City of Irvine

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

Project Name:

Operations Support Facility
6405 Oak Canyon.
Irvine, CA 92618

Prepared for:

City of Irvine
1 Civic Center Plaza
Irvine, CA 92606

Prepared by:

Tait & Associates, Inc.

701 N. Parkcenter Dr.
Santa Ana, CA 92705
714-560-8200

Prepared 03/03/2022

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Project Owner's Certification			
Planning Application No. (If applicable)		Grading Permit No.	TBD
Tract/Parcel Map and Lot(s) No.	OR 87-528317	Building Permit No.	
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)		6405 Oak Canyon	

This Water Quality Management Plan (WQMP) has been prepared for the City of Irvine by Tait & Associates, Inc. The WQMP is intended to comply with the requirements of the County of Orange NPDES Stormwater Program requiring the preparation of the plan.

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

Owner: TBD			
Title	TBD		
Company	City of Irvine		
Address	1 Civic Center Plaza Irvine CA 92060		
Email	TBD		
Telephone #	TBD		
I understand my responsibility to implement the provisions of this WQMP including the ongoing operation and maintenance of the best management practices (BMPs) described herein.			
Owner Signature		Date	

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Preparer (Engineer): Jacob Vandervis			
Title	Chief Operating Officer	PE Registration #	C46301
Company	Tait & Associates, Inc		
Address	701 N. Parkcenter Dr. Santa Ana, CA 92705		
Email	jvandervis@tait.com		
Telephone #	714-560-8676		
I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.			
Preparer Signature		Date	
Place Stamp Here			

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Attachments

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

Project Infomation			
Permit/Application No. (If applicable)		Grading or Building Permit No. (If applicable)	TBD
Address of Project Site (or Tract Map and Lot Number if no address) and APN	6405 Oak Canyon		
Water Quality Conditions of Approval or Issuance			
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	**A copy of the Conditions of Approval will be provided in Attachment E with the Final WQMP.**		
Conceptual WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	No.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	**Upper Newport Bay**– Chlordane, Copper, DDT, Indicator Bacteria, Malathion, Nutrients, PCBs, Sedimentation, Toxicity, **Lower Newport Bay** – Chlordane, Copper, DDT, Indicator Bacteria, Nutrients, PCBs, Toxicity,		

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Section II Project Description

II.1 Project Description

Description of Proposed Project				
Development Category (From Model WQMP, Table 7.11-2; or -3):	**Category 6**: Parking lots 5,000 square feet or more including associated drive aisle, and potentially exposed to urban stormwater runoff.			
Project Area (ft^2): Ex. 611,202 sf or 14.03 ac Prop. 579,169 sf or 13.30 ac	Number of Dwelling Units: N.A.		SIC Code: 5541 Gasoline Service station	
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	95832 sq ft 2.2 ac	44%	121968 sq ft 2.8 ac	56%
Post-Project Conditions	7064 sq ft 0.16 ac	3%	210795 sq ft 4.8 ac	97%
Drainage Patterns/Connections	**Off-site Existing Drainage Patterns/Connections:** All existing project runoff sheet flows to an inlet structure locate at the SW corner of the property near Oak Canyon. Stormwater enters the public storm drain system and flows westerly to Mashburn Channel. Flows then discharge into San Diego Creek which eventually outlets in the Upper Newport Bay. Lastly stormwater is conveyed through the Lower Newport Bay before discharging into the Pacific Ocean. **On-site Existing Drainage Patterns/Connections:** The existing project site is 5.00 acres. Stormwater flows generally flow in a NE to SW direction towards Oak Canyon. Discharge point 1: The existing site Is primarily a dog park with sparse ground cover. There is an existing industrial waste facility to the south with support parking. Surface runoff is collected in an earthen swale located along the western			

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property line from both the dog park and industrial facilities. Flows are then conveyed southerly to an at grade inlet structure located at the SW corner of the property. Stormwater enters an existing Hydrodynamic separator before entering the public storm drain system located in Oak Canyon.

See Attachment G for the existing storm drain and Attachment B which includes the existing hydrology map.

On-site Proposed Drainage Patterns/Connections:

Discharge point 1: drainage area "A" which consists of 5.0 acres of pavement, landscape, and building roofs. The building roofs discharge at grade on to the asphalt pavement. The site generally flows from NE to SW and is intended to match existing conditions. Runoff from the paved areas will sheet flow to nearby concrete ribbon gutters that flow into catch basins/grated inlets that are a part of the private storm drain system. The private storm drain system will capture onsite runoff and route water quality treatment flows to proposed Modular Wetland Systems for water treatment. A portion of the site will be treated by a biofiltration basins. Peak flows above the Design Treatment Flow Rate will bypass the treatment units through a diversion manhole and discharge directly the underground storm drain system. Flows will then enter the detention system then ultimately enter the public storm drain system as done previously in the existing condition.

A copy of the project proposed hydrology map is included in attachment B of this report

Proposed BMPs:

The site will consist of 2 main structural BMPs which will be classified by the DA they are treating.

BMP A1,

BMP Type Bioretention with Underdrain
Outfall ID: Outfall 1

BMP A2

BMP Type: Modular Wetland System
Model No.: 8X24 (1 unit)
Outfall ID: Outfall 1

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Narrative Project Description:

(Use as much space as necessary.)

Manager of Proposed Project

TBD

Community Name:

City of Irvine

Facility Locations & Sizes:

- Proposed fueling and maintenance support facility located at 6405 Oak Canyon
- 5 acres

Building Use & Activities Conducted:

- Household hazardous waste collection, City support activities

Materials and Products:

- The materials or products are not known at this time.

Waste Generated:

- The anticipated waste from the site will be general trash and debris etc.
- Hydrocarbons from fueling stations is expected

Paved Areas:

Total paved area of the site consists of 210795 sf or 4.84 ac

Landscape Areas:

Minor landscaped areas will be provide in the parking lots.

Outdoor Material Storage:

No outdoor storage is proposed at this time.

Food Preparation, cooking, eating areas:

No food cooking will occur on site.

Routinely conducted outdoor activities:

Loading and unloading. Parking, fueling

Existing Site: The existing site primarily an existing dog park with sparse cover. The southern portion of the site is an existing hazardous waste pickup facility with surrounding parking and asphalt pavement. The pervious area is approximately 44% in the existing condition. The proposed construction involves the redevelopment of approximately 5.00 acres of an existing dog park and adjacent parking lot located in the city of Irvine. The redevelopment will include constructing a fueling station, parking area, above ground tanks, and solar panel

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	structures. New underground storm drain and utility structures are proposed in conjunction with at grade catch basins and water treatment BMPs.

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II.2 Potential Stormwater Pollutants

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	• consist of soils or other surficial materials that are eroded and then transported or deposited by wind, water, or gravity. Excessive sedimentation can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth. Sediments in runoff also transport other pollutants that adhere to them, including trace metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and phosphorus. The largest source of suspended solids / sediment is typically erosion from disturbed soils.
Nutrients	E ☒	N ☐	• includes the macro-nutrients nitrogen and phosphorus. They commonly exist in the form of mineral salts dissolved or suspended in water and as particulate organic matter transported by stormwater. Excessive discharge of nutrients to water bodies and streams can cause eutrophication, including excessive aquatic algae and plant growth, loss of dissolved oxygen, release of toxins in sediment, and significant swings in hydrogen ion concentration (pH). Primary sources of nutrients in urban runoff are fertilizers, trash and debris, and eroded soils. Urban areas with improperly managed landscapes can be substantial sources.
Heavy Metals	E ☒	N ☐	• Including certain metals that can be toxic to aquatic life if concentrations become high enough to stress natural processes. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. Copper and zinc are typically associated with building materials, including galvanized metal and ornamental copper, and automotive products, including tires and brake pads. Humans can be impacted from

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			contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns regarding the potential for release of metals to the environment have already led to restricted metal usage in certain applications, for example lead additives in gasoline. The primary source of metals in urban stormwater is typically commercially available metal products and automobiles.
Pathogens (Bacteria/Virus)	E ☒	N ☐	• includes bacteria and viruses, which are ubiquitous microorganisms that thrive under a range of environmental conditions. Water containing excessive pathogenic bacteria and viruses can create a harmful environment for humans and aquatic life. The source of pathogenic bacteria and viruses is typically the transport of animal or human fecal wastes from the watershed, but pathogenic organisms do occur in the natural environment.
Pesticides	E ☒	N ☐	See Toxic Organic Compounds
Oil and Grease	E ☒	N ☐	• Characterized as high-molecular weight organic compounds. Elevated oil and grease content can decrease the aesthetic value of the water body, as well as the water quality. Introduction of these pollutants to water bodies may occur due to the wide uses and applications of some of these products in municipal, residential, commercial, industrial, and construction areas. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Toxic Organic Compounds	E ☒	N ☐	• Includes organic compounds (pesticides, solvents, hydrocarbons) which at toxic concentrations constitute a hazard to humans and aquatic organisms. Stormwater coming into contact with organic compounds can transport excessive levels organics to receiving waters. Dirt, grease, and grime retained in cleaning fluid or rinse water may also absorb levels of organic compounds that are harmful or hazardous to aquatic life. Sources of organic compounds include landscape maintenance areas, vehicle maintenance areas, waste handling areas, and potentially most other urban areas.
Trash and Debris	E ☒	N ☐	• Includes trash, such as paper, plastic, and various waste materials, that can typically be found throughout the urban landscape, and debris which includes waste products of natural origin which are not naturally discharged to water bodies such as landscaping waste, woody debris, etc. The presence of trash and debris may have a significant impact on the recreational value

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			of a water body and upon the health of aquatic habitat.

II.3 Hydrologic Conditions of Concern

☐ No – Show map

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

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Per the North Orange County Hydromodification Susceptibility Map provided in Attachment C, the project site is located in a Potential Area of Erosion, Habitat, & Physical Structure Susceptibility (See TGD Appendix C Map XVI.3) Therefore HCOC conditions are required for this project.

As a part of the project the storm drain infrastructure will be built to mitigate a 25 year storm back to pre-project conditions. Therefore the required HCOC conditions to limit the 2 year 24 hour results to existing conditions will be met. Below are the results for the 25 year storm after mitigation, refer to calculations located in attachment B:

The results for the 25yr 24hr storm event are as follows:

	Volume	Time of Concentration
Pre-Development	**1.45 AC-FT**	**10.98**
Post-Development	**1.67 Ac-Ft**	**7.38**
Delta HCOC	**+ 0.22 ac-ft**	**-3.6**

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II.4 Post Development Drainage Characteristics

On-site Proposed Drainage Patterns/Connections:

Discharge point 1: drainage area "A" which consists of 5.0 acres of pavement, landscape, and building roofs. The building roofs discharge at grade on to the asphalt pavement. The site generally flows from NE to SW and is intended to match existing conditions. Runoff from the paved areas will sheet flow to nearby concrete ribbon gutters that flow into catch basins/grated inlets that are a part of the private storm drain system. The private storm drain system will capture onsite runoff and route water quality treatment flows to proposed Modular Wetland Systems for water treatment. A portion of the site will be treated by a biofiltration basins. Peak flows above the Design Treatment Flow Rate will bypass the treatment units through a diversion manhole and discharge directly the underground storm drain system. Flows will then enter the detention system then ultimately enter the public storm drain system as done previously in the existing condition.

A copy of the project proposed hydrology map is included in attachment B of this report

Off-site Existing Drainage Patterns/Connections:

All existing project runoff sheet flows to an inlet structure locate at the SW corner of the property near Oak Canyon. Stormwater enters the public storm drain system and flows westerly to Mashburn Channel. Flows then discharge into San Diego Creek which eventually outlets in the Upper Newport Bay. Lastly stormwater is conveyed through the Lower Newport Bay before discharging into the Pacific Ocean.

See Attachment G for the existing storm drain and Attachment B which includes the existing hydrology map.

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II.5 Property Ownership/Management

Ownership:

City of Irvine

Long Term Maintenance:

The Owner will provide long term maintenance of all BMP's for this project.

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Section III Site Description

III.1 Physical Setting

Name of Planned Community/Planning Area (if applicable)	N/A
Location/Address	The site is bordered by a warehouse facility to the west, an industrial storage area to the north, several large commercial/industrial buildings to the east, and a hazardous waste facility to the south.
	The project is located at 6405 Oak Canyon Irvine, California 92618
General Plan Land Use Designation	
Zoning	
Acreage of Project Site	5.00 ac
Predominant Soil Type	The project site location resides within the hydrology soil group C.

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III.2 Site Characteristics

Site Characteristics	
Precipitation Zone	The rainfall zone for the project has a design capture storm depth of 0.80" based on the Rainfall zones map on the TGD figure XVI. See Attachment C.
Topography	Topography of the project site is relatively flat with a gentle slope from the northeast to the southwest and ground surface elevations ranging from ±170 to ±181 feet above mean sea level.
Drainage Patterns/Connections	See Section II.1 and II.4 for the description of the existing and proposed drainage patterns, connections and how it ties into adjacent areas, respectively.
Soil Type, Geology, and Infiltration Properties	The project site location resides within the hydrology soil group C. Group C Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
Hydrogeologic (Groundwater) Conditions	Per the Geotechnical report no groundwater was encountered up to 51' during on site testing. County maps indicate that groundwater is greater than 30'. The project site is however located within the El Toro Groundwater Plume
Geotechnical Conditions (relevant to infiltration)	See response above in "Soil Type, Geology,…."
Off-Site Drainage	All existing project runoff sheet flows to an inlet structure locate at the SW corner of the property near Oak Canyon. Stormwater enters the public storm drain system and flows westerly to Mashburn Channel. Flows then discharge into San Diego Creek which eventually outlets in the Upper Newport Bay. Lastly stormwater is conveyed through the Lower Newport Bay before discharging into the Pacific Ocean.
Utility and Infrastructure Information	The proposed construction involves the redevelopment of approximately 5.00 acres of an existing dog park and adjacent parking lot located in the city of Irvine. The redevelopment will include constructing a fueling station, parking area, above ground tanks, and solar panel structures. New underground storm drain and utility structures are proposed in conjunction with at grade catch

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	basins and water treatment BMPs. Utility infrastructure will also include underground storage tanks for fueling. On-site infrastructures will have no impact on proposed BMP's.

III.3 Watershed Description

Receiving Waters	Marshburn Channel San Diego Creek Newport Bay (Lower) Newport Bay (Upper) Pacific Ocean
303(d) Listed Impairments	**San Diego Creek Reach 1: -** Fecal Coliform, Nutrients, Pesticides, Sedimentation/Siltation, Selenium, Toxaphene **Newport Bay (Upper)** - Metals, Copper, Sediment Toxicity, Chlordane, DDT (Dichlorodiphenyl Trichloroethane), PCB's (Polychlorinated Biphenyls), Indicator Bacteria, Nutrients, Pesticides, Sedimentation/Siltation, Other Organics **Newport Bay (Lower)** - Copper, Sediment Toxicity, Chlordane, DDT, PCB's, Indicator Bacteria, Nutrients, Pesticides, Other Organics
Applicable TMDLs	**Newport Bay (Upper)** - Indicator Bacteria, Nutrients, Pesticides, Sedimentation/Siltation **Newport Bay (Lower)** - Nutrients, Pesticides
Pollutants of Concern for the Project	Primary Pollutants of Concern: Suspended-Solid / Sediment, Nutrients, Heavy Metals, Pathogens (Bacteria/Virus), Pesticides, and Toxic Organic Compounds Other Pollutants of Concern: Oil and Grease, Trash and Debris
Environmentally Sensitive and Special Biological Significant Areas	Newport Bay (Upper) Newport Bay (Lower)

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Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	There are currently no applicable approved WHIMP's within the watershed for this project.	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	In the North Orange County permit area, HCOCs are considered to exist if any streams located downstream from the project are determined to be potentially susceptible to hydromodification impacts and either of the following conditions exists: • Post-development runoff volume for the 2-yr, 24-hr storm exceeds the pre-development runoff volume for the 2-yr, 24-hr storm by more than 5 percent Or • Time of concentration of post-development runoff for the 2-yr, 24-hr storm event exceeds the time of concentration of the pre-development condition for the 2-yr, 24-hr storm event by more than 5 percent. Or • The project site is not located in a Potential Area of Erosion, Habitat, & Physical Structure Susceptibility (See TGD Appendix C Map XVI.3)

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	Per the North Orange County Hydromodification Susceptibility Map provided in Attachment C, the project site is located in a Potential Area of Erosion, Habitat, & Physical Structure Susceptibility (See TGD Appendix C Map XVI.3) Therefore HCOC conditions are required for this project.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	Underground infiltration **will not be utilized** for this project per Table VIII.1 from the TGD, the project is located in a contamination plume (El Toro Marine Base Ground water Plume) See Attachment C; therefore, infiltration is prohibited. Based on the depth of groundwater at the site the impact of construction activities should not warrant potential infiltration impacts during minor infiltration activities due to construction.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	A Proprietary Biotreatment BMP "Modular Wetlands", A bioretention basin with underdrain and a Stormwater Storage System (Old Castle Storm safe) used in series will be utilized for this project. The treatment flow rate will be treated for each drainage area by either the proprietary BMP or the bioretention basin. The downstream storage unit will then mitigate the peak discharge prior to leaving the site back to pre-project conditions. Calculations are included in Attachment B. BMP & Stormwater Storage System locations are shown in Section VI, WQMP Plot Plan.
Calculate LID design storm capture volume for Project.	Project Information: d=0.85" (See the "Rainfall Zones" Map in Attachment C) See the following pages for calculations. The calculations have been broken down by Drainage Management Areas (DMA's).

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IV.2. Site Design and Drainage

On-site Proposed Drainage Patterns/Connections:

Discharge point 1: drainage area "A" which consists of 5.0 acres of pavement, landscape, and building roofs. The building roofs discharge at grade on to the asphalt pavement. The site generally flows from NE to SW and is intended to match existing conditions. Runoff from the paved areas will sheet flow to nearby concrete ribbon gutters that flow into catch basins/grated inlets that are a part of the private storm drain system. The private storm drain system will capture onsite runoff and route water quality treatment flows to proposed Modular Wetland Systems for water treatment. A portion of the site will be treated by a biofiltration basins. Peak flows above the Design Treatment Flow Rate will bypass the treatment units through a diversion manhole and discharge directly the underground storm drain system. Flows will then enter the detention system then ultimately enter the public storm drain system as done previously in the existing condition.

A copy of the project proposed hydrology map is included in attachment B of this report

LID BMPs and Treatment Control BMPs Hierarchy

Infiltration BMPs:
Underground infiltration **will not be utilized** for this project per Table VIII.1 from the TGD, the project is located in a contamination plume (El Toro Marine Base Groundwater plume) See Attachment C; therefore, infiltration is prohibited.

Harvest and Reuse BMPs:
Rainwater harvest cannot be utilized for this project.
Dual plumbed recycled water systems are not accepted by the California State Health Department (See section 60313.General requirements of the "Regulations Related to Recycled Water"). "No person other than a recycled water agency shall deliver recycled water to a dual plumbed facility".
Rainwater harvest for irrigation reuse is not feasible for this project due to the landscape area required. The minimum irrigation area required is 4.88 acres, and the proposed irrigation area for the project is 0.16 acres. See Appendix B Worksheet J: Summary of Harvested Water Demand and Feasibility.

Bio-treatment & Evapotranspiration BMPs:
This project will utilize f**low based** biotreatment for the entire project site.

Treatment Control BMPs:
Treatment control type BMP's will note be used for the project.

IV.3 LID BMP Selection and Project Conformance Analysis

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IV.3.1 Hydrologic Source Controls (HSCs)

HSCs not required.

Hydrologic source controls will not be proposed for the project. The site BMP's will meet the DCV with LID BMP's.

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

IV.3.2 Infiltration BMPs

Underground infiltration **will not be utilized** for this project per Table VIII.1 from the TGD, the project is located in a contamination plume (El Toro Marine Base Groundwater Plume) See Attachment C; therefore, infiltration is prohibited.

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐

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Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other: Underground Infiltration	☐
Other:	☐

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

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

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Harvest and Reuse BMPs:

Rainwater harvest cannot be utilized for this project.

Rainwater harvest for irrigation reuse is not feasible for this project due to the landscape area required. The minimum irrigation area required is 4.88 acres, and the proposed irrigation area for the project is 0.16 acres. See Appendix B Worksheet J: Summary of Harvested Water Demand and Feasibility.

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IV.3.4 Biotreatment BMPs

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

This project will utilize a Proprietary Bio-treatment as described below.
Proposed BMPs:

The site will consist of 2 main structural BMPs which will be classified by the DMA they are treating.

BMP A1

BMP Type: Bioretention system with Underdrain
Treatment: 4,899 CF
Outfall ID: Outfall 1

BMP A2

BMP Type: Flow Based - Modular Wetland System
Model No.: 8X24 (1 unit)
Treatment: 0.60 CFS
Outfall ID: Outfall 1

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IV.3.5 Hydromodification Control BMPs

Per the North Orange County Hydromodification Susceptibility Map provided in Attachment C, the project site is located in a Potential Area of Erosion, Habitat, & Physical Structure Susceptibility (See TGD Appendix C Map XVI.3)

As a part of the project the storm drain infrastructure will be built to mitigate a 25 year storm back to pre-project conditions. Therefore the required HCOC conditions to limit the 2 year 24 hour results to existing conditions will be met.

Hydromodification Control BMPs	
BMP Name	**BMP Description**
Weir Structure	Jensen Manhole Wier structure – The device will divert treatment flows to the MWS and detain water for the 25 year event back to pre project conditions.
Detention Basin	Old Castle Storm safe – the underground detention basin will allow water to be stored so that the post project 25 year peak runoff can be detained to pre project conditions.

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IV.3.6 Regional/Sub-Regional LID BMPs

Regional/Sub Regional LID BMPs are not applicable for the project.

Regional/Sub-Regional LID BMPs

IV.3.7 Treatment Control BMPs

This project does not propose the use of treatment control BMPs.

Treatment Control BMPs	
BMP Name	**BMP Description**

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IV.3.8 Non-structural Source Control BMPs

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

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N1- Education for property Owners, Tenants and occupants & N-12 Employee Training

The property owner shall prepare a training manuals for all existing and future employees. The manual shall include information regarding proper practices that contribute to the protection of the stormwater quality. Training shall be provided upon hire of new associates. A copies of the training manuals shall remain in the building at all times for employees to use as needed. The manual shall include all Educational Material included on Attachment A of this report. Additional educational material may be found in the following website :
http://www.ocwatershed.com/PublicEd/resources/business-brochures.html

N2- Activity Restrictions

The property owner shall ensure that the rules and guidelines as determined by the project conditions of approval or other policies are followed at all times once the project is operational. Prohibited activities for the project that promoted water quality includes:

Prohibit discharges of fertilizer, pesticides, or animal wastes to streets or storm drains.

Prohibit blowing or sweeping of debris (leaf litter, grass clippings, litter, etc.) into streets or storm drains.

Requirement to keep dumpster lids closed at all times.

Prohibit vehicle washing, maintenance, or repair on the premises or restrict those activities to designated areas. (No vehicle maintenance, washing or repair is or are proposed on site)

N3- Common Area Landscape Management

Specific practices are followed for landscape maintenance as identified on the landscape specifications. Ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water and reduce pesticide and fertilizer applications.

All maintenance must be consistent with the City of Fullerton requirements. Proper maintenance practices should help reduce and/or eliminate pollution from pesticides, nutrients, trash/debris and sediments. The project common area landscape maintenance should be consistent with the following documents included in Attachment A:

-Tips for Landscape and Gardening

-Building and Ground Maintenance Guidelines

-Housekeeping practices

-Landscape maintenance

N4- BMP Maintenance

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BMP maintenance, implementation schedules and responsible parties are included with each specific BMP narrative in section V.

N5- Title 22 CCR compliance

Hazardous waste shall be managed properly through compliance with applicable title 22 regulations.

Storage and transportation of hazardous materials shall be per the title 22of the California Code of Regulations and the Health and Safety Code.

N6- Local Water Quality Permit Compliance

The Permittees, under the Water Quality Ordinance, may issue permits to ensure clean stormwater discharges from the site are compliant. At this time the City of Fullerton does not have a specific industrial Water Quality Permit.

N7- Spill Contingency Plan

The building operator shall prepare a Spill Contingency Plan. The plan shall describe how the employees will prepare for and respond to spill of hazardous materials. The plan shall describe the stockpiling of cleanup materials, how to notify the responsible agencies, how to dispose of cleanup materials, the documentation of the spill of hazardous material events.

See Attachment A for additional information on plan preparation:

IC17 Spill Prevention and Cleanup

SC-11 Spill Prevention, Control and Cleanup

N9- Hazardous Material Disclosure Compliance

The owner is responsible for obtaining the required permits for the use and transportation of hazardous materials. Permits may be required from the County of Orange Health Department, City of Fullerton and other local authorities.

N10- Uniform Fire Code Implementation

The owner is responsible for complying with the Orange County Fire Department requirements regarding proper management of hazardous materials and emergency response plans. An inventory of hazardous materials shall be maintained on-site and an emergency response plans shall be established.

N11-Common area litter control

The Owner will be required to implement trash management and litter control procedures in the common areas aimed at reducing pollution of drainage water. The Owner may contract with their landscape maintenance firm to provide this service with regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations and reporting the violations to the Owner for investigation.

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See Attachment A for additional information:

IC3 Building Maintenance

FP-4 Sidewalk, Plaza, and Fountain Maintenance and Cleaning

SC-41 Building and Grounds Maintenance

SC-60 Housekeeping Practices

SC-71 Plaza and Sidewalk Cleaning

N14-Common area catch basin inspection

The Owner must ensure that the on-site drain inlets, grates, and drainpipes will be periodically inspected visually. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. If necessary, clean, repair, or replace any drainage facility prior to the start of each rainy season (no later than October 15 of each year). Also, refer to "Drainage System Maintenance" and "Drainage Facility Operation and Maintenance" in Attachment A.

N15-Street Sweeping Private Streets and Parking Lots

The Owner must sweep outdoor lots regularly (minimum monthly) or as needed to maintain parking lot surface without trash, debris, or other removable solids, and prior to the storm season (no later than October 15 each year). Sweeping shall be done with a vacuum-type sweeper. Under no circumstances are outdoor areas/lots to be rinsed or washed with water unless said rinse/wash water is collected and disposed of properly (i.e. into the sewer).

See Attachment A for additional information:

IC15 Parking and Storage Area Maintenance

FF-9 Parking Lot Maintenance

SC-43 Parking/Storage Area Maintenance

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IV.3.9 Structural Source Control BMPs

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	This project does not propose the outdoor storage of hazardous materials.
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	This project does not contain slopes or channel of significance to require the use of energy dissipation devices.
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☐	☒	Not Applicable to this project.
S6	Dock areas	☐	☒	No Dock areas proposed
S7	Maintenance bays	☐	☒	This project does not contain maintenance bays.
S8	Vehicle wash areas	☐	☒	No vehicle wash areas proposed
S9	Outdoor processing areas	☐	☒	This project does not contain outdoor processing areas.
S10	Equipment wash areas	☐	☒	This project does not contain equipment wash areas.
S11	Fueling areas	☒	☐	
S12	Hillside landscaping	☐	☒	This project is not located on a hillside.

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S13	Wash water control for food preparation areas	☐	☒	This project does not contain food preparation areas.
S14	Community car wash racks	☐	☒	This project does not contain community car wash racks.

S1-Provide storm drain system stenciling and signage

All catch basins/inlets/outlets on site must be marked using the City's "No Dumping – Drains to Ocean" curb marker or stenciled. An approved stencil shall be used to paint this message on the top of curb directly above the inlet, and on one side of the curb face. Labeling for catch basins is to be inspected regularly and maintained so as to be reasonably legible at all times. The inspection and maintenance is to be performed by the Owner. This stencil is to alert the public/employees to the destination of pollutants discharged into the storm water.

See CASQA Stormwater Handbook BMP Fact Sheet SD-13 (Attachment A) for additional information.

S3-Design and construct trash and waste storage areas to reduce pollution introduction

The owner shall post signs on trash enclosure gates that state "Keep Dumpster Lids Closed." The Owner will monitor dumpster usage such that dumpsters are not overfilled and the dumpster lids can close completely. The Owner shall increase the trash pickup schedule as necessary to prevent dumpsters from overfilling. The Owner will observe and damge to the trash enclosure wall and any discharge from the trash storage area.

Trash storage areas shall be designed to reduce pollutant introduction. All trash container areas shall meet the following requirements:

1. Paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, screened or walled to prevent off-site transport of trash; and
2. Provide solid roof or awning to prevent direct precipitation.

Connection of trash area drains to the municipal storm drain system is prohibited.

Potential conflicts with fire code and garbage hauling activities should be considered in implementing this source control.

See CASQA Stormwater Handbook Section 3.2.9 and BMP Fact Sheet SD-32 (Attachment A) for additional information.

S4-Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control

All irrigation systems will be inspected to ensure that the systems are functioning properly and that the programmable timers are set correctly.

Timing and application methods of irrigation water shall be designed to minimize the runoff of excess irrigation water into the minicipal storm drain system. The following methods to reduce excessive irrigation runoff shall be incorporated in common areas of development:

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1. Employing rain shutoff devices to prevent irrigation after precipitation.
2. Designing irrigation systems to each landscape area's specific water requirements.
3. Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
4. Implementing landscape plan consistent with County Water Conservation Resolution or city equivalent, which may include provision of water sensors, programmable irrigation times (for short cycle), etc.
5. The timing and application methods or irrigation water shall be designed to minimize the runoff of excess irrigation water into the municipal storm drain system.
6. Employing other comparable, equally effective, methods to reduce irrigation water runoff.
7. Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider other design features, such as:
    - Use mulches (such as wood chips or shredded wood products) in planter areas without ground cover to minimize sediment in runoff.
    - Install appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant material where possible and/or as recommended by the landscape architect.
    - Leave a vegetative barrier along the property boundary and interior watercourse, to act as a pollutant filter, where appropriate and feasible.
    - Choose plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth.

Irrigation practices shall comply with local and statewide ordinanaces related to irrigation efficiency.
See CASQA Stormwater Handbook BMP Fact Sheet SD-12 (Attachment A) for additional information.

S11-Fueling areas

At a minimum, the fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less. The fuel dispensing area shall be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited. The fuel dispensing area shall have an appropriate slope (2% - 4%) to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of stormwater. 4. An overhanging roof structure or canopy shall be provided. The cover's minimum dimensions must be equal to or greater than the area of the fuel dispensing area in the first item above. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area shall drain to the project's Treatment Control BMP(s) prior to discharging to the municipal storm drain system.

IV.4 Alternative Compliance Plan (If Applicable)

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IV.4.1 Water Quality Credits

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

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IV.4.2 Alternative Compliance Plan Information

Not Applicable

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Section V Inspection/Maintenance Responsibility for BMPs

The responsible party of inspection and Maintenance for the plan will be the project owner. The "Owners" as referred below and their information is listed below:

TBD

The owner is aware of the maintenance responsibilities of the proposed BMP's. A funding mechanism will be established to maintain the BMP's at the frequency stated in the WQMP.

The owner will be responsible for long term funding for the inspection and maintenance of the proposed BMP's.

BMP Inspection/Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N1. Education for Property Owners, Tenants and Occupants	Owner	The owner shall prepare a training manual along with the Operations and Maintenance Manual for all existing and future employees. The manual shall include information regarding proper practices that contribute to the protection of the stormwater quality. Training shall be provided upon hire of new associates. A copy of the training manual shall remain in the building at all times for employees to use as needed. The manual shall include all Educational Material included Attachment A of this report. Additional education material may be found in the following website : http://www.ocwatershed.com/PublicEd/resources/business-brochures.html	Quarterly. Training shall be provided upon hire and regular intervals thereafter.

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N2. Activity Restrictions	Owner	The property owner shall ensure that the rules and guidelines as determined on the project conditions of approval or other policies are followed at all times once the project is operations. Prohibited activities for the project that promoted water quality includes: Prohibit discharges of fertilizer, pesticides, or animal wastes to streets or storm drains. Prohibit blowing or sweeping of debris (leaf litter, grass clippings, litter, etc.) into streets or storm drains. Requirement to keep dumpster lids closed at all times. Prohibit vehicle washing, maintenance, or repair on the premises on-site.	Ongoing
N3. Common Area Landscape Management	Owner	Ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water and reduce pesticide and fertilizer applications.	Weekly
N4. BMP Maintenance	Owner	All proposed BMP's shall be regularly maintained.	Ongoing
N5. Title 22 CCR Compliance	Owner	Hazardous waste shall be managed properly through compliance with applicable title 22 regulations. Storage and transportation of hazardous materials shall be per the title 22of the California Code of Regulations and the Health and Safety Code	Every time handling of hazardous materials is required
N7. Spill Contingency Plan	Owner	The owner shall develop a spill contingency plan. Owner shall ensure adequate spill/leak prevention measures are stored on-site and employees are made aware of their location. Owner shall ensure adequate training on spill response procedures,	Yearly Training of Employees & Every time handling of hazardous materials is

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		cleanup procedures, and reporting. This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills. Refer to Attachment A SC-11 for additional information on Inspection/Maintenance procedures and activities.	required
N9. Hazardous Materials Disclosure Compliance	Owner	The owner is responsible for obtaining the required permits for the use and transportation of hazardous materials. Permits may be required from the County of Orange Health Department, City of Fullerton and other local authorities.	Every time handling of hazardous materials is required.
N10. Uniform Fire Code Implementation	Owner	The owner is responsible for complying with the Orange County Fire Department requirements regarding proper management of hazardous materials and emergency response plans. An inventory of hazardous materials should be maintained on-site and an emergency response plans should be established.	Procedures shall be established prior to building occupancy.
N11. Common Area Litter Control	Owner	The Owner will be required to implement trash management and litter control procedures in the common areas aimed at reducing pllution of drainage water. The Owner may contract with their landscape maintenace firm to provide this service with regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations and reporting the violations to the Owner for investigation	Ongoing

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N12. Employee Training	Owner	The owner shall prepare a training manual for all existing and future employees. The manual shall include information regarding proper practices that contribute to the protection of the stormwater quality. Training shall be provided upon hire of new associates. A copy of the training manual shall remain in the building at all times for employees to use as needed. The manual shall include all Educational Material included on Attachment A of this report. Additional education material may be found in the following website : http://www.ocwatershed.com/PublicEd/resources/business-brochures.html	Quarterly. Training shall be provided upon hire and regular intervals thereafter.
N14. Common Area Catch Basin Inspection	Owner	The owner must ensure that the on-site inlet and drain pipe will be periodically inspected visually. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. If necessary, clean, repair, or replace any drainage facility prior to the start of each rainy season (no later than October 15 of each year).	Monthly -Before and after predicted storm events
N15. Street Sweeping Private Streets and Parking Lots	Owner	The Owner must sweep outdoor lots regularly (minimum monthly), or as needed to maintain parking lot surface without trash, debris, or other removable solids, and prior to the storm season (no later than October 15 each year). Sweeping shall be done with a vacuum-type sweeper. Under no circumstances are outdoor areas/lots to be rinsed or washed with water unless said rinse/wash water is collected and disposed of properly (i.e. into the sewer).	Monthly

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BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
S1. Provide Storm Drain System Stenciling and Signage	Owner	All catch basins/inlets/outlets/parkway drains on site must be marked using the City's "No Dumping – Drains to Ocean" curb marker or stenciled using an approved stencil to paint this message on the top of curb directly above the inlet, and on one side of the curb face. Labeling for catch basins & parkway drains is to be inspected regularly and maintained so as to be reasonably legible at all times. The inspection and maintenance is to be performed by the Owner. This stencil is to alert the public/employees to the destination of pollutants discharged into the storm water.	Annually
S3. Design Trash Enclosures to Reduce Pollutant Introduction	Owner	The owner shall post signs on trash enclosure gates that state "Keep Dumpster Lids Closed." The Owner will monitor dumpster usage such that dumpsters are not overfilled and the dumpster lids can close completely. The Owner shall increase the trash pickup schedule as necessary to prevent dumpsters from overfilling. The Owner will observe and damage to the trash enclosure wall and any discharge	Ongoing

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		from the trash storage area.	
S4. Use Efficient Irrigation Systems and Landscape Design	Owner	All irrigation systems will be inspected to ensure that the systems are functioning properly and that the programmable timers are set correctly. See CASQA Stormwater Handbook BMP Fact Sheet SD-12 (Attachment A) for additional information S4. Use Efficient Irrigation Systems and Landscape Design implementation/maintenance activities.	Monthly
Proprietary Biotreatment BMP (Modular Wetlands)	Owner	Refer to the manufacturer's maintenance specifications included in Attachment D	Refer to the manufacturer's maintenance specifications included in Attachment D
Proprietary Stormwater Storage System (Old Castle)	Owner	Refer to the manufacturer's maintenance specifications included in Attachment D	Refer to the manufacturer's maintenance specifications included in Attachment D
FloGard Catch Basin Media Filter Inserts	Owner	Refer to the manufacturer's maintenance specifications included in Attachment D	Refer to the manufacturer's maintenance specifications included in Attachment D
Bioretention Basin	Owner	Inspect soil and planting. Remove weeds and clear any accumulation of trash, or debris. Inspect side slopes for evidence of instability or erosion and correct as necessary. Observe bottom of ponding area for uniform percolation throughout. If portions of area do not drain within 48 hrs after the end of the storm the soil should be tilled and replanted and remove any accumulated sediment.	Monthly or after a rain event

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Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

- See following page

VI.2 Submittal and Recordation of Water Quality Management Plan

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

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

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Section VII Educational Materials

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

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☐	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☒
Household Tips	☐	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐	Tips for Protecting Your Watershed	☒
Recycle at Your Local Used Oil Collection Center (Central County)	☐	SD-10 Site Design & Landscape Planning	☒
Recycle at Your Local Used Oil Collection Center (South County)	☐	SD-11 Roof Runoff Controls	☒
Tips for Maintaining a Septic Tank System	☐	SD-12 Efficient Irrigation	☒
Responsible Pest Control	☐	SD-13 Storm Drain Signage	☒
Sewer Spill	☐	SD-32 Trash Storage Areas	☒
Tips for the Home Improvement Projects	☐	IC2 Animal Handling Areas	☐
Tips for Horse Care	☐	IC3 Building Maintenance	☒
Tips for Landscaping and Gardening	☒	IC7 Landscape Maintenance	☒
Tips for Pet Care	☐	IC15 Parking and Storage Area Maintenance	☒
Tips for Pool Maintenance	☐	IC17 Spill Prevention and Cleanup	☒
Tips for Residential Pool, Landscape and Hardscape Drains	☐		☐
Tips for Projects Using Paint	☐	FP-2 Landscape Maintenance	☒

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		FP-4 Sidewalk, Plaza, and Fountain Maintenance and Cleaning	☒
		FP-5 Solid Waste Handling	☒
		FF-9 Parking Lot Maintenance	☒
		DF-1 Drainage Facility Operation and Maintenance	☒
		SC-10 Non-Stormwater Discharges	☒
		SC-11 Spill Prevention, Control and Cleanup	☒
		SC-34 Waste Handling and Disposal	☒
		SC-41 Building and Grounds Maintenance	☒
		SC-43 Parking/Storage Area Maintenance	☒
		SC-60 Housekeeping Practices	☒
		SC-71 Plaza and Sidewalk Cleaning	☒
		SC-73 Landscape Maintenance	☒
		SC-74 Drainage System Maintenance	☒

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ATTACHMENT A

EDUCATIONAL MATERIALS

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FP-5

SOLID WASTE HANDLING

It is important to control litter to eliminate trash and other materials in storm water runoff. Waste reduction is a major component of waste management and should be encouraged through training and public outreach. Management of waste once it is collected may involve reuse, recycling, or proper disposal. Specific solid waste handling activities may include one or more of the following:

1. **Solid Waste Collection**
2. **Waste Reduction and Recycling**
3. **Hazardous Waste Collection**
4. **Litter Control**

Reduce by purchasing only the amount needed.
Reuse products when possible.
Recycle leftover products that are recyclable, and dispose of other wastes safely.

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for solid waste handling include:

- Reuse products when possible.
- Recycle leftover products that are recyclable.
- Once per year, educate municipal staff on pollution prevention measures.

MODEL PROCEDURES:

1. Solid Waste Collection

✓ Implement procedures, where applicable, to collect, transport, and dispose of solid waste at appropriate disposal facilities in accordance with applicable federal, state, and local laws and regulations. Optional disposal options include the reuse and recycling of appropriate materials (see following sections).

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- ✓ Include properly designed trash storage areas.
- ✓ Regularly inspect solid waste containers for structural damage. Repair or replace damaged containers as necessary.
- ✓ Secure solid waste containers; containers must be closed tightly when not in use.
- ✓ Do not fill waste containers with washout water or any other liquid.
- ✓ Remove all debris from containers prior to cleaning with water. Only clean out containers in a designated area that drains to a washrack that is connected to a sanitary sewer.
- ✓ Minimize spillage/leaking from solid waste containers. For larger solid waste containers (especially compactors) that utilize a hydraulic fluid pump system, regularly inspect and replace faulty pumps or hoses to minimize the potential of releases and spills.

Also see Emergency Spill Response procedure sheet.

- ✓ Ensure that only appropriate solid wastes are disposed of. Certain wastes such as hazardous wastes, appliances, fluorescent bulbs, pesticides, etc. may not be disposed of in solid waste containers.

2. Waste Reduction and Recycling

Although many types of waste can be recycled, recycling options for each waste type may be limited. All gasoline, antifreeze, waste oil, and lead-acid batteries can be recycled. Latex and oil-based paint can be reused, as well as recycled. Materials that cannot be reused or recycled should be disposed of properly.

- ✓ Provide containers for the collection and storage of recyclable materials.
- ✓ Do not mix liquid wastes, this can cause chemical reactions or make recycling impossible and complicate disposal.
- ✓ Recycle used motor oil. Municipalities are required to have a used oil recycling element within their integrated waste management plan.

> *CalRecycle has a Recycling Hotline, (800) RECYCLE, that provides information and recycling locations for used oil.*

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3. Hazardous Waste Collection

Household hazardous wastes (HHW) are defined as waste materials which are typically found in homes or similar sources, which exhibit characteristics such as: corrosivity, ignitability, reactivity, and/or toxicity, or are listed as hazardous materials by EPA.

List of most common HHW products:
Drain opener
Oven cleaners
Wood and metal cleaners and polishes
Paint Thinners
Automotive oil and fuel additives
Adhesives
Grease and rust solvents Batteries
Herbicides
Paint strippers and removers Pesticides
Fungicides/wood preservatives
Starter fluids
Carburetor and fuel injection cleaners

- ✓ Follow proper storage and disposal measures for hazardous waste materials as identified on packaging or Material Safety Data Sheets.
- ✓ Emergencies related to hazardous waste should be reported to 911

OPTIONAL:

- Identify and promote use of non-hazardous alternatives.
- Promote household hazardous waste (HHW) reuse and recycling.

4. Litter Control

- ✓ Enforce anti-litter laws.
- ✓ Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- ✓ Clean out and cover litter receptacles frequently to prevent overflow.
- ✓ Increase litter control for events generating substantial quantities of litter.

OPTIONAL:

- Post “No Littering” signs
- Place trash receptacles at transit stops and maintain as necessary.
- Participate in and/or organize additional clean-up programs (e.g., “Coastal Clean Up Day”, “Pride Days”, “Volunteer Connection Days”).

REFERENCES:

Bay Area Stormwater Management Agencies Association. 1996. *Pollution From Surface Cleaning.*

California Storm Water Best Management Practice Handbooks. Municipal Best Management Practice Handbook. Prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates for Stormwater Quality Task Force. March 1993.

Environmental Protection Agency (EPA). *Pollution Prevention and Good Housekeeping for Municipal Operations Storm Water. Pet Waste Collection.* Office of Wastewater Management. Online:

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http://www.epa.gov/npdes/menuofbmps/poll_3.htm

Harvard University. 2002. Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety.

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IC3. BUILDING MAINTENANCE

Best Management Practices (BMPs)

A BMP is a technique, measure or structural control that is used for a given set of conditions to improve the quality of the stormwater runoff in a cost effective manner[1]. The minimum required BMPs for this activity are outlined in the box to the right. Implementation of pollution prevention/good housekeeping measures may reduce or eliminate the need to implement other more costly or complicated procedures. Proper employee training is key to the success of BMP implementation.

MINIMUM BEST MANAGEMENT PRACTICES

Pollution Prevention/Good Housekeeping

- Properly collect and dispose of water when pressure washing buildings, rooftops, and other large objects.
- Properly prepare work area before conducting building maintenance.
- Properly clean and dispose of equipment and wastes used and generated during building maintenance.
- Store toxic material under cover when not in use and during precipitation events.

Stencil storm drains

Training

- Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
- Provide on-going employee training in pollution prevention.

The BMPs outlined in this fact sheet target the following pollutants:

Targeted Constituents	
Sediment	x
Nutrients	x
Floatable Materials	
Metals	x
Bacteria	x
Oil & Grease	
Organics & Toxicants	
Pesticides	
Oxygen Demanding	

Provided below are specific procedures associated with each of the minimum BMPs along with procedures for additional BMPs that should be considered if this activity takes place at a facility located near a sensitive waterbody. In order to meet the requirements for medium and high priority facilities, the owners/operators must select, install and maintain appropriate BMPs on site. Since the selection of the appropriate BMPs is a site-specific process, the types and numbers of additional BMPs will vary for each facility.

1. Properly collect and dispose of water when pressure washing buildings, rooftops, and other large objects.
    - If pressure washing where the surrounding area is paved, use a water collection device that enables collection of wash water and associated solids. Use a sump pump, wet vacuum or similarly effective device to collect the runoff and loose materials. Dispose of the collected runoff and solids properly. Refer to fact sheet *IC24 Wastewater Disposal* for guidance on appropriate methods for disposal of wash water to the sanitary sewer.
    - If pressure washing on a landscaped area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the landscaping and not drain to pavement.
2. Properly prepare work area before conducting building maintenance.
    - Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
    - Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

[1] EPA " *Preliminary Data Summary of Urban Stormwater Best Management Practices"*

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3. Properly clean and dispose of equipment and wastes used and generated during building maintenance.
    - Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
    - Properly dispose of wash water, sweepings, and sediments.
    - Properly store equipment, chemicals, and wastes.
    - Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.

    OPTIONAL:
    - Recycle residual paints, solvents, lumber, and other materials to the maximum extent practicable
4. Employ soil erosion and stabilization techniques when exposing large areas of soil.
    - Confine excavated materials to pervious surfaces away from storm drain inlets, sidewalks, pavement, and ditches. Material must be covered if rain is expected.
    - Use chemical stabilization or geosynthetics to stabilize bare ground surfaces.
5. Store toxic material under cover when not in use and during precipitation events.
6. Properly dispose of fluids from air conditioning, cooling tower, and condensate drains.
7. Regularly inspect air emission control equipment under AQMD permit.
8. Switch to non-toxic chemicals for maintenance when possible.
    - If cleaning agents are used, select biodegradable products whenever feasible
    - Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).
9. Use chemicals that can be recycled.
    - Buy recycled products to the maximum extent practicable

Training

1. Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
2. Train employees on proper spill containment and cleanup.
    - Establish training that provides employees with the proper tools and knowledge to immediately begin cleaning up a spill.
    - Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
    - Fact sheet IC17 discusses Spill Prevention and Control in detail.
3. Establish a regular training schedule, train all new employees, and conduct annual refresher training.
4. Use a training log or similar method to document training.

Stencil storm drains

Storm drain system signs act as highly visible source controls that are typically stenciled directly adjacent to storm drain inlets. Stencils should read "No Dumping Drains to Ocean".

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References

California Storm Water Best Management Practice Handbook. Industrial and Commercial. 2003. www.cabmphandbooks.com

California Storm Water Best Management Practice Handbooks. Industrial/Commercial Best Management Practice Handbook. Prepared by Camp Dresser& McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates for Stormwater Quality Task Force. March 1993.

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IC7. LANDSCAPE MAINTENANCE

Best Management Practices (BMPs)

A BMP is a technique, measure or structural control that is used for a given set of conditions to improve the quality of the stormwater runoff in a cost effective manner[1]. The minimum required BMPs for this activity are outlined in the box to the right. Implementation of pollution prevention/good housekeeping measures may reduce or eliminate the need to implement other more costly or complicated procedures. Proper employee training is key to the success of BMP implementation.

MINIMUM BEST MANAGEMENT PRACTICES

Pollution Prevention/Good Housekeeping

- Properly store and dispose of gardening wastes.
- Use mulch or other erosion control measures on exposed soils.
- Properly manage irrigation and runoff.
- Properly store and dispose of chemicals.
- Properly manage pesticide and herbicide use.
- Properly manage fertilizer use.

Stencil storm drains

Training

- Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
- Provide on-going employee training in pollution prevention.

The BMPs outlined in this fact sheet target the following pollutants:

Targeted Constituents	
Sediment	x
Nutrients	x
Floatable Materials	x
Metals	
Bacteria	x
Oil & Grease	
Organics & Toxicants	
Pesticides	x
Oxygen Demanding	x

Provided below are specific procedures associated with each of the minimum BMPs along with procedures for additional BMPs that should be considered if this activity takes place at a facility located near a sensitive waterbody. In order to meet the requirements for medium and high priority facilities, the owners/operators must select, install and maintain appropriate BMPs on site. Since the selection of the appropriate BMPs is a site-specific process, the types and numbers of additional BMPs will vary for each facility.

1. Take steps to reduce landscape maintenance requirements.
    - Where feasible, retain and/or plant native vegetation with features that are determined to be beneficial. Native vegetation usually requires less maintenance than planting new vegetation.
    - When planting or replanting consider using low water use flowers, trees, shrubs, and groundcovers.
    - Consider alternative landscaping techniques such as naturescaping and xeriscaping.
2. Properly store and dispose of gardening wastes.
    - Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage at a permitted landfill or by composting.
    - Do not dispose of gardening wastes in streets, waterways, or storm drainage systems.
    - Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm and/or cover.
3. Use mulch or other erosion control measures on exposed soils.

[1] EPA " *Preliminary Data Summary of Urban Stormwater Best Management Practices"*

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4. Properly manage irrigation and runoff.
    - Irrigate slowly or pulse irrigate so the infiltration rate of the soil is not exceeded.
    - Inspect irrigation system regularly for leaks and to ensure that excessive runoff is not occurring.
    - If re-claimed water is used for irrigation, ensure that there is no runoff from the landscaped area(s).
    - If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
    - Use automatic timers to minimize runoff.
    - Use popup sprinkler heads in areas with a lot of activity or where pipes may be broken. Consider the use of mechanisms that reduce water flow to broken sprinkler heads.
5. Properly store and dispose of chemicals.
    - Implement storage requirements for pesticide products with guidance from the local fire department and/or County Agricultural Commissioner.
    - Provide secondary containment for chemical storage.
    - Dispose of empty containers according to the instructions on the container label.
    - Triple rinse containers and use rinse water as product.
6. Properly manage pesticide and herbicide use.
    - Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of pesticides and herbicides and training of applicators and pest control advisors.
    - Follow manufacturers' recommendations and label directions.
    - Use pesticides only if there is an actual pest problem (not on a regular preventative schedule). When applicable use less toxic pesticides that will do the job. Avoid use of copper-based pesticides if possible. Use the minimum amount of chemicals needed for the job.
    - Do not apply pesticides if rain is expected or if wind speeds are above 5 mph.
    - Do not mix or prepare pesticides for application near storm drains. Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the targeted pest.
    - Whenever possible, use mechanical methods of vegetation removal rather than applying herbicides. Use hand weeding where practical.
    - Do not apply any chemicals directly to surface waters, unless the application is approved and permitted by the state. Do not spray pesticides within 100 feet of open waters.
    - Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
    - When conducting mechanical or manual weed control, avoid loosening the soil, which could lead to erosion.
    - Purchase only the amount of pesticide that you can reasonably use in a given time period.
    - Careful soil mixing and layering techniques using a topsoil mix or composted organic material can be used as an effective measure to reduce herbicide use and watering.
7. Properly manage fertilizer use.
    - Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers.
    - Follow manufacturers' recommendations and label directions.
    - Employ techniques to minimize off-target application (e.g. spray drift) of fertilizer, including consideration of alternative application techniques. Calibrate fertilizer distributors to avoid excessive application.
    - Periodically test soils for determining proper fertilizer use.
    - Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
    - Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
    - Use slow release fertilizers whenever possible to minimize leaching

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8. Incorporate the following integrated pest management techniques where appropriate:
    - Mulching can be used to prevent weeds where turf is absent.
    - Remove insects by hand and place in soapy water or vegetable oil. Alternatively, remove insects with water or vacuum them off the plants.
    - Use species-specific traps (e.g. pheromone-based traps or colored sticky cards).
    - Sprinkle the ground surface with abrasive diatomaceous earth to prevent infestations by soft-bodied insects and slugs. Slugs also can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
    - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
    - Small mammals and birds can be excluded using fences, netting, and tree trunk guards.
    - Promote beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seedhead weevils, and spiders that prey on detrimental pest species.

Training

1. Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
2. Educate and train employees on the use of pesticides and pesticide application techniques. Only employees properly trained to use pesticides can apply them.
3. Train and encourage employees to use integrated pest management techniques.
4. Train employees on proper spill containment and cleanup.
    - Establish training that provides employees with the proper tools and knowledge to immediately begin cleaning up a spill.
    - Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
    - Fact sheet IC17 discusses Spill Prevention and Control in detail.
5. Establish a regular training schedule, train all new employees, and conduct annual refresher training.
6. Use a training log or similar method to document training.

Stencil storm drains

Storm drain system signs act as highly visible source controls that are typically stenciled directly adjacent to storm drain inlets. Stencils should read "No Dumping Drains to Ocean".

References

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IC10. OUTDOOR LOADING/UNLOADING OF MATERIALS

Best Management Practices (BMPs)

A BMP is a technique, measure or structural control that is used for a given set of conditions to improve the quality of the stormwater runoff in a cost effective manner[1]. The minimum required BMPs for this activity are outlined in the box to the right. Implementation of pollution prevention/good housekeeping measures may reduce or eliminate the need to implement other more costly or complicated procedures. Proper employee training is key to the success of BMP implementation.

MINIMUM BEST MANAGEMENT PRACTICES

Pollution Prevention/Good Housekeeping

- Park vehicles and conduct loading/unloading only in designated loading/unloading areas so that spills or leaks can be contained.
- Clean loading/unloading areas regularly to remove potential sources of pollutants.
- Reduce exposure of materials to rain.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections.
- Inspect equipment regularly.
- If possible, conduct loading and unloading in dry weather.

Stencil storm drains

Training

- Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
- Provide on-going employee training in pollution prevention.

The BMPs outlined in this fact sheet target the following pollutants:

Targeted Constituents	
Sediment	x
Nutrients	x
Floatable Materials	
Metals	x
Bacteria	
Oil & Grease	x
Organics & Toxicants	x
Pesticides	x
Oxygen Demanding	

Provided below are specific procedures associated with each of the minimum BMPs along with procedures for additional BMPs that should be considered if this activity takes place at a facility located near a sensitive waterbody. In order to meet the requirements for medium and high priority facilities, the owners/operators must select, install and maintain appropriate BMPs on site. Since the selection of the appropriate BMPs is a site-specific process, the types and numbers of additional BMPs will vary for each facility.

1. Properly design loading/unloading areas to prevent storm water runon, runoff of spills, etc.
    - Grade and/or berm the area to prevent runon.
    - Position roof downspouts to direct stormwater away from the area.
    - Grade and/or berm the loading/unloading area to a drain that is connected to a dead-end.
    - The area where truck transfers take place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
    - Avoid placing loading/unloading areas near storm drains.
2. Park vehicles and conduct loading/unloading only in designated loading/unloading areas so that spills or leaks can be contained.
3. Clean loading/unloading areas regularly to remove potential sources of pollutants. This includes outside areas that are regularly covered by containers or other materials.
4. Reduce exposure of materials to rain.
    - Cover the loading/unloading areas.
    - If a cover is unfeasible, use overhangs, or seals or door skirts to enclose areas.
5. Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections.

[1] EPA " *Preliminary Data Summary of Urban Stormwater Best Management Practices"*

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6. Inspect equipment regularly
    - Designate a responsible party to check under delivery vehicles for leaking fluids, spilled materials, debris, or other foreign materials.
    - Check loading/unloading equipment regularly for leaks.
7. If possible, conduct loading and unloading in dry weather.

Training

1. Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
2. Train employees on proper spill containment and cleanup.
    - Establish training that provides employees with the proper tools and knowledge to immediately begin cleaning up a spill.
    - Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
    - Fact sheet IC17 discusses Spill Prevention and Control in detail.
3. Train employees on the proper techniques used during liquid transfers to avoid leaks and spills.
4. Train forklift operators on the proper loading and unloading procedures.
5. Establish a regular training schedule, train all new employees, and conduct annual refresher training.
6. Use a training log or similar method to document training.

Stencil storm drains

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References

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IC15. PARKING AND STORAGE AREA MAINTENANCE

Best Management Practices (BMPs)

A BMP is a technique, measure or structural control that is used for a given set of conditions to improve the quality of the stormwater runoff in a cost effective manner[1]. The minimum required BMPs for this activity are outlined in the box to the right. Implementation of pollution prevention/good housekeeping measures may reduce or eliminate the need to implement other more costly or complicated procedures. Proper employee training is key to the success of BMP implementation.

MINIMUM BEST MANAGEMENT PRACTICES

Pollution Prevention/Good Housekeeping

- Conduct regular cleaning.
- Properly collect and dispose of wash water.
- Keep the parking and storage areas clean and orderly.
- Use absorbent materials and properly dispose of them when cleaning heavy oily deposits.
- When conducting surface repair work cover materials and clean paintbrushes and tools appropriately.

Stencil storm drains

Training

- Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
- Provide on-going employee training in pollution prevention.

The BMPs outlined in this fact sheet target the following pollutants:

Targeted Constituents	
Sediment	x
Nutrients	x
Floatable Materials	x
Metals	x
Bacteria	x
Oil & Grease	x
Organics & Toxicants	x
Pesticides	x
Oxygen Demanding	x

Provided below are specific procedures associated with each of the minimum BMPs along with procedures for additional BMPs that should be considered if this activity takes place at a facility located near a sensitive waterbody. In order to meet the requirements for medium and high priority facilities, the owners/operators must select, install and maintain appropriate BMPs on site. Since the selection of the appropriate BMPs is a site-specific process, the types and numbers of additional BMPs will vary for each facility.

1. Conduct regular cleaning.
    - Sweeping or vacuuming the parking facility is encouraged over other methods.
    - Sweep all parking lots at least once before the onset of the wet season.
    - Establish frequency of sweeping based on usage and field observations of waste accumulation.
2. Properly collect and dispose of wash water.
    - Block the storm drain or contain runoff.
    - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains. Refer to fact sheet *IC24 Wastewater Disposal* for guidance on appropriate methods for disposal of wash water to the sanitary sewer.
    - Dispose of parking lot sweeping debris and dirt at a landfill.
3. Consider use of source treatment BMPs to treat runoff.
    - Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
    - Utilize sand filters or oleophilic collectors for oily waste in low quantities.

[1] EPA " *Preliminary Data Summary of Urban Stormwater Best Management Practices"*

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4. Keep the parking and storage areas clean and orderly.
    - Clean out and cover litter receptacles frequently to prevent spillage.
    - Remove debris in a timely fashion.

    OPTIONAL:
    - Post "No Littering" signs.
5. When cleaning heavy oily deposits:
    - If possible, clean oily spots with absorbent materials.
    - Do not allow discharges to the storm drain.
    - Appropriately dispose of spilled materials and absorbents.
6. When conducting surface repair work:
    - Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
    - Conduct surface repair work during dry weather to prevent contamination from contacting stormwater runoff.
    - Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and clean any debris for proper disposal.
    - To avoid runoff, use only as much water as necessary for dust control.
    - Use drip pans or absorbent material to catch drips from paving equipment that is not in use. Dispose of collected material and absorbents properly.
7. Conduct inspections on a regular basis.
    - Designate personnel to conduct inspections of the parking facilities and stormwater conveyance systems associated with them.
    - Inspect cleaning equipment/sweepers for leaks on a regular basis.
8. Keep accurate maintenance logs to evaluate materials removed/stored and improvements made.
9. Arrange rooftop drains to prevent drainage directly onto paved surfaces.

Training

1. Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
2. Train employees on proper spill containment and cleanup.
    - Establish training that provides employees with the proper tools and knowledge to immediately begin cleaning up a spill.
    - Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
    - Fact sheet IC17 discusses Spill Prevention and Control in detail.
3. Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
4. Establish a regular training schedule, train all new employees, and conduct annual refresher training.
5. Use a training log or similar method to document training.

Stencil storm drains

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IC17. SPILL PREVENTION AND CLEANUP

Best Management Practices (BMPs)

A BMP is a technique, measure or structural control that is used for a given set of conditions to improve the quality of the stormwater runoff in a cost effective manner[1]. The minimum required BMPs for this activity are outlined in the box to the right. Implementation of pollution prevention/good housekeeping measures may reduce or eliminate the need to implement other more costly or complicated procedures. Proper employee training is key to the success of BMP implementation.

MINIMUM BEST MANAGEMENT PRACTICES

Pollution Prevention/Good Housekeeping

- Develop procedures to prevent/mitigate spills to storm drain systems.
- Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal.
- Conduct routine cleaning, inspections, and maintenance.
- Properly store and handle chemical materials.
- Protect materials stored outside from stormwater runon.
- Secure drums stored in an area where unauthorized persons may gain access to prevent accidental spillage, pilferage, or any unauthorized use.
- Identify key spill response personnel.
- Clean up leaks and spills immediately.
- Report and track spills.

Stencil storm drains

Training

- Train employees on these BMPs, storm water discharge prohibitions, and wastewater discharge requirements.
- Provide on-going employee training in pollution prevention.

The BMPs outlined in this fact sheet target the following pollutants:

Targeted Constituents	
Sediment	x
Nutrients	x
Floatable Materials	x
Metals	x
Bacteria	x
Oil & Grease	x
Organics & Toxicants	x
Pesticides	x
Oxygen Demanding	x

Provided below are specific procedures associated with each of the minimum BMPs along with procedures for additional BMPs that should be considered if this activity takes place at a facility located near a sensitive waterbody. In order to meet the requirements for medium and high priority facilities, the owners/operators must select, install and maintain appropriate BMPs on site. Since the selection of the appropriate BMPs is a site-specific process, the types and numbers of additional BMPs will vary for each facility.

Spill Prevention

1. Develop procedures to prevent/mitigate spills to storm drain systems. Standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
2. Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal.
3. Conduct routine cleaning, inspections, and maintenance
    - Sweep and clean storage areas consistently at a designated frequency (e.g. weekly, monthly). DO NOT hose down areas to storm drains.
    - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Reuse, recycle, or properly dispose of any collected liquids or soiled absorbent materials.
    - Check tanks (and any containment sumps) frequently for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

[1] EPA " *Preliminary Data Summary of Urban Stormwater Best Management Practices"*

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- Check for external corrosion of material containers, structural failures, spills and overfills due to operator error, failure of piping system, etc.
- Inspect tank foundations, connections, coatings, and tank walls and piping system.

4. Properly store and handle chemical materials.
    - Designate a secure material storage area that is paved with Portland cement concrete, free of cracks and gaps, and impervious in order to contain leaks and spills.
    - Do not store chemicals, drums, or bagged materials directly on the ground. Place these items in secondary containers.
    - Keep chemicals in their original containers, if feasible.
    - Keep containers well labeled according to their contents (e.g., solvent, gasoline).
    - Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
    - Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
5. Utilize secondary containment systems for liquid materials.
    - Surround storage tanks with a berm or other secondary containment system.
    - Slope the area inside the berm to a drain.
    - Drain liquids to the sanitary sewer if available. DO NOT discharge wash water to sanitary sewer until contacting the local sewer authority to find out if pretreatment is required
    - Pass accumulated stormwater in petroleum storage areas through an oil/water separator.
    - Use catch basin filtration inserts.
6. Protect materials stored outside from stormwater runon. Construct a berm around the perimeter of the material storage area to prevent the runon of uncontaminated stormwater from adjacent areas as well as runoff of stormwater from the material.
7. Secure drums stored in an area where unauthorized persons may gain access to prevent accidental spillage, pilferage, or any unauthorized use.

Spill Control and Cleanup Activities

8. Identify key spill response personnel.
9. Adopt the Orange County Hazardous Materials Area Plan or an equivalent plan, which includes a set of planned responses to hazardous materials emergencies. The plan should include:
    - Description of the facility, owner and address, activities and chemicals present
    - Facility map
    - Notification and evacuation procedures
    - Cleanup instructions
    - Identification of responsible departments
10. Clean up leaks and spills immediately.
    - Place a stockpile of spill cleanup materials where they will be readily accessible (e.g. near storage and maintenance areas).
    - Utilize dry cleaning methods to clean up spills to minimize the use of water. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use brooms, shovels, sweepers, or plows.
    - Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
    - Clean up chemical materials with absorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
    - For larger spills, a private spill cleanup company or Hazmat team may be necessary.

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11. Reporting
    1. Report spills that pose an immediate threat to human health or the environment to local agencies, such as the fire department, and the Regional Water Quality Control Board.
    2. Establish a system for tracking incidents. The system should be designed to identify the following:
        - Types and quantities (in some cases) of wastes
        - Patterns in time of occurrence (time of day/night, month, or year)
        - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
        - Responsible parties
    3. Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).

Training
1. Educate employees about spill prevention and cleanup.
    - Establish training that provides employees with the proper tools and knowledge to immediately begin cleaning up a spill.
    - Educate employees on aboveground storage tank requirements.
    - Train all employees upon hiring and conduct annual refresher training.
2. Train employees responsible for aboveground storage tanks and liquid transfers on the Spill Prevention Control and Countermeasure Plan.

Stencil storm drains

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Preventing water pollution at your commercial/industrial site

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many landscape and building maintenance activities can lead to water pollution if you're not careful. Paint, chemicals, plant clippings and other materials can be blown or washed into storm drains that flow to the ocean. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour soap or fertilizers into the ocean, so why would you let them enter the storm drains? Follow these easy tips to help prevent water pollution.

