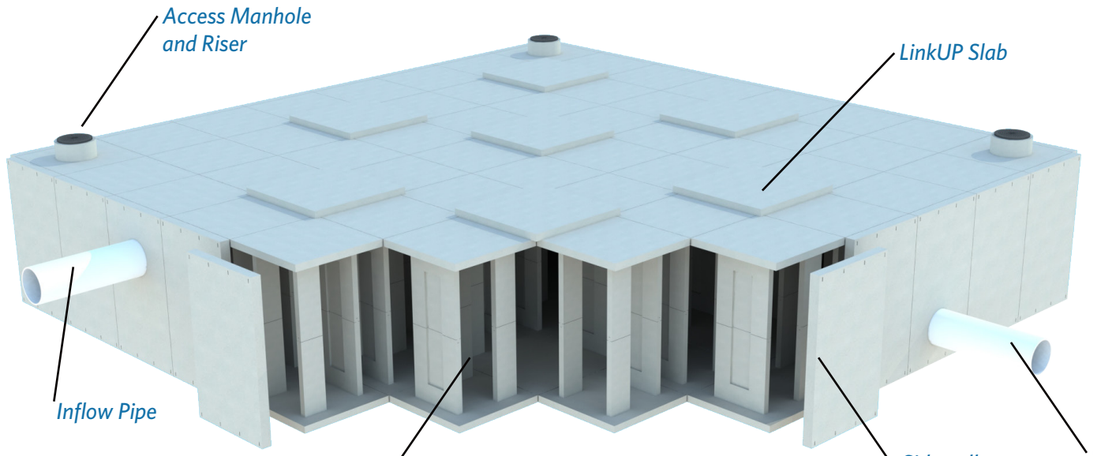
Double UrbanPond

The Bio Clean Double UrbanPond module is available in heights from 4 ft to 14 ft

Optional Infiltration Opening

UrbanPond Advantages

- The square tessellation provides superior strength and load capacity.
- Designed to exceed H20 loading requirements.
- Can be installed deeper without the need to increase wall thickness or add additional rebar.
- Higher void percentages and increased material efficiency for best in class cost per cubic foot storage.
- Lighter weight means it's easier to install.
- Every module drains down fully.
- In 9-module arrays, a linkUP slab allows us to eliminate a module, further decreasing cost and installation time.



LinkUP Slabs span the open cavities in a 9-module array.

Sidewalls easily attach using standard wedge anchors and bolts.

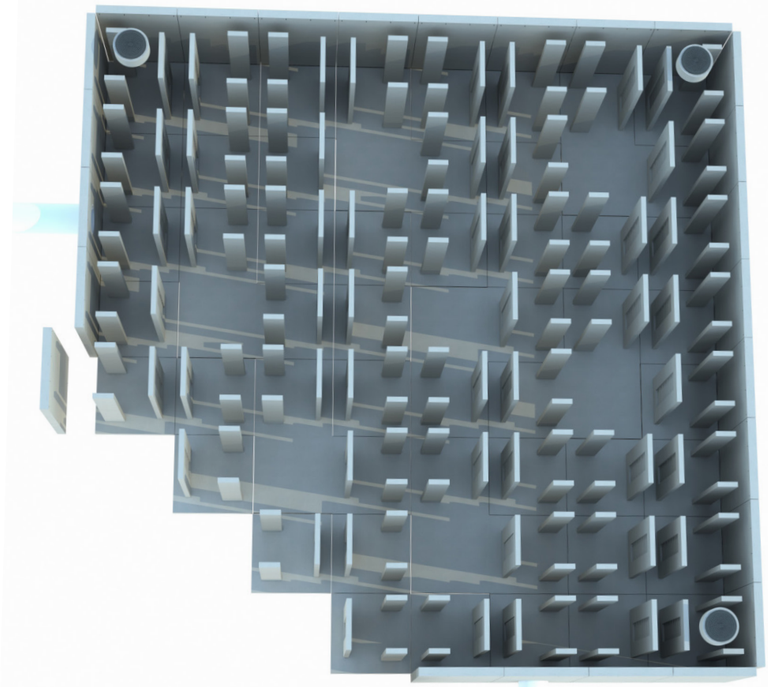
UrbanPond Assembly

The UrbanPond is based on a square tessellation. A tessellation is created when a shape is repeated over and over again covering a plane without any gaps or overlaps. Because of the self-supporting characteristic of tessellated shaped structures, Bio Clean has been able to further reduce material usage and costs up to 20% without sacrificing structural strength.

As shown in the image to the right the offset leg configuration of the modules creates a very open and channel-less internal space.

Each module offers access walkways of greater than 3 ft in each module and between modules for easy inspection and maintenance.

View looking down with top slabs removed



UrbanPond Sizing

UrbanPond is available from heights of 2 ft (I.D.) to up to 14 ft. Single UrbanPond modules are available up to 7 ft height and the Double UrbanPond modules up to 14 ft.

The system's internal offset leg configuration provides channel-less water distribution for stormwater entering and exiting the system.

	I.D. Module Height (ft)	Module Storage Capacity (cu ft)
Single UrbanPond	2	119
	3	179
	4	237
	5	298
	6	358
	7	419
Double UrbanPond	8	479
	9	540
	10	600
	11	661
	12	721
	13	782
	14	842

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.

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Preliminary Geotechnical Evaluation

San Diego Fire-Rescue Air Operations Hangars
Montgomery-Gibbs Executive Airport
San Diego, California

Platt/Whitelaw Architects, Inc.

4034 30th Street | San Diego, California 92104

September 6, 2018 | Project No. 108605001

Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Preliminary Geotechnical Evaluation

San Diego Fire-Rescue Air Operations Hangars
Montgomery-Gibbs Executive Airport
San Diego, California

Ms. Alison Whitelaw
Platt/Whitelaw Architects, Inc.
4034 30th Street | San Diego, California 92104

September 6, 2018 | Project No. 108605001

CERTIFIED ENGINEERING GEOLOGIST
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Principal Engineer

NMM/JTK/KHM/gg

Distribution: (1) Addressee (via e-mail)

CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

In accordance with your request, we have performed a preliminary geotechnical evaluation for the planned San Diego Fire-Rescue Air Operations Hangars project at the Montgomery-Gibbs Executive Airport located at 3750 John J. Montgomery Drive in San Diego, California (Figure 1). This report presents the results of our field explorations and laboratory testing as well as our conclusions regarding the geotechnical conditions at the site and our preliminary recommendations for use in project bridging documents and technical representation. We understand that design-build services, which will include additional subsurface evaluation, will be performed at a later date.

2 SCOPE OF SERVICES

Our scope of services for this evaluation included the following:

- Reviewing readily available published and in-house geotechnical literature including a previous geotechnical report for the adjacent Taxiway C (Ninyo & Moore, 2011a), topographic maps, geologic and geologic hazard maps, fault maps, flood zone maps, and stereoscopic aerial photographs.

- Performing a field reconnaissance to observe site conditions and to mark the locations of the exploratory borings.

- Notifying Underground Service Alert (USA) to clear excavation locations for the potential presence of underground utilities. In addition, a private utility locating company was used to clear the locations for the potential presence of underground utilities.

- Performing a subsurface exploration program consisting of the drilling, logging, and sampling of eight exploratory borings (B-1 through B-4 and IT-1 through IT-4). Relatively undisturbed drive and bulk soil samples of the materials encountered were collected at selected intervals from the borings and transported to our in-house geotechnical laboratory for testing.

- Performing infiltration tests in four of our borings to evaluate the infiltration rates of the underlying soils.

- Performing geotechnical laboratory testing of representative soil samples to evaluate soil characteristics and parameters for design purposes.

- Compiling and performing an engineering analysis of the information obtained from our background review, subsurface exploration, and laboratory testing.

- Preparing this geotechnical report presenting our preliminary findings, conclusions, and geotechnical recommendations for use in bridging documents for the eventual design and building of this project.

3 SITE AND PROJECT DESCRIPTION

The site is located within the Montgomery-Gibbs Executive Airport located at 3950 John J. Montgomery Drive in San Diego, California (Figure 1). The airport consists of three runways and various taxiways, buildings, and hangars. Other improvements include an air traffic control tower, a concrete helipad, and an operations building located in the northeast portion of the airport. An access road connects this area with Ponderosa Avenue to the northeast (Figure 2). The airport property is relatively level and elevations generally range from approximately 410 feet above mean sea level (MSL) in the southwestern portion of the site to approximately 425 feet above MSL in the eastern portion.

Based on our review of project information, including scoping documents and a project Feasibility Study (Atkins, 2017), as well as discussions with your office, we understand that the project will include the construction of new hangars and associated improvements in the vicinity of the existing operations building. Specifically, the project includes two new helicopter hangars, a concrete apron, a support building, a fueling station, parking areas, and a concrete helipad extension (Figure 2). In addition, the access road to Ponderosa Avenue will be improved and biofiltration basins may be constructed.

4 SUBSURFACE EXPLORATION

Our subsurface exploration was conducted on August 16 and August 17, 2018 and included the drilling, logging, and sampling of eight small-diameter borings (B-1 through B-4 and IT-1 through IT-4). Borings IT-1 through IT-4 were also used for infiltration testing. Prior to commencing the subsurface exploration, the locations were cleared of underground utilities of Underground Service Alert. In addition, a private utility locator was retained to locate existing utilities in the area of our exploratory borings. The purpose of the borings was to evaluate subsurface conditions and to collect soil samples for laboratory testing.

The borings were drilled to depths up to approximately 15 feet using manual equipment and a truck-mounted drill rig equipped with 8-inch diameter, continuous-flight, hollow-stem augers. Drilling refusal was encountered in three of our eight borings (B-1 through B-3). Ninyo & Moore personnel logged the borings in general accordance with the Unified Soil Classification System (USCS) by observing cuttings and drive samples. Representative bulk and in-place soil samples were collected at selected depths from within the exploratory borings and transported to our in-house geotechnical laboratory for analysis. The approximate locations of the borings are presented on Figure 2. The boring logs are presented in Appendix A.

Ninyo & Moore previously performed subsurface explorations within the Montgomery-Gibbs Executive Airport property for geotechnical evaluations associated with various runway and taxiway projects (Ninyo & Moore, 2004; 2008; 2011a; and 2011b). Information related to those evaluations are incorporated herein, as appropriate.

5 LABORATORY TESTING

Geotechnical laboratory testing was performed on representative soil samples collected during our subsurface exploration. This testing included an evaluation of in-situ moisture content, gradation, expansion index, soil corrosivity, and R-value. The results of the in-situ moisture content tests are presented at the corresponding depths on the boring logs in Appendix A. Descriptions of the geotechnical laboratory test methods and the results of the other geotechnical laboratory tests performed are presented in Appendix B.

