FUSCOE ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

THE BOWERY

October 3, 2019

FUSCOE ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

THE BOWERY

October 3, 2019

FUSCOE ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

THE BOWERY

October 3, 2019

FUSCOE ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (PWQMP)

THE BOWERY

Santa Ana, California

PREPARED FOR
VINEYARDS DEVELOPMENT CORPORATION
240 Newport Center Dr. Suite #200
Newport Beach, CA 92660
310.571.8227

FUSCOE ENGINEERING, INC.
16795 Von Karman, Suite 100
Irvine, California 92606
949.474.1960
www.fuscoe.com

PROJECT MANAGER
Josh Ruiz, PE

DATE PREPARED: October 3, 2019

PROJECT NUMBER: 1154-003-01

full circle thinking®

PRELIMINARY
WATER QUALITY MANAGEMENT PLAN (WQMP)

THE BOWERY

2300, 2310 & 2320 Red Hill Ave, City of Santa Ana, County of Orange

APN: 430-222-01 & 430-222-16

Prepared for:

VINEYARDS DEVELOPMENT CORPORATION
240 Newport Center Dr. Suite #200
Newport Beach, CA 92660
310. 571.8227

Prepared by:

FUSCOE ENGINEERING, INC.
16795 Von Karman, Suite 100
Irvine, CA 92618
949.474.1960
Josh Ruiz

Date Prepared: October 03, 2019

PROJECT OWNER'S CERTIFICATION			
Permit/Application No.:	Pending	**Grading Permit No.:**	Pending
Tract/Parcel Map and Lot(s)No.:	Parcel 2 & 3, P.M.B. 125 PG 45-46	**Building Permit No.:**	Pending
Address of Project Site and APN:	2300, 2310 & 2320 Red Hill Ave, Satna Ana, CA 92705 APN: 430-222-07 & 430-222-16		

This Water Quality Management Plan (WQMP) has been prepared for VINEYARDS DEELOPMENT CORPORATION by FUSCOE ENGINEERING, 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 , including the ongoing operation and maintenance of all best management practices (BMPs), 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. 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:			
Name:	Jeremy Ogulnick		
Title:	Vice President of Development		
Company:	Vineyards Development Corporation		
Address:	240 Newport Center Drive, Suite 200, Newport Beach, CA 92660		
Email:	Jeremy@vineyardsdc.com		
Telephone #:	310.849.5793		
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:**	

TABLE OF CONTENTS

APPENDICES

EXHIBITS & BMP DETAILS (INCLUDED IN SECTION VI)

- Vicinity Map
- Site Plan
- Preliminary WQMP Exhibit
- Modular Wetland System Details
- BIO-7 Proprietary Biotreatment BMP Fact Sheets

EDUCATIONAL MATERIALS (INCLUDED IN APPENDIX C)

- The Ocean Begins at Your Front Door
- Tips for the Home Mechanic
- Household Tips
- Proper Disposal of Household Hazardous Waste
- Recycle at Your Local Used Oil Collection Center (Central County)
- Responsible Pest Control
- Tips for Pet Care
- Tips for Pool Maintenance
- Tips for Residential Pool, Landscape and Hardscape Drains
- Tips for Protecting your Watershed
- Tips for the Food Service Industry
- Proper Maintenance Practices for your Business
- DF-1 Drainage System Operation & Maintenance R-3 Automobile Parking
- R-5 Disposal of Pet Waste
- R-8 Water Conservation

- SD-10 Site Design & Landscape Planning
- SD-12 Efficient Irrigation
- SD-13 Storm Drain Signage
- SD-32 Trash Storage Areas

SECTION I DISCRETIONARY PERMITS AND WATER QUALITY CONDITIONS

PROJECT INFORMATION			
Permit/Application No.:	Pending	**Grading or Building Permit No.:**	Pending
Address of Project Site (or Tract Map and Lot Number if no address) and APN:	2300, 2310 & 2320 Red Hill Ave, Satna Ana, CA 92705 APN: 430-222-07 & 430-222-16		
WATER QUALITY CONDITIONS OF APPROVAL OR ISSUANCE			
Discretionary Permit(s):	There are no discretionary permits applicable to this project.		
Water Quality Conditions of Approval or Issuance applied to this project: **(Please list verbatim.)**	Pending – to be provided in Final WQMP		
CONCEPTUAL WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	This report serves as a Preliminary Water Quality Management Plan for The Bowery Mixed-Use Project.		
WATERSHED-BASED PLAN CONDITIONS			
Applicable conditions from watershed - based plans including WIHMPs and TMDLs:	Applicable TMDLs for San Diego Creek Reach 1, Upper and Lower Newport Bay, include the following: ▪ Metals ▪ Nutrients ▪ Pesticides ▪ Siltation ▪ Pathogens ▪ Priority Organics		

SECTION II PROJECT DESCRIPTION

II.1 PROJECT DESCRIPTION

The proposed Bowery project site encompasses approximately 14.69 acres in the City of Santa Ana. The project site is bounded by Warner Avenue to the northeast and Red Hill Avenue to the southeast. A Vicinity Map is included in Section VI.

Under existing conditions, the project site consist of three vacant warehouse buildings and associated parking lots. Adjacent land uses include a mix of commercial and light industrial.

The table below summarizes the proposed project.

DESCRIPTION OF PROPOSED PROJECT				
Development Category (Model WQMP, Table 7.11-2; or 7.11-3):	8. All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety.			
Project Area (ft^2):	639,896.4 ft^2 (14.69 acres)			
# of Dwelling Units:	1,060 units			
SIC Code:	TBD; to include residential and commercial land use pending lease agreements			
Narrative Project Description:	Under existing conditions, the project site consists of three vacant warehouse buildings and associated parking lots. A vacant lot is located in the northeastern corner of the property. The property was formerly occupied by Ricoh Electronics, Inc., a manufacturer and distributor of thermal paper. The proposed project will include four residential buildings. Building A will consist of a 272-unit project consisting of 5-story residential with a portion of residential uses over retail space surrounding a 6.5-story parking structure with amenity deck. Building B is a 241-unit project consisting of 5-story residential with a portion of residential uses over retail space surrounding a 6.5-story parking structure with amenity deck. Building C is a 309-unit project consisting of 5-story residential with a portion of residential uses over retail space surrounding a 6-story parking structure. Building D is a 238-unit project consisting of 5-story residential uses surrounding a 6-story parking structure. Overall, the project will consist of 1,060 residential units and 80,000 SF of retail space.			
Project Area:	**Pervious Area**	**Pervious Area Percentage**	**Impervious Area**	**Impervious Area Percentage**
Pre-Project Conditions:	3.73 ac	25%	10.96 ac	75%
Post-Project Conditions:	2.05 ac	14%	12.64 ac	86%

DESCRIPTION OF PROPOSED PROJECT	
Drainage Patterns/ Connections:	Under existing conditions, the project site drains northwest where flows enter an existing catch basin. The catch basin connects to a 6x10 RCB culvert designed for flood control that then ties into an 84" RCP. From there flows travel southeast and are temporarily detained in a Tustin Flood Control Basin before exiting to travel along Barranca Channel. Barranca Channel connects to San Diego Creek Reach 1 and ultimately drains to Newport Bay and the Pacific Ocean. The post development drainage will maintain existing drainage patterns. The 14.69 project area will collect on-site drainage via roof drains, surface flow, curb and area drains. Low flows and first flush runoff will be pumped to one of four Modular Wetland System (MWS) units for water quality treatment. High flows will by-pass the biotreatment and exit the site. All flows will tie into an existing 84" RCP along Redhill Avenue. From there flows will travel southeast and be temporarily detained in a Tustin Flood Control Basin before exiting to travel along Barranca Channel. Barranca Channel connects to San Diego Creek Reach 1 and ultimately drains to Newport Bay and the Pacific Ocean.

PROJECT FEATURES				
Building Summary:				
	Studio Units	1 Bed	2 Bed	Total Units
Building A	54	143	75	272
Building B	35	133	73	241
Building C	64	154	91	309
Building D	35	125	78	238
Total	188	555	317	1,060
Commercial Retail Space	80,000 SF			
Amenities:	Recreation amenities for residents would include pool and spa areas, a fitness area, a community/club room, a leasing office, and a mail room in each residential building. Each residential building would also have a common area with outdoor kitchen and seating areas. Buildings A & B will have rooftop level spaces, while Buildings C & D will have at-grade courtyard spaces. The retail areas will also include one at-grade plaza and one rooftop level deck area. The project would also provide 247,506 square feet of open space in courtyards, common area amenities, roof decks, and perimeter plazas and open space areas for residents and the public.			

<table>
<tr><th colspan="2">PROJECT FEATURES</th></tr>
<tr><td>Landscaped Areas:</td><td>Proposes landscaped areas will be situated along Red Hill Avenue, Warner Avenue, along building setbacks, along the project entryway, within residential courtyards and in rooftop areas. Trees, shrubs, and groundcover is included within proposed landscaped areas accounting for the site's 14% of pervious area.</td></tr>
<tr><td>Parking Facilities:</td><td>Parking stalls are provided throughout the project site for residential, leasing, and commercial retail use.
<table>
<tr><th></th><th>Residential Stalls</th><th>Commercial Stalls</th><th>Total Stalls</th></tr>
<tr><td>Building A</td><td>486</td><td>170</td><td>656</td></tr>
<tr><td>Building B</td><td>420</td><td>130</td><td>550</td></tr>
<tr><td>Building C</td><td>526</td><td>100</td><td>626</td></tr>
<tr><td>Building D</td><td>406</td><td>0</td><td>406</td></tr>
<tr><td>Total</td><td>1,838</td><td>400</td><td>2,238</td></tr>
</table></td></tr>
<tr><td>Other Project Features:</td><td>The property will include four trash storage areas, twelve trash rooms, and five satellite trash rooms. Eight trash rooms are located in the residential areas and four trash rooms are located in the commercial areas. One trash storage area will be located near Building C adjacent to the main roadway that bisects the site. Another storage area will be located across the main roadway outside of Building B. The third storage area will be located at the western edge of the main roadway outside of Building D. The fourth storage area will be located on the southeastern edge of the main roadway outside of Building A. Trash will be taken from the interior trash rooms to the exterior trash storage areas at the time trash collection is set to occur. The trash storage areas will drain into a water quality inlet to prevent discharge of spilled contaminants, consistent with local design standards.

Three loading dock areas will be located throughout the central and southern portions of the site. One loading dock area consisting of two parking stalls will be located along the northern edge of the main roadway. Another loading dock area will be located directly across the main roadway. The third loading dock area will be located at the southern edge of the site adjacent to the sidewalk along Warner Ave. The site will not have any outdoor storage areas, vehicle/ community car wash racks, vehicle/equipment wash areas. However, there will be commercial kitchens/food preparation areas within the retail spaces.</td></tr>
</table>

PROJECT FEATURES	
Outdoor Activities:	For the commercial/retail areas, outdoor activities are anticipated with passive uses in the common landscaped areas surrounding the buildings. Outdoor lounge furniture and restaurant seating is proposed. All vehicular parking will be located at surface parking lots. No outdoor storage of materials is anticipated. For the residential areas, outdoor areas throughout the site will be used for recreational and open space purposes. Each building will have a central recreation area that will include a pool, spa, fireplace/BBQ areas, various lounge/dining furnishings, and open areas (courtyards or roof decks). All other outdoor areas will be used for walkways, common areas and landscaping, and other recreational purposes.
Materials Stored:	Materials anticipated to be stored on-site include those associated with retail buildings (i.e. cleaning products, storage, etc.); however, no hazardous wastes will be stored on-site. No outdoor storage of materials is anticipated (materials will be stored indoors).
Wastes Generated:	The project is not anticipated to generate any wastes other than landscape clippings, typical trash, debris and refuse from the tenants. Outdoor trash receptacles will be provided in trash room areas within buildings for the residential and commercial tenants to dispose of their refuse in a proper manner, and property maintenance will provide trash and waste material removal to maintain a trash-free property. All wastes shall be collected and properly disposed of off-site.

II.2 POTENTIAL STORM WATER POLLUTANTS

The table below, derived from Table 2 of the Countywide Model WQMP Technical Guidance Document (December 2013), summarizes the categories of land use or project features of concern and the general pollutant categories associated with them.

ANTICIPATED & POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE								
Priority Project Categories and/or Project Features	**General Pollutant Categories**							
	Suspended Solid/ Sediments	**Nutrients**	**Heavy Metals**	**Pathogens (Bacteria/ Virus)**	**Pesticides**	**Oil & Grease**	**Toxic Organic Compounds**	**Trash & Debris**
Detached Residential Development	E	E	N	E	E	E	N	E
Attached Residential Development	E	E	N	E	E	E[(2)]	N	E

ANTICIPATED & POTENTIAL POLLUTANTS GENERATED BY LAND USE TYPE								
Priority Project Categories and/or Project Features	General Pollutant Categories							
	Suspended Solid/ Sediments	Nutrients	Heavy Metals	Pathogens (Bacteria/ Virus)	Pesticides	Oil & Grease	Toxic Organic Compounds	Trash & Debris
Commercial/Industrial Development	E(1)	E(1)	E(5)	E(3)	E(1)	E	E	E
Automotive Repair Shops	N	N	E	N	N	E	E	E
Restaurants	E(1)(2)	E(1)	E(2)	E	E(1)	E	N	E
Hillside Development >5,000 ft^2	E	E	N	E	E	E	N	E
Parking Lots	E	E(1)	E	E(4)	E(1)	E	E	E
Streets, Highways, & Freeways	E	E(1)	E	E(4)	E(1)	E	E	E
Retail Gasoline Outlets	N	N	E	N	N	E	E	E

Notes:
E = expected to be of concern N = not expected to be of concern
(1) Expected pollutant if landscaping exists on-site, otherwise not expected.
(2) Expected pollutant if the project includes uncovered parking areas, otherwise not expected.
(3) Expected pollutant if land use involves food or animal waste products, otherwise not expected.
(4) Bacterial indicators are routinely detected in pavement runoff.
(5) Expected if outdoor storage or metal roofs, otherwise not expected.
Source: County of Orange. (2013, December 20). Technical Guidance Document for the Preparation of Conceptual/ Preliminary and/or Project Water Quality Management Plans (WQMPs). Table 2.1.