Some types of industrial facilities are required to obtain coverage under the State General Industrial Permit. For more information visit: **www.swrcb.ca.gov/stormwater/industrial.html**

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL** (1-877-897-7455) or visit **www.ocwatersheds.com**

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline** at **1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

RECYCLE USED OIL

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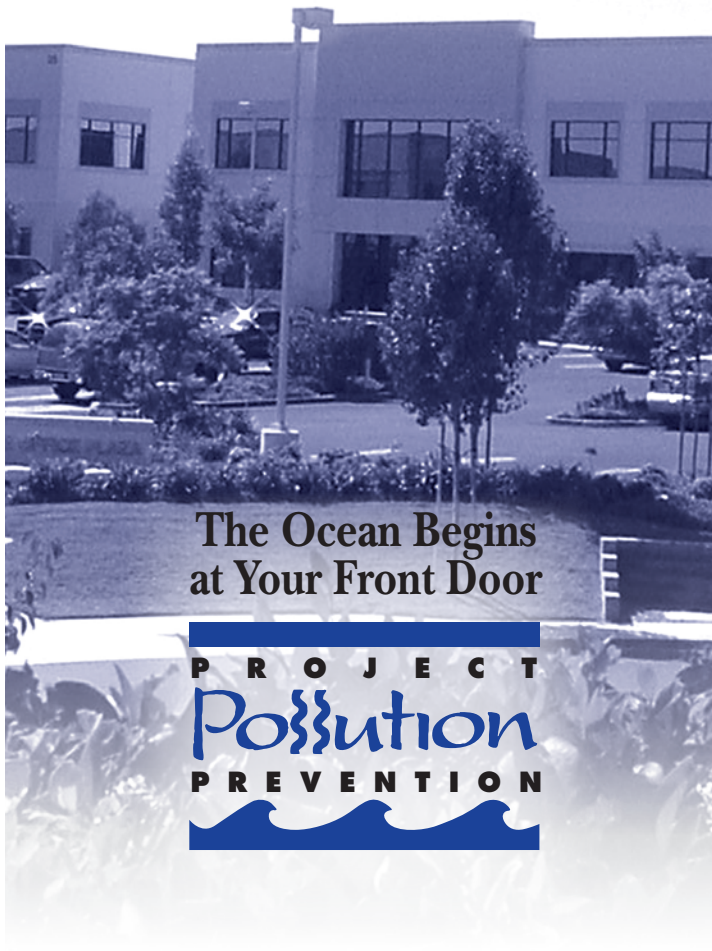
Help Prevent Ocean Pollution:

Proper Maintenance Practices for Your Business



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

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Proper Maintenance Practices for your Business

Landscape Maintenance

- Compost grass clippings, leaves, sticks and other vegetation, or dispose of it at a permitted landfill or in green waste containers. Do not dispose of these materials in the street, gutter or storm drain.
- Irrigate slowly and inspect the system for leaks, overspraying and runoff. Adjust automatic timers to avoid overwatering.
- Follow label directions for the use and disposal of fertilizers and pesticides.
- Do not apply pesticides or fertilizers if rain is expected within 48 hours or if wind speeds are above 5 mph.
- Do not spray pesticides within 100 feet of waterways.
- Fertilizers should be worked into the soil rather than dumped onto the surface.
- If fertilizer is spilled on the pavement or sidewalk, sweep it up immediately and place it back in the container.

Building Maintenance

- Never allow washwater, sweepings or sediment to enter the storm drain.
- Sweep up dry spills and use cat litter, towels or similar materials to absorb wet spills. Dispose of it in the trash.
- If you wash your building, sidewalk or parking lot, you **must** contain the water. Use a shop vac to collect the water and contact your city or sanitation agency for proper disposal information. Do not let water enter the street, gutter or storm drain.
- Use drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of materials in the trash.
- Use a ground cloth or oversized tub for mixing paint and cleaning tools.
- Use a damp mop or broom to clean floors.
- Cover dumpsters to keep insects, animals, rainwater and sand from entering. Keep the area around the dumpster clear of trash and debris. Do not overfill the dumpster.
- Call your trash hauler to replace leaking dumpsters.
- Do not dump any toxic substance or liquid waste on the pavement, the ground, or near a storm drain. Even materials that seem harmless such as latex paint or biodegradable cleaners can damage the environment.

NEVER DISPOSE OF ANYTHING IN THE STORM DRAIN.

- Recycle paints, solvents and other materials. For more information about recycling and collection centers, visit **www.oclandfills.com**.
- Store materials indoors or under cover and away from storm drains.
- Use a construction and demolition recycling company to recycle lumber, paper, cardboard, metals, masonry, carpet, plastic, pipes, drywall, rocks, dirt, and green waste. For a listing of construction and demolition recycling locations in your area, visit **www.ciwmb.ca.gov/recycle.**
- Properly label materials. Familiarize employees with Material Safety Data Sheets.

PROJECT Pollution PREVENTION

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The Ocean Begins at Your Front Door

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

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The Ocean Begins at Your Front Door

Never allow pollutants to enter the street, gutter or storm drain!

Did You Know?

- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called “non-point source” pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.

The Effect on the Ocean

Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.

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For More Information

Orange County Stormwater Program

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency's Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

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COUNTY OF ORANGE

PUBLIC FACILITIES & RESOURCES DEPARTMENT

MANAGEMENT GUIDELINES FOR THE USE OF FERTILIZERS AND PESTICIDES

September 2000
(Revision to March 1993)

VICKI L. WILSON
Director

ORANGE COUNTY BOARD OF SUPERVISORS

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GLOSSARY

California Code of Regulations, Title 3, Division 6 (3 CCR)
The State of California Code regulating pesticides and pest control operations.

California Fertilizer Association (CFA)
An organization promoting progress in the fertilizer industry in the interest of an efficient and profitable agricultural community. Activities of CFA include developing and disseminating new information to its members and others; supporting production-oriented research programs to identify maximum yield systems for farmers; promoting argonomic topics at our schools, colleges and universities; and maintaining open communications among the industry, universities and other state and federal agencies.

Chemical Labels
As required by federal law, manufacturers of pesticides must provide chemical labels on the containers of all pesticides distributed. These labels include all necessary information on the chemical constituents of the pesticide, including recommendations and instructions for use, toxicity classification and the appropriate warning statements and emergency procedures in case of acute exposures. As required by state law, labels must be kept in good, readable condition and be attached to all pesticide containers at all times.

Drainage Area Management Plan (DAMP)
A document required under the municipal NPDES stormwater permits issued to the co-permittees by Santa Ana and San Diego Regional Water Quality Control Boards.

Equivalent Training
A term referring to public agency employees dealing with the application of pesticides who have not received a qualified applicator's license (QAL) from the State of California, but who has completed a training course in pesticide application offered by the County of Orange.

Eutrophication
A decrease in dissolved oxygen in a body of water to such an extreme extent that plant life is favored over animal life. For example, a lake that is overgrown in algae on the surface is likely in a state of eutrophication.

Integrated Pest Management
The trend in vegetation management that supports moving away from reliance on pesticides and toward an integrated approach of limited pesticide use with more environmentally friendly pest control techniques.

Maximum Extent Practicable (MEP)
MEP means taking into account equitable considerations of competing factors, including, but not limited to, the gravity of the problem, fiscal feasibility, public health risks, societal concern and social benefit.

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Materials Data Safety Sheet (MSDS)
Similar to chemical labels and also required by federal law, these sheets should contain all information necessary for the safe handling of pesticides. They include chemical identifications, hazardous ingredients, physical data, fire and explosion data, health hazards, reactivity data, spill or leak cleanup procedures, special protection and special precautions.

National Pollutant Discharge Elimination System (NPDES)
The national program under the Clean Water Act for controlling discharges from point sources directly into Waters of the United States.

Permittee
A permittee to an NPDES permit that is responsible for permit conditions relating to the discharge for which it its operator. As used in the Stormwater Permit Implementation Agreement, permittees are the County of Orange, the 33 cities of Orange County and the Orange County Flood Control District.

Pest Control Advisor (PCA)
Certification obtained from the State of California after demonstrating adequate knowledge of pests, pesticides and the implications of pesticide use. A recommendation for pesticide use must be obtained from a PCA before public agencies may approve any pesticide applications.

Qualified Applicator's License (QAL)
A license obtained from the State of California after demonstrating adequate knowledge of the proper techniques for handling, storing, transporting and applying pesticides. Workers must obtain a QAL before being permitted to apply or supervise application of Category 1 pesticides.

Qualified Fertilizer Specialist
A person designated by the governing public agency who is knowledgeable of the proper techniques for handling, storing, transporting and applying fertilizers as defined in the Management Guidelines for Use of Fertilizers and Pesticides. This person shall be able to sample, inspect, test and make analyses of fertilizers that are in use or being considered for use in the agency's jurisdiction to such an extent to adequately determine their compliance with the management guidelines.

Restricted Materials Permit
A permit that must be acquired by any public agency before application of the pesticides listed as restricted by the State of California in the Code of Regulations ("CCR"), Title 3, Division 6. In Orange County, this permit must be obtained from the County Agricultural Commissioner.

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State Code
In this report, referring to CCR, Title 3, Division 6, and noted as "3 CCR."

Storm Drain
Pipe or channel structure designed to convey only stormwater runoff for purposes of flood protection. Federal regulations use the term "storm sewer." Use of the word "sewer" for a stormwater conveyance structure should be discouraged, since the word "sewer" also includes sanitary sewers and combined sewers which carry human waste.

Toxicity Classification
The California Department of Food and Agriculture groups pesticides into three categories according to their toxicity or potential to cause injury to people. Category 1 pesticides are the most hazardous and their use is normally restricted, while Category 3 pesticides are the least toxic to people and are generally less hazardous.

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EXECUTIVE SUMMARY

This document was prepared to establish guidelines for the management of fertilizers and pesticides. The main objective of these guidelines is to safeguard to "the maximum extent practicable"* against unnecessary discharges of fertilizers and pesticides into surface and groundwater systems and to establish safe and reasonable standards for handling those materials. The guidelines are based on state and federal laws, environmental policies and "best management practices" established by various public and private agencies. Through this document, it is envisaged that these practices will establish a set of uniform standards and procedures.

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1.0 INTRODUCTION

1.1 Status of Fertilizer and Pesticide Use

Fertilizers and pesticides are a primary tool of vegetation management. Used properly, fertilizers provide important nutrient supplies for vegetation and agriculture, and pesticides help to protect those resources from potential harm.

Used improperly, fertilizers and pesticides can become an impairment to surface and groundwater supplies. Careless application, mixing, transportation, storage and disposal allow chemicals to enter surface and groundwater through runoff and infiltration; the same handling problems endanger human health through exposure to toxic chemicals; soil degradation often results from overuse and misuse of pesticides and fertilizers. Even under ideal conditions, there is still a high level of risk, and consequently, there is a need for considerable professional planning and management.

1.2 Management Options

Because of the risk involved in using fertilizers and pesticides, the development of management guidelines for use of fertilizers and pesticides is an essential element of the DAMP. These guidelines are designed not only to comply with the NPDES Stormwater Program, but also to minimize any threat to human health and environmental resources from improper use of fertilizers and pesticides. It is envisaged that consideration of these guidelines by the permittees will cause public agencies to re-evaluate their approach to using fertilizers and pesticides and move toward reducing dependence on them.

The guidelines that follow are intended for the use of the Permittees, although they may ultimately be used on a broader scale. They are based on the laws, management guidelines and "best management practices" established by other federal, state and local agencies. They recognize that the safe management of fertilizers and pesticides is a shared responsibility between the field worker and management. These guidelines address the concern for fertilizer and pesticide use at a basic level, and if followed, they should reasonably prevent environmental damage to the highest degree possible.

1.3 Definitions

For the purpose of these guidelines, fertilizers may be referred to as "nutrients" or "soil nutrients," and the term "pesticides" will encompass all herbicides, insecticides, fungicides and rodenticides. The California Food and Agricultural Code and the California Code of Regulations, Title 3 (3 CCR)*, constitute the laws and regulations referenced in this plan. They are referenced often and usually referred to as the "State Code."* Also, Permittees will be referred to as "public agencies," and employees working for these public agencies who handle fertilizers & pesticides will be referred to as "workers" or "public employees."

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2.0 FERTILIZER MANAGEMENT

2.1 Definition and Scope of Guidelines

Fertilizers are nutrients applied to soil to provide a better growing environment for plants. The fertilizers most commonly in use in Southern California today are nitrogen- and phosphorus-based. Both leach into soils easily in the presence of water and have become a water quality concern, causing algal blooms and eutrophication* and, in some cases, causing levels to exceed federal drinking water standards.

However, fertilizers also play the important role of promoting vegetation growth that protects soil from erosion and enhances landscape aesthetics. Because there is a necessity for soil nutrients and because there is a potential for adverse effects on local waterways due to the loss of these nutrients through runoff and infiltration, management guidelines are necessary as a means of reducing the loss of fertilizers into water supplies.

2.2 General Considerations

2.2.1 State and Federal Law

Because most fertilizers are not as toxic as pesticides, state and federal lawmakers have not developed regulations for their use. Fertilizers are not usually considered an immediate danger to public health or safety. However, the California Fertilizer Association (CFA)*, a Sacramento-based organization, has developed complete management guidelines for fertilizer use and the State Department of Food and Agriculture has recommendations for use of nitrate-based fertilizers, both of which are available for consultation.

2.2.2 General Recommendations

1. Public agencies should periodically have soils tested before applying fertilizers to be certain that application is appropriate for and compatible with soil conditions. The samples should be analyzed by a qualified specialist for fertilizer applications*, and workers should follow the recommendations.

2. Public agencies should choose to use organic fertilizers such as compost, peat and mulch wherever possible to increase soil porosity and water retention.

3. Workers should apply only the minimum amount of fertilizer needed and incorporate it directly into the soil around the plant, where possible, to minimize potential surface runoff.

4. Workers should not apply fertilizers in the rain or on the same day that rain is expected.

5. Workers should immediately cleanup any spill of fertilizers.

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6. Storage facilities should be covered and have impermeable foundations so that potential spills don't have the opportunity to runoff into surface water or leach into groundwater systems.

7. Fertilizers that may be carried by the wind should be stored in areas away from open loading spaces and entrances of storage warehouses.

8. Fertilizers should be securely covered in the vehicle before being taken to application sites so that none can spill or fly out during transport.

9. Use slow release fertilizers -- such as water soluble nitrogen fertilizers, coated fertilizers and fertilizers of limited solubility -- whenever possible to minimize the possibility of leaching.

2.3 Planning for Use of Fertilizers

2.3.1 Soil Testing

Most fertilizers travel quickly through water. Therefore, fertilizers will leach through soil and potentially contaminate groundwater more quickly after excess watering or irrigation, after heavy rains and where the water table is high. For this reason, soil testing is an important management technique to determine the safest fertilizer application rate.

The California Landscape Contractors Association (CLCA) has a complete list of organizations in Southern California that offer soil testing and analyzing for fertilizer use. To get a copy of that list, CLCA can be contacted at (916) 448-2522. If a reliable soil analyst is not already known, it is advisable for public agencies to consult CLCA and research a specialist who can make recommendations for fertilizer use.

2.3.2 Application Rates

The amount of fertilizer needed for different applications depends on a number of factors. For specific recommendations, a qualified specialist should be consulted. The following are some factors to be considered:

- The vegetation's ability to use fertilizer;
- The amount of nutrients already in the soil, including fertilizer that may still be present from a previous application;
- The amount of soil nutrients that will or can be obtained from natural processes;
- The expected loss of nutrients from the soil; and
- The temperature at the time of application.

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2.3.3 Timing

For vegetation with different growth patterns, fertilizers should be applied at different times and in different quantities. The vegetation being managed should be researched and fertilizers applied only according to the amounts and at the time intervals recommended by a qualified specialist for fertilizer applications. This should minimize the waste of fertilizer and reduce any risk of water contamination.

2.4 Application Methods of Fertilizers

This section details the most common methods for application of fertilizers. These are not the only acceptable methods of fertilizer application. Every application has its own circumstances and variables to consider. A qualified fertilizer specialist should be consulted to recommend the most appropriate application method.

2.4.1 Banding of Fertilizer

Probably the most common and safest application method, this involves physically working small amounts of fertilizer into the soil in a band beneath and around the sides of a seed. It allows new roots to efficiently use the nutrients and minimizes potential nutrient loss to surface runoff. However, given the labor involved, banding may not be practical for most public agency fertilizer applications.

2.4.2 Foliar Fertilization

This is fertilizer applied in solution form that is absorbed through leaves and stems. The method can reduce nutrient leaching into the soil when applied correctly and can be performed at the same time as pesticides application to avoid spraying twice. In this case, the guidelines for pesticide applications must also apply.

2.4.3 Broadcast Application

By this method, dry or liquid fertilizer is uniformly spread over the soil surface. This is often done mechanically, an example being the "drop spreader" which is usually an inverted triangle hopper. The simplest of mechanical applicators, the drop spreader is commonly mounted on wheels and pushed by hand or pulled by vehicle to drop fertilizer out of the bottom of the triangle.

Other types of broadcast applicators include spray booms for liquid fertilization or "spinning disks" mounted on a moving vehicle that throw dry fertilizer into the air. It should be noted that these latter methods do not offer much control over fertilizer drift in adverse weather conditions.

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2.4.4 Fertigation

Although not likely to be used by public agencies for fertilizer applications, this method is common among Californian farmers who incorporate fertilizers into irrigation water. The potential for nutrient leaching using this method, though, appears to be high.

2.5 Storage and Handling of Fertilizers

2.5.1 General Description

When stored and handled properly, fertilizers present no hazard to the users' health. Public employees responsible for the storage and handling of fertilizers should be aware that some fertilizers have properties that can result in dangerous chemical reactions if mixed with other substances or under unusual circumstances. For example, ammonium nitrate may become explosive if it becomes mixed in diesel fuel; a dehumidifier may be necessary for storage areas where sensitive fertilizers are stored. Also, because most fertilizers tend to be corrosive, concrete structures are preferred for fertilizer storage facilities.

2.5.2 Dry Fertilizer

In most cases, dry fertilizers are safe to store, transport and handle. However, because some fertilizers have unique, potentially dangerous properties, it is advisable for public agencies to consult a qualified fertilizer specialist for the safest storage and handling procedures for specific fertilizers.

2.5.3 Liquid Fertilizer

Fertilizers in liquid form are potentially more hazardous than dry fertilizer. Public employees responsible for storage and handling need to be aware of the specific properties of each liquid fertilizer in use, including corrosivity and tolerable temperature and pressure ranges. Protective equipment may be necessary for workers handling fertilizers such as sulfuric or phosphoric acid. A qualified fertilizer specialist should be consulted for recommending the safest handling and storage procedures for specific liquid fertilizers.

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3.0 PESTICIDE MANAGEMENT

3.1 Definition and Scope of Guidelines

Pesticides are designed to kill or restrict the growth of plants and organisms, and thus, are potentially dangerous chemicals. Increasing scientific concern for their safe use and heightened public awareness of health concerns has led to more and more regulations in the United States at both the state and federal level. Pesticide use by public agencies often involves applications to keep flood control channels and roadways clear or to minimize health and safety hazards of disease-bearing rodents and insects. Any of these applications can drain into stormwater basins if not controlled properly. Although safety concerns and the cost of complying with new regulations have encouraged some public agencies to cut back on the use of pesticides, use is still common, and their management is therefore essential.

3.2 General Considerations

3.2.1 State and Federal Law

The California Department of Food and Agriculture and the federal Toxic Substances Control Act (TSCA) have set forth extensive rules and regulations that must be met by all public agencies. At an absolute minimum, public agencies must comply with these laws or be subject to the penalties described in the statutes.

3.2.2 Chemical Labels and Materials Safety Data Sheets (MSDS)

1. Without exception, chemical labels* provided by the manufacturer of each pesticide are the first source of recommendations and instructions for chemical use. Whenever a chemical is to be used by a worker or a contractor of a public agency, the user needs to be intimately familiar with the label instructions and requirements.

   As described in the State Code (Ch. 2, Subch. 1, Art. 10), the label must appear on the immediate container of the chemical and include, in prominent, bold type, the appropriate warning or caution statement according to its toxicity classification*. If a chemical is transferred to another container, a copy of the label should be transferred with it.

   Workers should never handle a container that doesn't have a warning label attached, and the supervisor in charge should be immediately advised of the situation. If a label is badly damaged, the supervisor should replace it.

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2. Workers using pesticides should have readily available the Materials Safety Data Sheets (MSDS)* for each chemical they are using. Although the MSDS is a form that may vary in appearance for different chemicals, the information is the same, as required by law. Similar to the chemical labels, these sheets contain information necessary to handle each chemical safely, and all workers should be familiar with the information.

   MSDS sheets include chemical identifications, hazardous ingredients, physical data, fire and explosion data, health hazards, reactivity data, spill or leak cleanup procedures, special protection and special precautions.

3.2.3 General Recommendations

1. Public agencies should maintain a complete list of all chemicals and their uses.

2. Public agencies should thoroughly investigate and consider all alternatives to pesticide use.

3. Workers should use pesticides only according to label instructions.

4. Work crews should bring to the work site only the amount of chemical to be used during the application and use only the minimum amount the chemical necessary.

5. Workers should consider weather conditions that could affect application (for example, they shouldn't spray when winds are exceeding 5 mph, when raining or when rain is likely).

6. Workers should consider area drainage patterns (for example, they shouldn't apply near wetlands, streams and lakes or ponds unless it is for an approved maintenance activity).

7. Workers should consider soil conditions before applying pesticides (for example, they shouldn't apply to bare or eroded ground).

8. Workers should triple-rinse empty pesticide containers before disposal and use the leftover wash as spray.

9. Workers should never clean or rinse pesticide equipment and containers in the vicinity of storm drains*.

10. Pesticides should only be stored in areas with cement floors and in areas insulated from temperature extremes.

11. Workers should secure chemicals and equipment during transportation to prevent tipping or excess jarring in apart of the vehicle completely isolated from people, food and clothing.

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12. Workers or their supervisors should inspect pesticide equipment, storage containers and transportation vehicles daily.

13. Public agencies should adopt a plan for dealing with potential accidents before they happen.

14. Workers should immediately clean up any chemical spill according to label instructions and notify the appropriate supervisors and agencies.

3.3 Planning for Use of Pesticides

3.3.1 Selection of Appropriate Pesticides

1. Pesticides are to be used only after recommendation from a state-licensed or certified pest control advisor.

2. Public agencies should also seek advice for appropriate pesticide use from the Orange County Agricultural Commission, from other professional pesticide handlers and/or through professional publications. The County Agricultural Commission can be contacted at (714) 447-7100.

3. A special effort should be made to limit use of restricted pesticides and all other Category One pesticides.

3.3.2 Certification, Licensing and Permitting

1. Pesticides are only to be applied by or under the direct supervision of an individual with a qualified applicators license (QAL)* for pesticide applications or by workers with equivalent training*.

2. Chemicals listed as "restricted" in the State of California may be used only under a restricted materials permit* (StateCode Ch. 2, Subch. 4) to be issued by the Orange County Agricultural Commission. The permit must be renewed annually for continued use. For more information, contact the Commission at (714) 447-7100.

3. All other guidelines concerning permits, licensing and certification requirements to be followed before pesticide application are detailed in the State Code, Chapter 3, Subchapter 1.

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3.3.3 Employee Training

1. Public agency employees must know the information on the chemical label and its MSDS before using pesticides in any capacity. In addition, they should (a) know the immediate and long-term health hazards posed by chemicals to be used, the common symptoms of chemical poisoning and the ways poisoning could occur, and (b) know the safe work practices to be followed, including the appropriate protective clothing, equipment, mixing, transportation, storage, disposal and spill cleanup procedures that apply to the specific chemicals being used.

2. In addition to the training and annual continuing education required for licensing and certification (3 CCR, Ch. 3, Subch.3, Art. 2), public employees are encouraged to participate in continuing pesticide education programs whenever the programs are available.

3.3.4 Accident Mitigation

Public agencies using pesticides should have plans for dealing with potential accidents before they happen. These plans should consider:

1. Labels and MSDS Sheets -- All workers handling pesticides must be familiar with these instructions. The steps for accident mitigation are spelled out on chemical labels and MSDS sheets.

2. Spill Cleanup Kits -- Any time pesticides are being handled, there should be a cleanup kit on hand in case of an accident. This means there should always be a cleanup kit located in pesticide storage areas, on vehicles used to transport pesticides and on location where the chemicals are being applied. Although these kits may vary in what they contain depending on the chemical type and the situation, at a minimum they should include:

    - spill-control procedures
    - a five gallon drum with sealable lid
    - a dust pan and broom
    - a squeegee
    - a shovel
    - protective goggles, gloves, boots, coveralls
    - a tarp (for covering dry spills)
    - detergent and water (check label or MSDS for proper use)
    - barricade tape, florescent traffic safety cones or string to cordon off an area
    - large sponges, containment booms or some other absorbent material

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3. Cleanup Procedures -- Spilled pesticides must be prevented from entering the local surface and/or groundwater supplies. Specific recommendations for spill cleanup should be available on each chemical label or MSDS. Specific recommendations for the sequence of procedures may also vary depending on the situation. However, generally, in case of a spill, the responsible worker(s) should:

   EVALUATE the accident and quickly determine the most immediate concerns (medical and/or environmental).

   CONTAIN OR CONTROL the spill.

   NOTIFY the supervisor in charge who should, in turn, notify the proper authorities. If contact cannot be made, dial 911.

   ISOLATE the area with fluorescent traffic safety cones, ropes or some other cordoning device to be sure that no one walks, wanders or drives through the spill area.

   CLEAN UP the spill as best as possible following label instructions and using the appropriate spill cleanup kit.

   EVALUATE any damage that may have occurred resulting from the spill (property damage, health damage, equipment damage, etc.) and make notes on all relevant details and circumstances before leaving the scene.

   PREPARE A COMPLETE REPORT detailing the incident immediately after leaving the scene upon returning to the work place and submit it to the immediate supervisor.

3.3.5 Emergency Medical Care

Accident situations requiring emergency medical care are likely to involve acute exposure to potentially toxic chemicals. Instructions for handling these exposures appear on the chemical label. Workers should:

1. Be aware of the symptoms of acute exposures for each chemical being used.

2. Have a predetermined strategy for dealing with exposure scenarios, including knowing (a) the label recommendations for dealing with acute exposures and (b) the nearest medical facility where emergency care is available.

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3.3.6 Equipment and Equipment Maintenance

All equipment for the handling of pesticides should be inspected and cleaned by workers before each use to ensure that there are no problems that could lead to chemical leaks, spills or accidents during the day's work (State Code Ch. 3, Subch. 3, Art. 2).

3.3.7 Groundwater and Surface Water Protection

Similar to the discussion of leaching in fertilizer management, the main factors determining the rate at which pesticides enter groundwater and surface water systems are chemical mobility, solubility and persistence and the soil type. For example, potentially dangerous chemicals are likely to have a high solubility and an extremely long half-life, and they are not likely to be easily absorbed into the soil. Therefore, chemicals that decompose rapidly may be preferred. However, note that to choose a chemical that may need to be applied two or three times as often may not make sense from a transportation and application risk standpoint.

Because of these factors, regardless of the category of chemicals being used, pesticide advisors should always test the soil for compatibility with specific chemicals before recommending pesticides for a specific area.

Furthermore, because the effect of these uses is not always immediately apparent, public agencies should periodically test areas that could be particularly vulnerable to contamination or deterioration. The results of these tests should be kept on public record.

3.4 Application of Pesticides

3.4.1 Supervision

1. In cases where supervision of pesticide applications is required by the State Code, supervision must be handled by a state-licensed or certified pesticide applicator. For all other pesticide applications, supervision may be handled by workers with equivalent training.

2. Public agencies that contract pesticide applications should periodically inspect contracted work crews to be certain that contractors are following proper management guidelines. Public agencies handling their own applications should likewise inspect their work crews on a regular basis to ensure that safety standards are being met.

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3.4.2 Proper Techniques

1. Read the label carefully and follow application instructions exactly. Be absolutely certain that the right chemical is being used for the right job before applying.

2. To prevent potentially harmful runoff, only the absolute minimum amount of pesticides should be used to ensure vegetation safety.

3. Recommendations for best weather conditions to prevent pesticide spray drift are outlined in State Code Chapter 2, Subchapter 4, Article 2.

3.4.3 User Safety and Protection

1. Public agencies should have on hand equipment for application of pesticides should include eye protection, gloves, respiratory gear and impervious full-body, chemical resistant clothing when called for by the chemical label.

2. Even when wearing respiratory gear or masks, when dealing with spray applications of pesticides, workers should avoid directly inhaling in the spray mist.

3. Workers should avoid working alone, especially at night.

4. Workers should clean equipment, clothing and self thoroughly after each application.

5. State laws regarding re-entry into fields that have recently been treated with pesticides should be followed (State Code Chapter 3, Subchapter 3, Article 3).

6. Public agencies are responsible for knowing and informing workers about the specific pesticides being used including how they are properly handled, the dangers involved and the proper training and safety procedures.

7. Public agencies are responsible for keeping updated records and a complete list of the pesticides being used in their jurisdiction. This should include the chemicals, amount in storage, amount of applications, dates and location of applications and pests controlled with each application.

8. Public agencies should keep all relevant label and MSDS information for each chemical updated and readily available at all times to workers handling the materials.

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3.5 Storage, Disposal and Transportation

3.5.1 Proper Storage

1. Storage areas should be away from living areas and in a covered area that is well-insulated from temperature extremes; they should have a cement floor and good ventilation. Also, storage areas should be clearly marked according to state standards and be securely locked at all times when not in use.

2. Public agencies should ensure that chemical labels on pesticides being stored or used are kept in good condition and attached to all containers holding pesticides (State Code Ch. 3, Subch. 2, Art. 4).

3. Workers should ensure that storage equipment and containers are inspected daily for leaks or defects before being taken on the job. Containers should also be inspected and before storing at the end of the day.

3.5.2 Proper Disposal

1. Workers should make certain that chemical containers are triple-rinsed before disposal (State Code Ch. 3, Subch. 2)

2. It is recommended that cleaned containers be sent back to the manufacturer for recycling whenever possible. However, once triple-rinsed, most haulers will take them to most landfills.

3. Workers should use left over rinse water as spray.

4. Public agencies should ensure that surplus or out-of-date chemicals are given to a licensed hazardous waste hauler for disposal.

3.5.3 Safe Transportation Methods

1. Workers should ensure that all pesticides containers are tightly sealed and secured from tipping or excess jarring (State Code Ch. 3, Subch. 2, Art. 4).

2. Transportation compartments on vehicles should be isolated from the compartment carrying people, food and clothing and should be securely locked (State Code Ch. 3, Subch. 2, Art. 4).

3. Workers should transport only the amount of pesticide needed for the day to the site.

4. Workers should be certain that the appropriate chemical labels and MSDS sheets, a spill cleanup kit, the location of emergency medical care and a first aid kit are always brought along when transporting pesticides.

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5. Public agencies should encourage all vehicles used for pesticide transportation to include radio communications for contacting help in case of a spill or some other emergency.

4.0 INTEGRATED PEST MANAGEMENT*

4.1 Background on Pesticide Use

For most of the last 50 years, the trend in vegetation management has been toward a greater reliance on pesticides. The result has been not only a tremendous increase in the use of many dangerous chemicals, but also an enormous increase in the number of pests that are resistant to the pesticides being produced. In essence, as more pesticides have been produced, more resistant strains of pests have evolved. Worse, recent studies have shown that the end result of this global trend has been no net gain in vegetation survival rates.

With these realizations becoming well known, vegetation managers are now moving away from their reliance on pesticides and toward an integrated approach that combines limited pesticides use with more environmentally-friendly pest control techniques.

4.2 Scope of Guidelines

For public agencies in Orange County, IPM practices should be preferred to the sole use of pesticides as the primary means of vegetation management. These techniques are designed to prevent overuse and to reduce reliance on them. IPM should be considered by all public agencies or their contractors before intensive use of pesticides.

The goal of IPM is not to eliminate all pests, but to keep their populations at a manageable number. Pesticides are part of IPM techniques, but they are used in small quantities and only after all other alternatives have been reviewed.

4.3 Alternatives to Pesticides

Some of the alternatives to pesticides that may be considered as part of an IPM program include:

1. Introduction of natural predators such as ladybugs, lacewings, garter snakes and toads. Also, some bacteria, viruses and insect parasites may be preferable to pesticides.

2. Selected removal or rotation of vegetation habitat to eliminate the breeding places of specific pests.

3. Weeding, hoeing and trapping manually. Pruning and thinning of trees is also an effective means of preventing epidemic tree insects and diseases.

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Also, at certain times of the year and under certain environmental conditions, certain pests can be expected. Therefore, timely planting or well-timed use of small quantities of pesticides may avoid the need for some chemical use.

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Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, if we are not careful, our daily activities can lead directly to water pollution problems. Water that drains through your watershed can pick up pollutants which are then transported to our waterways and beautiful ocean.

You can prevent water pollution by taking personal action and by working with members of your watershed community to prevent urban runoff from entering your waterway.

For more information, please call the **Orange County Stormwater Program** at **1.877.89.SPILL** or visit **www.ocwatersheds.com**

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline** at **1.877.89.SPILL**.

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help protect your watershed. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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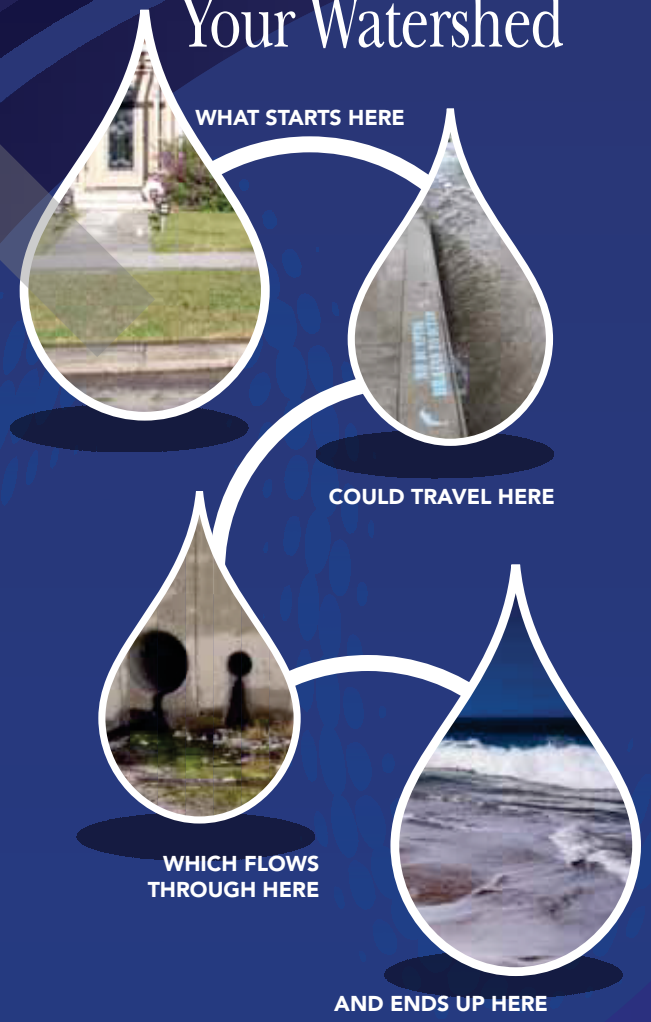
Help Prevent Ocean Pollution:

Tips For Protecting Your Watershed



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Protecting Your Watershed

My Watershed. Our Ocean.

Water + shed, *noun: A region of land within which water flows down into a specified water body, such as a river, lake, sea, or ocean; a drainage basin or catchment basin.*

Orange County is comprised of 11 major watersheds into which most of our water flows, connecting all of Orange County to the Pacific Ocean.

As water from rain (stormwater) or sprinklers and hoses (urban runoff) runs down your driveway and into your neighborhood streets, sidewalks and gutters, it flows into storm drains that lead to waterways within your watershed. The waterways from other cities merge as they make their way through our watersheds until all the runoff water in Orange County meets at the Pacific Ocean. The water that reaches our ocean is not pure. As it flows through the watershed, it picks up pollutants such as litter, cigarette butts, fertilizer, pesticides, pet waste, motor oil and lawn clippings. Unlike water that enters the sewer (from sinks and toilets), water that enters the storm drain is not treated before it flows, ultimately, to the ocean.

Water quality can be improved by "Adopting Your Watershed." Through this effort, we are challenging citizens and organizations to join the Orange County Stormwater Program and others who are working to protect and restore our creeks, rivers, bays and ocean.

There are many opportunities to get involved:

- Appreciate your watershed - explore the creeks, trails and ocean and make observations about its conditions. If you see anything abnormal (such as dead fish, oil spills, leaking barrels, and other pollution) contact the Orange County 24-hour water pollution problem reporting hotline at 1.877.89.SPILL to report the problem.
- Research your watershed. Learn about what watershed you live in by visiting www.ocwatersheds.com.
- Find a watershed organization in your community and volunteer to help. If there are no active groups, consider starting your own.
- Visit EPA's Adopt Your Watershed's Catalog of Watershed Groups at www.epa.gov/adopt to locate groups in your community.
- Organize or join in a creek, river, bay or ocean cleanup event such as Coastal & Inner Coastal Cleanup Day that takes place the 3rd Saturday of every September. For more information visit www.coast4u.org.

Follow these simple tips to protect the water quality of your watershed:

- **Sweep up debris and dispose of it in the trash. Do not hose down driveways or sidewalks into the street or gutter.**
- **Use dry cleanup methods such as cat litter to absorb spills and sweep up residue.**
- **Set your irrigation systems to reflect seasonal water needs or use weather-based controllers. Inspect for runoff regularly.**
- **Cover trashcans securely.**
- **Take hazardous waste to a household hazardous waste collection center. (For example, paint, batteries and petroleum products)**
- **Pick up after your pet.**
- **Follow application and disposal directions for pesticides and fertilizers.**
- **If you wash your car at home, wash it on your lawn or divert the runoff onto a landscaped area. Consider taking your car to a commercial car wash, where the water is reclaimed or recycled.**
- **Keep your car well maintained.**
- **Never pour oil or antifreeze in the street, gutter or storm drain.**

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Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Fertilizers, pesticides and other chemicals that are left on yards or driveways can be blown or washed into storm drains that flow to the ocean. Overwatering lawns can also send materials into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour gardening products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information, please call the **Orange County Stormwater Program** at **1-877-89-SPILL** (1-877-897-7455) or visit **www.ocwatersheds.com**

UCCE Master Gardener Hotline: (714) 708-1646

To report a spill, call the **Orange County 24-Hour Water Pollution Problem Reporting Hotline 1-877-89-SPILL** (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while landscaping or gardening. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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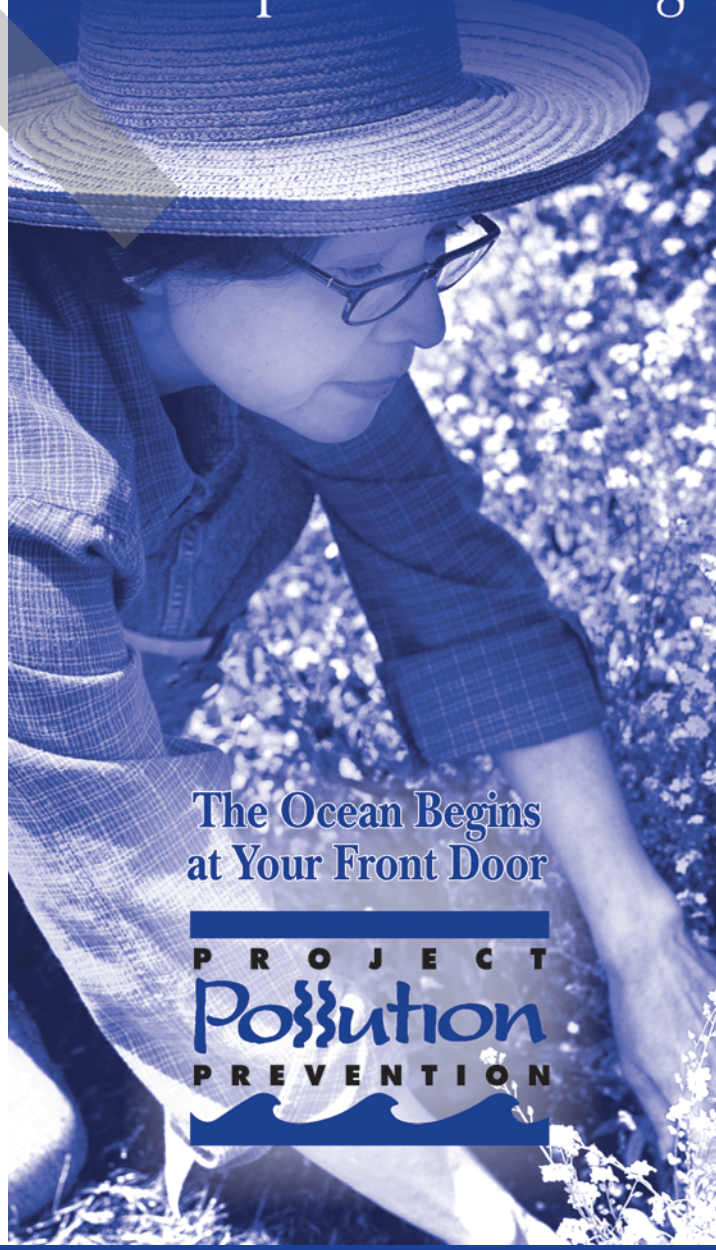
Help Prevent Ocean Pollution:

Tips for Landscape & Gardening



The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Landscape & Gardening

Never allow gardening products or polluted water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.
- Plant native vegetation to reduce the amount of water, fertilizers, and pesticide applied to the landscape.

- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro spray systems. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.

- Use slow-release fertilizers to minimize leaching, and use organic fertilizers.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.

- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting. For more information, visit **www.ipm.ucdavis.edu**.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Hazardous Waste Collection Center to be recycled. Locations are provided below.

Household Hazardous Waste Collection Centers

Anaheim:	1071 N. Blue Gum St.
Huntington Beach:	17121 Nichols St.
Irvine:	6411 Oak Canyon
San Juan Capistrano:	32250 La Pata Ave.

For more information, call (714) 834-6752 or visit www.oclandfills.com

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ATTACHMENT B

- **INFILTRATION FEASIBILITY WORKSHEET,**
- **SUMMARY OF HARVESTED WATER DEMAND AND FEASIBILITY WORKSHEET,**
- **EXISTING HYDROLOGY MAP**
- **PROPOSED HYDROLOGY MAP**
- **DMA MATRIX & DCV EXCEL TABLE CALCULATIONS**
  - **Excel Matrix**
  - **85th Percentile Rainfall Zones (XVI-1)**
  - **DCV Worksheets for Capture Efficiency Method**
    - **Worksheets C & D**
- **APPLICABLE BMP FACT SHEETS**
- **STORM GATE DETAIL**
- **MODULAR WETLANDS UNIT INFORMATION**
- **OLDCASTLE FLOGARD DETAILS**

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Table 2.7: Infiltration BMP Feasibility Worksheet

	Infeasibility Criteria	*Yes*	*No*
1	**Would Infiltration BMPs pose significant risk for groundwater related concerns?** Refer to Appendix VIII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.	X	
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Would Infiltration BMPs **pose significant risk of increasing risk of geotechnical hazards that cannot be mitigated to an acceptable level**? (Yes if the answer to any of the following questions is yes, as established by a geotechnical expert): • The BMP can only be located less than 50 feet away from slopes steeper than 15 percent • The BMP can only be located less than eight feet from building foundations or an alternative setback. • A study prepared by a geotechnical professional or an available watershed study substantiates that stormwater infiltration would potentially result in significantly increased risks of geotechnical hazards that cannot be mitigated to an acceptable level.		X
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
3	Would infiltration of the DCV from drainage area **violate downstream water rights**?		X
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

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Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

	Partial Infeasibility Criteria	*Yes*	*No*
4	Is proposed infiltration facility **located on HSG D soils** or the site geotechnical investigation identifies presence of soil characteristics which support categorization as D soils?		X
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
5	Is **measured infiltration rate below proposed facility less than 0.3 inches per hour**? This calculation shall be based on the methods described in **Appendix VII**.		X
Provide basis: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
6	Would **reduction of over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
7	Would **an increase in infiltration over predeveloped conditions cause impairments to downstream beneficial uses, such as change of seasonality of ephemeral washes or increased discharge of contaminated groundwater to surface waters?**		X
Provide citation to applicable study and summarize findings relative to the amount of infiltration that is permissible: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

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Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

Infiltration Screening Results (check box corresponding to result):		
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See **Appendix XVII**) Provide narrative discussion and supporting evidence: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.	No, I & I has not been analyzed for this project at this time.
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis: Summarize findings of infeasibility screening	X
10	If any answer from row 4-7 is yes, infiltration is **permissible but is not presumed to be feasible for the entire DCV.** Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis: Summarize findings of infeasibility screening	
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable.	

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Table X.8: Minimum Irrigated Area for Potential Partial Capture Feasibility

General Landscape Type	Conservation Design: K_L = 0.35			Active Turf Areas: K_L = 0.7		
Closest ET Station	*Irvine*	*Santa Ana*	*Laguna*	*Irvine*	*Santa Ana*	*Laguna*
Design Capture Storm Depth, inches	**Minimum Required Irrigated Area per Tributary Impervious Acre for Potential Partial Capture, ac/ac**					
0.60	0.66	0.68	0.72	0.33	0.34	0.36
0.65	0.72	0.73	0.78	0.36	0.37	0.39
0.70	0.77	0.79	0.84	0.39	0.39	0.42
0.75	0.83	0.84	0.90	0.41	0.42	0.45
0.80	0.88	0.90	0.96	0.44	0.45	0.48
0.85	0.93	0.95	1.02	0.47	0.48	0.51
0.90	0.99	1.01	1.08	0.49	0.51	0.54
0.95	1.04	1.07	1.14	0.52	0.53	0.57
1.00	1.10	1.12	1.20	0.55	0.56	0.60

Worksheet J: Summary of Harvested Water Demand and Feasibility

1	What demands for harvested water exist in the tributary area (check all that apply):			
2	Toilet and urinal flushing		☐	
3	Landscape irrigation		✕	
4	Other:_____		☐	
5	What is the design capture storm depth? (**Figure III.1**)	d	0.80	inches
6	What is the project size?	A	5.00	ac
7	What is the acreage of impervious area?	IA	4.84	ac
	For projects with multiple types of demand (toilet flushing, indoor demand, and/or other demand)			
8	What is the minimum use required for partial capture? (**Table X.6**)	N.A.		gpd
9	What is the project estimated wet season total daily use?	N.A.		gpd
10	Is partial capture potentially feasible? (Line 9 > Line 8?)	N.A.		
	For projects with only toilet flushing demand			
11	What is the minimum TUTIA for partial capture? (**Table X.7**)	N.A.		
12	What is the project estimated TUTIA?	N.A.		

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Worksheet J: Summary of Harvested Water Demand and Feasibility

13	Is partial capture potentially feasible? (Line 12 > Line 11?)	N.A.	
	For projects with only irrigation demand		
14	What is the minimum irrigation area required based on conservation landscape design? (**Table X.8**)	4.4	ac
15	What is the proposed project irrigated area? (multiply conservation landscaping by 1; multiply active turf by 2)	0.16	ac
16	Is partial capture potentially feasible? (Line 15 > Line 14?)	NO	

Provide supporting assumptions and citations for controlling demand calculation:

Line 14: KL x Line 7
Line 14: 5.00 x 0.88 = 4.88
Line 15: Landscape Area = 0.16
Line 15 < Line 14 Therefore, re-use for irrigation is not feasible.

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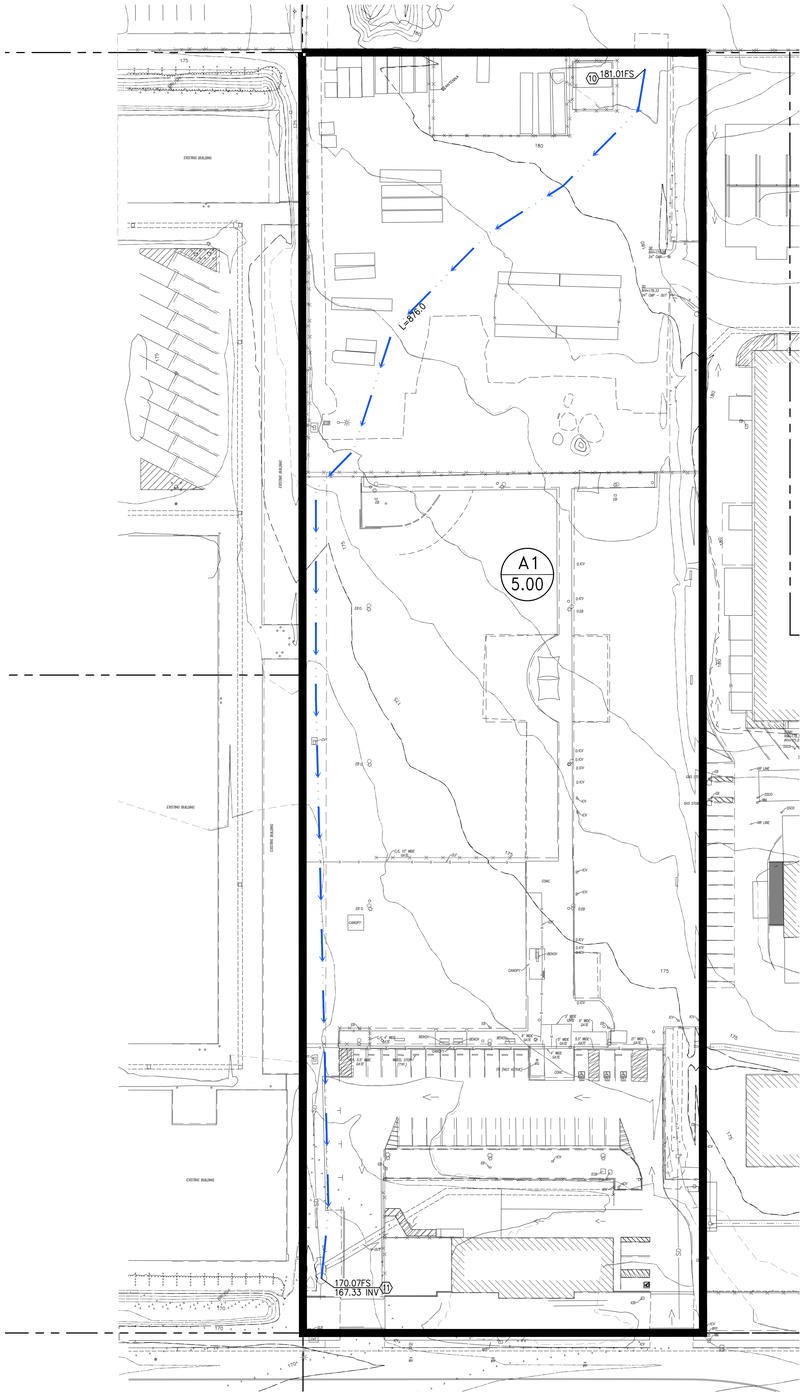

LEGEND

- DRAINAGE AREA BOUNDARY
- DRAINAGE SUB-AREA BOUNDARY
- SUB-AREA FLOW PATH
- STORM DRAIN FLOW PATH
- EXISTING STORM DRAIN LINE
- C1 / X — SUBAREA ID
- SUBAREA ACREAGE
- 1000.00 FS / 1000.00 INV — NODE ELEVATION

N

0 40' 80'

SCALE: 1" = 40'

NO	DESCRIPTION	BY	DATE	CHK
	REVISIONS			

NO	DESCRIPTION	BY	DATE	CHK
	REVISIONS			

TAIT
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CITY OF IRVINE
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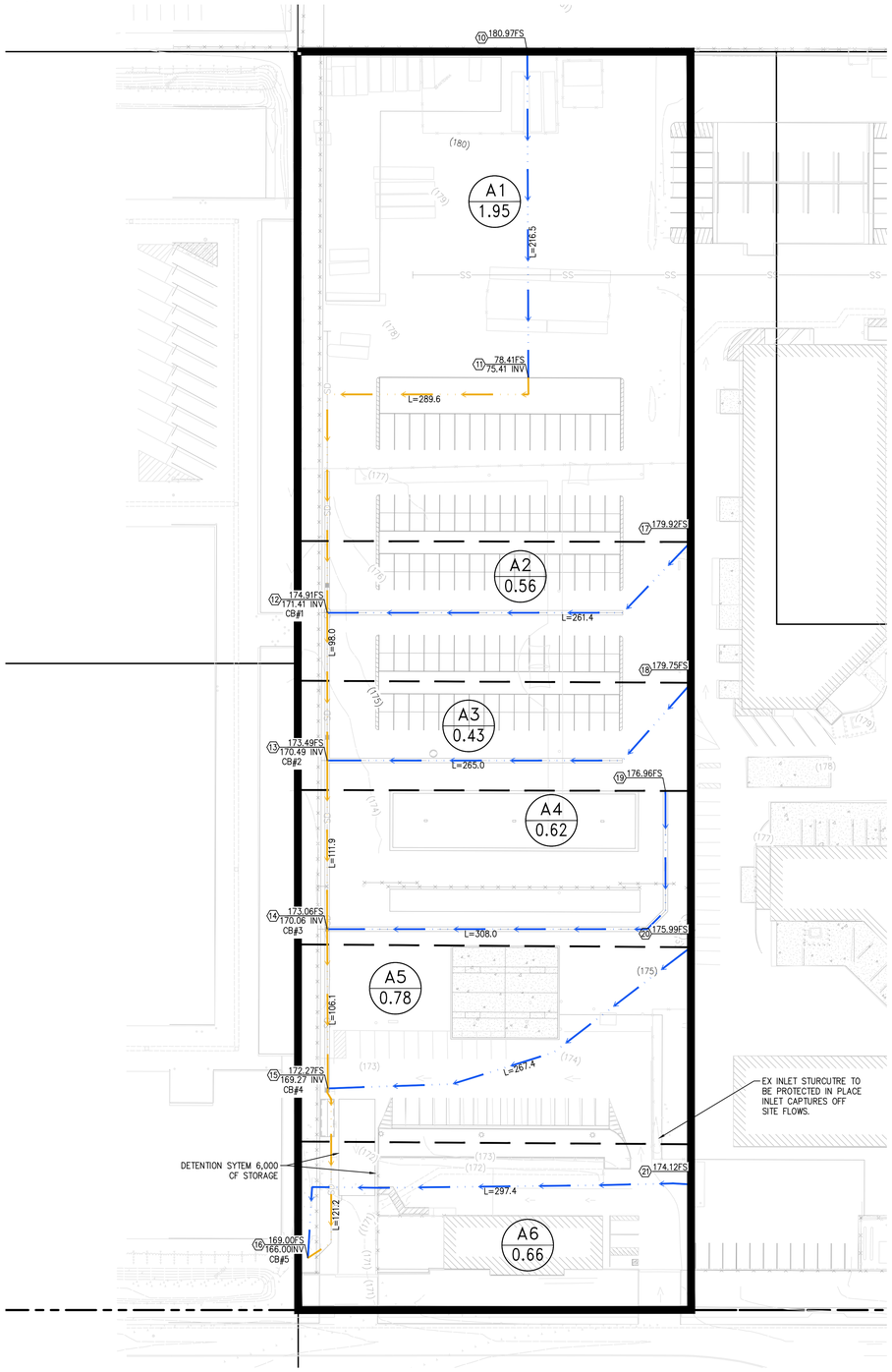
THE OAK CANYON PLAZA
IRVINE, CA 92606

DRAWN: CD
DATE: 02/28/2022
CHECKED: JV
DATE: 02/28/2022
REVISION #: ##
DATE: DATE
JOB NO: MED413

\\192.168.3.1\pod\Drawings\MED\MED4130 - Irvine\ENG\Hydrology\MED4130--PRE HYDRO.dwg
PLOTTED: 3/1/2022 11:10:41 AM BY: Sequoia Shire PAGESETUP: ------ PLOTSTYLE: Tait2014.ctb

DRAFT



LEGEND

- DRAINAGE AREA BOUNDARY
- DRAINAGE SUB-AREA BOUNDARY
- SUB-AREA FLOW PATH
- STORM DRAIN FLOW PATH
- EXISTING STORM DRAIN LINE
- C1 / X — SUBAREA ID
- SUBAREA ACREAGE
- XX 1000.00 FS / 1000.00 INV — NODE ELEVATION

NOTE:
INVERTS HAVE BEEN ASSUMED AT CONCEPTUL STAGE AND WILL BE VERIFIED PRIOR TO FINAL DESIGN

N

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

NO.	DESCRIPTION	BY	DATE	CHK
	REVISIONS			

NO.	DESCRIPTION	BY	DATE	CHK
	REVISIONS			

TAIT
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OPERATIONS SUPPORT FACILITY
CITY OF IRVINE
6427 OAK CANYON RD.
THE CITY OF IRVINE, CA 92618

DRAWN: CD
DATE: 02/28/2022
CHECKED: JV
DATE: 02/28/2022
REVISION #: ##
DATE: DATE
JOB NO: MED413

\\192.168.3.1\Local\Drawings\MED\MED413\0 - Final\ENG\Hydrology\MED413b-POST HYDRO.dwg
PLOTTED: 3/1/2022 10:01:35 AM BY Sagasia Shine PAGESETUP: ---- PLOTSTYLE: tait2014.ctb

Basin - Area A (on-site flows)

AMC III

25 Year Storm - Existing Condition

E25	4.27	in.									
CN	S	Ia	Y	Ybar			Total A	Fm	Tc	Calibration Co.	
56	7.86	1.57	0.16	0.84			5.00	0.11	10.98	0.9	

Rainfall	Depth (in)
5 min	0.286
30 min	0.691
1 hr	0.954
3 hr	1.73
6 hr	2.43
24 hr	4.27

Soil Group	**C**
Fp	0.25
Fm	ap*Fp
ap	0.44
Fm	0.11

AMC III

25 Year Storm - Proposed Condition

P25	4.27	in.									
CN	S	Ia	Y	Ybar			Total A	Fm	Tc	Calibration Co.	
90	1.11	0.22	0.74	0.26			5.00	0.0075	7.38	0.9	

Rainfall	Depth (in)
5 min	0.286
30 min	0.691
1 hr	0.954
3 hr	1.73
6 hr	2.43
24 hr	4.27

Soil Group	**C**
Fp	0.25
Fm	ap*Fp
ap	0.03
Fm	0.0075

		Is DCV met?	At what elevation?
Required Treatment HGL	0	NO	#REF!

Stage	Elevation (sys)	Head in Basin	Total. Vol (af)*	Total Flows (cfs)
1.000	64.30	0.00	0.000	0.000
2.000	65.30	1.00	0.023	2.674
3.000	66.30	2.00	0.046	4.632
4.000	67.30	3.00	0.069	5.979
5.000	67.80	3.50	0.092	6.550
6.000	68.30	4.00	0.115	13.623
7.000	69.30	5.00	0.138	25.563

*

SEE NEXT SHEET FOR DETAILED CALCULATIONS

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DIVERSION MANHOLE A1

High Flow Orifice C =	0.6
High Flow Orifice Size (inch) =	18
Centroid Elevation (ft) =	0.75
MH Weir Length (Feet) =	6.00
MH Weir C =	3.087

Low Flow Orifice C =	0.6
Low Flow Orifice Size (inch) =	12
Centroid Elevation (ft) =	0.5
Diversion Manhole A1 RIM Elevation	73.14
Inside Manhole C Top Elevation	72.14

Driveway Weir C =		3.087
Driveway Weir Length (ft)		49.88

			SYSTEM VOLUME			MANHOLE A									
Stage (Feet)	Water Elevation at Manhole (ft)	Head in Basin (ft)	Cumulative Volume Storage (cu.ft)*	Cumulative Volume Storage (ace-ft)*	Water Level at Manhole (ft)	Head (Feet)	Low Flow Orifice (cfs)	Weir Head (Feet)	Weir Flow (cfs)	Head (Feet)	High Flow Orifice (cfs)	Head (Feet)	Flow Regime	Flow (cfs)	
1	64.30	0.00	0	0.000	0.00	0.00				0.00		0.00	0.00	0.00	
2	65.30	1.00	1000	0.023	1.00	1.00	2.67			1.00		0.00	0.00	2.67	
3	66.30	2.00	2000	0.046	2.00	2.00	4.63			2.00		0.00	0.00	4.63	
4	67.30	3.00	3000	0.069	3.00	3.00	5.98			3.00		0.00	0.00	5.98	
5	67.80	3.50	4000	0.092	3.50	3.50	6.55	0.00		3.50		0.00	0.00	6.55	WEIR
6	68.30	4.00	5000	0.115	4.00	4.00	7.07	0.50	6.5	4.00	15.34	0.50	6.55	13.62	
7	69.30	5.00	6000	0.138	5.00	5.00	8.02	1.50	34.0	5.00	17.54	1.50	17.54	25.56	

Notes:

$$Qo = KA\sqrt{2gHo}$$

Qo = Orifice Outflow (cfs)
Ho = Water height above orifice center (ft)
K = Orifice flow coef., 0.6
A = Cross sectional area of orifice (ft^2)
g = gravitational accel., 32.2 ft/sec^2

$$Qw = CLH^{3/2}$$

$$Qw = CLH^{3/2}$$

= Weir Outflow (CFS)
Qw = Weir flow Coef., 3.087
C = Length of Weir (Ft)
L = Water height above top of Weir (Ft)
H

DRAFT

```
______________________________________________________________________________
******************************************************************************

            F L O O D    R O U T I N G    A N A L Y S I S
            USING COUNTY HYDROLOGY MANUAL OF ORANGE(1986)
        (c) Copyright 1989-2016 Advanced Engineering Software (aes)
            Ver. 23.0  Release Date: 07/01/2016  License ID 1334

                        Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* ME04130-IRVINE                                                       *
* SMALL AREA UNIT HYDROGRAPH                                           *
* EXISTING 25 YEAR                                                     *
 ************************************************************************

  FILE NAME: EX25H.DAT
  TIME/DATE OF STUDY: 08:35 03/01/2022

   The Small Area Unit Hydrograph Procedures in Section J
   of the Hydrology Manual provides estimates of runoff
   hydrograph and runoff volume for watersheds whose time of
   concentration is less than 25 minutes. The PROGRAM User
   should check the applicability of using the small area unit
   hydrograph procedures, and follow the guidelines in
   Sections J and K.5 in complex watershed modeling.


******************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     81.00 IS CODE = 1.2
------------------------------------------------------------------------------
  >>>>>SUBAREA RUNOFF (SMALL AREA UNIT-HYDROGRAPH ANALYSIS) <<<<<
==============================================================================

  (SMALL AREA UNIT-HYDROGRAPH ADDED TO STREAM #1)

    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    5.00
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.025
    LOW LOSS FRACTION = 0.840
    TIME OF CONCENTRATION(MIN.) = 10.98
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED:
    RETURN FREQUENCY(YEARS) =  25
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.87
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.15
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.94
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.71
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.49

------------------------------------------------------------------------------
  TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.45
  TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.42

------------------------------------------------------------------------------
♠
==============================================================================

                    2 4 - H O U R    S T O R M
                R U N O F F    H Y D R O G R A P H

==============================================================================
            HYDROGRAPH IN  ONE-MINUTE UNIT INTERVALS(CFS)
        (Notes: Time indicated is at END of Each Unit Intervals.
                Peak 5-minute rainfall intensity is modeled as
                a constant value for entire 5-minute period.)
------------------------------------------------------------------------------
 TIME(HRS) VOLUME(AF)   Q(CFS) 0.        3.4       6.9      10.3      13.7
------------------------------------------------------------------------------
  10.000      0.2375      0.45  .Q    V   .         .         .         .
  10.017      0.2381      0.45  .Q    V   .         .         .         .
  10.033      0.2388      0.45  .Q    V   .         .         .         .
  10.050      0.2394      0.45  .Q    V   .         .         .         .
  10.067      0.2400      0.45  .Q    V   .         .         .         .
  10.083      0.2406      0.45  .Q    V   .         .         .         .
  10.100      0.2413      0.46  .Q    V   .         .         .         .
  10.117      0.2419      0.46  .Q    V   .         .         .         .
  10.133      0.2425      0.46  .Q    V   .         .         .         .
  10.150      0.2432      0.46  .Q    V   .         .         .         .
  10.167      0.2438      0.46  .Q    V   .         .         .         .
  10.183      0.2444      0.46  .Q    V   .         .         .         .
  10.200      0.2451      0.46  .Q    V   .         .         .         .
  10.217      0.2457      0.46  .Q    V   .         .         .         .
  10.233      0.2463      0.46  .Q    V   .         .         .         .
  10.250      0.2470      0.47  .Q    V   .         .         .         .
  10.267      0.2476      0.47  .Q    V   .         .         .         .
  10.283      0.2483      0.47  .Q    V   .         .         .         .
  10.300      0.2489      0.47  .Q    V   .         .         .         .
  10.317      0.2496      0.47  .Q    V   .         .         .         .
  10.333      0.2502      0.47  .Q    V   .         .         .         .
  10.350      0.2509      0.47  .Q    V   .         .         .         .
  10.367      0.2515      0.47  .Q    V   .         .         .         .
  10.383      0.2522      0.47  .Q    V   .         .         .         .
  10.400      0.2528      0.48  .Q    V   .         .         .         .
```

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10.417	0.2535	0.48	.Q	V	.	.	.	.
10.433	0.2541	0.48	.Q	V	.	.	.	.
10.450	0.2548	0.48	.Q	V	.	.	.	.
10.467	0.2554	0.48	.Q	V	.	.	.	.
10.483	0.2561	0.48	.Q	V	.	.	.	.
10.500	0.2568	0.48	.Q	V	.	.	.	.
10.517	0.2574	0.48	.Q	V	.	.	.	.
10.533	0.2581	0.48	.Q	V	.	.	.	.
10.550	0.2588	0.48	.Q	V	.	.	.	.
10.567	0.2594	0.48	.Q	V	.	.	.	.
10.583	0.2601	0.49	.Q	V	.	.	.	.
10.600	0.2608	0.49	.Q	V	.	.	.	.
10.617	0.2614	0.49	.Q	V	.	.	.	.
10.633	0.2621	0.49	.Q	V	.	.	.	.
10.650	0.2628	0.49	.Q	V	.	.	.	.
10.667	0.2635	0.49	.Q	V	.	.	.	.
10.683	0.2642	0.50	.Q	V	.	.	.	.
10.700	0.2648	0.50	.Q	V	.	.	.	.
10.717	0.2655	0.50	.Q	V	.	.	.	.
10.733	0.2662	0.50	.Q	V	.	.	.	.
10.750	0.2669	0.50	.Q	V	.	.	.	.
10.767	0.2676	0.50	.Q	V	.	.	.	.
10.783	0.2683	0.50	.Q	V	.	.	.	.
10.800	0.2690	0.50	.Q	V	.	.	.	.
10.817	0.2697	0.50	.Q	V	.	.	.	.
10.833	0.2704	0.50	.Q	V	.	.	.	.
10.850	0.2711	0.50	.Q	V	.	.	.	.
10.867	0.2718	0.51	.Q	V	.	.	.	.
10.883	0.2724	0.51	.Q	V	.	.	.	.
10.900	0.2731	0.51	.Q	V	.	.	.	.
10.917	0.2738	0.51	.Q	V	.	.	.	.
10.933	0.2746	0.51	.Q	V	.	.	.	.
10.950	0.2753	0.51	.Q	V	.	.	.	.
10.967	0.2760	0.51	.Q	V	.	.	.	.
10.983	0.2767	0.52	.Q	V	.	.	.	.
11.000	0.2774	0.52	.Q	V	.	.	.	.
11.017	0.2781	0.52	.Q	V	.	.	.	.
11.033	0.2788	0.52	.Q	V	.	.	.	.
11.050	0.2795	0.52	.Q	V	.	.	.	.
11.067	0.2803	0.52	.Q	V	.	.	.	.
11.083	0.2810	0.53	.Q	V	.	.	.	.
11.100	0.2817	0.53	.Q	V	.	.	.	.
11.117	0.2824	0.53	.Q	V	.	.	.	.
11.133	0.2832	0.53	.Q	V	.	.	.	.
11.150	0.2839	0.53	.Q	V	.	.	.	.
11.167	0.2846	0.53	.Q	V	.	.	.	.
11.183	0.2854	0.53	.Q	V	.	.	.	.
11.200	0.2861	0.53	.Q	V	.	.	.	.
11.217	0.2868	0.53	.Q	V	.	.	.	.
11.233	0.2876	0.53	.Q	V	.	.	.	.