6 INFILTRATION TESTING

Field infiltration testing was performed on August 16 and August 17, 2018 at locations selected by the project Civil Engineer. The infiltration test holes (IT-1 through IT-4) were excavated with a truck-mounted drill rig to depths of approximately 5 feet at the locations shown on Figure 2. The infiltration tests were performed in general accordance with the City of San Diego BMP Design Manual (2018). Approximately 2 inches of gravel was placed on the bottom of each prepared boring. A 2-inch diameter, perforated PVC pipe was installed in the boring and the annulus was then backfilled with pea gravel. As part of the test procedure, presoaking of each hole was performed on August 16, 2018 to represent adverse conditions for infiltration. The presoak consisted of maintaining approximately 1 foot of water in each boring for approximately 4 hours. The water level was then allowed to drop overnight. Infiltration testing was then performed in the presoaked test borings on August 17, 2018. Measurements of the water depth after infiltration were recorded approximately every thirty minutes. As necessary, the borings were refilled to maintain the water level until the infiltration rate stabilized.

Infiltration rates were calculated using the Porchet method. Based on the City of San Diego BMP Design Manual (2018), infiltration rates greater than 0.05 inches per hour and less than 0.5 inches per hour may be suitable for partial infiltration. Infiltration rates of 0.5 inches per hour or greater per hour may be considered suitable for full infiltration design. Infiltration rates less than 0.05 inches per hour are considered a no infiltration condition.

Our in-situ infiltration testing indicated that the water level within IT-1, IT-2, IT-3, and IT-4 generally remained constant over the 30 minute testing intervals and did not infiltrate. Accordingly, infiltration within the subsurface materials at IT-1, IT-2, IT-3, and IT-4 is not considered feasible. Based on the results of our infiltration testing, we recommend lining the sides of biofiltration basins with an impermeable liner or other hydraulic restricted layer. Infiltration test results and calculations are included in Appendix C. A completed Worksheet C.4-1: Categorization of Infiltration Feasibility Condition Based on Geotechnical Conditions with the appropriate geotechnical aspects is presented in Appendix C. Recommendations for placement, design, and construction of permanent stormwater BMPs are presented in Section 10.8 of this report.

Other areas of the site not specifically tested may or may not accommodate partial infiltration of storm water. Additional infiltration testing would be needed in these other areas to evaluate whether infiltration in these areas/depths are feasible. It is noted that the soils underlying the site are mapped by the Natural Resources Conservation Service (NCRS, 2018) as belonging to Hydrologic Soil Group D, which typically exhibits very slow infiltration rates. In addition, seasonal vernal pools, which are ephemeral pools of standing water, are present in the site vicinity. Based on these conditions, we anticipate that other areas of the site will also possess poor infiltration characteristics.

7 GEOLOGY AND SUBSURFACE CONDITIONS

Our findings regarding regional and site geology at the project location are provided in the following sections.

7.1 Regional Geologic Setting

The project area is situated in the coastal foothill section of the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California (Norris and Webb, 1990; Harden, 2004). The province varies in width from approximately 30 to 100 miles. In general, the province consists of rugged mountains underlain by Jurassic metavolcanic and metasedimentary rocks, and Cretaceous igneous rocks of the southern California batholith.

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest. Several of these faults, which are shown on Figure 3, are considered active faults. The Elsinore, San Jacinto, and San Andreas faults are active fault systems located

northeast of the project area and the Rose Canyon, Coronado Bank, San Diego Trough, and San Clemente faults are active faults located west of the project area. The Rose Canyon Fault Zone, the nearest active fault system, has been mapped approximately 4½ miles west of the project site. Major tectonic activity associated with these and other faults within this regional tectonic framework consists primarily of right-lateral, strike-slip movement. Further discussion of faulting relative to the site is provided in the Faulting and Seismicity section of this report.

7.2 Site Geology

Geologic units encountered during our field reconnaissance and subsurface exploration included fill, topsoils, and very old paralic deposits. Generalized descriptions of the earth units encountered during our subsurface exploration are provided below. The geology of the site vicinity is shown on Figure 4. Additional descriptions are provided on the boring logs in Appendix A.

7.2.1 Pavement Sections

Our exploratory borings B-1, IT-3, and IT-4 encountered pavement sections that consisted of asphalt concrete (AC) and aggregate base material underlain by fill materials and very old paralic deposits. Table 1 below summarizes the pavement sections as encountered in our borings.

Table 1 – Encountered Pavement Sections

Boring	AC thickness (inches)	Base Thickness (inches)
B-1	3½	3
IT-3	2½	3½
IT-4	2½	9½

7.2.2 Fill

Fill materials were encountered at the ground surface or underlying the pavement sections in borings B-1, B-4, and IT-3 to depths of up to 4 feet. Refusal was encountered in the fill material within B-1. As encountered, the fill soils generally consisted of brown and reddish brown, moist, loose to medium dense, clayey sand, and stiff, sandy clay. Gravel and cobbles were encountered within the fill materials. Documentation regarding placement of these fills was not available for review.

7.2.3 Topsoil

Topsoil was encountered at the ground surface in borings B-2, B-3, IT-1, and IT-2. In our borings, the topsoil was relatively thin and generally one-foot in thickness or less. As encountered, the topsoil materials generally consisted of brown, dry to moist, loose to medium dense, silty sand with roots.

7.2.4 Very Old Paralic Deposits

Materials of the middle to early Pleistocene-aged very old paralic deposits are mapped at the site (Figure 4; Kennedy and Tan, 2008), previously designated as the Lindavista Formation (Kennedy, 1975), and were encountered in borings B-2 through B-4 and IT-1 through IT-4 underlying the pavements, fill, and topsoil and extending to the total depths explored. As encountered, these materials generally consisted of reddish brown, olive brown, grayish brown, and gray, dry to moist, moderately to strongly cemented, silty and clayey sandstone. Cobbles were also encountered in the very old paralic deposits and drilling refusal within the very old paralic deposits occurred in three of our borings (B-1, B-2, and B-3).

7.3 Groundwater

Groundwater was not encountered in our exploratory borings. According to our review of readily available data from the Geotracker (2018) website, groundwater is anticipated at depths greater than 50 feet. Six borings were drilled to depths ranging from approximately 20 to 50 feet below the ground surface as part of an assessment by SCS Engineers (2008) of a former underground storage tank located approximately 15 feet west of the existing air traffic control tower. The assessment report by SCS (2008) indicated that the borings, which were drilled at roughly the same elevation as those performed in our evaluation, did not encounter groundwater. Existing utility trench lines may act as conduits for perched water conditions and seepage may be anticipated. Fluctuations in the groundwater level and perched conditions may occur due to variations in ground surface topography, subsurface geologic conditions and structure, rainfall, irrigation, and other factors. While surface water was not observed at the site during our exploration activities, seasonal vernal pools, which are ephemeral pools of standing water, are present in the site vicinity.

8 GEOLOGIC HAZARDS

In general, hazards associated with seismic activity include strong ground motion, ground surface rupture, and liquefaction. These considerations and other geologic hazards, such as landsliding and flooding, are discussed in the following section.

8.1 Faulting and Seismicity

Based on our review of the referenced geologic maps and stereoscopic aerial photographs, as well as on our geologic field mapping, the subject site is not underlain by known active or potentially active faults (i.e., faults that exhibit evidence of ground displacement in the last 11,000 years and 2,000,000 years, respectively). However, like the majority of southern California, the site is located in a seismically active area and the potential for strong ground motion is considered significant during the design life of the proposed structures. The nearest known active fault is the Rose Canyon fault, located approximately 4½ miles west of the site. Table 2 lists selected principal known active faults that may affect the subject site, including the approximate fault-to-site distances, and the maximum moment magnitudes (Mmax) as published by the USGS (2018a).

Table 2 – Principal Active Faults

Fault	Approximate Fault-to-Site Distance miles (kilometers)	Maximum Moment Magnitude (Mmax)
Rose Canyon	4.5 (7.3)	6.9
Coronado Bank	18 (29)	7.4
Newport-Inglewood (Offshore)	29 (47)	7.0
Elsinore (Julian Segment)	36 (57)	7.4
Elsinore (Temecula Segment)	37 (59)	7.1
Earthquake Valley	40 (65)	6.8
Elsinore (Coyote Mountain)	48 (77)	6.9

In general, hazards associated with seismic activity include surface ground rupture, strong ground motion, and liquefaction. A brief description of these hazards and the potential for their occurrences on site are discussed below.

8.2 Surface Ground Rupture

Based on our review of the referenced literature and our field evaluation, no active faults are known to cross the project vicinity. Therefore, the potential for ground rupture due to faulting at the project site is considered low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

8.3 Strong Ground Motion

The 2016 California Building Code (CBC) specifies that the Risk-Targeted, Maximum Considered Earthquake (MCE_R) ground motion response accelerations be used to evaluate seismic loads for design of buildings and other structures. The MCE_R ground motion response accelerations are based on the spectral response accelerations for 5 percent damping in the direction of maximum horizontal response and incorporate a target risk for structural collapse equivalent to 1 percent in 50 years with deterministic limits for near-source effects. The horizontal peak ground acceleration (PGA) that corresponds to the MCE_R for the segments was calculated as 0.44g using the United States Geological Survey (USGS, 2018b) seismic design tool (web-based).

The 2016 CBC specifies that the potential for liquefaction and soil strength loss be evaluated, where applicable, for the Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration with adjustment for site class effects in accordance with the American Society of Civil Engineers (ASCE) 7-10 Standard. The MCE_G peak ground acceleration is based on the geometric mean peak ground acceleration with a 2 percent probability of exceedance in 50 years. The MCE_G peak ground acceleration with adjustment for site class effects (PGA_M) was calculated as 0.45g using the USGS (USGS, 2018b) seismic design tool that yielded a mapped MCE_G peak ground acceleration of 0.414g for the site and a site coefficient (F_{PGA}) of 1.086 for Site Class D.

8.4 Liquefaction

Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by a relatively shallow groundwater table are susceptible to liquefaction. Based on the relatively dense nature of the very old paralic deposits encountered in our borings, it is our opinion that the potential for liquefaction to occur at the site is not a design consideration.

8.5 Geologic Hazard Map

Per the City of San Diego's Seismic Safety Study (2008), the project site is located within an area designated as Category 51, which is described as "Level mesas, underlain by terrace deposits and bedrock, nominal risk." A portion of the Seismic Safety Study map that includes the site and vicinity is presented in Figure 5.

8.6 Landslides

Our review of referenced geologic maps, literature, topographic maps, and stereoscopic aerial photographs, no landslides or indications of deep-seated landsliding underlie the subject site (Kennedy and Tan, 2008; Tan, 1995). In addition, no indications of landsliding were observed during our site reconnaissance or subsurface exploration. As such, the potential for significant large-scale slope instability at the site is not a design consideration.

8.7 Flood Hazards

Based on review of the Federal Emergency Management Agency Flood Insurance Rate Maps (FIRM), flood hazard mapping has not been published at the project site. Based on our review of maps indicating the presence of vernal pools on the site (Atkins, 2017), seasonal flooding may be anticipated.