Priority Project Categories and/or Features: Attached Residential Development; Commercial/Industrial Development; Restaurants; Parking Lots; Streets, Highways, & Freeways

POLLUTANTS OF CONCERN		
Pollutant	E = Expected to be of concern N =Not Expected to be of concern	Additional Information and Comments
Suspended Solid/ Sediment	E	303(d) listed impairments, TMDL in effect (see table in Section III.3 for TMDL details)
Nutrients	E	303(d) listed impairments, TMDL in effect (see table in Section III.3 for TMDL details)
Heavy Metals	E	303(d) listed impairments, TMDL in effect (see table in Section III.3 for TMDL details)

POLLUTANTS OF CONCERN		
Pollutant	E = Expected to be of concern N =Not Expected to be of concern	Additional Information and Comments
Pathogens (Bacteria/Virus)	E	303(d) listed impairments, TMDL in effect (see table in Section III.3 for TMDL details)
Pesticides	E	303(d) listed impairments, TMDL in effect (see table in Section III.3 for TMDL details)
Oil & Grease	E	
Toxic Organic Compounds	E	303(d) listed impairments, TMDL in effect (see table in Section III.3 for TMDL details)
Trash & Debris	E	

II.3 HYDROLOGIC CONDITIONS OF CONCERN

The purpose of this section is to identify any hydrologic conditions of concern (HCOC) with respect to downstream flooding, erosion potential of natural channels downstream, impacts of increased flows on natural habitat, etc. As specified in Section 2.3.3 of the 2011 Model WQMP, projects must identify and mitigate any HCOCs. A HCOC is a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of streams.

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 (Tc) 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.

If these conditions do not exist or streams are not potentially susceptible to hydromodification impacts, an HCOC does not exist and hydromodification does not need to be considered further. In the North Orange County permit area, downstream channels are considered not susceptible to hydromodification, and therefore do not have the potential for a HCOC, if all downstream conveyance channels that will receive runoff from the project are engineered, hardened, and regularly maintained to ensure design flow capacity, and no sensitive habitat areas will be affected.

Is the proposed project potentially susceptible to hydromodification impacts?

☒ Yes ☐ No (show map)

2-YEAR, 24-HOUR STORM SUMMARY				
Condition	**Acreage**	**Tc (min)**	**Peak Runoff (cfs)**	**Volume (ac-ft)**
Pre-development	14.69	10.33	14.9	1.241
Proposed	14.69	13.06	16.3	1.699
Difference	**0**	**+2.73**	**+1.4**	**+0.458**
% Change		**+26%**	**+9.4%**	**+37%**

The proposed project will increase imperviousness as compared to the existing conditions. The two year volumes will increase 37%. The results indicate the 2-year time of concentration (Tc) increases by 26% as compared to existing conditions. The TGD recognizes that increases in Tc are acceptable, as a longer Tc is generally associated with natural conditions and nearly universally results in lower concerns for hydromodification impacts (TGD, Section 2.2.3.1, footnote 4).

Due to poor infiltrating soils, south basin groundwater plume, and shallow groundwater levels (see Section III.2), infiltration of project runoff is not feasible, and reuse demands are not sufficient to draw down the volume within 30 days (see Section IV.3.3). Therefore, as stated in the 4th Term Storm Water Permit, "In cases where the excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow." (Section XII.D.4) The 2-year peak flow rate increases by 9.4% as compared to existing conditions, which is consistent with the Fourth Term MS4 permit. Therefore, the project complies with the hydromodification requirements and allowable discharge provisions. Calculations are provided in Appendix G.

Detention for Flood Control may be needed to mitigate the difference from existing to proposed conditions for the 10-year storm event. Please refer to the Hydrology Report for 10-year calculations, requirements, and proposed detention for Flood Control.

II.4 POST DEVELOPMENT DRAINAGE CHARACTERISTICS

The post development drainage will maintain existing drainage patterns. The 14.69 project area will collect on-site drainage via roof drains, surface flow, curb and area drains. Low flows and first flush runoff will be pumped to one of four Modular Wetland System (MWS) units for water quality treatment. High flows will by-pass the biotreatment and exit the site. All flows will tie into an existing 84" RCP along Redhill Avenue. From there flows will travel southeast and be temporarily detained in a Tustin Flood Control Basin before exiting to travel along Barranca Channel. Barranca Channel connects to San Diego Creek Reach 1 and ultimately drains to Newport Bay and the Pacific Ocean.

II.5 PROPERTY OWNERSHIP/MANAGEMENT

PROPERTY OWNERSHIP/MANAGEMENT	
Private Streets:	Vineyards Development Corporation
Landscaped Areas:	Vineyards Development Corporation
Open Space:	Vineyards Development Corporation
Buildings:	Vineyards Development Corporation
Structural BMPs:	Vineyards Development Corporation

A Property Owners Association (POA) will be formed upon project completion. The POA will be responsible for inspecting and maintaining all BMPs prescribed for The Bowery Mixed-Use project. Until a POA is formally established, Vineyards Development Corporation shall assume all BMP maintenance and inspection responsibilities for the proposed project. Inspection and maintenance responsibilities are outlined in Section V of this report.

SECTION III SITE DESCRIPTION

III.1 PHYSICAL SETTING

Planning Area/ Community Name:	The Bowery Mixed-Use Project
Address:	2300, 2310 & 2320 Red Hill Ave, Santa Ana, CA 92705
Project Area Description:	The project is bound by Red Hill Ave to the southeast, Warner Ave to the northeast, and existing light industrial buildings to the southwest and northwest.
Land Use:	PAO - Professional & Administration Office
Zoning:	M1 – Light Industrial
Acreage:	14.69 acres
Predominant Soil Type:	Type B – per Figure XVI-2a of the TGD
Impervious Conditions:	Existing Impervious: 75% (25% Pervious) Proposed Impervious: 86% (14% Pervious)

III.2 SITE CHARACTERISTICS

Precipitation Zone:	0.75 inches per Figure XVI-1 (see Appendix A)
Topography:	The project site is relatively flat (approx. 0.5% grade), and generally drains from the north to the south.
Existing Drainage Patterns/ Connections:	Under existing conditions, the project site drains northwest where flows enter an existing catch basin. The catch basin connects to a 6x10 RCB culvert designed for flood control that then ties into an 84" RCP. From there flows travel southeast and are temporarily detained in a Tustin Flood Control Basin before exiting to travel along Barranca Channel. Barranca Channel connects to San Diego Creek Reach 1 and ultimately drains to Newport Bay and the Pacific Ocean.
Proposed Drainage Patterns/ Connections:	The post development drainage will maintain existing drainage patterns. The 14.69 project area will collect on-site drainage via roof drains, surface flow, curb and area drains. Low flows and first flush runoff will be pumped to one of four Modular Wetland System (MWS) units for water quality treatment. High flows will by-pass the biotreatment and exit the site. All flows will tie into an existing 84" RCP along Redhill Avenue. From there flows will travel southeast and be temporarily detained in a Tustin Flood Control Basin before exiting to travel along Barranca Channel. Barranca Channel connects to San Diego Creek Reach 1 and ultimately drains to Newport Bay and the Pacific Ocean.

Soil Type, Geology, and Infiltration Properties:	A geotechnical study was performed for the site in 2019 by LGC Geotechnical, Inc. Soils within the vicinity of the project site generally consist of older artificial fill materials and quaternary alluvial deposits. Artificial fill materials consist of slightly moist to moist clays and silts with variable amounts of sand to depths up to 7.5 feet below ground surface (bgs). Alluvial soils beneath the artificial fill generally consist of loose to medium dense silty sands to depths of approximately 50 feet bgs. In addition, the study is located within a liquefaction hazard zone.
Hydrogeologic (Groundwater) Conditions:	The project site is located in an area with shallow (or high) groundwater levels, approximately between 5-10 feet below bgs as illustrated in the TGD Figure XVI-2e (see Appendix A). During the geotechnical study, moist to wet soils were encountered at depths 24 to 33 feet bgs, and previous data indicates that historic high groundwater within the region of the site is approximately 10 feet bgs.
Geotechnical Conditions (relevant to infiltration):	Infiltration testing performed by LGC Geotechnical, Inc. observed a measured infiltration rate of 0.15 in/hr which, according to Section 2.4.2.4 of the OC TGD, is considered infeasible. As illustrated in the TGD Figure XVI-2f (see Appendix A), the project site is located within the South Basin Groundwater Protection Project and borders the Tustin Marine Air Base as well as the Selenium Contamination Area. Due to low infiltration rates, historical shallow groundwater and location of the project in the South Basin Groundwater Plume, infiltration is considered infeasible for the project site.
Off-Site Drainage:	The project site does not receive any off-site storm water flows onto the property.
Utility and Infrastructure Information:	Dry and wet utilities will be incorporated into the proposed project and will tie into existing facilities associated with the existing development.

III.3 WATERSHED DESCRIPTION

Receiving Waters:	San Diego Creek, Reach 1; Upper Newport Bay, Lower Newport Bay
303(d) Listed Impairments:	**San Diego Creek, Reach 1:** fecal coliform, nutrients, pesticides, sedimentation, selenium, toxaphene **Newport Bay, Upper:** chlordane, copper, DDT, metals, nutrients, PCBs, sediment toxicity, sedimentation **Newport Bay, Lower:** chlordane, DDT, nutrients, PCBs, pesticides, sediment toxicity

Applicable TMDLs:	**San Diego Creek, Reach 1:** metals, nutrients, pesticides, sedimentation **Newport Bay, Upper:** metals, nutrients, pathogens, pesticides, sedimentation **Newport Bay, Lower:** metals, nutrients, pathogens, pesticides/priority organics, sedimentation
Pollutants of Concern for the Project:	▪ Suspended Solid/Sediments o 303(d) listed impairment & Total Maximum Daily Load (TMDL) for Sediment ▪ Nutrients o 303(d) listed impairment & TMDL for Nutrients ▪ Pathogens/Bacteria/Virus o 303(d) listing for Fecal Coliform, TMDL for Pathogens ▪ Pesticides o 303(d) listings for Pesticides & DDT, TMDLs for Organochlorine Compounds, Metals, Diazinon & Clorpyrifos ▪ Trash & Debris
Hydrologic Conditions of Concern (HCOCs):	The project complies with the hydromodification requirements and allowable discharge provisions. Refer to Section II.3 for details.
Environmentally Sensitive and Special Biological Significant Areas:	There are no Environmentally Sensitive Areas (ESAs) within 200 ft. of the project site. In addition, there are no Areas of Special Biological Significance (ASBS) within the project site.

SECTION IV BEST MANAGEMENT PRACTICES (BMPs)

IV.1 PROJECT PERFORMANCE CRITERIA

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

PROJECT PERFORMANCE CRITERIA	
Hydromodification Control Performance Criteria: (Model WQMP Section 7.II-2.4.2.2)	If a hydrologic condition of concern (HCOC) exists, priority projects shall implement onsite or regional hydromodification controls such that: ▪ Post-development runoff volume for the two-year frequency storm does not exceed that of the predevelopment condition by more than five percent, and ▪ Time of concentration of post-development runoff for the two-year storm event is not less than that for the predevelopment condition by more than five percent. Where the Project WQMP documents that excess runoff volume from the two-year runoff event cannot feasibly be retained and where in-stream controls cannot be used to otherwise mitigate HCOCs, the project shall implement on-site or regional hydromodification controls to: ▪ Retain the excess volume from the two-year runoff event to the MEP, and ▪ Implement on-site or regional hydromodification controls such that the post-development runoff two-year peak flow rate is no greater than 110 percent of the predevelopment runoff two-year peak flow rate.
LID Performance Criteria: (Model WQMP Section 7.II-2.4.3)	Infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume). LID BMPs must be designed to retain, on-site, (infiltrate, harvest and use, or evapotranspire) storm water runoff up to 80 percent average annual capture efficiency.
Treatment Control BMP Performance Criteria: (Model WQMP Section 7.II-3.2.2)	If it is not feasible to meet LID performance criteria through retention and/or biotreatment provided on-site or at a sub-regional/regional scale, then treatment control BMPs shall be provided on-site or offsite prior to discharge to waters of the US. Sizing of treatment control BMP(s) shall be based on either the unmet volume after claiming applicable water quality credits, if appropriate.

PROJECT PERFORMANCE CRITERIA	
LID Design Storm Capture Volume:	DCV = C × d × A × 43560 sf/ac × 1/12 in/ft Where: DCV = design storm capture volume, cu-ft C = runoff coefficient = (0.75 × imp + 0.15) Imp = impervious fraction of drainage area (ranges from 0 to 1) d = storm depth (inches) A = tributary area (acres) Imp = 86 d = 0.75 inches A = 14.69 acres *DCV* = *(0.75 x* 0.86 *+0.15) x* 0.75 *inches x* 14.69 *ac x 43560 sf/ac x 1/12 in/ft* = 31,795 cu-ft *Refer to Section IV.2.2 for specific Drainage Manage Area (DMA) breakdown and Appendix A for detailed calculations (Worksheet B).*

IV.2 SITE DESIGN AND DRAINAGE PLAN

The following section describes the site design BMPs used in this project and the methods used to incorporate them. Careful consideration of site design is a critical first step in storm water pollution prevention from new developments and redevelopments.

IV.2.1 Site Design BMPs

Minimize Impervious Area

Impervious surfaces have been minimized by incorporating landscaped areas throughout the site surrounding the proposed building. Landscaping will be provided throughout the site within the common areas as well as around the perimeter of the building.

Maximize Natural Infiltration Capacity

Infiltration is not recommended for the project site due to proximity to groundwater, poor infiltrating soils and the site's proximity to the South Basin Groundwater Plume. Refer to Section IV.3.2 for details.

Preserve Existing Drainage Patterns and Time of Concentration

Runoff from the site will continue to flow similar to existing conditions. Low-flows and first-flush runoff will drain to modular wetland units for water quality treatment via bio-filtration.

Disconnect Impervious Areas

Landscaping will be provided between the proposed buildings. Low-flows and first-flush runoff will drain to modular wetland units for water quality treatment via bio-filtration. Refer to Section IV.3.4 for further details.

Protect Existing Vegetation and Sensitive Areas, and Revegetate Disturbed Areas

There are no existing vegetated or sensitive areas to preserve on the project site. All disturbed areas will either be paved or landscaped.

Xeriscape Landscaping

Xeriscape landscaping is not proposed for the project. However, native and/or tolerant landscaping will be incorporated into the site design consistent with City guidelines.

IV.2.2 Drainage Management Areas

In accordance with the MS4 permit and the 2011 Model WQMP, the project site has been divided into Drainage Management Areas (DMAs) to be utilized for defining drainage areas and sizing LID and other treatment control BMPs. DMAs have been delineated based on the proposed site grading patterns, drainage patterns, storm drain and catch basin locations.

The design capture volumes (DCV) and treatment flow rates (Q_{Design}) for each DMA are summarized in the table below. These have been derived utilizing the "Simple Method" in accordance with the TGD Section III.1.1. Actual BMP sizing requirements, including 80 percent capture design volumes, flow rates, depths, and other design details for the specific BMPs proposed are provided in Section IV.3.4 below. Locations of DMAs and associated LID and treatment BMPs are identified on the exhibits in Section VI. Additional calculations and TGD Worksheets are provided in Appendix A.