11.250	0.2883	0.53	.Q	V	.	.	.	.
11.267	0.2890	0.54	.Q	V	.	.	.	.
11.283	0.2898	0.54	.Q	V	.	.	.	.
11.300	0.2905	0.54	.Q	V	.	.	.	.
11.317	0.2913	0.54	.Q	V	.	.	.	.
11.333	0.2920	0.54	.Q	V	.	.	.	.
11.350	0.2928	0.55	.Q	V	.	.	.	.
11.367	0.2935	0.55	.Q	V	.	.	.	.
11.383	0.2943	0.55	.Q	V	.	.	.	.
11.400	0.2950	0.55	.Q	V	.	.	.	.
11.417	0.2958	0.55	.Q	V	.	.	.	.
11.433	0.2966	0.56	.Q	V	.	.	.	.
11.450	0.2973	0.56	.Q	V	.	.	.	.
11.467	0.2981	0.56	.Q	V	.	.	.	.
11.483	0.2989	0.56	.Q	V	.	.	.	.
11.500	0.2997	0.56	.Q	V	.	.	.	.
11.517	0.3004	0.56	.Q	V	.	.	.	.
11.533	0.3012	0.56	.Q	V	.	.	.	.
11.550	0.3020	0.56	.Q	V	.	.	.	.
11.567	0.3028	0.56	.Q	V	.	.	.	.
11.583	0.3035	0.57	.Q	V	.	.	.	.
11.600	0.3043	0.57	.Q	V	.	.	.	.
11.617	0.3051	0.57	.Q	V	.	.	.	.
11.633	0.3059	0.57	.Q	V	.	.	.	.
11.650	0.3067	0.57	.Q	V	.	.	.	.
11.667	0.3075	0.57	.Q	V	.	.	.	.
11.683	0.3082	0.58	.Q	V	.	.	.	.
11.700	0.3090	0.58	.Q	V	.	.	.	.
11.717	0.3098	0.58	.Q	V	.	.	.	.
11.733	0.3106	0.58	.Q	V	.	.	.	.
11.750	0.3115	0.58	.Q	V	.	.	.	.
11.767	0.3123	0.59	.Q	V	.	.	.	.
11.783	0.3131	0.59	.Q	V	.	.	.	.
11.800	0.3139	0.59	.Q	V	.	.	.	.
11.817	0.3147	0.59	.Q	V	.	.	.	.
11.833	0.3155	0.59	.Q	V	.	.	.	.
11.850	0.3163	0.59	.Q	V	.	.	.	.
11.867	0.3172	0.60	.Q	V	.	.	.	.
11.883	0.3180	0.60	.Q	V	.	.	.	.
11.900	0.3188	0.60	.Q	V	.	.	.	.
11.917	0.3196	0.60	.Q	V	.	.	.	.
11.933	0.3205	0.60	.Q	V	.	.	.	.
11.950	0.3213	0.60	.Q	V	.	.	.	.
11.967	0.3221	0.60	.Q	V	.	.	.	.
11.983	0.3230	0.61	.Q	V	.	.	.	.
12.000	0.3238	0.63	.Q	V	.	.	.	.
12.017	0.3247	0.64	.Q	V	.	.	.	.
12.033	0.3256	0.66	.Q	V	.	.	.	.
12.050	0.3266	0.68	.Q	V	.	.	.	.
12.067	0.3275	0.70	. Q	V	.	.	.	.

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12.083	0.3285	0.72	. Q	V.	.	.	.
12.100	0.3296	0.74	. Q	V.	.	.	.
12.117	0.3306	0.76	. Q	V.	.	.	.
12.133	0.3317	0.78	. Q	V.	.	.	.
12.150	0.3328	0.80	. Q	V.	.	.	.
12.167	0.3339	0.82	. Q	V.	.	.	.
12.183	0.3351	0.83	. Q	V.	.	.	.
12.200	0.3362	0.83	. Q	V.	.	.	.
12.217	0.3374	0.84	. Q	V.	.	.	.
12.233	0.3385	0.85	. Q	V.	.	.	.
12.250	0.3397	0.85	. Q	V.	.	.	.
12.267	0.3409	0.86	. Q	V.	.	.	.
12.283	0.3421	0.86	. Q	V.	.	.	.
12.300	0.3433	0.87	. Q	V.	.	.	.
12.317	0.3445	0.88	. Q	V.	.	.	.
12.333	0.3457	0.88	. Q	V.	.	.	.
12.350	0.3469	0.89	. Q	V.	.	.	.
12.367	0.3482	0.89	. Q	V.	.	.	.
12.383	0.3494	0.89	. Q	V.	.	.	.
12.400	0.3506	0.90	. Q	V.	.	.	.
12.417	0.3519	0.90	. Q	V.	.	.	.
12.433	0.3531	0.90	. Q	V.	.	.	.
12.450	0.3544	0.91	. Q	V.	.	.	.
12.467	0.3556	0.91	. Q	V.	.	.	.
12.483	0.3569	0.91	. Q	V.	.	.	.
12.500	0.3581	0.92	. Q	V.	.	.	.
12.517	0.3594	0.92	. Q	V.	.	.	.
12.533	0.3607	0.92	. Q	V.	.	.	.
12.550	0.3619	0.92	. Q	V.	.	.	.
12.567	0.3632	0.93	. Q	V	.	.	.
12.583	0.3645	0.93	. Q	V	.	.	.
12.600	0.3658	0.93	. Q	V	.	.	.
12.617	0.3671	0.93	. Q	V	.	.	.
12.633	0.3684	0.93	. Q	V	.	.	.
12.650	0.3696	0.93	. Q	V	.	.	.
12.667	0.3709	0.94	. Q	V	.	.	.
12.683	0.3722	0.94	. Q	V	.	.	.
12.700	0.3735	0.94	. Q	V	.	.	.
12.717	0.3748	0.94	. Q	V	.	.	.
12.733	0.3761	0.95	. Q	V	.	.	.
12.750	0.3774	0.95	. Q	V	.	.	.
12.767	0.3787	0.95	. Q	V	.	.	.
12.783	0.3801	0.96	. Q	V	.	.	.
12.800	0.3814	0.96	. Q	V	.	.	.
12.817	0.3827	0.96	. Q	V	.	.	.
12.833	0.3840	0.97	. Q	V	.	.	.
12.850	0.3854	0.97	. Q	V	.	.	.
12.867	0.3867	0.98	. Q	V	.	.	.
12.883	0.3881	0.98	. Q	V	.	.	.
12.900	0.3894	0.98	. Q	V	.	.	.
12.917	0.3908	0.98	. Q	V	.	.	.
12.933	0.3921	0.99	. Q	V	.	.	.
12.950	0.3935	0.99	. Q	V	.	.	.
12.967	0.3949	0.99	. Q	V	.	.	.
12.983	0.3962	0.99	. Q	V	.	.	.
13.000	0.3976	0.99	. Q	V	.	.	.
13.017	0.3990	1.00	. Q	.V	.	.	.
13.033	0.4003	1.00	. Q	.V	.	.	.
13.050	0.4017	1.00	. Q	.V	.	.	.
13.067	0.4031	1.00	. Q	.V	.	.	.
13.083	0.4045	1.00	. Q	.V	.	.	.
13.100	0.4059	1.01	. Q	.V	.	.	.
13.117	0.4073	1.01	. Q	.V	.	.	.
13.133	0.4087	1.02	. Q	.V	.	.	.
13.150	0.4101	1.02	. Q	.V	.	.	.
13.167	0.4115	1.03	. Q	.V	.	.	.
13.183	0.4129	1.03	. Q	.V	.	.	.
13.200	0.4143	1.04	. Q	.V	.	.	.
13.217	0.4158	1.04	. Q	.V	.	.	.
13.233	0.4172	1.04	. Q	.V	.	.	.
13.250	0.4187	1.05	. Q	.V	.	.	.
13.267	0.4201	1.05	. Q	.V	.	.	.
13.283	0.4216	1.06	. Q	.V	.	.	.
13.300	0.4230	1.06	. Q	.V	.	.	.
13.317	0.4245	1.06	. Q	.V	.	.	.
13.333	0.4259	1.06	. Q	.V	.	.	.
13.350	0.4274	1.06	. Q	.V	.	.	.
13.367	0.4289	1.07	. Q	.V	.	.	.
13.383	0.4304	1.07	. Q	.V	.	.	.
13.400	0.4318	1.07	. Q	.V	.	.	.
13.417	0.4333	1.07	. Q	.V	.	.	.
13.433	0.4348	1.08	. Q	. V	.	.	.
13.450	0.4363	1.08	. Q	. V	.	.	.
13.467	0.4378	1.09	. Q	. V	.	.	.
13.483	0.4393	1.09	. Q	. V	.	.	.
13.500	0.4408	1.10	. Q	. V	.	.	.
13.517	0.4423	1.10	. Q	. V	.	.	.
13.533	0.4438	1.11	. Q	. V	.	.	.
13.550	0.4454	1.11	. Q	. V	.	.	.
13.567	0.4469	1.12	. Q	. V	.	.	.
13.583	0.4484	1.12	. Q	. V	.	.	.
13.600	0.4500	1.13	. Q	. V	.	.	.
13.617	0.4516	1.13	. Q	. V	.	.	.
13.633	0.4531	1.14	. Q	. V	.	.	.
13.650	0.4547	1.14	. Q	. V	.	.	.
13.667	0.4563	1.14	. Q	. V	.	.	.
13.683	0.4579	1.15	. Q	. V	.	.	.
13.700	0.4594	1.15	. Q	. V	.	.	.
13.717	0.4610	1.15	. Q	. V	.	.	.
13.733	0.4626	1.16	. Q	. V	.	.	.

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13.750	0.4642	1.16	.	Q	.	V	.	.	.
13.767	0.4658	1.16	.	Q	.	V	.	.	.
13.783	0.4674	1.17	.	Q	.	V	.	.	.
13.800	0.4690	1.17	.	Q	.	V	.	.	.
13.817	0.4706	1.17	.	Q	.	V	.	.	.
13.833	0.4723	1.18	.	Q	.	V	.	.	.
13.850	0.4739	1.19	.	Q	.	V	.	.	.
13.867	0.4755	1.19	.	Q	.	V	.	.	.
13.883	0.4772	1.20	.	Q	.	V	.	.	.
13.900	0.4789	1.21	.	Q	.	V	.	.	.
13.917	0.4805	1.21	.	Q	.	V	.	.	.
13.933	0.4822	1.22	.	Q	.	V	.	.	.
13.950	0.4839	1.23	.	Q	.	V	.	.	.
13.967	0.4856	1.23	.	Q	.	V	.	.	.
13.983	0.4873	1.24	.	Q	.	V	.	.	.
14.000	0.4890	1.25	.	Q	.	V	.	.	.
14.017	0.4907	1.25	.	Q	.	V	.	.	.
14.033	0.4925	1.25	.	Q	.	V	.	.	.
14.050	0.4942	1.25	.	Q	.	V	.	.	.
14.067	0.4959	1.26	.	Q	.	V	.	.	.
14.083	0.4977	1.26	.	Q	.	V	.	.	.
14.100	0.4994	1.26	.	Q	.	V	.	.	.
14.117	0.5011	1.27	.	Q	.	V	.	.	.
14.133	0.5029	1.27	.	Q	.	V	.	.	.
14.150	0.5046	1.27	.	Q	.	V	.	.	.
14.167	0.5064	1.28	.	Q	.	V	.	.	.
14.183	0.5082	1.28	.	Q	.	V	.	.	.
14.200	0.5099	1.29	.	Q	.	V	.	.	.
14.217	0.5117	1.30	.	Q	.	V	.	.	.
14.233	0.5135	1.30	.	Q	.	V	.	.	.
14.250	0.5153	1.31	.	Q	.	V	.	.	.
14.267	0.5172	1.32	.	Q	.	V	.	.	.
14.283	0.5190	1.33	.	Q	.	V	.	.	.
14.300	0.5208	1.34	.	Q	.	V	.	.	.
14.317	0.5227	1.34	.	Q	.	V	.	.	.
14.333	0.5245	1.35	.	Q	.	V	.	.	.
14.350	0.5264	1.36	.	Q	.	V	.	.	.
14.367	0.5283	1.37	.	Q	.	V	.	.	.
14.383	0.5302	1.37	.	Q	.	V	.	.	.
14.400	0.5321	1.38	.	Q	.	V	.	.	.
14.417	0.5340	1.38	.	Q	.	V	.	.	.
14.433	0.5359	1.39	.	Q	.	V	.	.	.
14.450	0.5378	1.39	.	Q	.	V	.	.	.
14.467	0.5397	1.40	.	Q	.	V	.	.	.
14.483	0.5417	1.40	.	Q	.	V	.	.	.
14.500	0.5436	1.41	.	Q	.	V	.	.	.
14.517	0.5456	1.41	.	Q	.	V	.	.	.
14.533	0.5475	1.42	.	Q	.	V	.	.	.
14.550	0.5495	1.43	.	Q	.	V	.	.	.
14.567	0.5515	1.44	.	Q	.	V	.	.	.
14.583	0.5534	1.45	.	Q	.	V	.	.	.
14.600	0.5555	1.46	.	Q	.	V	.	.	.
14.617	0.5575	1.47	.	Q	.	V	.	.	.
14.633	0.5595	1.49	.	Q	.	V	.	.	.
14.650	0.5616	1.50	.	Q	.	V	.	.	.
14.667	0.5637	1.51	.	Q	.	V	.	.	.
14.683	0.5658	1.52	.	Q	.	V	.	.	.
14.700	0.5679	1.54	.	Q	.	V	.	.	.
14.717	0.5700	1.55	.	Q	.	V	.	.	.
14.733	0.5722	1.56	.	Q	.	V	.	.	.
14.750	0.5743	1.57	.	Q	.	V	.	.	.
14.767	0.5765	1.57	.	Q	.	V	.	.	.
14.783	0.5787	1.58	.	Q	.	V	.	.	.
14.800	0.5809	1.59	.	Q	.	V	.	.	.
14.817	0.5831	1.60	.	Q	.	V	.	.	.
14.833	0.5853	1.60	.	Q	.	V	.	.	.
14.850	0.5875	1.61	.	Q	.	V	.	.	.
14.867	0.5897	1.62	.	Q	.	V	.	.	.
14.883	0.5920	1.63	.	Q	.	V	.	.	.
14.900	0.5942	1.63	.	Q	.	V	.	.	.
14.917	0.5965	1.64	.	Q	.	V	.	.	.
14.933	0.5988	1.66	.	Q	.	V	.	.	.
14.950	0.6011	1.68	.	Q	.	V	.	.	.
14.967	0.6034	1.70	.	Q	.	V	.	.	.
14.983	0.6058	1.72	.	Q	.	V	.	.	.
15.000	0.6082	1.74	.	Q	.	V	.	.	.
15.017	0.6106	1.76	.	Q	.	V	.	.	.
15.033	0.6131	1.78	.	Q	.	V	.	.	.
15.050	0.6155	1.79	.	Q	.	V	.	.	.
15.067	0.6180	1.81	.	Q	.	V	.	.	.
15.083	0.6205	1.83	.	Q	.	V	.	.	.
15.100	0.6231	1.85	.	Q	.	V	.	.	.
15.117	0.6256	1.86	.	Q	.	V	.	.	.
15.133	0.6282	1.87	.	Q	.	V	.	.	.
15.150	0.6308	1.88	.	Q	.	V	.	.	.
15.167	0.6334	1.90	.	Q	.	V	.	.	.
15.183	0.6361	1.91	.	Q	.	V	.	.	.
15.200	0.6387	1.92	.	Q	.	V	.	.	.
15.217	0.6414	1.93	.	Q	.	V	.	.	.
15.233	0.6440	1.94	.	Q	.	V	.	.	.
15.250	0.6467	1.96	.	Q	.	V	.	.	.
15.267	0.6494	1.97	.	Q	.	V	.	.	.
15.283	0.6522	1.98	.	Q	.	V	.	.	.
15.300	0.6549	2.00	.	Q	.	V	.	.	.
15.317	0.6577	2.02	.	Q	.	V	.	.	.
15.333	0.6605	2.04	.	Q	.	V	.	.	.
15.350	0.6633	2.05	.	Q	.	V	.	.	.
15.367	0.6662	2.07	.	Q	.	V	.	.	.
15.383	0.6691	2.09	.	Q	.	V	.	.	.
15.400	0.6720	2.11	.	Q	.	V	.	.	.

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15.417    0.6749    2.12  .    Q   .      V .        .        .
15.433    0.6778    2.14  .    Q   .      V .        .        .
15.450    0.6808    2.16  .    Q   .      V .        .        .
15.467    0.6838    2.17  .    Q   .      V .        .        .
15.483    0.6868    2.18  .    Q   .      V .        .        .
15.500    0.6898    2.18  .    Q   .       V.        .        .
15.517    0.6928    2.19  .    Q   .       V.        .        .
15.533    0.6958    2.19  .    Q   .       V.        .        .
15.550    0.6989    2.20  .    Q   .       V.        .        .
15.567    0.7019    2.21  .    Q   .       V.        .        .
15.583    0.7050    2.21  .    Q   .       V.        .        .
15.600    0.7080    2.22  .    Q   .       V.        .        .
15.617    0.7111    2.22  .    Q   .       V.        .        .
15.633    0.7141    2.23  .    Q   .       V.        .        .
15.650    0.7173    2.28  .    Q   .       V.        .        .
15.667    0.7206    2.39  .    Q   .       V.        .        .
15.683    0.7240    2.50  .     Q  .       V.        .        .
15.700    0.7276    2.60  .     Q  .        V        .        .
15.717    0.7313    2.71  .     Q  .        V        .        .
15.733    0.7352    2.82  .      Q .        V        .        .
15.750    0.7393    2.93  .      Q .        V        .        .
15.767    0.7434    3.04  .      Q .        V        .        .
15.783    0.7478    3.14  .       Q.        V        .        .
15.800    0.7522    3.25  .       Q.        V        .        .
15.817    0.7569    3.36  .       Q.        V        .        .
15.833    0.7617    3.47  .        Q        .V       .        .
15.850    0.7666    3.59  .        Q        .V       .        .
15.867    0.7717    3.71  .        Q        .V       .        .
15.883    0.7770    3.83  .        .Q       .V       .        .
15.900    0.7824    3.96  .        .Q       .V       .        .
15.917    0.7881    4.08  .        .Q       .V       .        .
15.933    0.7938    4.20  .        . Q      .V       .        .
15.950    0.7998    4.32  .        . Q      . V      .        .
15.967    0.8059    4.44  .        . Q      . V      .        .
15.983    0.8122    4.56  .        .  Q     . V      .        .
16.000    0.8186    4.68  .        .  Q     . V      .        .
16.017    0.8257    5.15  .        .   Q    . V      .        .
16.033    0.8339    5.97  .        .    Q   .  V     .        .
16.050    0.8433    6.78  .        .     Q.  V      .        .
16.067    0.8537    7.60  .        .      . QV      .        .
16.083    0.8653    8.42  .        .      .  VQ     .        .
16.100    0.8781    9.24  .        .      .   V Q   .        .
16.117    0.8919   10.06  .        .      .   V   Q.        .
16.133    0.9069   10.88  .        .      .    V    .Q      .
16.150    0.9230   11.69  .        .      .    V    .   Q    .
16.167    0.9402   12.51  .        .      .    V    .    Q   .
16.183    0.9591   13.72  .        .      .     V   .      Q
16.200    0.9773   13.20  .        .      .     V   .     Q .
16.217    0.9941   12.18  .        .      .      V  .    Q   .
16.233    1.0095   11.17  .        .      .      V  . Q      .
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16.250    1.0235   10.16  .         .         .       VQ.         .
16.267    1.0361    9.15  .         .         .     Q V .         .
16.283    1.0473    8.14  .         .         .  Q    V .         .
16.300    1.0571    7.13  .         .         Q        V.         .
16.317    1.0655    6.12  .         .      Q  .        V.         .
16.333    1.0726    5.10  .         .   Q     .        V.         .
16.350    1.0782    4.09  .        .Q         .        V.         .
16.367    1.0825    3.08  .      Q  .         .        V.         .
16.383    1.0860    2.59  .      Q  .         .        V.         .
16.400    1.0895    2.55  .      Q  .         .         V         .
16.417    1.0930    2.50  .      Q  .         .         V         .
16.433    1.0964    2.46  .      Q  .         .         V         .
16.450    1.0997    2.42  .      Q  .         .         V         .
16.467    1.1030    2.37  .     Q   .         .         V         .
16.483    1.1062    2.33  .     Q   .         .         V         .
16.500    1.1093    2.29  .     Q   .         .         V         .
16.517    1.1124    2.24  .     Q   .         .         V         .
16.533    1.1155    2.20  .     Q   .         .         V         .
16.550    1.1184    2.16  .     Q   .         .         V         .
16.567    1.1214    2.12  .     Q   .         .         V         .
16.583    1.1242    2.08  .     Q   .         .         .V        .
16.600    1.1270    2.04  .    Q    .         .         .V        .
16.617    1.1298    2.01  .    Q    .         .         .V        .
16.633    1.1325    1.97  .    Q    .         .         .V        .
16.650    1.1352    1.93  .    Q    .         .         .V        .
16.667    1.1378    1.90  .    Q    .         .         .V        .
16.683    1.1403    1.86  .    Q    .         .         .V        .
16.700    1.1428    1.82  .    Q    .         .         .V        .
16.717    1.1453    1.78  .    Q    .         .         .V        .
16.733    1.1477    1.75  .    Q    .         .         .V        .
16.750    1.1501    1.72  .    Q    .         .         .V        .
16.767    1.1524    1.70  .   Q     .         .         .V        .
16.783    1.1547    1.67  .   Q     .         .         .V        .
16.800    1.1570    1.65  .   Q     .         .         .V        .
16.817    1.1592    1.63  .   Q     .         .         . V       .
16.833    1.1615    1.61  .   Q     .         .         . V       .
16.850    1.1636    1.58  .   Q     .         .         . V       .
16.867    1.1658    1.56  .   Q     .         .         . V       .
16.883    1.1679    1.54  .   Q     .         .         . V       .
16.900    1.1700    1.52  .   Q     .         .         . V       .
16.917    1.1720    1.49  .   Q     .         .         . V       .
16.933    1.1741    1.48  .   Q     .         .         . V       .
16.950    1.1761    1.46  .   Q     .         .         . V       .
16.967    1.1781    1.44  .   Q     .         .         . V       .
16.983    1.1800    1.43  .   Q     .         .         . V       .
17.000    1.1820    1.41  .   Q     .         .         . V       .
17.017    1.1839    1.40  .   Q     .         .         . V       .
17.033    1.1858    1.38  .   Q     .         .         . V       .
17.050    1.1877    1.37  .  Q      .         .         . V       .
17.067    1.1896    1.35  .  Q      .         .         . V       .
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17.083	1.1914	1.34	.	Q	.	.	.	V	.			
17.100	1.1932	1.32	.	Q	.	.	.	V	.			
17.117	1.1950	1.31	.	Q	.	.	.	V	.			
17.133	1.1968	1.30	.	Q	.	.	.	V	.			
17.150	1.1986	1.29	.	Q	.	.	.	V	.			
17.167	1.2003	1.28	.	Q	.	.	.	V	.			
17.183	1.2021	1.27	.	Q	.	.	.	V	.			
17.200	1.2038	1.26	.	Q	.	.	.	V	.			
17.217	1.2055	1.25	.	Q	.	.	.	V	.			
17.233	1.2073	1.24	.	Q	.	.	.	V	.			
17.250	1.2089	1.23	.	Q	.	.	.	V	.			
17.267	1.2106	1.22	.	Q	.	.	.	V	.			
17.283	1.2123	1.21	.	Q	.	.	.	V	.			
17.300	1.2139	1.20	.	Q	.	.	.	V	.			
17.317	1.2156	1.19	.	Q	.	.	.	V	.			
17.333	1.2172	1.18	.	Q	.	.	.	V	.			
17.350	1.2188	1.17	.	Q	.	.	.	V	.			
17.367	1.2204	1.16	.	Q	.	.	.	V	.			
17.383	1.2220	1.16	.	Q	.	.	.	V	.			
17.400	1.2236	1.15	.	Q	.	.	.	V	.			
17.417	1.2252	1.14	.	Q	.	.	.	V	.			
17.433	1.2267	1.13	.	Q	.	.	.	V	.			
17.450	1.2283	1.12	.	Q	.	.	.	V	.			
17.467	1.2298	1.11	.	Q	.	.	.	V	.			
17.483	1.2313	1.10	.	Q	.	.	.	V	.			
17.500	1.2328	1.10	.	Q	.	.	.	V	.			
17.517	1.2343	1.09	.	Q	.	.	.	V	.			
17.533	1.2358	1.08	.	Q	.	.	.	V	.			
17.550	1.2373	1.07	.	Q	.	.	.	V	.			
17.567	1.2388	1.07	.	Q	.	.	.	V	.			
17.583	1.2402	1.06	.	Q	.	.	.	V	.			
17.600	1.2417	1.05	.	Q	.	.	.	V	.			
17.617	1.2431	1.04	.	Q	.	.	.	V	.			
17.633	1.2445	1.04	.	Q	.	.	.	V	.			
17.650	1.2459	1.03	.	Q	.	.	.	V	.			
17.667	1.2474	1.02	.	Q	.	.	.	V	.			
17.683	1.2488	1.02	.	Q	.	.	.	V	.			
17.700	1.2501	1.01	.	Q	.	.	.	V	.			
17.717	1.2515	1.01	.	Q	.	.	.	V	.			
17.733	1.2529	1.00	.	Q	.	.	.	V	.			
17.750	1.2543	0.99	.	Q	.	.	.	V	.			
17.767	1.2556	0.99	.	Q	.	.	.	V	.			
17.783	1.2570	0.98	.	Q	.	.	.	V	.			
17.800	1.2583	0.97	.	Q	.	.	.	V	.			
17.817	1.2597	0.97	.	Q	.	.	.	V	.			
17.833	1.2610	0.96	.	Q	.	.	.	V	.			
17.850	1.2623	0.96	.	Q	.	.	.	V	.			
17.867	1.2636	0.95	.	Q	.	.	.	V	.			
17.883	1.2649	0.95	.	Q	.	.	.	V	.			
17.900	1.2662	0.94	.	Q	.	.	.	V	.			
17.917	1.2675	0.94	.	Q	.	.	.	V	.			
17.933	1.2688	0.93	.	Q	.	.	.	V	.			
17.950	1.2701	0.93	.	Q	.	.	.	V	.			
17.967	1.2713	0.92	.	Q	.	.	.	V	.			
17.983	1.2726	0.92	.	Q	.	.	.	V	.			
18.000	1.2739	0.91	.	Q	.	.	.	V	.			
18.017	1.2751	0.91	.	Q	.	.	.	V	.			
18.033	1.2763	0.89	.	Q	.	.	.	V	.			
18.050	1.2775	0.86	.	Q	.	.	.	V	.			
18.067	1.2787	0.83	.	Q	.	.	.	V	.			
18.083	1.2798	0.81	.	Q	.	.	.	V	.			
18.100	1.2809	0.78	.	Q	.	.	.	V	.			
18.117	1.2819	0.76	.	Q	.	.	.	V	.			
18.133	1.2829	0.73	.	Q	.	.	.	V	.			
18.150	1.2839	0.70	.	Q	.	.	.	V	.			
18.167	1.2848	0.68	.	Q	.	.	.	V	.			
18.183	1.2857	0.65	.	Q	.	.	.	V	.			
18.200	1.2866	0.63	.	Q	.	.	.	V	.			
18.217	1.2874	0.62	.	Q	.	.	.	V	.			
18.233	1.2882	0.61	.	Q	.	.	.	V	.			
18.250	1.2891	0.61	.	Q	.	.	.	V	.			
18.267	1.2899	0.60	.	Q	.	.	.	V	.			
18.283	1.2907	0.60	.	Q	.	.	.	V	.			
18.300	1.2916	0.60	.	Q	.	.	.	V	.			
18.317	1.2924	0.59	.	Q	.	.	.	V	.			
18.333	1.2932	0.59	.	Q	.	.	.	V	.			
18.350	1.2940	0.59	.	Q	.	.	.	V	.			
18.367	1.2948	0.58	.	Q	.	.	.	V	.			
18.383	1.2956	0.58	.	Q	.	.	.	V	.			
18.400	1.2964	0.58	.	Q	.	.	.	V	.			
18.417	1.2972	0.57	.	Q	.	.	.	V	.			
18.433	1.2980	0.57	.	Q	.	.	.	V	.			
18.450	1.2988	0.57	.	Q	.	.	.	V	.			
18.467	1.2995	0.56	.	Q	.	.	.	V	.			
18.483	1.3003	0.56	.	Q	.	.	.	V	.			
18.500	1.3011	0.56	.	Q	.	.	.	V	.			
18.517	1.3018	0.56	.	Q	.	.	.	V	.			
18.533	1.3026	0.55	.	Q	.	.	.	V	.			
18.550	1.3034	0.55	.	Q	.	.	.	V	.			
18.567	1.3041	0.55	.	Q	.	.	.	V	.			
18.583	1.3049	0.54	.	Q	.	.	.	V	.			
18.600	1.3056	0.54	.	Q	.	.	.	V	.			
18.617	1.3063	0.54	.	Q	.	.	.	V	.			
18.633	1.3071	0.53	.	Q	.	.	.	V	.			
18.650	1.3078	0.53	.	Q	.	.	.	V	.			
18.667	1.3085	0.53	.	Q	.	.	.	V	.			
18.683	1.3093	0.53	.	Q	.	.	.	V	.			
18.700	1.3100	0.52	.	Q	.	.	.	V	.			
18.717	1.3107	0.52	.	Q	.	.	.	V	.			
18.733	1.3114	0.52	.	Q	.	.	.	V	.			

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18.750	1.3121	0.52	.Q	.	.	.	V	.
18.767	1.3128	0.51	.Q	.	.	.	V	.
18.783	1.3135	0.51	.Q	.	.	.	V	.
18.800	1.3142	0.51	.Q	.	.	.	V	.
18.817	1.3149	0.51	.Q	.	.	.	V	.
18.833	1.3156	0.50	.Q	.	.	.	V	.
18.850	1.3163	0.50	.Q	.	.	.	V	.
18.867	1.3170	0.50	.Q	.	.	.	V	.
18.883	1.3177	0.50	.Q	.	.	.	V	.
18.900	1.3184	0.49	.Q	.	.	.	V	.
18.917	1.3191	0.49	.Q	.	.	.	V	.
18.933	1.3197	0.49	.Q	.	.	.	V	.
18.950	1.3204	0.49	.Q	.	.	.	V	.
18.967	1.3211	0.48	.Q	.	.	.	V	.
18.983	1.3217	0.48	.Q	.	.	.	V	.
19.000	1.3224	0.48	.Q	.	.	.	V	.
19.017	1.3231	0.48	.Q	.	.	.	V	.
19.033	1.3237	0.48	.Q	.	.	.	V	.
19.050	1.3244	0.47	.Q	.	.	.	V	.
19.067	1.3250	0.47	.Q	.	.	.	V	.
19.083	1.3257	0.47	.Q	.	.	.	V	.
19.100	1.3263	0.47	.Q	.	.	.	V	.
19.117	1.3269	0.47	.Q	.	.	.	V	.
19.133	1.3276	0.46	.Q	.	.	.	V	.
19.150	1.3282	0.46	.Q	.	.	.	V	.
19.167	1.3288	0.46	.Q	.	.	.	V	.
19.183	1.3295	0.46	.Q	.	.	.	V	.
19.200	1.3301	0.46	.Q	.	.	.	V	.
19.217	1.3307	0.45	.Q	.	.	.	V	.
19.233	1.3313	0.45	.Q	.	.	.	V	.
19.250	1.3320	0.45	.Q	.	.	.	V	.
19.267	1.3326	0.45	.Q	.	.	.	V	.
19.283	1.3332	0.45	.Q	.	.	.	V	.
19.300	1.3338	0.44	.Q	.	.	.	V	.
19.317	1.3344	0.44	.Q	.	.	.	V	.
19.333	1.3350	0.44	.Q	.	.	.	V	.
19.350	1.3356	0.44	.Q	.	.	.	V	.
19.367	1.3362	0.44	.Q	.	.	.	V	.
19.383	1.3368	0.43	.Q	.	.	.	V	.
19.400	1.3374	0.43	.Q	.	.	.	V	.
19.417	1.3380	0.43	.Q	.	.	.	V	.
19.433	1.3386	0.43	.Q	.	.	.	V	.
19.450	1.3392	0.43	.Q	.	.	.	V	.
19.467	1.3398	0.43	.Q	.	.	.	V	.
19.483	1.3404	0.42	.Q	.	.	.	V	.
19.500	1.3409	0.42	.Q	.	.	.	V	.
19.517	1.3415	0.42	.Q	.	.	.	V	.
19.533	1.3421	0.42	.Q	.	.	.	V	.
19.550	1.3427	0.42	.Q	.	.	.	V	.
19.567	1.3432	0.42	.Q	.	.	.	V	.
19.583	1.3438	0.41	.Q	.	.	.	V	.
19.600	1.3444	0.41	.Q	.	.	.	V	.
19.617	1.3449	0.41	.Q	.	.	.	V	.
19.633	1.3455	0.41	.Q	.	.	.	V	.
19.650	1.3461	0.41	.Q	.	.	.	V	.
19.667	1.3466	0.41	.Q	.	.	.	V	.
19.683	1.3472	0.40	.Q	.	.	.	V	.
19.700	1.3477	0.40	.Q	.	.	.	V	.
19.717	1.3483	0.40	.Q	.	.	.	V	.
19.733	1.3488	0.40	.Q	.	.	.	V	.
19.750	1.3494	0.40	.Q	.	.	.	V	.
19.767	1.3499	0.40	.Q	.	.	.	V	.
19.783	1.3505	0.40	.Q	.	.	.	V	.
19.800	1.3510	0.39	.Q	.	.	.	V	.
19.817	1.3516	0.39	.Q	.	.	.	V	.
19.833	1.3521	0.39	.Q	.	.	.	V	.
19.850	1.3526	0.39	.Q	.	.	.	V	.
19.867	1.3532	0.39	.Q	.	.	.	V	.
19.883	1.3537	0.39	.Q	.	.	.	V	.
19.900	1.3542	0.38	.Q	.	.	.	V	.
19.917	1.3548	0.38	.Q	.	.	.	V	.
19.933	1.3553	0.38	.Q	.	.	.	V	.
19.950	1.3558	0.38	.Q	.	.	.	V	.
19.967	1.3563	0.38	.Q	.	.	.	V	.
19.983	1.3569	0.38	.Q	.	.	.	V	.
20.000	1.3574	0.38	.Q	.	.	.	V	.

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1201.0
10%	795.0
20%	195.0
30%	125.0
40%	90.0
50%	75.0
60%	60.0
70%	45.0
80%	30.0
90%	15.0

END OF FLOODSCx ROUTING ANALYSIS

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______________________________________________________________________________
******************************************************************************

             F L O O D    R O U T I N G    A N A L Y S I S
             USING COUNTY HYDROLOGY MANUAL OF ORANGE(1986)
          (c) Copyright 1989-2016 Advanced Engineering Software (aes)
              Ver. 23.0  Release Date: 07/01/2016  License ID 1334

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* ME04130-IRVINE                                                       *
* SMALL AREA UNIT HYDROGRAPH                                           *
* PROPOSED 25 YEAR                                                     *
 ************************************************************************

  FILE NAME: P25H.DAT
  TIME/DATE OF STUDY: 09:10 03/01/2022

   The Small Area Unit Hydrograph Procedures in Section J
   of the Hydrology Manual provides estimates of runoff
   hydrograph and runoff volume for watersheds whose time of
   concentration is less than 25 minutes. The PROGRAM User
   should check the applicability of using the small area unit
   hydrograph procedures, and follow the guidelines in
   Sections J and K.5 in complex watershed modeling.


******************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     16.00 IS CODE = 1.2
------------------------------------------------------------------------------
  >>>>>SUBAREA RUNOFF (SMALL AREA UNIT-HYDROGRAPH ANALYSIS) <<<<<
==============================================================================

  (SMALL AREA UNIT-HYDROGRAPH ADDED TO STREAM #1)

    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    5.00
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.000
    LOW LOSS FRACTION = 0.260
    TIME OF CONCENTRATION(MIN.) =  7.38
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED:
    RETURN FREQUENCY(YEARS) =  25
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.87
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.15
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.94
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.71
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.49

------------------------------------------------------------------------------
  TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.67
  TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.20

------------------------------------------------------------------------------
♠
==============================================================================