9 CONCLUSIONS

Based on our review of the referenced background data, the subsurface exploration, and geotechnical laboratory testing, it is our opinion that construction of the proposed project is feasible from a geotechnical standpoint provided the recommendations presented in this report are incorporated into subsequent evaluations for the design and construction of the project. In general, the following conclusions were made:

- The project site is generally underlain by fill, topsoil, and very old paralic deposits. The existing fill and topsoil are not considered suitable for structural support in their current condition. The very old paralic deposits encountered at the site are considered suitable for structural support.

- Groundwater was not encountered during our subsurface exploration that included borings that extended to a depth of approximately 15 feet. Perched conditions and fluctuations in groundwater may occur due to variations in ground surface topography, subsurface geologic structure, rainfall, irrigation, and other factors.

- Gravel and cobble were encountered in the very old paralic deposits and drilling refusal within the very old paralic deposits occurred in two of our borings (B-2 and B-3). Accordingly, the contractor for site development should anticipate encountering difficult excavation conditions that may require additional efforts including heavy ripping and/or coring for drilling operations.

- Soils derived from on-site excavations are anticipated to generate gravel, cobbles, and oversize pieces of cemented sandstone. On-site soils may be suitable for reuse as engineered fill, provided they are processed in accordance with the following recommendations. Additional processing and handling of materials including screening and/or crushing should be anticipated.

- The closest known active fault, the Rose Canyon fault, has been mapped approximately 4½ miles west of the site. No active faults are reported underlying the subject site. Therefore, potential for ground rupture due to faulting at the site is considered low.

- Field infiltration testing indicated that infiltration within the subsurface materials is not feasible. Recommendations for placement, design, and construction of permanent stormwater BMPs are presented herein.

- Results of our geotechnical laboratory testing indicate that the upper soils at the site possess a very low expansion potential. However, variability of onsite soils should be anticipated as soils possessing medium and high expansion potential were encountered in a previous evaluation for Taxiway C, located northwest of the project site (Ninyo & Moore, 2011a).

- Based on the results of our limited geotechnical laboratory testing presented in Appendix B, as compared to the Caltrans (2018) corrosion guidelines, the on-site soils would be classified as corrosive

- Additional evaluation should be performed by the design-build team.

10 PRELIMINARY RECOMMENDATIONS

The following preliminary recommendations are provided for the design and construction of the proposed project. These preliminary recommendations are based on our evaluation of the site geotechnical conditions and our assumptions regarding the planned development. Subsequent evaluations and the proposed construction should be performed in accordance with the requirements of applicable governing agencies including the Federal Aviation Administration (FAA) and the San Diego County Regional Airport Authority. As noted previously, our preliminary recommendations are intended for use in project bridging documents and technical representation. We understand that design-build services, which will include additional subsurface evaluation, will be performed at a later date.

10.1 Earthwork

In general, earthwork should be performed in accordance with the preliminary recommendations presented in this report.

10.1.1 Site Preparation

Site preparation should begin with the removal of existing improvements, vegetation, utility lines, asphalt, concrete, and other deleterious debris from areas to be graded. Tree stumps and roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside of the proposed excavation and fill areas. The debris and unsuitable material generated during clearing and grubbing should

be removed from areas to be graded and disposed of at a legal dumpsite away from the project area, unless noted otherwise in the following sections.

10.1.2 Excavation Characteristics

The results of our background review and field exploration program indicate that the project site is underlain by fill, topsoils, and very old paralic deposits. Excavation of the on-site materials should be should be generally achievable with heavy-duty earth moving equipment in good working condition. However, as noted, drilling refusal was encountered in three of our borings. Due to the presence of cobbles and possible strongly cemented zones within the very old paralic deposits, some areas may require heavy ripping or mechanical rock breaking equipment. Excavations may generate oversized material and additional processing and handling of these materials, including screening and/or crushing, should be anticipated.

10.1.3 Remedial Grading for Structures

In order to provide suitable support for proposed settlement-sensitive structures, including the proposed hangars and building, we recommend that the existing undocumented fill soils within the limits of the structures be removed to competent very old paralic deposits. Based on the subsurface information in our exploratory borings within the building areas, the existing fill is anticipated to extend to depths of up to 4 feet within the project limits. However, the depth of removals may be deeper and should be evaluated in the field to confirm that existing fills have been removed. The removed materials may be processed and replaced as compacted fill. The lateral extent of these removals should be approximately 5 feet outside the limits of proposed settlement-sensitive structures, including foundations for attached overhangs, canopies, and other building appurtenances.

Subsequent to removal, the resulting surface should be scarified to a depth of approximately 6 inches, moisture conditioned, and recompacted to a relative compaction of 90 percent as evaluated by the ASTM D 1557 prior to placing new fill. Once the resulting removal surface has been recompacted, the overexcavation should be backfilled with generally granular soils that possess a very low to low expansion potential (i.e., an expansion index [EI] less than 50).

10.1.4 Temporary Excavations

For temporary excavations, we recommend that the following Occupational Safety and Health Administration (OSHA) soil classifications be used:

Fill and Topsoil	*Type C*
Very Old Paralic Deposits	*Type B*

Upon making the excavations, the soil classifications and excavation performance should be evaluated in the field by the geotechnical consultant in accordance with the OSHA regulations. Temporary excavations should be constructed in accordance with OSHA recommendations. For trenches or other excavations, OSHA requirements regarding personnel safety should be met using appropriate shoring (including trench boxes) or by laying back the slopes to no steeper than 1.5:1 (horizontal to vertical) in fill and topsoil and 1:1 for very old paralic deposits. Temporary excavations that encounter seepage may be shored or stabilized by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis. On-site safety of personnel is the responsibility of the contractor.

10.1.5 Materials For Fill

Soils derived from on-site excavations are anticipated to generate gravel, cobbles, and oversize pieces of cemented sandstone. On-site soils may be suitable for reuse as engineered fill, provided they are processed in accordance with the following recommendations. Additional processing and handling of materials including screening and/or crushing should be anticipated. Engineered fill soils should possess an organic content of less than approximately 3 percent by volume (or 1 percent by weight). In general, engineered fill material should not contain rocks or lumps over approximately 3 inches in diameter, and not more than approximately 30 percent larger than ¾ inch. Oversize materials should be separated from material to be used for fill and removed from the site.

Imported fill material, if needed, should generally be granular soils with a very low to low expansion potential (i.e., an expansion index [EI] of 50 or less). Import material should also be non-corrosive in accordance with the Caltrans (2018) corrosion guidelines. Based on the Caltrans (2018) criteria, soil is classified as corrosive if one or more of the following conditions exist: chloride concentration of 500 ppm or greater, soluble sulfate concentration of 1,500 ppm or greater, an electrical resistivity of 1,100 ohm-centimeters or less, and a pH 5.5 or less. Materials for use as fill should be evaluated prior to filling or importing.

10.1.6 Compacted Fill

Prior to placement of compacted fill, the contractor should request an evaluation of the exposed ground surface by Ninyo & Moore. Unless otherwise recommended, the exposed ground surface should then be scarified to a depth of approximately 6 inches and watered

or dried, as needed, to achieve moisture contents generally at or slightly above the optimum moisture content. The scarified materials should then be compacted to a relative compaction of 90 percent as evaluated in accordance with the ASTM D 1557. The evaluation of compaction by the geotechnical consultant should not be considered to preclude any requirements for observation or approval by governing agencies. It is the contractor's responsibility to notify this office and the appropriate governing agency when project areas are ready for observation, and to provide reasonable time for that review.

Fill materials should be moisture conditioned to generally at or slightly above the laboratory optimum moisture content prior to placement. The optimum moisture content will vary with material type and other factors. Moisture conditioning of fill soils should be generally consistent within the soil mass.

Prior to placement of additional compacted fill material following a delay in the grading operations, the exposed surface of previously compacted fill should be prepared to receive fill. Preparation may include scarification, moisture conditioning, and recompaction.

Compacted fill should be placed in horizontal lifts of approximately 8 inches in loose thickness. Prior to compaction, each lift should be watered or dried as needed to achieve a moisture content generally at or slightly above the laboratory optimum, mixed, and then compacted by mechanical methods to a relative compaction of 90 percent as evaluated by ASTM D 1557. The upper 12 inches of the subgrade materials beneath vehicular pavements should be compacted to a relative compaction of 95 percent relative density as evaluated by ASTM D 1557. Successive lifts should be treated in a like manner until the desired finished grades are achieved. Where planned under airport pavements, fill should be placed per FAA guidelines.

10.1.7 Drainage

Roof, pad, and slope drainage should be conveyed such that runoff water is diverted away from slopes and structures to suitable discharge areas by nonerodible devices (e.g., gutters, downspouts, concrete swales, etc.). Positive drainage adjacent to structures should be established and maintained. Positive drainage may be accomplished by providing drainage away from the foundations of the structure at a gradient of 2 percent or steeper for a distance of 5 feet or more outside building perimeters, and further maintained by a graded swale leading to an appropriate outlet, in accordance with the recommendations of the project civil engineer and/or landscape architect.

Surface drainage on the site should be provided so that water is not permitted to pond. A gradient of 2 percent or steeper should be maintained over the pad area and drainage patterns should be established to divert and remove water from the site to appropriate outlets.

Care should be taken by the contractor during grading to preserve any berms, drainage terraces, interceptor swales or other drainage devices of a permanent nature on or adjacent to the property. Drainage patterns established at the time of grading should be maintained for the life of the project. The property owner and the maintenance personnel should be made aware that altering drainage patterns might be detrimental to foundation performance.

10.2 Seismic Design Parameters

Design of the proposed improvements should be performed in accordance with the requirements of governing jurisdictions and applicable building codes. Table 3 presents the seismic design parameters for the site in accordance with the CBC (2016) guidelines and adjusted MCE spectral response acceleration parameters (USGS, 2018b).

Table 3 – 2016 California Building Code Seismic Design Criteria

Seismic Design Factors	Values
Site Class	D
Site Coefficient, F_a	1.098
Site Coefficient, F_v	1.631
Mapped Spectral Acceleration at 0.2-second Period, S_s	1.004g
Mapped Spectral Acceleration at 1.0-second Period, S_1	0.385g
Spectral Acceleration at 0.2-second Period Adjusted for Site Class, S_{MS}	1.103g
Spectral Acceleration at 1.0-second Period Adjusted for Site Class, S_{M1}	0.627g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0.735g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.418g

10.3 Foundations

Based on our understanding of the proposed structures, we are providing the following recommendations. The proposed hangars and building may be supported on shallow, continuous and/or spread footings bearing on compacted fill or very old paralic deposits. Foundations should be designed in accordance with structural considerations and the following recommendations. In addition, requirements of the appropriate governing jurisdictions and applicable building codes should be considered in the design of the structures.

10.3.1 Bearing Capacity

Shallow, spread or continuous footings supported on compacted fill or competent very old paralic deposits may be designed using an allowable bearing capacity of 3,000 pounds per square foot (psf). These allowable bearing capacities may be increased by one-third when considering loads of short duration such as wind or seismic forces. Footings should be designed and reinforced in accordance with the recommendations of the project structural engineer.