DRAINAGE MANAGEMENT AREAS (DMAs)								
DMA/ Drainage Area ID[1]	Tributary Drainage Area (ft^2)	Tributary Drainage Area (ac)	% Imp.	Design Storm Depth[2] (in)	Estimated Tc (min)	Rainfall Intensity[3] (in/hr)	Simple Method DCV[4] (ft^3)	Q_{Design} [5] (cfs)
DMA 1	639,896	14.69	86	0.75	5	0.26	31,795	3.036

Notes:
1. Refer to exhibits in Section VI for locations of each DMA.
2. Per Figure XVI-1 of the Technical Guidance Document, dated December 20, 2013. See also Appendix A.
3. Per Figure III.4 of the Technical Guidance Document, dated December 20, 2013. See also Appendix A.
4. Per Section III.1.1 of the Technical Guidance Document.
5. Per Section III.3.3 and Worksheet D of the Technical Guidance Document.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Low Impact Development (LID) BMPs are required in addition to site design measures and source controls to reduce pollutants in storm water discharges. LID BMPs are engineered facilities that are designed to retain or biotreat runoff on the project site. The 4th Term MS4 Storm Water Permit (Order R8-2009-0030) requires the evaluation and use of LID features using the following hierarchy of

treatment: infiltration, evapotranspiration, harvest/reuse, and biotreatment. The following sections summarize the LID BMPs proposed for the project in accordance with the permit hierarchy and performance criteria outlined in Section IV.1.

IV.3.1 Hydrologic Source Controls (HSCs)

Hydrologic source controls (HSCs) can be considered to be a hybrid between site design practices and LID BMPs. HSCs are distinguished from site design BMPs in that they do not reduce the tributary area or reduce the imperviousness of a drainage area; rather they reduce the runoff volume that would result from a drainage area with a given imperviousness compared to what would result if HSCs were not used.

HYDROLOGIC SOURCE CONTROLS		
ID	**Name**	**Included?**
HSC-1	Localized on-lot infiltration	☐
HSC-2	Impervious area dispersion (e.g. roof top disconnection)	☐
HSC-3	Street trees (canopy interception)	☐
HSC-4	Residential rain barrels (not actively managed)	☐
HSC-5	Green roofs/Brown roofs	☐
HSC-6	Blue roofs	☐
HSC-7	Impervious area reduction (e.g. permeable pavers, site design)	☐

HSCs were not incorporated into the project's design at this stage in the project's development. Any HSC's will be accounted for during final design and the cumulative volume of the HSC's will be subtracted from the required treatment volume in the Final WQMP.

IV.3.2 Infiltration BMPs

Infiltration BMPs are LID BMPs that capture, store and infiltrate storm water runoff. These BMPs are engineered to store a specified volume of water and have no design surface discharge (underdrain or outlet structure) until this volume is exceeded. Examples of infiltration BMPs include infiltration trenches, bioretention without underdrains, drywells, permeable pavement, and underground infiltration galleries.

INFILTRATION		
ID	**Name**	**Included?**
INF-3	Bioretention Without Underdrains	☐
INF-4	Rain Gardens	☐

INFILTRATION		
ID	**Name**	**Included?**
	Porous Landscaping	☐
	Infiltration Planters	☐
	Retention Swales	☐
INF-2	Infiltration Trenches	☐
INF-1	Infiltration Basins	☐
INF-5	Drywells	☐
INF-7	Subsurface Infiltration Galleries	☐
--	French Drains	☐
	Permeable Asphalt	☐
INF-6	Permeable Concrete	☐
	Permeable Concrete Pavers	☐
	Other:	☐

No infiltration BMPs are proposed within the redevelopment project. As discussed in Section III.2, due to low infiltration rates, historical shallow groundwater and location of the project in the South Basin Groundwater Plume, infiltration is considered infeasible for the project site. See Appendices A and F for further details.

IV.3.3 Evapotranspiration & Rainwater Harvesting BMPs

Evapotranspiration (ET) BMPs are a class of retention BMPs that discharges stored volume predominately to ET, though some infiltration may occur. ET includes both evaporation and transpiration, and ET BMPs may incorporate one or more of these processes. BMPs must be designed to achieve the maximum feasible ET, where required to demonstrate that the maximum amount of water has been retained on-site. Since ET is not the sole process in these BMPs, specific design and sizing criteria have not been developed for ET-based BMPs.

EVAPOTRANSPIRATION		
ID	**Name**	**Included?**
--	HSCs, *see Section IV.3.1*	☐
--	Surface-based infiltration BMPs	☐
--	Biotreatment BMPs, see *Section VI.3.4*	☐

EVAPOTRANSPIRATION		
ID	**Name**	**Included?**
	Other:	☐

Bioretention BMPs are proposed which utilize evapotranspiration as a physical process for runoff volume reduction. Bioretention BMPs are described further in Section IV.3.4.

Harvest and use (aka. Rainwater Harvesting) BMPs are LID BMPs that capture and store storm water runoff for later use. These BMPs are engineered to store a specified volume of water and have no design surface discharge until this volume is exceeded. Harvest and use BMPs include both above-ground and below-ground cisterns. Examples of uses for harvested water include irrigation, toilet and urinal flushing, vehicle washing, evaporative cooling, industrial processes and other non-potable uses.

HARVEST & REUSE / RAINWATER HARVESTING		
ID	**Name**	**Included?**
HU-1	Above-ground cisterns and basins	☐
HU-2	Underground detention	☐
--	Other:	☐

In order to quantify harvested water demand for the common areas of the project, the Modified Estimated Applied Water Use (EAWU) method was used, consistent with Appendix X of the Model WQMP's Technical Guidance Document (TGD), dated December 20, 2013.

The Modified EAWU method is modified from the OC Irrigation Code (County Ordinance No. 09-010) to account for the wet season demand and storm events (assuming that no irrigation would be applied for approximately 30% of the days in the wet season).

The equation used to calculate the Modified EAWU is:

$$Modified\ EAWU = \frac{(ETo\text{wet} \times K\text{L} \times LA \times 0.015)}{IE}$$

Where:

$Modified\ EAWU$ = estimated daily average water use during wet season
ETo_{wet} = average reference ET from November through April (inches per month) per Table X.2 of the TGD
K_L = landscape coefficient (Table X.4 of the TGD)
LA = landscape area irrigated with harvested water (square feet)
IE = irrigation efficiency (assumed at 90%)

Note: In the equation, the coefficient (0.015) accounts for unit conversions and shut down of irrigation during and for three days following a significant precipitation event.

For a system to be considered "feasible", the system must be designed with a storage volume equal to the DCV from the tributary area and achieve more than 40% capture. The system must also be able to drawdown in 30 days to meet the 40% capture value. In addition, Table X.6 of the Technical Guidance Document sets forth the demand thresholds for minimum partial capture.

TABLE X.6: HARVESTED WATER DEMAND THRESHOLDS FOR MINIMUM PARTIAL CAPTURE	
Design Capture Storm Depth, inches	Wet Season Demand Required for Minimum Partial Capture, gpd per impervious acre
0.60	490
0.65	530
0.70	570
0.75	610
0.80	650
0.85	690
0.90	730
0.95	770
1.00	810

The following table summarizes the estimated applied water use for the common area landscaping of the project.

ESTIMATED APPLIED WATER USE (EAWU) FOR COMMON AREA LANDSCAPING									
Landscape Type	Total Area (ac)	% Impervious	Impervious Tributary (ac)	Irrigated LS Area (ac)	ETo_{Wet} [1] (in/mo)	K_L [2]	Modified EAWU (gpd)	Modified EAWU per impervious acre (gpd/ac)	Minimum Capture Threshold [3] (gpd/ac)
Blend	14.69	86	12.63	89,585	2.93	0.55	2,406	190.5	610
Design Capture Volume (gal)				237,825	Drawdown (days)				99

Notes:
1 Per Table X.2 for Santa Ana Region (similar climate type), Model WQMP Technical Guidance Document, dated May 19, 2011.
2 Per Table X.4 of the Model WQMP Technical Guidance Document, dated May 19, 2011.
3 Per Table X.6 of Model WQMP Technical Guidance Document, dated May 19, 2011.

As shown above, the project site does not have sufficient water demand during the wet season to support harvest and reuse. For this project a blend of high and low water use landscaping was

assumed, and the project, therefore, does not meet the minimum capture threshold of 610 gallons per day/acre with its Modified EAWU or estimated daily average water usage during the wet season. The DCV will not be fully utilized and emptied for the next storm event. Drawdown of the DCV is anticipated to take approximately 99 days by the landscape's water demand usage, which is greater than the maximum drawdown time of 30 days.

IV.3.4 Biotreatment BMPs

Biotreatment BMPs are a broad class of LID BMPs that reduce storm water volume to the maximum extent practicable, treat storm water using a suite of treatment mechanisms characteristic of biologically active systems, and discharge water to the downstream storm drain system or directly to receiving waters. Treatment mechanisms include media filtration (though biologically-active media), vegetative filtration (straining, sedimentation, interception, and stabilization of particles resulting from shallow flow through vegetation), general sorption processes (i.e., absorption, adsorption, ion-exchange, precipitation, surface complexation), biologically-mediated transformations, and other processes to address both suspended and dissolved constituents. Examples of biotreatment BMPs include bioretention with underdrains, vegetated swales, constructed wetlands, and proprietary biotreatment systems.

BIOTREATMENT		
ID	**Name**	**Included?**
BIO-1	Bioretention with underdrains	☐
	Storm Water planter boxes with underdrains	☐
	Rain gardens with underdrains	☐
BIO-5	Constructed wetlands	☐
BIO-2	Vegetated swales	☐
BIO-3	Vegetated filter strips	☐
BIO-7	Proprietary vegetated biotreatment systems	☒
BIO-4	Wet extended detention basin	☐
BIO-6	Dry extended detention basins	☐
--	Other:	☐

Since both infiltration and harvest and reuse are considered infeasible, biotreatment BMPs will be utilized on-site for water quality treatment, including four proprietary Modular Wetland System units. This BMP was chosen based on its ability to treat the project's pollutants of concerns to a medium or high effectiveness, in accordance with the Model WQMP and TGD requirements. The table below summarizes the overall treatment effectiveness for Modular Wetland Systems, derived from Table 4.2 of the Technical Guidance Document and testing data provided by the manufacturer. Additional details on the proposed BMPs are included in Section VI of this WQMP.

POLLUTANTS OF CONCERN AND PERFORMANCE RATINGS		
Pollutant of Concern (1)	Treatment Effectiveness	
	Bioretention System (2)	Modular Wetlands Proprietary Bioretention Units (3)
Suspended Solids/Sediments	High	High
Nutrients	Low	Medium-High
Metals	High	Medium
Pathogens/Bacteria	Medium	Medium-High
Pesticides	N/A	N/A
Oil & Grease	High	High
Toxic Organic Compounds	Medium	N/A(4)
Trash & Debris	High	High

Notes:
1 See Section II.2 of this WQMP.
2 Per Table 4.2 of the Model WQMP's companion Technical Guidance Document dated May 19, 2011.
3 Based on Washington State University Technology Assessment Protocol – Ecology (TAPE) third-party independent field tests for a high-flow biotreatment system with raised under drain (Modular Wetland System-Linear). Refer to manufacturer documentation (attached) for specific removal efficiencies and source references.
4 Field and Lab Testing demonstrates 75-83% removal rates of Chemical Oxygen Demand (COD), a measure of the amount of organic pollutants commonly found in surface water. COD removals of this range would fall within the Medium-High effectiveness category.

Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes including screening media filtration, settling, and biofiltration. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.

In accordance with the Model WQMP and TGD, the bioretention/biotreatment BMPs will be sized to treat runoff from the Design Capture Storm (85th percentile, 24-hour). Since Modular Wetlands are sized based on flow rate, they were sized utilizing the methodology for flow based BMPs (TGD Section III.1.2 and Worksheet D). Locations and tributary drainage areas are shown on the WQMP Exhibit included in Section VI. BMP details are also included in Section VI. Detailed calculations and associated TGD Worksheets are included in Appendix A. Operation and maintenance details are included in Section V and Appendix D (O&M Plan).

MODULAR WETLAND SYSTEM DESIGN SUMMARY							
DMA ID[1]	Area (ac)	% Imp.	2-Year Tc (min)	Rainfall Intensity (in/hr)	Q_{Design}[3] (cfs)	Size / Model[4]	Combined Treatment Capacity [5] (cfs)
DMA 1	14.69	86%	5.0	0.26	3.036	Four MWS-L-8-24 High Capacity (3.75')	3.056

Notes:
(1) See also Section IV.2.2.
(2) Refer to WQMP Exhibit in Section VI for locations of each drainage area and BMP.
(3) Detailed calculations and worksheets are included in Appendix A.
(4) Unit details and specifications are included in Section VI.
(5) Treatment capacities of each unit are based on wetland media design loading rate (controlled by downstream orifice) and perimeter surface area of wetland media provided. Individual unit sizing calculations provided by the manufacturer are included on each cut sheet/detail included in Section VI.

Four high capacity modular wetland systems will be installed in the parking lot along Redhill Avenue. Low flows will be diverted and pumped to the MWS units for treatment before joining the main storm drain system along Redhill Avenue.

IV.3.5 Hydromodification Control BMPs

Not applicable. Refer to Section II.3 for further information.

IV.3.6 Regional/Sub-Regional LID BMPs

Not applicable. LID BMPs (biofiltration) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs.

TREATMENT CONTROL BMPs		
ID	Name	Included?
TRT-1	Sand Filters	☐
TRT-2	Cartridge Media Filter	☐
PRE-1	Hydrodynamic Separation Device	☐
PRE-2	Catch Basin Insert	☐
	Other:	☐

Not applicable. LID BMPs (biofiltration) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.3.8 Non-Structural Source Control BMPs

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

NON-STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
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)	☐	☒	Not applicable – no hazardous materials.
N6	Local Water Quality Permit Compliance	☐	☒	The City of Santa Ana does not issue water quality permits.
N7	Spill Contingency Plan	☐	☒	Not applicable, no proposed hazardous materials on site
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks are proposed.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Not applicable – no proposed hazardous materials on site
N10	Uniform Fire Code Implementation	☐	☒	Not applicable – no hazardous materials.
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☒	☐	
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	

NON-STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
N16	Retail Gasoline Outlets	☐	☒	No retail gasoline outlets are proposed.

N1, Education for Property Owners, Tenants and Occupants

Educational materials will be provided to tenants, including brochures and restrictions to reduce pollutants from reaching the storm drain system. Examples include tips for pet care, household tips, and proper household hazardous waste disposal. Tenants will be provided with these materials by the property management prior to occupancy, and periodically thereafter. Refer to Section VII for a list of materials available and attached to this WQMP. Additional materials are available through the County of Orange Stormwater Program website (http://ocwatersheds.com/PublicEd/) and the California Stormwater Quality Association's (CASQA) BMP Handbooks (http://www.cabmphandbooks.com/).

N2, Activity Restrictions

The Owner shall develop ongoing activity restrictions that include those that have the potential to create adverse impacts on water quality. Activities include, but are not limited to: handling and disposal of contaminants, fertilizer and pesticide application restrictions, litter control and pick-up, and vehicle or equipment repair and maintenance in non-designated areas, as well as any other activities that may potentially contribute to water pollution.