                    2 4 - H O U R    S T O R M
                 R U N O F F    H Y D R O G R A P H

==============================================================================
            HYDROGRAPH IN  ONE-MINUTE UNIT INTERVALS(CFS)
        (Notes: Time indicated is at END of Each Unit Intervals.
                Peak 5-minute rainfall intensity is modeled as
                a constant value for entire 5-minute period.)
------------------------------------------------------------------------------
 TIME(HRS) VOLUME(AF)   Q(CFS) 0.        4.3       8.7      13.0      17.3
------------------------------------------------------------------------------
  10.000      0.3304      0.57  .Q     V  .         .         .         .
  10.017      0.3312      0.57  .Q     V  .         .         .         .
  10.033      0.3319      0.57  .Q     V  .         .         .         .
  10.050      0.3327      0.57  .Q     V  .         .         .         .
  10.067      0.3335      0.57  .Q     V  .         .         .         .
  10.083      0.3343      0.57  .Q     V  .         .         .         .
  10.100      0.3351      0.57  .Q      V .         .         .         .
  10.117      0.3359      0.57  .Q      V .         .         .         .
  10.133      0.3367      0.57  .Q      V .         .         .         .
  10.150      0.3374      0.57  .Q      V .         .         .         .
  10.167      0.3382      0.58  .Q      V .         .         .         .
  10.183      0.3390      0.58  .Q      V .         .         .         .
  10.200      0.3398      0.58  .Q      V .         .         .         .
  10.217      0.3406      0.58  .Q      V .         .         .         .
  10.233      0.3414      0.58  .Q      V .         .         .         .
  10.250      0.3422      0.58  .Q      V .         .         .         .
  10.267      0.3430      0.58  .Q      V .         .         .         .
  10.283      0.3438      0.58  .Q      V .         .         .         .
  10.300      0.3446      0.58  .Q      V .         .         .         .
  10.317      0.3454      0.58  .Q      V .         .         .         .
  10.333      0.3462      0.59  .Q      V .         .         .         .
  10.350      0.3471      0.59  .Q      V .         .         .         .
  10.367      0.3479      0.59  .Q      V .         .         .         .
  10.383      0.3487      0.59  .Q      V .         .         .         .
  10.400      0.3495      0.59  .Q      V .         .         .         .
```

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10.417	0.3503	0.59	.Q	V	.	.	.	.
10.433	0.3511	0.59	.Q	V	.	.	.	.
10.450	0.3519	0.59	.Q	V	.	.	.	.
10.467	0.3528	0.60	.Q	V	.	.	.	.
10.483	0.3536	0.60	.Q	V	.	.	.	.
10.500	0.3544	0.60	.Q	V	.	.	.	.
10.517	0.3552	0.60	.Q	V	.	.	.	.
10.533	0.3560	0.60	.Q	V	.	.	.	.
10.550	0.3569	0.60	.Q	V	.	.	.	.
10.567	0.3577	0.60	.Q	V	.	.	.	.
10.583	0.3585	0.60	.Q	V	.	.	.	.
10.600	0.3594	0.60	.Q	V	.	.	.	.
10.617	0.3602	0.60	.Q	V	.	.	.	.
10.633	0.3610	0.61	.Q	V	.	.	.	.
10.650	0.3619	0.61	.Q	V	.	.	.	.
10.667	0.3627	0.61	.Q	V	.	.	.	.
10.683	0.3635	0.61	.Q	V	.	.	.	.
10.700	0.3644	0.61	.Q	V	.	.	.	.
10.717	0.3652	0.61	.Q	V	.	.	.	.
10.733	0.3661	0.61	.Q	V	.	.	.	.
10.750	0.3669	0.62	.Q	V	.	.	.	.
10.767	0.3678	0.62	.Q	V	.	.	.	.
10.783	0.3686	0.62	.Q	V	.	.	.	.
10.800	0.3695	0.62	.Q	V	.	.	.	.
10.817	0.3703	0.62	.Q	V	.	.	.	.
10.833	0.3712	0.62	.Q	V	.	.	.	.
10.850	0.3720	0.62	.Q	V	.	.	.	.
10.867	0.3729	0.62	.Q	V	.	.	.	.
10.883	0.3738	0.62	.Q	V	.	.	.	.
10.900	0.3746	0.63	.Q	V	.	.	.	.
10.917	0.3755	0.63	.Q	V	.	.	.	.
10.933	0.3763	0.63	.Q	V	.	.	.	.
10.950	0.3772	0.63	.Q	V.	.	.	.	.
10.967	0.3781	0.63	.Q	V.	.	.	.	.
10.983	0.3790	0.63	.Q	V.	.	.	.	.
11.000	0.3798	0.63	.Q	V.	.	.	.	.
11.017	0.3807	0.64	.Q	V.	.	.	.	.
11.033	0.3816	0.64	.Q	V.	.	.	.	.
11.050	0.3825	0.64	.Q	V.	.	.	.	.
11.067	0.3833	0.64	.Q	V.	.	.	.	.
11.083	0.3842	0.64	.Q	V.	.	.	.	.
11.100	0.3851	0.64	.Q	V.	.	.	.	.
11.117	0.3860	0.64	.Q	V.	.	.	.	.
11.133	0.3869	0.64	.Q	V.	.	.	.	.
11.150	0.3878	0.65	.Q	V.	.	.	.	.
11.167	0.3887	0.65	.Q	V.	.	.	.	.
11.183	0.3895	0.65	.Q	V.	.	.	.	.
11.200	0.3904	0.65	.Q	V.	.	.	.	.
11.217	0.3913	0.65	.Q	V.	.	.	.	.
11.233	0.3922	0.65	.Q	V.	.	.	.	.
11.250	0.3931	0.65	.Q	V.	.	.	.	.
11.267	0.3940	0.66	.Q	V.	.	.	.	.
11.283	0.3950	0.66	.Q	V.	.	.	.	.
11.300	0.3959	0.66	.Q	V.	.	.	.	.
11.317	0.3968	0.66	.Q	V.	.	.	.	.
11.333	0.3977	0.66	.Q	V.	.	.	.	.
11.350	0.3986	0.66	.Q	V.	.	.	.	.
11.367	0.3995	0.66	.Q	V.	.	.	.	.
11.383	0.4004	0.67	.Q	V.	.	.	.	.
11.400	0.4013	0.67	.Q	V.	.	.	.	.
11.417	0.4023	0.67	.Q	V.	.	.	.	.
11.433	0.4032	0.67	.Q	V.	.	.	.	.
11.450	0.4041	0.67	.Q	V.	.	.	.	.
11.467	0.4050	0.67	.Q	V.	.	.	.	.
11.483	0.4060	0.68	.Q	V.	.	.	.	.
11.500	0.4069	0.68	.Q	V.	.	.	.	.
11.517	0.4078	0.68	.Q	V.	.	.	.	.
11.533	0.4088	0.68	.Q	V.	.	.	.	.
11.550	0.4097	0.68	.Q	V.	.	.	.	.
11.567	0.4106	0.68	.Q	V.	.	.	.	.
11.583	0.4116	0.68	.Q	V.	.	.	.	.
11.600	0.4125	0.68	.Q	V.	.	.	.	.
11.617	0.4135	0.69	.Q	V.	.	.	.	.
11.633	0.4144	0.69	.Q	V.	.	.	.	.
11.650	0.4154	0.69	.Q	V.	.	.	.	.
11.667	0.4163	0.69	.Q	V.	.	.	.	.
11.683	0.4173	0.70	.Q	V.	.	.	.	.
11.700	0.4182	0.70	.Q	V.	.	.	.	.
11.717	0.4192	0.70	.Q	V	.	.	.	.
11.733	0.4202	0.70	.Q	V	.	.	.	.
11.750	0.4211	0.70	.Q	V	.	.	.	.
11.767	0.4221	0.70	.Q	V	.	.	.	.
11.783	0.4231	0.70	.Q	V	.	.	.	.
11.800	0.4240	0.70	.Q	V	.	.	.	.
11.817	0.4250	0.71	.Q	V	.	.	.	.
11.833	0.4260	0.71	.Q	V	.	.	.	.
11.850	0.4270	0.71	.Q	V	.	.	.	.
11.867	0.4280	0.71	.Q	V	.	.	.	.
11.883	0.4289	0.71	.Q	V	.	.	.	.
11.900	0.4299	0.72	.Q	V	.	.	.	.
11.917	0.4309	0.72	.Q	V	.	.	.	.
11.933	0.4319	0.72	.Q	V	.	.	.	.
11.950	0.4329	0.72	.Q	V	.	.	.	.
11.967	0.4339	0.73	.Q	V	.	.	.	.
11.983	0.4349	0.73	.Q	V	.	.	.	.
12.000	0.4359	0.73	.Q	V	.	.	.	.
12.017	0.4369	0.73	.Q	V	.	.	.	.
12.033	0.4379	0.73	.Q	V	.	.	.	.
12.050	0.4389	0.73	.Q	V	.	.	.	.
12.067	0.4399	0.73	.Q	V	.	.	.	.

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12.083	0.4410	0.76	.Q	V	.	.	.
12.100	0.4421	0.79	.Q	V	.	.	.
12.117	0.4432	0.83	.Q	V	.	.	.
12.133	0.4444	0.86	.Q	V	.	.	.
12.150	0.4456	0.90	. Q	V	.	.	.
12.167	0.4469	0.93	. Q	V	.	.	.
12.183	0.4483	0.97	. Q	V	.	.	.
12.200	0.4496	0.99	. Q	V	.	.	.
12.217	0.4510	1.00	. Q	V	.	.	.
12.233	0.4524	1.00	. Q	V	.	.	.
12.250	0.4537	1.00	. Q	V	.	.	.
12.267	0.4551	1.00	. Q	V	.	.	.
12.283	0.4565	1.00	. Q	V	.	.	.
12.300	0.4579	1.00	. Q	V	.	.	.
12.317	0.4593	1.00	. Q	V	.	.	.
12.333	0.4607	1.01	. Q	.V	.	.	.
12.350	0.4620	1.01	. Q	.V	.	.	.
12.367	0.4634	1.01	. Q	.V	.	.	.
12.383	0.4648	1.02	. Q	.V	.	.	.
12.400	0.4662	1.02	. Q	.V	.	.	.
12.417	0.4677	1.02	. Q	.V	.	.	.
12.433	0.4691	1.03	. Q	.V	.	.	.
12.450	0.4705	1.03	. Q	.V	.	.	.
12.467	0.4719	1.03	. Q	.V	.	.	.
12.483	0.4733	1.03	. Q	.V	.	.	.
12.500	0.4748	1.03	. Q	.V	.	.	.
12.517	0.4762	1.04	. Q	.V	.	.	.
12.533	0.4776	1.04	. Q	.V	.	.	.
12.550	0.4790	1.04	. Q	.V	.	.	.
12.567	0.4805	1.04	. Q	.V	.	.	.
12.583	0.4819	1.04	. Q	.V	.	.	.
12.600	0.4834	1.05	. Q	.V	.	.	.
12.617	0.4848	1.05	. Q	.V	.	.	.
12.633	0.4863	1.05	. Q	.V	.	.	.
12.650	0.4877	1.06	. Q	.V	.	.	.
12.667	0.4892	1.06	. Q	.V	.	.	.
12.683	0.4906	1.06	. Q	.V	.	.	.
12.700	0.4921	1.07	. Q	.V	.	.	.
12.717	0.4936	1.07	. Q	.V	.	.	.
12.733	0.4951	1.07	. Q	.V	.	.	.
12.750	0.4965	1.07	. Q	.V	.	.	.
12.767	0.4980	1.07	. Q	.V	.	.	.
12.783	0.4995	1.08	. Q	.V	.	.	.
12.800	0.5010	1.08	. Q	.V	.	.	.
12.817	0.5025	1.08	. Q	. V	.	.	.
12.833	0.5040	1.08	. Q	. V	.	.	.
12.850	0.5055	1.09	. Q	. V	.	.	.
12.867	0.5070	1.09	. Q	. V	.	.	.
12.883	0.5085	1.10	. Q	. V	.	.	.
12.900	0.5100	1.10	. Q	. V	.	.	.
12.917	0.5115	1.10	. Q	. V	.	.	.
12.933	0.5130	1.11	. Q	. V	.	.	.
12.950	0.5146	1.11	. Q	. V	.	.	.
12.967	0.5161	1.11	. Q	. V	.	.	.
12.983	0.5176	1.11	. Q	. V	.	.	.
13.000	0.5192	1.12	. Q	. V	.	.	.
13.017	0.5207	1.12	. Q	. V	.	.	.
13.033	0.5223	1.12	. Q	. V	.	.	.
13.050	0.5238	1.12	. Q	. V	.	.	.
13.067	0.5254	1.13	. Q	. V	.	.	.
13.083	0.5269	1.13	. Q	. V	.	.	.
13.100	0.5285	1.13	. Q	. V	.	.	.
13.117	0.5300	1.14	. Q	. V	.	.	.
13.133	0.5316	1.14	. Q	. V	.	.	.
13.150	0.5332	1.15	. Q	. V	.	.	.
13.167	0.5348	1.15	. Q	. V	.	.	.
13.183	0.5364	1.16	. Q	. V	.	.	.
13.200	0.5380	1.16	. Q	. V	.	.	.
13.217	0.5396	1.16	. Q	. V	.	.	.
13.233	0.5412	1.16	. Q	. V	.	.	.
13.250	0.5428	1.17	. Q	. V	.	.	.
13.267	0.5444	1.17	. Q	. V	.	.	.
13.283	0.5460	1.17	. Q	. V	.	.	.
13.300	0.5476	1.17	. Q	. V	.	.	.
13.317	0.5492	1.18	. Q	. V	.	.	.
13.333	0.5509	1.18	. Q	. V	.	.	.
13.350	0.5525	1.19	. Q	. V	.	.	.
13.367	0.5541	1.19	. Q	. V	.	.	.
13.383	0.5558	1.20	. Q	. V	.	.	.
13.400	0.5574	1.20	. Q	. V	.	.	.
13.417	0.5591	1.21	. Q	. V	.	.	.
13.433	0.5608	1.21	. Q	. V	.	.	.
13.450	0.5624	1.21	. Q	. V	.	.	.
13.467	0.5641	1.22	. Q	. V	.	.	.
13.483	0.5658	1.22	. Q	. V	.	.	.
13.500	0.5675	1.22	. Q	. V	.	.	.
13.517	0.5692	1.22	. Q	. V	.	.	.
13.533	0.5709	1.23	. Q	. V	.	.	.
13.550	0.5726	1.23	. Q	. V	.	.	.
13.567	0.5743	1.24	. Q	. V	.	.	.
13.583	0.5760	1.24	. Q	. V	.	.	.
13.600	0.5777	1.25	. Q	. V	.	.	.
13.617	0.5794	1.25	. Q	. V	.	.	.
13.633	0.5811	1.26	. Q	. V	.	.	.
13.650	0.5829	1.26	. Q	. V	.	.	.
13.667	0.5846	1.27	. Q	. V	.	.	.
13.683	0.5864	1.27	. Q	. V	.	.	.
13.700	0.5881	1.28	. Q	. V	.	.	.
13.717	0.5899	1.28	. Q	. V	.	.	.
13.733	0.5917	1.28	. Q	. V	.	.	.

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13.750	0.5934	1.29	.	Q	.	V	.	.	.
13.767	0.5952	1.29	.	Q	.	V	.	.	.
13.783	0.5970	1.29	.	Q	.	V	.	.	.
13.800	0.5988	1.30	.	Q	.	V	.	.	.
13.817	0.6006	1.30	.	Q	.	V	.	.	.
13.833	0.6024	1.31	.	Q	.	V	.	.	.
13.850	0.6042	1.32	.	Q	.	V	.	.	.
13.867	0.6060	1.32	.	Q	.	V	.	.	.
13.883	0.6079	1.33	.	Q	.	V	.	.	.
13.900	0.6097	1.34	.	Q	.	V	.	.	.
13.917	0.6116	1.34	.	Q	.	V	.	.	.
13.933	0.6134	1.35	.	Q	.	V	.	.	.
13.950	0.6153	1.35	.	Q	.	V	.	.	.
13.967	0.6171	1.36	.	Q	.	V	.	.	.
13.983	0.6190	1.36	.	Q	.	V	.	.	.
14.000	0.6209	1.36	.	Q	.	V	.	.	.
14.017	0.6228	1.37	.	Q	.	V	.	.	.
14.033	0.6247	1.37	.	Q	.	V	.	.	.
14.050	0.6266	1.37	.	Q	.	V	.	.	.
14.067	0.6285	1.38	.	Q	.	V	.	.	.
14.083	0.6304	1.39	.	Q	.	V	.	.	.
14.100	0.6323	1.39	.	Q	.	V	.	.	.
14.117	0.6342	1.40	.	Q	.	V	.	.	.
14.133	0.6361	1.40	.	Q	.	V	.	.	.
14.150	0.6381	1.41	.	Q	.	V	.	.	.
14.167	0.6400	1.41	.	Q	.	V	.	.	.
14.183	0.6420	1.42	.	Q	.	V	.	.	.
14.200	0.6439	1.42	.	Q	.	V	.	.	.
14.217	0.6459	1.43	.	Q	.	V	.	.	.
14.233	0.6479	1.43	.	Q	.	V	.	.	.
14.250	0.6498	1.44	.	Q	.	V	.	.	.
14.267	0.6518	1.44	.	Q	.	V	.	.	.
14.283	0.6538	1.44	.	Q	.	V	.	.	.
14.300	0.6558	1.45	.	Q	.	V	.	.	.
14.317	0.6578	1.46	.	Q	.	V	.	.	.
14.333	0.6599	1.47	.	Q	.	V	.	.	.
14.350	0.6619	1.48	.	Q	.	V	.	.	.
14.367	0.6640	1.49	.	Q	.	V	.	.	.
14.383	0.6660	1.50	.	Q	.	V	.	.	.
14.400	0.6681	1.51	.	Q	.	V	.	.	.
14.417	0.6702	1.52	.	Q	.	V	.	.	.
14.433	0.6723	1.53	.	Q	.	V	.	.	.
14.450	0.6744	1.53	.	Q	.	V	.	.	.
14.467	0.6765	1.54	.	Q	.	V	.	.	.
14.483	0.6787	1.54	.	Q	.	V	.	.	.
14.500	0.6808	1.55	.	Q	.	V	.	.	.
14.517	0.6829	1.55	.	Q	.	V	.	.	.
14.533	0.6851	1.56	.	Q	.	V	.	.	.
14.550	0.6872	1.57	.	Q	.	V	.	.	.
14.567	0.6894	1.58	.	Q	.	V	.	.	.
14.583	0.6916	1.60	.	Q	.	V	.	.	.
14.600	0.6938	1.61	.	Q	.	V	.	.	.
14.617	0.6961	1.62	.	Q	.	V	.	.	.
14.633	0.6983	1.63	.	Q	.	V	.	.	.
14.650	0.7006	1.64	.	Q	.	V	.	.	.
14.667	0.7028	1.65	.	Q	.	V	.	.	.
14.683	0.7051	1.66	.	Q	.	V	.	.	.
14.700	0.7074	1.67	.	Q	.	V	.	.	.
14.717	0.7097	1.67	.	Q	.	V	.	.	.
14.733	0.7121	1.68	.	Q	.	V	.	.	.
14.750	0.7144	1.69	.	Q	.	V	.	.	.
14.767	0.7167	1.70	.	Q	.	V	.	.	.
14.783	0.7191	1.71	.	Q	.	V	.	.	.
14.800	0.7214	1.72	.	Q	.	V	.	.	.
14.817	0.7238	1.74	.	Q	.	V	.	.	.
14.833	0.7262	1.75	.	Q	.	V	.	.	.
14.850	0.7287	1.77	.	Q	.	V	.	.	.
14.867	0.7311	1.79	.	Q	.	V	.	.	.
14.883	0.7336	1.80	.	Q	.	V	.	.	.
14.900	0.7361	1.82	.	Q	.	V	.	.	.
14.917	0.7386	1.83	.	Q	.	V	.	.	.
14.933	0.7412	1.84	.	Q	.	V	.	.	.
14.950	0.7437	1.85	.	Q	.	V	.	.	.
14.967	0.7463	1.86	.	Q	.	V	.	.	.
14.983	0.7488	1.87	.	Q	.	V	.	.	.
15.000	0.7514	1.88	.	Q	.	V	.	.	.
15.017	0.7540	1.88	.	Q	.	V	.	.	.
15.033	0.7566	1.90	.	Q	.	V	.	.	.
15.050	0.7593	1.92	.	Q	.	V	.	.	.
15.067	0.7620	1.95	.	Q	.	V	.	.	.
15.083	0.7647	1.97	.	Q	.	V	.	.	.
15.100	0.7674	1.99	.	Q	.	V	.	.	.
15.117	0.7702	2.01	.	Q	.	V	.	.	.
15.133	0.7730	2.04	.	Q	.	V	.	.	.
15.150	0.7758	2.06	.	Q	.	V	.	.	.
15.167	0.7787	2.07	.	Q	.	V	.	.	.
15.183	0.7816	2.08	.	Q	.	V	.	.	.
15.200	0.7844	2.10	.	Q	.	V	.	.	.
15.217	0.7873	2.11	.	Q	.	V	.	.	.
15.233	0.7903	2.12	.	Q	.	V	.	.	.
15.250	0.7932	2.14	.	Q	.	V	.	.	.
15.267	0.7962	2.15	.	Q	.	V	.	.	.
15.283	0.7992	2.18	.	Q	.	V	.	.	.
15.300	0.8022	2.20	.	Q	.	V	.	.	.
15.317	0.8053	2.23	.	Q	.	V	.	.	.
15.333	0.8084	2.26	.	Q	.	V	.	.	.
15.350	0.8116	2.29	.	Q	.	V	.	.	.
15.367	0.8147	2.31	.	Q	.	V	.	.	.
15.383	0.8180	2.34	.	Q	.	V	.	.	.
15.400	0.8212	2.35	.	Q	.	V	.	.	.

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15.417    0.8244    2.33  .   Q   .       V.        .        .
15.433    0.8276    2.30  .   Q   .       V.        .        .
15.450    0.8307    2.28  .   Q   .       V.        .        .
15.467    0.8338    2.26  .   Q   .       V.        .        .
15.483    0.8369    2.23  .   Q   .        V        .        .
15.500    0.8399    2.21  .   Q   .        V        .        .
15.517    0.8430    2.20  .   Q   .        V        .        .
15.533    0.8461    2.25  .   Q   .        V        .        .
15.550    0.8493    2.31  .   Q   .        V        .        .
15.567    0.8525    2.37  .   Q   .        V        .        .
15.583    0.8559    2.43  .   Q   .        V        .        .
15.600    0.8593    2.49  .   Q   .        V        .        .
15.617    0.8628    2.55  .   Q   .        V        .        .
15.633    0.8664    2.61  .    Q  .        V        .        .
15.650    0.8701    2.67  .    Q  .        V        .        .
15.667    0.8738    2.71  .    Q  .        V        .        .
15.683    0.8776    2.76  .    Q  .        V        .        .
15.700    0.8815    2.81  .    Q  .        .V       .        .
15.717    0.8854    2.86  .    Q  .        .V       .        .
15.733    0.8894    2.90  .    Q  .        .V       .        .
15.750    0.8935    2.95  .    Q  .        .V       .        .
15.767    0.8977    3.05  .     Q .        .V       .        .
15.783    0.9022    3.25  .     Q .        .V       .        .
15.800    0.9069    3.45  .     Q .        .V       .        .
15.817    0.9119    3.66  .      Q.        .V       .        .
15.833    0.9173    3.86  .      Q.        .V       .        .
15.850    0.9229    4.06  .       Q.       . V      .        .
15.867    0.9287    4.27  .       Q.       . V      .        .
15.883    0.9349    4.47  .        Q       . V      .        .
15.900    0.9414    4.69  .        Q       . V      .        .
15.917    0.9481    4.90  .        .Q      . V      .        .
15.933    0.9552    5.11  .        .Q      . V      .        .
15.950    0.9625    5.33  .         . Q     .  V     .        .
15.967    0.9701    5.54  .         . Q     .  V     .        .
15.983    0.9781    5.76  .          . Q    .  V     .        .
16.000    0.9863    5.97  .          . Q    .  V     .        .
16.017    0.9957    6.84  .            .  Q  .  V     .        .
16.033    1.0072    8.36  .            .    Q.  V     .        .
16.050    1.0208    9.89  .            .     . Q V     .        .
16.067    1.0365   11.41  .            .       .  V Q  .        .
16.083    1.0544   12.94  .            .       .   V   Q.      .
16.100    1.0743   14.46  .            .       .   V     .  Q   .
16.117    1.0963   15.98  .            .       .    V    .    Q .
16.133    1.1202   17.33  .            .       .    V    .      Q
16.150    1.1412   15.26  .            .       .     V   .    Q  .
16.167    1.1597   13.41  .            .       .     V   Q      .
16.183    1.1756   11.57  .            .       .      Q V .     .
16.200    1.1890    9.72  .            .       . Q     V .      .
16.217    1.1998    7.88  .            .     Q .       V .      .
16.233    1.2081    6.03  .            .  Q    .       V .      .
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16.250    1.2140    4.24  .          Q.        .        V.       .
16.267    1.2189    3.57  .         Q .        .        V.       .
16.283    1.2236    3.40  .        Q  .        .        V.       .
16.300    1.2280    3.22  .        Q  .        .        V.       .
16.317    1.2322    3.04  .        Q  .        .        V.       .
16.333    1.2361    2.86  .      Q    .        .        V.       .
16.350    1.2398    2.68  .      Q    .        .        V.       .
16.367    1.2433    2.50  .    Q      .        .        V.       .
16.383    1.2465    2.38  .    Q      .        .        V.       .
16.400    1.2498    2.36  .    Q      .        .        V.       .
16.417    1.2530    2.35  .    Q      .        .        V.       .
16.433    1.2562    2.33  .    Q      .        .         V       .
16.450    1.2594    2.32  .    Q      .        .         V       .
16.467    1.2626    2.30  .    Q      .        .         V       .
16.483    1.2657    2.29  .    Q      .        .         V       .
16.500    1.2689    2.27  .    Q      .        .         V       .
16.517    1.2719    2.23  .    Q      .        .         V       .
16.533    1.2750    2.19  .    Q      .        .         V       .
16.550    1.2779    2.15  .  Q        .        .         V       .
16.567    1.2808    2.11  .  Q        .        .         V       .
16.583    1.2837    2.07  .  Q        .        .         V       .
16.600    1.2865    2.02  .  Q        .        .         V       .
16.617    1.2892    1.98  .  Q        .        .         V       .
16.633    1.2919    1.95  .  Q        .        .         V       .
16.650    1.2945    1.92  .  Q        .        .         V       .
16.667    1.2971    1.89  .  Q        .        .         .V      .
16.683    1.2997    1.86  .  Q        .        .         .V      .
16.700    1.3022    1.84  .  Q        .        .         .V      .
16.717    1.3047    1.81  .  Q        .        .         .V      .
16.733    1.3072    1.78  .  Q        .        .         .V      .
16.750    1.3096    1.75  .  Q        .        .         .V      .
16.767    1.3120    1.73  .  Q        .        .         .V      .
16.783    1.3143    1.71  .  Q        .        .         .V      .
16.800    1.3166    1.69  .  Q        .        .         .V      .
16.817    1.3189    1.67  .  Q        .        .         .V      .
16.833    1.3212    1.65  .  Q        .        .         .V      .
16.850    1.3234    1.63  .  Q        .        .         .V      .
16.867    1.3257    1.60  .  Q        .        .         .V      .
16.883    1.3278    1.59  .  Q        .        .         .V      .
16.900    1.3300    1.57  .  Q        .        .         .V      .
16.917    1.3321    1.55  .  Q        .        .         .V      .
16.933    1.3343    1.54  .  Q        .        .         .V      .
16.950    1.3364    1.52  .  Q        .        .         .V      .
16.967    1.3384    1.51  .  Q        .        .         .V      .
16.983    1.3405    1.49  .  Q        .        .         . V     .
17.000    1.3425    1.47  .  Q        .        .         . V     .
17.017    1.3445    1.46  .  Q        .        .         . V     .
17.033    1.3465    1.45  .  Q        .        .         . V     .
17.050    1.3485    1.44  .  Q        .        .         . V     .
17.067    1.3505    1.43  .  Q        .        .         . V     .
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17.083	1.3524	1.42	. Q . . . V .
17.100	1.3544	1.40	. Q . . . V .
17.117	1.3563	1.39	. Q . . . V .
17.133	1.3582	1.38	. Q . . . V .
17.150	1.3601	1.37	. Q . . . V .
17.167	1.3619	1.36	. Q . . . V .
17.183	1.3638	1.35	. Q . . . V .
17.200	1.3657	1.34	. Q . . . V .
17.217	1.3675	1.33	. Q . . . V .
17.233	1.3693	1.32	. Q . . . V .
17.250	1.3711	1.31	. Q . . . V .
17.267	1.3729	1.30	. Q . . . V .
17.283	1.3747	1.29	. Q . . . V .
17.300	1.3765	1.28	. Q . . . V .
17.317	1.3782	1.27	. Q . . . V .
17.333	1.3800	1.27	. Q . . . V .
17.350	1.3817	1.26	. Q . . . V .
17.367	1.3834	1.25	. Q . . . V .
17.383	1.3851	1.24	. Q . . . V .
17.400	1.3868	1.23	. Q . . . V .
17.417	1.3885	1.22	. Q . . . V .
17.433	1.3902	1.22	. Q . . . V .
17.450	1.3918	1.21	. Q . . . V .
17.467	1.3935	1.20	. Q . . . V .
17.483	1.3951	1.19	. Q . . . V .
17.500	1.3968	1.18	. Q . . . V .
17.517	1.3984	1.18	. Q . . . V .
17.533	1.4000	1.17	. Q . . . V .
17.550	1.4016	1.16	. Q . . . V .
17.567	1.4032	1.16	. Q . . . V .
17.583	1.4048	1.15	. Q . . . V .
17.600	1.4063	1.14	. Q . . . V .
17.617	1.4079	1.14	. Q . . . V .
17.633	1.4095	1.13	. Q . . . V .
17.650	1.4110	1.12	. Q . . . V .
17.667	1.4126	1.12	. Q . . . V .
17.683	1.4141	1.11	. Q . . . V .
17.700	1.4156	1.10	. Q . . . V .
17.717	1.4171	1.10	. Q . . . V .
17.733	1.4186	1.09	. Q . . . V .
17.750	1.4201	1.09	. Q . . . V .
17.767	1.4216	1.08	. Q . . . V .
17.783	1.4231	1.08	. Q . . . V .
17.800	1.4246	1.07	. Q . . . V .
17.817	1.4260	1.06	. Q . . . V .
17.833	1.4275	1.06	. Q . . . V .
17.850	1.4289	1.05	. Q . . . V .
17.867	1.4304	1.05	. Q . . . V .
17.883	1.4318	1.04	. Q . . . V .
17.900	1.4333	1.04	. Q . . . V .

17.917	1.4347	1.03	. Q . . . V .
17.933	1.4361	1.03	. Q . . . V .
17.950	1.4375	1.02	. Q . . . V .
17.967	1.4389	1.02	. Q . . . V .
17.983	1.4403	1.01	. Q . . . V .
18.000	1.4417	1.00	. Q . . . V .
18.017	1.4430	0.99	. Q . . . V .
18.033	1.4444	0.98	. Q . . . V .
18.050	1.4457	0.96	. Q . . . V .
18.067	1.4470	0.95	. Q . . . V .
18.083	1.4483	0.94	. Q . . . V .
18.100	1.4496	0.93	. Q . . . V .
18.117	1.4508	0.90	. Q . . . V .
18.133	1.4520	0.87	. Q . . . V .
18.150	1.4532	0.84	.Q . . . V .
18.167	1.4543	0.81	.Q . . . V .
18.183	1.4554	0.78	.Q . . . V .
18.200	1.4564	0.75	.Q . . . V .
18.217	1.4574	0.73	.Q . . . V .
18.233	1.4584	0.71	.Q . . . V .
18.250	1.4594	0.71	.Q . . . V .
18.267	1.4604	0.71	.Q . . . V .
18.283	1.4613	0.70	.Q . . . V .
18.300	1.4623	0.70	.Q . . . V .
18.317	1.4633	0.70	.Q . . . V .
18.333	1.4642	0.69	.Q . . . V .
18.350	1.4652	0.69	.Q . . . V .
18.367	1.4661	0.69	.Q . . . V .
18.383	1.4670	0.68	.Q . . . V .
18.400	1.4680	0.68	.Q . . . V .
18.417	1.4689	0.68	.Q . . . V .
18.433	1.4698	0.67	.Q . . . V .
18.450	1.4708	0.67	.Q . . . V .
18.467	1.4717	0.67	.Q . . . V .
18.483	1.4726	0.66	.Q . . . V .
18.500	1.4735	0.66	.Q . . . V .
18.517	1.4744	0.66	.Q . . . V .
18.533	1.4753	0.66	.Q . . . V .
18.550	1.4762	0.65	.Q . . . V .
18.567	1.4771	0.65	.Q . . . V .
18.583	1.4780	0.65	.Q . . . V .
18.600	1.4789	0.64	.Q . . . V .
18.617	1.4798	0.64	.Q . . . V .
18.633	1.4807	0.64	.Q . . . V .
18.650	1.4815	0.64	.Q . . . V .
18.667	1.4824	0.63	.Q . . . V .
18.683	1.4833	0.63	.Q . . . V .
18.700	1.4841	0.63	.Q . . . V .
18.717	1.4850	0.63	.Q . . . V .
18.733	1.4859	0.62	.Q . . . V .

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 18.750     1.4867     0.62  .Q       .        .        .    V    .
 18.767     1.4876     0.62  .Q       .        .        .    V    .
 18.783     1.4884     0.62  .Q       .        .        .    V    .
 18.800     1.4893     0.61  .Q       .        .        .    V    .
 18.817     1.4901     0.61  .Q       .        .        .    V    .
 18.833     1.4909     0.61  .Q       .        .        .    V    .
 18.850     1.4918     0.61  .Q       .        .        .    V    .
 18.867     1.4926     0.60  .Q       .        .        .    V    .
 18.883     1.4934     0.60  .Q       .        .        .    V    .
 18.900     1.4943     0.60  .Q       .        .        .    V    .
 18.917     1.4951     0.60  .Q       .        .        .    V    .
 18.933     1.4959     0.59  .Q       .        .        .    V    .
 18.950     1.4967     0.59  .Q       .        .        .    V    .
 18.967     1.4975     0.59  .Q       .        .        .    V    .
 18.983     1.4983     0.59  .Q       .        .        .    V    .
 19.000     1.4991     0.59  .Q       .        .        .    V    .
 19.017     1.5000     0.58  .Q       .        .        .    V    .
 19.033     1.5008     0.58  .Q       .        .        .    V    .
 19.050     1.5016     0.58  .Q       .        .        .    V    .
 19.067     1.5023     0.58  .Q       .        .        .    V    .
 19.083     1.5031     0.58  .Q       .        .        .    V    .
 19.100     1.5039     0.57  .Q       .        .        .    V    .
 19.117     1.5047     0.57  .Q       .        .        .    V    .
 19.133     1.5055     0.57  .Q       .        .        .    V    .
 19.150     1.5063     0.57  .Q       .        .        .     V   .
 19.167     1.5071     0.57  .Q       .        .        .     V   .
 19.183     1.5078     0.56  .Q       .        .        .     V   .
 19.200     1.5086     0.56  .Q       .        .        .     V   .
 19.217     1.5094     0.56  .Q       .        .        .     V   .
 19.233     1.5102     0.56  .Q       .        .        .     V   .
 19.250     1.5109     0.56  .Q       .        .        .     V   .
 19.267     1.5117     0.55  .Q       .        .        .     V   .
 19.283     1.5124     0.55  .Q       .        .        .     V   .
 19.300     1.5132     0.55  .Q       .        .        .     V   .
 19.317     1.5140     0.55  .Q       .        .        .     V   .
 19.333     1.5147     0.55  .Q       .        .        .     V   .
 19.350     1.5155     0.54  .Q       .        .        .     V   .
 19.367     1.5162     0.54  .Q       .        .        .     V   .
 19.383     1.5170     0.54  .Q       .        .        .     V   .
 19.400     1.5177     0.54  .Q       .        .        .     V   .
 19.417     1.5184     0.54  .Q       .        .        .     V   .
 19.433     1.5192     0.54  .Q       .        .        .     V   .
 19.450     1.5199     0.53  .Q       .        .        .     V   .
 19.467     1.5206     0.53  .Q       .        .        .     V   .
 19.483     1.5214     0.53  .Q       .        .        .     V   .
 19.500     1.5221     0.53  .Q       .        .        .     V   .
 19.517     1.5228     0.53  .Q       .        .        .     V   .
 19.533     1.5236     0.53  .Q       .        .        .     V   .
 19.550     1.5243     0.52  .Q       .        .        .     V   .
 19.567     1.5250     0.52  .Q       .        .        .     V   .
 19.583     1.5257     0.52  .Q       .        .        .     V   .
 19.600     1.5264     0.52  .Q       .        .        .     V   .
 19.617     1.5271     0.52  .Q       .        .        .     V   .
 19.633     1.5279     0.52  .Q       .        .        .     V   .
 19.650     1.5286     0.52  .Q       .        .        .     V   .
 19.667     1.5293     0.51  .Q       .        .        .     V   .
 19.683     1.5300     0.51  .Q       .        .        .     V   .
 19.700     1.5307     0.51  .Q       .        .        .     V   .
 19.717     1.5314     0.51  .Q       .        .        .     V   .
 19.733     1.5321     0.51  .Q       .        .        .     V   .
 19.750     1.5328     0.51  .Q       .        .        .     V   .
 19.767     1.5335     0.50  .Q       .        .        .     V   .
 19.783     1.5342     0.50  .Q       .        .        .     V   .
 19.800     1.5349     0.50  .Q       .        .        .     V   .
 19.817     1.5355     0.50  .Q       .        .        .     V   .
 19.833     1.5362     0.50  .Q       .        .        .     V   .
 19.850     1.5369     0.50  .Q       .        .        .     V   .
 19.867     1.5376     0.50  .Q       .        .        .     V   .
 19.883     1.5383     0.49  .Q       .        .        .     V   .
 19.900     1.5390     0.49  .Q       .        .        .     V   .
 19.917     1.5396     0.49  .Q       .        .        .     V   .
 19.933     1.5403     0.49  .Q       .        .        .     V   .
 19.950     1.5410     0.49  .Q       .        .        .     V   .
 19.967     1.5417     0.49  .Q       .        .        .     V   .
 19.983     1.5423     0.49  .Q       .        .        .     V   .
 20.000     1.5430     0.49  .Q       .        .        .     V   .
-------------------------------------------------------------------------------
  TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
  (Note: 100% of Peak Flow Rate estimate assumed to have
  an instantaneous time duration)

  Percentile of Estimated          Duration
      Peak Flow Rate               (minutes)
  =======================          =========
            0%                      1201.0
           10%                       585.0
           20%                       140.0
           30%                        90.0
           40%                        60.0
           50%                        50.0
           60%                        40.0
           70%                        30.0
           80%                        20.0
           90%                        10.0


*******************************************************************************
  FLOW PROCESS FROM NODE     16.00 TO NODE     16.00 IS CODE = 3.2
-------------------------------------------------------------------------------
  >>>>>FLOW-THROUGH DETENTION BASIN ROUTING MODEL APPLIED TO STREAM #1<<<<<
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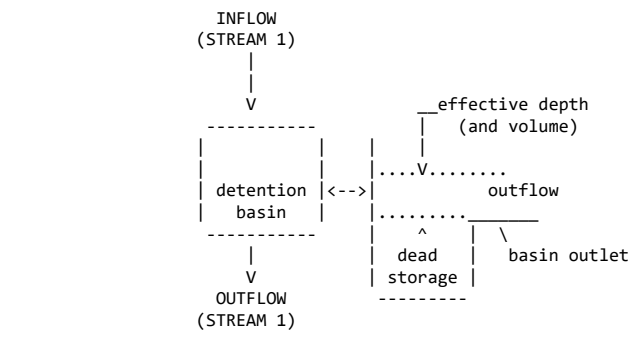

ROUTE RUNOFF HYDROGRAPH FROM STREAM NUMBER 1
THROUGH A FLOW-THROUGH DETENTION BASIN
SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
DEAD STORAGE(AF) = 0.000
SPECIFIED DEAD STORAGE(AF) FILLED = 0.000
SPECIFIED EFFECTIVE VOLUME(AF) FILLED ABOVE OUTLET = 0.000
DETENTION BASIN CONSTANT LOSS RATE(CFS) = 0.00

BASIN DEPTH VERSUS OUTFLOW AND STORAGE INFORMATION:

INTERVAL NUMBER	DEPTH (FT)	OUTFLOW (CFS)	STORAGE (AF)
1	0.00	0.00	0.000
2	1.00	2.67	0.020
3	2.00	4.63	0.046
4	3.00	5.98	0.069
5	3.50	6.55	0.092
6	4.00	13.62	0.115
7	5.00	25.56	0.138

MODIFIED-PULS BASIN ROUTING MODEL RESULTS(1-MINUTE COMPUTATION INTERVALS):
(Note: Computed EFFECTIVE DEPTH and VOLUME are estimated at the clock time;
MEAN OUTFLOW is the average value during the unit interval.)

CLOCK TIME (HRS)	DEAD-STORAGE FILLED(AF)	INFLOW (CFS)	LOSS (CFS)	EFFECTIVE DEPTH(FT)	MEAN OUTFLOW (CFS)	EFFECTIVE VOLUME(AF)
10.000	0.000	0.57	0.00	0.21	0.6	0.004
10.017	0.000	0.57	0.00	0.21	0.6	0.004
10.033	0.000	0.57	0.00	0.21	0.6	0.004
10.050	0.000	0.57	0.00	0.21	0.6	0.004
10.067	0.000	0.57	0.00	0.21	0.6	0.004
10.083	0.000	0.57	0.00	0.21	0.6	0.004
10.100	0.000	0.57	0.00	0.21	0.6	0.004
10.117	0.000	0.57	0.00	0.21	0.6	0.004
10.133	0.000	0.57	0.00	0.21	0.6	0.004
10.150	0.000	0.57	0.00	0.21	0.6	0.004
10.167	0.000	0.58	0.00	0.21	0.6	0.004
10.183	0.000	0.58	0.00	0.21	0.6	0.004
10.200	0.000	0.58	0.00	0.21	0.6	0.004
10.217	0.000	0.58	0.00	0.21	0.6	0.004
10.233	0.000	0.58	0.00	0.22	0.6	0.004
10.250	0.000	0.58	0.00	0.22	0.6	0.004
10.267	0.000	0.58	0.00	0.22	0.6	0.004
10.283	0.000	0.58	0.00	0.22	0.6	0.004
10.300	0.000	0.58	0.00	0.22	0.6	0.004
10.317	0.000	0.58	0.00	0.22	0.6	0.004
10.333	0.000	0.59	0.00	0.22	0.6	0.004
10.350	0.000	0.59	0.00	0.22	0.6	0.004
10.367	0.000	0.59	0.00	0.22	0.6	0.004
10.383	0.000	0.59	0.00	0.22	0.6	0.004
10.400	0.000	0.59	0.00	0.22	0.6	0.004
10.417	0.000	0.59	0.00	0.22	0.6	0.004
10.433	0.000	0.59	0.00	0.22	0.6	0.004
10.450	0.000	0.59	0.00	0.22	0.6	0.004
10.467	0.000	0.60	0.00	0.22	0.6	0.004
10.483	0.000	0.60	0.00	0.22	0.6	0.004
10.500	0.000	0.60	0.00	0.22	0.6	0.004
10.517	0.000	0.60	0.00	0.22	0.6	0.004
10.533	0.000	0.60	0.00	0.22	0.6	0.004
10.550	0.000	0.60	0.00	0.22	0.6	0.004
10.567	0.000	0.60	0.00	0.22	0.6	0.004
10.583	0.000	0.60	0.00	0.22	0.6	0.004
10.600	0.000	0.60	0.00	0.22	0.6	0.004
10.617	0.000	0.60	0.00	0.22	0.6	0.004
10.633	0.000	0.61	0.00	0.22	0.6	0.004
10.650	0.000	0.61	0.00	0.23	0.6	0.005
10.667	0.000	0.61	0.00	0.23	0.6	0.005
10.683	0.000	0.61	0.00	0.23	0.6	0.005
10.700	0.000	0.61	0.00	0.23	0.6	0.005
10.717	0.000	0.61	0.00	0.23	0.6	0.005
10.733	0.000	0.61	0.00	0.23	0.6	0.005
10.750	0.000	0.62	0.00	0.23	0.6	0.005
10.767	0.000	0.62	0.00	0.23	0.6	0.005
10.783	0.000	0.62	0.00	0.23	0.6	0.005
10.800	0.000	0.62	0.00	0.23	0.6	0.005

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10.817	0.000	0.62	0.00	0.23	0.6	0.005
10.833	0.000	0.62	0.00	0.23	0.6	0.005
10.850	0.000	0.62	0.00	0.23	0.6	0.005
10.867	0.000	0.62	0.00	0.23	0.6	0.005
10.883	0.000	0.62	0.00	0.23	0.6	0.005
10.900	0.000	0.63	0.00	0.23	0.6	0.005
10.917	0.000	0.63	0.00	0.23	0.6	0.005
10.933	0.000	0.63	0.00	0.23	0.6	0.005
10.950	0.000	0.63	0.00	0.23	0.6	0.005
10.967	0.000	0.63	0.00	0.23	0.6	0.005
10.983	0.000	0.63	0.00	0.23	0.6	0.005
11.000	0.000	0.63	0.00	0.24	0.6	0.005
11.017	0.000	0.64	0.00	0.24	0.6	0.005
11.033	0.000	0.64	0.00	0.24	0.6	0.005
11.050	0.000	0.64	0.00	0.24	0.6	0.005
11.067	0.000	0.64	0.00	0.24	0.6	0.005
11.083	0.000	0.64	0.00	0.24	0.6	0.005
11.100	0.000	0.64	0.00	0.24	0.6	0.005
11.117	0.000	0.64	0.00	0.24	0.6	0.005
11.133	0.000	0.64	0.00	0.24	0.6	0.005
11.150	0.000	0.65	0.00	0.24	0.6	0.005
11.167	0.000	0.65	0.00	0.24	0.6	0.005
11.183	0.000	0.65	0.00	0.24	0.6	0.005
11.200	0.000	0.65	0.00	0.24	0.6	0.005
11.217	0.000	0.65	0.00	0.24	0.6	0.005
11.233	0.000	0.65	0.00	0.24	0.6	0.005
11.250	0.000	0.65	0.00	0.24	0.6	0.005
11.267	0.000	0.66	0.00	0.24	0.6	0.005
11.283	0.000	0.66	0.00	0.24	0.6	0.005
11.300	0.000	0.66	0.00	0.24	0.7	0.005
11.317	0.000	0.66	0.00	0.24	0.7	0.005
11.333	0.000	0.66	0.00	0.24	0.7	0.005
11.350	0.000	0.66	0.00	0.25	0.7	0.005
11.367	0.000	0.66	0.00	0.25	0.7	0.005
11.383	0.000	0.67	0.00	0.25	0.7	0.005
11.400	0.000	0.67	0.00	0.25	0.7	0.005
11.417	0.000	0.67	0.00	0.25	0.7	0.005
11.433	0.000	0.67	0.00	0.25	0.7	0.005
11.450	0.000	0.67	0.00	0.25	0.7	0.005
11.467	0.000	0.67	0.00	0.25	0.7	0.005
11.483	0.000	0.68	0.00	0.25	0.7	0.005
11.500	0.000	0.68	0.00	0.25	0.7	0.005
11.517	0.000	0.68	0.00	0.25	0.7	0.005
11.533	0.000	0.68	0.00	0.25	0.7	0.005
11.550	0.000	0.68	0.00	0.25	0.7	0.005
11.567	0.000	0.68	0.00	0.25	0.7	0.005
11.583	0.000	0.68	0.00	0.25	0.7	0.005
11.600	0.000	0.68	0.00	0.25	0.7	0.005
11.617	0.000	0.69	0.00	0.25	0.7	0.005
11.633	0.000	0.69	0.00	0.25	0.7	0.005
11.650	0.000	0.69	0.00	0.26	0.7	0.005
11.667	0.000	0.69	0.00	0.26	0.7	0.005
11.683	0.000	0.70	0.00	0.26	0.7	0.005
11.700	0.000	0.70	0.00	0.26	0.7	0.005
11.717	0.000	0.70	0.00	0.26	0.7	0.005
11.733	0.000	0.70	0.00	0.26	0.7	0.005
11.750	0.000	0.70	0.00	0.26	0.7	0.005
11.767	0.000	0.70	0.00	0.26	0.7	0.005
11.783	0.000	0.70	0.00	0.26	0.7	0.005
11.800	0.000	0.70	0.00	0.26	0.7	0.005
11.817	0.000	0.71	0.00	0.26	0.7	0.005
11.833	0.000	0.71	0.00	0.26	0.7	0.005
11.850	0.000	0.71	0.00	0.26	0.7	0.005
11.867	0.000	0.71	0.00	0.26	0.7	0.005
11.883	0.000	0.71	0.00	0.26	0.7	0.005
11.900	0.000	0.72	0.00	0.26	0.7	0.005
11.917	0.000	0.72	0.00	0.27	0.7	0.005
11.933	0.000	0.72	0.00	0.27	0.7	0.005
11.950	0.000	0.72	0.00	0.27	0.7	0.005
11.967	0.000	0.73	0.00	0.27	0.7	0.005
11.983	0.000	0.73	0.00	0.27	0.7	0.005
12.000	0.000	0.73	0.00	0.27	0.7	0.005
12.017	0.000	0.73	0.00	0.27	0.7	0.005
12.033	0.000	0.73	0.00	0.27	0.7	0.005
12.050	0.000	0.73	0.00	0.27	0.7	0.005
12.067	0.000	0.73	0.00	0.27	0.7	0.005
12.083	0.000	0.76	0.00	0.27	0.7	0.005
12.100	0.000	0.79	0.00	0.28	0.7	0.006
12.117	0.000	0.83	0.00	0.28	0.7	0.006
12.133	0.000	0.86	0.00	0.29	0.8	0.006
12.150	0.000	0.90	0.00	0.30	0.8	0.006
12.167	0.000	0.93	0.00	0.31	0.8	0.006
12.183	0.000	0.97	0.00	0.32	0.8	0.006
12.200	0.000	0.99	0.00	0.33	0.9	0.007
12.217	0.000	1.00	0.00	0.33	0.9	0.007
12.233	0.000	1.00	0.00	0.34	0.9	0.007
12.250	0.000	1.00	0.00	0.35	0.9	0.007
12.267	0.000	1.00	0.00	0.35	0.9	0.007
12.283	0.000	1.00	0.00	0.35	0.9	0.007
12.300	0.000	1.00	0.00	0.36	1.0	0.007
12.317	0.000	1.00	0.00	0.36	1.0	0.007
12.333	0.000	1.01	0.00	0.36	1.0	0.007
12.350	0.000	1.01	0.00	0.37	1.0	0.007
12.367	0.000	1.01	0.00	0.37	1.0	0.007
12.383	0.000	1.02	0.00	0.37	1.0	0.007
12.400	0.000	1.02	0.00	0.37	1.0	0.007
12.417	0.000	1.02	0.00	0.37	1.0	0.007
12.433	0.000	1.03	0.00	0.38	1.0	0.008
12.450	0.000	1.03	0.00	0.38	1.0	0.008
12.467	0.000	1.03	0.00	0.38	1.0	0.008

DRAFT

12.483	0.000	1.03	0.00	0.38	1.0	0.008
12.500	0.000	1.03	0.00	0.38	1.0	0.008
12.517	0.000	1.04	0.00	0.38	1.0	0.008
12.533	0.000	1.04	0.00	0.38	1.0	0.008
12.550	0.000	1.04	0.00	0.38	1.0	0.008
12.567	0.000	1.04	0.00	0.39	1.0	0.008
12.583	0.000	1.04	0.00	0.39	1.0	0.008
12.600	0.000	1.05	0.00	0.39	1.0	0.008
12.617	0.000	1.05	0.00	0.39	1.0	0.008
12.633	0.000	1.05	0.00	0.39	1.0	0.008
12.650	0.000	1.06	0.00	0.39	1.0	0.008
12.667	0.000	1.06	0.00	0.39	1.0	0.008
12.683	0.000	1.06	0.00	0.39	1.0	0.008
12.700	0.000	1.07	0.00	0.39	1.1	0.008
12.717	0.000	1.07	0.00	0.40	1.1	0.008
12.733	0.000	1.07	0.00	0.40	1.1	0.008
12.750	0.000	1.07	0.00	0.40	1.1	0.008
12.767	0.000	1.07	0.00	0.40	1.1	0.008
12.783	0.000	1.08	0.00	0.40	1.1	0.008
12.800	0.000	1.08	0.00	0.40	1.1	0.008
12.817	0.000	1.08	0.00	0.40	1.1	0.008
12.833	0.000	1.08	0.00	0.40	1.1	0.008
12.850	0.000	1.09	0.00	0.40	1.1	0.008
12.867	0.000	1.09	0.00	0.40	1.1	0.008
12.883	0.000	1.10	0.00	0.40	1.1	0.008
12.900	0.000	1.10	0.00	0.41	1.1	0.008
12.917	0.000	1.10	0.00	0.41	1.1	0.008
12.933	0.000	1.11	0.00	0.41	1.1	0.008
12.950	0.000	1.11	0.00	0.41	1.1	0.008
12.967	0.000	1.11	0.00	0.41	1.1	0.008
12.983	0.000	1.11	0.00	0.41	1.1	0.008
13.000	0.000	1.12	0.00	0.41	1.1	0.008
13.017	0.000	1.12	0.00	0.41	1.1	0.008
13.033	0.000	1.12	0.00	0.41	1.1	0.008
13.050	0.000	1.12	0.00	0.42	1.1	0.008
13.067	0.000	1.13	0.00	0.42	1.1	0.008
13.083	0.000	1.13	0.00	0.42	1.1	0.008
13.100	0.000	1.13	0.00	0.42	1.1	0.008
13.117	0.000	1.14	0.00	0.42	1.1	0.008
13.133	0.000	1.14	0.00	0.42	1.1	0.008
13.150	0.000	1.15	0.00	0.42	1.1	0.008
13.167	0.000	1.15	0.00	0.42	1.1	0.008
13.183	0.000	1.16	0.00	0.43	1.1	0.009
13.200	0.000	1.16	0.00	0.43	1.1	0.009
13.217	0.000	1.16	0.00	0.43	1.1	0.009
13.233	0.000	1.16	0.00	0.43	1.1	0.009
13.250	0.000	1.17	0.00	0.43	1.1	0.009
13.267	0.000	1.17	0.00	0.43	1.2	0.009
13.283	0.000	1.17	0.00	0.43	1.2	0.009
13.300	0.000	1.17	0.00	0.43	1.2	0.009
13.317	0.000	1.18	0.00	0.44	1.2	0.009
13.333	0.000	1.18	0.00	0.44	1.2	0.009
13.350	0.000	1.19	0.00	0.44	1.2	0.009
13.367	0.000	1.19	0.00	0.44	1.2	0.009
13.383	0.000	1.20	0.00	0.44	1.2	0.009
13.400	0.000	1.20	0.00	0.44	1.2	0.009
13.417	0.000	1.21	0.00	0.44	1.2	0.009
13.433	0.000	1.21	0.00	0.45	1.2	0.009
13.450	0.000	1.21	0.00	0.45	1.2	0.009
13.467	0.000	1.22	0.00	0.45	1.2	0.009
13.483	0.000	1.22	0.00	0.45	1.2	0.009
13.500	0.000	1.22	0.00	0.45	1.2	0.009
13.517	0.000	1.22	0.00	0.45	1.2	0.009
13.533	0.000	1.23	0.00	0.45	1.2	0.009
13.550	0.000	1.23	0.00	0.45	1.2	0.009
13.567	0.000	1.24	0.00	0.46	1.2	0.009
13.583	0.000	1.24	0.00	0.46	1.2	0.009
13.600	0.000	1.25	0.00	0.46	1.2	0.009
13.617	0.000	1.25	0.00	0.46	1.2	0.009
13.633	0.000	1.26	0.00	0.46	1.2	0.009
13.650	0.000	1.26	0.00	0.46	1.2	0.009
13.667	0.000	1.27	0.00	0.47	1.2	0.009
13.683	0.000	1.27	0.00	0.47	1.2	0.009
13.700	0.000	1.28	0.00	0.47	1.3	0.009
13.717	0.000	1.28	0.00	0.47	1.3	0.009
13.733	0.000	1.28	0.00	0.47	1.3	0.009
13.750	0.000	1.29	0.00	0.47	1.3	0.009
13.767	0.000	1.29	0.00	0.48	1.3	0.010
13.783	0.000	1.29	0.00	0.48	1.3	0.010
13.800	0.000	1.30	0.00	0.48	1.3	0.010
13.817	0.000	1.30	0.00	0.48	1.3	0.010
13.833	0.000	1.31	0.00	0.48	1.3	0.010
13.850	0.000	1.32	0.00	0.48	1.3	0.010
13.867	0.000	1.32	0.00	0.49	1.3	0.010
13.883	0.000	1.33	0.00	0.49	1.3	0.010
13.900	0.000	1.34	0.00	0.49	1.3	0.010
13.917	0.000	1.34	0.00	0.49	1.3	0.010
13.933	0.000	1.35	0.00	0.49	1.3	0.010
13.950	0.000	1.35	0.00	0.50	1.3	0.010
13.967	0.000	1.36	0.00	0.50	1.3	0.010
13.983	0.000	1.36	0.00	0.50	1.3	0.010
14.000	0.000	1.36	0.00	0.50	1.3	0.010
14.017	0.000	1.37	0.00	0.50	1.3	0.010
14.033	0.000	1.37	0.00	0.51	1.3	0.010
14.050	0.000	1.37	0.00	0.51	1.4	0.010
14.067	0.000	1.38	0.00	0.51	1.4	0.010
14.083	0.000	1.39	0.00	0.51	1.4	0.010
14.100	0.000	1.39	0.00	0.51	1.4	0.010
14.117	0.000	1.40	0.00	0.51	1.4	0.010
14.133	0.000	1.40	0.00	0.52	1.4	0.010

DRAFT

14.150	0.000	1.41	0.00	0.52	1.4	0.010
14.167	0.000	1.41	0.00	0.52	1.4	0.010
14.183	0.000	1.42	0.00	0.52	1.4	0.010
14.200	0.000	1.42	0.00	0.52	1.4	0.010
14.217	0.000	1.43	0.00	0.53	1.4	0.011
14.233	0.000	1.43	0.00	0.53	1.4	0.011
14.250	0.000	1.44	0.00	0.53	1.4	0.011
14.267	0.000	1.44	0.00	0.53	1.4	0.011
14.283	0.000	1.44	0.00	0.53	1.4	0.011
14.300	0.000	1.45	0.00	0.53	1.4	0.011
14.317	0.000	1.46	0.00	0.54	1.4	0.011
14.333	0.000	1.47	0.00	0.54	1.4	0.011
14.350	0.000	1.48	0.00	0.54	1.4	0.011
14.367	0.000	1.49	0.00	0.54	1.5	0.011
14.383	0.000	1.50	0.00	0.55	1.5	0.011
14.400	0.000	1.51	0.00	0.55	1.5	0.011
14.417	0.000	1.52	0.00	0.55	1.5	0.011
14.433	0.000	1.53	0.00	0.56	1.5	0.011
14.450	0.000	1.53	0.00	0.56	1.5	0.011
14.467	0.000	1.54	0.00	0.56	1.5	0.011
14.483	0.000	1.54	0.00	0.56	1.5	0.011
14.500	0.000	1.55	0.00	0.57	1.5	0.011
14.517	0.000	1.55	0.00	0.57	1.5	0.011
14.533	0.000	1.56	0.00	0.57	1.5	0.011
14.550	0.000	1.57	0.00	0.57	1.5	0.011
14.567	0.000	1.58	0.00	0.58	1.5	0.012
14.583	0.000	1.60	0.00	0.58	1.5	0.012
14.600	0.000	1.61	0.00	0.58	1.6	0.012
14.617	0.000	1.62	0.00	0.59	1.6	0.012
14.633	0.000	1.63	0.00	0.59	1.6	0.012
14.650	0.000	1.64	0.00	0.60	1.6	0.012
14.667	0.000	1.65	0.00	0.60	1.6	0.012
14.683	0.000	1.66	0.00	0.60	1.6	0.012
14.700	0.000	1.67	0.00	0.61	1.6	0.012
14.717	0.000	1.67	0.00	0.61	1.6	0.012
14.733	0.000	1.68	0.00	0.61	1.6	0.012
14.750	0.000	1.69	0.00	0.62	1.6	0.012
14.767	0.000	1.70	0.00	0.62	1.7	0.012
14.783	0.000	1.71	0.00	0.62	1.7	0.012
14.800	0.000	1.72	0.00	0.63	1.7	0.013
14.817	0.000	1.74	0.00	0.63	1.7	0.013
14.833	0.000	1.75	0.00	0.64	1.7	0.013
14.850	0.000	1.77	0.00	0.64	1.7	0.013
14.867	0.000	1.79	0.00	0.64	1.7	0.013
14.883	0.000	1.80	0.00	0.65	1.7	0.013
14.900	0.000	1.82	0.00	0.65	1.7	0.013
14.917	0.000	1.83	0.00	0.66	1.8	0.013
14.933	0.000	1.84	0.00	0.66	1.8	0.013
14.950	0.000	1.85	0.00	0.67	1.8	0.013
14.967	0.000	1.86	0.00	0.67	1.8	0.013
14.983	0.000	1.87	0.00	0.68	1.8	0.014
15.000	0.000	1.88	0.00	0.68	1.8	0.014
15.017	0.000	1.88	0.00	0.69	1.8	0.014
15.033	0.000	1.90	0.00	0.69	1.8	0.014
15.050	0.000	1.92	0.00	0.70	1.8	0.014
15.067	0.000	1.95	0.00	0.70	1.9	0.014
15.083	0.000	1.97	0.00	0.71	1.9	0.014
15.100	0.000	1.99	0.00	0.71	1.9	0.014
15.117	0.000	2.01	0.00	0.72	1.9	0.014
15.133	0.000	2.04	0.00	0.73	1.9	0.015
15.150	0.000	2.06	0.00	0.73	2.0	0.015
15.167	0.000	2.07	0.00	0.74	2.0	0.015
15.183	0.000	2.08	0.00	0.75	2.0	0.015
15.200	0.000	2.10	0.00	0.75	2.0	0.015
15.217	0.000	2.11	0.00	0.76	2.0	0.015
15.233	0.000	2.12	0.00	0.77	2.0	0.015
15.250	0.000	2.14	0.00	0.77	2.1	0.015
15.267	0.000	2.15	0.00	0.78	2.1	0.016
15.283	0.000	2.18	0.00	0.78	2.1	0.016
15.300	0.000	2.20	0.00	0.79	2.1	0.016
15.317	0.000	2.23	0.00	0.80	2.1	0.016
15.333	0.000	2.26	0.00	0.81	2.1	0.016
15.350	0.000	2.29	0.00	0.82	2.2	0.016
15.367	0.000	2.31	0.00	0.82	2.2	0.016
15.383	0.000	2.34	0.00	0.83	2.2	0.017
15.400	0.000	2.35	0.00	0.84	2.2	0.017
15.417	0.000	2.33	0.00	0.85	2.3	0.017
15.433	0.000	2.30	0.00	0.85	2.3	0.017
15.450	0.000	2.28	0.00	0.85	2.3	0.017
15.467	0.000	2.26	0.00	0.85	2.3	0.017
15.483	0.000	2.23	0.00	0.85	2.3	0.017
15.500	0.000	2.21	0.00	0.84	2.3	0.017
15.517	0.000	2.20	0.00	0.84	2.2	0.017
15.533	0.000	2.25	0.00	0.84	2.2	0.017
15.550	0.000	2.31	0.00	0.84	2.2	0.017
15.567	0.000	2.37	0.00	0.85	2.3	0.017
15.583	0.000	2.43	0.00	0.86	2.3	0.017
15.600	0.000	2.49	0.00	0.87	2.3	0.017
15.617	0.000	2.55	0.00	0.89	2.4	0.018
15.633	0.000	2.61	0.00	0.90	2.4	0.018
15.650	0.000	2.67	0.00	0.92	2.4	0.018
15.667	0.000	2.71	0.00	0.94	2.5	0.019
15.683	0.000	2.76	0.00	0.95	2.5	0.019
15.700	0.000	2.81	0.00	0.97	2.6	0.019
15.717	0.000	2.86	0.00	0.99	2.6	0.020
15.733	0.000	2.90	0.00	1.00	2.7	0.020
15.750	0.000	2.95	0.00	1.02	2.7	0.020
15.767	0.000	3.05	0.00	1.03	2.7	0.021
15.783	0.000	3.25	0.00	1.06	2.8	0.022
15.800	0.000	3.45	0.00	1.09	2.8	0.022

DRAFT

15.817	0.000	3.66	0.00	1.13	2.9	0.023
15.833	0.000	3.86	0.00	1.18	3.0	0.025
15.850	0.000	4.06	0.00	1.23	3.1	0.026
15.867	0.000	4.27	0.00	1.29	3.2	0.028
15.883	0.000	4.47	0.00	1.35	3.3	0.029
15.900	0.000	4.69	0.00	1.42	3.4	0.031
15.917	0.000	4.90	0.00	1.49	3.6	0.033
15.933	0.000	5.11	0.00	1.56	3.7	0.035
15.950	0.000	5.33	0.00	1.64	3.9	0.037
15.967	0.000	5.54	0.00	1.72	4.0	0.039
15.983	0.000	5.76	0.00	1.81	4.2	0.041
16.000	0.000	5.97	0.00	1.89	4.3	0.043
16.017	0.000	6.84	0.00	2.02	4.5	0.046
16.033	0.000	8.36	0.00	2.23	4.8	0.051
16.050	0.000	9.89	0.00	2.52	5.1	0.058
16.067	0.000	11.41	0.00	2.87	5.6	0.066
16.083	0.000	12.94	0.00	3.14	6.0	0.076
16.100	0.000	14.46	0.00	3.39	6.3	0.087
16.117	0.000	15.98	0.00	3.64	7.5	0.098
16.133	0.000	17.33	0.00	3.86	10.1	0.108
16.150	0.000	15.26	0.00	3.95	12.3	0.113
16.167	0.000	13.41	0.00	3.96	13.0	0.113
16.183	0.000	11.57	0.00	3.92	12.8	0.112
16.200	0.000	9.72	0.00	3.85	12.1	0.108
16.217	0.000	7.88	0.00	3.76	10.9	0.104
16.233	0.000	6.03	0.00	3.66	9.5	0.099
16.250	0.000	4.24	0.00	3.55	8.0	0.094
16.267	0.000	3.57	0.00	3.45	6.8	0.090
16.283	0.000	3.40	0.00	3.36	6.4	0.085
16.300	0.000	3.22	0.00	3.26	6.3	0.081
16.317	0.000	3.04	0.00	3.17	6.2	0.077
16.333	0.000	2.86	0.00	3.07	6.1	0.072
16.350	0.000	2.68	0.00	2.94	6.0	0.068
16.367	0.000	2.50	0.00	2.75	5.8	0.063
16.383	0.000	2.38	0.00	2.56	5.5	0.059
16.400	0.000	2.36	0.00	2.39	5.3	0.055
16.417	0.000	2.35	0.00	2.22	5.0	0.051
16.433	0.000	2.33	0.00	2.07	4.8	0.048
16.450	0.000	2.32	0.00	1.94	4.6	0.045
16.467	0.000	2.30	0.00	1.83	4.4	0.042
16.483	0.000	2.29	0.00	1.73	4.2	0.039
16.500	0.000	2.27	0.00	1.64	4.0	0.037
16.517	0.000	2.23	0.00	1.55	3.8	0.034
16.533	0.000	2.19	0.00	1.47	3.7	0.032
16.550	0.000	2.15	0.00	1.40	3.5	0.030
16.567	0.000	2.11	0.00	1.33	3.4	0.029
16.583	0.000	2.07	0.00	1.27	3.3	0.027
16.600	0.000	2.02	0.00	1.21	3.1	0.025
16.617	0.000	1.98	0.00	1.16	3.0	0.024
16.633	0.000	1.95	0.00	1.10	2.9	0.023
16.650	0.000	1.92	0.00	1.06	2.8	0.021
16.667	0.000	1.89	0.00	1.01	2.7	0.020
16.683	0.000	1.86	0.00	0.96	2.6	0.019
16.700	0.000	1.84	0.00	0.92	2.5	0.018
16.717	0.000	1.81	0.00	0.88	2.4	0.018
16.733	0.000	1.78	0.00	0.84	2.3	0.017
16.750	0.000	1.75	0.00	0.81	2.2	0.016
16.767	0.000	1.73	0.00	0.78	2.1	0.016
16.783	0.000	1.71	0.00	0.76	2.1	0.015
16.800	0.000	1.69	0.00	0.74	2.0	0.015
16.817	0.000	1.67	0.00	0.72	1.9	0.014
16.833	0.000	1.65	0.00	0.70	1.9	0.014
16.850	0.000	1.63	0.00	0.69	1.9	0.014
16.867	0.000	1.60	0.00	0.67	1.8	0.013
16.883	0.000	1.59	0.00	0.66	1.8	0.013
16.900	0.000	1.57	0.00	0.65	1.7	0.013
16.917	0.000	1.55	0.00	0.64	1.7	0.013
16.933	0.000	1.54	0.00	0.63	1.7	0.013
16.950	0.000	1.52	0.00	0.62	1.7	0.012
16.967	0.000	1.51	0.00	0.61	1.6	0.012
16.983	0.000	1.49	0.00	0.60	1.6	0.012
17.000	0.000	1.47	0.00	0.59	1.6	0.012
17.017	0.000	1.46	0.00	0.58	1.6	0.012
17.033	0.000	1.45	0.00	0.58	1.5	0.012
17.050	0.000	1.44	0.00	0.57	1.5	0.011
17.067	0.000	1.43	0.00	0.56	1.5	0.011
17.083	0.000	1.42	0.00	0.56	1.5	0.011
17.100	0.000	1.40	0.00	0.55	1.5	0.011
17.117	0.000	1.39	0.00	0.55	1.5	0.011
17.133	0.000	1.38	0.00	0.54	1.5	0.011