10.3.2 Lateral Resistance

For resistance to lateral loads when footings are supported in compacted fill or competent very old paralic deposits, we recommend an allowable passive pressure of 350 pounds per cubic foot (pcf) be used with an upper bound value of up to 3,500 psf. This value assumes that the ground is horizontal for a distance of 10 feet, or three times the height generating the passive pressure, whichever is more. We recommend that the upper 1 foot of soil not protected by pavement or a concrete slab be neglected when calculating passive resistance.

For frictional resistance to lateral loads, we recommend a coefficient of friction of 0.35 be used between soil and concrete. The lateral resistance values presented above may be increased by one-third when considering loads of short duration such as wind or seismic forces.

10.4 Pavements

Based on the results of our previous evaluations at Montgomery-Gibbs Executive Airport (Ninyo & Moore, 2004, 2008, 2011a, and 2011b), site soils have been classified as “cohesive” based on FAA guidelines. Laboratory testing performed as part of these previous evaluations indicated California Bearing Ratio (CBR) values at the site generally range from 3 to 14 for pavement subgrade with a relative compaction of 95 percent. CBR values were not assessed within the project limits during this evaluation. CBR values should be evaluated during design-build services in accordance with applicable FAA specifications.

10.5 Preliminary Access Road Pavement Design

Our laboratory testing indicated the site soils along the access road to Ponderosa Avenue possess an R-value of 13. Accordingly, we have used a design R-value of 13 and Traffic Indices (TI) of 6 and 7 for the basis of preliminary design of flexible pavements for the access road. However, actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils exposed at the finished subgrade elevations following grading operations. We recommend that the geotechnical consultant re-evaluate the pavement design

at the time of construction. The recommended preliminary flexible pavement sections for the access road are presented in the table below.

Table 4 – Recommended Preliminary Flexible Pavement Sections

Traffic Index (Pavement Usage)	Design R-Value	Asphalt Concrete (in)	Class 2 Aggregate Base (in)
6 (Drive Aisles)	13	4	10
7 (Fire Lanes and Delivery Routes	13	5	12

These values assume traffic indices of seven or less for site pavements. In addition, we recommend that the upper 12 inches of the subgrade and aggregate base materials be compacted to a relative compaction of 95 percent relative density as evaluated by the current version of ASTM D 1557. The AC materials should be compacted to a relative compaction of 95 percent as evaluated by the materials Hveem density. If traffic loads are different from those assumed, the pavement design should be re-evaluated.

10.5.1 Subgrade Stabilization

Due to the relatively impermeable nature of the very old paralic deposits, we anticipate that perched groundwater may be present in some areas. Due to the potential presence of perched groundwater or wet subgrade soils, excavations may encounter yielding subgrade conditions. Mitigation measures may include the removal and replacement of the wet soils or stabilization through a combination of aggregate base material reinforced with geogrid or geotextiles. Specific recommendations should be based on conditions exposed in the field during construction and evaluated on a case-by-case basis.

10.6 Soil Corrosivity

Laboratory testing was performed on a representative sample of the near-surface soil to evaluate soil pH, electrical resistivity, water-soluble chloride content, and water-soluble sulfate content. The soil pH and electrical resistivity tests were performed in general accordance with California Test Method (CT) 643. The chloride content test was performed in general accordance with CT 422. Sulfate testing was performed in general accordance with CT 417.

The results of the corrosivity testing indicated an electrical resistivity of 880 ohm-centimeters (ohm-cm), a soil pH of 8.6, a chloride content of 400 parts per million (ppm), and a sulfate content of 0.011 percent (i.e., 110 ppm). A comparison with the Caltrans corrosion (2018) criteria

indicates that the on-site soils would be classified as corrosive. Based on the Caltrans (2018) criteria, a project site is classified as corrosive if one or more of the following conditions exist for the representative soil samples retrieved from the site: chloride concentration of 500 ppm or greater, soluble sulfate concentration of 1,500 ppm or greater, an electrical resistivity of 1,100 ohm-centimeters or less, and a pH 5.5 or less.

10.7 Concrete

Concrete in contact with soil or water that contains high concentrations of water-soluble sulfates can be subject to premature chemical and/or physical deterioration. A soil samples tested during this evaluation indicated a water-soluble sulfate content of 0.011 percent (i.e., 110 ppm). Based on the ACI 318 criteria, the potential for sulfate attack is considered negligible for water-soluble sulfate contents in soil ranging from 0 to 0.10 percent by weight (0 to 1,000 ppm), indicating that soils underlying the site may be considered to have a negligible potential for sulfate attack. However, due to the potential for variability of on-site soils, we recommend that Type II, II/V, or V cement be used for concrete in contact with soil.

10.8 Permanent Stormwater BMPs

We understand that the project will include construction of BMP devices to satisfy the City of San Diego Stormwater requirements. As presented in Section 6, the results of in-situ testing of the underlying materials indicate that infiltration within the subsurface soils at IT-1, IT-2, IT-3, and IT-4 is not feasible. Based on the relatively impermeable nature of the very old paralic deposits, it is anticipated that lateral movement of infiltrating water will affect surrounding improvements including underground utility trenches, pavement subgrades, and foundation elements. Therefore, we recommend that permanent biofiltration basins be lined with an impermeable liner to restrict the movement of water to nearby improvements. The permanent biofiltration basins should be equipped with a drain to an appropriate outlet.

11 LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions

can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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United States Geological Survey (USGS), 2018b, U.S. Seismic Design Maps website, https://earthquake.usgs.gov/designmaps/us/application.php.

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FIGURES

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: ESRI WORLD TOPO, 2017

1_108605001_SL.mxd 9/4/2018 AOB

FIGURE 1

SITE LOCATION

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

108605001 | 9/18

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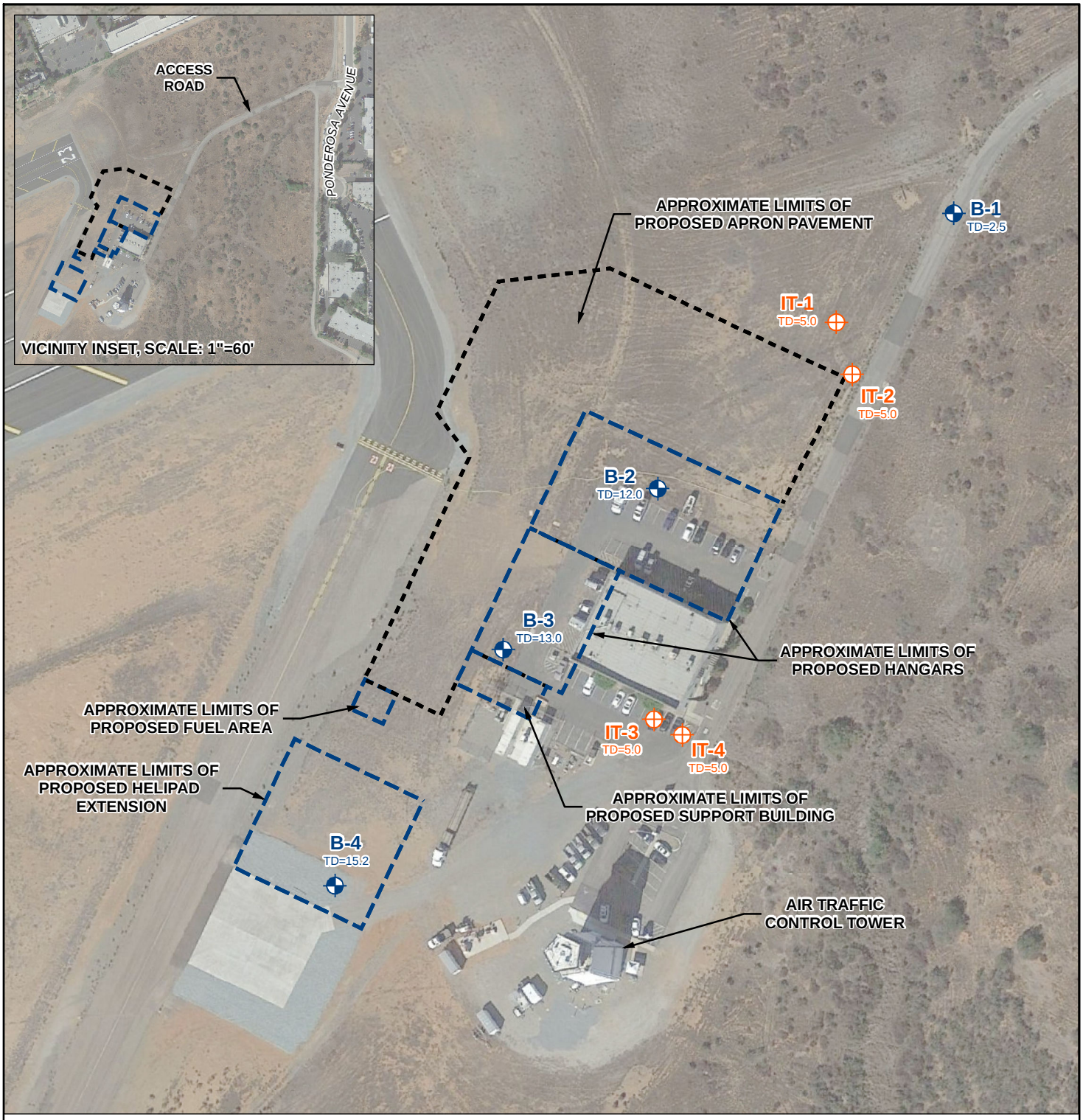