N3, Common Area Landscape Management

Management programs will be designed and implemented by the Owner to maintain all the common areas within the project site. These programs will cover how to reduce the potential pollutant sources of fertilizer and pesticide uses, utilization of water-efficient landscaping practices and proper disposal of landscape wastes by the owner/developer and/or contractors.

N4, BMP Maintenance

The Owner will be responsible for the implementation and maintenance of each applicable non-structural BMP, as well as scheduling inspections and maintenance of all applicable structural BMP facilities through its staff, landscape contractor, and/or any other necessary maintenance contractors. Details on BMP maintenance are provided in Section V of this WQMP, and the O&M Plan is included in Appendix D.

N11, Common Area Litter Control

The Owner will be responsible for performing trash pickup and sweeping of littered common areas on a weekly basis or whenever necessary. Responsibilities will also include noting improper disposal materials by the public and reporting such violations for investigation.

N12, Employee Training

All employees of the Owner and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not be limited to, spill cleanup procedures, proper waste disposal, housekeeping practices, etc.

N13, Housekeeping of Loading Docks

Housekeeping measures will be implemented by the Owner to keep the proposed loading dock and delivery areas clean and orderly condition. Includes sweeping, removal of trash & debris on a weekly basis, and use of dry methods for cleanup (e.g., sweeping).

N14, Common Area Catch Basin Inspection

All on-site catch basin inlets and drainage facilities shall be inspected and maintained by the Owner at least once a year, prior to the rainy season, no later than October 1st of each year.

N15, Street Sweeping Private Streets and Parking Lots

The Owner shall be responsible for sweeping all on-site streets, drive aisles, and parking lots within the project on a quarterly basis.

IV.3.9 Structural Source Control BMPs

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
S1 SD-13	Provide storm drain system stenciling and signage	☒	☐	
S2 SD-34	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	No outdoor storage areas are proposed.
S3 SD-32	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	There are no slopes or channels on the project site.
S6 SD-31	Properly Design: Dock areas	☒	☐	

STRUCTURAL SOURCE CONTROL BMPs				
ID	Name	Included?	Not Applicable?	If Not Applicable, Provide Brief Reason
S7 SD-31	Properly Design: Maintenance bays	☐	☒	No maintenance bays are proposed.
S8 SD-33	Properly Design: Vehicle wash areas	☐	☒	No vehicle wash areas are proposed.
S9 SD-36	Properly Design: Outdoor processing areas	☐	☒	No outdoor processing areas are proposed.
S10	Properly Design: Equipment wash areas	☐	☒	No equipment wash areas are proposed.
S11 SD-30	Properly Design: Fueling areas	☐	☒	No fueling areas are proposed.
S12 SD-10	Properly Design: Hillside landscaping	☐	☒	Project is not located in a hillside area.
S13	Properly Design: Wash water control for food preparation areas	☒	☐	
S14	Properly Design: Community car wash racks	☐	☒	No community car wash racks are proposed.

S1/SD-13, Provide storm drain system stenciling and signage

The phrase "NO DUMPING! DRAINS TO OCEAN", or an equally effective phrase approved by the City, will be stenciled on all major storm drain inlets within the project site to alert the public to the destination of pollutants discharged into storm water. Stencils shall be in place prior to release of certificate of occupancy. Stencils shall be inspected for legibility on an annual basis and re-stenciled as necessary.

S3/SD-32, Design and construct trash and waste storage areas to reduce pollution introduction

All trash and waste shall be stored in containers that have lids or tarps to minimize direct precipitation into the containers. There will be four trash staging areas. One trash storage area will be located near Building C adjacent to the main roadway that bisects the site. Another storage area will be located across the main roadway outside of Building B. The third storage area will be located at the western edge of the main roadway outside of Building D. The fourth storage area will be located on the southeastern edge of the main roadway outside of Building A. The trash storage areas will be designed to City standards, and will be walled, roofed, have gates and proper drainage per City standards.

S4/SD-12, Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control

The Owner will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff.

The Owner will be responsible for implementing all efficient irrigation systems for common area landscaping including, but not limited to, provisions for water sensors and programmable irrigation cycles. This includes smart timers, rain sensors, and moisture shut-off valves. The irrigation systems shall be in conformance with water efficiency guidelines. Systems shall be tested twice per year, and water used during testing/flushing shall not be discharged to the storm drain system.

S6/SD-31, Properly Design: Dock areas

Three loading dock areas will be located throughout the central and southern portions of the site. One loading dock area consisting of two parking stalls will be located along the northern edge of the main roadway. Another loading dock area will be located directly across the main roadway. The third loading dock area will be located at the southern edge of the site adjacent to the sidewalk along Warner Ave. Runoff from the loading dock will not discharge into the storm drain system. Housekeeping measures shall be implemented in accordance with BMP N13.

S13, Properly Design: Wash water control for food preparation areas

All wash water from food prep areas will be controlled and proper staff training conducted by the site operator. Food preparation facilities shall meet all health and safety, building and safety and any other applicable regulations, codes requirements, including installation of a grease interceptor where required. Sinks shall be contained with sanitary sewer connections for disposal of wash waters containing kitchen and food wastes.

IV.4 ALTERNATIVE COMPLIANCE PLAN

IV.4.1 Water Quality Credits

Local jurisdictions may develop a water quality credit program that applies to certain types of development projects after they first evaluate the feasibility of meeting LID requirements on-site. If it is not feasible to meet the requirements for on-site LID, project proponents for specific project types can apply credits that would reduce project obligations for selecting and sizing other treatment BMPs or participating in other alternative programs.

WATER QUALITY CREDITS	
Credit	**Applicable?**
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 water quality 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)	☐

WATER QUALITY CREDITS	
Credit	**Applicable?**
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.	☐

Not applicable. Water quality credits will not be applied for the project. LID BMPs will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

IV.4.2 Alternative Compliance Plan Information

Not applicable. LID BMPs (biofiltration) will be utilized for water quality treatment on-site in accordance with the MS4 Permit hierarchy identified at the beginning of this Section.

SECTION V INSPECTION/MAINTENANCE RESPONSIBILITY FOR BMPs

It has been determined that Vineyards Development Corporation shall assume all BMP inspection and maintenance responsibilities for The Bowery Mixed-Use project.

Contact Name:	Jeremy Ogulnick
Title:	Vice President of Development
Company:	Vineyards Development Corporation
Address:	240 Newport Center Drive, Suite 200, Newport Beach, CA 92660
Phone:	310.849.5793
Email:	Jeremy@vineyardsdc.com

Should the maintenance responsibility be transferred at any time during the operational life of The Bowery Mixed-Use project, such as when an HOA or POA is formed for a project, a formal notice of transfer shall be submitted to the City of Santa Ana at the time responsibility of the property subject to this WQMP is transferred. The transfer of responsibility shall be incorporated into this WQMP as an amendment.

The POA shall verify BMP implementation and ongoing maintenance through inspection, self-certification, survey, or other equally effective measure. The certification shall verify that, at a minimum, the inspection and maintenance of all structural BMPs including inspection and performance of any required maintenance in the late summer / early fall, prior to the start of the rainy season. A form that may be used to record implementation, maintenance, and inspection of BMPs is included in Appendix D.

The City of Santa Ana may conduct verifications to assure that implementation and appropriate maintenance of structural and non-structural BMPs prescribed within this WQMP is taking place at the project site. The POA shall retain operations, inspections and maintenance records of these BMPs and they will be made available to the City or County upon request. All records must be maintained for at least five (5) years after the recorded inspection date for the lifetime of the project.

Long-term funding for BMP maintenance will be provided by Vineyards Development Corporation.

The Operations and Maintenance (O&M) Plan can be found in Appendix D.

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
BIOTREATMENT BMPs				
BIO-7	Proprietary Biotreatment: Modular Wetland Systems (MWS)	The Modular Wetland unit shall be maintained in accordance with manufacturer's specifications. The system shall be inspected at a minimum of once every six months, prior to the start of the rainy season (October 1) each year, and after major storm events. Typical maintenance includes removing trash & debris from the catch basin screening filter (by hand), removal of sediment and solids in the settlement chamber (vacuum truck), replacement of the BioMediaGREEN™ filter cartridge, and replacement of the BioMediaGREEN™ drain down filter (if equipped). In addition, plants within the wetland chamber will require trimming as needed in conjunction with routine landscape maintenance activities. No fertilizer shall be used in this chamber. Wetland chamber should be inspected during rain events to verify flow through the system. If little to no flow is observed from the lower valve or orifice plate, the wetland media may require replacement. If prior treatment stages are properly maintained, the life of the wetland media can be up to 20 years.	2x per year	Vineyards Development Corporation
NON-STRUCTURAL SOURCE CONTROL BMPs				
N1	Education for Property Owners, Tenants and Occupants	Educational materials will be provided to tenants annually. Materials to be distributed are found in Appendix C of this WQMP. Tenants will be provided these materials by Property Management prior to occupancy and annually thereafter.	Annually	Vineyards Development Corporation

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N2	Activity Restrictions	The Owner will prescribe activity restrictions to protect surface water quality, through lease terms or equally effective measure, for the property. Restrictions include but are not limited to prohibiting vehicle maintenance or vehicle washing.	Ongoing	Vineyards Development Corporation
N3	Common Area Landscape Management	Maintenance shall be consistent with County requirements. Fertilizer and/or pesticide usage shall be consistent with County Management Guidelines for Use of Fertilizers (OC DAMP § 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting, and replacement of mulch shall be performed on an as-needed basis to prevent exposure of erodible surfaces. Trimmings, clippings, and other landscape wastes shall be properly disposed of in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and drain inlets.	Monthly	Vineyards Development Corporation
N4	BMP Maintenance	Maintenance of structural BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP (Appendix B). Records of inspections and BMP maintenance shall be kept by the Owner and shall be available for review upon request.	Ongoing	Vineyards Development Corporation
N5	Title 22 CCR Compliance (How development will comply)	Not Applicable		
N6	Local Industrial Permit Compliance	Not Applicable		
N7	Spill Contingency Plan	Not Applicable		

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
N8	Underground Storage Tank Compliance	Not Applicable		
N9	Hazardous Materials Disclosure Compliance	Not Applicable		
N10	Uniform Fire Code Implementation	Not Applicable		
N11	Common Area Litter Control	Litter patrol, violations investigations, reporting and other litter control activities shall be performed on a weekly basis and in conjunction with routine maintenance activities.	Weekly	Vineyards Development Corporation
N12	Employee Training	The Owner shall educate all new employees/managers on storm water pollution prevention, particularly good housekeeping practices, prior to the start of the rainy season (October 1). Refresher courses shall be conducted on an as needed basis. Materials that may be utilized on BMP maintenance are included in Appendix B.	Annually	Vineyards Development Corporation
N13	Housekeeping of Loading Docks	Sweep area routinely and before October 1 each year. Keep area clean of trash and debris at all times. Spills shall be cleaned up immediately using dry methods.	Weekly	Vineyards Development Corporation
N14	Common Area Catch Basin Inspection	On-site catch basin inlets shall be inspected and, if necessary, cleaned prior to the storm season by October 1st each year.	Annually	Vineyards Development Corporation
N15	Street Sweeping Private Streets and Parking Lots	All private streets, drive aisles and exposed parking areas within the project shall be swept at a minimum frequency quarterly as well as once per year prior to the storm season, no later than October 1 each year.	Quarterly	Vineyards Development Corporation

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	**Inspection/Maintenance Activities**	**Minimum Frequency**	**Responsible Party**
N16	Retail Gasoline Outlets	Not Applicable		
STRUCTURAL SOURCE CONTROL BMPs				
S1 SD-13	Provide storm drain system stenciling and signage	On-site storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1st each year. Those determined to be illegible will be re-stenciled as soon as possible.	Annually	Vineyards Development Corporation
S2 SD-34	Design and construct outdoor material storage areas to reduce pollution introduction	Not Applicable		
S3 SD-32	Design and construct trash and waste storage areas to reduce pollution introduction	Trash receptacles will be monitored and emptied by management of the Bowery. Trash will be taken from the interior trash rooms to the exterior trash storage areas at the time trash collection is set to occur. The four trash storage areas will drain into a water quality inlet to prevent discharge of spilled contaminants, consistent with local design standards.	Ongoing	Vineyards Development Corporation
S4 SD-12	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	In conjunction with routine maintenance, verify that landscape design continues to function properly by adjusting systems to eliminate overspray to hardscape areas and to verify that irrigation timing and cycle lengths are adjusted in accordance to water demands, given the time of year, weather, and day or nighttime temperatures. System testing shall occur twice per year. Water from testing/flushing shall be collected and properly disposed to the sewer system and shall not discharge to the storm drain system.	2x per year	Vineyards Development Corporation

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
S5	Protect slopes and channels and provide energy dissipation	Not Applicable		
S6 SD-31	Properly Design: Dock areas	Sweep area routinely and before October 1 each year. Keep area clean of trash and debris at all times. Spills shall be cleaned up immediately. See also BMP N13.	Weekly	Vineyards Development Corporation
S7 SD-31	Properly Design: Maintenance bays	Not Applicable		
S8 SD-33	Properly Design: Vehicle wash areas	Not Applicable		
S9 SD-36	Properly Design: Outdoor processing areas	Not Applicable		
S10	Properly Design: Equipment wash areas	Not Applicable		
S11 SD-30	Properly Design: Fueling areas	Not Applicable		
S12 SD-10	Properly Design: Hillside landscaping	Not Applicable		
S13	Properly Design: Wash water control for food preparation areas	Adequate signs shall be provided and appropriately placed stating the prohibition of discharging wash water to the storm drain system. Employees shall be trained in discharge and safety requirements outlined in State Health & Safety Code 27520. All cooking utensils shall be cleaned in appropriate wash stations.	Ongoing	Vineyards Development Corporation

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX				
	BMP	Inspection/Maintenance Activities	Minimum Frequency	Responsible Party
S14	Properly Design: Community car wash racks	Not Applicable		

Any waste generated from maintenance activities will be disposed of properly. Wash water and other waste from maintenance activities is not to be discharged or disposed of into the storm drain system. Clippings from landscape maintenance (i.e. prunings) will be collected and disposed of properly off-site, and will not be washed into the streets, local area drains/conveyances, or catch basin inlets.

SECTION VI SITE PLAN AND DRAINAGE PLAN

The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well.