17.150	0.000	1.37	0.00	0.54	1.4	0.011
17.167	0.000	1.36	0.00	0.53	1.4	0.011
17.183	0.000	1.35	0.00	0.53	1.4	0.011
17.200	0.000	1.34	0.00	0.52	1.4	0.010
17.217	0.000	1.33	0.00	0.52	1.4	0.010
17.233	0.000	1.32	0.00	0.52	1.4	0.010
17.250	0.000	1.31	0.00	0.51	1.4	0.010
17.267	0.000	1.30	0.00	0.51	1.4	0.010
17.283	0.000	1.29	0.00	0.50	1.4	0.010
17.300	0.000	1.28	0.00	0.50	1.3	0.010
17.317	0.000	1.27	0.00	0.50	1.3	0.010
17.333	0.000	1.27	0.00	0.49	1.3	0.010
17.350	0.000	1.26	0.00	0.49	1.3	0.010
17.367	0.000	1.25	0.00	0.49	1.3	0.010
17.383	0.000	1.24	0.00	0.48	1.3	0.010
17.400	0.000	1.23	0.00	0.48	1.3	0.010
17.417	0.000	1.22	0.00	0.47	1.3	0.009
17.433	0.000	1.22	0.00	0.47	1.3	0.009
17.450	0.000	1.21	0.00	0.47	1.3	0.009
17.467	0.000	1.20	0.00	0.47	1.2	0.009

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17.483	0.000	1.19	0.00	0.46	1.2	0.009
17.500	0.000	1.18	0.00	0.46	1.2	0.009
17.517	0.000	1.18	0.00	0.46	1.2	0.009
17.533	0.000	1.17	0.00	0.45	1.2	0.009
17.550	0.000	1.16	0.00	0.45	1.2	0.009
17.567	0.000	1.16	0.00	0.45	1.2	0.009
17.583	0.000	1.15	0.00	0.44	1.2	0.009
17.600	0.000	1.14	0.00	0.44	1.2	0.009
17.617	0.000	1.14	0.00	0.44	1.2	0.009
17.633	0.000	1.13	0.00	0.44	1.2	0.009
17.650	0.000	1.12	0.00	0.43	1.2	0.009
17.667	0.000	1.12	0.00	0.43	1.2	0.009
17.683	0.000	1.11	0.00	0.43	1.1	0.009
17.700	0.000	1.10	0.00	0.43	1.1	0.009
17.717	0.000	1.10	0.00	0.42	1.1	0.008
17.733	0.000	1.09	0.00	0.42	1.1	0.008
17.750	0.000	1.09	0.00	0.42	1.1	0.008
17.767	0.000	1.08	0.00	0.42	1.1	0.008
17.783	0.000	1.08	0.00	0.41	1.1	0.008
17.800	0.000	1.07	0.00	0.41	1.1	0.008
17.817	0.000	1.06	0.00	0.41	1.1	0.008
17.833	0.000	1.06	0.00	0.41	1.1	0.008
17.850	0.000	1.05	0.00	0.41	1.1	0.008
17.867	0.000	1.05	0.00	0.40	1.1	0.008
17.883	0.000	1.04	0.00	0.40	1.1	0.008
17.900	0.000	1.04	0.00	0.40	1.1	0.008
17.917	0.000	1.03	0.00	0.40	1.1	0.008
17.933	0.000	1.03	0.00	0.40	1.1	0.008
17.950	0.000	1.02	0.00	0.39	1.1	0.008
17.967	0.000	1.02	0.00	0.39	1.0	0.008
17.983	0.000	1.01	0.00	0.39	1.0	0.008
18.000	0.000	1.00	0.00	0.39	1.0	0.008
18.017	0.000	0.99	0.00	0.38	1.0	0.008
18.033	0.000	0.98	0.00	0.38	1.0	0.008
18.050	0.000	0.96	0.00	0.38	1.0	0.008
18.067	0.000	0.95	0.00	0.37	1.0	0.007
18.083	0.000	0.94	0.00	0.37	1.0	0.007
18.100	0.000	0.93	0.00	0.37	1.0	0.007
18.117	0.000	0.90	0.00	0.36	1.0	0.007
18.133	0.000	0.87	0.00	0.36	1.0	0.007
18.150	0.000	0.84	0.00	0.35	0.9	0.007
18.167	0.000	0.81	0.00	0.34	0.9	0.007
18.183	0.000	0.78	0.00	0.33	0.9	0.007
18.200	0.000	0.75	0.00	0.32	0.9	0.006
18.217	0.000	0.73	0.00	0.32	0.9	0.006
18.233	0.000	0.71	0.00	0.31	0.8	0.006
18.250	0.000	0.71	0.00	0.30	0.8	0.006
18.267	0.000	0.71	0.00	0.29	0.8	0.006
18.283	0.000	0.70	0.00	0.29	0.8	0.006
18.300	0.000	0.70	0.00	0.28	0.8	0.006
18.317	0.000	0.70	0.00	0.28	0.8	0.006
18.333	0.000	0.69	0.00	0.28	0.7	0.006
18.350	0.000	0.69	0.00	0.27	0.7	0.005
18.367	0.000	0.69	0.00	0.27	0.7	0.005
18.383	0.000	0.68	0.00	0.27	0.7	0.005
18.400	0.000	0.68	0.00	0.27	0.7	0.005
18.417	0.000	0.68	0.00	0.26	0.7	0.005
18.433	0.000	0.67	0.00	0.26	0.7	0.005
18.450	0.000	0.67	0.00	0.26	0.7	0.005
18.467	0.000	0.67	0.00	0.26	0.7	0.005
18.483	0.000	0.66	0.00	0.26	0.7	0.005
18.500	0.000	0.66	0.00	0.26	0.7	0.005
18.517	0.000	0.66	0.00	0.25	0.7	0.005
18.533	0.000	0.66	0.00	0.25	0.7	0.005
18.550	0.000	0.65	0.00	0.25	0.7	0.005
18.567	0.000	0.65	0.00	0.25	0.7	0.005
18.583	0.000	0.65	0.00	0.25	0.7	0.005
18.600	0.000	0.64	0.00	0.25	0.7	0.005
18.617	0.000	0.64	0.00	0.25	0.7	0.005
18.633	0.000	0.64	0.00	0.24	0.7	0.005
18.650	0.000	0.64	0.00	0.24	0.7	0.005
18.667	0.000	0.63	0.00	0.24	0.6	0.005
18.683	0.000	0.63	0.00	0.24	0.6	0.005
18.700	0.000	0.63	0.00	0.24	0.6	0.005
18.717	0.000	0.63	0.00	0.24	0.6	0.005
18.733	0.000	0.62	0.00	0.24	0.6	0.005
18.750	0.000	0.62	0.00	0.24	0.6	0.005
18.767	0.000	0.62	0.00	0.24	0.6	0.005
18.783	0.000	0.62	0.00	0.24	0.6	0.005
18.800	0.000	0.61	0.00	0.23	0.6	0.005
18.817	0.000	0.61	0.00	0.23	0.6	0.005
18.833	0.000	0.61	0.00	0.23	0.6	0.005
18.850	0.000	0.61	0.00	0.23	0.6	0.005
18.867	0.000	0.60	0.00	0.23	0.6	0.005
18.883	0.000	0.60	0.00	0.23	0.6	0.005
18.900	0.000	0.60	0.00	0.23	0.6	0.005
18.917	0.000	0.60	0.00	0.23	0.6	0.005
18.933	0.000	0.59	0.00	0.23	0.6	0.005
18.950	0.000	0.59	0.00	0.23	0.6	0.005
18.967	0.000	0.59	0.00	0.23	0.6	0.005
18.983	0.000	0.59	0.00	0.22	0.6	0.004
19.000	0.000	0.59	0.00	0.22	0.6	0.004
19.017	0.000	0.58	0.00	0.22	0.6	0.004
19.033	0.000	0.58	0.00	0.22	0.6	0.004
19.050	0.000	0.58	0.00	0.22	0.6	0.004
19.067	0.000	0.58	0.00	0.22	0.6	0.004
19.083	0.000	0.58	0.00	0.22	0.6	0.004
19.100	0.000	0.57	0.00	0.22	0.6	0.004
19.117	0.000	0.57	0.00	0.22	0.6	0.004
19.133	0.000	0.57	0.00	0.22	0.6	0.004

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19.150	0.000	0.57	0.00	0.22	0.6	0.004
19.167	0.000	0.57	0.00	0.22	0.6	0.004
19.183	0.000	0.56	0.00	0.21	0.6	0.004
19.200	0.000	0.56	0.00	0.21	0.6	0.004
19.217	0.000	0.56	0.00	0.21	0.6	0.004
19.233	0.000	0.56	0.00	0.21	0.6	0.004
19.250	0.000	0.56	0.00	0.21	0.6	0.004
19.267	0.000	0.55	0.00	0.21	0.6	0.004
19.283	0.000	0.55	0.00	0.21	0.6	0.004
19.300	0.000	0.55	0.00	0.21	0.6	0.004
19.317	0.000	0.55	0.00	0.21	0.6	0.004
19.333	0.000	0.55	0.00	0.21	0.6	0.004
19.350	0.000	0.54	0.00	0.21	0.6	0.004
19.367	0.000	0.54	0.00	0.21	0.6	0.004
19.383	0.000	0.54	0.00	0.21	0.6	0.004
19.400	0.000	0.54	0.00	0.21	0.5	0.004
19.417	0.000	0.54	0.00	0.20	0.5	0.004
19.433	0.000	0.54	0.00	0.20	0.5	0.004
19.450	0.000	0.53	0.00	0.20	0.5	0.004
19.467	0.000	0.53	0.00	0.20	0.5	0.004
19.483	0.000	0.53	0.00	0.20	0.5	0.004
19.500	0.000	0.53	0.00	0.20	0.5	0.004
19.517	0.000	0.53	0.00	0.20	0.5	0.004
19.533	0.000	0.53	0.00	0.20	0.5	0.004
19.550	0.000	0.52	0.00	0.20	0.5	0.004
19.567	0.000	0.52	0.00	0.20	0.5	0.004
19.583	0.000	0.52	0.00	0.20	0.5	0.004
19.600	0.000	0.52	0.00	0.20	0.5	0.004
19.617	0.000	0.52	0.00	0.20	0.5	0.004
19.633	0.000	0.52	0.00	0.20	0.5	0.004
19.650	0.000	0.52	0.00	0.20	0.5	0.004
19.667	0.000	0.51	0.00	0.20	0.5	0.004
19.683	0.000	0.51	0.00	0.19	0.5	0.004
19.700	0.000	0.51	0.00	0.19	0.5	0.004
19.717	0.000	0.51	0.00	0.19	0.5	0.004
19.733	0.000	0.51	0.00	0.19	0.5	0.004
19.750	0.000	0.51	0.00	0.19	0.5	0.004
19.767	0.000	0.50	0.00	0.19	0.5	0.004
19.783	0.000	0.50	0.00	0.19	0.5	0.004
19.800	0.000	0.50	0.00	0.19	0.5	0.004
19.817	0.000	0.50	0.00	0.19	0.5	0.004
19.833	0.000	0.50	0.00	0.19	0.5	0.004
19.850	0.000	0.50	0.00	0.19	0.5	0.004
19.867	0.000	0.50	0.00	0.19	0.5	0.004
19.883	0.000	0.49	0.00	0.19	0.5	0.004
19.900	0.000	0.49	0.00	0.19	0.5	0.004
19.917	0.000	0.49	0.00	0.19	0.5	0.004
19.933	0.000	0.49	0.00	0.19	0.5	0.004
19.950	0.000	0.49	0.00	0.19	0.5	0.004
19.967	0.000	0.49	0.00	0.19	0.5	0.004
19.983	0.000	0.49	0.00	0.18	0.5	0.004
20.000	0.000	0.49	0.00	0.18	0.5	0.004

PROCESS SUMMARY OF STORAGE:
INFLOW VOLUME = 1.673 AF
BASIN STORAGE = 0.000 AF (WITH 0.000 AF INITIALLY FILLED)
OUTFLOW VOLUME = 1.673 AF
LOSS VOLUME = 0.000 AF

==========

END OF FLOODSCx ROUTING ANALYSIS

DRAFT

Oldcastle Infrastructure™
A CRH COMPANY

STORMCAPTURE®

Design Summary

DRAFT

PROJECT INFORMATION

PROJECT NAME: ME04130-IRVINE

PROJECT CITY: Irvine

PROJECT STATE: California

COMPANY: City of Irvine

SITE TYPE: Industrial

SYSTEM DESIGN

System Type:
| Detention

Module Construction Type:
| Base with Top Slab

Storage Volume Required (cf):
| 6000

Configured Storage Volume (cf):
| 6586

System Internal Height (ft):
| 5

Nominal Module Capacity (cf):
| 525

Required Number of Modules:
| 12

Module Designation:
| SC1 0-5

SITE DESIGN

System Invert Elevation (ft):
| 100.00

Top of Module Elevation (ft):
| 105.60

Maximum Rim Elevation (ft):
| 106.10

Depth of Cover (ft):
| 0.50

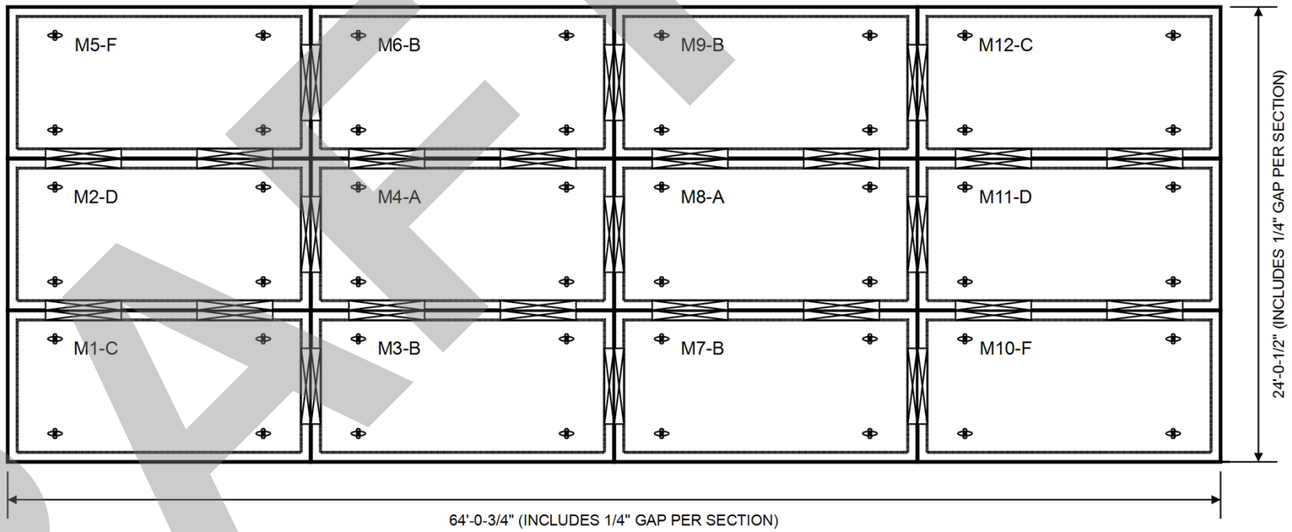
Minimum Inlet Elevation (ft):
| 0.00

Maximum Inlet Elevation (ft):
| 0.00

Minimum Outlet Elevation (ft):
| 0.00

Maximum Outlet Elevation (ft):
| 0.00

DRAFT



PLAN VIEW
SCALE: 1/8" = 1'-0"

MODULE NOTES		
TYPE	QUANTITY	HEIGHT
C	2	5
D	2	5
B	4	5
A	2	5
F	2	5
TOTAL	12	
VOLUME	6,586	CUBIC FEET

PIPE SCHEDULE		
PIPE	SIZE	INVERT

MANHOLE SCHEDULE		
MANHOLE	TYPE	RIM

DESIGN NOTES:
1. DESIGN LOADINGS:
   A. AASHTO HS-20-44 W/ IMPACT.
   B. DEPTH OF COVER = 6" - 5'-0" (120 PCF ASSUMED).
   C. ASSUMED WATER TABLE = BELOW BOTTOM OF PRECAST.
   D. DRY LATERAL EARTH PRESSURE (EFP) = 45 PCF.
   E. LATERAL LIVE LOAD SURCHARGE = 80 PSF (APPLIED TO 8' BELOW GRADE).
   F. NO LATERAL SURCHARGE FROM ADJACENT BUILDINGS, WALL PIERS, OR FOUNDATIONS.
2. CONCRETE 28 DAY COMPRESSIVE STRENGTH SHALL BE 6,000 PSI.
3. STEEL REINFORCEMENT: REBAR, ASTM A-615 OR A-706, GRADE 60.
4. MESH REINFORCEMENT: ASTM A-1064, S1.2, GRADE 80.
5. CEMENT: ASTM C-150 SPECIFICATION.
6. STORMCAPTURE MODULE TYPE = DETENTION
7. REQUIRED BASE LAYER DEPTH = NOT APPLICABLE.
8. REQUIRED NATIVE ALLOWABLE SOIL BEARING PRESSURE = 2,500 PSF. NATIVE SOIL SHOULD BE LEVEL/SCREEDED AND COMPACTED ADEQUATELY TO ALLOW FOR REQUIRED BEARING CAPACITY.
9. REFERENCE STANDARDS:
   A. ASTM C 890
   B. ASTM C 891
   C. ASTM C 913
10. CONSTRUCTION EQUIPMENT EXCEEDING DESIGN LOADING SHALL NOT BE ALLOWED ON STRUCTURE. ANY DESIGN CONSTRAINT DIFFERENT FROM ABOVE REQUIRES CUSTOM STRUCTURAL DESIGN AND MAY REQUIRE THICKER SUBGRADE AND REVISED PRICING.

NOTES TO REVIEWING ENGINEER:
1. THIS SYSTEM IS DESIGNED TO THE PARAMETERS NOTED. PLEASE VERIFY THAT THESE PARAMETERS MEET PROJECT REQUIREMENTS (I.E. LIVE LOAD AND FILL RANGE). IF DESIGN PARAMETERS ARE INCORRECT NOTIFY OLDCASTLE IMMEDIATELY FOR REDESIGN AND RE-PRICING.
2. ENGINEER OF RECORD TO CONFIRM ALL PIPE PENETRATION LOCATIONS, SIZES, AND INVERTS.
3. ENGINEER OF RECORD TO CONFIRM ALL MANWAY ACCESS LOCATIONS AND RIM ELEVATIONS.
4. UNLESS OTHERWISE NOTED, ALL PIPE SUPPLIED AND INSTALLED BY OTHERS.
5. THIS SYSTEM IS DESIGNED FOR A GROUNDWATER TABLE BELOW SYSTEM INVERT. ENGINEER OF RECORD TO VERIFY THAT THE DESIGN GROUNDWATER TABLE IS BELOW INVERT OF PRECAST. IF DESIGN PARAMETERS ARE INCORRECT NOTIFY OLDCASTLE IMMEDIATELY FOR REDESIGN AND REVISED PRICING.
6. THIS SYSTEM IS DESIGNED WITHOUT A CONTAINMENT MEMBRANE LINER. IF A LINER IS NEEDED PLEASE CONTACT OLDCASTLE TO PROVIDE THIS OPTION IN THE FINAL DESIGN.

Detention/
Infiltration

- PRELIMINARY –
NOT FOR CONSTRUCTION

Oldcastle Infrastructure™
A CRH COMPANY

Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater

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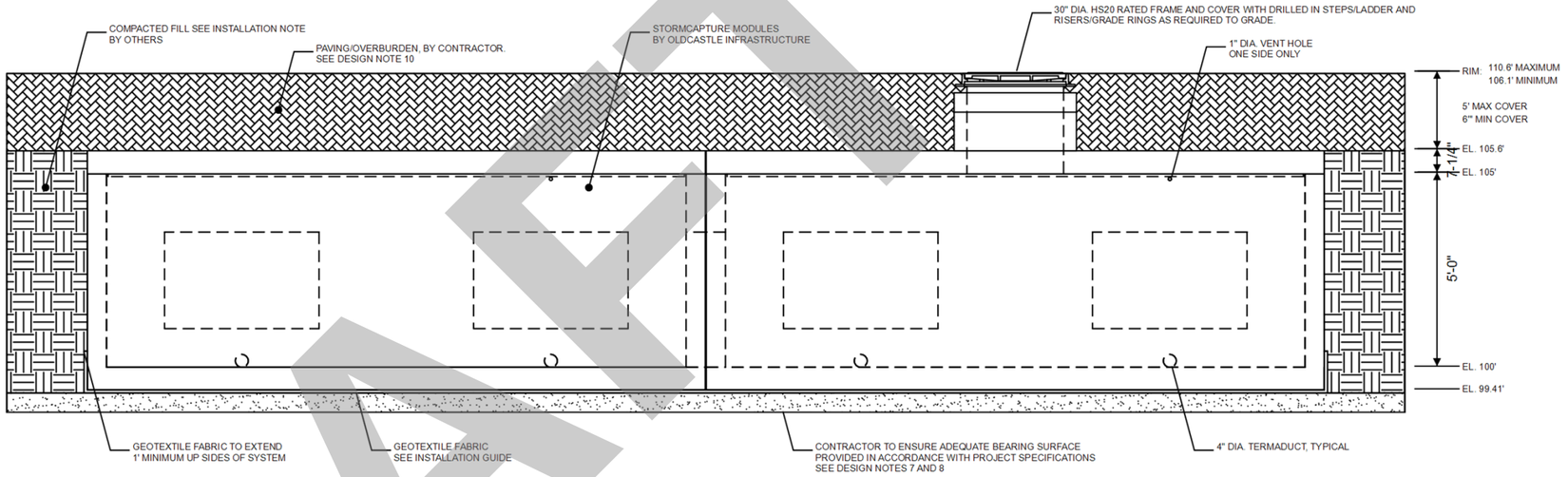
STORMCAPTURE ®
SC1 DETENTION SYSTEM

CUSTOMER:
City of Irvine

JOB NAME & LOCATION:
ME04130-IRVINE - Irvine,California

DRAWING NUMBER	REVISION	SHEET
WSCDD-2789-0_SC1_DT	- REV DATE 3/1/22	1 OF 2



TYPICAL ELEVATION
SCALE: 3/8" = 1'-0"

NOTE:
TERMADUCT INSERTS TO BE KNOCKED OUT
AT SPECIFIED LOCATIONS ONLY (BY OTHERS)

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- PRELIMINARY –
NOT FOR CONSTRUCTION

Detention/
Infiltration

Oldcastle Infrastructure™
A CRH COMPANY

Ph: 800.579.8819 | www.oldcastleinfrastructure.com/stormwater

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STORMCAPTURE ®

SC1 DETENTION SYSTEM

CUSTOMER:

City of Irvine

JOB NAME & LOCATION:

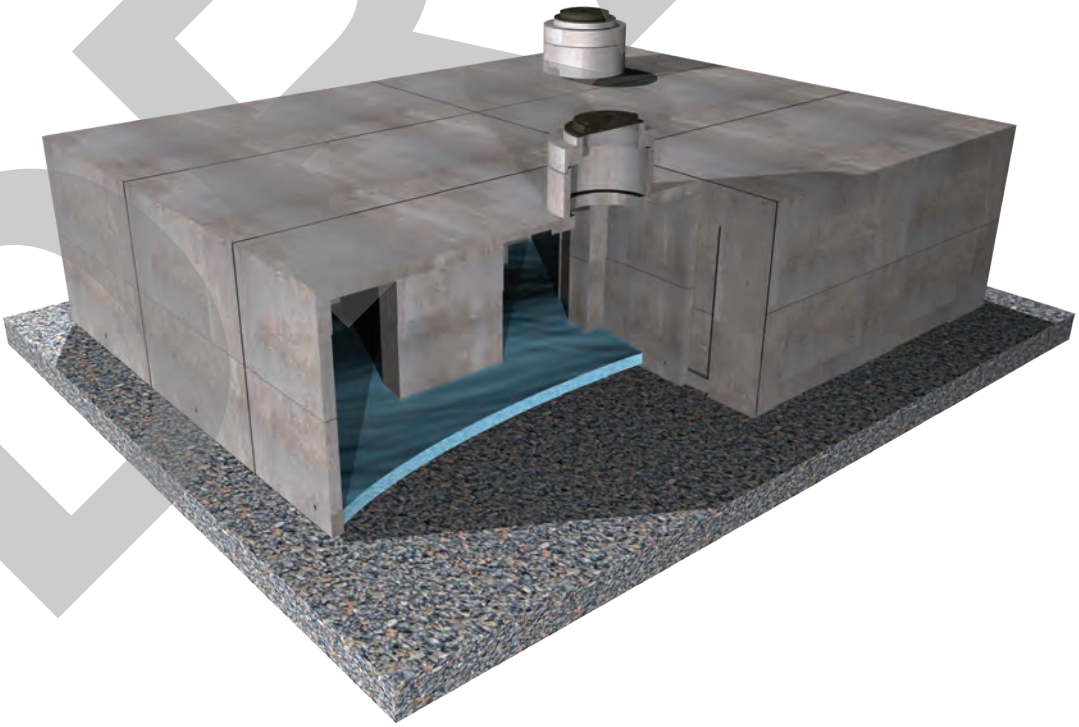
ME04130-IRVINE - Irvine,California

DRAWING NUMBER	REVISION	SHEET
WSCDD-2789-0_SC1_DT	- REV DATE 3/1/22	2 OF 2

Oldcastle Infrastructure™
A CRH COMPANY

STORMCAPTURE®

Inspection and Maintenance Guide



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Water

Description

The StormCapture® system is an underground, modular, structural precast concrete storage system for stormwater detention, retention, infiltration, harvesting and reuse, and water quality volume storage. The system's modular design utilizes multiple standard precast concrete units with inside dimensions of 7 feet by 15 feet (outside dimensions of 8 feet by 16 feet) to form an underground storage system. The inside height of the StormCapture system can range from 2 feet to 14 feet. This modular design provides limitless configuration options for site-specific layouts.

StormCapture components can be provided as either open-bottom modules to promote infiltration or closed-bottom modules for detention. In some cases, StormCapture modules can be placed in a checkerboard configuration for an even more efficient design. A Link Slab, with a footprint of 9 feet by 17 feet, is then used to bridge each space without a module.

The standard StormCapture design incorporates lateral and longitudinal passageways between modules to accommodate internal stormwater conveyance throughout the system. These passageways may be classified as either a "window configuration" with standard 12-inch tall sediment baffles extending up from the floor of the module to the bottom of the window, or a "doorway configuration" without the sediment baffles. The function and drainage rate of a StormCapture system depends on site-specific conditions and requirements.

Stormwater typically enters the StormCapture system through an inlet pipe. Grated inlets can also be used for direct discharge into the system. The StormCapture system is rated for H-20 traffic loading with limited cover. Higher load requirements can also be accommodated. In addition, StormCapture systems are typically equipped with a limited number of maintenance modules that provide access to the system for ongoing inspection and maintenance.

Function

The StormCapture system is primarily used to manage water quantity by temporarily storing stormwater runoff from impervious surfaces to prevent flooding, slow down the rate at which stormwater leaves the site, and reduce receiving stream erosion. In addition, the StormCapture system can be used to capture stormwater runoff for water quality treatment. Regardless of how the StormCapture system is used, some sedimentation may occur in the modules during the time water is stored.

Configurations

The configuration of the StormCapture systems may vary, depending on the water quality and/or quantity requirements of the site. StormCapture configurations for detention, retention/infiltration, and retention/harvesting are described below.

Detention

StormCapture Detention systems are designed with a closed bottom to detain stormwater runoff for controlled discharge from the site. This design may incorporate a dead storage sump and a permanent pool of water if the outlet pipe is higher than the floor elevation. Discharge from the system is typically controlled by an outlet orifice and/or outlet weir to regulate the rate of stormwater leaving the system. StormCapture Detention systems are typically designed with silt-tight joints, however when conditions exist that require a StormCapture system to be watertight, the system may be wrapped in a continuous, impermeable geomembrane liner. If the StormCapture Detention system includes Link Slabs, a liner must be used to detain water since the chambers under each Link Slab have no floor slab. In this case, care must be taken by maintenance personnel not to damage the exposed liner beneath each Link Slab.

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Retention/Infiltration

StormCapture Retention/Infiltration systems are designed with an open bottom to allow for the retention of stormwater onsite through infiltration into the base rock and surrounding soils. For infiltration systems, the configuration of the base of the StormCapture system may vary, depending on the needs of the site and the height of the system. Some systems may use modules that have fully open bottoms with no concrete floor, while other systems may use modules that incorporate floor openings in the base of each module. These are typically 24-inch by 24-inch openings. For open-bottom systems, concrete splash pads may be installed below inlet grate openings and pipe inlets to prevent erosion of base rock. A StormCapture Infiltration system may have an elevated discharge pipe for peak overflow.

Retention/Harvesting

StormCapture Retention/Harvesting systems are similar to detention systems using closed-bottom modules, but stormwater is typically retained onsite for an extended period of time and later reused for non-potable applications or irrigation. For rainwater harvesting systems, an impermeable geomembrane liner is typically installed around the modules to provide a water-tight system.

Inspection and Maintenance Overview

State and local regulations typically require all stormwater management systems to be inspected on a regular basis and maintained as necessary to ensure performance and protect downstream receiving waters. Inspections should be used to evaluate the conditions of the system. Based on these inspections, maintenance needs can be determined. Maintenance needs vary by site and system. Using this Inspection & Maintenance Guide, qualified maintenance personnel should be able to provide a recommendation for maintenance needs. Requirements may range from minor activities such as removing trash, debris or pipe blockages to more substantial activities such as vacuuming and removal of sediment and/or non-draining water. Long-term maintenance is important to the operation of the system since it prevents excessive pollutant buildup that may limit system performance by reducing the operating capacity and increasing the potential for scouring of pollutants during periods of high flow.

Only authorized personnel shall inspect and/or enter a StormCapture system. Personnel must be properly trained and equipped before entering any underground or confined space structure. Training includes familiarity with and adherence to any and all local, state and federal regulations governing confined space access and the operation, inspection, and maintenance of underground structures.

Inspection and Maintenance Frequency

The StormCapture system should be inspected on a regular basis, typically twice per year, and maintained as required. The maintenance frequency will be driven by the amount of runoff and pollutant loading encountered by a given system. Local jurisdictions may also dictate inspection and maintenance frequencies.

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Inspection Equipment

The following equipment is helpful when conducting StormCapture inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- Measuring stick or sludge sampler
- Long-handled net (optional)

Inspection Procedures

A typical StormCapture system provides strategically placed access points that may be used for inspection. StormCapture inspections are usually conducted visually from the ground surface, without entering the unit. This typically limits inspection to the assessment of sediment depth, water drain down, and general condition of the modules and components, but a more detailed assessment of structural condition may be conducted during a maintenance event.

To complete an inspection, safety measures including traffic control should be deployed before the access covers are removed. Once the covers have been removed, the following items should be inspected and recorded (see form provided at the end of this document) to determine whether maintenance is required:

- Observe inlet and outlet pipe penetrations for blockage or obstruction.
- If possible, observe internal components like baffles, flow control weirs or orifices, and steps or ladders to determine whether they are broken, missing, or possibly obstructed.
- Observe, quantify, and record the sediment depths within the modules.
- Retrieve as much floating trash as possible with a long-handled net. If a significant amount of trash remains, make a note in the Inspection & Maintenance Log.
- For infiltration systems, local regulations may require monitoring of the system to ensure drain down is occurring within the required permit time period (typically 24 to 72 hours). If this is the case, refer to local regulations for proper inspection procedure.

Maintenance Indicators

Maintenance should be scheduled if any of the following conditions are identified during the inspection:

- Inlet or outlet piping is blocked or obstructed.
- Internal components are broken, missing, or obstructed.
- Accumulation of more than six inches of sediment on the system floor or in the sump, if applicable.
- Significant accumulation of floating trash and debris that cannot be retrieved with a net.
- The system has not drained completely after it hasn't rained for one to three days, or the drain down does not meet permit requirements.
- Any hazardous material is observed or reported.

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Maintenance Equipment

The following equipment is helpful when conducting StormCapture maintenance:

- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- Vacuum truck

Maintenance Procedures

Maintenance should be conducted during dry weather when no flow is entering the system. Confined space entry is usually required to maintain the StormCapture. Only personnel that are OSHA Confined Space Entry trained and certified may enter underground structures. Once safety measures such as traffic control have been deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove trash and debris using an extension on the end of the boom hose of the vacuum truck. Continue using the vacuum truck to completely remove accumulated sediment. Some jetting may be necessary to fully evacuate sediment from the system floor or sump. Jetting is acceptable in systems with solid concrete floors or base slabs (referred to as closed-bottom systems). However, jetting is not recommended for open-bottom systems with a gravel foundation since it may cause bedding displacement, undermining of the foundation, or internal disturbance.
- All material removed from the system during maintenance must be disposed of in accordance with local regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.
- Inspect inlet and outlet pipe penetrations for cracking and other signs of movement that may cause leakage.
- Inspect the concrete splash pads (applicable for open-bottom systems only) for proper function and placement.
- Inspect the system for movement of modules. There should be less than 3/4-inch spacing between modules.
- Inspect the general interior condition of modules for concrete cracking or deterioration. If the system consists of horizontal joints as part of the modules, inspect those joints for leakage, displacement or deterioration.

Be sure to securely replace all access covers, as appropriate, following inspection and/or maintenance. If the StormCapture modules or any of the system components show significant signs of cracking, spalling, or deterioration or if there is evidence of excessive differential settlement between modules, contact Oldcastle Infrastructure at **800-579-8819.**

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StormCapture
Inspection & Maintenance Log

Refer to as-built records for details about system size and location onsite

Location _____

System Configuration:

Inspection Date _____

☐ Detention ☐ Infiltration ☐ Retention/Harvesting

Inlet or Outlet Blockage or Obstruction

Notes:

☐ Yes ☐ No

Condition of Internal Components

Notes:

☐ Good ☐ Damaged ☐ Missing

Sediment Depth Observed

Notes:

☐ Inches of Sediment: _____

Trash and Debris Accumulation

Notes:

☐ Significant ☐ Not Significant

Drain Down Observations

Notes:

☐ Appropriate Time Frame ☐ Inappropriate Time Frame

Maintenance Requirements

☐ **Yes - Schedule Maintenance** ☐ **No - Inspect Again in _____ Months**

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MWS Linear 2.0 HGL Sizing Calculations

MWS MODEL SIZE	WETLAND PERMITER LENGTH	LOADING RATE GPM/SF	HGL HEIGHT																												
			SHALLOW MODELS																			STANDARD HEIGHT MODEL	HIGH CAPACITY MODELS									
			1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.65	3.70	3.75	3.80	3.85	3.90	3.95
MWS-L-4-4	6.70	1.0	0.022	0.023	0.025	0.026	0.028	0.029	0.031	0.032	0.034	0.035	0.037	0.038	0.040	0.042	0.043	0.045	0.046	0.048	0.049	0.051	**0.052**	0.054	0.055	0.056	0.057	0.058	0.058	0.059	0.060	0.061
MWS-L-3-6	10.06	1.0	0.032	0.035	0.037	0.039	0.042	0.044	0.046	0.048	0.051	0.053	0.055	0.058	0.060	0.062	0.065	0.067	0.069	0.072	0.074	0.076	**0.078**	0.081	0.083	0.084	0.085	0.087	0.088	0.089	0.090	0.091
MWS-L-4-6	9.30	1.0	0.030	0.032	0.034	0.036	0.038	0.041	0.043	0.045	0.047	0.049	0.051	0.053	0.055	0.058	0.060	0.062	0.064	0.066	0.068	0.070	**0.073**	0.075	0.077	0.078	0.079	0.080	0.081	0.082	0.083	0.084
MWS-L-4-8	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	**0.115**	0.119	0.122	0.124	0.126	0.127	0.129	0.131	0.132	0.134
MWS-L-4-13	18.40	1.0	0.059	0.063	0.068	0.072	0.076	0.080	0.084	0.089	0.093	0.097	0.101	0.106	0.110	0.114	0.118	0.122	0.127	0.131	0.135	0.139	**0.144**	0.148	0.152	0.154	0.156	0.158	0.160	0.163	0.165	0.167
MWS-L-4-15	22.40	1.0	0.072	0.077	0.082	0.087	0.093	0.098	0.103	0.108	0.113	0.118	0.123	0.129	0.134	0.139	0.144	0.149	0.154	0.159	0.165	0.170	**0.175**	0.180	0.185	0.188	0.190	0.193	0.195	0.198	0.200	0.203
MWS-L-4-17	26.40	1.0	0.085	0.091	0.097	0.103	0.109	0.115	0.121	0.127	0.133	0.139	0.145	0.151	0.158	0.164	0.170	0.176	0.182	0.188	0.194	0.200	**0.206**	0.212	0.218	0.221	0.224	0.227	0.230	0.233	0.236	0.239
MWS-L-4-19	30.40	1.0	0.098	0.105	0.112	0.119	0.126	0.133	0.140	0.147	0.153	0.160	0.167	0.174	0.181	0.188	0.195	0.202	0.209	0.216	0.223	0.230	**0.237**	0.244	0.251	0.255	0.258	0.262	0.265	0.269	0.272	0.276
MWS-L-4-21	34.40	1.0	0.111	0.118	0.126	0.134	0.142	0.150	0.158	0.166	0.174	0.182	0.189	0.197	0.205	0.213	0.221	0.229	0.237	0.245	0.253	0.261	**0.268**	0.276	0.284	0.288	0.292	0.296	0.300	0.304	0.308	0.312
MWS-L-6-8	18.80	1.0	0.060	0.065	0.069	0.073	0.078	0.082	0.086	0.091	0.095	0.099	0.104	0.108	0.112	0.116	0.121	0.125	0.129	0.134	0.138	0.142	**0.147**	0.151	0.155	0.157	0.160	0.162	0.164	0.166	0.168	0.170
MWS-L-8-8	29.60	1.0	0.095	0.102	0.109	0.115	0.122	0.129	0.136	0.143	0.149	0.156	0.163	0.170	0.177	0.183	0.190	0.197	0.204	0.211	0.217	0.224	**0.231**	0.238	0.245	0.248	0.251	0.255	0.258	0.262	0.265	0.268
MWS-L-8-12	44.40	1.0	0.143	0.153	0.163	0.173	0.183	0.194	0.204	0.214	0.224	0.234	0.245	0.255	0.265	0.275	0.285	0.296	0.306	0.316	0.326	0.336	**0.346**	0.357	0.367	0.372	0.377	0.382	0.387	0.392	0.397	0.402
MWS-L-8-16	59.20	1.0	0.190	0.204	0.217	0.231	0.245	0.258	0.272	0.285	0.299	0.312	0.326	0.340	0.353	0.367	0.380	0.394	0.408	0.421	0.435	0.448	**0.462**	0.476	0.489	0.496	0.503	0.509	0.516	0.523	0.530	0.537
MWS-L-8-20	74.00	1.0	0.238	0.255	0.272	0.289	0.306	0.323	0.340	0.357	0.374	0.391	0.408	0.425	0.442	0.459	0.476	0.493	0.509	0.526	0.543	0.560	**0.577**	0.594	0.611	0.620	0.628	0.637	0.645	0.654	0.662	0.671
MWS-L-10-20 or MWS-L-8-24	88.80	1.0	0.285	0.306	0.326	0.346	0.367	0.387	0.408	0.428	0.448	0.469	0.489	0.509	0.530	0.550	0.571	0.591	0.611	0.632	0.652	0.673	**0.693**	0.713	0.734	0.744	0.754	0.764	0.774	0.785	0.795	0.805
4'x'4 media cage	14.80	1.0	0.048	0.051	0.054	0.058	0.061	0.065	0.068	0.071	0.075	0.078	0.082	0.085	0.088	0.092	0.095	0.099	0.102	0.105	0.109	0.112	**0.115**	0.119	0.122	0.124						

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PROPOSED DMA SUMMARY

Area ID	Area (sf)	Area (ac)	85th percentile depth (in)	Pervious Area (sf)	Impervious Area (sf)	Percent Impervious	Runoff Coefficient	DCV (cf)	Idesign (in/hr) * from worksheet D	Treatment Flow Rate (CFS) (CXIdesignXA
DA-A1	84,814	1.95	0.8	3,791	81,023	0.9553	0.8665	4,899	0.225	0.38
DA-A2	24,347	0.56	0.8	0	24,347	1.0000	0.9000	1,461	0.225	0.11
DA-A3	18,765	0.43	0.8	0	18,765	1.0000	0.9000	1,126	0.225	0.09
DA-A4	26,892	0.62	0.8	0	26,892	1.0000	0.9000	1,614	0.225	0.13
DA-A5	34,132	0.78	0.8	1,535	32,597	0.9550	0.8663	1,971	0.225	0.15
DA-A6	28,909	0.66	0.8	1,738	27,171	0.9399	0.8549	1,648	0.225	0.13
TOTALS	**217,859**	**5.00**		**7,064**	**210,795**			**12,718**		**0.99**

BMP SIZING (BIO-7) PROPRIETARY BIO-FILTRATION FLOW BASED

AREA ID	BMP ID	Treatment Flow Rate of unit	Design treatment Rate (CFS)
DA-A2	MWS A	0.6900	0.1132
DA-A3	MWS A	0.6900	0.0872
DA-A4	MWS A	0.6900	0.1250
DA-A5	MWS A	0.6900	0.1527
DA-A6	MWS A	0.6900	0.1277
SUMMARY	8X24 MWS A	0.6900	0.6058

BMP SIZING (BIO-1) BIO-RETENTION W/UNDERDRAIN

CAPTURE EFFICIENCY METHOD FOR BIORETENTION WITH UNDERDRAINS

Area ID	K_{DESIGN} (IN/HR)	$D_{PONDING}$ (IN)	$D_{PONDING}$ (FT)	DD Drawdown Time (HR)	X_1	85TH Percentile Storm Depth (IN)	Fraction 85th $D_{FRACTION}$	$D_{FRACTION}$*DCV	Footprint Area (SF)	Footprint Area Provided (SF)
DA-A1	2.5	12	1.00	4.8	0.34	0.8	0.272	1,333	1,333	2,222

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XIV.5. Biotreatment BMP Fact Sheets (BIO)

Conceptual criteria for biotreatment BMP selection, design, and maintenance are contained in **Appendix XII**. These criteria are generally applicable to the design of biotreatment BMPs in Orange County and BMP-specific guidance is provided in the following fact sheets. [24]

Note: Biotreatment BMPs shall be designed to provide the maximum feasible infiltration and ET based on criteria contained in ***Appendix*** **XI.2**.

BIO-1: Bioretention with Underdrains

Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plants. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded, and sequestered by the soil and plants. Bioretention with an underdrain are utilized for areas with low permeability native soils or steep slopes where the underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration. **Bioretention must be designed without an underdrain** in areas of high soil permeability.

Also known as:

- *Rain gardens with underdrains*
- *Vegetated media filter*
- *Downspout planter boxes*

Bioretention
Source: Geosyntec Consultants

Feasibility Screening Considerations

- If there are no hazards associated with infiltration (such as groundwater concerns, contaminant plumes or geotechnical concerns), **bioinfiltration facilities**, which achieve partial infiltration, should be used to maximize infiltration.

[24] Not all BMPs presented in this section are considered "biofiltration BMPs" under the South Orange County Permit Area. Biofiltration BMPs are vegetated treat-and-release BMPs that filter stormwater through amended soil media that is biologically active, support plant growth, and also promote infiltration and/or evapotranspiration. For projects in South Orange County, the total volume of storage in surface ponding and pores spaces is required to be at least 75% of the remaining DCV that the biofiltration BMP is designed to address. This prevents significant down-sizing of BMPs which otherwise may be possible via routing calculations. Biotreatment BMPs that do not meet this definition are not considered to be LID BMPs, but may be used as treatment control or pre-treatment BMPs. See Section III.7 and Worksheet SOC-1 for guidance.

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- Bioretention with underdrain facilities should be lined if contaminant plumes or geotechnical concerns exist. If high groundwater is the reason for infiltration infeasibility, bioretention facilities with underdrains do not need to be lined.

Opportunity Criteria

- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Bioretention may also be applied in parking lot islands, cul-de-sacs, traffic circles, road shoulders, road medians, and next to buildings in planter boxes.
- Drainage area is ≤ 5 acres.
- Area is available for infiltration.
- Site must have adequate relief between land surface and the stormwater conveyance system to permit vertical percolation through the soil media and collection and conveyance in underdrain to stormwater conveyance system.

OC-Specific Design Criteria and Considerations

☒ Ponding depth should not exceed 18 inches; fencing may be required if ponding depth is greater than 6 inches to mitigate drowning.

☒ The minimum soil depth is 2 feet (3 feet is preferred).

☒ The maximum drawdown time of the bioretention ponding area is 48 hours. The maximum drawdown time of the planting media and gravel drainage layer is 96 hours, if applicable.

☒ Infiltration pathways may need to be restricted due to the close proximity of roads, foundations, or other infrastructure. A geomembrane liner, or other equivalent water proofing, may be placed along the vertical walls to reduce lateral flows. This liner should have a minimum thickness of 30 mils.

☒ If infiltration in bioretention location is hazardous due to groundwater or geotechnical concerns, a geomembrane liner must be installed at the base of the bioretention facility. This liner should have a minimum thickness of 30 mils.

☒ The planting media placed in the cell shall be designed per the recommendations contained in MISC-1: Planting/Storage Media

☒ Plant materials should be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 hours; native place species and/or hardy cultivars that are not invasive and do not require chemical inputs should be used to the maximum extent feasible

☒ The bioretention area should be covered with 2-4 inches (average 3 inches) or mulch at the start and an additional placement of 1-2 inches of mulch should be added annually.

☒ Underdrain should be sized with a 6 inch minimum diameter and have a 0.5% minimum slope. Underdrain should be slotted polyvinyl chloride (PVC) pipe; underdrain pipe should be more than 5 feet from tree locations (if space allows).

☒ A gravel blanket or bedding is required for the underdrain pipe(s). At least 0.5 feet of washed aggregate must be placed below, to the top, and to the sides of the underdrain pipe(s).

☒ An overflow device is required at the top of the bioretention area ponding depth.

☒ Dispersed flow or energy dissipation (i.e. splash rocks) for piped inlets should be provided at basin inlet to prevent erosion.

☒ Ponding area side slopes shall be no steeper than 3:1 (H:V) unless designed as a planter box BMP with appropriate consideration for trip and fall hazards.

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Simple Sizing Method for Bioretention with Underdrain

If the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** is used to size a bioretention with underdrain facility, the user selects the basin depth and then determines the appropriate surface area to capture the DCV. The sizing steps are as follows:

Step 1: Determine DCV

Calculate the DCV using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1**.

Step 2: Verify that the Ponding Depth will Draw Down within 48 Hours

The ponding area drawdown time can be calculated using the following equation:

$DD_P = (d_P / K_{MEDIA}) \times 12$ in/ft

Where:

DD_P = time to drain ponded water, hours

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

If the drawdown time exceeds 48 hours, adjust ponding depth and/or media infiltration rate until 48 hour drawdown time is achieved.

Step 3: Determine the Depth of Water Filtered During Design Capture Storm

The depth of water filtered during the design capture storm can be estimated as the amount routed through the media during the storm, or the ponding depth, whichever is smaller.

$d_{FILTERED}$ = Minimum [$((K_{MEDIA} \times T_{ROUTING})/12)$, d_P]

Where:

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

K_{MEDIA} = media design infiltration rate, in/hr (equivalent to the media hydraulic conductivity with a factor of safety of 2; K_{MEDIA} of 2.5 in/hr should be used unless other information is available)

$T_{ROUTING}$ = storm duration that may be assumed for routing calculations; this should be assumed to be no greater than 3 hours. If the designer desires to account for further routing effects, the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) should be used.

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

Step 4: Determine the Facility Surface Area

$A = DCV/ (d_P + d_{FILTERED})$

Where:

A = required area of bioretention facility, sq-ft

DCV = design capture volume, cu-ft

$d_{FILTERED}$ = depth of water that may be considered to be filtered during the design storm event, ft

d_P = depth of ponding above bioretention area, ft (not to exceed 1.5 ft)

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. See Section III.7 and Worksheet SOC-1.

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Capture Efficiency Method for Bioretention with Underdrains

If the bioretention geometry has already been defined and the user wishes to account more explicitly for routing, the user can determine the required footprint area using the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) to determine the fraction of the DCV that must be provided to manage 80 percent of average annual runoff volume. This method accounts for drawdown time different than 48 hours.

Step 1: Determine the drawdown time associated with the selected basin geometry

$DD = (d_p / K_{DESIGN}) \times 12$ in/ft

Where:

DD = time to completely drain infiltration basin ponding depth, hours

d_P = bioretention ponding depth, ft (should be less than or equal to 1.5 ft)

K_{DESIGN} = design media infiltration rate, in/hr (assume 2.5 inches per hour unless otherwise proposed)

If drawdown is less than 3 hours, the drawdown time should be rounded to 3 hours or the Capture Efficiency Method for Flow-based BMPs (See **Appendix III.3.3**) shall be used.

Step 2: Determine the Required Adjusted DCV for this Drawdown Time

Use the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs (See **Appendix III.3.2**) to calculate the fraction of the DCV the basin must hold to achieve 80 percent capture of average annual stormwater runoff volume based on the basin drawdown time calculated above.

Step 3: Determine the Basin Infiltrating Area Needed

The required infiltrating area (i.e. the surface area of the top of the media layer) can be calculated using the following equation:

$A = \text{Design Volume} / d_p$

Where:

A = required infiltrating area, sq-ft (measured at the media surface)

Design Volume = fraction of DCV, adjusted for drawdown, cu-ft (see Step 2)

d_p = ponding depth of water stored in bioretention area, ft (from Step 1)

This does not include the side slopes, access roads, etc. which would increase bioretention footprint. If the area required is greater than the selected basin area, adjust surface area or adjust ponding depth and recalculate required area until the required area is achieved.

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. See Section III.7 and Worksheet SOC-1.

Configuration for Use in a Treatment Train

- Bioretention areas may be preceeded in a treatment train by HSCs in the drainage area, which would reduce the required design volume of the bioretention cell. For example, bioretention could be used to manage overflow from a cistern.
- Bioretention areas can be used to provide pretreatment for underground infiltration systems.

Additional References for Design Guidance

- CASQA BMP Handbook for New and Redevelopment: http://www.cabmphandbooks.com/Documents/Development/TC-32.pdf

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- SMC LID Manual (pp 68):
  http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 5:
  http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- San Diego County LID Handbook Appendix 4 (Factsheet 7):
  http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf

  Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4:
  http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- County of Los Angeles Low Impact Development Standards Manual, Chapter 5:
  http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf

DRAFT

BIO-7: Proprietary Biotreatment

Proprietary biotreatment devices are devices that are manufactured to mimic natural systems such as bioretention areas by incorporating plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their natural counterparts. Incoming flows are typically filtered through a planting media (mulch, compost, soil, plants, microbes, etc.) and either infiltrated or collected by an underdrain and delivered to the storm water conveyance system. Tree box filters are an increasingly common type of proprietary biotreatment device that are installed at curb level and filled with a bioretention type soil. For low to moderate flows they operate similarly to bioretention systems and are bypassed during high flows. Tree box filters are highly adaptable solutions that can be used in all types of development and in all types of soils but are especially applicable to dense urban parking lots, street, and roadways.

Also known as:

- *Catch basin planter box*
- *Bioretention vault*
- *Tree box filter*

Proprietary biotreatment
Source: http://www.americastusa.com /index.php/filterra/

Feasibility Screening Considerations

- Proprietary biotreatment devices that are unlined may cause incidental infiltration. Therefore, an evaluation of site conditions should be conducted to evaluate whether the BMP should include an impermeable liner to avoid infiltration into the subsurface.

Opportunity Criteria

- Drainage areas of 0.25 to 1.0 acres.
- Land use may include commercial, residential, mixed use, institutional, and subdivisions. Proprietary biotreatment facilities may also be applied in parking lot islands, traffic circles, road shoulders, and road medians.
- Must not adversely affect the level of flood protection provided by the drainage system.

OC-Specific Design Criteria and Considerations

☒ Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.

☒ Consult proprietors for specific criteria concerning the design and performance.

☒ Proprietary biotreatment may include specific media to address pollutants of concern. However, for proprietary device to be considered a biotreatment device the media must be capable of supporting rigorous growth of vegetation.

☒ Proprietary systems must be acceptable to the reviewing agency. Reviewing agencies shall have the discretion to request performance information. Reviewing agencies shall have the discretion to deny the use of a proprietary BMP on the grounds of performance, maintenance considerations, or other relevant factors.

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☒ In right of way areas, plant selection should not impair traffic lines of site. Local jurisdictions may also limit plant selection in keeping with landscaping themes.

Computing Sizing Criteria for Proprietary Biotreatment Device

- Proprietary biotreatment devices can be volume based or flow-based BMPs.
- Volume-based proprietary devices should be sized using the Simple Design Capture Volume Sizing Method described in **Appendix III.3.1** or the Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs described in **Appendix III.3.2**.
- The required design flowrate for flow-based proprietary devices should be computed using the Capture Efficiency Method for Flow-based BMPs described in **Appendix III.3.3)**.

In South Orange County, the provided ponding plus pore volume must be checked to demonstrate that it is greater than 0.75 of the remaining DCV that this BMP is designed to address. Many propretary biotreatment BMPs will not be able to meet the definition of "biofiltration" that applies in South Orange County. See Section III.7 and Worksheet SOC-1.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 4: http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850
- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf
- Santa Barbara BMP Guidance Manual, Chapter 6: http://www.santabarbaraca.gov/NR/rdonlyres/91D1FA75-C185-491E-A882-49EE17789DF8/0/Manual_071008_Final.pdf

DRAFT

TRT-2: Cartridge Media Filter

Cartridge media filters (CMFs) are manufactured devices that consist of a series of modular filters packed with engineered media that can be contained in a catch basin, manhole, or vault that provide treatment through filtration and sedimentation. The manhole or vault may be divided into multiple chambers where the first chamber acts as a pre-settling basin for removal of coarse sediment while another chamber acts as the filter bay and houses the filter cartridges. A variety of media types are available from various manufacturers which can target pollutants of concern.

Also known as:

- *Manufactured Media Filters*

Cartridge Media Filter
Source: Contech Stormwater Solution, Inc.

Feasibility Screening Considerations

- Not applicable

Opportunity Criteria

- Intended for use when retention and biotreatment options are infeasible.
- Recommended for drainage area with limited available surface area or where surface BMPs would restrict uses.
- For drainage areas with significant areas of non-stabilized soil, permanent soil stablization must be achieved before before cartridge media filters are installed and put on line to minimize risk of clogging.
- Depending on the number of cartridges, maintenance events can have long durations. Care should be exercised in siting these facilities so that maintenance events will not significantly disrupt businesses or traffic.

OC-Specific Design Criteria and Considerations

☒ Cartridge media filter BMP vendors should be consulted regarding design and specifications.

☒ Filter media should be selected to target pollutants of concern. A combination of media may be appropriate to remove a variety of pollutants.

☒ If CMF are integrated with a vault for equalization, the system should be designed to completely drain the vault within 96 hours of storm event or otherwise protect against standing water and mosquito breeding concerns.

Computing Sizing Criteria for Cartridge Media Filters

The required design flowrate should be calculated based on the **Capture Efficiency Method for Flow-based BMPs** (See **Appendix III.3.3**).

Additional References for Design Guidance

- Los Angeles County Stormwater BMP Design and Maintenance Manual, Chapter 9: http://dpw.lacounty.gov/DES/design_manuals/StormwaterBMPDesignandMaintenance.pdf

DRAFT

- SMC LID Manual: http://www.lowimpactdevelopment.org/guest75/pub/All_Projects/SoCal_LID_Manual/SoCalLID_Manual_FINAL_040910.pdf
- Western Washington Stormwater Management Manual, Volume V, Chapter 12: http://www.ecy.wa.gov/pubs/0510033.pdf

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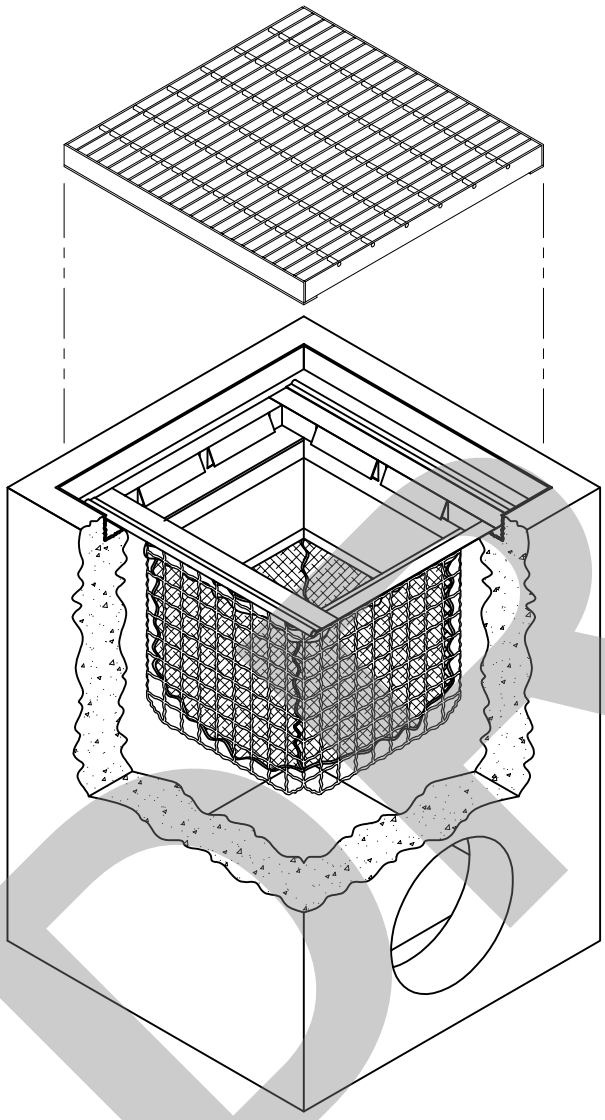
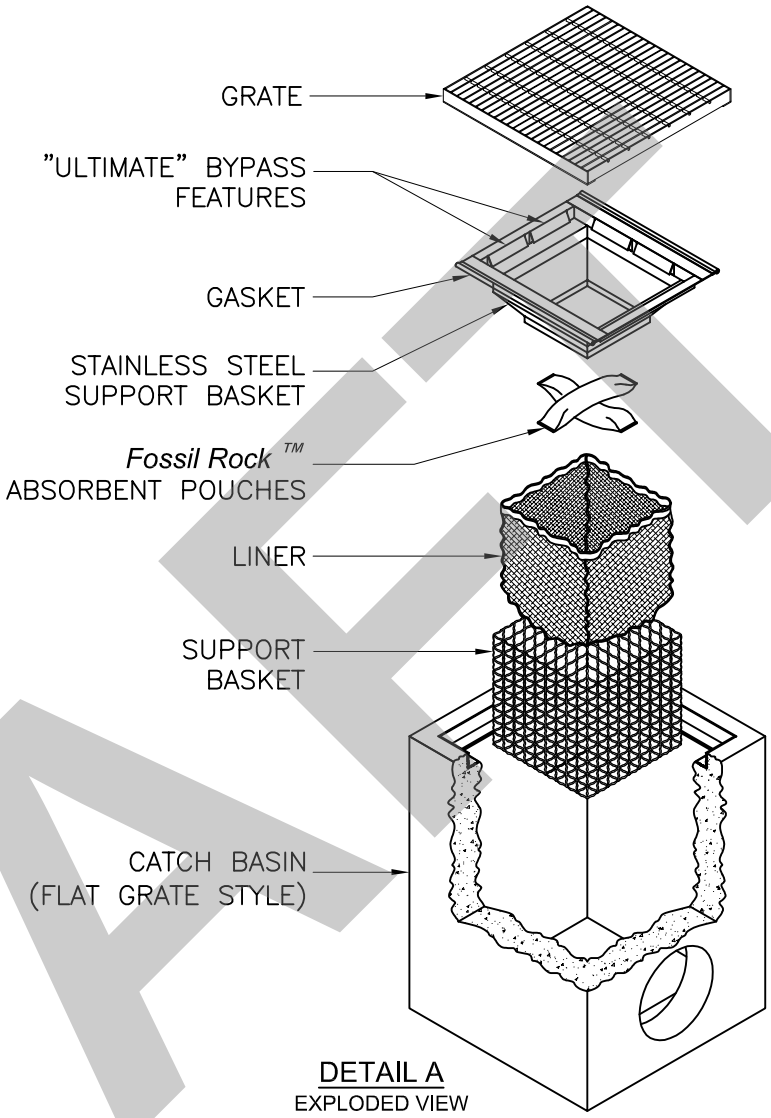
FGP-0001



FloGard® FILTER
-INSTALLED INTO CATCH BASIN-



DETAIL A
EXPLODED VIEW

NOTES:

1. Filter insert shall have a high flow bypass feature.
2. Filter support frame shall be constructed from stainless steel Type 304.
3. Filter medium shall be *Fossil Rock* ™, installed and maintained in accordance with manufacturer specifications.
4. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.

U.S. PATENT # 6,00,023 & 6,877,029

Inlet Filtration

FloGard®

Catch Basin Insert Filter

Grated Inlet Style

Oldcastle® Stormwater Solutions

7921 Southpark Plaza, Suite 200 | Littleton, CO | 80120 | Ph: 800.579.8819 | oldcastlestormwater.com

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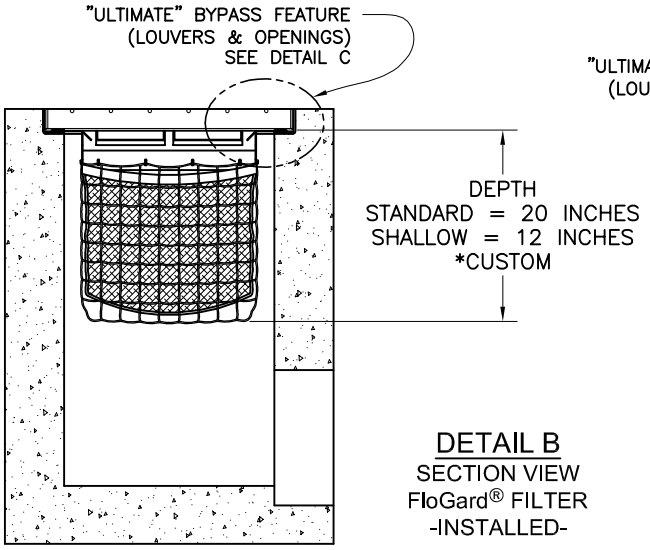
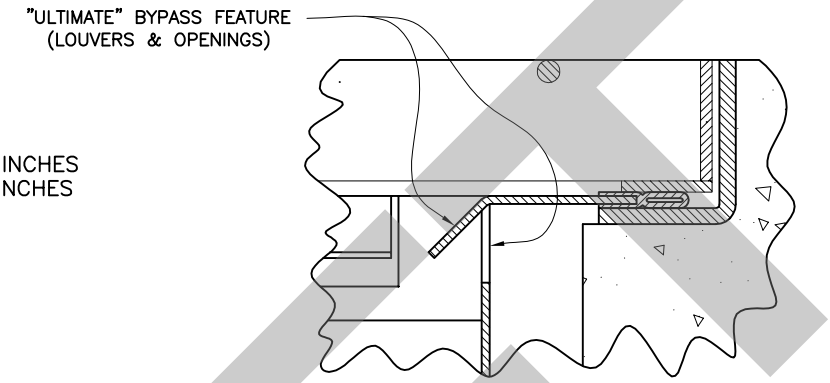
DRAWING NO.	REV	ECO	DATE	
FGP-0001	G	ECO-0142 JPR 7/13/16	JPR 11/3/06	SHEET 1 OF 2

DRAFT

U.S. PATENT # 6,00,023 & 6,877,029



DETAIL B
SECTION VIEW
FloGard® FILTER
-INSTALLED-



DETAIL C
"ULTIMATE"
BYPASS FEATURES

* MANY OTHER STANDARD & CUSTOM SIZES & DEPTHS AVAILABLE UPON REQUEST.

SPECIFIER CHART

MODEL NO. STANDARD DEPTH	STANDARD & SHALLOW DEPTH (Data In these columes Is the same for both STANDARD & SHALLOW versions)			STANDARD DEPTH -20 Inches-		MODEL NO. SHALLOW DEPTH	SHALLOW DEPTH -12 Inches-	
	INLET ID Inside Dimension (inch x inch)	GRATE OD Outside Dimension (inch x inch)	TOTAL BYPASS CAPACITY (cu. ft. / sec.)	SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)		SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)
FGP-12F	12 X 12	12 X 14	2.8	0.3	0.4	FGP-12F8	.15	.25
FGP-16F	16 X 16	16 X 19	4.7	0.8	0.7	FGP-16F8	.45	.4
FGP-18F	18 X 18	18 X 20	4.7	0.8	0.7	FGP-18F8	.45	.4
FGP-1824F	16 X 22	18 X 24	5.0	1.5	1.2	FGP-1824F8	.85	.7
FGP-1836F	18 X 36	18 X 40	6.9	2.3	1.6	FGP-1836F8	1.3	.9
FGP-2024F	18 X 22	20 X 24	5.9	1.2	1.0	FGP-2024F8	.7	.55
FGP-21F	22 X 22	22 X 24	6.1	2.2	1.5	FGP-21F8	1.25	.85
FGP-24F	24 X 24	24 X 27	6.1	2.2	1.5	FGP-24F8	1.25	.85
FGP-2430F	24 X 30	26 X 30	7.0	2.8	1.8	FGP-2430F8	1.6	1.05
FGP-2436F	24 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8	1.95	1.15
FGP-2448F	24 X 48	26 X 48	9.3	4.4	2.4	FGP-2448F8	2.5	1.35
FGP-28F	28 X 28	32 X 32	6.3	2.2	1.5	FGP-28F8	1.25	.85
FGP-30F	30 X 30	30 X 34	8.1	3.6	2.0	FGP-30F8	2.05	1.15
FGP-36F	36 X 36	36 X 40	9.1	4.6	2.4	FGP-36F8	2.65	1.35
FGP-3648F	36 X 48	40 X 48	11.5	6.8	3.2	FGP-3648F8	3.9	1.85
FGP-48F	48 X 48	48 X 54	13.2	9.5	3.9	FGP-48F8	5.45	2.25
FGP-SD24F	24 X 24	28 X 28	6.1	2.2	1.5	FGP-SD24F8	1.25	.85

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Inlet Filtration

FloGard®

Catch Basin Insert Filter

Grated Inlet Style

Oldcastle® Stormwater Solutions
7921 Southpark Plaza, Suite 200 | Littleton, CO | 80120 | Ph: 800.579.8819 | oldcastlestormwater.com

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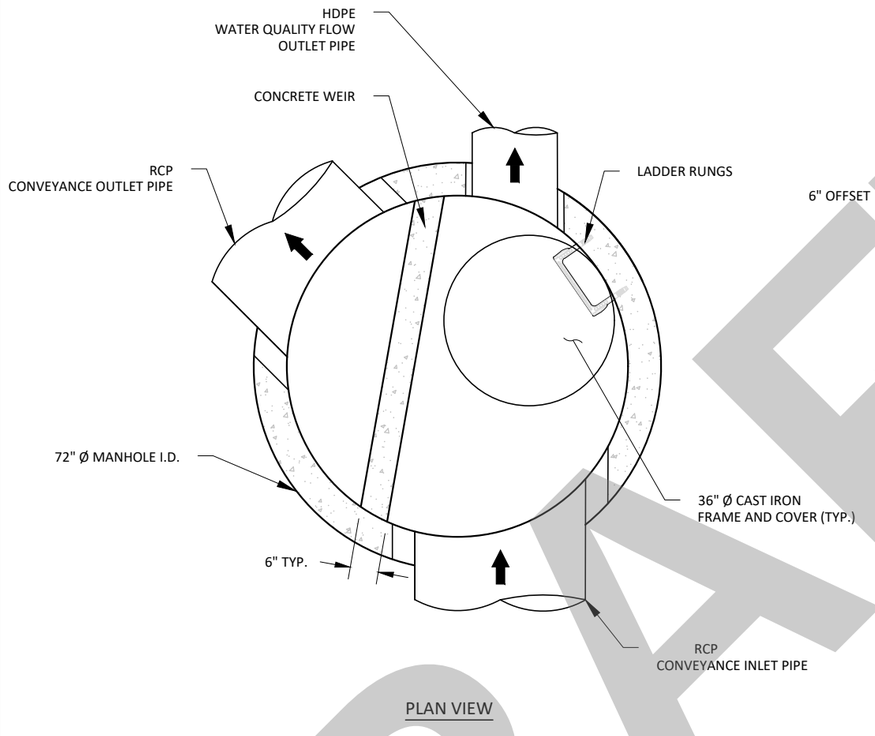
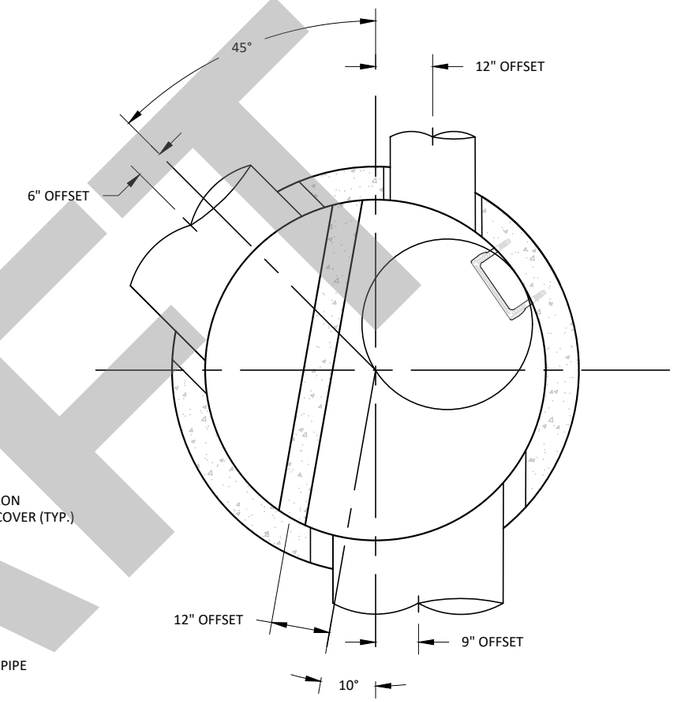
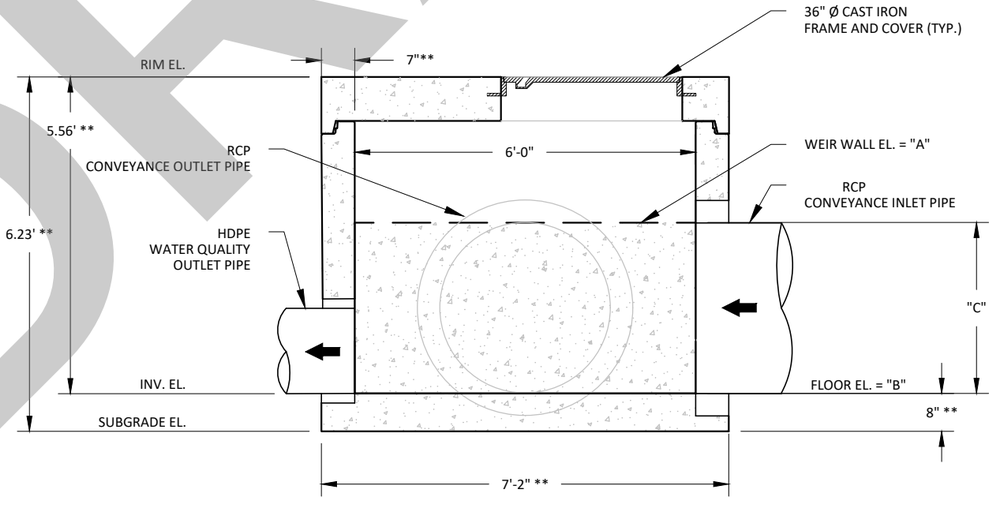
DRAWING NO.	REV	ECO	DATE	
FGP-0001	G	ECO-0142 JPR 7/13/16	JPR 11/3/06	SHEET 2 OF 2



PLAN VIEW



PLAN VIEW



ELEVATION VIEW

SCALE: 1" = 32"

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GENERIC DETAIL FOR REFERENCE ONLY

ITEM #70 - DIVERSION STRUCTURE, PLAN SHEET 29
BASIN A, STRUCTURE 1
STORMVAULT DIVERTER MANHOLE
MODEL: SVDMH-72

MANHOLE DATA :

DIVERTED STORMWATER QUALITY DESIGN FLOW (SQDF)	45-CFS (20,197-GPM)
MANHOLE INTERNAL DIAMETER INCHES (Ø)	72"
RIM ELEVATION (FT)	176.19' ±

PIPE DATA	DIAMETER (Ø)	MATERIAL	INV. EL.	ORIENTATION
INLET PIPE	36"	RCP		180°
WATER QUALITY FLOW OUTLET PIPE	18"	HDPE		0°
OUTLET PIPE	36"	RCP		315°

ADJUSTABLE WEIR ELEVATIONS AND HEIGHTS :

A	WEIR WALL ELEVATION	
B	FLOOR ELEVATION	
C	WEIR WALL TOTAL HEIGHT	
D	WEIR ORIENTATION (45° TYP.)	

(*) WEIR HEIGHT DIMENSION DETERMINED BY DESIGN ENGINEER'S HYDRAULIC ANALYSIS

NOTES/SPECIAL REQUIREMENTS:

WEIR LENGTH "L" = 5.75'

GENERAL NOTES :

1. THIS LAYOUT SKETCH IS PROVIDED IN A SCHEMATIC FORMAT. THIS SHEET IS IN ENGINEERING & CONSTRUCTION FORMATTED DETAIL. ENGINEERING & CONSTRUCTION DETAIL READILY AVAILABLE. CONTACT JENSEN PRECAST.
2. PLAN VIEW FRAME AND COVER NOT SHOWN FOR CLARITY.
3. 48" DIAMETER RCP/HDPE IS THE LARGEST SUGGESTED INLET/OUTLET PIPE SIZE FOR THIS DIVERSION STRUCTURE.
4. INLET/OUTLET PIPE STUBS PROVIDED BY JENSEN PRECAST, PIPE TYPE ADAPTERS PROVIDED BY CUSTOMER.
5. DESIGN LOAD: H-20 TRAFFIC FROM 1' TO 6' OF COVER PER ASTM C890 & C915 AND ASSHTO LOADING METHODS.
6. CONTACT JENSEN PRECAST FOR OTHER INSTALLATION DEPTHS, INLET/OUTLET CONFIGURATIONS, AND/OR LOADING CONDITIONS FOR STRUCTURAL DESIGN REVISION TO MEET PROJECT SPECIFIC NEEDS.

CONSTRUCTION NOTES :

1. CONTRACTOR TO VERIFY VERTICAL DIMENSIONS OF ALL PRECAST PIECES IN FIELD.
2. VERIFY SUBBASE ELEVATION BEFORE PLACING PRECAST COMPONENTS OR BACKFILLING.
3. APPLY BUTYL MASTIC AND/OR GROUT TO SEAL JOINTS OF STRUCTURE.
4. CONTRACTOR TO GROUT ALL PIPE PENETRATIONS IN FIELD AS NECESSARY.
5. CONTRACTOR TO ADJUST FRAME/COVER ELEVATION IN FIELD AS NECESSARY.
6. ALL INTERNAL COMPONENTS INSTALLED BY MANUFACTURER.

MATERIALS :

1. ALL DIMENSIONS ARE IN FEET OR DECIMAL INCHES
2. PRECAST MATERIALS AND MANUFACTURING METHODS SHALL CONFORM TO ASTM C-857 & C-478.
3. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH F'c = 3,000-PSI AT 28-DAYS.
4. THE PORTLAND CEMENT USED IN THE PRECAST SECTION SHALL MEET THE REQUIREMENTS OF TYPE II/V HIGH SULFATE RESISTANT CEMENT IN ACCORDANCE WITH ASTM CLASS M C-150.

LIFTING WEIGHTS :

1. HEAVIEST PICK WEIGHT IS 15,000-LBS.
2. JENSEN CRANE TRUCK CAN SET A MAXIMUM OF 25,000-LBS AT 15-FT OFFSET DISTANCE FROM CENTER OF CRANE TRUNNION.

(**) REGIONAL MANUFACTURING DIFFERENCE :

THESE ARE TEMPLATE DRAWINGS. JOINTS, WALL, TOP AND BOTTOM SLAB THICKNESS VARY ACROSS JENSEN'S REGIONAL MANUFACTURING FACILITIES AND ALSO FOR SITE SPECIFIC LOADING CONDITIONS. CONFIRM FINAL THICKNESS, PIPING CONFIGURATION AND CONCRETE THICKNESS PER CONSTRUCTION SUBMITTAL DRAWINGS. ADJUST FINAL DIMENSIONS TO EXTERIOR INVERT AND SUBGRADE ELEVATION PER REGIONAL DIFFERENCES.

MODEL:

SVDMH-72

STORMVAULT DIVERTER MANHOLE

PROJECT:

JENSEN WATER RESOURCES
521 DUNN CIRCLE, SPARKS, NV 89431-6312
(877) 649-0095 FAX (775) 440-2013

ORG. DWG. DATE	SCALE:	SHEET SIZE	DRAWN BY	SHEET NUMBER
	AS SHOWN	11" X 17"		SVDMH-72

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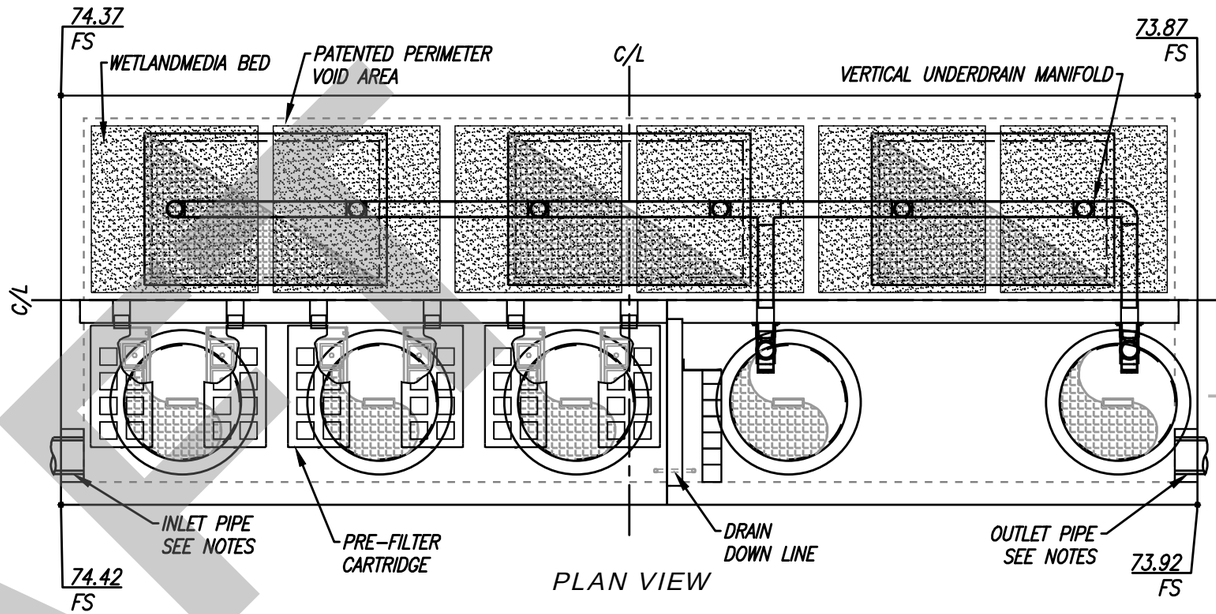
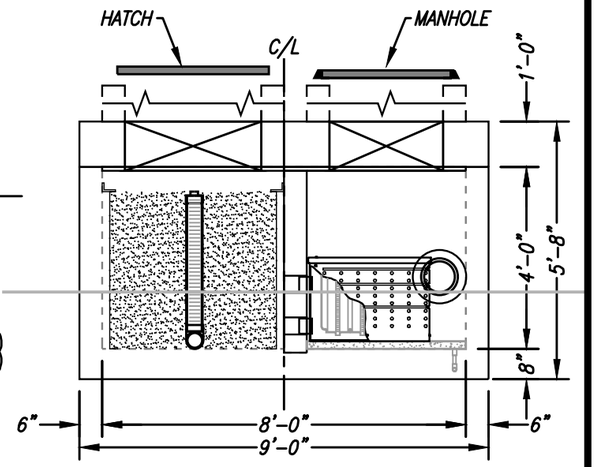
SITE SPECIFIC DATA			
PROJECT NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A			
TREATMENT HGL AVAILABLE (FT)			N/K
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	65.80	PVC	8"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	64.47	PVC	8"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	SEE PLAN VIEW	SEE PLAN VIEW	SEE PLAN VIEW
SURFACE LOAD	HS–20	HS–20	HS–20
FRAME & COVER	3EA ø30"	3EA 36" X 60"	2EA ø30"
WETLANDMEDIA VOLUME (CY)			10.52
ORIFICE SIZE (DIA. INCHES)			ø2.65 EA

NOTES: PRELIMINARY NOT FOR CONSTRUCTION.
REQUIRED OVERFLOW INVERT ELEVATION SET AT TREATMENT HGL OF 67.77



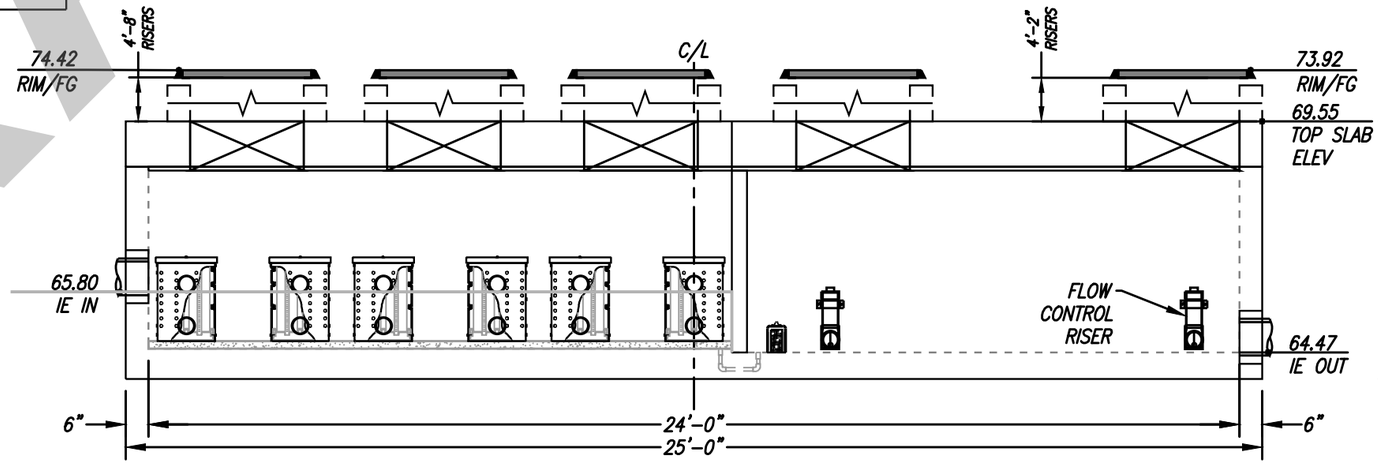
PLAN VIEW



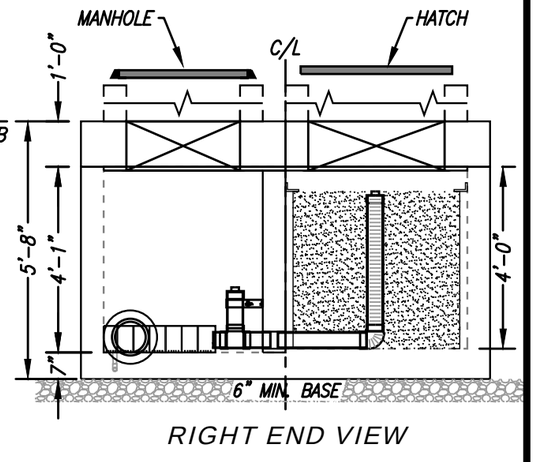
LEFT END VIEW

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
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 WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, 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. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.



ELEVATION VIEW



RIGHT END VIEW

GENERIC DETAIL FOR REFERENCE ONLY

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.

TREATMENT FLOW (CFS)	0.68
OPERATING HEAD (FT)	3.3
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

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

PROPRIETARY AND CONFIDENTIAL:
THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE SOLE PROPERTY OF FORTERRA AND ITS COMPANIES. THIS DOCUMENT, NOR ANY PART THEREOF, MAY BE USED, REPRODUCED OR MODIFIED IN ANY MANNER WITH OUT THE WRITTEN CONSENT OF FORTERRA.

Bio Clean
A Forterra Company

MWS-L-8-24-4'-0"-V-UG
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

12/21/21 MRILLINGS

August 2021

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) ENHANCED AND PHOSPHORUS TREATMENT

For

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, Phosphorus, and Enhanced treatment
    - Sized at a hydraulic loading rate of:
        - 1 gallon per minute (gpm) per square foot (sq ft) of Wetland Cell Surface Area
        - Prefilter box (approved at either 22 inches or 33 inches tall)
            - 3.0 gpm/sq ft of prefilter box surface area for moderate pollutant loading rates (low to medium density residential basins).
            - 2.1 gpm/sq ft of prefilter box surface area for high pollutant loading rates (commercial and industrial basins).
2. Ecology approves the MWS – Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:
    - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute water quality treatment design flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology- approved continuous runoff model.

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3. These use level designations have no expiration date but may be amended or revoked 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) MSW – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to and approved by Ecology.
4) The applicant tested the MWS – Linear Modular Wetland Stormwater Treatment System with an external bypass weir. This weir limited the depth of water flowing through the media, and therefore the active treatment area, to below the root zone of the plants. This GULD applies to MWS – Linear Modular Wetland Stormwater Treatment Systems whether plants are included in the final product or not.
5) Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of stormwater treatment technology.
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    - 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: 5796 Armada Drive, Suite 250
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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.
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Findings of Fact:

<u>Laboratory Testing</u>

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.
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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.
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Ecology: Douglas C. Howie, P.E. Department of Ecology Water Quality Program
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- 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.

DRAFT

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

Contact Information:

Applicant: Zach Kent
BioClean A Forterra Company
5796 Armada Drive, Suite 250
Carlsbad, CA 92008
zach.kent@forterrabp.com

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

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

Ecology: Douglas C. Howie, P.E. Department of Ecology Water Quality Program
(360) 870-0983
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment
December 2015	Updated GULD to document the acceptance of MWS – Linear Modular Wetland installations with or without the inclusion of plants
July 2017	Revised Manufacturer Contact Information (name, address, and email)
December 2019	Revised Manufacturer Contact Address
July 2021	Added additional prefilter sized at 33 inches
August 2021	Changed “Prefilter” to “Prefilter box”

DRAFT

ATTACHMENT C

SUPPORTING MAPS AND EXHIBITS

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PROJECT SITE

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Step 1: Determine the design capture storm depth used for calculating volume			DA-A2-6	
1	Enter the time of concentration, T_c (min) (See **Appendix IV.2**)	T_c=	7.3	AES
2	Using **Figure III.4**, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.225	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (**Worksheet A**)	d_{HSC}=	0	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (**Worksheet A**)	Y_2=	0	%
5	Using **Figure III.4**, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	0	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.225	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	3.05	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.97	WQMP
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.88	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.60	cfs

Supporting Calculations

Describe system:

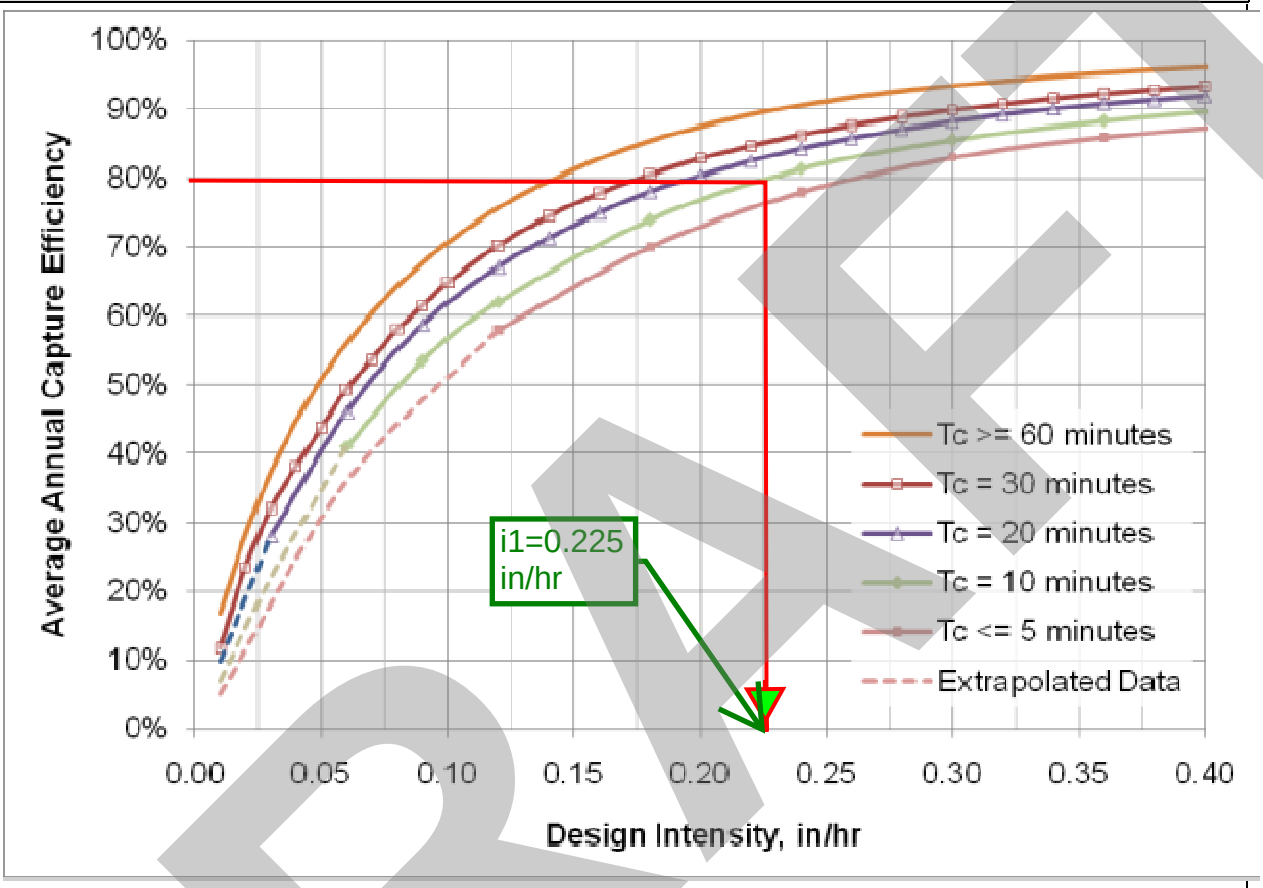
Flow rate developed for all areas flowing to BMP to size treatment flow for Proprietary Water Quality Treatment System.

Provide time of concentration assumptions:

DRAFT

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

DRAFT

PROJECT SITE

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

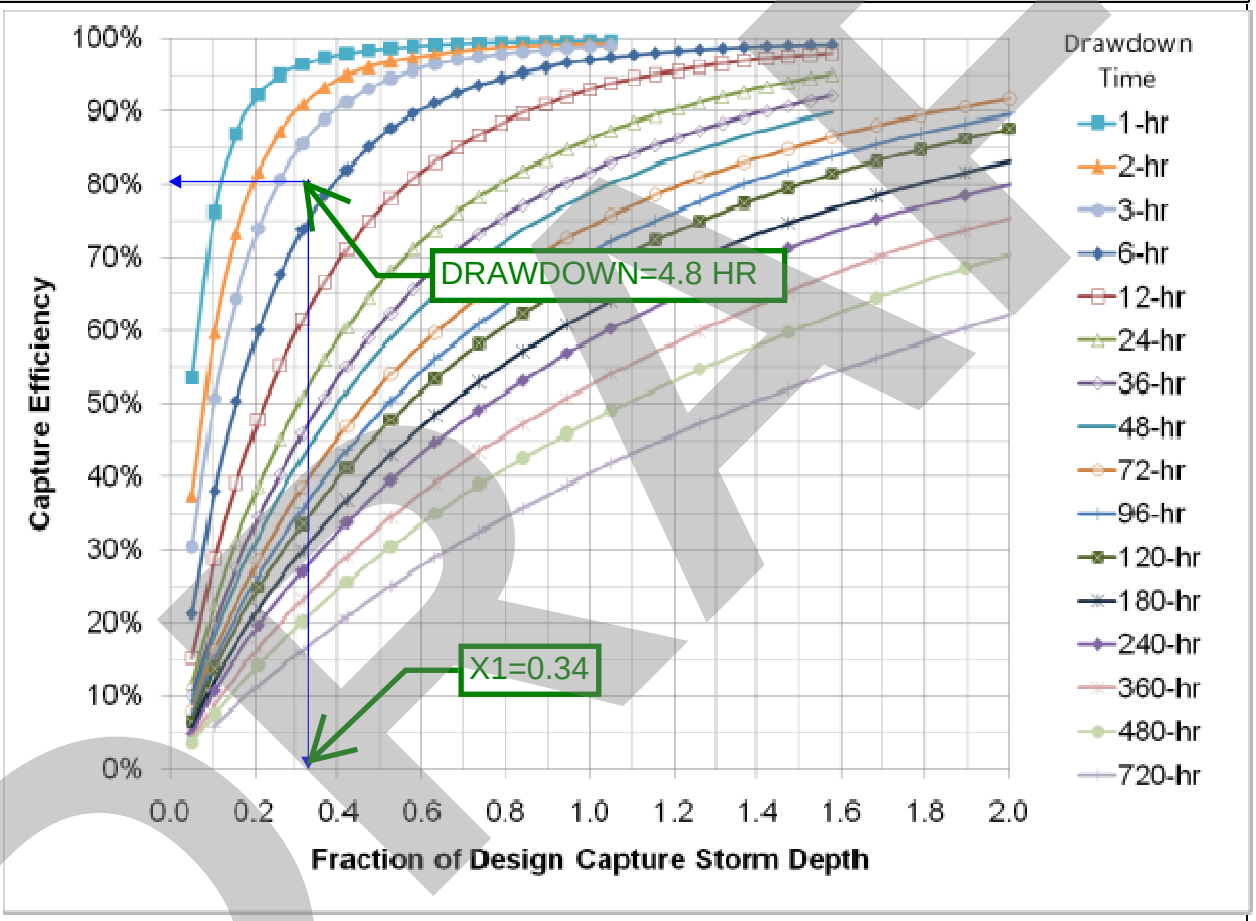
Step 1: Determine the design capture storm depth used for calculating volume			DA-A1	
1	Enter design capture storm depth from **Figure III.1**, *d* (inches)	d=	0.80	inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, *T* (hours)	T=	4.8	hours
3	Using **Figure III.2**, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=	0.34	
4	Enter the effective depth of provided HSCs upstream, d_{HSC} (inches) (**Worksheet A**)	d_{HSC}=	0	inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (**Worksheet A**)	Y_2=	0	%
6	Using **Figure III.2**, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=	0	
7	Calculate the fraction of design volume that must be provided by BMP, *fraction* = $X_1 - X_2$	fraction=	0.34	
8	Calculate the resultant design capture storm depth (inches), $d_{fraction}$= *fraction* × *d*	$d_{fraction}$=	0.272	inches
9	SOC Only: When using this method for biofiltration sizing, check that the resulting volume in pre-filter detention volume plus pore spaces is at least 0.75 of the remaining DCV (See Section III.7 and Worksheet SOC-1).		Y / N / NA	N/A
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	1.95	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.95	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.86	
4	Calculate runoff volume, V_{design}= *(C x* $d_{rfraction}$ *x A x 43560 x (1/12))*	V_{design}=	1333	cu-ft
Supporting Calculations				
Describe system:				

DRAFT

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

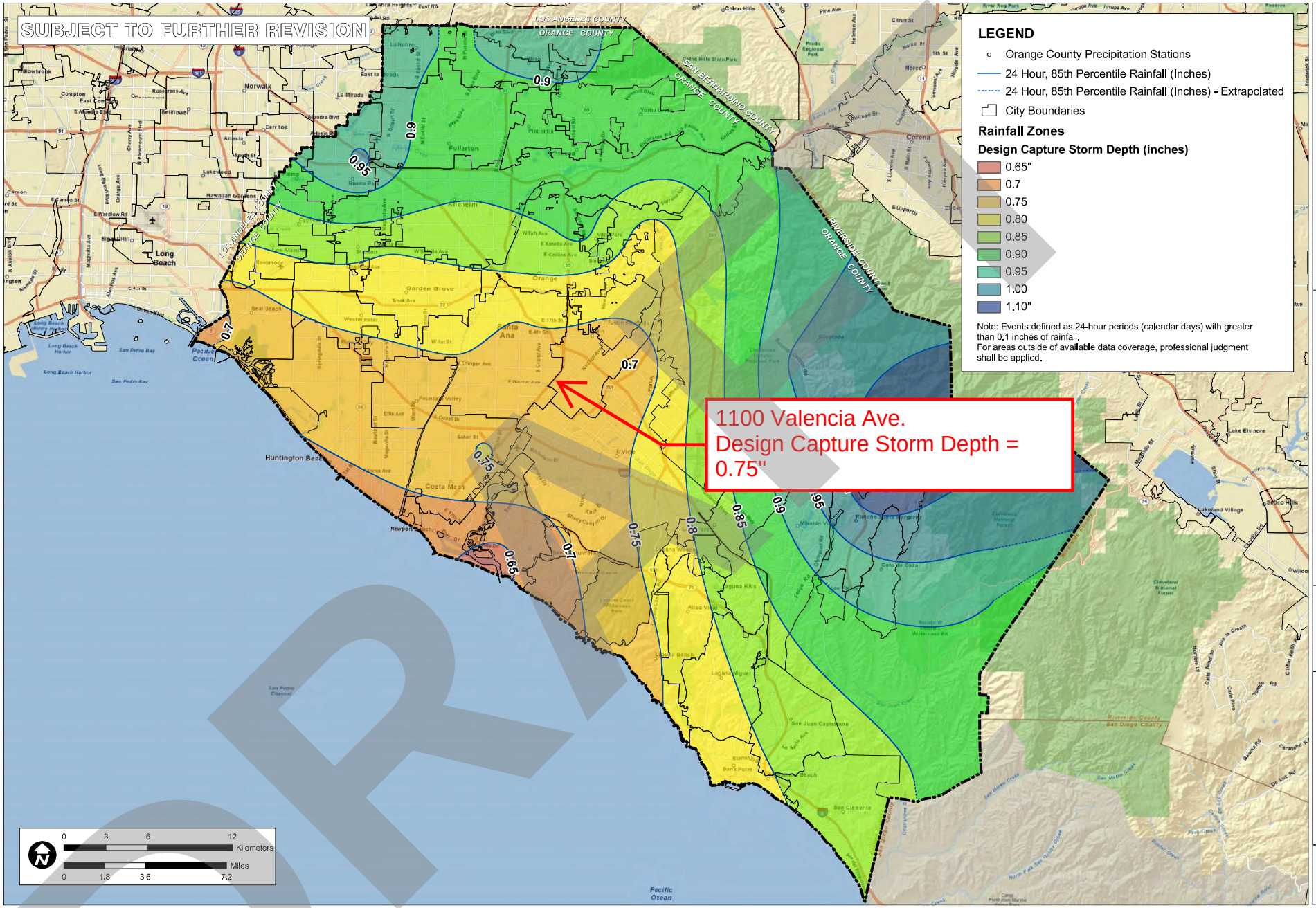
Provide drawdown time calculations per applicable BMP Fact Sheet:

Graphical Operations



Provide supporting graphical operations. See Example III.6.

DRAFT



TITLE: RAINFALL ZONES

JOB: ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT

CA

ORANGE CO.

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

PACE Advanced Water Engineering

FIGURE XVI-1

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SUBJECT TO FURTHER REVISION

LEGEND

- Depth To First Groundwater Contours
- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Note: Data are not available for South Orange County at this time.

Source:
Sprotte, Fuller and Greenwood, 1980.
California Division of Mines and Geology;
California Geological Survey

LOS ANGELES COUNTY
ORANGE COUNTY
SAN BERNARDINO COUNTY
ORANGE COUNTY
RIVERSIDE COUNTY
ORANGE COUNTY

6405 Oak Canyon

0 2 4 8 Kilometers
0 1.25 2.5 5 Miles

DRAFT

TITLE
NORTH ORANGE COUNTY
MAPPED DEPTH TO FIRST
GROUNDWATER

JOB
ORANGE CO.
ORANGE COUNTY
INFILTRATION STUDY
CA

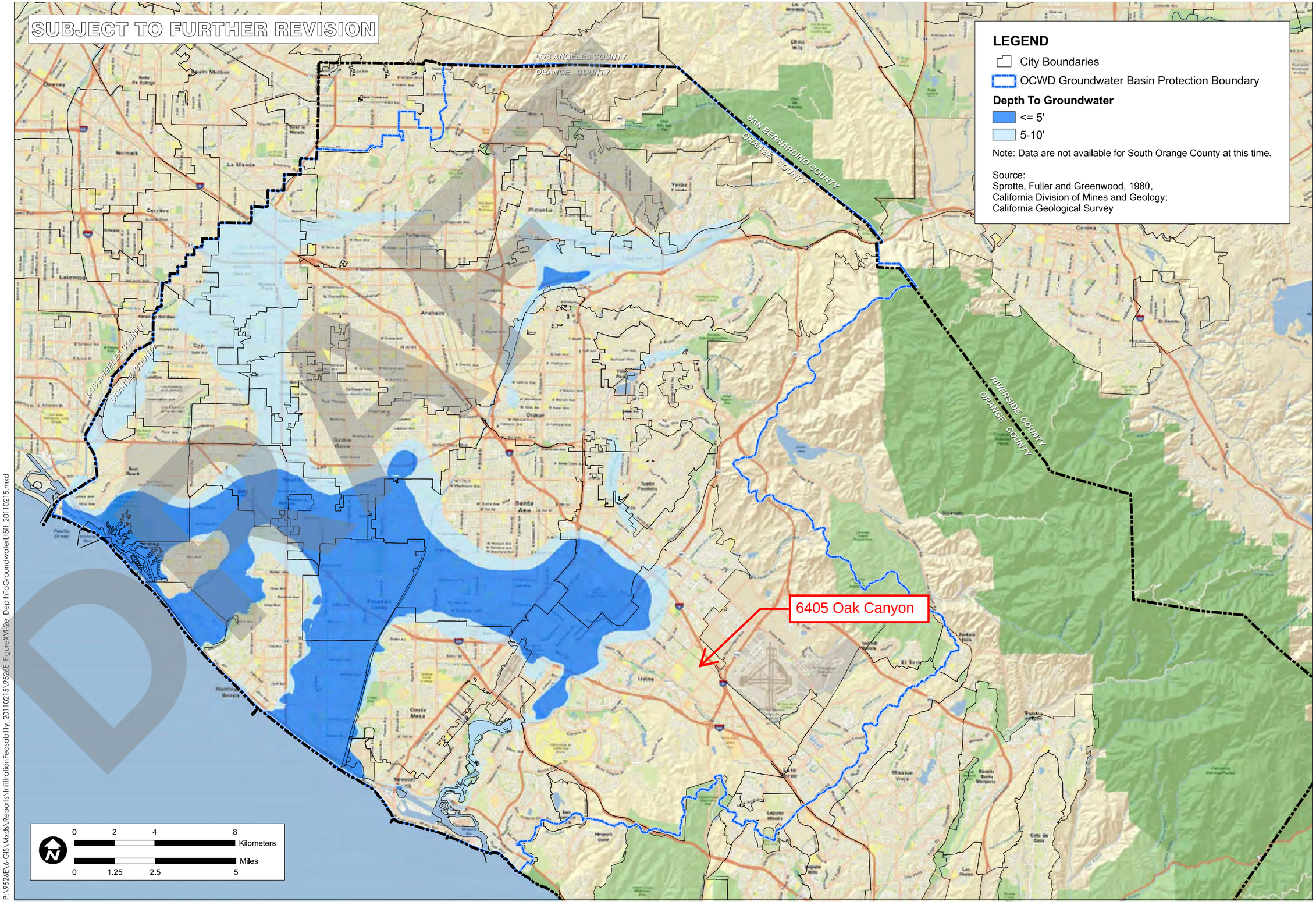
SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE
Advanced Water Engineering

FIGURE
XVI-2d

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2d_DepthToGroundwaterOverview_20110215.mxd

SUBJECT TO FURTHER REVISION



LEGEND

- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Depth To Groundwater

- <= 5'
- 5-10'

Note: Data are not available for South Orange County at this time.

Source:
Sprotte, Fuller and Greenwood, 1980.
California Division of Mines and Geology;
California Geological Survey

TITLE
NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

ORANGE COUNTY
INFILTRATION STUDY

JOB
ORANGE CO. CA

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

PACE
Advanced Water Engineering

FIGURE
XVI-2e

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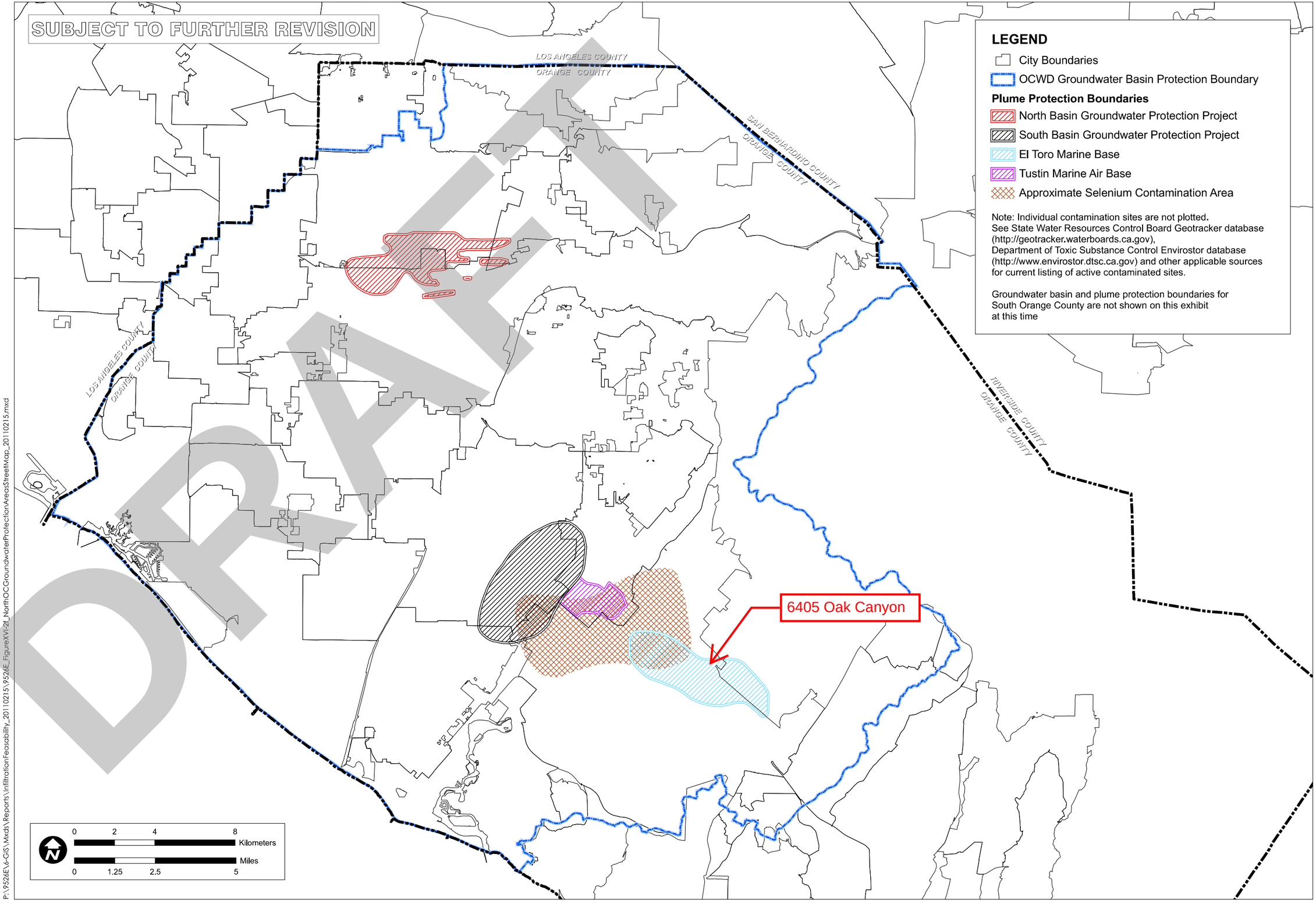
DRAFT

SUBJECT TO FURTHER REVISION



LEGEND

- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Plume Protection Boundaries

- North Basin Groundwater Protection Project
- South Basin Groundwater Protection Project
- El Toro Marine Base
- Tustin Marine Air Base
- Approximate Selenium Contamination Area

Note: Individual contamination sites are not plotted.
See State Water Resources Control Board Geotracker database (http://geotracker.waterboards.ca.gov), Department of Toxic Substance Control Envirostor database (http://www.envirostor.dtsc.ca.gov) and other applicable sources for current listing of active contaminated sites.

Groundwater basin and plume protection boundaries for South Orange County are not shown on this exhibit at this time

TITLE
NORTH ORANGE COUNTY GROUNDWATER PROTECTION AREAS

JOB
ORANGE CO. INFILTRATION STUDY
ORANGE CO.
CA

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

PACE
Advanced Water Engineering

FIGURE
XVI-2f

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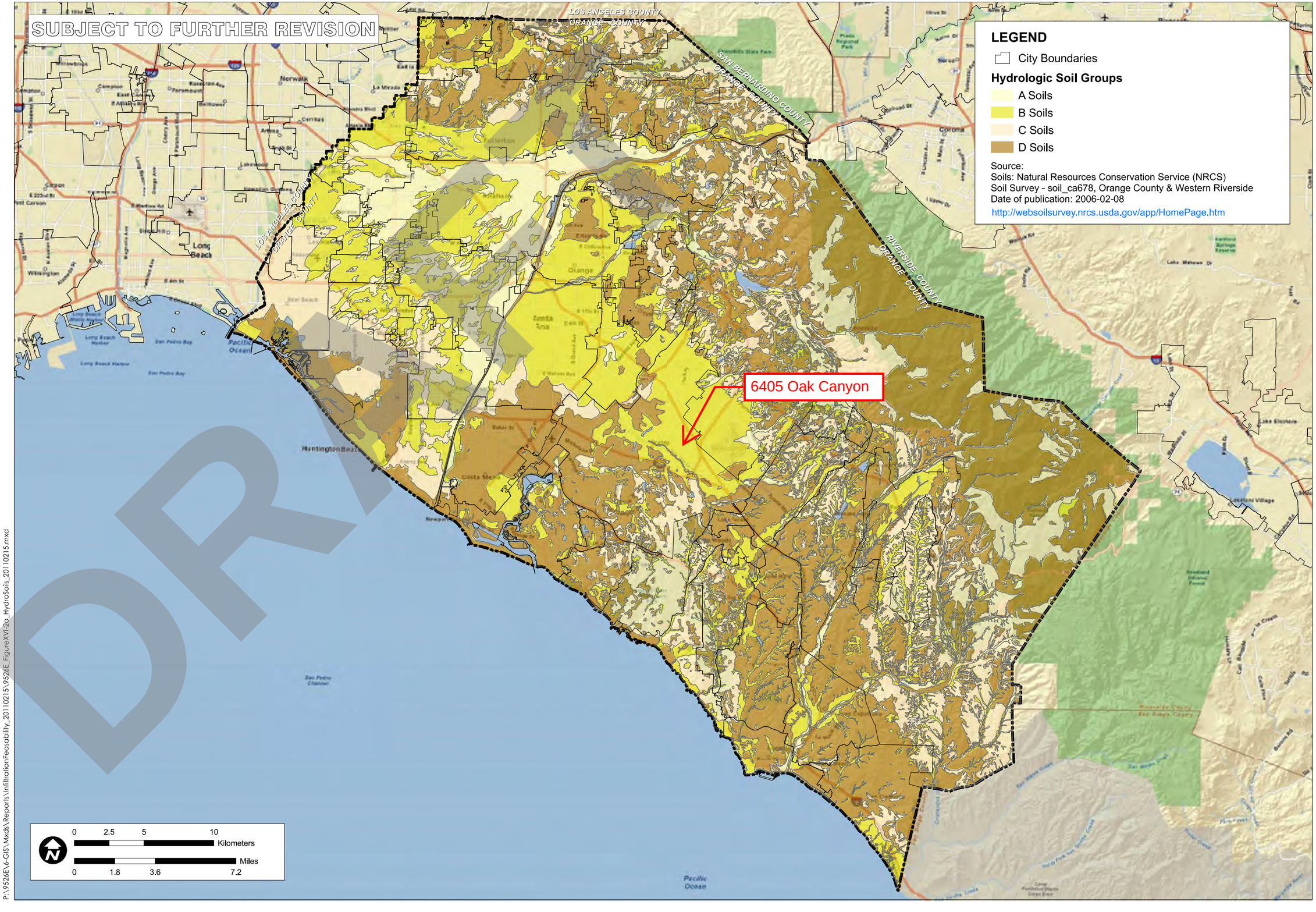
DRAFT

SUBJECT TO FURTHER REVISION



LEGEND

City Boundaries

Hydrologic Soil Groups

- A Soils
- B Soils
- C Soils
- D Soils

Source:
Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

TITLE
NRCS HYDROLOGIC SOILS GROUPS

ORANGE COUNTY
INFILTRATION STUDY

CA

JOB
ORANGE CO.

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

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Advanced Water Engineering

FIGURE
XVI-2a

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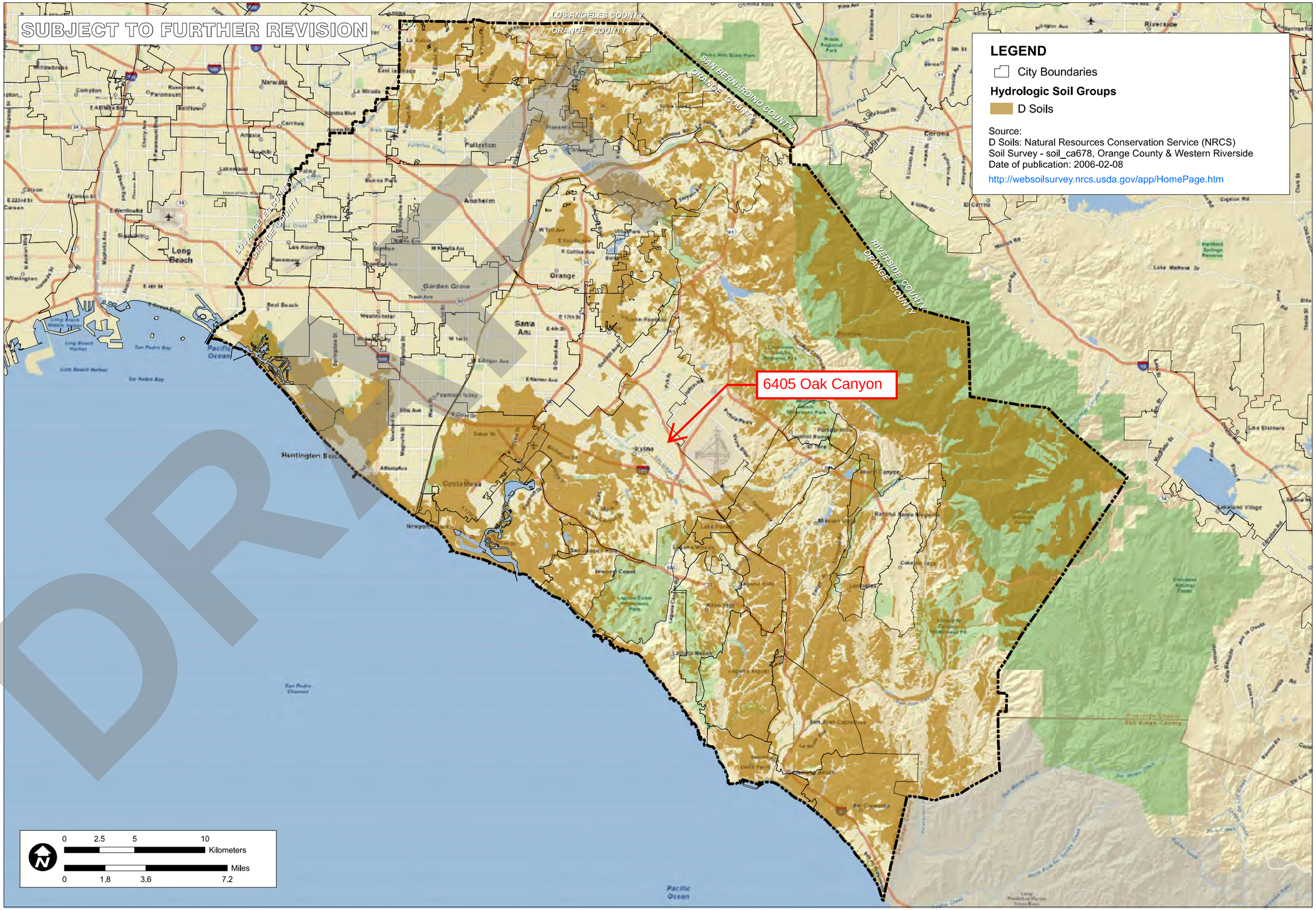
DRAFT

SUBJECT TO FURTHER REVISION



LEGEND

City Boundaries

Hydrologic Soil Groups

D Soils

Source:
D Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08

http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

0 2.5 5 10 Kilometers

0 1.8 3.6 7.2 Miles

TITLE

HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

ORANGE COUNTY
INFILTRATION STUDY

CA

JOB

ORANGE CO.

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

PACE
Advanced Water Engineering

FIGURE

XVI-2b

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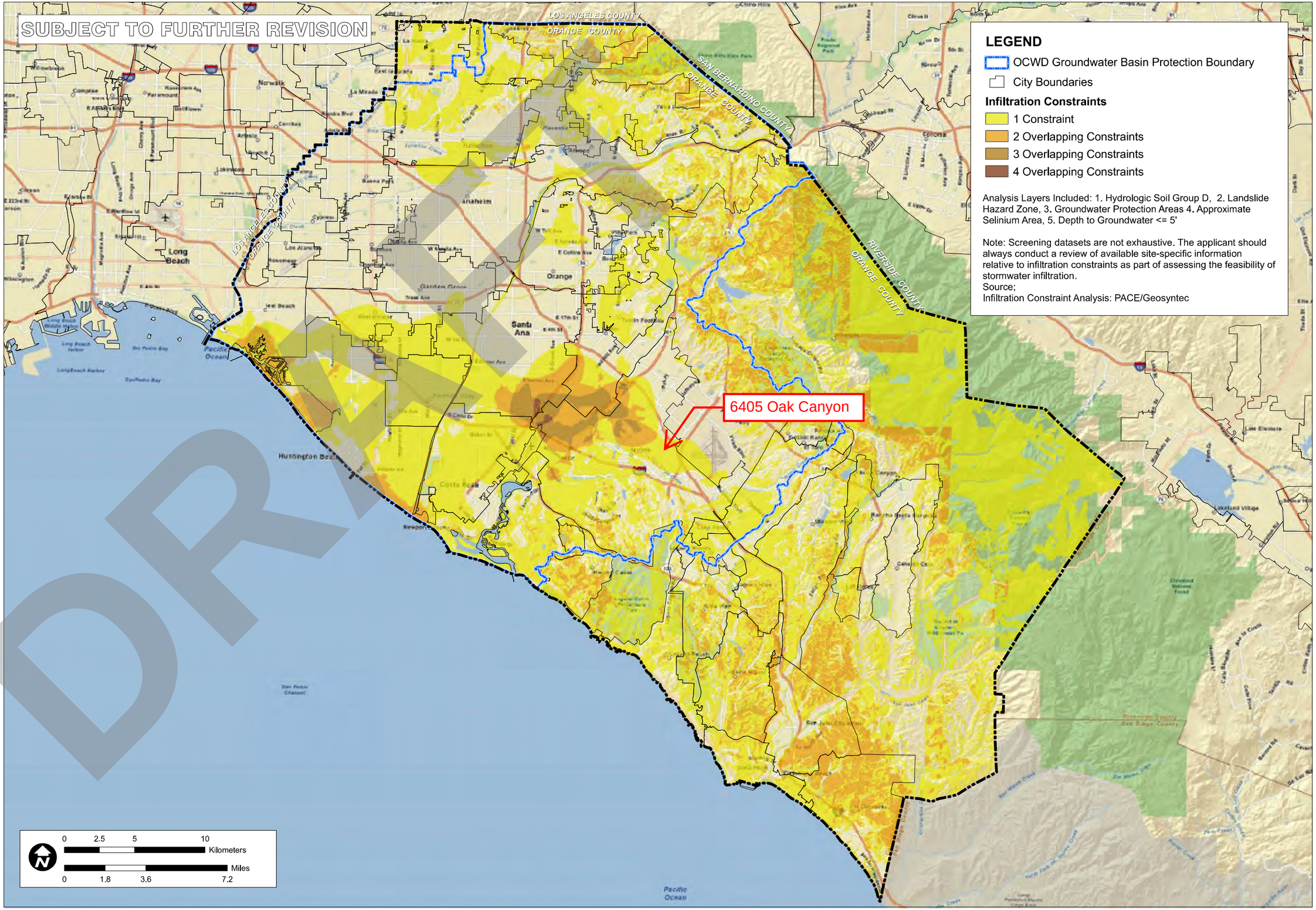
DRAFT

SUBJECT TO FURTHER REVISION



LEGEND

- OCWD Groundwater Basin Protection Boundary
- City Boundaries

Infiltration Constraints

- 1 Constraint
- 2 Overlapping Constraints
- 3 Overlapping Constraints
- 4 Overlapping Constraints

Analysis Layers Included: 1. Hydrologic Soil Group D, 2. Landslide Hazard Zone, 3. Groundwater Protection Areas 4. Approximate Selinium Area, 5. Depth to Groundwater <= 5'

Note: Screening datasets are not exhaustive. The applicant should always conduct a review of available site-specific information relative to infiltration constraints as part of assessing the feasibility of stormwater infiltration.
Source;
Infiltration Constraint Analysis: PACE/Geosyntec

0 2.5 5 10 Kilometers
0 1.8 3.6 7.2 Miles

TITLE
INFILTRATION ANALYSIS
OVERLAPPING CONSTRAINT LOCATIONS

JOB
ORANGE COUNTY
INFILTRATION STUDY
CA
ORANGE CO.

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

PACE
Advanced Water Engineering

FIGURE
XVI-2g

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Susceptibility

Potential Areas of Erosion, Habitat, & Physical Structure Susceptibility

Channel Type

- Earth (Unstable)
- Earth (Stabilized)
- Stabilized

Tidal Influence

- <= Mean High Water Line (4.28')

Water Body

- Basin
- Dam
- Lake
- Reservoir

Other Lands

- Airport/Military

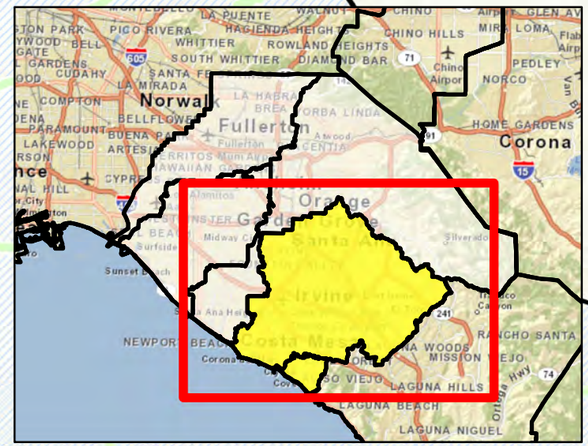
AnaheimBay-HuntingtonHarbor Watershed

Santa Ana River Watershed

Santa Ana River Watershed

South Orange County

El Modena-Irvine Retarding Basin
Lower Peters Canyon Retarding Basin
Eastfoot Retarding Basin
Orchard Estates Retention Basin
Hicks Canyon Retarding Basin
Rattlesnake Reservoir
East Hicks Canyon Retarding Basin
Siphon Reservoir
Bee Canyon Retarding Basin
Round Canyon Retarding Basin
Trabuco Retarding Basin
Marshburn Retarding Basin
Agua Chinon Retarding Basin
6405 Oak Canyon
North Lake
South Lake
Basin Number 2
Basin Number 1
Sand Canyon Reservoir
Laguna Reservoir
Bonita Canyon Reservoir
San Joaquin Reservoir
Big Canyon Reservoir
Harbor View Dam
Village Pond Park
John Wayne Airport



0 9,000 18,000 Feet

DRAFT

TITLE: SUSCEPTIBILITY ANALYIS NEWPORT BAY-NEWPORT COASTAL STREAMS

JOB: ORANGE COUNTY WATERSHED MASTER PLANNING ORANGE CO. CA

SCALE	1" = 12000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE 4

P:\9526E\6-GIS\Mxds\SuceptabilityMaps_20100505\9526E_NewportBaySusceptibility_20100430.mxd

Ocean Standards

STATE WATER QUALITY PROTECTION AREAS OF SPECIAL BIOLOGICAL SIGNIFICANCE

California's Marine State Water Quality Protection Areas

This pamphlet contains information on the Areas of Special Biological Significance, including legal descriptions, maps, and applicable Board resolutions, including exceptions. The document presented is the June 2003 publication, with electronic revisions as of October 2003. For a black and white hard copy of this document, contact Dominic Gregorio, Ocean Standards Unit, Division of Water Quality.

Maps and Photos of Areas of Special Biological Significance (pages 11-62 of the above document)

Page Nos.	Maps, Photos and Information	County	Region No.	SWRCB Resolution No.	ASBS No.
11-14	Redwoods National Park (Reconnaissance Report) (Map) (Picture) (Panoramic) • Northern Section (Map) • Central Section (Map) • Southern Section (Map)	Del Norte and Humboldt	1	74-28	8
15	Trinidad Head Kelp Beds (Reconnaissance Report) (Map) (Picture) (Panoramic)	Humboldt	1	74-28	6
16-19	Kings Range National Conservation Area (Reconnaissance Report) (Map) (Picture) (Panoramic) • Northern Section (Map) • Central Section (Map) • Southern Section (Map)	Humboldt and Mendocino	1	74-28	7
20	Pygmy Forest Ecological Staircase (Map) (Picture)	Mendocino	1	74-28	1
21	Saunders Reef Kelp Beds (Reconnaissance Report) (Map) (Picture)	Mendocino	1	74-28	5
22	Del Mar Landing Ecological Reserve (Map) (Picture)	Sonoma	1	74-28	2
23	Gerstle Cove (Reconnaissance Report) (Map) (Picture)	Sonoma	1	74-28	3
24	Bodega Marine Life Refuge (Reconnaissance Report) (Map) (Picture)	Sonoma	1	74-28	4
25	Bird Rock (Reconnaissance Report) (Map) (Picture)	Marin	2	74-28	14
26		Marin	2	74-28	12

DRAFT

	Point Reyes Headland Reserve and Extension (Map) (Picture) (Panoramic)				
27	Double Point Reconnaissance Report) (Map) (Picture)	Marin	2	74-28	13
28	Duxbury Reef Reserve and Extension (Reconnaissance Report) (Map) (Picture) (Picture) (Picture)	Marin	2	74-28	11
29-31	Farallon Island (Reconnaissance Report) (Map) (Picture) • Northern Section (Map) • Southern Section (Map)	San Francisco	2	74-28	10
32	James V. Fitzgerald Marine Reserve (Map) (Picture) (Picture)	San Mateo	2	74-28	9
33	Ano Nuevo Point and Island (Map) (Picture)	San Mateo	3	74-28	15
34	Pacific Grove Marine Gardens Fish Refuge and Hopkins Marine Life Refuge (Reconnaissance Report) (Map) (Picture)	Monterey	3	74-28	19
35	Carmel Bay (Reconnaissance Report) (Map) (Picture) (Panoramic)	Monterey	3	75-61	34
36	Point Lobos Ecological Reserve (Map) (Picture) (Panoramic)	Monterey	3	74-28	16
37	Julia Pfeiffer Burns Underwater Park (Map) (Picture)	Monterey	3	74-28	18
38	Ocean Area Surrounding the Mouth of Salmon Creek (Map) (Picture)	Monterey	3	74-28	20
39-42	San Miguel, Santa Rosa, and Santa Cruz Islands (Map) • San Miguel Island (Reconnaissance Report) (Map) • Santa Rosa Island (Reconnaissance Report) (Map) (Picture) • Santa Cruz Island (Reconnaissance Report) (Map) (Picture)	Santa Barbara	3	74-28	17
43-45	Santa Barbara Island and Anacapa Island (Map) • Anacapa Island (Map) (Picture) • Santa Barbara Island (Map) (Picture)	Santa Barbara and Ventura	4	74-28	22
46-50	Mugu Lagoon to Latigo Point (Reconnaissance Report: Part A & Part B) (Map) (Panoramic) (Picture) (Picture) (Picture) • Western Section (Map) • West Central Section (Map) • East Central Section (Map) • Eastern Section (Map)	Ventura and Los Angeles	4	74-28	24
51	San Nicolas Island and Begg Rock (Map) (Picture)	Ventura	4	74-28	21
52-53	Santa Catalina Island (Map)	Los Angeles	4	74-28	25

DRAFT

	• Subarea One, Isthmus Cove to Catalina Head (Reconnaissance Report) (Map) (Picture)				
54	Santa Catalina Island (Map) • Subarea Two, North End of Little Harbor to Ben Weston Point (Reconnaissance Report) (Map)	Los Angeles	4	74-28	26
55	Santa Catalina Island (Map) • Subarea Three, Farnsworth Bank Ecological Reserve (Reconnaissance Report) (Map)	Los Angeles	4	74-28	27
56	Santa Catalina Island (Map) • Subarea Four, Binnacle Rock to Jewfish Point (Reconnaissance Report) (Map)	Los Angeles	4	74-28	28
57	Newport Beach Marine Life Refuge (Reconnaissance Report) (Map) (Picture)	Orange	8	74-32	32
58	Irvine Coast Marine Life Refuge (Reconnaissance Report) (Map) (Picture) (Picture)	Orange	8 & 9	74-32	33
59	Heisler Park Ecological Reserve (Map) (Picture)	Orange	9	74-28	30
60	San Clemente Island (Map) (Picture)	Los Angeles	4	74-28	23
61	San Diego Marine Life Refuge (Reconnaissance Report) (Map) (Picture)	SanDiego	9	74-28	31
62	San Diego-La Jolla Ecological Reserve (Reconnaissance Report) (Map) (Picture) (Picture)	San Diego	9	74-28	29

Questions or Comments?

For more information on Areas of Special Biological Signficance, contact Dominic Gregorio, Ocean Standards Unit, Division of Water Quality.

(Updated 10/6/11)

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The California Water Boards include the State Water Resources Control Board and nine Regional Boards
The State Water Board is one of six environmental entities operating under
the authority of the California Environmental Protection Agency
Cal/EPA | ARB | CalRecycle | DPR | DTSC | OEHHA | **SWRCB**

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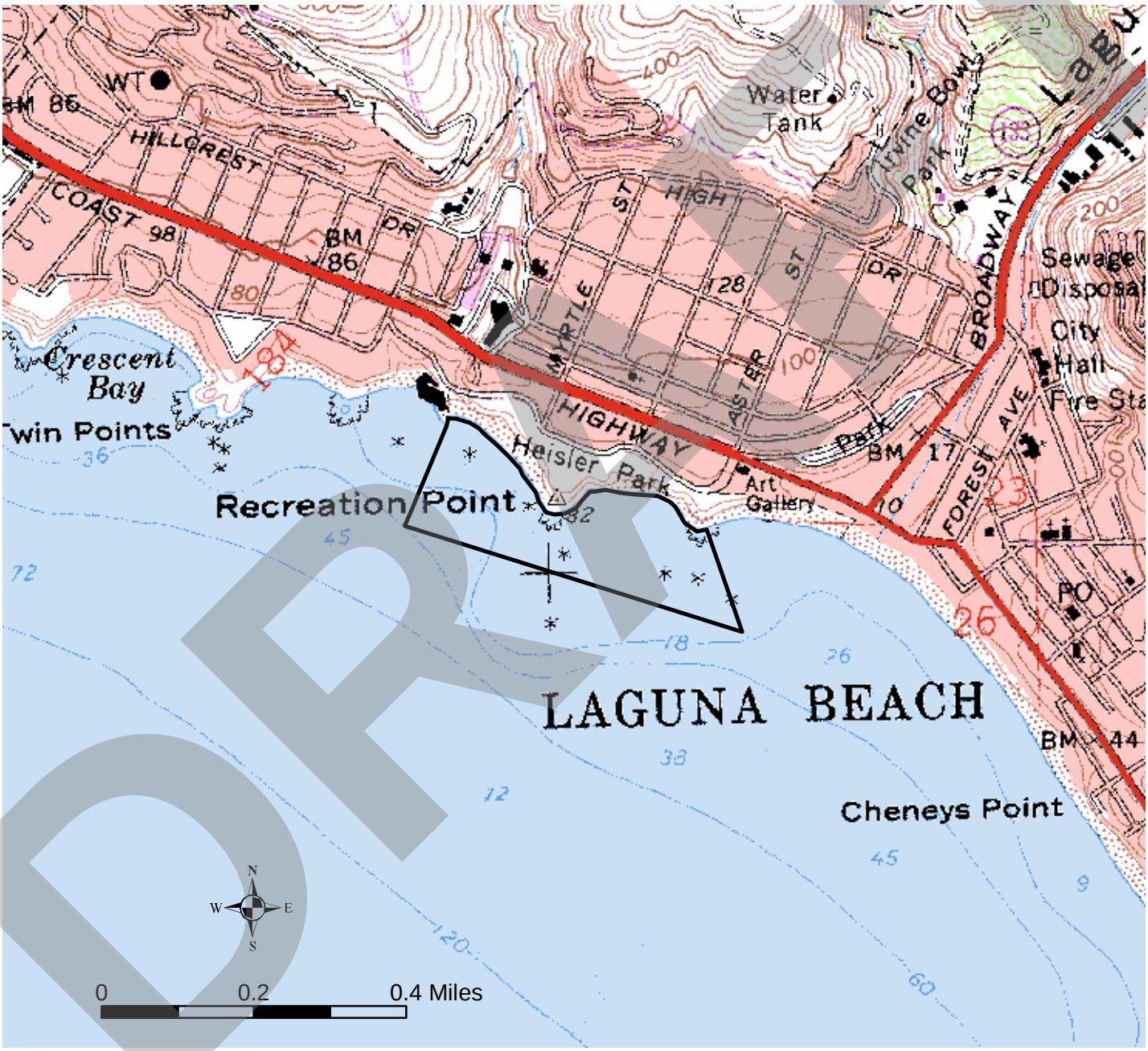
San Diego Regional Water Quality Control Board

State Water Quality Protection Area
Area of Special Biological Significance No. 30
Heisler Park Ecological Reserve



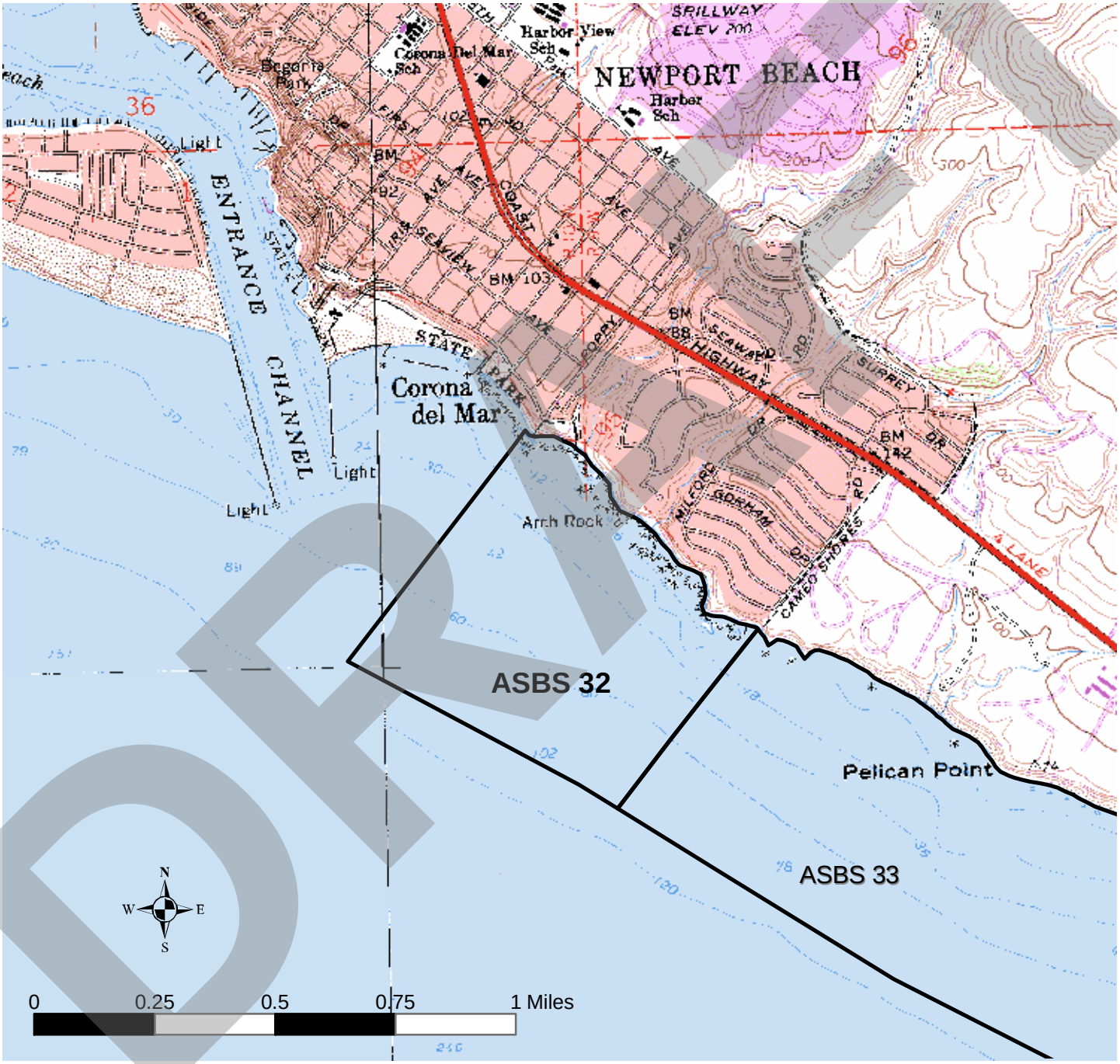
DRAFT

Ref. Map: USGS Laguna Beach, CA

D. E. Gregorio
C. S. Bianchi
Division of Water Quality
January 2003

Santa Ana Regional Water Quality Control Board

State Water Quality Protection Area
Area of Special Biological Significance No. 32
Newport Beach Marine Life Refuge



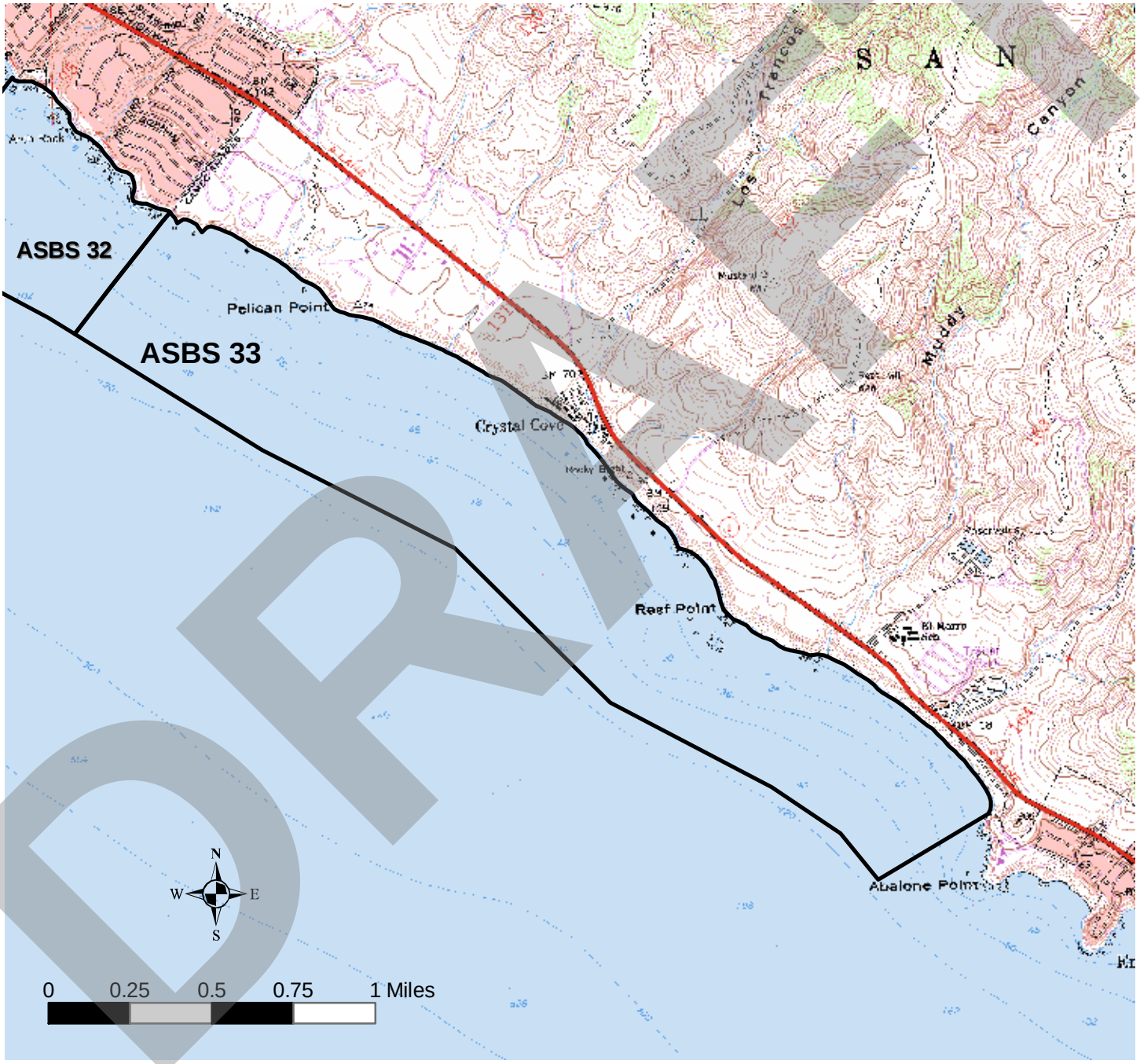
DRAFT

Ref. Map: USGS Newport Beach, CA
USGS Laguna Beach, CA

D. E. Gregorio
C. S. Bianchi
Division of Water Quality
January 2003

Santa Ana Regional Water Quality Control Board

State Water Quality Protection Area
Area of Special Biological Significance No. 33
Irvine Coast Marine Life Refuge



DRAFT

Ref. Map: USGS Laguna Beach, CA

D. E. Gregorio
C. S. Bianchi
Division of Water Quality
January 2003

ATTACHMENT D

LONG TERM AGREEMENTS FOR IMPLEMENTATION AND MAINTENANCE

(OPERATIONS AND MAINTENANCE PLAN)

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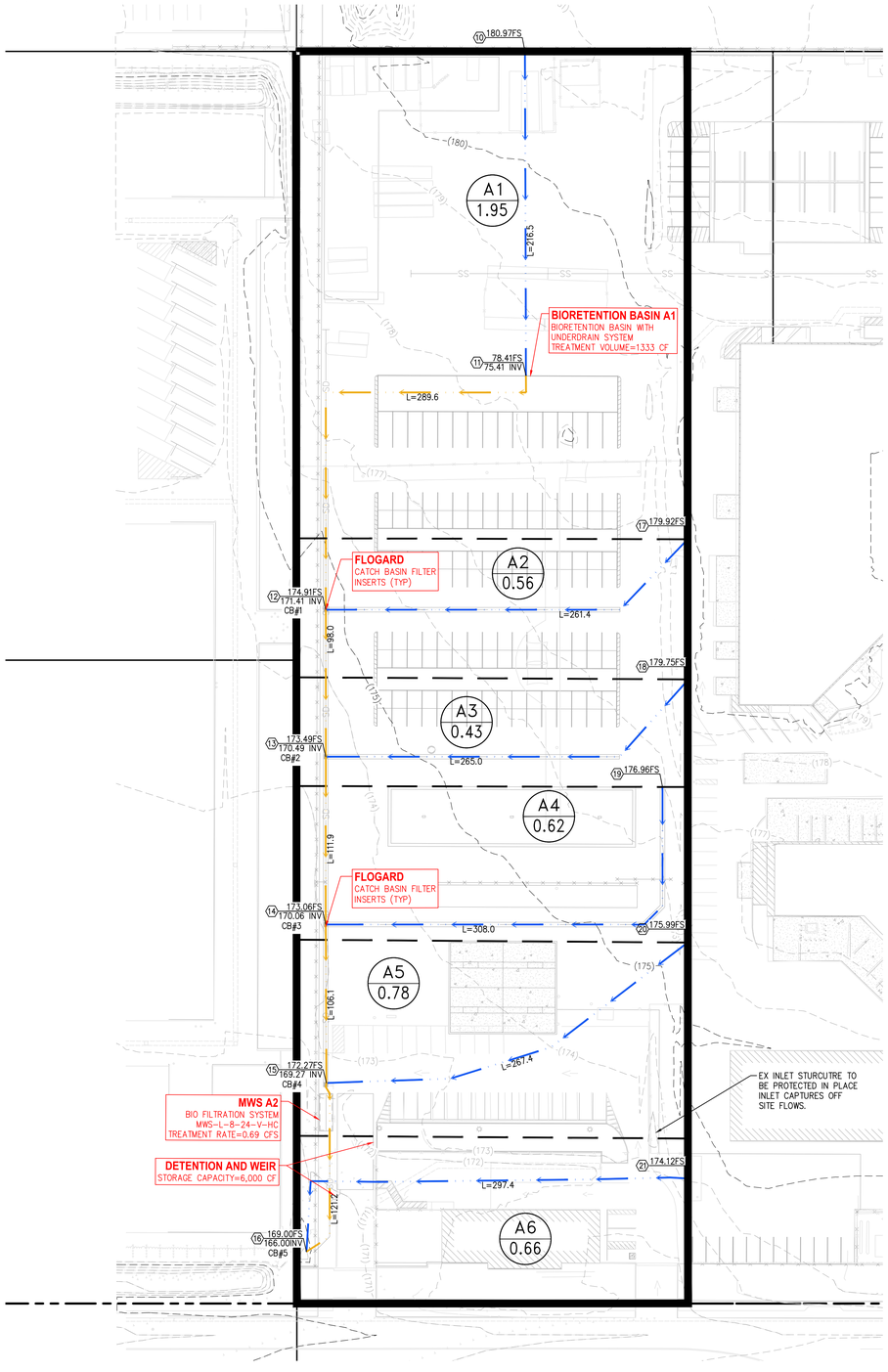
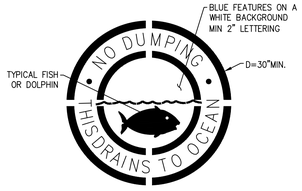




NOTE: STORM DRAIN IS A PRIVATE SYSTEM. ALL STORM DRAIN INLETS (CATCH BASINS) THAT DISCHARGE INTO AN EXISTING OR PROPOSED STORM DRAIN SHALL BE MARKED (LABELED) WITH THE ABOVE NOTATION TO DISCOURAGE ILLEGAL DUMPING OF POLLUTANTS.

78 STORM DRAIN INLET MARKING
NTS

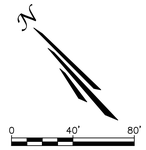
SOURCE CONTROL BMPs:

- S1 PROVIDE STORM DRAIN SYSTEM STENCILING & SIGNAGE.
- S3 DESIGN AND CONSTRUCT TRASH AND WASTE STORAGE AREAS TO REDUCE POLLUTION INTRODUCTION.
- S4 USE EFFICIENT IRRIGATION SYSTEMS & LANDSCAPE DESIGN, WATER CONSERVATION, SMART CONTROLLERS, AND SOURCE CONTROL.
- N3 COMMON AREA LANDSCAPE MANAGEMENT.
- N11 COMMON AREA LITTER CONTROL
- N14 COMMON AREA CATCH BASIN INSPECTION.
- S11 FUELING AREA INSPECTION.

LEGEND

- DRAINAGE AREA BOUNDARY
- DRAINAGE SUB-AREA BOUNDARY
- SUB-AREA FLOW PATH
- STORM DRAIN FLOW PATH
- EXISTING STORM DRAIN LINE
- C1 / X — SUBAREA ID
- SUBAREA ACREAGE
- XX 1000.00 FS / 1000.00 INV — NODE ELEVATION

NOTE:
INVERTS HAVE BEEN ASSUMED AT CONCEPTUL STAGE AND WILL BE VERIFIED PRIOR TO FINAL DESIGN



NO.	DESCRIPTION	BY	DATE	CHK
	REVISIONS			

NO.	DESCRIPTION	BY	DATE	CHK
	REVISIONS			

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6427 OAK CANYON RD.
THE CITY OF IRVINE
IRVINE, CA 92618

DRAWN: CD
DATE: 02/28/2022
CHECKED: JV
DATE: 02/28/2022
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DATE: DATE
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Operations and Maintenance (O&M) Plan

Water Quality Management Plan
for

City of Irvine

1 Civic Center Plaza

Irvine, CA 92606

DRAFT

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
	Non-Structural Source Control BMPs		
Yes	**N1. Education for Property Owners, Tenants and Occupants** The owner shall prepare a training manual along with the Operations and Maintenance Manual for all existing and future employees. The manual shall include information regarding proper practices that contribute to the protection of the stormwater quality. Training shall be provided upon hire of new associates. A copy of the training manual shall remain in the building at all times for employees to use as needed. The manual shall include all Educational Materials. Additional education material may be found in the following website : http://www.ocwatershed.com/PublicEd/resources/business-brochures.html	Quarterly. Training shall be provided upon hire and regular intervals thereafter.	Owner
Yes	**N2. Activity Restrictions** The property owner shall ensure that the rules and guidelines as determined on the project conditions of approval or other policies are followed at all times once the project is operations. Prohibited activities for the project that promoted water quality includes: Prohibit discharges of fertilizer, pesticides, or animal wastes to streets or storm drains. Prohibit blowing or sweeping of debris (leaf litter, grass clippings, litter, etc.) into streets or storm drains. Requirement to keep dumpster lids closed at all times. Prohibit vehicle washing, maintenance, or repair on the premises or restrict those activities to designated areas.	Ongoing	Owner

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BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N3. Common Area Landscape Management** Ongoing maintenance is conducted to minimize erosion and over-irrigation, conserve water and reduce pesticide and fertilizer applications. All maintenance must be consistent with the City of Fullerton requirements. Proper maintenance practices should help reduce and/or eliminate pollution from pesticides, nutrients, trash/debris and sediments. The project common area landscape maintenance should be consistent with the following documents included in Attachment A: • Building and Ground Maintenance Guidelines • Housekeeping practices • Plaza and sidewalk cleaning Landscape maintenance	Weekly	Owner
Yes	**N4. BMP Maintenance** Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be maintained by the responsible party and documented with the WQMP, and shall be available for review upon request.	Ongoing	Owner
No	**N5. Title 22 CCR Compliance**		
No	**N6. Local Water Quality Permit Compliance**		

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BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N7. Spill Contingency Plan** The owner shall develop a spill contingency plan. Owner shall ensure adequate spill/leak prevention measures are stored on-site and employees are made aware of their location. Owner shall ensure adequate training on spill response procedures, cleanup procedures, and reporting. This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills. Refer to Attachment A "IC17" for additional information on Inspection/Maintenance procedures and activities.	Yearly Training of Employees & Every time handling of hazardous materials is required	Owner
No	**N8. Underground Storage Tank Compliance**		
Yes	**N9. Hazardous Materials Disclosure Compliance** The owner is responsible for obtaining the required permits for the use and transportation of hazardous materials. Permits may be required from the County of Orange Health Department, City of Fullerton and other local authorities.	Every time handling of hazardous materials is required.	Owner
Yes	**N10. Uniform Fire Code Implementation** The owner is responsible for complying with the Orange County Fire Department requirements regarding proper management of hazardous materials and emergency response plans. An inventory of hazardous materials should be maintained on-site and an emergency response plans should be established.	Procedures shall be established prior to building occupancy.	Owner
Yes	**N11. Common Area Litter Control** The Owner will be required to implement trash management and litter control procedures in the common areas aimed at reducing pllution of drainage water. The Owner may contract with their landscape maintenace firm to provide this service with regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations and reporting the violations to the Owner for investigation	Ongoing	Owner

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BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**N12. Employee Training** The owner shall prepare a training manual for all existing and future employees. The manual shall include information regarding proper practices that contribute to the protection of the stormwater quality. Training shall be provided upon hire of new associates. A copy of the training manual shall remain in the building at all times for employees to use as needed. The manual shall include all Educational Materials. Additional education material may be found in the following website : http://www.ocwatershed.com/PublicEd/resources/business-brochures.html	Quarterly. Training shall be provided upon hire and regular intervals thereafter.	Owner
Yes	**N13. Housekeeping of Loading Docks** The owner shall conduct regular inspections and make repairs and improvements as necessary. Check loading and unloading equipment regularly for leaks. Conduct regular broom dry-sweeping of area. Do not wash with water.	Weekly	
Yes	**N14. Common Area Catch Basin Inspection** The Owner must ensure that the on-site drain inlets, grates, and drain pipes will be periodically inspected visually. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. If necessary, clean, repair, or replace any drainage facility prior to the start of each rainy season (no later than October 15 of each year). 80% of private facilities shall be inspected and cleaned annually, with 100% of private facilities inspected and maintained within a 2-year period. Also refer to "Drainage System Maintenance" in Attachment A.	Monthly -Before and after predicted storm events -Prior to the start of the rainy season.	Owner
Yes	**N15. Street Sweeping Private Streets and Parking Lots** The Owner must sweep outdoor lots regularyly (minimum monthly), or as needed to maintain parking lot surface without trash, debris, or other removable solids, and prior to the storm season (no later than October 15 each year). Sweeping shall be done with a vacuum-type sweeper. Under no circumstances are outdoor areas/lots to be rinsed or washed with water unless said rinse/wash water is collected and disposed of properly (i.e. into the sewer).	Monthly	Owner
Structural Source Control BMPs			

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BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S1. Provide Storm Drain System Stenciling and Signage** All catch basins/inlets/outlets/parkway drains on site must be marked using the City's "No Dumping – Drains to Ocean" curb marker or stenciled using an approved stencil to paint this message on the top of curb directly above the inlet, and on one side of the curb face. Labeling for catch basins & parkway drains is to be inspected regularly and maintained so as to be reasonably legible at all times. The inspection and maintenance is to be performed by the Owner. This stencil is to alert the public/employees to the destination of pollutants discharged into the storm water. See CASQA Stormwater Handbook BMP Fact Sheet SD-13 for additional information.	Annually	Owner
No	**S2. Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction**		
Yes	**S3. Design Trash Enclosures to Reduce Pollutant Introduction** The owner shall post signs on trash enclosure gates that state "Keep Dumpster Lids Closed." The Owner will monitor dumpster usage such that dumpsters are not overfilled and the dumpster lids can close completely. The Owner shall increase the trash pickup schedule as necessary to prevent dumpsters from overfilling. The Owner will observe and damage to the trash enclosure wall and any discharge from the trash storage area.	Ongoing	Owner

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BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S4. Use Efficient Irrigation Systems and Landscape Design** In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting overspray to hardscape areas to be eliminated, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, day or night time temperatures based on system specifications and local climate patterns.See CASQA Stormwater Handbook BMP Fact Sheet SD-12 for additional information S4. Use Efficient Irrigation Systems and Landscape Design implementation/maintenance activities.	Monthly	Owner
No	**S5. Protect Slopes and Channels**		
No	**S6. Loading Dock Areas**		
No	**S7. Maintenance Bays and Docks**		
No	**S8. Vehicle Wash Areas**		
No	**S9. Outdoor Processing Areas**		
No	**S10. Equipment Wash Areas**		
Yes	**S11. Fueling Areas** In conjunction with the maintenance activities and as previously discussed, Conduct regular inspections and make repairs and improvements as necessary. Check fueling equipment regularly for leaks. Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.	As needed	Owner
No	**S12. Site Design and Landscape Planning**		
No	**S13. Wash Water Controls for Food Preparation Areas**		

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BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
No	**S14. Community Car Wash Racks**		
Funding Mechanism for Maintenance of all Proposed Structural BMPs by Owner.			
Yes	**Modular Wetlands Proprietary Bio Filtration System** Refer to the manufacturer's maintenance specifications included on the following pages.	Refer to the manufacturer's maintenance specifications included on the following pages.	Owner
Yes	**Stormwater Storage System and Weir Structure (Old Castle & Jensen)** Inspections should include the following: - Removal of manhole cover - Visual inspection and measurement of sump area for sedimentation material - Visual inspection of weir structure and inlet and outlet pipes for clogging - Sedimentation and clogging material should be removed as appropriate (vacuum truck, hand removal ect.) - If any Structural damage is observed during inspection the manufacturer should be notified for recommendations.	Routine inspections should follow the inspection schedule for the city/county jurisdiction's stormwater facility inspection schedule or should occur at least once a year.	Owner
Yes	**Flogard Catch Basin Media Filter Insert** Refer to the manufacturer's maintenance specifications included on the following pages.	Refer to the manufacturer's maintenance specifications included on the following pages.	Owner

DRAFT

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**Bioretention Basin** Inspect soil and planting. Remove weeds and clear any accumulation of trash, or debris. Inspect side slopes for evidence of instability or erosion and correct as necessary. Observe bottom of ponding area for uniform percolation throughout. If portions of area do not drain within 48 hrs after the end of the storm the soil should be tilled and replanted and remove any accumulated sediment.	Monthly or after a rain event	Owner

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Required Permits

This section must list any permits required for the implementation, operation, and maintenance of the BMPs. Possible examples are:

- Permits for connection to sanitary sewer
- Permits from California Department of Fish and Game
- Encroachment permits

If no permits are required, a statement to that effect should be made.

Forms to Record BMP Implementation, Maintenance, and Inspection

The form that will be used to record implementation, maintenance, and inspection of BMPs is attached.

Recordkeeping

All records must be maintained for at least five (5) years and must be made available for review upon request.

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RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

TEMPLATE

ATTACHMENT E

CONDITIONS OF APPROVAL

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ATTACHMENT F

GEOTECHNICAL REPORT

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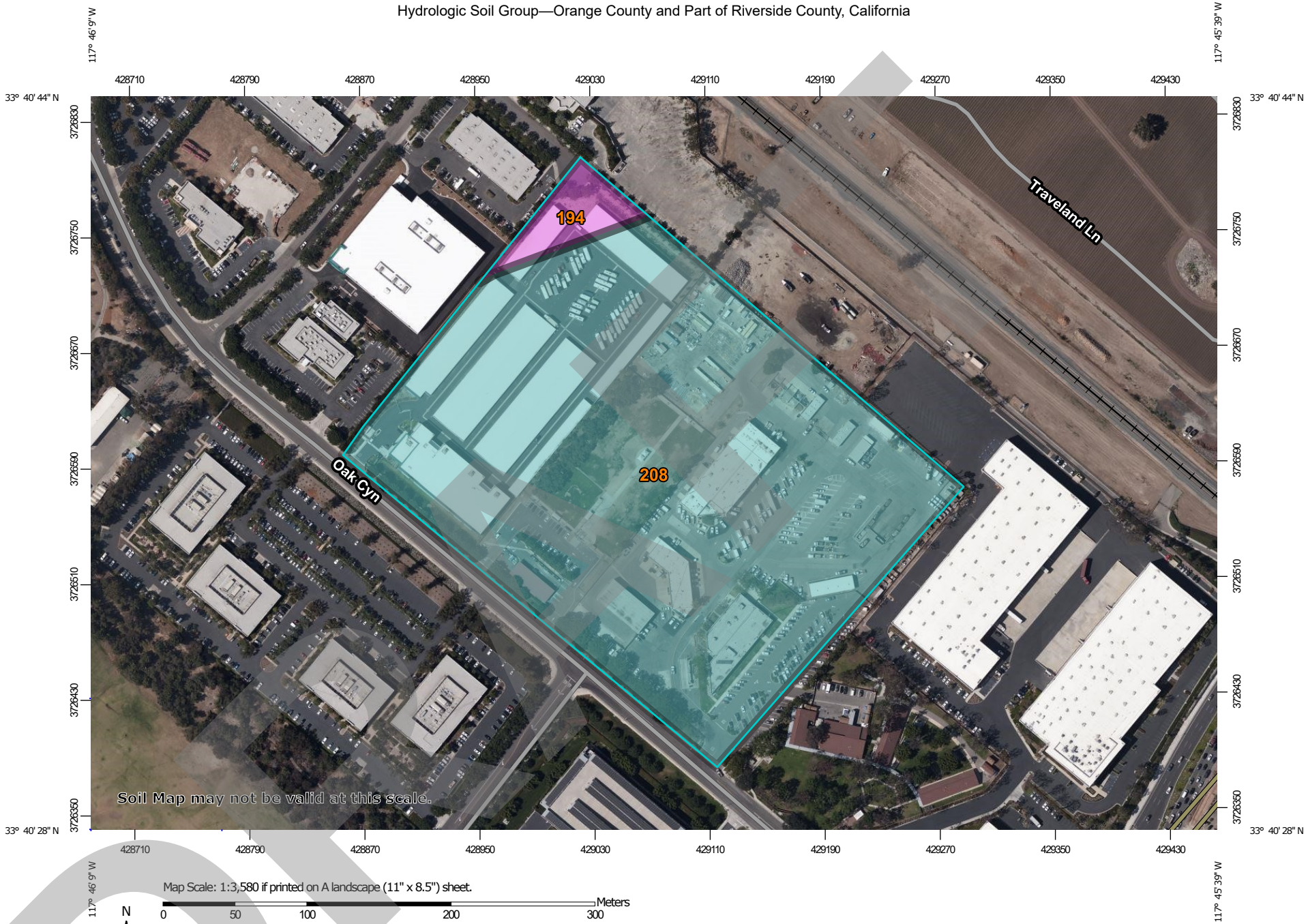

Map Scale: 1:3,580 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Orange County and Part of Riverside County, California
Survey Area Data: Version 14, May 27, 2020

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

Date(s) aerial images were photographed: Apr 11, 2018—May 5, 2018

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

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
194	San Emigdio fine sandy loam, 0 to 2 percent slopes	A	0.8	3.8%
208	Sorrento clay loam, 0 to 2 percent slopes, warm MAAT, MLRA 19	C	21.5	96.2%
Totals for Area of Interest			**22.4**	**100.0%**

Description

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

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

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

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

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

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

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

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Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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Geotechnical Investigation and
Design Recommendations,
Irvine Operations Support Facility,
6427 Oak Canyon,
Irvine, California

Prepared For

CITY OF IRVINE
c/o Griffin Structures

May 4, 2021

GMU Project No. 21-031-00

DRAFT

23241 Arroyo Vista
Rancho Santa Margarita | CA 92688
949.888.6513 | FX: 949.888.1380 | www.gmugeo.com

TRANSMITTAL

CITY OF IRVINE
c/o Griffin Structures
2 Technology Drive
Irvine, CA 92618

DATE: May 4, 2021

PROJECT: 21-031-00

ATTENTION: Mr. Tom Ottenstein

SUBJECT: Geotechnical Investigation and Design Recommendations, Irvine Operations Support Facility, 6427 Oak Canyon, Irvine, California

DISTRIBUTION:

Addressee: electronic copy

Lionakis
Attn: Brandon Rachac and Steven Kendrick (electronic copy)

DRAFT

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TABLE OF CONTENTS

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INTRODUCTION

PURPOSE

This report summarizes the results of our geotechnical investigation for the proposed Irvine Operations Support Facility (IOSF) Site Project located at 6427 Oak Canyon, Irvine, California. The purpose of our investigation was to determine the nature of the subsurface soils, evaluate their in-place characteristics, and provide geotechnical recommendations with respect to site clearing, remedial grading, and design and construction of foundations and slabs for the proposed new structures and associated exterior site improvements. The scope of work was in accordance with our Agreement for Professional Consulting Services with the City of Irvine, previously approved on June 12, 2019.

SCOPE

The scope of our geotechnical investigation, as outlined in our December 24, 2020 proposal, was as follows:

1. Researched background information pertaining to the site, including information in your files, published geologic maps by CGS and/or USGS, and any available project plans and documents.

2. Marked five (5) hollow-stem auger (HSA) drill hole locations during our initial site visit and contacted Underground Service Alert (USA/Dig Alert) in order to provide advance notification of the subsurface drill holes planned within the subject site.

3. Performed a field subsurface exploration program consisting of advancing two HSA drill holes to a depth of approximately 51 feet, one HSA drill hole to a depth of approximately 21.5 feet, and two HSA drill holes to a depth of 11.5 feet within/near the footprint of the proposed prefabricated metal structures and above-ground tanks. Logged all field exploration work and obtained soil samples for geotechnical laboratory testing.

4. Performed laboratory testing on the soil samples obtained from the drill holes. Testing included in-situ moisture content and density, particle size distribution, maximum density and optimum moisture content, expansion index, shear strength characteristics, consolidation with one time rate, R-value, and full chemical analysis.

5. Interpreted and evaluated the field and laboratory data collected from our investigation and incorporated it with the previous data. Performed geotechnical engineering design analyses which included geologic hazards and seismicity study, settlement analysis, bearing capacity, lateral earth pressure, liquefaction analysis, seismic analysis in accordance with the American Society of Civil Engineers (ASCE) 7-16 standards, and pavement analysis.

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6. Reviewed the reference (1) conceptual site plan showing the planned site improvements.

7. Prepared this formal geotechnical report for the proposed IOSF Site Project presenting our final geotechnical conclusions and recommendations to support the proposed new structures and associated exterior site improvements.

LOCATION

The IOSF Site Project is located at 6427 Oak Canyon within the City of Irvine, California. The general location of the project site is shown on Plate 1 – Location Map.

SITE DESCRIPTION