SOURCE: ATKINS, 2017.
GOOGLE EARTH, 2017

LEGEND

B-4 TD=15.2 BORING
TD=TOTAL DEPTH IN FEET

IT-4 TD=5.0 INFILTRATION TEST
TD=TOTAL DEPTH IN FEET

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

N

FEET
0 120 240

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FIGURE 2

BORING LOCATIONS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

108605001 | 9/18

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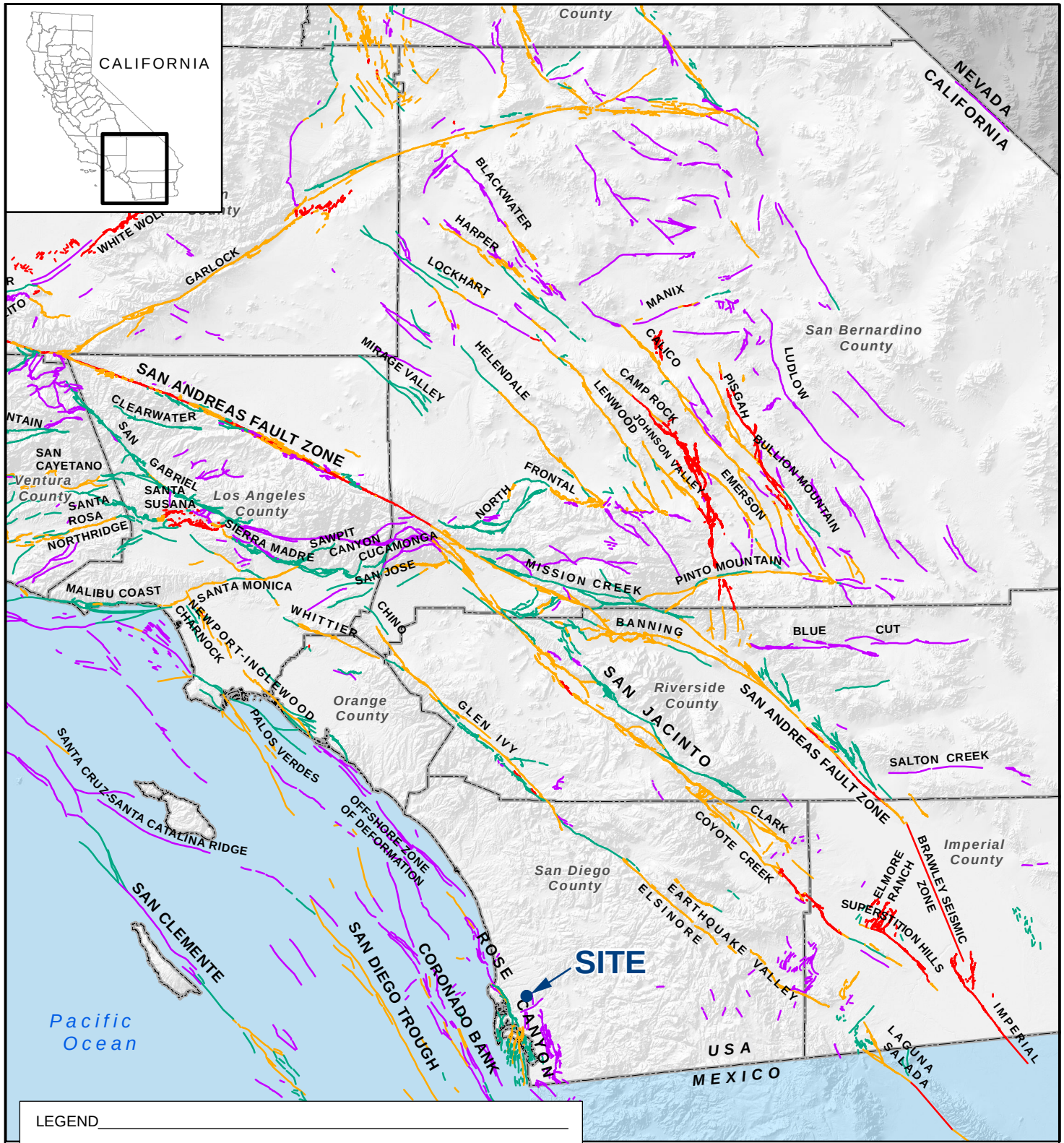

LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- STATE/COUNTY BOUNDARY

SOURCE: U.S. GEOLOGICAL SURVEY AND CALIFORNIA GEOLOGICAL SURVEY, 2006, QUATERNARY FAULT AND FOLD DATABASE FOR THE UNITED STATES.

N

MILES

0 30 60

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

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FIGURE 3

FAULT LOCATIONS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

108605001 | 9/18

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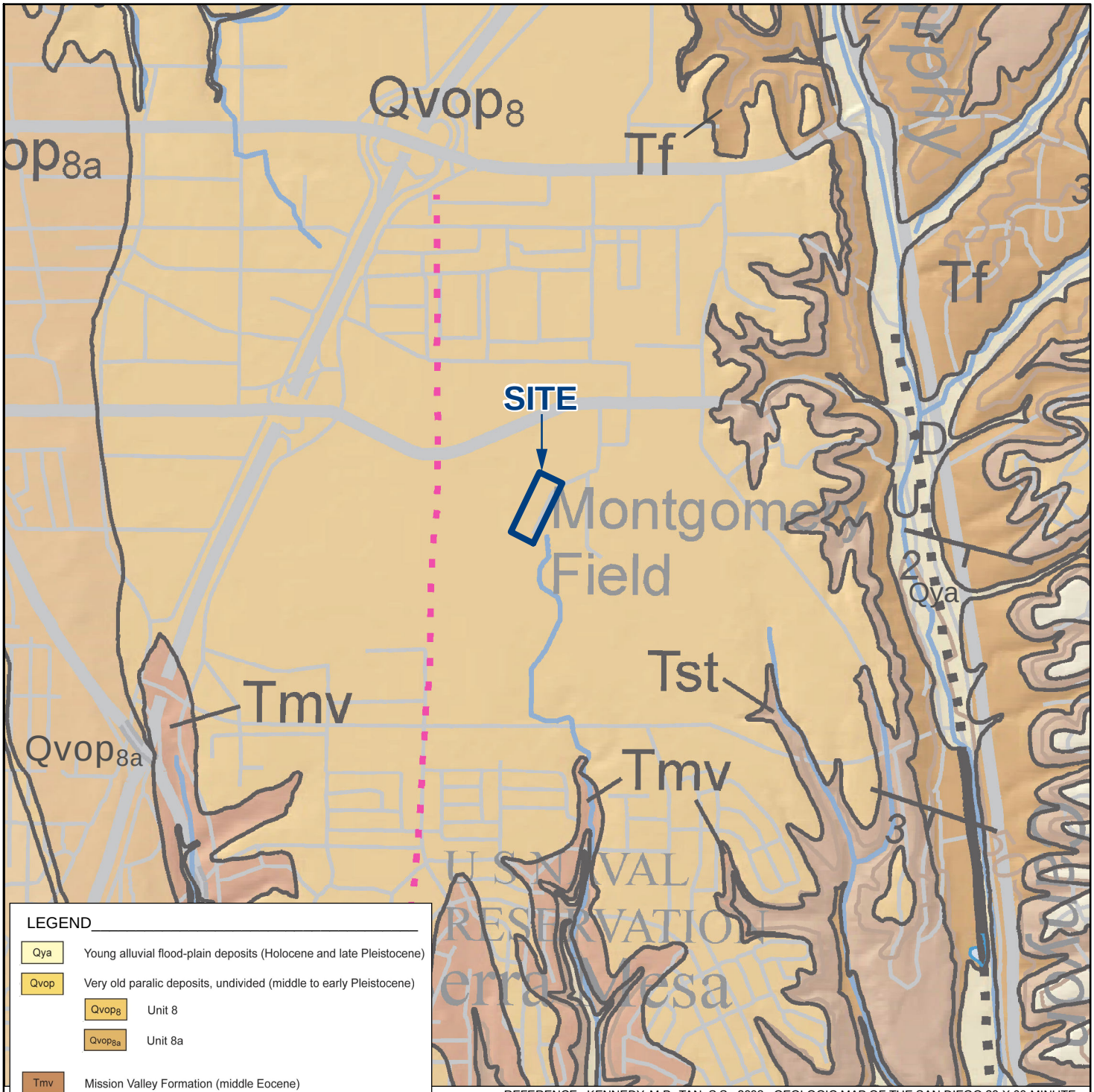
Geotechnical & Environmental Sciences Consultants



REFERENCE: KENNEDY, M.P., TAN, S.S., 2008, GEOLOGIC MAP OF THE SAN DIEGO 30 X 60-MINUTE QUADRANGLE, CALIFORNIA

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

4_108605001_G.mxd 9/5/2018 AOB

FIGURE 4

GEOLOGY

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

108605001 | 9/18

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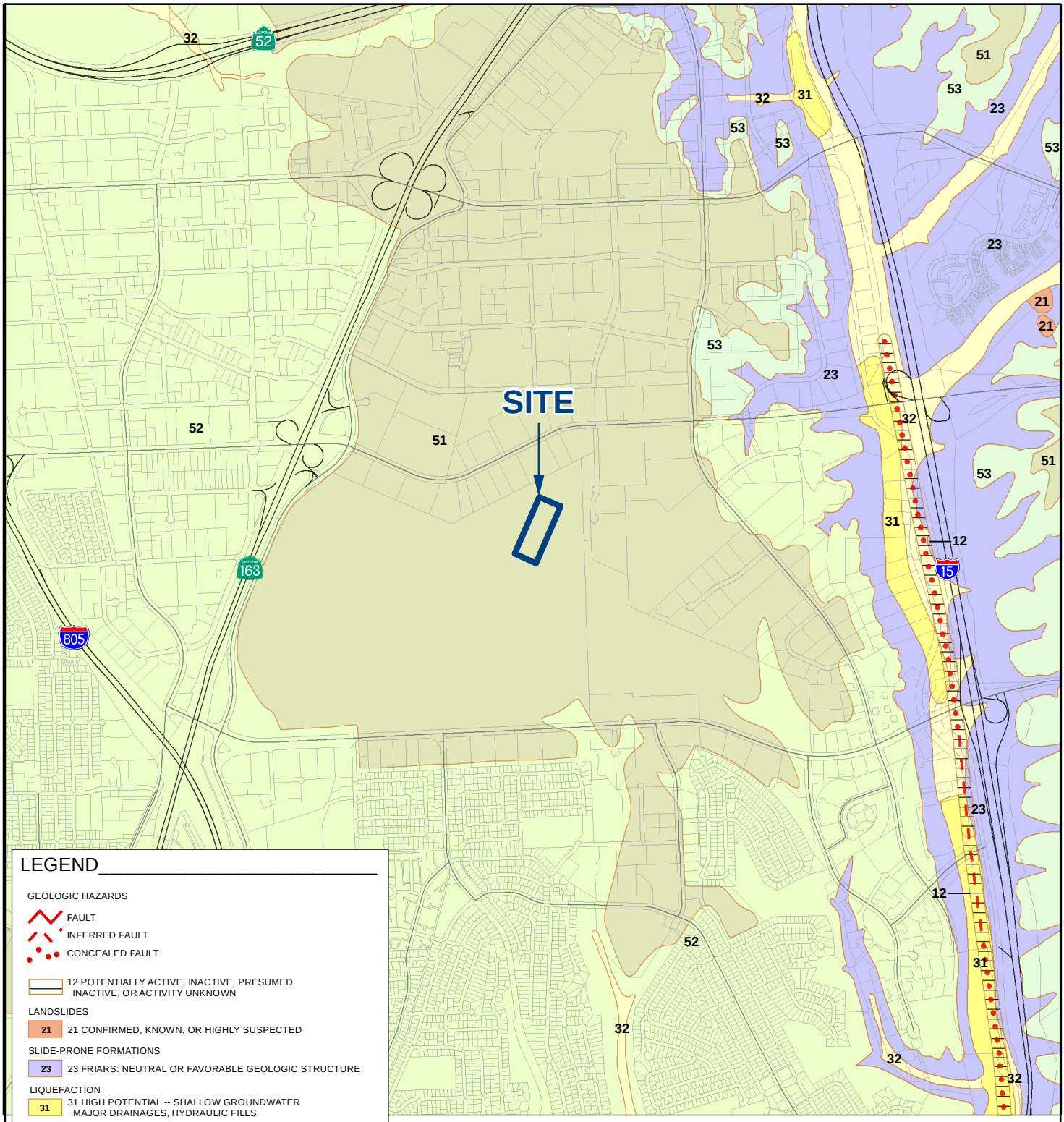

SOURCE: CITY OF SAN DIEGO SEISMIC SAFETY STUDY GEOLOGIC HAZARDS AND FAULTS, SANGIS, 2008

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

5_108605001_GH.mxd 9/5/2018 AOB

FIGURE 5

GEOLOGIC HAZARDS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

108605001 | 9/18

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APPENDIX A

Boring Logs

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1⅜ inches. The sampler was driven into the ground with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples
Relatively undisturbed soil samples were obtained in the field using the following method.