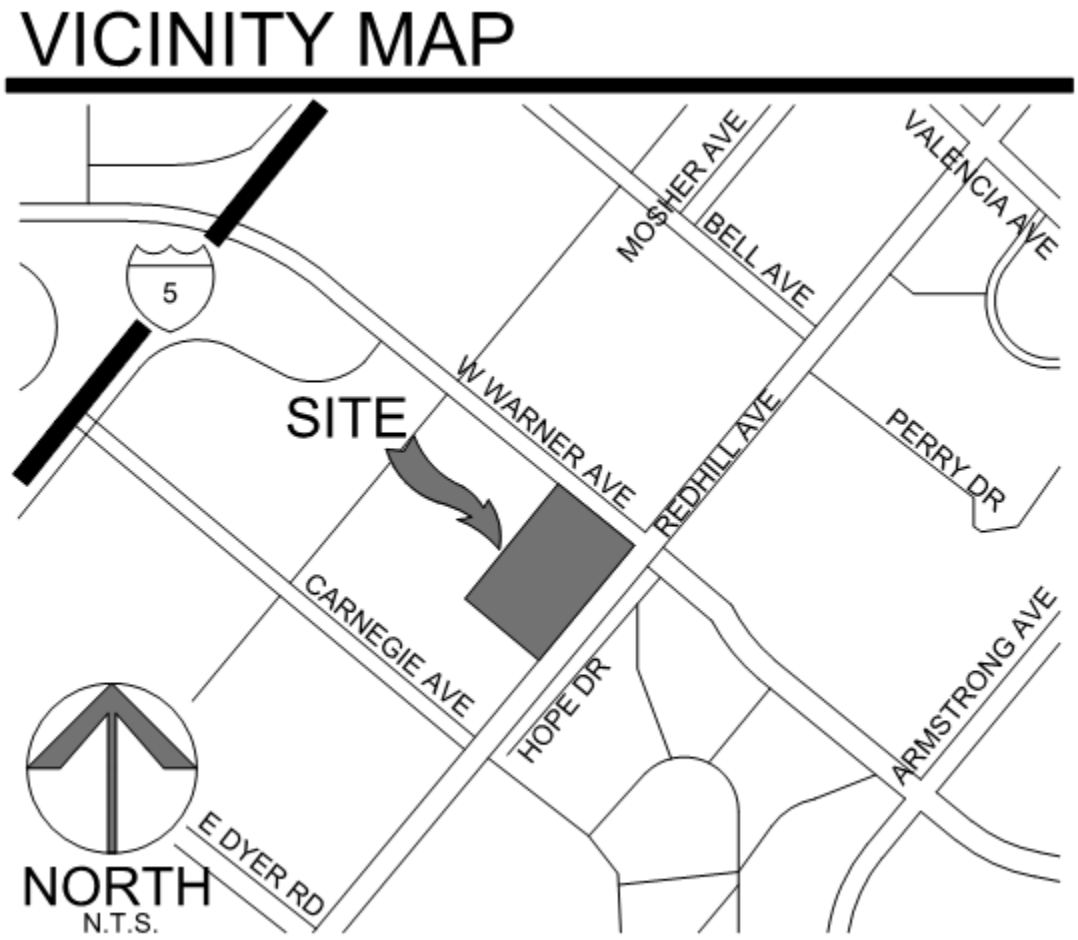
EXHIBITS

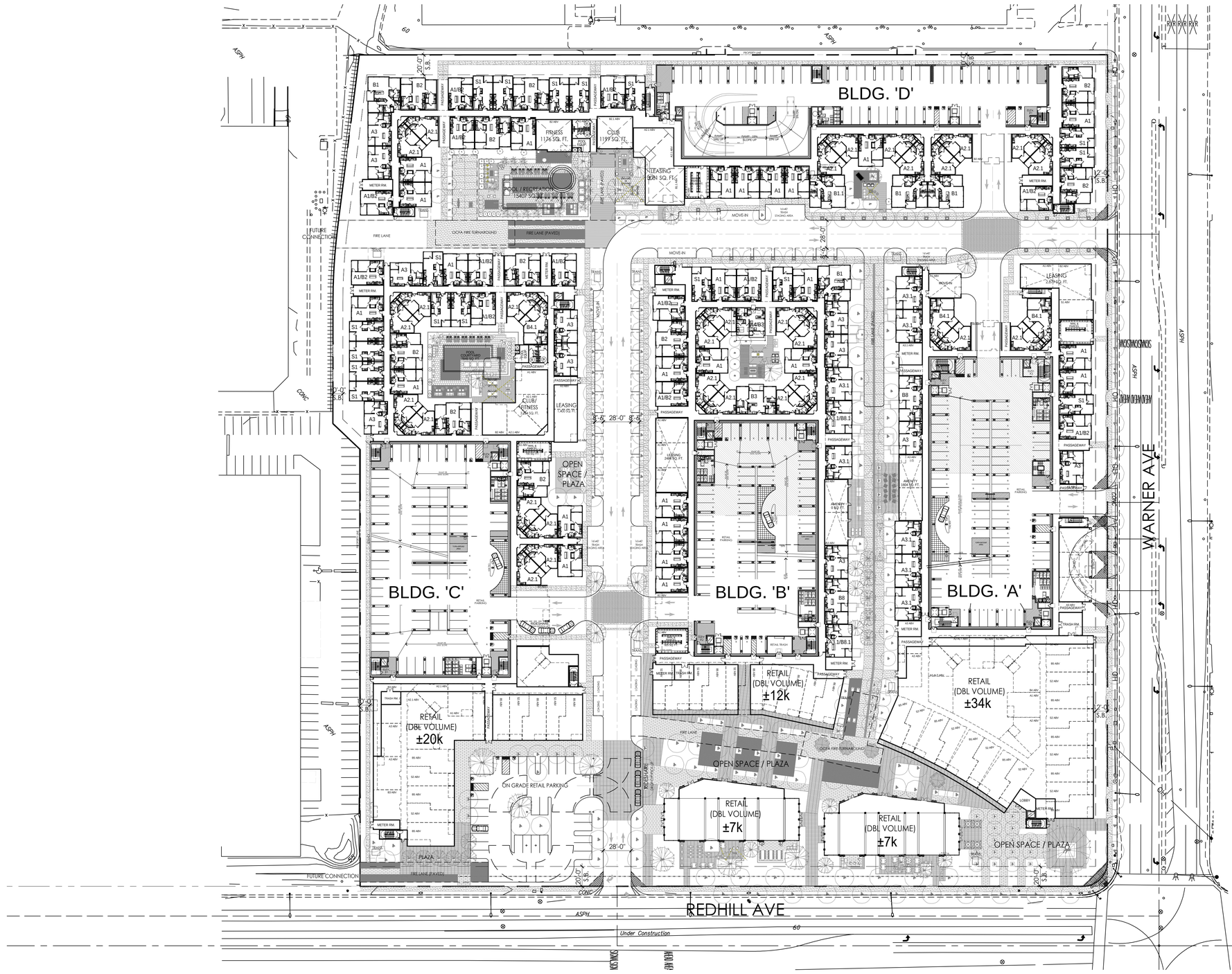
- Vicinity Map
- Site Plan
- WQMP Exhibit
- Modular Wetland System Details

BMP DETAILS & FACT SHEETS

- BIO-7 Proprietary Biotreatment BMP Fact Sheets

VICINITY MAP





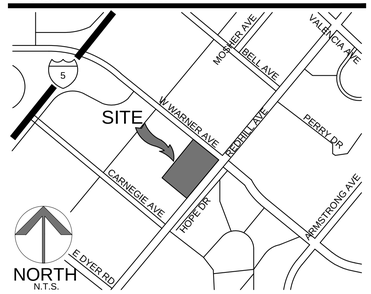
SITE PLAN NOTES

1. THIS ARCHITECTURAL SITE PLAN IS PROVIDED FOR OVERALL SITE REFERENCE. THE LOCATION OF ITEMS INCLUDED IN THIS SET OF PLANS IS FOR AGENCY DEPARTMENT USE ONLY.
2. THIS SITE PLAN IS FOR REFERENCE ONLY, AS AN ARCHITECTURAL PLAN FOR GENERAL LAYOUT AND IDENTIFICATION PURPOSES ONLY
3. FOR LOT LINE DIMENSIONS & HORIZONTAL CONTROL, SEE CIVIL DRAWINGS
4. FOR HARDSCAPE AND ALL SITE IMPROVEMENTS, SEE LANDSCAPE DRAWINGS
5. FOR PARKING GARAGE, SEE SEPARATE SUBMITTAL PACKAGE
6. FOR "FIRE LANE" DESIGN, SEE CIVIL AND LANDSCAPE DRAWINGS
7. FOR PERIMETER FENCING, SEE LANDSCAPE DRAWINGS
8. REFER TO CIVIL AND LANDSCAPE DRAWINGS FOR SPECIFIC SITE REQUIREMENTS
9. ALL PROPERTY LINES, EASEMENTS, AND BUILDINGS, EXISTING AND PROPOSED ARE SHOWN ON THIS PLAN BUT MUST BE VERIFIED WITH THE CIVIL PLANS
10. BUILDING SIGNAGE IS DESIGNED BY OTHERS AND INSTALLED BY THE GENERAL CONTRACTOR.
11. SITE SIGNAGE IS DESIGNED BY OTHERS AND INSTALLED BY THE CONTRACTOR.
12. SITE WALLS ARE DESIGNED BY OTHERS
13. DECORATIVE SITE LIGHTING IS DESIGNED BY OTHERS.
14. SURFACE WATER MUST DRAIN AWAY FROM BUILDING SEE CIVIL AND LANDSCAPE PLANS FOR DRAINAGE DESIGN.

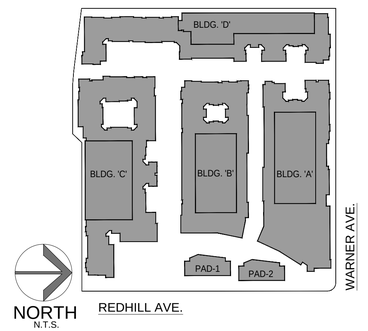
GENERAL NOTES

1. SEE SHEETS L.1 - L.2 FOR LANDSCAPE.

VICINITY MAP



KEY MAP



0 25' 50' 100' 150'
1"=50'-0"

CONCEPTUAL SITE PLAN

A1.4

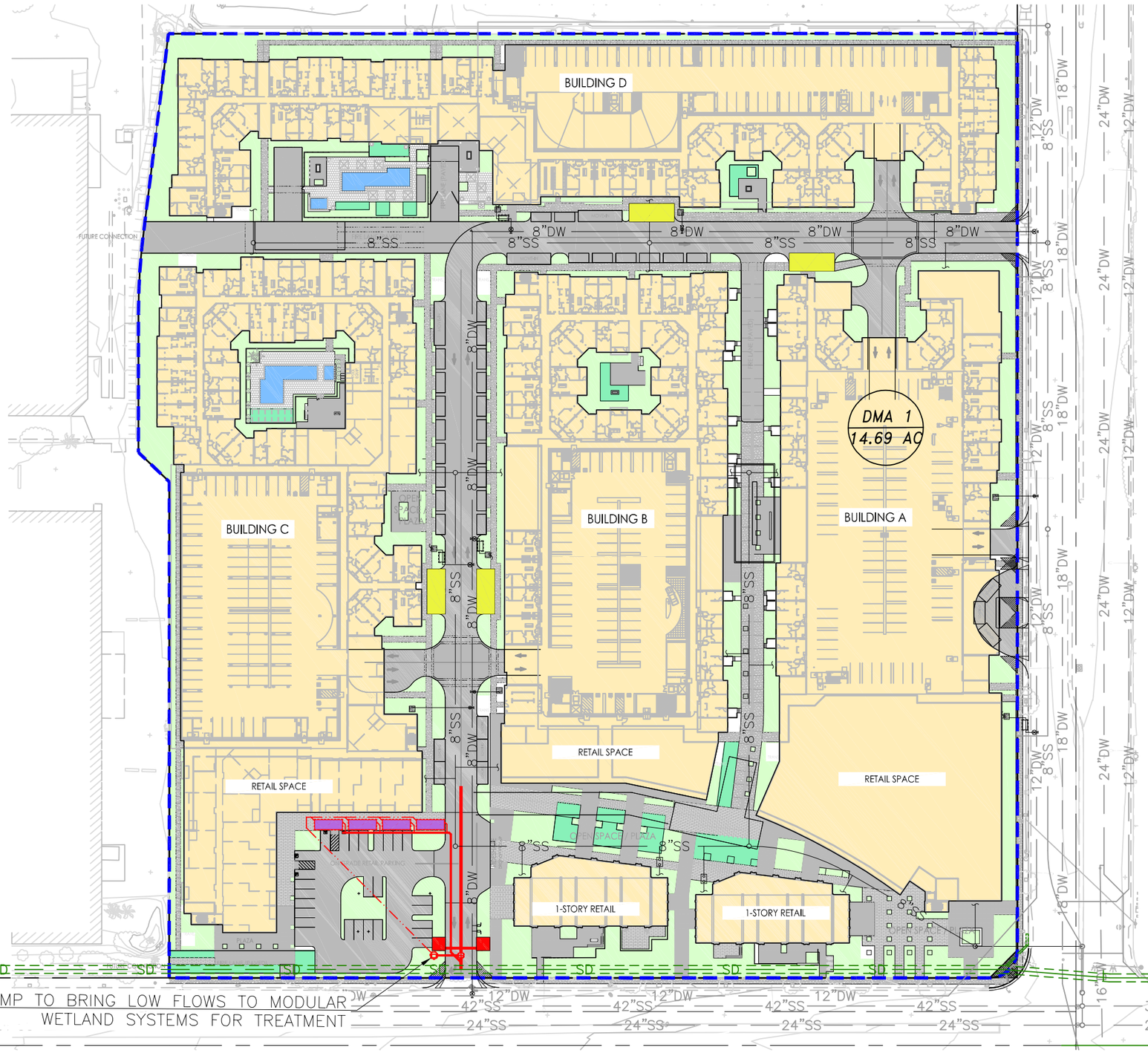
DATE: 09.30.19
JOB NO.: 2018-174

THE BOWERY

SANTA ANA, CA.