Currently, the subject site is occupied by a dog park and an operations support facility for the City of Irvine consisting of six buildings, a fueling station, and several storage and shade structures. The majority of the facility buildings are either completely or partially surrounded by either concrete flatwork or asphalt pavement while the dog park is covered by dirt and grass with trees along the western side. The Operations Support Facility building within the southeast portion of this site is surrounded by landscaping that consists of lawns and planter areas that contain shrubs and trees. The subject site is relatively flat, with only minor changes in grade.

PROJECT DESCRIPTION

The City of Irvine is planning to remove the existing dog park and a portion of the adjacent parking lot to the south to construct a fueling station with fuel islands and above ground tanks and a new parking area covered by solar panel canopies. Other parking areas within the site will also be reconfigured with solar panel canopies. Site improvements will also include a new canopy to replace the existing canopy along the west side of the Operations building, new pre-fabricated metal structures within the northeast and northwest portions of the site, new yard lighting throughout the site, a new dog path trail with lighting along the perimeter of the site, and new security gates.

A new detention basin will be constructed to treat surface runoff prior to discharging to a permanent drainage device. Infiltration at the site is not permitted due to the site being located within the El Toro Groundwater Plume area. Final grades of all improvements, excluding the detention basin, are planned to be near existing grades. The planned improvements are shown on Plate 2 – Geotechnical Map which uses the reference (1) concept site plan as the base map.

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SUBSURFACE EXPLORATION

GMU conducted a field investigation program to characterize the subsurface soils in the vicinity of the proposed structures and site improvements. A total of five (5) hollow-stem auger (HSA) exploratory borings were performed to a maximum depth of 51 feet below ground surface (bgs). Relatively undisturbed Modified California samples and Standard Penetration Test (SPT) samples were obtained from the drill holes alternating every 5 feet for visual classification and laboratory testing. Groundwater was not encountered during our investigation.

The locations of our drill holes are shown on the attached Plate 2 – Geotechnical Map. The logs of our drill holes are included in Appendix A.

LABORATORY TESTING

Laboratory testing was performed on bulk and relatively undisturbed samples collected from the exploratory drill holes during our recent subsurface exploration. Testing on soil samples included the following:

- In-situ moisture and density;
- Sieve analysis;
- Maximum density and optimum moisture content;
- Expansion index;
- Consolidation;
- Direct shear tests;
- R-value; and
- Corrosion (pH, resistivity, chlorides, soluble sulfates)

The results of our laboratory testing are summarized on Table B-1 included in Appendix B.

GEOLOGIC FINDINGS

REGIONAL GEOLOGIC SETTING

The general location of the site is positioned in the southeastern portion of the Central Block of the Los Angeles Basin within an area known as the Tustin Plain (CDMG, 1980). Locally, the site exists on a series of coalescing alluvial fans between the Santa Ana Mountains and the San Joaquin

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Hills. Review of the available logs, documents, and literature indicates the site is underlain predominantly by engineered fill (Qaf) and younger alluvial fan deposits (Qyfa) (USGS, 2006).

SUBSURFACE MATERIALS

Engineered Fill (Qaf)

Fill soils were encountered in all of the borings drilled within the site and consist of dark brown to brown, damp to moist, medium dense silty to clayey sands, and soft to firm sandy clays. The fills were placed as part of the previous grading operations and were observed to be approximately 3 to 3.5 feet in depth. However, deeper engineered fill may exist in local areas. The fine-grained fill soils largely possess medium to high plasticity/expansion characteristics.

Younger Alluvial Fan Deposits (Qyfa)

Younger alluvial fan deposits were encountered within the drill holes to the maximum depth explored (51 feet). The alluvial deposits encountered consisted mainly of light brown to yellowish brown, crudely stratified, firm to stiff sandy clays, and medium dense to dense silty sands, clayey sands, and poorly graded sands. The soils are generally dry to moist. Moisture contents and dry unit weights varied as summarized on Table B-1 of Appendix B.

LOCAL GROUNDWATER

No static groundwater was encountered within our drill holes to the maximum depth explored (51 feet). This is in general agreement with the depth of historically high groundwater provided in the reference Seismic Hazard Zone Report for the Tustin Quadrangle (CDMG, 2001) which indicates that historic high groundwater is in excess of 40 feet below the ground surface.

It should be noted that seasonal fluctuations in the groundwater level may occur. However, given that no groundwater was encountered to a depth of 51 feet below existing ground surface for this investigation, and historic high groundwater is in excess of 40 feet below the ground surface, it is anticipated that present and/or future groundwater is not expected to have an impact on the proposed construction.

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SEISMIC CONDITIONS

Faulting and Seismicity

The site is not located within an official Alquist-Priolo Earthquake Fault Zone (Jennings, 1994; Hart and Bryant, 2007), and no known active faults are shown crossing the site on the reviewed geologic maps. The site is, however, located within close proximity to several surface faults that are presently zoned as active or potentially active by the California Geological Survey (CGS). The nearest known active fault is the San Joaquin Hills blind thrust fault which is located approximately 1 mile from the site and capable of generating a maximum earthquake magnitude (Mw) of 7.1. The site is also located within 10 miles of the Newport-Inglewood fault which is capable of generating a maximum earthquake magnitude (Mw) of 7.5.

Most of southern California is subject to some level of ground shaking (ground motion) because of movement along active and potentially active fault zones in the region. Given the proximity of the site to several active and potentially active faults, the site will likely be subject to earthquake ground motions in the future. The level of ground motion at a given site resulting from an earthquake is a function of several factors including earthquake magnitude, type of faulting, rupture propagation path, distance from the epicenter, earthquake depth, duration of shaking, site topography, and site geology.

Seismic Hazard Zones

According to the reference Seismic Hazard Zone map for the Tustin 7.5-Minute Quadrangle, the subject site does not lie within an area that is susceptible to earthquake-induced liquefaction or landsliding. However, a liquefaction zone is located on the west side of Jeffrey Road, approximately 1 mile northwest of the subject site.

GEOTECHNICAL ENGINEERING FINDINGS

STATIC SETTLEMENT/COMPRESSIBILITY

The proposed grades of the new prefabricated structures and site improvements are planned to be essentially at the same elevations as existing grades. Therefore, static settlement of the site will only be induced by introducing new structure loads to the existing grades and subsurface soils. The underlying alluvial deposits encountered were found to be medium dense/soft to dense/stiff and are considered susceptible to consolidation. Static settlement at the site was analyzed for new fill over in-situ alluvial deposits condition under our recommended bearing capacity utilizing the approximate preliminary assumed structure foundation loads by means of our consolidation laboratory test from the subject site. Calculated total static settlements under the anticipated

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foundation loads is approximately 1-inch with a differential settlement of 0.5 inch over a span of 40 feet.

LIQUEFACTION AND EARTHQUAKE-INDUCED SETTLEMENTS

Liquefaction

The subject site is not located within a zone of potential liquefaction per the Seismic Hazard Zone Map for the Tustin Quadrangle (CDMG, 2001). However, it is adjacent to a liquefaction zone located approximately 1 mile northwest of the subject site. Therefore, a liquefaction analysis was performed.

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soils most susceptible to liquefaction are loose to moderately dense, saturated granular soils with poor drainage, such as silty sands or sands and gravels capped by or containing seams of impermeable sediment.

When seismic ground shaking occurs, the soil is subjected to cyclic shear stresses that can cause increased hydrostatic pressure that induces liquefaction. Liquefaction can cause softening, which can result in large cyclic deformations. In loose granular soils, softening can also be accompanied by a loss of shear strength that may lead to large shear deformations or even flow failure under moderate to high shear stresses, such as beneath a foundation or sloping ground (NCEER/NSF, 1998).

Loose granular soil can also settle (compact) during liquefaction and as pore pressures dissipate following an earthquake. Very limited field data is available on this subject; however, in some cases, settlement on the order of 2 to 3 percent of the thickness of the liquefied zone has been measured.

Youd and Idriss, et al. (2001) methodology was used to evaluate the liquefaction resistance of subsurface soils within the site from our drill hole data. Our liquefaction analysis was based on the ASCE 7-16 ground motion criteria. The California Geological Survey (CDMG, 2001) groundwater data, which provides a historical high groundwater depth in excess of 40 feet, was used in our analysis.

Our liquefaction analysis determined that the potential for liquefaction at the subject site is low for a design groundwater table at or deeper than 40 feet below ground surface. The results of our liquefaction analysis are included in Appendix C.

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Earthquake-Induced Settlement

If near-surface soils vary in composition both vertically and laterally, strong earthquake shaking can cause non-uniform compaction of soil strata, resulting in movement of the near-surface soils. But because the subsurface soils encountered at the site do not appear to change in thickness or consistency abruptly over short distances, we judge the probability of significant differential compaction at the site to be low. The total and differential earthquake-induced settlements are expected to be less than 1-inch and ½-inch, respectively. The results of our earthquake-induced settlement analysis are included in Appendix C.

Lateral Spreading

Lateral spreading typically occurs as a form of horizontal displacement of relatively flat-lying alluvial material toward an open or "free" face such as an open body of water, channel, or excavation. In soils, this movement is generally due to failure along a weak plane and may often be associated with liquefaction. As cracks develop within the weakened material, blocks of soil displace laterally towards the open face. Cracking and lateral movement may gradually propagate away from the face as blocks continue to break free. Generally, failure in this mode is analytically unpredictable since it is difficult to determine where the first tension crack will occur.

Since the liquefaction potential is considered low at the site, and there are no creeks or open bodies of water within an appropriate distance from the site for lateral spreading to occur, the probability of lateral spreading occurring at the site during a seismic event is very low.

TSUNAMI, SEICHE, AND FLOODING

The site is not located on any State of California – County of Orange Tsunami Inundation Map for Emergency Planning. The potential for the site to be adversely impacted by earthquake-induced tsunamis is considered to be negligible since the site is located several miles inland from the Pacific Ocean coast at an elevation exceeding the maximum height of potential tsunami inundation.

The potential for the site to be adversely impacted by earthquake-induced seiches is considered to be negligible due to the lack of any significant enclosed bodies of water located in the vicinity of the site.

According to the County of Orange FEMA Flood Insurance Rate Map, the site is located within "Zone X", an area of minimal flood hazards. The potential for the site to be adversely impacted by significant flooding is considered very low.

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SOIL EXPANSION

According to the 2019 CBC, soils meeting all four of the following provisions shall be considered expansive, except that tests for compliance with Items 1, 2, and 3 shall not be required if the test prescribed in Item 4 is conducted:

1. Plasticity index (PI) of 15 or greater (ASTM D4318).
2. More than 10 percent of the soil particles pass the #200 sieve (ASTM D422).
3. More than 10 percent of the soil particles are less than 5 micrometers in size (ASTM D422).
4. Expansion index greater than 20 (ASTM D422).

One expansion index (EI) test was performed on the near surface soils at the site. The expansion index of the tested soil was 113, which indicates a high expansion potential. Therefore, the shallow soils within the site have a potential for expansion and special design considerations will be required for design of the proposed improvements. Test results are provided in Appendix B.

SOIL CORROSION

Based on the test results for pH, soluble chlorides, sulfate, and minimum resistivity obtained during this investigation (presented in Appendix B), the on-site soils should be considered to have:

- A low minimum resistivity (severely corrosive to ferrous metals).
- A negligible sulfate exposure to concrete per the ACI 318 Table 19.3.1.1 (Exposure Class S_0).
- A low chloride content (i.e., less than 400 ppm).

Further corrosivity testing is recommended below proposed structures and improvements upon completion of precise grading and prior to construction to confirm the preliminary results provided herein.

EXCAVATION CHARACTERISTICS

Rippability

The soil materials to be encountered for the project can be excavated with conventional grading and excavation equipment.

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Excavation and Trenching

We expect that the proposed corrective grading and utility trenches can be accomplished utilizing conventional excavating and trenching machines and backhoes. Significant quantities of gravels or oversize materials were not observed during our field investigation. However, zones of medium dense, sandy soils were encountered during our exploration, and these materials may be subject to caving or sloughing due to the granular nature of the uncemented soil matrix. Trench support requirements will be limited to those required by safety laws or other locations where trench slopes will need to be flattened or supported by shoring designed to suit the specific conditions exposed.

Excavation Stability

Excavations created for corrective grading and utility trenches will need to be laid back at an angle no greater than 1:1 up to a depth of 4 feet and/or shored per OSHA requirements. Below 4 feet, excavations will need to be laid back 1.5:1 as Type C soils were encountered during the investigation.

The above verbiage regarding excavation stability is presented for general guidance only. All aspects of construction stability are the responsibility of the contractor. All governing regulations in regards to excavation stability (i.e., OSHA, City of Irvine, etc.) should be followed.

Volume Change

In order to aid in the planning for the anticipated precise grading, we estimate that the change in volume of the on-site engineered fill excavated and placed as compacted fill at an average relative compaction of 90%, will result in about 2% to 5% decrease of volume or shrink.

IN-SITU SOIL MOISTURE CHARACTERISTICS

The fill and alluvial soils within the site are generally dry to very moist. Soils within the upper 5 to 10 feet have an average degree of saturation between 48 to 93 percent. Consequently, the potential for expansive soil movements to impact all improvements is high. It should be noted, however, that the moisture content within the upper several feet may vary depending on rainfall and the time of year in which grading occurs. One or more of the following measures during site grading may be required: 1) moisture conditioning, 2) locally drying back of the soils, and/or 3) mixing of the soils.

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CONCLUSIONS

Based on the geologic and geotechnical findings, the following is a summary of our conclusions:

1. It is our opinion that the proposed project is feasible assuming all applicable recommendations contained herein are implemented.

2. The sandy alluvial deposits may be subject to caving or sloughing due to the granular nature of the uncemented soil matrix.

3. Groundwater is not anticipated to be a design constraint and/or encountered during the planned precise grading or during the installation of shallow underground utilities.

4. There are no known active faults crossing the subject site. The site seismicity is typical for the Irvine area. Structure design should be in accordance with the current CBC.

5. The magnitude of total static settlements beneath the proposed structures (i.e., prefabricated metal structures and aboveground tanks) are not expected to exceed 1 inch.

6. The potential for liquefaction is considered low and total earthquake-induced settlement is expected to be less than 1 inch.

7. The potential for liquefaction-induced lateral spreading is considered very low.

8. The on-site soils have a high expansion potential. Due to the potential for expansive soils, special design considerations will be required for the foundations, slabs, and flatwork associated with the proposed improvements. The previously graded site contains soils within the upper 5 to 10 feet that have an average degree of saturation between 48 and 93% indicating damp to moist conditions and a high potential for expansive soil movements.

9. The on-site soils are corrosive to ferrous metals and have a potential for chloride corrosion exposure to concrete (i.e., as defined by the CBC) and reinforcement. Special design considerations will be required for proposed improvements in contact with on-site soil.

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RECOMMENDATIONS

DEVELOPMENT FEASIBILITY

Based on the geologic and geotechnical findings, it is our opinion that the proposed grading and construction shown on the reference (1) precise grading plans is feasible and practical from a geotechnical standpoint if accomplished in accordance with the City of Irvine grading and building requirements and the recommendations presented in this report. Geotechnical recommendations provided in this report include the following:

- Recommendations for corrective grading for the proposed improvements (i.e., foundations, structure pads, and pavement/flatwork areas);
- Design parameters for spread and continuous footings, slab-on-grade systems, and pole foundations to support the proposed structures and site improvements;
- Utility trench and structure excavations, and backfill recommendations; and
- Asphalt pavement and concrete flatwork recommendations.

GENERAL SITE PREPARATION AND GRADING

General

The following recommendations pertain to any required grading associated with the proposed improvements. All site preparation and grading should be performed in accordance with the City of Irvine grading code requirements and the recommendations presented in this report.

Clearing

All significant organic material such as weeds, brush, tree branches, or roots, or construction debris such as old irrigation lines, asphalt concrete, and other decomposable material should be removed from the area to be graded. No rock or broken concrete greater than 6 inches in diameter should be utilized in the fills.

Corrective Grading

Corrective grading will serve to create a firm and workable platform for construction of the proposed developments such as new prefabricated structures and associated pavement and site flatwork.

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It should be noted that the recommendations provided herein are based on our subsurface exploration and knowledge of the on-site geology. Actual removals may vary in configuration and volume based on observations of geologic materials and conditions encountered during grading. The bottom of all remedial grading removals should be observed by a GMU representative to verify the suitability of in-place soil prior to performing scarification and recompaction. Corrective grading recommendations are outlined below.

Structure Foundations/Slabs: Grading recommendations for support of the new prefabricated metal structure pads, above-ground tank pads, and miscellaneous shallow spread/continuous foundations should consist of the following:

- The existing ground surfaces should be over-excavated to a depth of at least 24 inches below existing grades or to a depth of at least 18 inches below the bottoms of new footings or slabs, whichever is deeper. The lateral extent of the over-excavation should extend a minimum of 3 feet beyond the perimeter edges of the footings or slabs, where possible.
- The bottoms of the over-excavations should then be scarified to a depth of at least 6 inches, moisture conditioned to 3% above optimum moisture content, and recompacted to at least 90% relative compaction.
- Following the approval and processing of the over-excavation bottom by a representative of GMU, the onsite material may be used as fill material to achieve the planned subgrade elevation.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to at least 3% above optimum moisture content, blended to achieve uniform moisture content, and compacted to achieve 90% relative compaction.

Flatwork/Pavement Areas: Grading recommendations for the support of asphalt and concrete pavement and flatwork areas should consist of the following:

- The upper 18 inches of existing fill within new pavement and flatwork areas should be removed. The removal should, at a minimum, provide for at least 1 foot of new engineered fill supporting the structural asphalt and concrete flatwork sections.
- The bottom of the removal should be scarified to a depth of 6 inches, moisture conditioned to least 3% above optimum moisture content, and recompacted to at least 90% relative compaction.

Detention Basin: The following corrective grading recommendations for the proposed stormwater detention basin are based on preliminary conceptual plans. These recommendations may require revisions after the final design of the proposed detention basin has been determined. Preliminary corrective grading recommendations for the detention basin are as follows:

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- If a structure is planned for the stormwater detention basin, then the subgrade for the structure should be over-excavated 2 feet to provide a minimum of 2 feet of engineered fill under the design section for the basin. The over-excavation should extend at least 2 feet outside the footprint of the structure.
  - The bottom of the excavation should then be scarified to a depth of at least 6 inches, moisture conditioned to 3% above optimum moisture content, and compacted to at least 90% relative compaction.
  - Following the approval and processing of the over-excavation bottom by a representative of GMU, the onsite material may be used as fill material to achieve the planned subgrade elevation.
  - The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to at least 3% above optimum moisture content, blended to achieve uniform moisture content, and compacted to achieve 90% relative compaction.
- If a liner is planned for the stormwater detention basin, then only processing of the liner subgrade, as described above, is required.

FILL MATERIAL AND PLACEMENT

Suitability and Selective Grading

All on-site soil materials within the limits of grading are suitable for use as compacted fill if care is taken to remove all significant organic and other decomposable debris and to separate and selectively place and/or stockpile rock materials larger than 6 inches in diameter.

Compaction Standard and Moisture Requirements

All on-site soil material used as compacted fill, material processed in place, or used to backfill trenches should be moistened, dried, or blended as necessary to achieve a minimum of 3% over optimum moisture content (i.e., if the optimum moisture content is 12%, the compacted fill's moisture content shall be at least 15%), and densified to at least 90% relative compaction as determined by ASTM Test Method D1557. Final surface subgrade soils should be frequently watered in order to keep the soil moist until structure slabs, flatwork, or any other final improvements are installed. If the soil is allowed to dry out and deep shrinkage cracks appear, at least the upper 6 inches should be re-processed, moisture conditioned to 3% over optimum, and re-compacted.

Use of Rock or Broken Concrete

No rock or broken concrete greater than 6 inches in diameter should be utilized in the fills.

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STRUCTURE SEISMIC DESIGN

The average shear wave velocity for the upper 100 feet of subsurface soils (V_{s30}) was estimated to be approximately 760 feet per second (fps) based on the empirical relationship between SPT blow counts and shear wave velocity of DH-1 and DH-5. Based on this shear wave velocity, Table 20.3-1 of ASCE 7-16 indicates that the site should be designated as Site Class D which corresponds to a "stiff soil" profile. The seismic design coefficients based on ASCE 7-16 are listed below in Table 1.

Table 1. 2019 CBC and ASCE 7-16 Seismic Design Parameters
(To be utilized as per the requirements of Section 11.4.8 of ASCE 7-16)

Seismic Item	Design Value	2016 ASCE 7-16 or 2019 CBC Reference
Site Class based on soil profile (ASCE 7-16 Table 20.3-1)	D[(a)]	ASCE 7-16 Table 20.3-1
Short Period Spectral Acceleration S_s	1.246[(a)]	CBC Figures 1613.2.1 (1-8)
1-sec. Period Spectral Acceleration S_1	0.446[(a)]	CBC Figures 1613.2.1 (1-8)
Site Coefficient F_a (2019 CBC Table 1613.2.3(1))	1.002[(a)]	CBC Table 1613.2.3 (1)
Site Coefficient F_v (2019 CBC Table 1613.2.3(2))	1.854[(b)]	CBC Table 1613.2.3 (2)
Short Period MCE* Spectral Acceleration S_{MS} $S_{MS} = F_a S_s$	1.249[(a)]	CBC Equation 16-36
1-sec. Period MCE Spectral Acceleration S_{M1} $S_{M1} = F_v S_1$	0.827[(b)]	CBC Equation 16-37
Short Period Design Spectral Acceleration S_{DS} $S_{DS} = 2/3S_{Ms}$	0.832[(a)]	CBC Equation 16-38
1-sec. Period Design Spectral Acceleration S_{D1} $S_{D1} = 2/3S_{M1}$	0.551[(b)]	CBC Equation 16-39
Short Period Transition Period T_S (sec) $T_S = S_{D1}/S_{DS}$	0.663[(b)]	ASCE 7-16 Section 11.4.6
Long Period Transition Period Tl (sec)	8[(b)]	ASCE 7-16 Figures 22-14 to 22-17
MCE[(c)] Peak Ground Acceleration (PGA)	0.521[(a)]	ASCE 7-16 Figures 22-9 to 22-13
Site Coefficient F_{PGA} (ASCE 7-16 Table 11.8-1)	1.100[(a)]	ASCE 7-16 Table 11.8-1
Modified MCE[(c)] Peak Ground Acceleration (PGA_M)	0.573[(a)]	ASCE 7-16 Equation 11.8-1
Seismic Design Category	D[(b)]	ASCE 7-16 Tables 11.6.1 and 11.6.2

[(a)] Design Values Obtained from USGS Earthquake Hazards Program website that are based on the ASCE-7-16 and 2019 CBC and site coordinates of N33.676450° and W117.764625°.
[(b)] Design Values Determined per ASCE Table 11.4-2 and CBC Equations 16-36 through 16-39.
[(c)] MCE: Maximum Considered Earthquake.

The Maximum Considered Earthquake (MCE) Peak Horizontal Ground Acceleration (PGA_M) is 0.57g as determined in accordance with ASCE 7-16. This PGA_M is primarily dominated by earthquakes with a mean magnitude of 6.6 at a mean distance of 9 miles from the site using the USGS 2014 Interactive Deaggregation website.

Since the Site Class is designated as D and the S_1 value is greater than or equal to 0.2, the 2019 CBC requires either a site-specific ground motion hazard analysis per Section 21.2 of ASCE 7-16 or the application of Exception 2 of Section 11.4.8 of ASCE 7-16. Exception 2 states

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that a site-specific ground motion hazard analysis is not required provided that the value of the seismic response coefficient, C_s, is conservatively calculated by the project structural engineer using Equation 12.8-2 of ASCE 7-16 for values of $T \leq 1.5Ts$ and taken as equal to 1.5 times the value computed in accordance with either Equation 12.8-3 for $T_L \geq T > 1.5Ts$ or Eqn. 12.8-4 for $T > T_L$.

It should be recognized that much of southern California is subject to some level of damaging ground shaking as a result of movement along the major active (and potentially active) fault zones that characterize this region. Design utilizing the 2019 CBC is not meant to completely protect against damage or loss of function. Therefore, the preceding parameters should be considered as minimum design criteria.

SHALLOW FOUNDATION AND SLAB-ON-GRADE RECOMMENDATIONS

General

The following design parameters are considered applicable for shallow foundations and slab-on-grade systems that may be constructed for the proposed prefabricated metal structures, aboveground tanks, and other miscellaneous improvements provided the grading recommendations outlined above are followed.

Soil Parameters

Bearing Material: New Engineered Fill

Allowable Bearing Capacity:

- Allowable bearing capacity: 2,500 psf for minimum footing size
- May be increased by 500 psf for each additional foot of footing depth and by 150 psf for each additional foot of footing width to a maximum of 4,000 psf
- Above value may be increased by 1/3 for temporary loads such as wind or seismic

Lateral Foundation Resistance:

- Allowable passive resistance: 250 psf/ft (disregard upper 6 inches, max 2,500 psf)
- Allowable friction coefficient: 0.33
- Above values may be combined without reduction and may be increased by 1/3 for temporary loads such as wind or seismic

Subgrade Reaction Modulus: 100 pci

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Minimum Foundation Design Parameters

Minimum Footing Sizes (for designing):

- Spread (i.e., Square): 1.5 feet wide and 1.5-foot embedment below lowest adjacent soil grade (depth)
  - Due to the expansive nature of the onsite soils, grade beams to tie together the individual pad footings for canopy structures should be considered by the structural engineer.
- Continuous: 1.5 feet wide and 1.5-foot embedment below lowest adjacent soil grade (depth)

Settlement:

- Static:
  - Total: 1.0"
  - Differential: 0.5" over 40 feet
- Seismic Settlement:
  - Total: 1.0"
  - Differential: 0.5" over 40 feet

Slab Subgrade and Slab Design

Minimum Thickness:

- Prefabricated Metal Structure Slab: 6 inches
- Aboveground Tank Slab: 8 inches
- Final slab thickness should be determined by the structural engineer.

Minimum Slab Reinforcement:

- Minimum slab reinforcement shall not be less than No. 4 bars placed at 18 inches on center.
- Welded wire mesh is not recommended. Care should be taken to position the reinforcement bars in the center of the slab.
- Final reinforcement should be determined by the structural engineer.
- Final design details should be provided to our office by the design structural engineer for review.

Slab Subgrade:

- The on-site soils and subgrade soil should be moisture conditioned to a minimum of 3% over optimum moisture content.
- 4-inch section of ¾-inch gravel or crushed stone layer (i.e., to act as a capillary break) placed over engineered fill.
- Sand above the moisture retarder/barrier (i.e., directly below the slab) is not a geotechnical issue. This should be provided by the structural engineer of record or architect based on the type of slab, potential for curling, etc.

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MOISTURE VAPOR TRANSMISSION

Moisture Vapor Retarder

A vapor retarder or barrier such as Stego 15 Mil Class A or equivalent should be utilized overtop of the required gravel/stone course for the prefabricated metal structure slabs. The retarder/barrier should be installed as follows:

- Below moisture-sensitive floor areas.
- Installed per manufacture's specifications as well as with all applicable recognized installation procedures such as ASTM E1643.
- Joints between the sheets and the openings for utility piping should be lapped and taped. If the retarder/barrier is not continuously placed across footings/ribs, the retarder/barrier should, as a minimum, be lapped into the sides of the footing/rib trenches down to the bottom of the trench.
- A 4-inch section of ¾-inch gravel or crushed stone layer shall be provided directly below the moisture vapor retarder/barrier to act as a moisture or capillary break.
- Punctures in the vapor retarder/barrier should be repaired prior to concrete placement.

The need for sand and/or the amount of sand above the moisture vapor retarder/barrier should be specified by the owner with approval by the structural engineer. The selection of sand above the retarder/barrier is not a geotechnical engineering issue and is hence outside our purview. However, if sand is to be placed above the retarder/barrier for this project, the sand should be placed in a dry condition.

Water Vapor Transmission Discussion

As discussed above, placement of a moisture vapor retarder/barrier below all slab areas is recommended where moisture sensitive flooring will be placed. This moisture vapor retarder/barrier recommendation is intended only to reduce moisture vapor transmissions from the soil beneath the concrete and is consistent with the current standard of the industry for construction in southern California. It is not intended to provide a "waterproof" or "vapor proof" barrier or reduce vapor transmission from sources above the retarder. Sources above the retarder/barrier include any sand placed on top of the retarder/barrier (i.e., to be determined by the project structural designer) and from the concrete itself (i.e., vapor emitted during the curing process). The evaluation of water vapor from any source and its effect on any aspect of the proposed living space above the slab (i.e., floor covering applicability, mold growth, etc.) is outside our purview and the scope of this report.

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Floor Coverings

Prior to the placement of flooring, the floor slabs should be properly cured and tested to verify that the water vapor transmission rate (WVTR) is compatible with the flooring requirements.

POLE FOUNDATION DESIGN PARAMETERS

The following design parameters are considered applicable for pole foundation systems associated with the proposed site improvements (i.e., canopies, light poles, fencing, etc.) provided the grading recommendations outlined above are followed. Final depth and size of pole foundations should be determined by the project structural engineer.

Soil Parameters

Bearing Material: Existing Engineered Fill or Competent Alluvium

End Bearing:

- 1,600 psf (for minimum pole foundation depth of 2 feet)
  - May be increased by 450 psf for each additional foot of pole depth and by 90 psf for each additional foot of pole diameter to a maximum of 5,000 psf
  - One-third increase for wind or seismic loading
  - Assumes bottom of drill hole thoroughly cleaned of all loose soil prior to pour.

Allowable Average Unit Skin Friction:

- 150 psf
  - One-third increase for wind or seismic loading

Allowable Passive Resistance:

- Allowable passive resistance: 250 psf/ft of pole foundation depth
  - Disregard the upper 1 foot due to possible soil disturbance.
  - Passive may be increased by an isolated pile factor of 2 (e.g., 500 psf/ft of pole diameter per foot of depth) when center-to-center distance of poles is greater than 3 times their diameter.
  - One-third increase for wind or seismic loading.

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Minimum Pole Foundation Design Parameters

Improvements > 6 feet in height:

- Minimum pole foundation diameter: 18 inches
- Minimum pole foundation depth: 4 feet (final depth to be determined by structural engineer)

Improvements ≤ 6 feet in height:

- Minimum pole foundation diameter: 12 inches
- Minimum pole foundation depth: 2 feet (final depth to be determined by structural engineer)

Construction Considerations for Pole Foundations

GMU recommends the following construction considerations for the pole foundations:

- Drilling for pole foundations should be performed under the observation of GMU to confirm the poles have been extended to the design embedment depths.
- The alluvial deposits may be subject to caving due to the granular nature of some subsurface alluvial deposits. Casing or other means of sidewall stabilization and protection may be required.
- The drill holes should be cleaned of loose soil prior to placement of rebar and concrete.

UTILITY TRENCH BACKFILL CONSIDERATIONS

General

New utility line pipeline trenches should be backfilled with select bedding materials beneath and around the pipes (pipe zone) and compacted soil above the pipe bedding. Recommendations for the types of the materials to be used and the proper placement of these materials are provided in the following sections.

Pipe Zone (Bedding and Shading)

The pipe bedding and shading materials should extend from at least 6 inches below the pipes to at least 12 inches above the crown of the pipes. Pipe bedding and shading should consist of either clean sand with a sand equivalent (SE) of at least 30, or crushed rock. If crushed rock is used, it should consist of ¾-inch crushed rock that conforms to Table 200-1.2.1 (A) of the 2021 "Greenbook." Pipe bedding and shading should also meet the minimum requirements of the City of Irvine. If the requirements of the City are more stringent, they should take precedence over the geotechnical recommendations. Sufficient laboratory testing should be performed to verify the

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bedding and shading meet the minimum requirements of the Greenbook and City of Irvine grading code.

Based on our subsurface exploration and knowledge of the onsite materials, the soils that will be excavated from the pipeline trenches will not meet the recommendations for pipe bedding and shading materials; therefore, imported materials will be required for pipe bedding and shading.

Granular pipe bedding and shading material having a sand equivalent of 30 or greater should be properly placed in thicknesses not exceeding 3 feet, and then sufficiently flooded or jetted in place. Crushed rock, if used, should be capped with filter fabric (Mirafi 180N, or equivalent) to prevent the migration of fines into the rock.

Trench Backfill

All existing soil material within the limits of the site are considered suitable for use as trench backfill above the pipe bedding and shading zone if care is taken to remove all significant organic and other decomposable debris, moisture condition the soil materials as necessary, and separate and selectively place and/or stockpile any inert materials larger than 6 inches in maximum diameter.

Imported soils are not anticipated for backfill since the on-site soils are suitable. However, if imported soils are used, the soils should consist of clean, granular materials with physical and chemical characteristics similar to or better than those described herein for on-site soils. Any imported soils to be used as backfill should be evaluated and approved by GMU prior to placement.

Soils to be used as trench backfill should be moistened, dried, or blended as necessary to achieve a minimum of 3% over optimum moisture content (i.e., if the optimum moisture content is 12.0%, the compacted fill's moisture content shall be at least 15.0%), placed in lifts which, prior to compaction, shall not exceed the thickness specified in Section 306-12.3 of the 2021 "Greenbook" for various types of equipment, and mechanically compacted/densified to at least 90% relative compaction as determined by ASTM Test Method D1557. Jetting is not permitted in this trench zone.

No rock or broken concrete greater than 6 inches in maximum diameter should be utilized in the trench backfills.

DETENTION BASIN RECOMMENDATIONS

Our grading recommendations for the proposed detention basin are outlined in the "Corrective Grading" section of this report. These recommendations are based on conceptual plans provided by Lionakis, the project Civil engineer, and may require revisions once the final design of the

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detention basin has been determined. Based on the final design of the proposed detention basin, supplemental recommendations can be provided as necessary.

PAVEMENTS

Asphalt Pavement Design

Pavement engineering analyses were performed in accordance with the Caltrans Highway Design Manual. Topic 633 of the Caltrans Design Manual was followed to develop pavement thickness design recommendations. This design method considers the relationship between the subgrade R-value, gravel factor of the various pavement layers, and the traffic index (TI).

Pavement thickness recommendations were developed based on an assumed range of traffic indices (TI's) for a 20-year design life. A traffic engineer should review and confirm the appropriateness of the TI's used in our analysis. Based on our R-value test result and shallow soil types encountered, an R-value of 5 was used for the design.

The actual service life of the pavement can be extended with proper maintenance and rehabilitation (i.e., slurry seal every 7 years, mill-and-overlay every 12-16 years, etc.)

The following table summarizes the recommended minimum pavement thicknesses.

Table 2. Conventional Asphalt Concrete (AC) Pavement Thickness Recommendations

Location	Assumed Traffic Index	Composite Pavement Asphalt Concrete over Aggregate Base (AC over AB over subgrade)	Full-Depth Asphalt Concrete (AC over subgrade)
Passenger Vehicle Parking Stalls	4.5	4.0" AC over 9.5" AB over Properly Prepared Subgrade	7.0" AC over Properly Prepared Subgrade
Drive Aisles	5.5	4.0" AC over 12.0" AB over Properly Prepared Subgrade	8.5" AC over Properly Prepared Subgrade
Heavy Truck Areas	7.0	4.5" AC over 16.0" AB over Properly Prepared Subgrade	11.0" AC over Properly Prepared Subgrade

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Implementing any of these recommendations involves:

- Grading the existing site to create sufficient depth for the recommended asphalt concrete (AC) or asphalt concrete over aggregate base (AC/AB) sections;
- Processing and re-compacting the exposed subgrade material to a depth of at least 12 inches in accordance with Standard Specifications for Public Works Construction (Greenbook) Sections 301-1.2 and 301-1.3. The required relative compaction of the subgrade is 90% minimum with a moisture content at least 3% above optimum moisture content for the composite section (AC/AB), and 95% relative compaction with a moisture content at least 3% above optimum moisture content for the full depth section (AC over subgrade). Maximum density and optimum moisture content of the subgrade should be determined by ASTM D1557;
- Placing the aggregate base (AB) section to at least 95% relative compaction and moisture conditioning to near optimum moisture content. Maximum density and optimum moisture content of the aggregate base should be determined by ASTM D1557; and
- Placing the asphalt concrete (AC) section in lifts not exceeding Greenbook minimum lift thicknesses.

All materials used and work performed should meet the current edition of the Standard Specifications for Public Works Construction (Greenbook) with all supplements, unless superseded by the recommendations provided within this report.

The AB section may be Crushed Miscellaneous Base (CMB) or Crushed Aggregate Base (CAB) meeting Greenbook Section 200-2.

We recommend using the Greenbook Type IIIC3 AC mix with PG 64-10 asphalt binder for both the AC surface and AC base course sections.

Concrete Pavement Design

Driveways, vehicular drives, and appurtenant concrete paving such as trash receptacle bays, will require PCC pavement. Assuming a T.I. of 6 to 7, a design section of 8 inches of PCC over 6 inches AB should be adequate. The AB should be compacted to a minimum of 95% relative compaction as per ASTM D1557 and moisture conditioned to near optimum moisture content.

CONCRETE FLATWORK DESIGN AND CONSTRUCTION

We recommend that the subgrade for the subject concrete flatwork be moisture conditioned to 3% above optimum moisture content (i.e., if the optimum moisture content is 12%, the compacted

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fill's moisture content should be at least 15%) to a depth of 18 inches below finish grade and compacted to 90% relative compaction as per ASTM D1557.

Concrete flatwork should be designed and constructed per the City of Irvine Standard Plans (such as Standard Plans 201, 204, 205, and/or 206) or the flatwork recommendations provided in Appendix D, whichever is more conservative.

CONCRETE

Due to low soil resistivity and medium chloride levels, the potential for on-site corrosion to ferrous metals and hence reinforcing steel are severe. Thus, we recommend the following:

Structural Elements (i.e., foundations, slabs, etc.)

- Cement Type: Type II/V
- Maximum Water Cement Ratio: 0.50
- Minimum Strength: 4,000 psi (geotechnical perspective only)