The Modified Split-Barrel Drive Sampler
The sampler, with an external diameter of 3 inches, was lined with 1-inch-long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

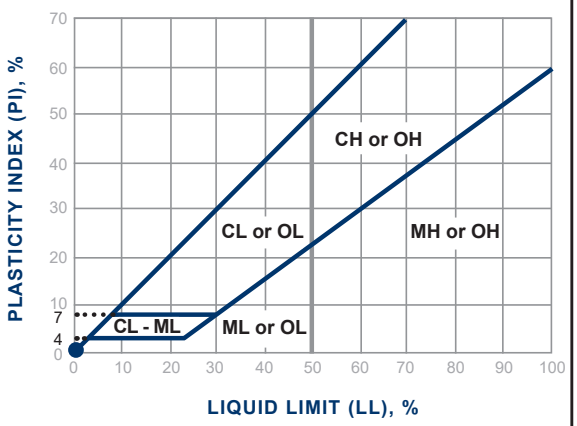
Soil Classification Chart Per ASTM D 2488

Primary Divisions			Secondary Divisions	
			Group Symbol	Group Name
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

Plasticity Chart



Apparent Density - Coarse-Grained Soil

Apparent Density	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

Consistency - Fine-Grained Soil

Consis-tency	Spooling Cable or Cathead		Automatic Trip Hammer	
	SPT (blows/foot)	Modified Split Barrel (blows/foot)	SPT (blows/foot)	Modified Split Barrel (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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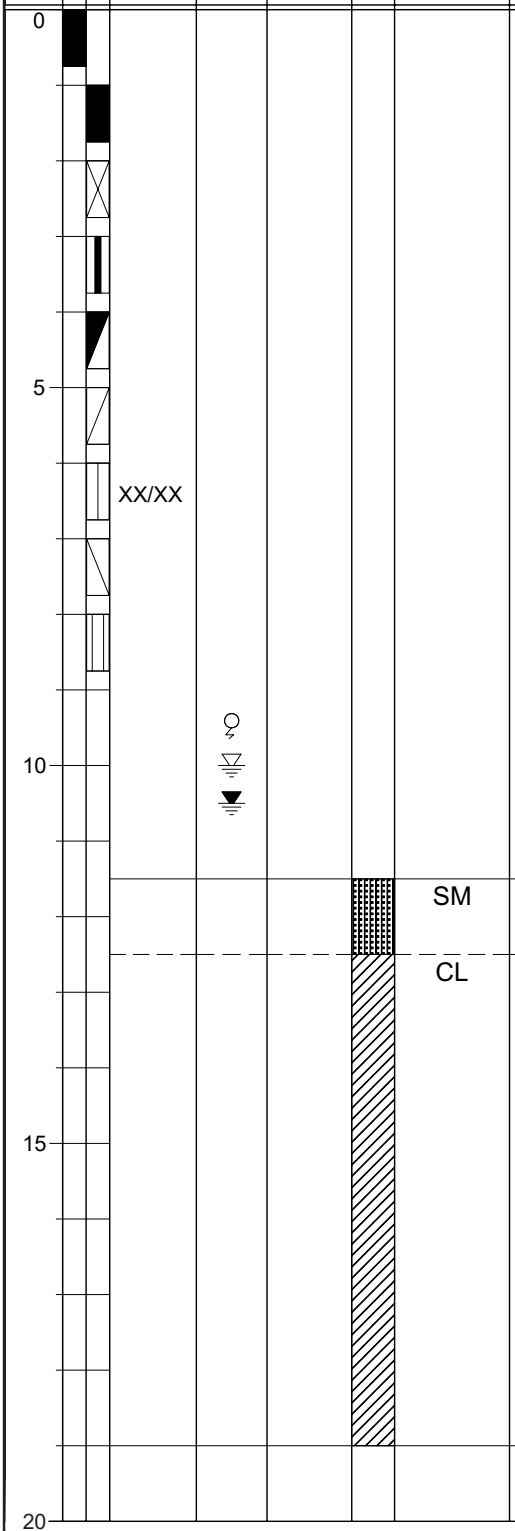
USCS METHOD OF SOIL CLASSIFICATION

BORING LOG EXPLANATION SHEET



Bulk sample.

Modified split-barrel drive sampler.

No recovery with modified split-barrel drive sampler.

Sample retained by others.

Standard Penetration Test (SPT).

No recovery with a SPT.

Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.

No recovery with Shelby tube sampler.

Continuous Push Sample.

Seepage.

Groundwater encountered during drilling.

Groundwater measured after drilling.

MAJOR MATERIAL TYPE (SOIL):

Solid line denotes unit change.

Dashed line denotes material change.

Attitudes: Strike/Dip
b: Bedding
c: Contact
j: Joint
f: Fracture
F: Fault
cs: Clay Seam
s: Shear
bss: Basal Slide Surface
sf: Shear Fracture
sz: Shear Zone
sbs: Shear Bedding Surface

The total depth line is a solid line that is drawn at the bottom of the boring.

DATE DRILLED 8/16/18 BORING NO. B-1

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Core/Manual

DRIVE WEIGHT N/A DROP N/A

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							GC	ASPHALT CONCRETE: Approximately 3-1/2 inches thick.
							CL	AGGREGATE BASE: Brown, moist, medium dense, clayey GRAVEL; approximately 3 inches thick.
								FILL: Reddish brown to olive, moist, stiff, sandy CLAY; scattered gravel and cobbles.
5								Total Depth = 2.5 feet. (Refusal) Groundwater not encountered during. Backfilled and patched shortly after drilling on 8/16/18. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

DATE DRILLED 8/16/18 BORING NO. B-2

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-95) (Baja)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	TOPSOIL: Brown, dry to moist, medium dense, silty SAND; scattered roots.
	■			24.4				VERY OLD PARALIC DEPOSITS: Reddish brown, moist, strongly cemented, silty fine- to medium-grained SANDSTONE; few gravel and cobbles.
5	■	◪	50/3"	5.4				Dry to moist. @ 7': Some gravel.
10		◪	50/2"					Cobbles; difficult drilling.
								Total Depth = 12 feet. (Refusal) Groundwater not encountered during drilling. Backfilled shortly after drilling on 8/16/18. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
15								
20								

DATE DRILLED 8/16/18 BORING NO. B-3

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-95) (Baja)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	TOPSOIL: Brown, moist, medium dense, silty SAND; scattered roots.
				10.5				VERY OLD PARALIC DEPOSITS: Reddish brown to gray, moist, moderately cemented, clayey fine- to medium-grained SANDSTONE; few gravel and cobbles.
5			66/11"	15.2				
10			50/6"					Grayish brown. Cobbles; difficult drilling.
15								Total Depth = 13 feet. (Refusal) Groundwater not encountered during drilling. Backfilled shortly after drilling on 8/16/18. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								

DATE DRILLED 8/16/18 BORING NO. B-4

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-95) (Baja)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0	■			9.9			SC	FILL: Brown to reddish brown, moist, medium dense, clayey SAND; scattered gravel and roots.
5		◪	50/3"	7.8				VERY OLD PARALIC DEPOSITS: Reddish brown, moist, strongly cemented, silty fine- to medium-grained SANDSTONE; few gravel and cobbles.
10		◪	50/2"					Cobbles; difficult drilling.
15		◪	50/2"					Total Depth = 15.2 feet. Groundwater not encountered during drilling. Backfilled shortly after drilling on 8/16/18. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
20								

DATE DRILLED 8/16/18 BORING NO. IT-1

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-95) (Baja)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	TOPSOIL: Brown, dry to moist, medium dense, silty SAND; scattered roots. VERY OLD PARALIC DEPOSITS: Reddish brown, dry to moist, moderately cemented, silty fine- to medium-grained SANDSTONE; few gravel and cobbles.
5								Total Depth = 5 feet. Groundwater not encountered. Backfilled shortly after testing on 8/17/18. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

DATE DRILLED 8/16/18 BORING NO. IT-2

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-95) (Baja)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	TOPSOIL: Brown, dry to moist, medium dense, silty SAND; scattered roots.
								VERY OLD PARALIC DEPOSISTS: Reddish brown, dry to moist, moderately cemented, silty fine- to medium-grained SANDSTONE.
5								Total Depth = 5 feet. Groundwater not encountered. Backfilled shortly after testing on 8/17/18. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

DATE DRILLED 8/16/18 BORING NO. IT-3

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-95) (Baja)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							GC	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
							SC	AGGREGATE BASE: Brown, moist, medium dense, clayey GRAVEL; approximately 3-1/2 inches thick.
								FILL: Brown, moist, loose to medium dense, clayey SAND; few cobbles.
								VERY OLD PARALIC DEPOSITS: Reddish brown, moist, moderately cemented, silty fine- to medium-grained SANDSTONE; trace gravel and cobbles.
5								Total Depth = 5 feet. Groundwater not encountered. Backfilled and patched shortly after testing on 8/17/18.
								Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
								The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

DATE DRILLED 8/16/18 BORING NO. IT-4

GROUND ELEVATION 420' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 8" Diameter Hollow Stem Auger (CME-95) (Baja)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY GSW LOGGED BY GSW REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							GC	ASPHALT CONCRETE: Approximately 2-1/2 inches thick. AGGREGATE BASE: Brown, moist, medium dense, clayey GRAVEL; approximately 9-1/2 inches thick. VERY OLD PARALIC DEPOSITS: Reddish brown, moist, moderately cemented, silty fine- to medium-grained SANDSTONE; few gravel and cobbles.
5								Total Depth = 5 feet. Groundwater not encountered. Backfilled and patched shortly after testing on 8/17/18. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
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APPENDIX B

Laboratory Testing

APPENDIX B

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory borings in Appendix A.

In-Place Moisture Tests

The moisture contents of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. The grain size distribution curves are shown on Figures B-1 through B-3. These test results were utilized in evaluating the soil classifications in accordance with the USCS.