VDC
240 NEWPORT CENTER DRIVE, SUITE 200 NEWPORT BEACH, CA. 92660
(310) 571-8227

ARCHITECTS ORANGE
144 NORTH ORANGE ST., ORANGE, CA 92866
(714) 639-9860



LEGEND

- PROPERTY LINE
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- BMP DRAINAGE AREA BOUNDARY
- PROPOSED COMMON AREA LANDSCAPING
- PROPOSED TURF LANDSCAPING
- PROPOSED BUILDING
- STREET SWEEPING PRIVATE STREETS & PARKING LOTS
- PROPOSED POOL
- PROPOSED TRASH ENCLOSURE
- CATCH BASIN STENCILING & MAINTENANCE
- PROPOSED MODULAR WETLAND SYSTEM
- DIRECTION OF FLOW
- DRAINAGE MANAGEMENT AREA (A, 14.69 AC)

100' 0' 50' 100'

SCALE: 1" = 100'

N

Scale: 1" = 100'

Exhibit Date: 10/03/2019

PRELIMINARY WATER QUALITY MANAGEMENT PLAN
THE BOWERY
SANTA ANA, CA

FUSCOE ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 • fax 949.474.5315
www.fuscoe.com

SITE SPECIFIC DATA*	
PROJECT NAME	
PROJECT LOCATION	
STRUCTURE ID	

PERFORMANCE DATA	
TREATMENT FLOW (CFS)	
TREATMENT HGL (FT)	3.4
BYPASS FLOW RATE (CFS)	

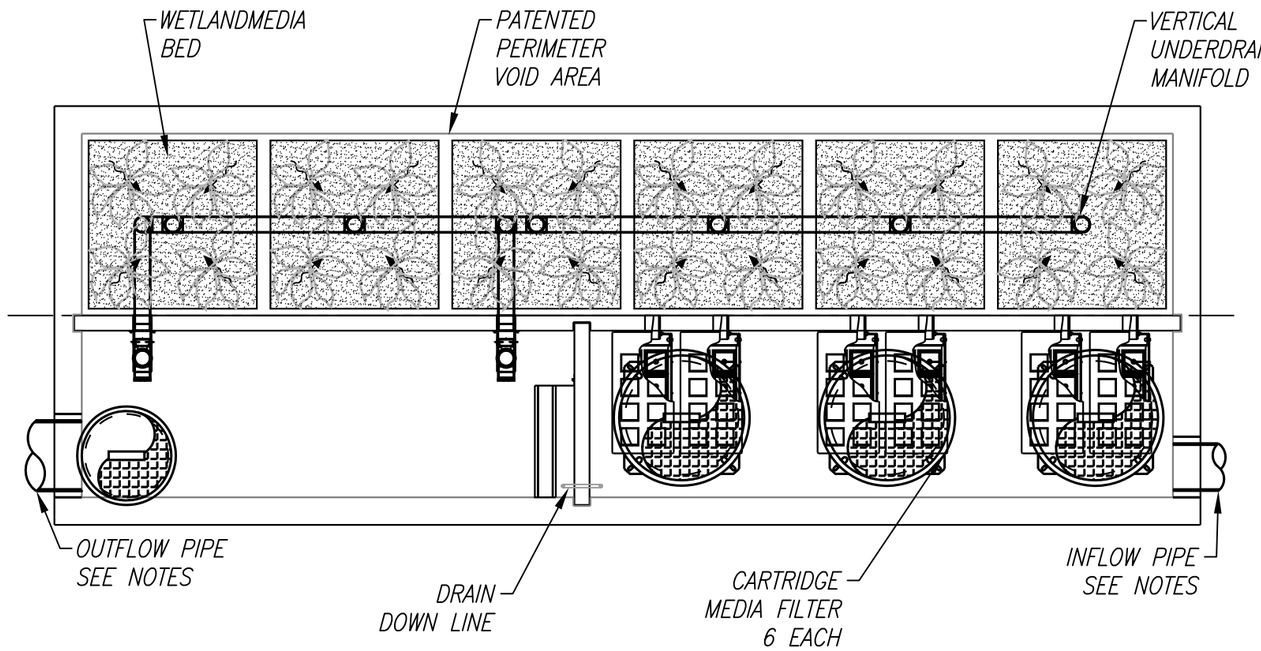
PROJECT PARAMETERS			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1		PVC	
OUTLET PIPE 1		PVC	
RIM ELEVATION			
SURFACE LOADING REQUIREMENT		PARKWAY	

FRAME & COVER	PRETREATMENT	BIOFILTRATION	DISCHARGE
	30"		24"

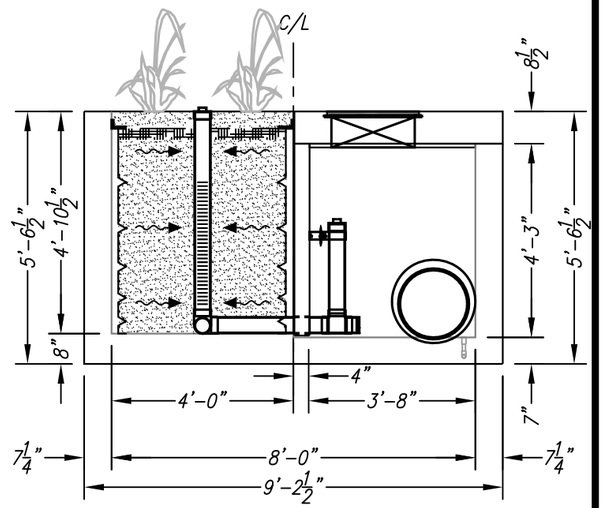
WETLANDMEDIA VOLUME (CY)	
MEDIA DELIVERED	
ORIFICE SIZE (DIA)	
MAX PICK WEIGHT (LBS)	

NOTES:

*PER ENGINEER OF RECORD



PLAN VIEW



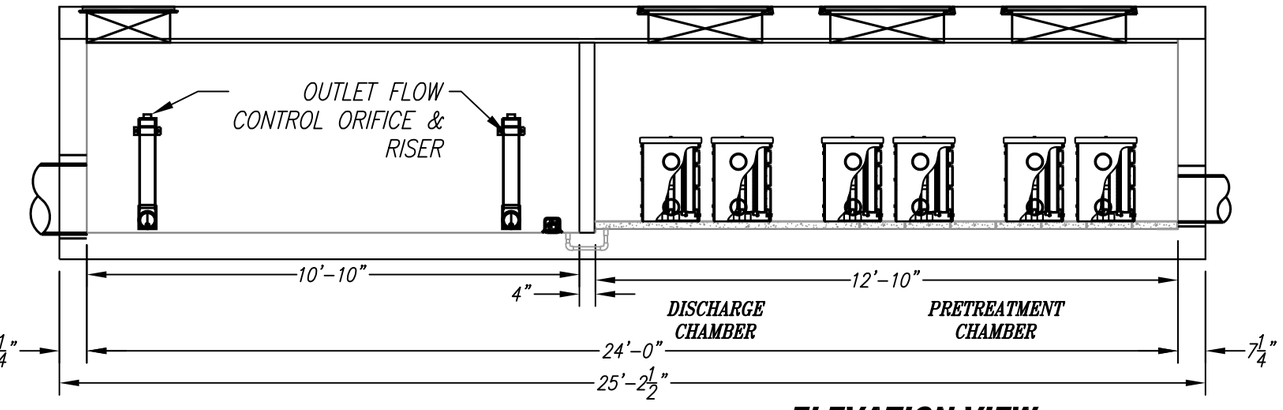
LEFT END VIEW

INSTALLATION NOTES

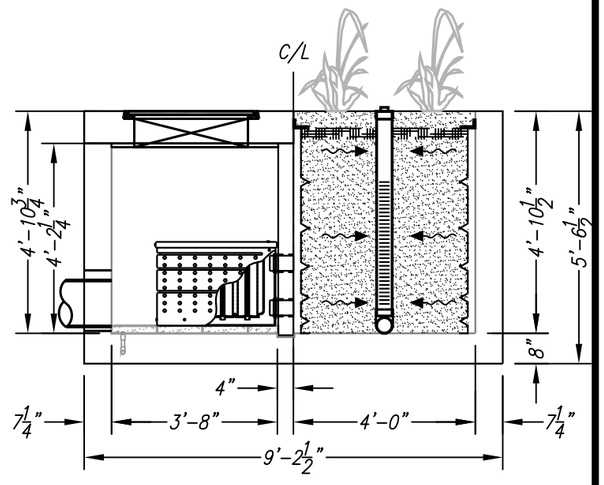
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. MANUFACTURER RECOMMENDS A MINIMUM 6"LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH).
4. INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR.
5. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
6. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.

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 MANUFACTURER.



ELEVATION VIEW



RIGHT END VIEW

MWS UNIT DESIGN DATA	
TREATMENT CAPACITY (CFS)	0.693
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

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

4/8/15/JUSTIN

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.

☐ 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)**.

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**

SECTION VII EDUCATIONAL MATERIALS

The educational materials included in this WQMP are provided to inform people involved in future uses, activities, or ownership of the site about the potential pitfalls associated with careless storm water management. "The Ocean Begins at Your Front Door" provides users with information about storm water that is/will be generated on site, what happens when water enters a storm drain, and its ultimate fate, discharging into the ocean. Also included are activities guidelines to educate anyone who is or will be associated with activities that have a potential to impact storm water runoff quality, and provide a menu of BMPs to effectively reduce the generation of storm water runoff pollutants from a variety of activities. The educational materials that may be used for the proposed project are included in Appendix C of this WQMP and are listed below.

EDUCATION MATERIALS			
Residential Materials (http://www.ocwatersheds.com)	**Check If Attached**	**Business Materials (http://www.ocwatersheds.com)**	**Check If Attached**
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 Materials (http://www.ocwatersheds.com) (https://www.casqa.org/resources/bmp-handbooks)**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☒		
Recycle at Your Local Used Oil Collection Center (North County)	☐	DF-1 Drainage System Operation & Maintenance	☒
Recycle at Your Local Used Oil Collection Center (Central County)	☒	R-1 Automobile Repair & Maintenance	☐
Recycle at Your Local Used Oil Collection Center (South County)	☐	R-2 Automobile Washing	☐
Tips for Maintaining Septic Tank Systems	☐	R-3 Automobile Parking	☐
Responsible Pest Control	☒	R-4 Home & Garden Care Activities	☐
Sewer Spill	☐	R-5 Disposal of Pet Waste	☒
Tips for the Home Improvement Projects	☐	R-6 Disposal of Green Waste	☐
Tips for Horse Care	☐	R-7 Household Hazardous Waste	☐
Tips for Landscaping and Gardening	☐	R-8 Water Conservation	☒
Tips for Pet Care	☒	SD-10 Site Design & Landscape Planning	☒
Tips for Pool Maintenance	☒	SD-11 Roof Runoff Controls	☐
Tips for Residential Pool, Landscape and Hardscape Drains	☒	SD-12 Efficient Irrigation	☒
Tips for Projects Using Paint	☐	SD-13 Storm Drain Signage	☒
Tips for Protecting Your Watershed	☒	SD-31 Maintenance Bays & Docs	☐
Other: Children's Brochure	☐	SD-32 Trash Storage Areas	☒

APPENDICES

APPENDIX A

SUPPORTING CALCULATIONS

SUBJECT TO FURTHER REVISION

LEGEND

- Orange County Precipitation Stations
- 24 Hour, 85th Percentile Rainfall (Inches)
- 24 Hour, 85th Percentile Rainfall (Inches) - Extrapolated
- City Boundaries

Rainfall Zones

Design Capture Storm Depth (inches)

- 0.65"
- 0.7
- 0.75
- 0.80
- 0.85
- 0.90
- 0.95
- 1.00
- 1.10"

Note: Events defined as 24-hour periods (calendar days) with greater than 0.1 inches of rainfall.
For areas outside of available data coverage, professional judgment shall be applied.

Project Site

0.9 0.9 0.95 0.7 0.75 0.7 0.65 0.8 0.75 0.85 0.9 0.95 1 1.05

0 3 6 12 Kilometers
0 1.8 3.6 7.2 Miles

TITLE: RAINFALL ZONES

JOB: ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT — ORANGE CO., CA

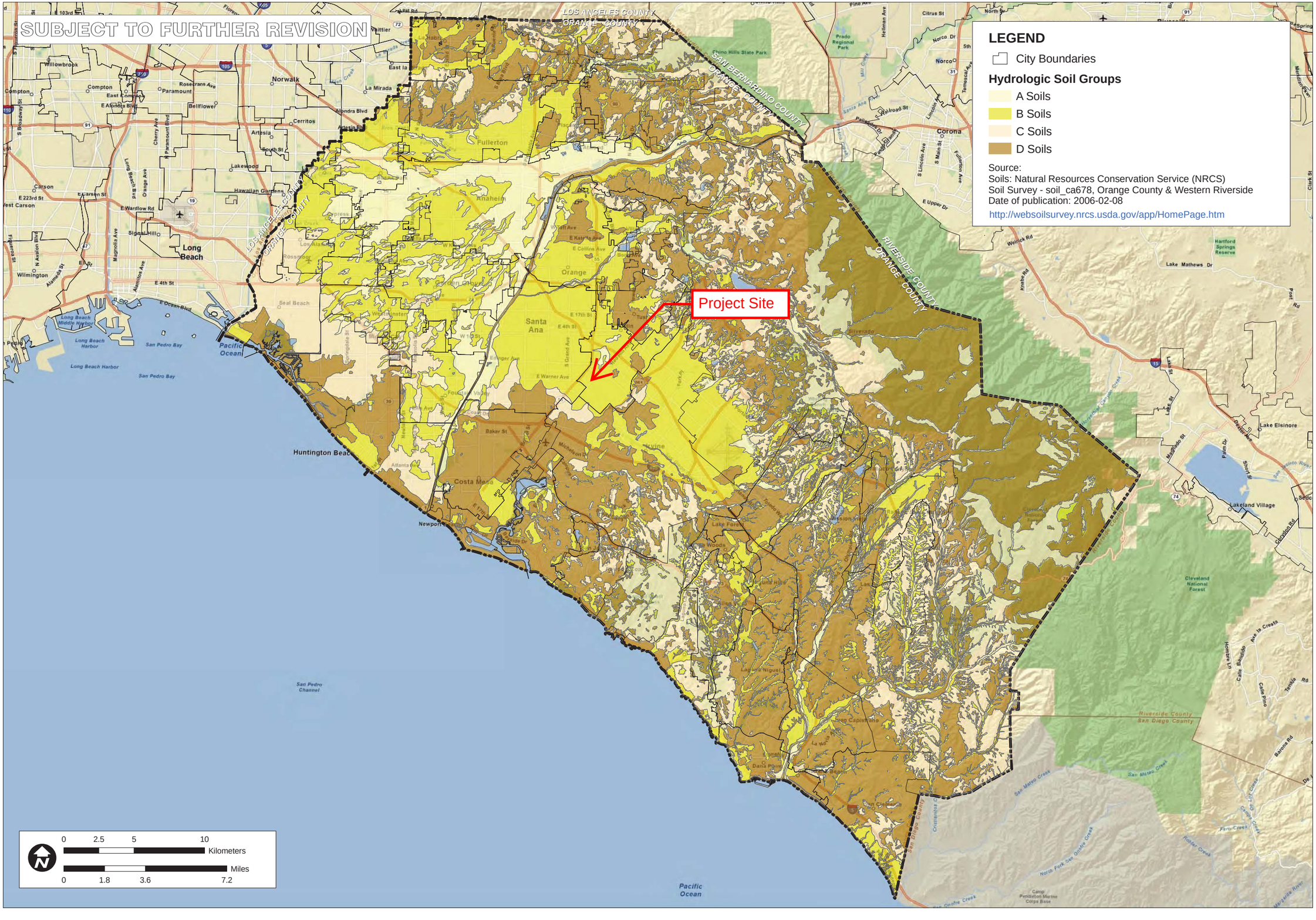
SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE XVI-1

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-1_RainfallZones_20110215.mxd