Utilization of CBC moderate sulfate level requirements will also serve to reduce the permeability of the concrete and help minimize the potential of water and/or vapor transmission through the concrete. Wet curing of the concrete per ACI Publication 308 is also recommended.

Non-structural Elements (i.e., flatwork, pavement, etc.)

Concrete mix design shall be selected by the concrete designer such that sulfate and chloride attack mitigations are balanced with shrinkage crack control. Concrete mix design is outside the geotechnical engineer's purview.

The aforementioned recommendations in regards to all concrete (i.e., structural and non-structural) are made from a soil's perspective only. Final concrete mix design is beyond our purview. All applicable codes, ordinances, regulations, and guidelines should be followed in regard to designing a durable concrete with respect to the potential for sulfate exposure from the on-site soils and/or changes in the environment.

CORROSION PROTECTION OF METAL STRUCTURES

The results of the laboratory chemical tests performed on soil samples collected within the subject area indicate that the on-site soils are corrosive to ferrous metals. Consequently, metal structures which will be in direct contact with the soil (i.e., underground metal conduits, pipelines, metal sign posts, metal door frames, etc.) and/or in close proximity to the soil (wrought iron fencing, etc.)

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may be subject to corrosion. The use of special coatings or cathodic protection around buried metal structures has been shown to be beneficial in reducing corrosion potential. The potential for corrosion of ferrous metal reinforcing elements embedded in structural concrete will be reduced by the use of the recommended maximum water/cement ratio for concrete and additional concrete cover.

The laboratory testing program performed for this project does not address the potential for corrosion to copper piping. In this regard, a corrosion engineer should be consulted to perform more detailed testing and develop appropriate mitigation measures (if necessary). Otherwise, the on-site soils should be considered corrosive to copper.

The above discussion is provided for general guidance in regards to the corrosiveness of the on-site soils to typical metal structures used for construction. Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements is beyond our purview.

PLANTERS AND TREES

Where new trees or large shrubs are to be located in close proximity to new concrete flatwork, pavement, or structure foundations, rigid moisture/root barriers should be placed around the perimeter of the flatwork to at least 2 feet in depth in order to offer protection to the adjacent flatwork against potential root and moisture damage. Existing mature trees near flatwork areas should also incorporate a rigid moisture/root barrier placed at least 2 feet in depth below the top of the flatwork, pavement, or structure foundations.

SURFACE DRAINAGE

Surface drainage should be carefully controlled during and after grading to prevent ponding and uncontrolled runoff adjacent to structures and/or other properties. Particular care will be required during grading to maintain slopes, swales, and other erosion control measures needed to direct runoff toward permanent surface drainage facilities. Positive drainage of at least 2% away from the perimeters of the structures and site pavements should be incorporated into the design. In addition, it is recommended that nuisance water be directed away from the perimeter of the structures by the use of swales and/or area drains in adjacent landscape and flatwork areas.

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PLAN REVIEW/GEOTECHNICAL TESTING DURING GRADING/FUTURE REPORTS

Plan Review

The final precise grading plans, foundation plans, and landscape plans should be reviewed by our office to verify that the plans have incorporated the recommendations presented in this report.

Geotechnical Testing

It is recommended that geotechnical observation and testing be performed by GMU during the following stages of precise grading and construction:

- During site clearing and grubbing.
- During removal of any buried irrigation lines or other subsurface structures.
- During all phases of grading including over-excavation, temporary excavations, removals, scarification, ground preparation, moisture conditioning, proof-rolling, over-excavation, and placement and compaction of all fill materials.
- During installation of all conventional foundations and floor slab elements.
- During backfill of the detention basin and underground utilities.
- During hardscape subgrade and base placement and compaction.
- During pavement section placement and compaction.
- When any unusual conditions are encountered.

Future Reports

It is expected that a geotechnical observation report will be required following all site precise grading and construction.

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LIMITATIONS

All parties reviewing or utilizing this report should recognize that the findings, conclusions, and recommendations presented represent the results of our professional geological and geotechnical engineering efforts and judgements. Due to the inexact nature of the state of the art of these professions and the possible occurrence of undetected variables in subsurface conditions, we cannot guarantee that the conditions actually encountered during grading and foundation installation will be identical to those observed and sampled during our study or that there are no unknown subsurface conditions which could have an adverse effect on the use of the property. We have exercised a degree of care comparable to the standard of practice presently maintained by other professionals in the fields of geotechnical engineering and engineering geology, and believe that our findings present a reasonably representative description of geotechnical conditions and their probable influence on the grading and use of the property.

Because our conclusions and recommendations are based on a limited amount of current and previous geotechnical exploration and analysis, all parties should recognize the need for possible revisions to our conclusions and recommendations during grading of the project. Additionally, our conclusions and recommendations are based on the assumption that our firm will act as the geotechnical engineer of record during grading of the project to observe the actual conditions exposed, to verify our design concepts and the grading contractor's general compliance with the project geotechnical specifications, and to provide our revised conclusions and recommendations should subsurface conditions differ significantly from those used as the basis for our conclusions and recommendations presented in this report.

Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements are beyond our purview.

This report has not been prepared for use by other parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

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CLOSURE

We are pleased to present the results of our geotechnical investigation for this project. The Plates and Appendices that complete this report are listed in the Table of Contents.

If you have any questions concerning our findings or recommendations, please do not hesitate to contact us and we will be happy to discuss them with you.

Respectfully submitted,

Dustin R. Williams, M.Sc., PG 9883
Senior Staff Geologist

Ashley A. Varni, M.Sc., PE 89576
Project Engineer

Alan B. Mutchnick, PG, CEG 1789
Associate Engineering Geologist

dw/aav/21-031-00R (5-4-21)

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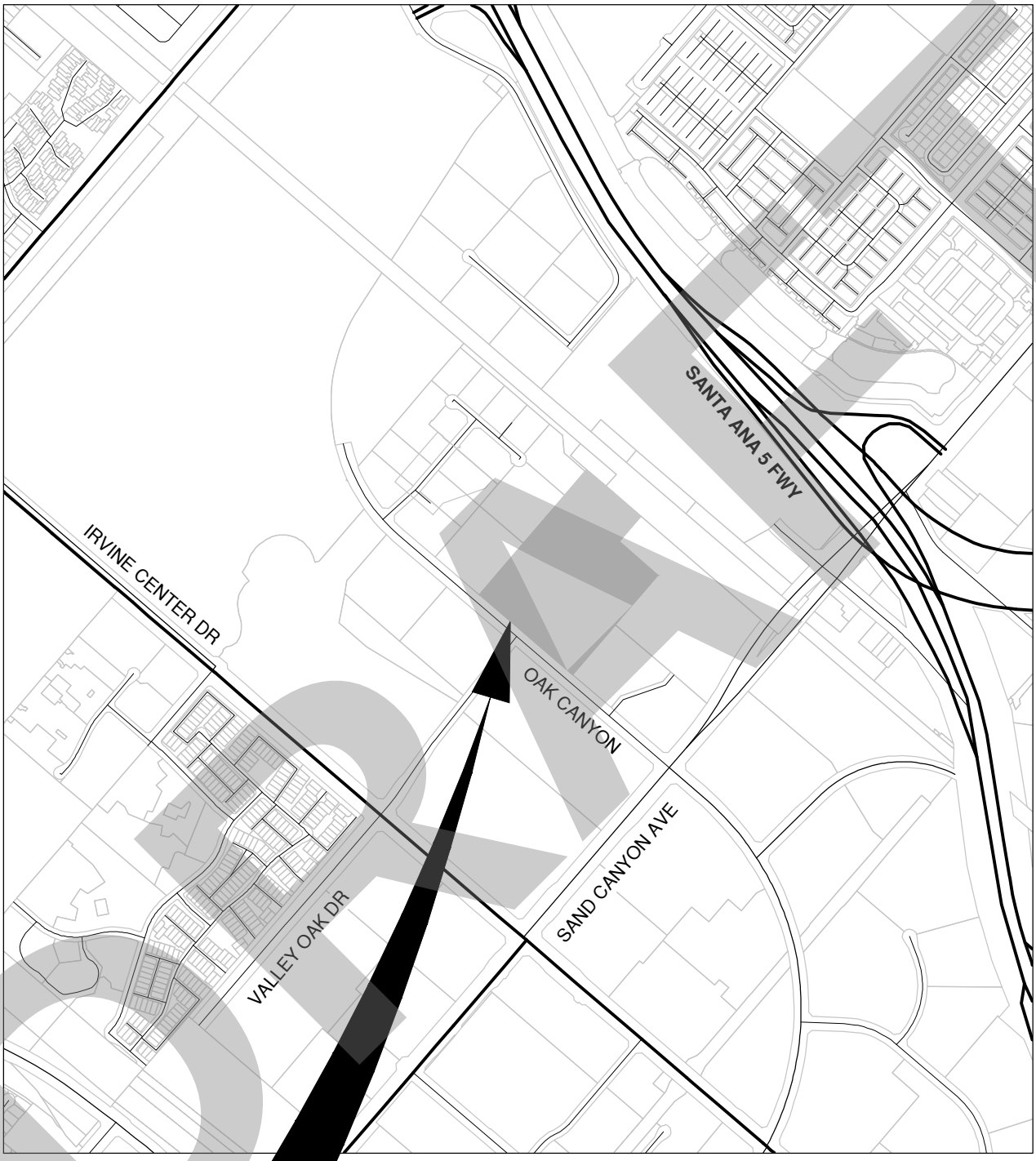

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IRVINE OPERATIONAL SUPPORT FACILITY
6427 OAK CANYON
IRVINE, CA 92618

0 1000'

Location Map

GMU

Date:	May 4, 2021
Project No.:	21-031-00

Plate 1

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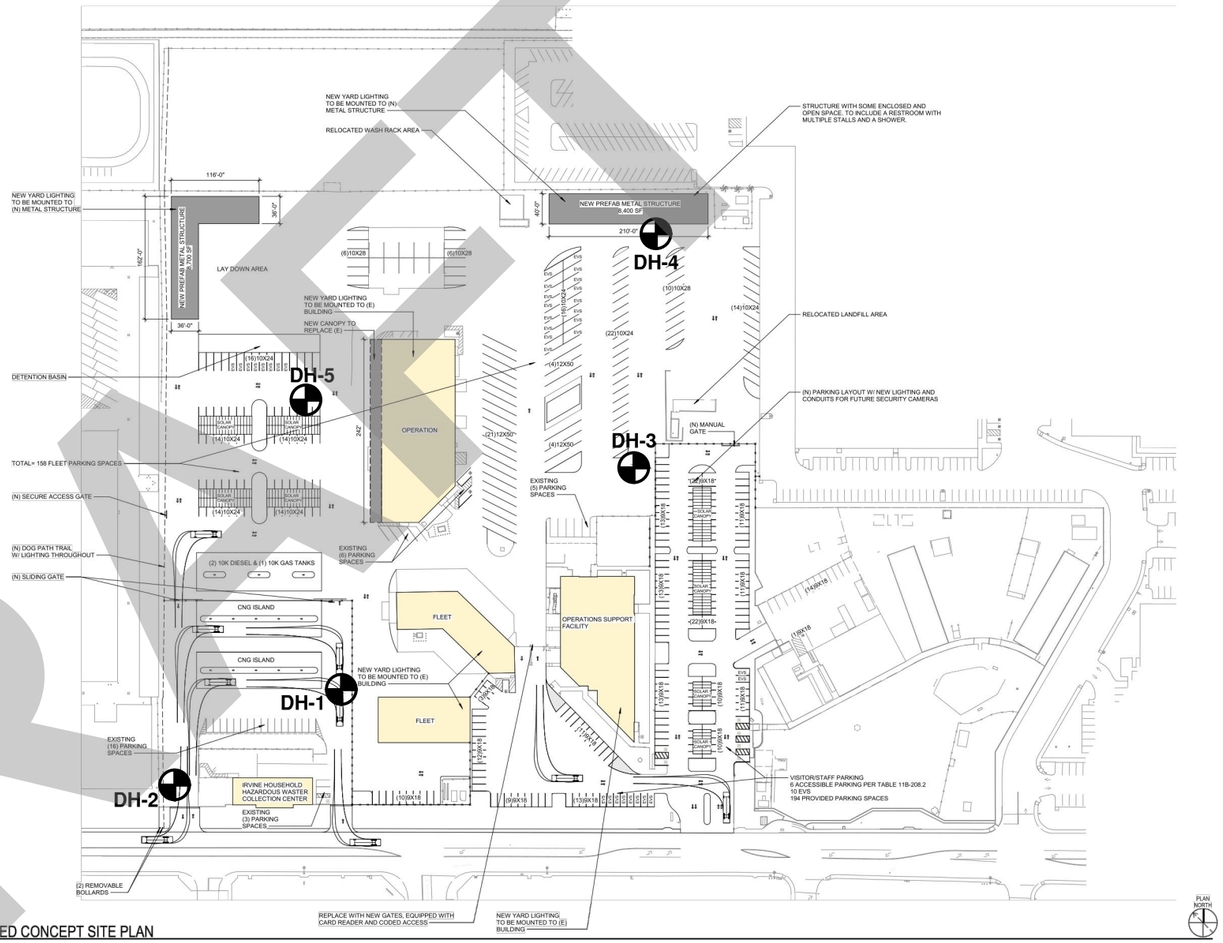

1 PROPOSED CONCEPT SITE PLAN

OPERATIONS SUPPORT FACILITY MARCH 02, 2021

LIONAKIS

GEOTECHNICAL LEGEND

DH-1 APPROXIMATE DRILL HOLE LOCATION

0 200'

GEOTECHNICAL MAP

GMU

Date:	May 4, 2021
Project No.:	21-031-00

Plate 2

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APPENDIX A

Geotechnical Exploration Procedures and Logs

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APPENDIX A

GMU GEOTECHNICAL EXPLORATION PROCEDURES AND LOGS

Our exploration at the subject site consisted of 5 drill holes. The estimated locations of the explorations are shown on Plate 2 – Geotechnical Map. Our drill holes were logged by a Certified Engineering Geologist, and California Modified, bulk, and SPT samples of the excavated soils were collected. "Undisturbed" samples were taken using a 3.0-inch outside-diameter California Modified sampler, which contains a 2.416-inch-diameter brass sample sleeve 6 inches in length. Standard penetration testing (SPT) with a 2.0-inch outside-diameter split spoon sampler without liners was performed in the borings during advancement. Blow counts recorded during sampling from the California Modified and SPT sampler are shown on the drill hole logs. The logs of each drill hole are contained in this Appendix A, and the Legend to Logs is presented as Plates A-1 and A-2.

The geologic and engineering field descriptions and classifications that appear on these logs are prepared according to Corps of Engineers and Bureau of Reclamation standards. Major soil classifications are prepared according to the Unified Soil Classification System as modified by ASTM Standard No. 2487. Since the descriptions and classifications that appear on the Log of Drill Hole are intended to be that which most accurately describe a given interval of a drill hole (frequently an interval of several feet), discrepancies do occur in the Unified Soil Classification System nomenclature between that interval and a particular sample in that interval. For example, an 8-foot-thick interval in a log may be identified as silty sand (SM) while one sample taken within the interval may have individually been identified as sandy silt (ML). This discrepancy is frequently allowed to remain to emphasize the occurrence of local textural variations in the interval.

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MAJOR DIVISIONS			Group Letter	Symbol	TYPICAL NAMES
COARSE-GRAINED SOILS More Than 50% Retained On No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	GRAVELS 50% or More of Coarse Fraction Retained on No.4 Sieve	Clean Gravels	GW		Well Graded Gravels and Gravel-Sand Mixtures, Little or No Fines.
			GP		Poorly Graded Gravels and Gravel-Sand Mixtures Little or No Fines.
		Gravels With Fines	GM		Silty Gravels, Gravel-Sand-Silt Mixtures.
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures.
	SANDS More Than 50% of Coarse Fraction Passes No.4 Sieve	Clean Sands	SW		Well Graded Sands and Gravelly Sands, Little or No Fines.
			SP		Poorly Graded Sands and Gravelly Sands, Little or No Fines.
		Sands With Fines	SM		Silty Sands, Sand-Silt Mixtures.
			SC		Clayey Sands, Sand-Clay Mixtures.
FINE-GRAINED SOILS 50% or More Passe The No.200 Sieve Based on The Material Passing The 3-Inch (75mm) Sieve. Reference: ASTM Standard D2487	SILTS AND CLAYS Liquid Limit Less Than 50%		ML		Inorganic Silts, Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts With Slight Plasticity.
			CL		Inorganic Clays of Low To Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
			OL		Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS Liquid Limit 50% or Greater		MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soils, Elastic Silts.
			CH		Inorganic Clays of High Plasticity, Fat Clays.
			OH		Organic Clays of Medium To High Plasticity, Organic Silts.
HIGHLY ORGANIC SOILS			PT		Peat and Other Highly Organic Soils.

The descriptive terminology of the logs is modified from current ASTM Standards to suit the purposes of this study

ADDITIONAL TESTS

DS = Direct Shear
HY = Hydrometer Test
TC = Triaxial Compression Test
UC = Unconfined Compression
CN = Consolidation Test
(T) = Time Rate
EX = Expansion Test
CP = Compaction Test
PS = Particle Size Distribution
EI = Expansion Index
SE = Sand Equivalent Test
AL = Atterberg Limits
FC = Chemical Tests
RV = Resistance Value
SG = Specific Gravity
SU = Sulfates
CH = Chlorides
MR = Minimum Resistivity
pH
(N) = Natural Undisturbed Sample
(R) = Remolded Sample
CS = Collapse Test/Swell-Settlement

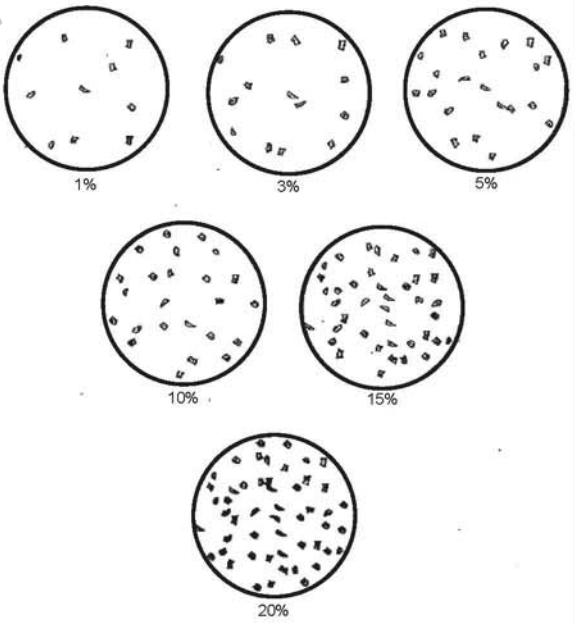
GEOLOGIC NOMENCLATURE

B = Bedding C = Contact J = Joint
F = Fracture Flt = Fault S = Shear
RS = Rupture Surface = Seepage
= Groundwater

SAMPLE SYMBOLS

Undisturbed Sample (California Sample)
Undisturbed Sample (Shelby Tube)
Bulk Sample
Unsuccessful Sampling Attempt
SPT Sample

5
10 Blows per 6-Inches Penetration
15
10: 10 Blows for 12-Inches Penetration
6/4": 6 Blows for 4-Inches Penetration
P: Push
(13): Uncorrected Blow Counts ("N" Values) for 12-Inches Penetration- Standard Penetration Test (SPT)



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LEGEND TO LOGS

ASTM Designation: D 2487
(Based on Unified Soil Classification System)

Plate
A-1

SOIL DENSITY/CONSISTENCY

FINE GRAINED

Consistency	Field Test	SPT (#blows/foot)	Mod (#blows/foot)
Very Soft	Easily penetrated by thumb, exudes between fingers	<2	<3
Soft	Easily penetrated one inch by thumb, molded by fingers	2-4	3-6
Firm	Penetrated over 1/2 inch by thumb with moderate effort	4-8	6-12
Stiff	Penetrated about 1/2 inch by thumb with great effort	8-15	12-25
Very Stiff	Readily indented by thumbnail	15-30	25-50
Hard	Indented with difficulty by thumbnail	>30	>50

COARSE GRAINED

Density	Field Test	SPT (#blows/foot)	Mod (#blows/foot)
Very Loose	Easily penetrated with 0.5" rod pushed by hand	<4	<5
Loose	Easily penetrated with 0.5" rod pushed by hand	4-10	5-12
Medium Dense	Easily penetrated 1' with 0.5" rod driven by 5lb hammer	10-30	12-35
Dense	Dificult to penetrat 1' with 0.5" rod driven by 5lb hammer	31-50	35-60
Very Dense	Penetrated few inches with 0.5" rod driven by 5lb hammer	>50	>60

BEDROCK HARDNESS

Density	Field Test	SPT (#blows/foot)
Soft	Can be crushed by hand, soil like and structureless	1-30
Moderately Hard	Can be grooved with fingernails, crumbles with hammer	30-50
Hard	Can't break by hand, can be grooved with knife	50-100
Very Hard	Scratches with knife, chips with hammer blows	>100

MODIFIERS

Trace	1%
Few	1-5%
Some	5-12%
Numerous	12-20%
Abundant	>20%

GRAIN SIZE

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than a basketball
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

MOISTURE CONTENT

Dry- Very little or no moisture
Damp- Some moisture but less than optimum
Moist- Near optimum
Very Moist- Above optimum
Wet/Saturated- Contains free moisture

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GMU

LEGEND TO LOGS

ASTM Designation: D 2487
(Based on Unified Soil Classification System)

Plate
A-2

Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-1

Sheet 1 of 3

Date(s) Drilled	**2/19/2021**	Logged By	**DW**	Checked By	**ABM**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling**	Total Depth of Drill Hole	**51.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**169.0**
Groundwater Depth [Elevation], feet	**NA []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and Bulk**	Drill Hole Backfill	**Native**
Remarks				Driving Method and Drop	**140lb hammer; 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	NUMBER OF BLOWS / 6"	DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			ARTIFICIAL FILL (Qaf)		ASPHALT CONCRETE - 3.5"				19		CP, DS, FC
					SANDY CLAY (CL); brown, moist, firm, fine- to medium-grained sand						
165	5		**YOUNGER ALLUVIAL DEPOSITS (Qyfa)**		SANDY CLAY (CL); yellowish brown, moist, stiff, fine- to medium-grained sand		4 5 9	140	16	108	DS
					SILTY SAND (SM) with CLAY; yellowish brown, damp to moist, medium dense, fine- to medium-grained sand						
160	10		Some fine-grained sand stringers		SILTY CLAY (CL); yellowish brown, moist, stiff, some fine-grained sand		3 5 7	140			
155	15				SANDY CLAY (CL); yellowish brown, moist, firm, fine to medium grained sand		3 7 7	140	21	101	
150											

DH_REV3 21-031-00.GPJ GMULAB.GPJ 4/13/21

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GMU

Drill Hole DH-1

Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-1

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		SILTY SAND (SM) with some CLAY; yellowish brown, damp, medium dense, fine- to medium-grained sand, few coarse-grained sand, rare gravel		5 6 8	140			
145	25				POORLY GRADED SAND to SILTY SAND (SP-SM); yellowish brown, damp, medium dense, fine- to medium-grained sand		7 11 8	140	9	113	
140	30				SILTY SAND (SM) with some CLAY; yellowish brown, damp, loose, fine- to medium-grained sand, trace fine-grained gravel		2 3 3	140			
135	35		Subangular gravel		Little to no CLAY, some coarse-grained sand and gravel		10 22 25	140	5	115	
130	40						3 3 4	140	13		PS
125					CLAYEY SAND (SC); yellowish brown, loose, damp, fine- to medium-grained sand						

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-1

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		SANDY CLAY (CL) with some SILT; yellowish brown, damp, firm, fine- to medium-grained sand		7 12 12	140	25	104	
120											
	50		0.5' zone of coarse-grained sand		Some coarse-grained sand		8 5 7	140			
					Total Depth 51.5' No Groundwater						

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-2

Sheet 1 of 1

Date(s) Drilled	**2/19/2021**	Logged By	**DW**	Checked By	**ABM**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling**	Total Depth of Drill Hole	**11.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**166.0**
Groundwater Depth [Elevation], feet	**NA []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and Bulk**	Drill Hole Backfill	**Native**
Remarks				Driving Method and Drop	**140lb hammer; 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
165			**ARTIFICIAL FILL (Qaf)**		ASPHALT CONCRETE - 8"						
					CLAYEY SAND to SANDY CLAY (SC-CL); dark brown, moist, medium dense/stiff, fine- to medium-grained sand						
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		SILTY SAND (SM) with some CLAY; yellowish brown, damp, medium dense, fine- to medium-grained sand						
	5				Few coarse-grained sand, rare gravel		3 5 9	140	14	116	
160											
	10				SANDY CLAY (CL); brown to yellowish brown, moist, stiff, fine- to medium-grained sand		4 7 11	140			
155					Total Depth = 11.5' No Groundwater						

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-3

Sheet 1 of 2

Date(s) Drilled	**2/19/2021**	Logged By	**DW**	Checked By	**ABM**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling**	Total Depth of Drill Hole	**21.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**175.0**
Groundwater Depth [Elevation], feet	**NA []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and Bulk**	Drill Hole Backfill	**Native**
Remarks				Driving Method and Drop	**140lb hammer; 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			ARTIFICIAL FILL (Qaf)		ASPHALT CONCRETE - 4"				25		EI, RV
					SANDY CLAY (CL); brown, moist, stiff, fine- to medium-grained sand						
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		CLAYEY SAND (SC); yellowish brown, damp, medium dense, fine- to medium-grained sand						
170	5				SILTY SAND (SM); yellowish brown, damp, loose, fine- to medium- grained sand, few coarse-grained sand		2 2 3	140			
165	10				SANDY CLAY to CLAYEY SAND (CL-SC); light brown, damp to moist, stiff/medium dense, fine- to medium-grained sand, few coarse-grained sand		9 10 15	140	21	103	
160	15				Becomes damp, medium dense/firm, little to no coarse-grained sand		3 3 5	140			

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-3

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		SANDY CLAY to CLAYEY SAND (CL-SC); light brown, damp to moist, stiff/medium dense, fine- to medium-grained sand		8 10 12	140	20	101	
					Total Depth = 21.5' No Groundwater						

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-4

Sheet 1 of 1

Date(s) Drilled	**2/19/2021**	Logged By	**DW**	Checked By	**ABM**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling**	Total Depth of Drill Hole	**11.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**180.0**
Groundwater Depth [Elevation], feet	**NA []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and Bulk**	Drill Hole Backfill	**Native**
Remarks				Driving Method and Drop	**140lb hammer; 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			ARTIFICIAL FILL (Qaf)		ASPHALT CONRETE - 3"						
					CRUSHED MISCELLANEOUS BASE - 3"/ CLAYEY SAND (SC); brown, moist, medium dense, fine- to medium-grained sand						
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		CLAYEY SAND (SC); yellowish brown, moist, medium dense, fine- to medium-grained sand						
175	5				SILTY SAND (SM); yellowish brown, damp, loose, fine- to medium-grained sand, few coarse-grained sand		4 5 6	140	10	107	
170	10						2 1 3	140			
			Some fine-grained sand stringers		CLAYEY SAND to SANDY CLAY (SC-CL); light brown, damp, loose/soft, fine- to medium-grained sand						
					Total Depth = 11.5' No Groundwater						

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-5

Date(s) Drilled	**2/19/2021**	Logged By	**DW**	Checked By	**ABM**
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**2R Drilling**	Total Depth of Drill Hole	**51.5 feet**
Drill Rig Type	**CME 75**	Diameter(s) of Hole, inches	**8**	Approx. Surface Elevation, ft MSL	**172.0**
Groundwater Depth [Elevation], feet	**NA []**	Sampling Method(s)	**Open drive sampler with 6-inch sleeve, SPT, and Bulk**	Drill Hole Backfill	**Native**
Remarks				Driving Method and Drop	**140lb hammer; 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
170			**ARTIFICIAL FILL (Qaf)**		SILTY SAND (SM) with CLAY; brown, damp, medium dense, fine- to medium-grained sand, few coarse-grained sand and fine-grained gravel						
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		SILTY SAND (SM); yellowish brown, damp, loose, fine- to medium-grained sand						
	5						2 4 5	140	14	112	
165					Some CLAY						
	10						4 7	140			
			Some fine-grained stringers		CLAYEY SAND to SANDY CLAY (SC-CL); light brown, damp to moist, medium dense/stiff, fine- to medium-grained sand		10				
160											
	15						2 4 6	140	21	99	
155											

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-5

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
150			**YOUNGER ALLUVIAL DEPOSITS (Qyfa)** Bulk sample collected from 20-25' which was characterized as silty sand to clayey sand		SILTY SAND (SM); yellowish brown, damp, loose, fine- to medium-grained sand		2 2 3	140			
	25				Becomes dense, some CLAY		11 15 25	140	11	120	
145											
	30				CLAYEY SAND (SC); yellowish brown, damp, medium dense, fine- to medium-grained sand		4 7 9	140			
140											
	35				SILTY SAND (SM) with minor CLAY; yellowish brown, damp, medium dense, fine- to medium-grained sand		7 11 17	140	13	119	
135											
	40				Little to no CLAY		4 5 6	140			
130											

DH_REV3 21-031-00.GPJ GMULAB.GPJ 4/13/21

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Project: Irvine Operation Support Facility
Project Location: Irvine, CA
Project Number: 21-031-00

Log of Drill Hole DH-5

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	GEOLOGICAL CLASSIFICATION AND DESCRIPTION	ORIENTATION DATA	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: NUMBER OF BLOWS / 6"	SAMPLE DATA: DRIVING WEIGHT, lbs	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
			YOUNGER ALLUVIAL DEPOSITS (Qyfa)		SILTY SAND (SM) with minor CLAY;		10	140	12	119	PS
			Faint structure		yellowish brown, damp, dense, fine- to		16				
					meidum-grained sand		21				
125											
	50						5	140			
							5				
							6				
					SANDY CLAY (CL); light brown, moist, stiff, fine-grained sand						
					Total Depth = 51.5'						
					No Groundwater						

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APPENDIX B

Geotechnical Laboratory Procedures and Test Results

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APPENDIX B

GMU GEOTECHNICAL LABORATORY PROCEDURES AND TEST RESULTS

MOISTURE AND DENSITY

Field moisture content and in-place density were determined for each 6-inch sample sleeve of undisturbed soil material obtained from the drill holes. The field moisture content was determined in general accordance with ASTM Test Method D 2216 by obtaining one-half the moisture sample from each end of the 6-inch sleeve. The in-place dry density of the sample was determined by using the wet weight of the entire sample.

At the same time the field moisture content and in-place density were determined, the soil material at each end of the sleeve was classified according to the Unified Soil Classification System. The results of the field moisture content and in-place density determinations are presented on the right-hand column of the Log of Drill Hole and are summarized on Table B-1. The results of the visual classifications were used for general reference.

PARTICLE SIZE DISTRIBUTION

As part of the engineering classification of the materials underlying the site, samples were tested to determine the distribution of particle sizes. The distribution was determined in general accordance with ASTM Test Method D 422 using U.S. Standard Sieve No. 200.

EXPANSION TESTS

To provide a standard definition of one-dimensional expansion, a test was performed on typical on-site materials in general accordance with ASTM Test Method D 4829. The result from this test procedure is reported as an "expansion index". The results of this test are contained in this Appendix B and also Table B-1.

CHEMICAL TESTS

The corrosion potential of typical on-site materials under long-term contact with both metal and concrete was determined by chemical and electrical resistance tests. The soluble sulfate test for potential concrete corrosion was performed in general accordance with California Test Method 417, the minimum resistivity test for potential metal corrosion was performed in general accordance with California Test Method 643, and the concentration of soluble chlorides was determined in general accordance with California Test Method 422. The results of these tests are contained in this Appendix B and also Table B-1.

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COMPACTION TESTS

A bulk sample representative of the on-site materials was tested to determine the maximum dry density and optimum moisture content of the soil. These compactive characteristics were determined in general accordance with ASTM Test Method D 1557. The results of this test are contained in this Appendix B and also Table B-1.

CONSOLIDATION TESTS

The one-dimensional consolidation properties of "undisturbed" samples were evaluated in general accordance with the provisions of ASTM Test Method D 2435. Sample diameter was 2.416 inches and sample height was 1.00 inch. Water was added during the test at various normal loads to evaluate the potential for hydro-collapse and to produce saturation during the remainder of the testing. Consolidation readings were taken regularly during each load increment until the change in sample height was less than approximately 0.0001 inch over a two-hour period. The graphic presentation of consolidation data is a representation of volume change in change in axial load.

DIRECT SHEAR STRENGTH TEST

A direct shear test was performed on typical on-site materials. The general philosophy and procedure of the test was in accord with ASTM Test Method D 3080 - "Direct Shear Tests for Soils Under Consolidated Drained Conditions".

The test is a single shear test and is performed using a sample diameter of 2.416 inches and a height of 1.00 inch. The normal load is applied by a vertical dead load system. A constant rate of strain is applied to the upper one-half of the sample until failure occurs. Shear stress is monitored by a strain gauge-type precision load cell and deflection is measured with a digital dial indicator. This data is transferred electronically to data acquisition software which plots shear strength vs. deflection. The shear strength plots are then interpreted to determine either peak or ultimate shear strengths. Residual strengths were obtained through multiple shear box reversals. A strain rate compatible with the grain size distribution of the soils was utilized. The interpreted result of this test is shown in this Appendix B.

R-VALUE TESTS

Bulk samples representative of the underlying on-site materials were tested to measure the response of a compacted sample to a vertically applied pressure under specific conditions. The R-value of a material is determined when the material is in a state of saturation such that water will be exuded from the compacted test specimen when a 16.8 kN load (2.07 MPa) is applied. The results from these test procedures are reported in this Appendix B.

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TABLE B-1
SUMMARY OF SOIL LABORATORY DATA

Sample Information			Geologic Unit	USCS Group Symbol	In Situ Water Content, %	In Situ Dry Unit Weight, pcf	In Situ Saturation, %	Sieve/Hydrometer				Atterberg Limits			Compaction		Expansion Index	R-Value	Chemical Test Results			
Boring Number	Depth, feet	Elevation, feet						Gravel, %	Sand, %	<#200, %	<2μ, %	LL	PL	PI	Maximum Dry Unit Weight, pcf	Optimum Water Content, %			pH	Sulfate (ppm)	Chloride (ppm)	Min. Resistivity (ohm/cm)
DH-1	0	169.0	Qaf/Qyfa	CL	19.0										119.0	12.0			8.7	252	174	879
DH-1	5	164.0	Qyfa	CL	15.6	108	77															
DH-1	15	154.0	Qyfa	CL	21.3	101	89															
DH-1	25	144.0	Qyfa	SM	9.5	113	54															
DH-1	35	134.0	Qyfa	SM	5.0	115	30															
DH-1	40	129.0	Qyfa	SM-SC	12.8					40												
DH-1	45	124.0	Qyfa	CL	16.5	112	92															
DH-2	5	161.0	Qyfa	SC	13.8	116	85															
DH-3	0	175.0	Qaf/Qyfa	CL	24.9												113	5				
DH-3	10	165.0	Qyfa	CL	21.3	103	93															
DH-3	20	155.0	Qyfa	CL	19.8	101	83															
DH-4	5	175.0	Qyfa	SM	9.9	107	48															
DH-5	5	167.0	Qyfa	SM/SC	14.3	112	79															
DH-5	15	157.0	Qyfa	CL	21.0	99	83															
DH-5	25	147.0	Qyfa	SM	10.6	120	74															
DH-5	35	137.0	Qyfa	SM	12.7	119	85															
DH-5	45	127.0	Qyfa	SM-SC	12.2	119	82			43												

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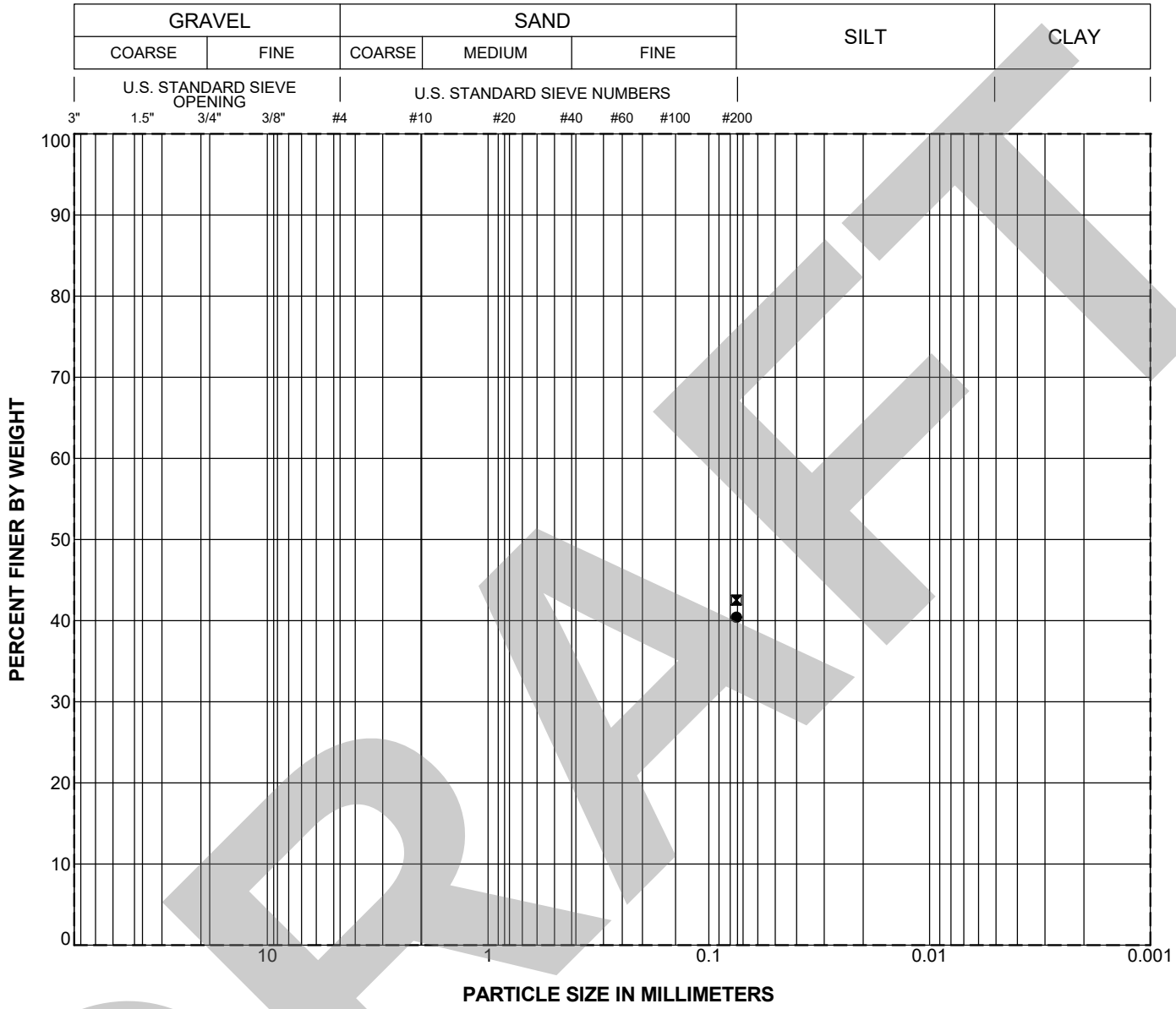
Project: Irvine Operation Support Facility
Project No. 21-031-00



Boring Number	Depth (feet)	Geologic Unit	Symbol	LL	PI	Classification
DH-1	40.0	Qyfa	●			SILTY SAND with CLAY (SM-SC)
DH-5	45.0	Qyfa	⊠			SILTY SAND with CLAY (SM-SC)

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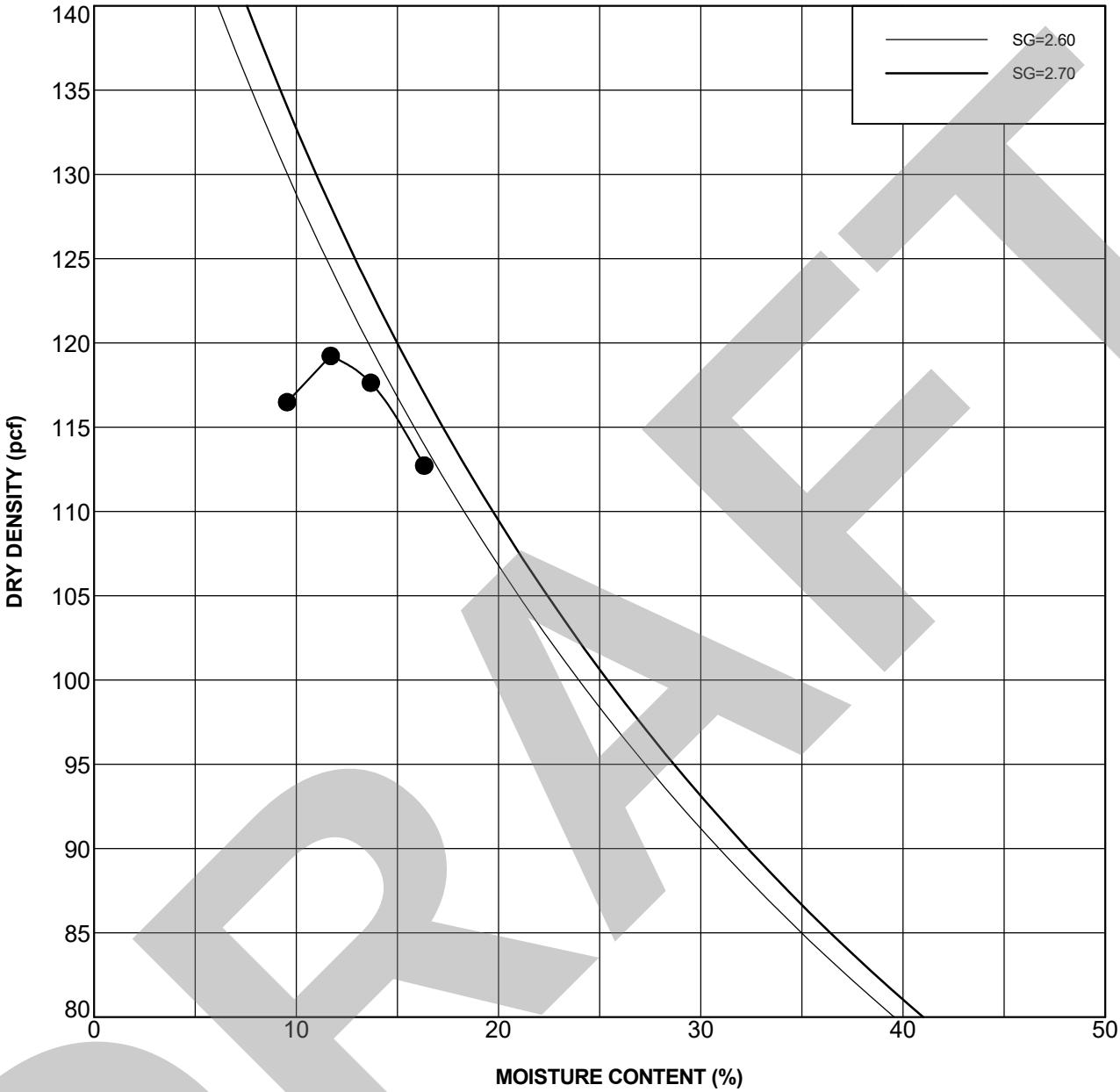
GMU_GRAIN_SIZE 21-031-00.GPJ 3/25/21

PARTICLE SIZE DISTRIBUTION

Project: Irvine Operation Support Facility
Project No. 21-031-00



Boring Number	Depth (feet)	Geologic Unit	Symbol	Maximum Dry Density, pcf	Optimum Moisture Content, %	Classification
DH-1	0.0	Qaf/Qyfa	●	119	12	SANDY CLAY (CL)

DVTCOMP 21-031-00.GPJ 3/9/21

COMPACTION TEST DATA

Project: Irvine Operation Support Facility
Project No. 21-031-00

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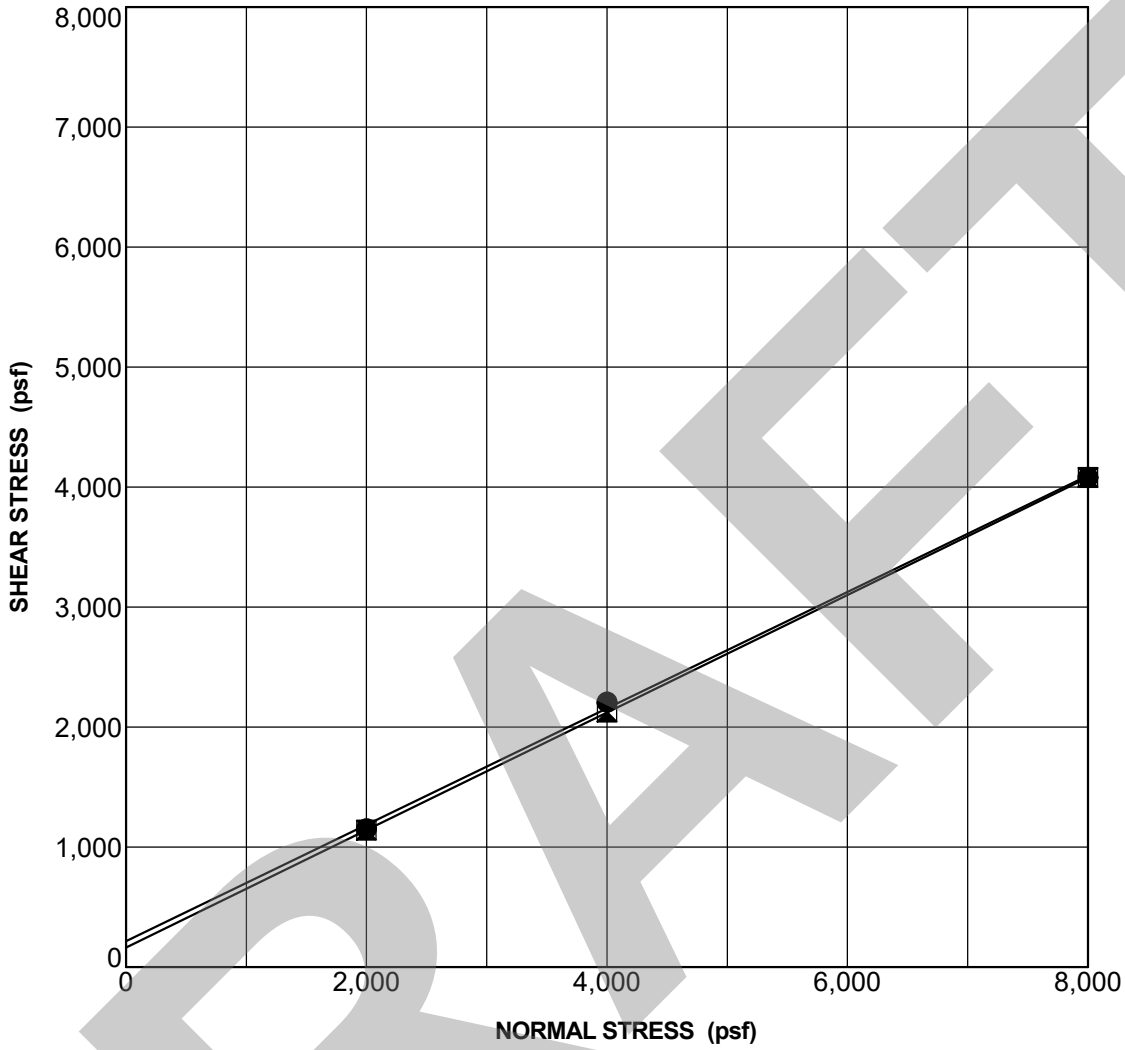

SAMPLE AND TEST DESCRIPTION
Sample Location: DH-1 @ 0.0 ft **Geologic Unit:** Qaf/Qyfa **Classification:** SANDY CLAY (CL) **Strain Rate (in/min):** 0.005 **Sample Preparation:** Remolded **Notes:** Remolded 90% compaction at optimum

STRENGTH PARAMETERS		
STRENGTH TYPE	**COHESION (psf)**	**FRICTION ANGLE (degrees)**
● Peak Strength	216	25.9
⊠ Ultimate Strength	162	26.1

SHEAR TEST DATA

Project: Irvine Operation Support Facility
Project No. 21-031-00

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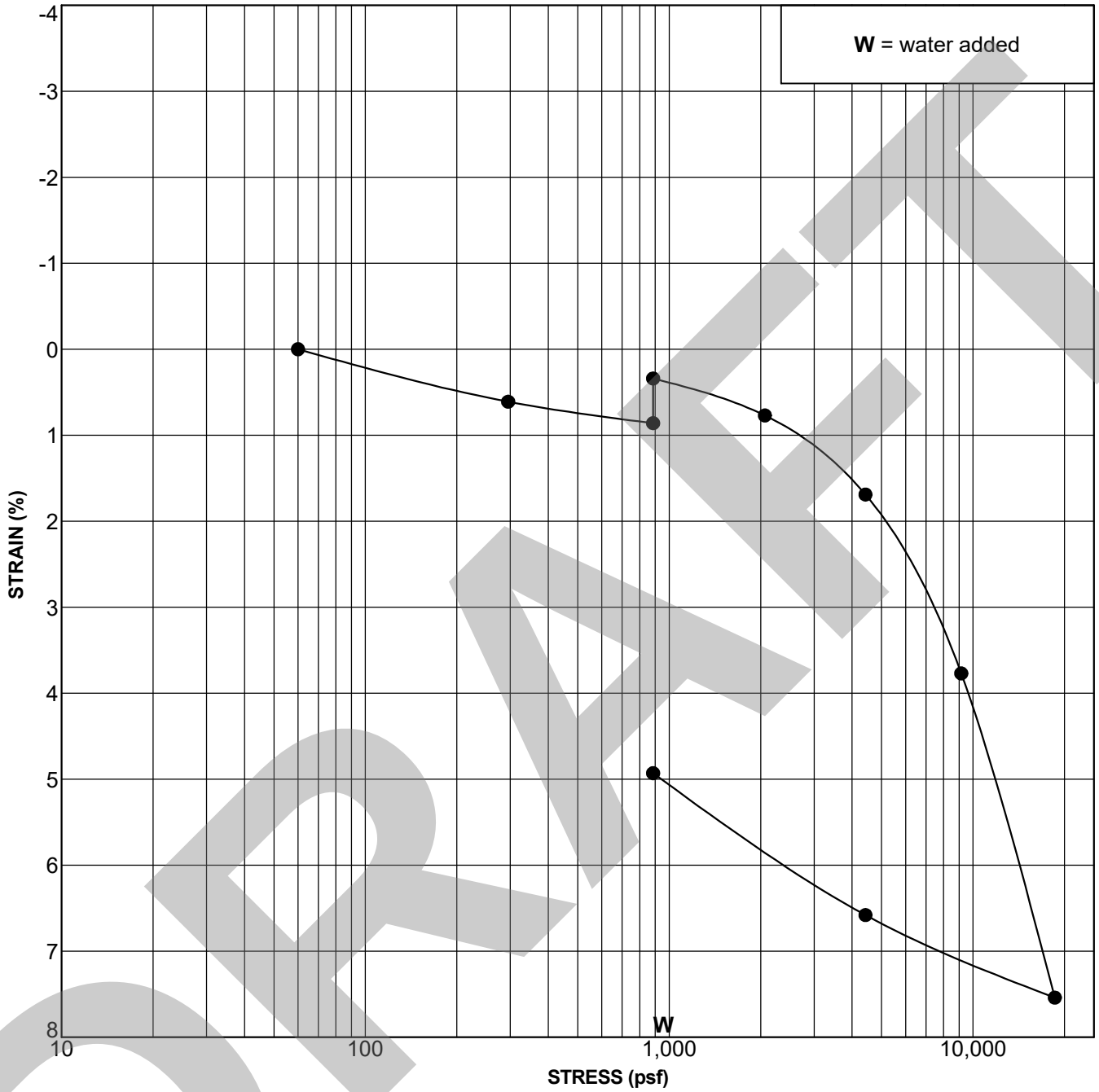
GMU_DIRECT_SHEAR 21-031-00.GPJ GM&U.GDT 3/9/21



Boring Number	Depth (feet)	Geologic Unit	Symbol	In Situ or Remolded Sample	% Hydro-Collapse	Classification
DH-1	5.0	Qyfa	●	In Situ	-0.52	SANDY CLAY (CL)

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GMU_CONSOL 21-031-00.GPJ GM&U.GDT 3/9/21

CONSOLIDATION TEST DATA

Project: Irvine Operation Support Facility

Project No. 21-031-00

APPENDIX B-1

Previous Geotechnical Laboratory Test Results by GMU

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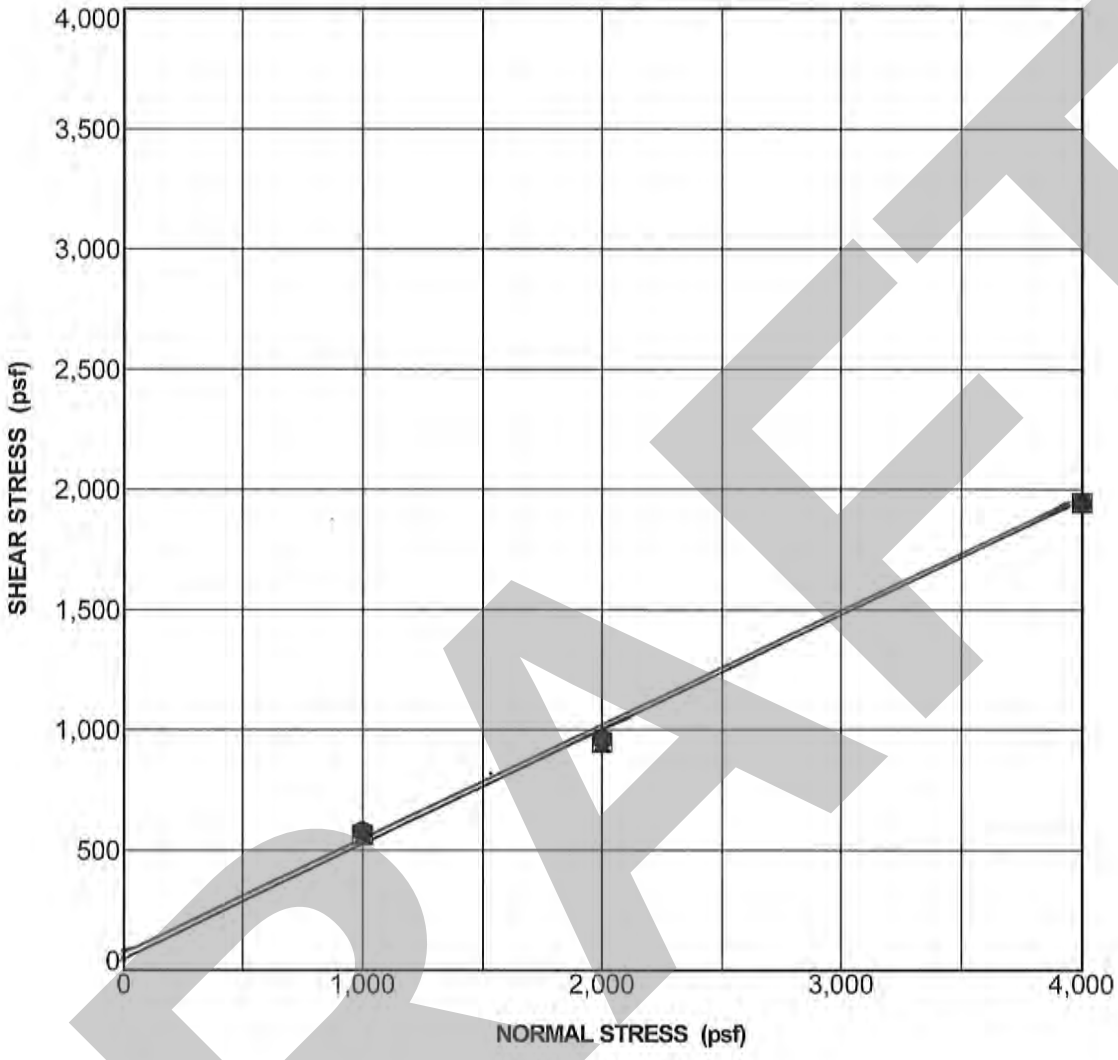

SAMPLE AND TEST DESCRIPTION
Sample Location: DH-06 @ 7.5 ft **Geologic Unit:** Qyfa **Classification:** SANDY CLAY (CL) **Strain Rate (in/min):** 0.005 **Sample Preparation:** Undisturbed **Notes:** Sample saturated prior and during shearing

STRENGTH PARAMETERS		
STRENGTH TYPE	**COHESION (psf)**	**FRICTION ANGLE (degrees)**
● Peak Strength	84	25.0
⊠ Ultimate Strength	66	25.0

SHEAR TEST DATA

Project: Discovery Business Center Phase II

Project No. 15-176-00

GMU GEOTECHNICAL, INC.

GMU_DIRECT_SHEAR 15-176-00.GPJ GMU.GDT 4/11/16

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APPENDIX C

Liquefaction Analysis

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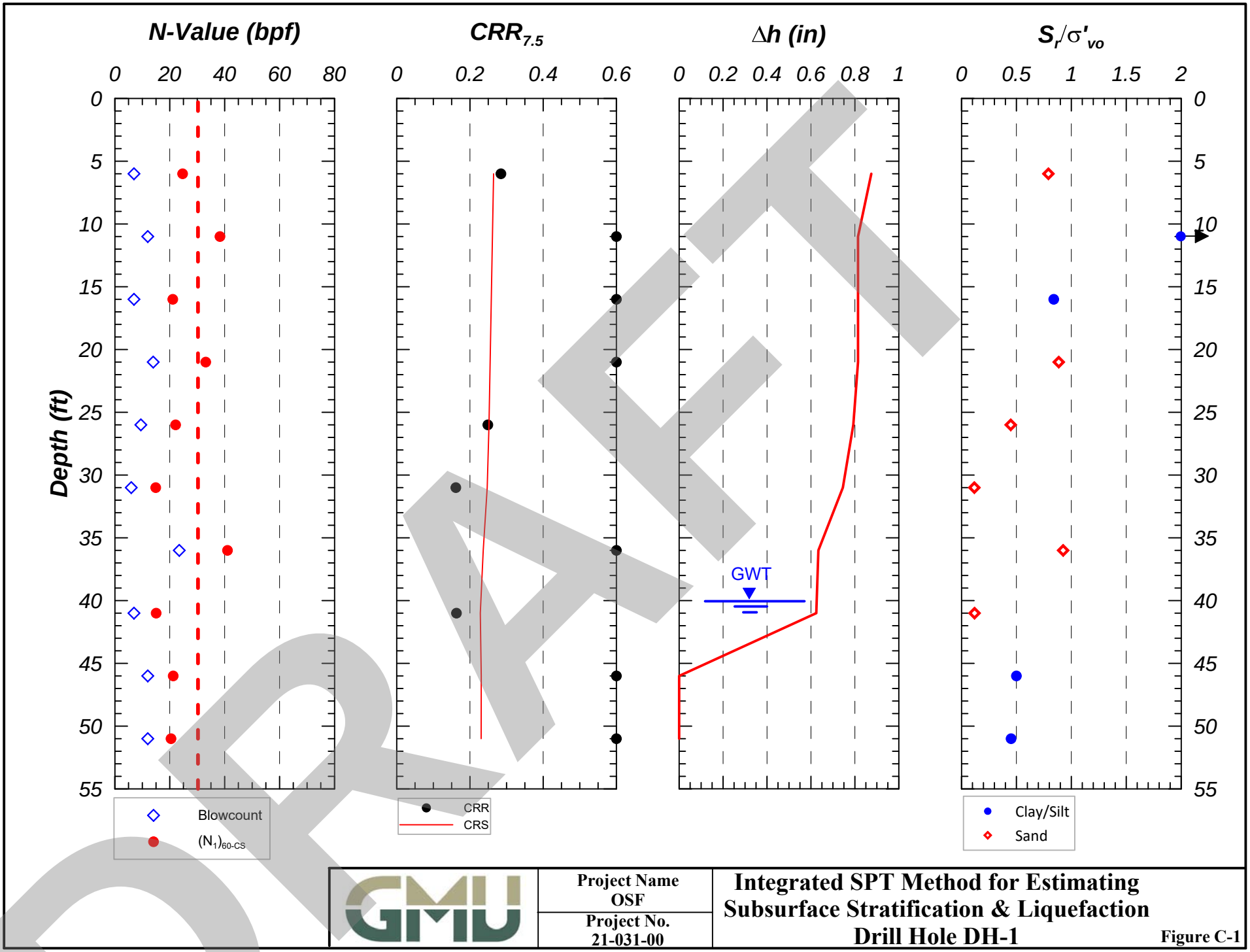

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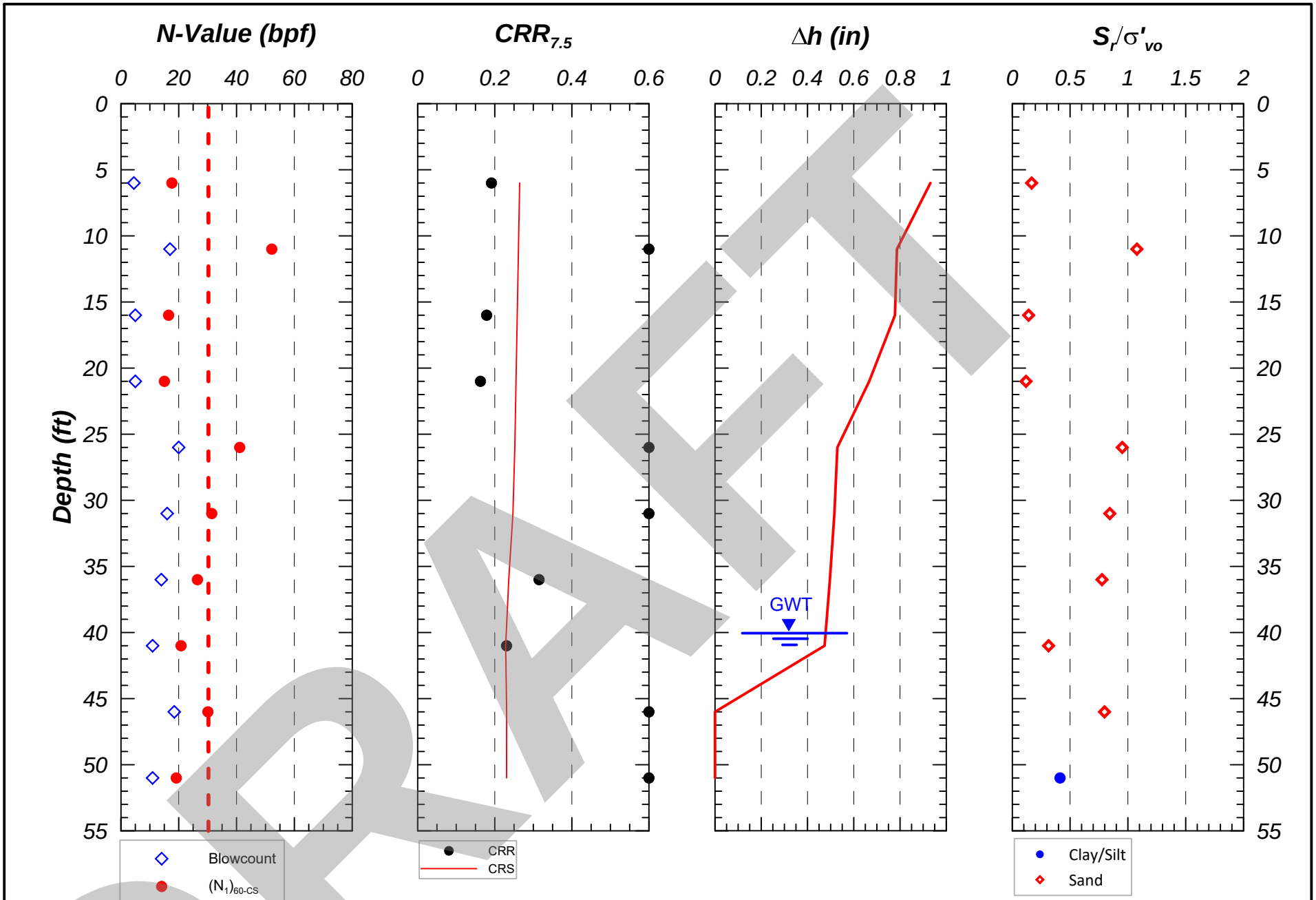
GMU	Project Name OSF Project No. 21-031-00	Integrated SPT Method for Estimating Subsurface Stratification & Liquefaction Drill Hole DH-1

Figure C-1

DH-1.xls, DH-1.grf

Date: April 2021



GMU	Project Name OSF Project No. 21-031-00	Integrated SPT Method for Estimating Subsurface Stratification & Liquefaction Drill Hole DH-5

Figure C-2

DH-5.xls, DH-5.grf

Date: April 2021

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APPENDIX D

Concrete Flatwork Recommendations

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TABLE 3. FLATWORK RECOMMENDATIONS
IOSF Site Project

Description	Subgrade Preparation	Minimum Concrete Thickness (Full)	Edge Thickness	Reinforcement[2]	Joint Spacing (Maximum)	Cement Type	Sulfate Resistance
Isolated Concrete Sidewalks and Walkways (≤6 feet in width) [4]	1) 3% over optimum to 18" [1], 2) optional 2" of sand or well graded rock (i.e., Class II base or equiv.) above moisture conditioned subgrade.	4 inches	Not Required	1) No. 3 bars at 18" o.c. [2], 2) where adjacent to curbs or structures and at cold joints/ expansion joints use dowels: No. 3 bars at 24" o.c. [5]	6 feet	II/V	(3)
Concrete Walkways, Patios, Entryways and Courtyards (> 6 feet in width) [4]	1) 3% over optimum to 18"[1], 2) optional 2" of sand or well graded rock (i.e., Class II base or equiv.) above moisture conditioned subgrade.	5 inches	Where adjacent to landscape areas – 12" from adjacent finish grade. Min. 8" width	1) No. 3 bars at 18" o.c. [2] extend into thickened edge, 2) Thickened Edge: one No. 3 bar placed in long direction, 3) dowel into adjacent curbs or structures and across cold joints/ expansion joints w/No. 3 bars at 18" o.c. [5]	6 feet	II/V	(3)
Concrete Driveways, Trash Enclosures and Fire Access Lanes [4]	1) 3% over optimum to 18" [1], 2) 6 inches of sand or well graded rock (i.e., Class II base or equiv.) above moisture conditioned subgrade.	8 inches	Where adjacent to landscape areas - 12" from adjacent finish grade. Min. 8" width	1) No. 3 bars at 18" o.c. [2] extend into thickened edge, 2) Thickened Edge: one No. 3 bar placed in long direction, 3) dowel into adjacent curbs or structures and across cold joints/ expansion joints w/No. 3 bars at 18" o.c. [5]	10 feet	II/V	(3)

(1) The moisture content of the subgrade must be verified by the geotechnical consultant prior to sand/rock placement.
(2) Reinforcement to be placed both ways and at or above the mid-point of the slab (i.e., a minimum of 2.0 to 2.5 inches above the prepared subgrade).
(3) Soils having negligible levels of sulfates as defined by CBC are expected. Concrete mix design shall be selected by the concrete designer. Concrete mix design is outside the geotechnical engineer's purview.
(4) Where concrete/ flatwork is adjacent a stucco surface, a ¼" to ½" foam separation/expansion joint should be used.
(5) If dowels are placed in cored holes, the core holes shall be placed at alternating in-plane angles (i.e., not cored straight into slab).

General Note: Minor deviations to the above recommendations may be required at the discretion of the soils engineer or his representative.

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ATTACHMENT G

WATERSHED MAP, COUNTY DRAINAGE MAPS, IMPAIRED WATER BODIES LIST AND TMDL LIST

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8	San Diego Creek Reach 1	River & Stream	80111000 / 18070201	• Fecal Coliform
				  ◦ Other Urban Runoff
				  ◦ Urban Runoff/Storm Sewers
				• Nutrients
				  ◦ Source Unknown
				• Pesticides
				  ◦ Unknown Nonpoint Source
				• Sedimentation/Siltation
				  ◦ Source Unknown
				• Selenium
				  ◦ Source Unknown
				• Toxaphene
				  ◦ Source Unknown

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8	Newport Bay, Lower (entire lower bay, including Rhine Channel, Turning Basin and South Lido Channel to east end of H-J Moorings)	Bay & Harbor	80114000 / 18070201	• Chlordane ◦ See TMDL documentation	767 Acres	2006	5B	2013
				• Copper ◦ Marinas and Recreational Boating	767 Acres	2006	5A	2019
				• DDT (Dichlorodiphenyltrichloroethane) ◦ See TMDL documentation	767 Acres	1990	5B	2013
				• Indicator Bacteria ◦ Source Unknown	767 Acres	2010	5B	2000
				The following LOEs had been incorrectly linked to Lower Newport Bay during the 2010 cycle : 8147, 8148, 8149, 8150, 8151, 8152, 8153, 8154, 8155, 8156, 8157, 8158, 8159, 8160, 8161, 8162, 28355, 28357, 28361, 28367, 28373, 28377, 28379, 28381, 28383. They have not been used in the Final Use Rating in the 2014 cycle and will be retired prior to the next cycle. They have been copied over to Upper Newport Bay (where the sampling points are located) and have new LOE #'s. LOE 26162 was created during the 2010 cycle and incorrectly combined sampling locations in both Upper and Lower Newport Bay. The data in LOE 26162 has been reanalyzed and 2 new LOEs have been created for those data in the proper waterbodies. LOE 26162 is not used in the Final Use Rating in the 2014 cycle and will be retired prior to the next cycle. In the 2010 cycle, the Shellfish Harvest Objective that was used in the LOEs was the Ocean Plan Total Coliform value, rather than the existing Region 8 Basin Plan Objective that was based on Fecal Coliform. While combining the LOEs written using the Ocean Plan Total Coliform objective results in a delisting for the Shellfish Harvest Beneficial Use, analysis of the 2008 -2010 Fecal Coliform data from the Beach Watch program resulted in 7 months of exceedance out of 23 months (where samples were collected) and based on weight of evidence, the decision was made to leave the Shellfish Harvest listing in place for Fecal Coliform.				
				• Nutrients ◦ Source Unknown	767 Acres	1992	5B	1999
				• PCBs (Polychlorinated biphenyls) ◦ See TMDL documentation	767 Acres	1990	5B	2013
				• Toxicity ◦ Source Unknown	767 Acres	2014	5A	2019

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8	Newport Bay, Upper (Ecological Reserve)	Estuary	80111000 / 18070201	• Chlordane ◦ See TMDL documentation	653 Acres	2006	5B	2013
				• Copper ◦ Marinas and Recreational Boating	653 Acres	2006	5A	2007
				• DDT (Dichlorodiphenyltrichloroethane) ◦ See TMDL documentation	653 Acres	2006	5B	2013
				• Indicator Bacteria ◦ Source Unknown	653 Acres	2010	5B	2000
				The following LOEs had been incorrectly linked to Upper Newport Bay during the 2010 cycle : 8075, 8076, 8077 and 8078. They have not been used in the Final Use Rating in the 2014 cycle and will be retired prior to the next cycle. They have been copied over to Lower Newport Bay (where the sampling points are located) and have new LOE #'s.				
				• Malathion ◦ Source Unknown	653 Acres	2014	5A	2027
				• Nutrients ◦ Source Unknown	653 Acres	2006	5B	1999
				• PCBs (Polychlorinated biphenyls) ◦ See TMDL documentation	653 Acres	2006	5B	2013
				• Sedimentation/Siltation ◦ Agriculture ◦ Channel Erosion ◦ Construction/Land Development ◦ Erosion/Siltation	653 Acres	2006	5B	1999
				• Toxicity ◦ Source Unknown	653 Acres	2014	5A	2027

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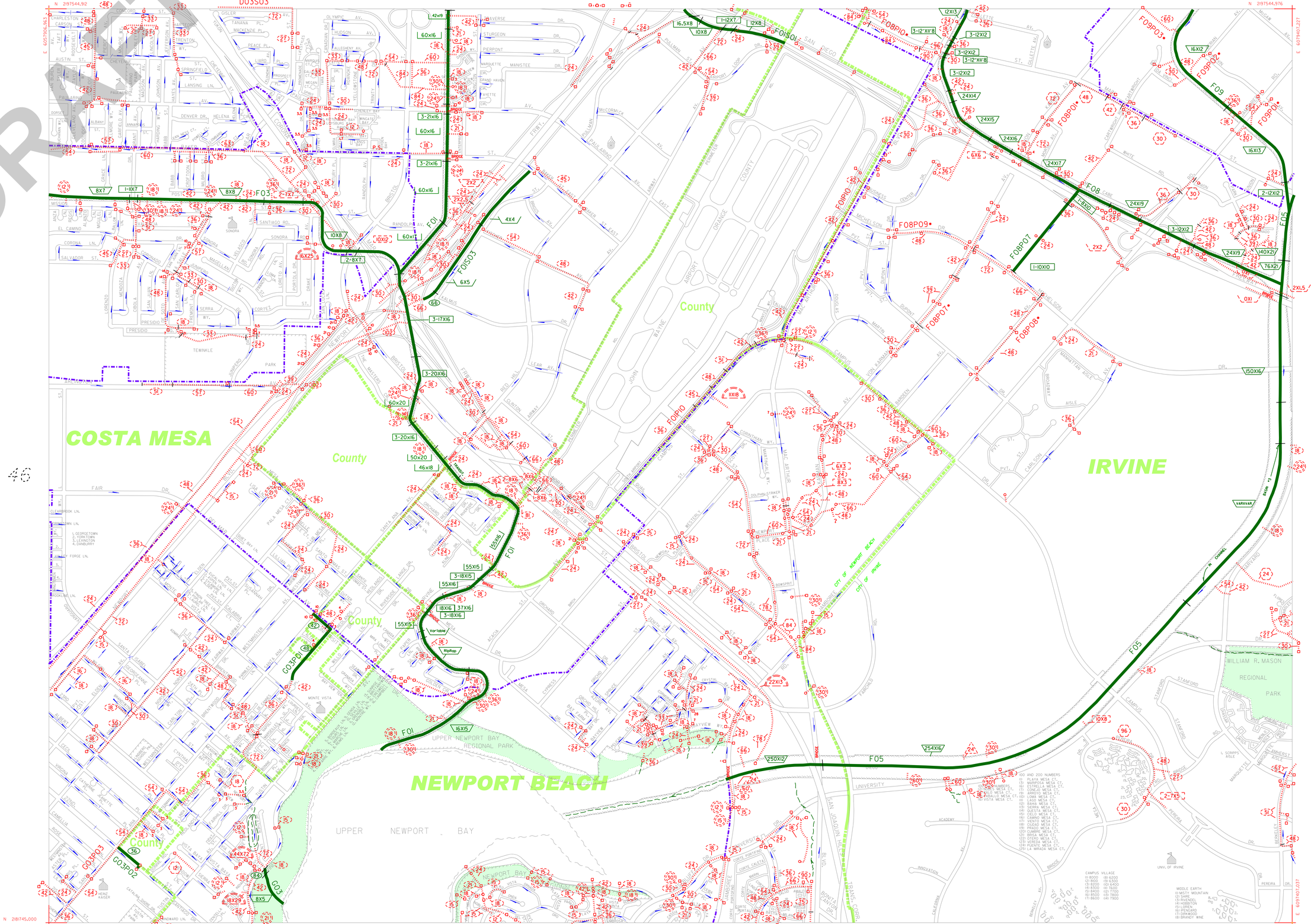

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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASE MAP OF DRAINAGE FACILITIES IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
S. GUTIERREZ	JAN. 26 2012	47	MAPS-113-3

- Channel Drainage Area Boundary
- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G G Greenbelt
- P.S. P.S. Pump Station
- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- OCFCD Basins or Reservoirs

Ownership (If other than City or County): Private = P State = S Federal = F

EXISTING FACILITIES

O.C.F.C.D.	LOCAL	
		Earth Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Trapezoidal Channel (base width by height in feet)
		Reinforced Concrete Rectangular Channel (base width by height in feet)
		Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
		Reinforced Concrete Pipe (RCP) (diameter in inches)
		Metal Sheet Channel (MSC) (Base width by pile height in feet /Sheet pile total length)
		Corrugated Metal Pipe (CMP) (diameter in inches)
		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

47

N

0 200 400 600 800
FEET

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E 6079407.227
N 2197544.976
E 6080907.334
N 2197545.008
E 6079407.037
N 2181745.056
E 6080907.142
N 2181745.110

47

49

48

48

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Call : Man Vu at (714) 834-5986 to notify Public Facility and Resources Department (PFRD) of additions or corrections.

Scale: 1"=600'

ORANGE COUNTY FLOOD CONTROL DISTRICT

BASEMAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
A/U	JAN.12/2000	48	MAPS-113-3

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- Major Sub-Area Drainage Boundary
- Minor Sub-Area Drainage Boundary
- Existing O.C.F.C.D. Facility
- Existing Local Facility
- Existing Retarding Basin or Reservoir
- Natural Watercourse
- City Limits
- G — Greenbelt
- G P.S. — Pump Station
- O — Catch Basin (length in feet)
- O — Drop Inlet or Other Entry
- Ownership (if other than city or county)
- P — Private
- S — State
- F — Federal

Existing O.C.F.C.D.	Existing LOCAL
	Earth Trapezoidal Channel (base width by height in feet)
	Reinforced Concrete Trapezoidal Channel (base width by height in feet)
	Reinforced Concrete Rectangular Channel (base width by height in feet)
	Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
	Reinforced Concrete Pipe (RCP) (diameter in inches)
	Corrugated Metal Pipe (CMP) (diameter in inches)
	Concrete Pipe (diameter in inches)
	Concrete Oval Pipe (width by height in inches)
	Steel Pipe (diameter in inches)
	Reinforced Concrete Arch (base span by height in inches)
	Corrugated Metal Arch (base span by height in inches)

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E 6057906.963
N 2187745.000

E 6079407.037
N 2187745.056

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UPPER NEWPORT BAY REGIONAL PARK

NEWPORT BAY

UPPER NEWPORT BAY

LOWER NEWPORT BAY

NEWPORT AQUATIC PARK

NEWPORT DUNES

NEWPORT CENTER

SAN JOAQUIN HILLS TRANSPORTATION CORRIDOR

BONITA CANYON DR.

NEWPORT COAST DR.

SAN JOAQUIN HILLS RD.

SAN JOAQUIN RES.

PACIFIC VIEW MEMORIAL PARK

BIG CANYON RESERVOIR

PACIFIC VIEW PARK

G02P01

G02P02

G02P03

G04P01

G04P02

G04P03

G00D02

N 2165945.056
E 6057906.805

N 2165945.134
E 6079406.847

55

N

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ORANGE COUNTY FLOOD CONTROL DISTRICT

BASEMAP
OF DRAINAGE FACILITIES
IN ORANGE COUNTY

REVISION	DATE	SHEET NO.	DWG. NO.
AVU	JAN12/2000	55	MAPS-113-3

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- Catch Basin (length in feet)
- Drop Inlet or Other Entry
- Ownership (if other than city or county)
- P — Private
- S — State
- F — Federal

Existing O.C.F.C.D. / Existing LOCAL

- Earth Trapezoidal Channel (base width by height in feet)
- Reinforced Concrete Trapezoidal Channel (base width by height in feet)
- Reinforced Concrete Rectangular Channel (base width by height in feet)
- Reinforced Concrete Box (RCB) (number of barrels-span by height in feet)
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- Corrugated Metal Pipe (CMP) (diameter in inches)
- Concrete Pipe (diameter in inches)
- Concrete Oval Pipe (width by height in inches)
- Steel Pipe (diameter in inches)
- Reinforced Concrete Arch (base span by height in inches)
- Corrugated Metal Arch (base span by height in inches)

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62

N

0 200 400 600 800
FEET

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ORANGE COUNTY FLOOD CONTROL DISTRICT

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S. GUTIERREZ	JAN.12/2000	62	MAPS-113-3

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		Concrete Pipe (diameter in inches)
		Concrete Oval Pipe (width by height in inches)
		Steel Pipe (diameter in inches)
		Reinforced Concrete Arch (base span by height in inches)
		Corrugated Metal Arch (base span by height in inches)

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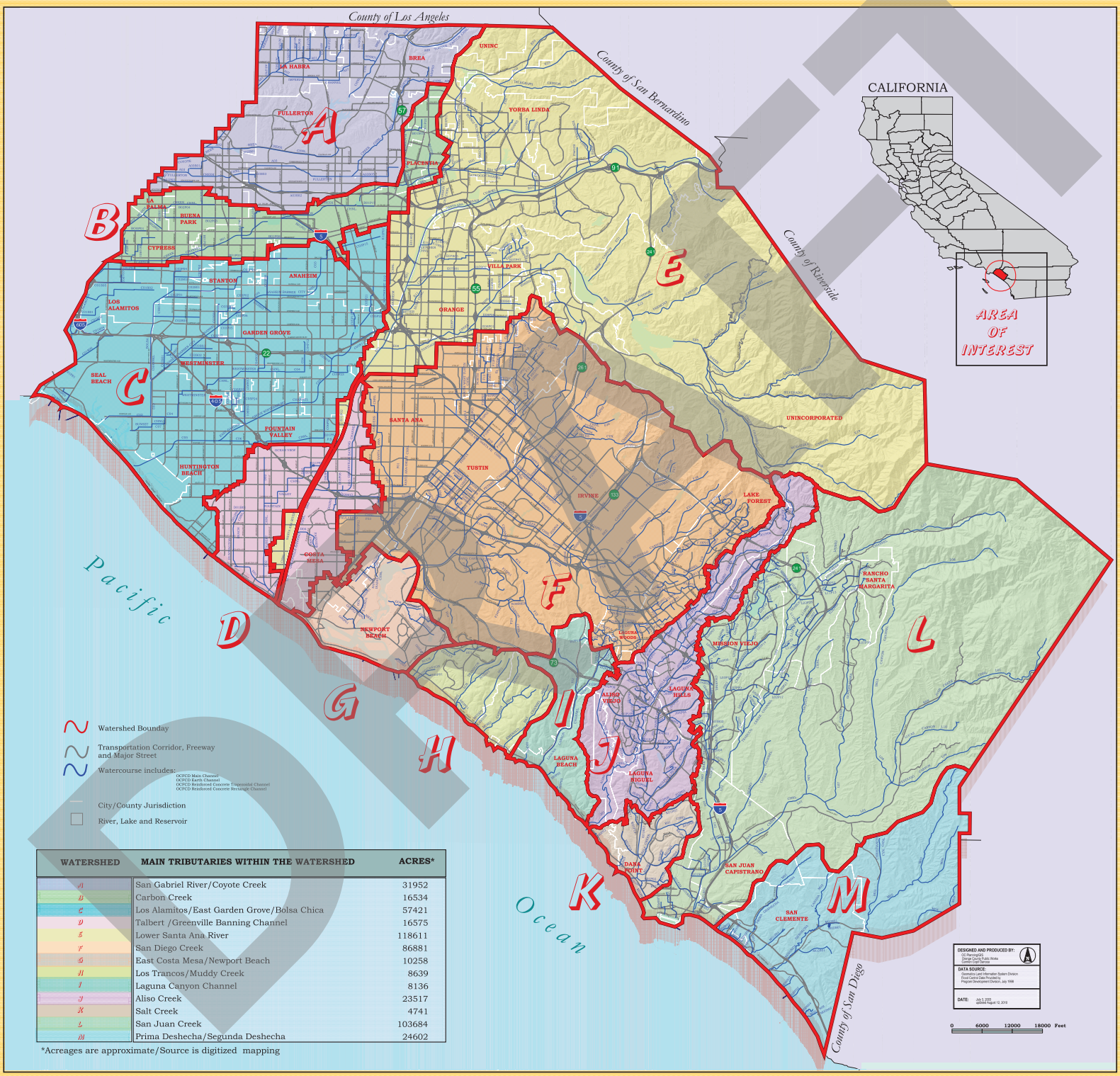
OCFCD DRAINAGE SYSTEM



WATERSHED	MAIN TRIBUTARIES WITHIN THE WATERSHED	ACRES*
A	San Gabriel River/Coyote Creek	31952
B	Carbon Creek	16534
C	Los Alamitos/East Garden Grove/Bolsa Chica	57421
D	Talbert /Greenville Banning Channel	16575
E	Lower Santa Ana River	118611
F	San Diego Creek	86881
G	East Costa Mesa/Newport Beach	10258
H	Los Trancos/Muddy Creek	8639
I	Laguna Canyon Channel	8136
J	Aliso Creek	23517
K	Salt Creek	4741
L	San Juan Creek	103684
M	Prima Deshecha/Segunda Deshecha	24602

*Acreages are approximate/Source is digitized mapping

COUNTY OF ORANGE, CALIFORNIA

ATTACHMENT H

MASTER COVENANT & AGREEMENT FORM

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ATTACHMENT I

REFERENCE PLANS

DRAFT