Expansion Index Tests

The expansion indices of selected materials were evaluated in general accordance with ASTM D 4829. The specimens were molded under a specified compactive energy at approximately 50 percent saturation. The prepared 1-inch thick by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and were inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The results of the tests are presented on Figure B-4.

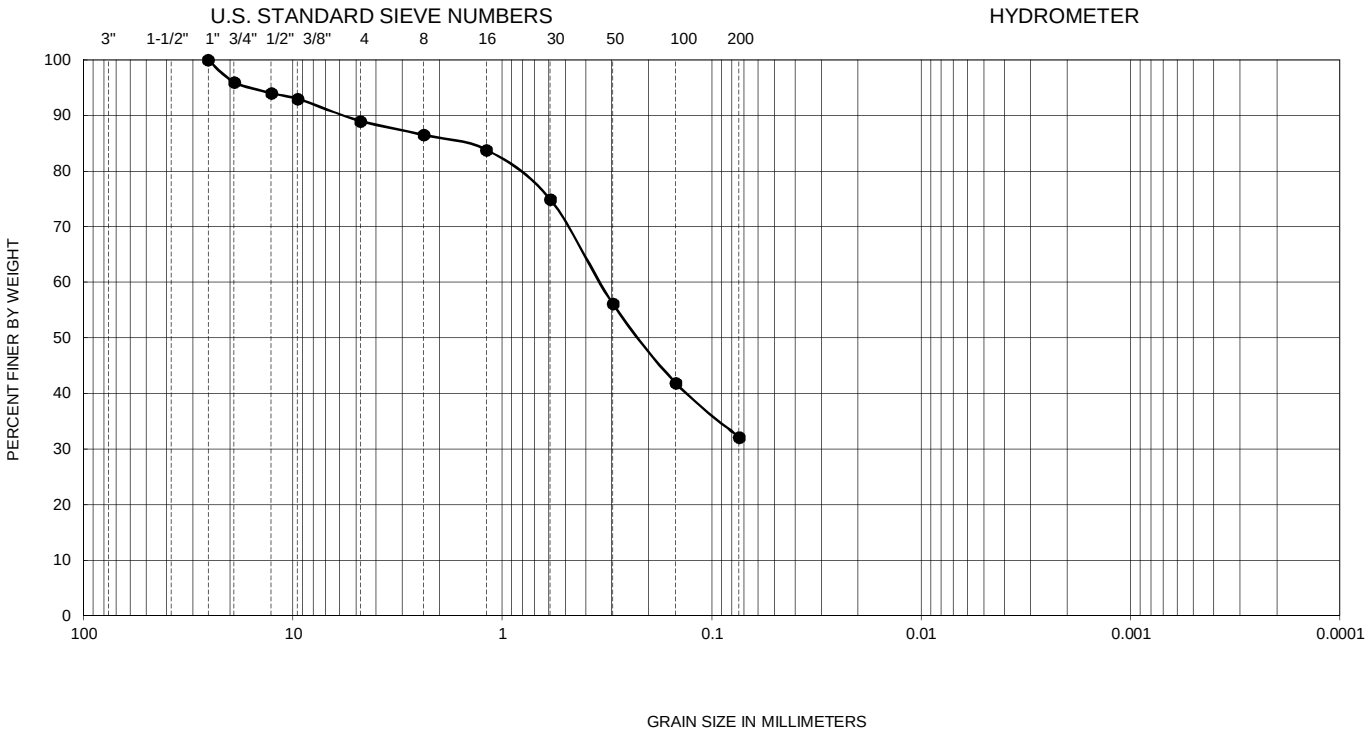
Soil Corrosivity Tests

Soil pH and electrical resistivity tests were performed on a representative sample in general accordance with CT 643. The sulfate and chloride contents of the selected sample were evaluated in general accordance with CT 417 and 422, respectively. The results of these tests are presented on Figure B-5.

R-Value

The resistance value (R-value) for site soils was evaluated in general accordance with CT 301. Samples were prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-value is reported as the lesser or more conservative of the two calculated results. The test results are presented in Figure B-6.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	B-3	1.0-5.0	--	--	--	--	--	--	--	--	32	SC

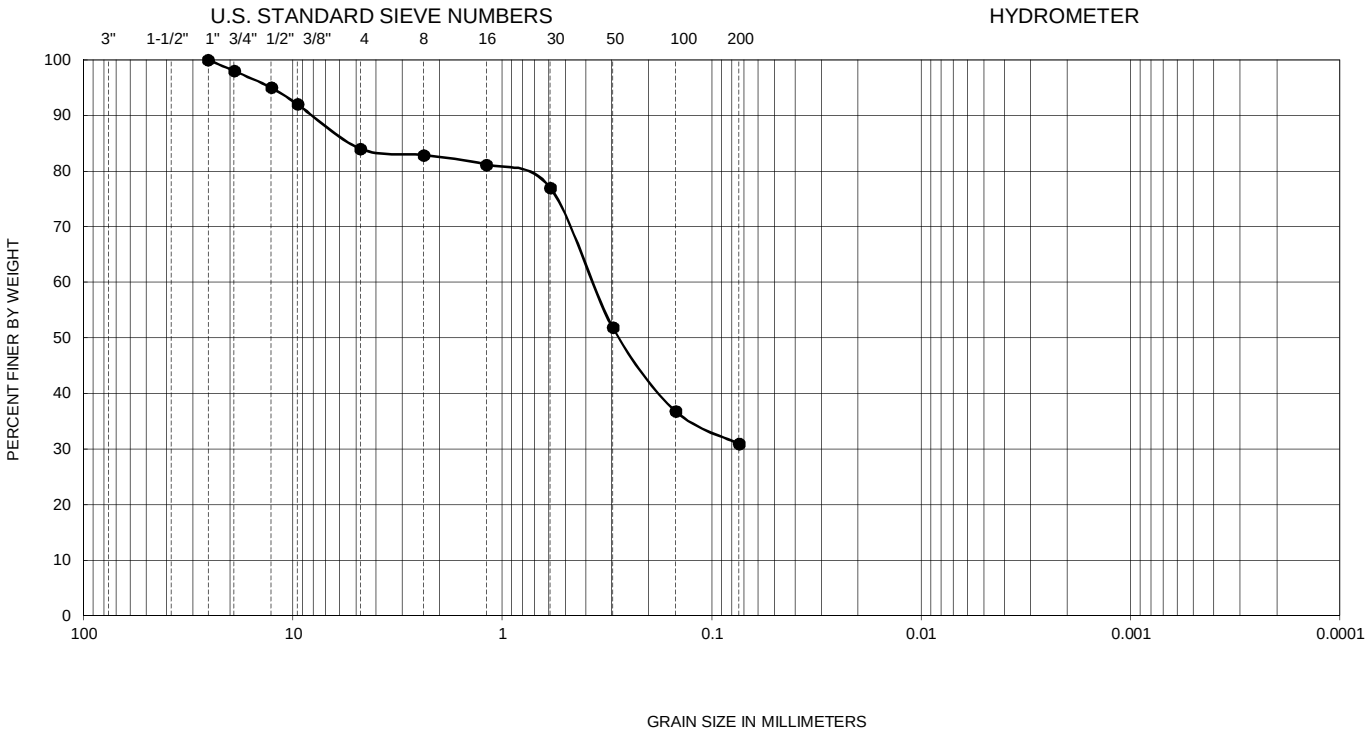
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

FIGURE B-1

GRADATION TEST RESULTS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	IT-2	1.0-5.0	--	--	--	--	--	--	--	--	31	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

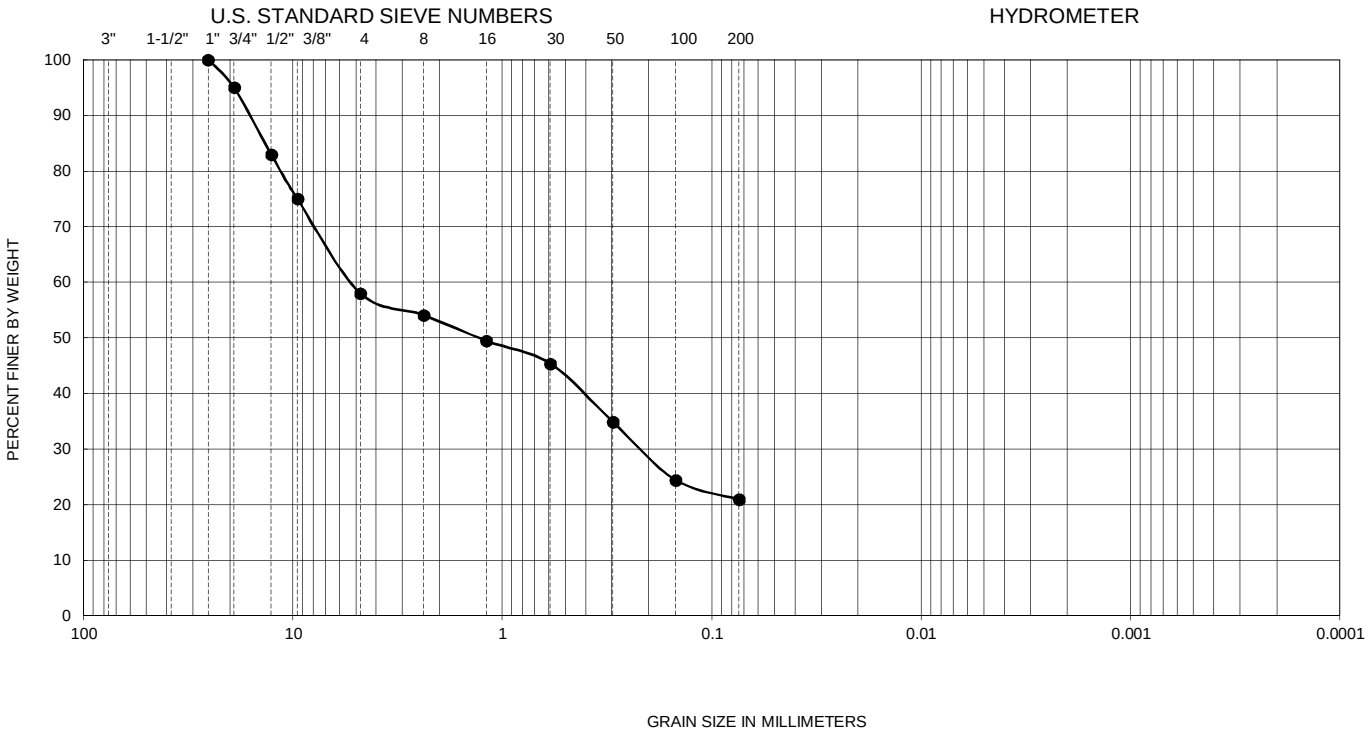
FIGURE B-2

GRADATION TEST RESULTS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (percent)	USCS
●	IT-4	1.0-5.0	--	--	--	--	--	--	--	--	21	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