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

0 2.5 5 10 Kilometers

0 1.8 3.6 7.2 Miles

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2a_HydroSoils_20110215.mxd

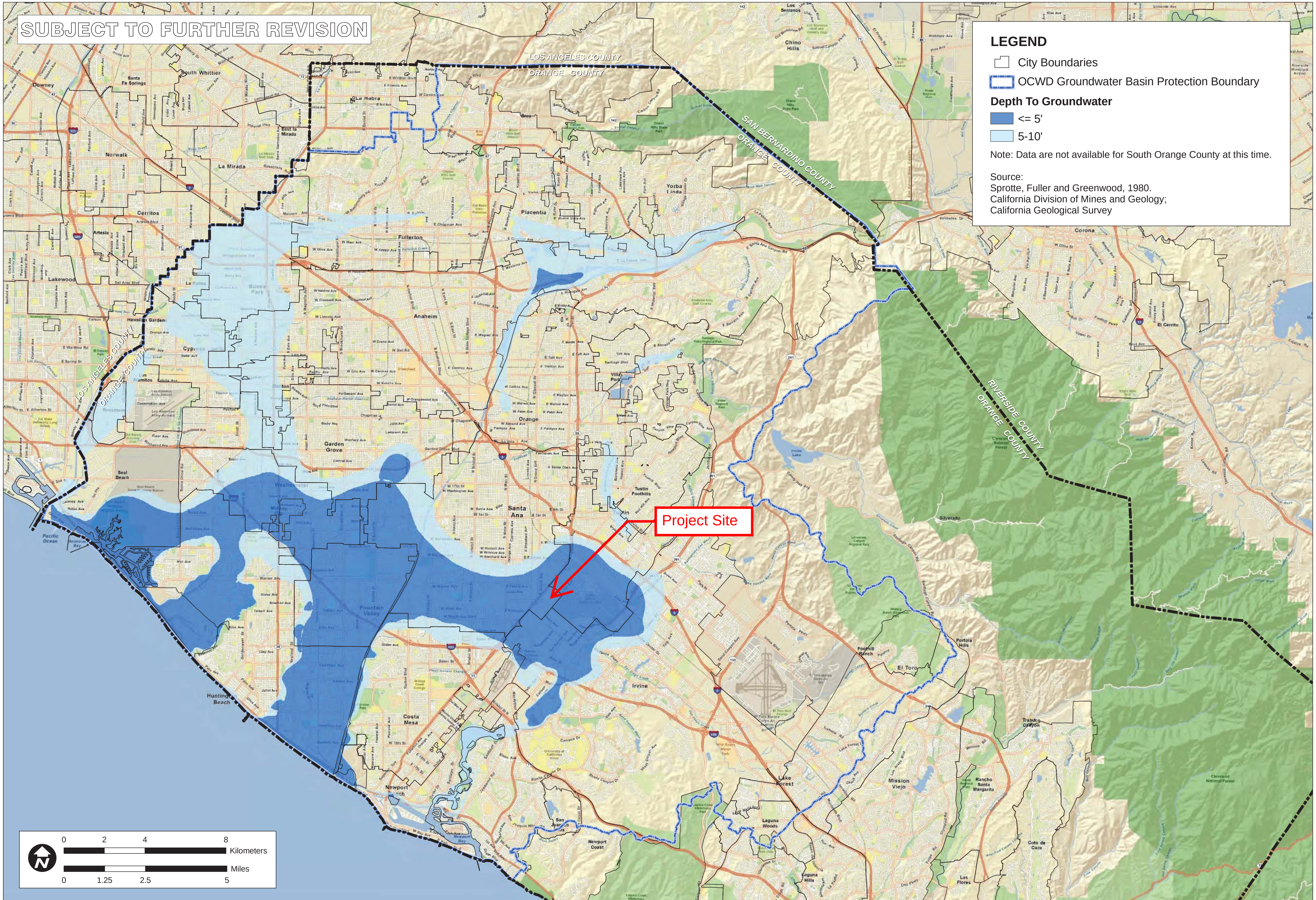
TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

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-2a



TITLE

NORTH ORANGE COUNTY MAPPED SHALLOW GROUNDWATER

JOB

ORANGE COUNTY INFILTRATION STUDY

ORANGE CO. CA

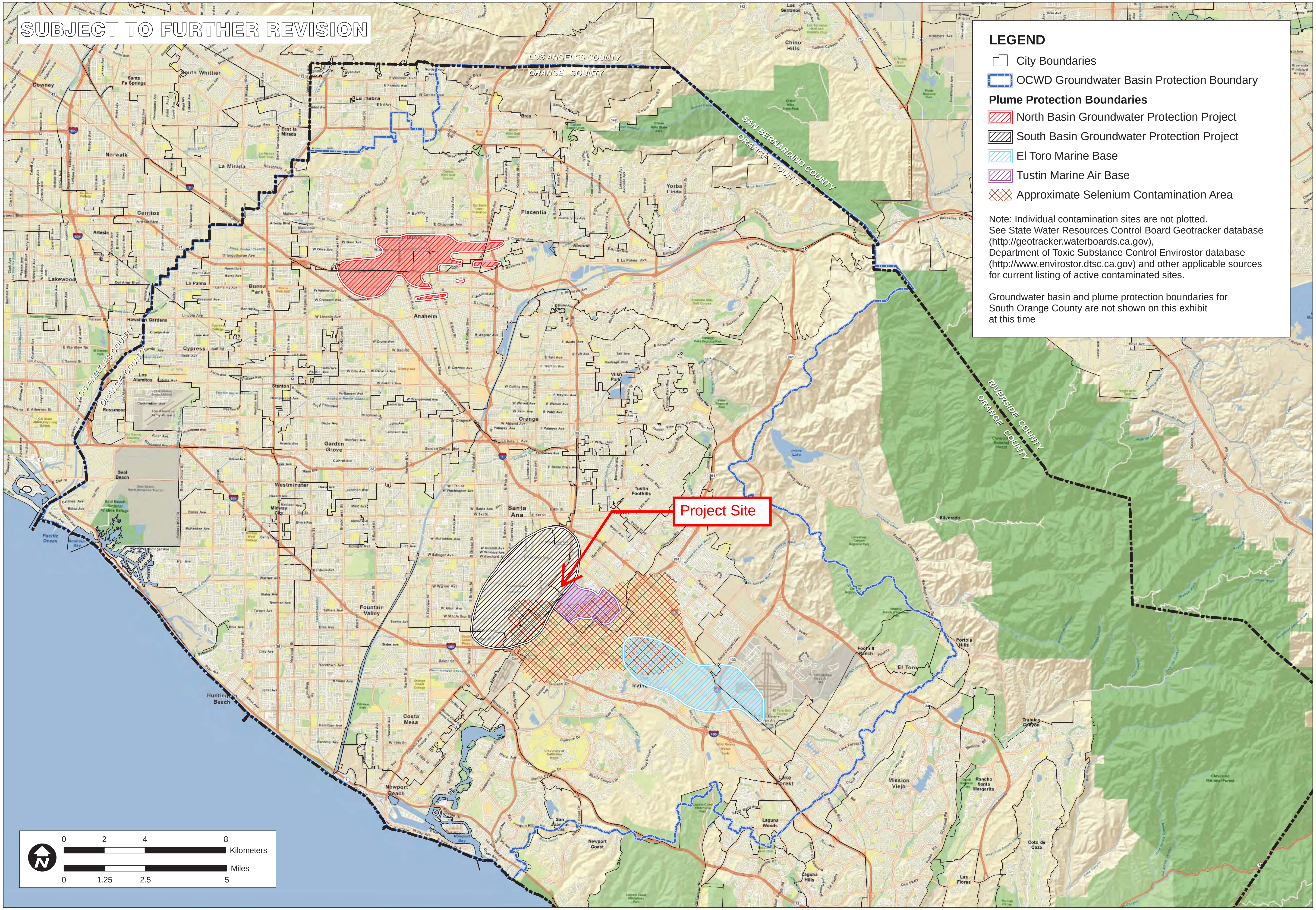
SCALE 1" = 1.25 miles
DESIGNED TH
DRAWING TH
CHECKED BMP
DATE 02/09/11
JOB NO. 9526-E

PACE Advanced Water Engineering

FIGURE

XVI-2e

P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2e_DepthToGroundwaterLt5ft_20110215.mxd



P:\9526E\6-GIS\Mxds\Reports\InfiltrationFeasability_20110215\9526E_FigureXVI-2f_NorthOCGroundwaterProtectionAreasStreetMap_20110215.mxd

TITLE
NORTH ORANGE COUNTY GROUNDWATER PROTECTION AREAS

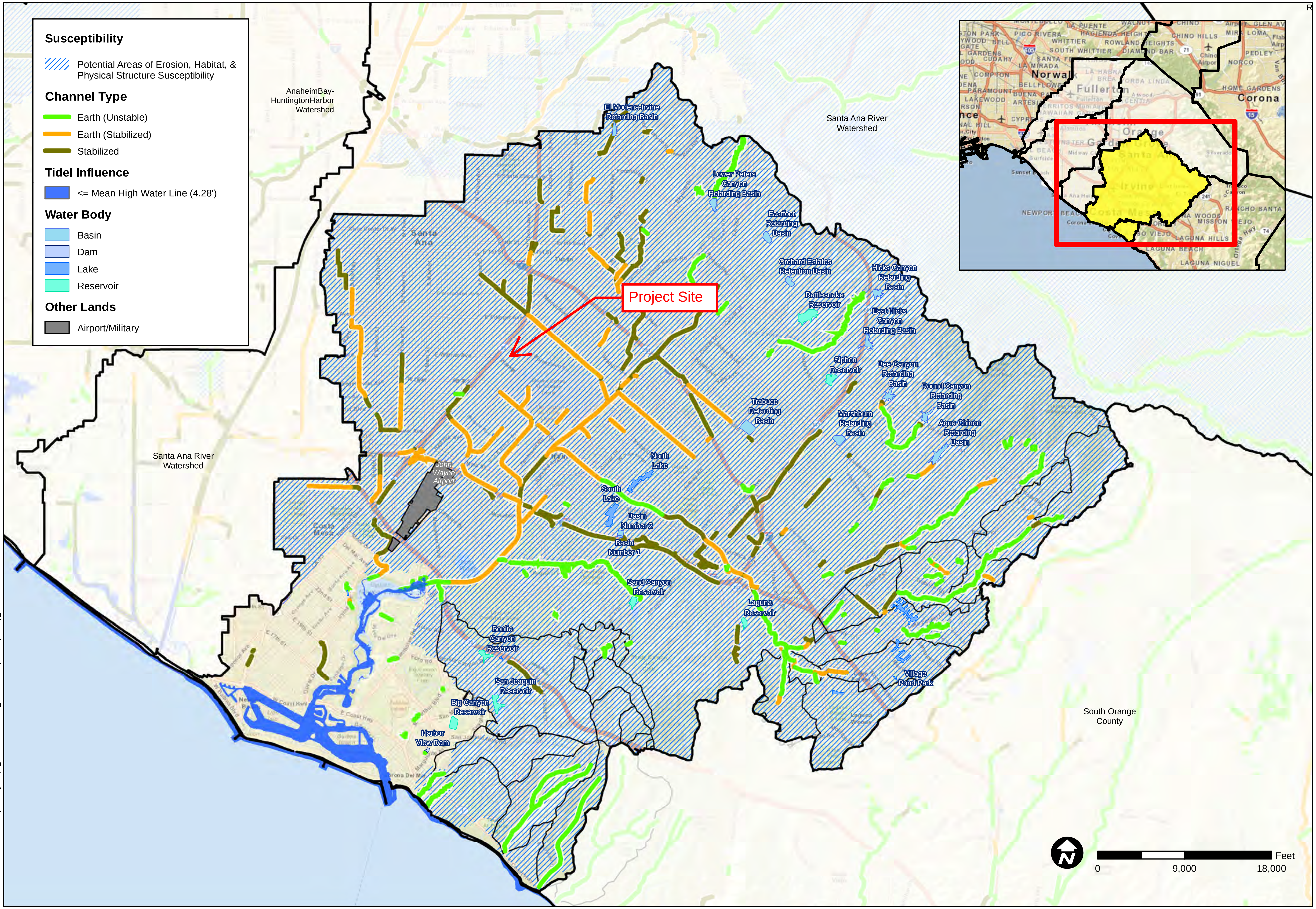
JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

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

SUSCEPTIBILITY MAP UPATE (FEB 2013)



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

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

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 VII (Worksheet I) for guidance on groundwater-related infiltration feasibility criteria.	X	
Provide basis: *As illustrated in the TGD Figure XVI-2f (see Appendix A), the project site is located within the South Basin Groundwater Protection Project and borders the Tustin Marine Air Base as well as the Selenium Contamination Area.* 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.			

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: *Infiltration testing performed by LGC Geotechnical, Inc. observed a measured infiltration rate of 0.15 in/hr which, according to Section 2.4.2.4 of the OC TGD, is considered infeasible.* 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

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

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.		
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.	
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis: *See above.* 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	

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

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.	

Harvest & Reuse Irrigation Demand Calculations

10/2/2019

Storm Water Design Caputre Volume (SQDV)

Drainage Area / Land Use Type	Impervious Area (ac)	Irrigated Area (ac)	% impervious	Runoff Coefficient	Design Storm Depth (in)	Drainage Area (acres)	DCV (ft^3)	DCV (gal)
Total Site	12.63	2.06	86%	0.795	0.75	14.690	**31,794.9**	**237,825**
				0.795			**0.0**	**0**
				0.150			**0.0**	**0**
				0.150			**0.0**	**0**
				0.150			**0.0**	**0**
				0.150			**0.0**	**0**

	Eto
Irvine	3.00
Laguna Beach	2.75
Santa Ana	2.93

Modified

$$EAWU = \frac{(Eto \times KL \times LA \times 0.015)}{IE}$$

$$EIATA = \frac{LA \times KL}{(IE \times \text{Tributary Imp. Area})}$$

Blend of High-Use and Low-Use Landscaping

Drainage Area / Land Use Type	Total Area (ac)	Total Area (sf)	% Impervious	Impervious (sf)	Pervious / LA (sf)	Eto	KL	Modified EAWU	EAWU/ Impervious Acre	Minimum EAWU/ Impervious Acre (Table X.6)	Feasible?	EIATA	Minimum EIATA (interpo-lated)	Drawdown (days)	Drawdown (hours)	% Capture (Fig. III.2)
Total Site	14.690	639,896	86%	550,311	89,585	2.93	0.55	2,406.12	190.46	610	No	0.10	0.00	98.8	2,372	<40%
0	0.000	0	0%	0	0		0.55	0.00	#DIV/0!			#DIV/0!	0.00	#DIV/0!	#DIV/0!	

TABLE X.6: HARVESTED WATER DEMAND THRESHOLDS FOR MINIMUM PARTIAL CAPTURE

Design Capture Storm Depth, inches	Wet Season Demand Required for Minimum Partial Capture, gpd per impervious acre
0.60	490
0.65	530
0.70	570
0.75	610
0.80	650
0.85	690
0.90	730
0.95	770
1.00	810

TABLE X.8: MINIMUM IRRIGATED AREA FOR POTENTIAL PARTIAL CAPTURE FEASIBILITY

General Landscape Type	Conservation Design: KL = 0.35			Active Turf Areas: KL = 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	0.9	0.41	0.42	0.45
0.80	0.88	0.9	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	1.1	1.12	1.2	0.55	0.56	0.6

Source: Technical Guidance Document for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs). March 22, 2011. Appendix X.