FIGURE B-3

GRADATION TEST RESULTS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

SAMPLE LOCATION	SAMPLE DEPTH (ft)	INITIAL MOISTURE (percent)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (percent)	VOLUMETRIC SWELL (in)	EXPANSION INDEX	POTENTIAL EXPANSION
B-1	0.5-2.5	7.6	120.2	14.3	0.002	2	Very Low
B-3	1.0-5.0	9.5	111.8	17.2	0.014	14	Very Low
B-4	0.0-4.0	10.5	106.6	17.9	0.009	9	Very Low

PERFORMED IN GENERAL ACCORDANCE WITH ☐ UBC STANDARD 18-2 ☑ ASTM D 4829

FIGURE B-4

EXPANSION INDEX TEST RESULTS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH [1]	RESISTIVITY [1] (ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-4	0.0-4.0	8.6	880	110	0.011	400

[1] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643
[2] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417
[3] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422

FIGURE B-5

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

CORROSIVITY TEST RESULTS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

108605001 | 9/18

SAMPLE LOCATION	SAMPLE DEPTH (ft)	SOIL TYPE	R-VALUE
B-1	0.5-2.5	Sandy CLAY	13

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

FIGURE B-6

R-VALUE TEST RESULTS

SAN DIEGO FIRE-RESCUE AIR OPERATIONS HANGARS
MONTGOMERY-GIBBS EXECUTIVE AIRPORT, SAN DIEGO, CALIFORNIA

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

APPENDIX C

Infiltration Test Data

Test Date:	8/17/2018					Infiltration Test No.:	IT-1
Test Hole Diameter, D (inches):	8.0					Excavation Depth (feet):	5.0
Test performed and recorded by:	GSW					Pipe Length (feet):	5.0

t_1	d_1 (feet)	t_2	d_2 (feet)	Δt (min)	ΔH (feet)	Percolation Rate (min/in)	H_{avg} (feet)	Infiltration Rate (in/hr)
7:00	2.90	7:25	2.90	25	0.00	---	2.10	<0.01
7:25	2.90	7:50	2.90	25	0.00	---	2.10	<0.01
7:50	2.90	8:20	2.90	30	0.00	---	2.10	<0.01
8:20	2.90	8:50	2.90	30	0.00	---	2.10	<0.01
8:50	2.90	9:20	2.91	30	0.01	250	2.10	0.02
9:20	2.90	9:50	2.90	30	0.00	---	2.10	<0.01
9:50	2.90	10:20	2.90	30	0.00	---	2.10	<0.01
10:20	2.90	10:50	2.90	30	0.00	---	2.10	<0.01
10:50	2.90	11:20	2.90	30	0.00	---	2.10	<0.01
11:20	2.90	11:50	2.90	30	0.00	---	2.10	<0.01
11:50	2.90	12:20	2.90	30	0.00	---	2.10	<0.01
12:20	2.90	12:50	2.90	30	0.00	---	2.10	<0.01

Test Date:	8/17/2018					Infiltration Test No.:	IT-2
Test Hole Diameter, D (inches):	8.0					Excavation Depth (feet):	5.0
Test performed and recorded by:	GSW					Pipe Length (feet):	5.0

t_1	d_1 (feet)	t_2	d_2 (feet)	Δt (min)	ΔH (feet)	Percolation Rate (min/in)	H_{avg} (feet)	Infiltration Rate (in/hr)
7:01	2.50	7:26	2.50	25	0.00	---	2.50	<0.01
7:26	2.50	7:51	2.50	25	0.00	---	2.50	<0.01
7:51	2.50	8:21	2.50	30	0.00	---	2.50	<0.01
8:21	2.50	8:51	2.50	30	0.00	---	2.50	<0.01
8:51	2.50	9:21	2.50	30	0.00	---	2.50	<0.01
9:21	2.50	9:51	2.51	30	0.01	250	2.50	0.02
9:51	2.50	10:21	2.50	30	0.00	---	2.50	<0.01
10:21	2.50	10:51	2.50	30	0.00	---	2.50	<0.01
10:51	2.50	11:21	2.50	30	0.00	---	2.50	<0.01
11:21	2.50	11:51	2.50	30	0.00	---	2.50	<0.01
11:51	2.50	12:21	2.50	30	0.00	---	2.50	<0.01
12:21	2.50	12:51	2.50	30	0.00	---	2.50	<0.01

Notes:

t_1 = initial time when filling or refilling is completed

d_1 = initial depth to water in hole at t_1

t_2 = final time when incremental water level reading is taken

d_2 = final depth to water in hole at t_2

Δt = change in time between initial and final water level readings

ΔH = change in depth to water or change in height of water column (i.e., $d_2 - d_1$)

H_0 = Initial height of water column

in/hr = inches per hour

Percolation Rate to Infiltration Rate Conversion [1]

$$I_t = \frac{\Delta H \times 60 \times r}{\Delta t\left(r + 2H_{avg}\right)}$$

I_t = tested infiltration rate, inches/hour

ΔH = change in head over the time interval, inches

Δt = time interval, minutes

r = effective radius of test hole

H_{avg} = average head over the time interval, inches

[1] Based on the "Porchet Method" as presented in:
Riverside County Flood Control, 2011, Design Handbook for Low Impact Development Best Management Practices: dated September.

Test Date:	8/17/2018						Infiltration Test No.:	IT-3
Test Hole Diameter, D (inches):		8.0					Excavation Depth (feet):	5.0
Test performed and recorded by:		GSW					Pipe Length (feet):	5.0

t_1	d_1 (feet)	t_2	d_2 (feet)	Δt (min)	ΔH (feet)	Percolation Rate (min/in)	H_{avg} (feet)	Infiltration Rate (in/hr)
7:04	2.85	7:29	2.85	25	0.00	---	2.15	<0.01
7:29	2.85	7:54	2.85	25	0.00	---	2.15	<0.01
7:54	2.85	8:24	2.85	30	0.00	---	2.15	<0.01
8:24	2.85	8:54	2.85	30	0.00	---	2.15	<0.01
8:54	2.85	9:24	2.85	30	0.00	---	2.15	<0.01
9:24	2.85	9:54	2.86	30	0.01	250	2.15	0.02
9:54	2.85	10:24	2.85	30	0.00	---	2.15	<0.01
10:24	2.85	10:54	2.85	30	0.00	---	2.15	<0.01
10:54	2.85	11:24	2.85	30	0.00	---	2.15	<0.01
11:24	2.85	11:54	2.85	30	0.00	---	2.15	<0.01
11:54	2.85	12:24	2.85	30	0.00	---	2.15	<0.01
12:24	2.85	12:54	2.85	30	0.00	---	2.15	<0.01

Test Date:	8/17/2018						Infiltration Test No.:	IT-4
Test Hole Diameter, D (inches):		8.0					Excavation Depth (feet):	5.0
Test performed and recorded by:		GSW					Pipe Length (feet):	5.0

t_1	d_1 (feet)	t_2	d_2 (feet)	Δt (min)	ΔH (feet)	Percolation Rate (min/in)	H_{avg} (feet)	Infiltration Rate (in/hr)
7:05	2.20	7:30	2.20	25	0.00	---	2.80	<0.01
7:30	2.20	7:55	2.20	25	0.00	---	2.80	<0.01
7:55	2.20	8:25	2.20	30	0.00	---	2.80	<0.01
8:25	2.20	8:55	2.20	30	0.00	---	2.80	<0.01
8:55	2.20	9:25	2.20	30	0.00	---	2.80	<0.01
9:25	2.20	9:55	2.20	30	0.00	---	2.80	<0.01
9:55	2.20	10:25	2.20	30	0.00	---	2.80	<0.01
10:25	2.20	10:55	2.20	30	0.00	---	2.80	<0.01
10:55	2.20	11:25	2.21	30	0.01	250	2.80	0.01
11:25	2.20	11:55	2.20	30	0.00	---	2.80	<0.01
11:55	2.20	12:25	2.20	30	0.00	---	2.80	<0.01
12:25	2.20	12:55	2.20	30	0.00	---	2.80	<0.01

Notes:

t_1 = initial time when filling or refilling is completed

d_1 = initial depth to water in hole at t_1

t_2 = final time when incremental water level reading is taken

d_2 = final depth to water in hole at t_2

Δt = change in time between initial and final water level readings

ΔH = change in depth to water or change in height of water column (i.e., $d_2 - d_1$)

H_0 = Initial height of water column

in/hr = inches per hour

Percolation Rate to Infiltration Rate Conversion [1]

$$I_t = \frac{\Delta H \times 60 \times r}{\Delta t\left(r + 2H_{avg}\right)}$$

I_t = tested infiltration rate, inches/hour

ΔH = change in head over the time interval, inches

Δt = time interval, minutes

r = effective radius of test hole

H_{avg} = average head over the time interval, inches

[1] Based on the "Porchet Method" as presented in:
Riverside County Flood Control, 2011, Design Handbook for Low Impact Development Best Management Practices: dated September.

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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[10]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
San Diego Fire-Rescue Air Operations Hangars	Design
Criteria 1: Infiltration Rate Screening	
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[11]? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ☐ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ☑ No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ☐ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ☐ Yes; Continue to Step 1C. ☐ No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ☐ No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ☐ Yes; continue to Step 1E. ☐ No; select an appropriate infiltration testing method.

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

[10] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[11] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[10]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ☐ Yes; continue to Step 1F. ☐ No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ☐ Yes; continue to Step 1G. ☐ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ☐ Yes; answer "Yes" to Criteria 1 Result. ☐ No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ☐ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ☑ No; full infiltration is not required. Skip to Part 1 Result.

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

In-situ infiltration testing of site soils indicated that the water level at all four test locations generally remained constant over the 30 minute testing intervals and did not infiltrate. For infiltration test method, locations, and results, refer to the project preliminary geotechnical evaluation report (2018) prepared by Ninyo & Moore.

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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐ Yes	☐ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐ Yes	☐ No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐ Yes	☐ No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	☐ Yes	☐ No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐ Yes	☐ No
Summarize findings and basis; provide references to related reports or exhibits.			

Part 1 Result – Full Infiltration Geotechnical Screening [12]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	☐ Full infiltration Condition ☑ Complete Part 2

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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[10]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
San Diego Fire-Rescue Air Operations Hangars	Design
Criteria 3 : Infiltration Rate Screening	
3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ☐ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☐ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☑ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ☐ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ☑ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ☐ Yes; Continue to Criteria 4. ☑ No: Skip to Part 2 Result.
Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate). A total of four infiltration tests were conducted at the site. Each test was performed at a depth of approximately 5 feet in very old paralic deposits consisting of silty sandstone. In-situ infiltration rates were measured as follows: IT-1: did not infiltrate IT-2: did not infiltrate IT-3: did not infiltrate IT-4: did not infiltrate	

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

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐ Yes	☐ No
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐ Yes	☐ No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐ Yes	☐ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	☐ Yes	☐ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐ Yes	☐ No
Summarize findings and basis; provide references to related reports or exhibits.			

Part 2 – Partial Infiltration Geotechnical Screening Result[13]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	☐ Partial Infiltration Condition ☑ No Infiltration Condition

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

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