Worksheet B: Simple Design Capture Volume Sizing Method

Project: Bowery

Date: 10-03-2019

		DMA =	DMA 1	
Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.75	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 – Line 2)	$d_{remainder}$=	0.75	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP(s), *A* (acres)	A=	14.690	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	86.0%	%
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.795	
4	Calculate runoff volume, $V_{design} = (C \times d_{remainder} \times A \times 43560 \times (1/12))$	V_{design}=	31,794.9	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{measured}$ (in/hr) (Appendix VII)	$K_{measured}$=	N/A	in/hr
2	Enter combined safety factor from Worksheet H, S_{final} (unitless)	S_{final}=	N/A	
3	Calculate design infiltration rate, $K_{design} = K_{measured} / S_{final}$	K_{design}=	N/A	in/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, *T* (max 48 hours)	T=	*See Worksheet D*	hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	D_{max}=		feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	A_{min}=		sq-ft

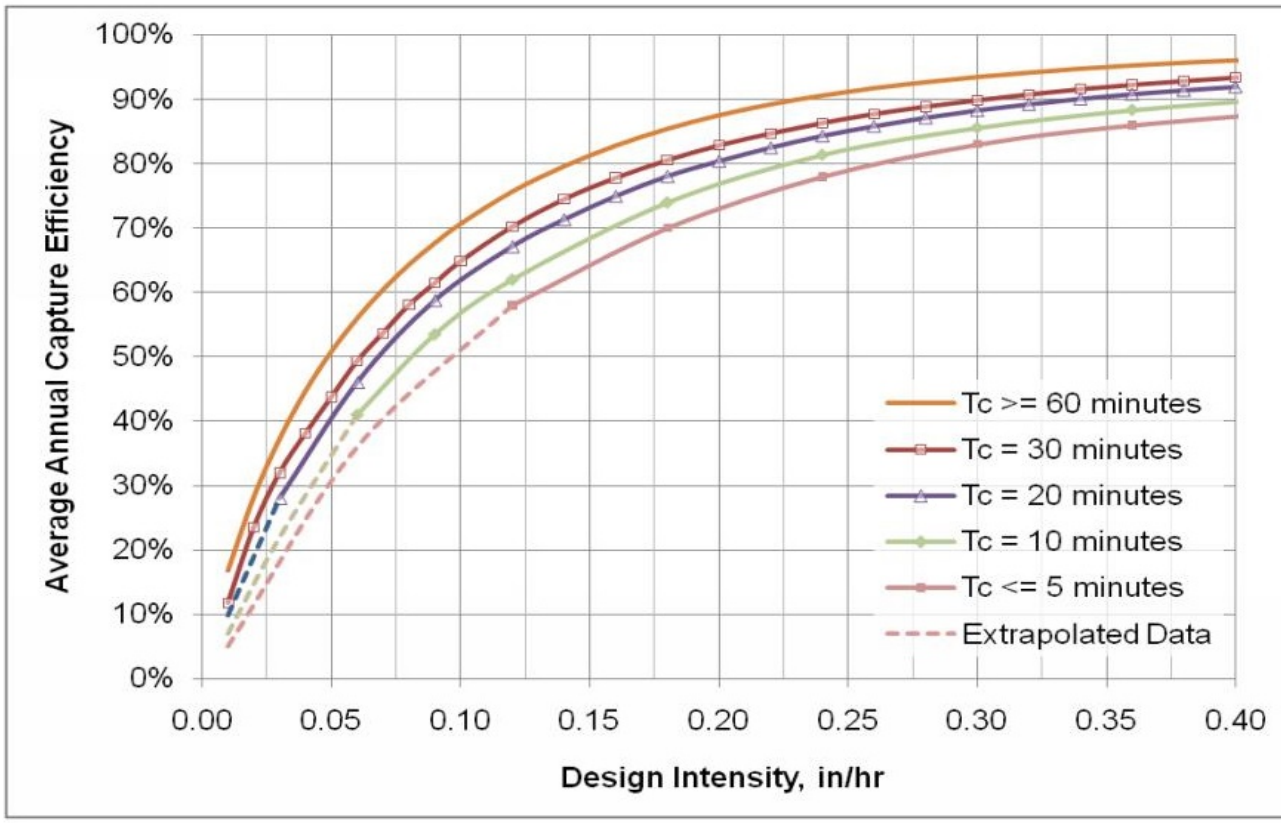
Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Project: Bowery

Date: 10-03-2019

			DMA 1	
Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5.0	min
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=	0.260	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	in/hr
6	Determine the design intensity that must be provided by BMP, $I_{design} = I_1 - I_2$	I_{design}=	0.260	in/hr
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP(s), *A* (acres)	A=	14.690	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	86.0%	%
3	Calculate runoff coefficient, $C = (0.75 \times imp) + 0.15$	C=	0.795	
4	Calculate design flowrate, $Q_{design} = (C \times i_{design} \times A)$	Q_{design}=	3.036	cfs
Supporting Calculations				
Describe System:				
		Proprietary BioTreatment (BIO-7):		
		Unit Size / Model =	*MWS-L-8-24-HC (3.75')*	
		Unit Size / Model Treatment Capacity =	*0.764*	cfs
		Number of Units Needed =	*4*	
		Total Bio-treatment Provided =	*3.056*	cfs
Provide time of concentration assumptions:				
	Conservative Tc of 5 minutes was used		*5.0*	min

Figure III.4. Capture Efficiency Nomograph for Off-line Flow-based Systems in Orange County



Appendix B

Notice of Transfer of Responsibility

NOTICE OF TRANSFER OF RESPONSIBILITY

WATER QUALITY MANAGEMENT PLAN

The Bowery
APN: 430-222-01 & 430-222-16

Submission of this Notice Of Transfer of Responsibility constitutes notice to the City of Santa Ana that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/her agent) of the site (or a portion thereof) to the New Owner, as further described below.

I. Previous Owner/ Previous Responsible Party Information

Company/ Individual Name:		Contact Person:	
Street Address:		Title:	
City:	State:	ZIP:	Phone:

II. Information about Site Transferred

Name of Project (if applicable):	
Title of WQMP Applicable to site:	
Street Address of Site (if applicable):	
Planning Area (PA) and/ or Tract Number(s) for Site:	Lot Numbers (if Site is a portion of a tract):
Date WQMP Prepared (and revised if applicable):	

III. New Owner/ New Responsible Party Information

Company/ Individual Name:		Contact Person:	
Street Address:		Title:	
City:	State:	ZIP:	Phone:

IV. Ownership Transfer Information

General Description of Site Transferred to New Owner:	General Description of Portion of Project/ Parcel Subject to WQMP Retained by Owner (if any):

Lot/ Tract Numbers of Site Transferred to New Owner:
Remaining Lot/ Tract Numbers Subject to WQMP Still Held by Owner (if any):
Date of Ownership Transfer:

Note: When the Previous Owner is transferring a Site that is a portion of a larger project/ parcel addressed by the WQMP, as opposed to the entire project/parcel addressed by the WQMP, the General Description of the Site transferred and the remainder of the project/ parcel no transferred shall be set forth as maps attached to this notice. These maps shall show those portions of a project/ parcel addressed by the WQMP that are transferred to the New Owner (the Transferred Site), those portions retained by the Previous Owner, and those portions previously transferred by Previous Owner. Those portions retained by Previous Owner shall be labeled as "Previously Transferred".

V. Purpose of Notice of Transfer

The purposes of this Notice of Transfer of Responsibility are: 1) to track transfer of responsibility for implementation and amendment of the WQMP when property to which the WQMP is transferred from the Previous Owner to the New Owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such New Order is now the Responsible Party of record for the WQMP for those portions of the site that it owns.

VI. Certifications

A. Previous Owner

I certify under penalty of law that I am no longer the owner of the Transferred Site as described in Section II above. I have provided the New Owner with a copy of the WQMP applicable to the Transferred Site that the New Owner is acquiring from the Previous Owner.

Printed Name of Previous Owner Representative:	Title:
Signature of Previous Owner Representative:	Date:

B. New Owner

I certify under penalty of law that I am the owner of the Transferred Site, as described in Section II above, that I have been provided a copy of the WQMP, and that I have informed myself and understand the New Owner's responsibilities related to the WQMP, its implementation, and Best Management Practices associated with it. I understand that by signing this notice, the New Owner is accepting all ongoing responsibilities for implementation and amendment of the WQMP for the Transferred Site, which the New Owner has acquired from the Previous Owner.

Printed Name of New Owner Representative:	Title:
Signature:	Date:

APPENDIX C
EDUCATIONAL MATERIALS

RESIDENTIAL MATERIALS:
HTTPS://H2OC.ORG/RESOURCES/VIEW-ORDER-BROCHURES/RESIDENT-BROCHURES/

- The Ocean Begins at Your Front Door
- Tips for the Home Mechanic
- Household Tips
- Proper Disposal of Household Hazardous Waste
- Recycle at Your Local Used Oil Collection Center (Central County)
- Responsible Pest Control
- Tips for Pet Care
- Tips for Pool Maintenance
- Tips for Residential Pool, Landscape and Hardscape Drains
- Tips for Protecting your Watershed

BUSINESS MATERIALS:
HTTPS://H2OC.ORG/RESOURCES/VIEW-ORDER-BROCHURES/BUSINESS-BROCHURES/

- Tips for the Food Service Industry
- Proper Maintenance Practices for Your Business

SITE DESIGN MATERIALS:
HTTPS://WWW.CASQA.ORG/RESOURCES/BMP-HANDBOOKS/NEW-DEVELOPMENT-REDEVELOPMENT-BMP-HANDBOOK

- DF-1 Drainage System Operations & Maintenance
- R-5 Disposal of Pet Waste
- R-8 Water Conservation
- SD-10 Site Design & Landscape Planning
- SD-12 Efficient Irrigation
- SD-13 Storm Drain Signage
- SD-32 Trash Storage Areas

APPENDIX D

BMP MAINTENANCE SUPPLEMENT / O&M PLAN

OPERATIONS AND MAINTENANCE (O&M) PLAN

Water Quality Management Plan

For

The Bowery

2300, 2310 & 2320 Red Hill Ave
Santa Ana, CA 92705

APN: 430-222-01 AND 430-222-16

This page intentionally left blank

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
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** Educational materials will be provided to tenants, including brochures and restrictions to reduce pollutants from reaching the storm drain system. Examples include tips for pet care, household tips, and proper household hazardous waste disposal.	Educational materials will be provided to tenants annually. Materials to be distributed are found in Appendix C of this WQMP. Tenants will be provided these materials by the Property Management prior to occupancy and annually thereafter. Frequency: Annually	Vineyards Development Corporation
Yes	**N2. Activity Restrictions** The owner shall develop ongoing activity restrictions that include those that have the potential to create adverse impacts on water quality. Activities include, but are not limited to: handling and disposal of contaminants, fertilizer and pesticide application restrictions, litter control and pick-up, and vehicle or equipment repair and maintenance in non-designated areas, as well as any other activities that may potentially contribute to water pollution.	The Owner will prescribe activity restrictions to protect surface water quality, through lease terms or other equally effective measure, for the property. Restrictions include, but are not limited to, prohibiting vehicle maintenance or vehicle washing. Frequency: Ongoing	Vineyards Development Corporation

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
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** The Owner shall be responsible for ongoing maintenance and management of landscaped areas on the project site, consistent with OC DAMP Section 5.5, Management Guidelines for Use of Fertilizers as well as City standards. Program includes how to reduce the potential pollutant sources of fertilizer and pesticide uses, utilization of water-efficient landscaping practices, ongoing trimming and other landscape maintenance activities and proper disposal of landscape wastes by the owner and/or contractors.	Maintenance shall be consistent with City requirements. Fertilizer and/or pesticide usage shall be consistent with County Management Guidelines for Use of Fertilizers (OC DAMP Section 5.5). Maintenance includes mowing, weeding, and debris removal on a weekly basis. Trimming, replanting, and replacement of mulch shall be performed on an as-needed basis to prevent exposure of erodible surfaces. Trimmings, clippings, and other landscape wastes shall be properly disposed of in accordance with local regulations. Materials temporarily stockpiled during maintenance activities shall be placed away from water courses and storm drains inlets. Frequency: Monthly	Vineyards Development Corporation
Yes	**N4. BMP Maintenance** The Owner will be responsible for the implementation and maintenance of each applicable LID and structural BMP prescribed for the project. Inspection and maintenance will be carried out by property management staff and/or contractors.	Maintenance of structural BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Records of inspections and BMP maintenance shall be kept by the Owner and shall be available for review upon request. Frequency: Ongoing	Vineyards Development Corporation
No	**N5. Title 22 CCR Compliance (How development will comply)**	Not Applicable	
No	**N6. Local Industrial Permit Compliance**	Not Applicable	

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
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	N7. Spill Contingency Plan	Not Applicable	
No	N8. Underground Storage Tank Compliance	Not Applicable	
No	N9. Hazardous Materials Disclosure Compliance	Not Applicable	
No	N10. Uniform Fire Code Implementation	Not Applicable	
Yes	N11. Common Area Litter Control The property management will be responsible for performing trash pickup and sweeping of littered common areas as needed, and weekly at a minimum. Any trash/debris waste collected shall be properly disposed of in accordance with local regulations. Responsibilities will also include noting improper disposal of materials and reporting such violations for further investigation.	Litter patrol, violations investigations, reporting and other litter control activities shall be performed on a weekly basis and in conjunction with routine maintenance activities. Frequency: Weekly	Vineyards Development Corporation
Yes	N12. Employee Training All employees of the property owner/management and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not be limited to, spill cleanup procedures, proper waste disposal, and housekeeping practices.	The Owner shall educate all new employees/managers on storm water pollution prevention, particularly good housekeeping practices, prior to the start of the rainy season (October 1). Refresher courses shall be conducted on an as needed basis. Materials that may be utilized on BMP maintenance are included in Appendix D. Frequency: Annually	Vineyards Development Corporation

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
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	**N13. Housekeeping of Loading Docks** Housekeeping measures will be implemented by the Owner to keep the proposed loading dock and delivery areas clean and orderly condition. Includes sweeping, removal of trash & debris on a weekly basis, and use of dry methods for cleanup (e.g., sweeping).	Sweep area routinely and before October 1 each year. Keep area clean of trash and debris at all times. Spills shall be cleaned up immediately using dry methods. Frequency: Weekly	Vineyards Development Corporation
Yes	**N14. Common Area Catch Basin Inspection**	Catch basin inlets shall be inspected and, if necessary, cleaned prior to the storm season by October 1st each year. Frequency: Annually	Vineyards Development Corporation
Yes	**N15. Street Sweeping Private Streets and Parking Lots**	Parking lots must be swept at least quarterly (every 3 months), including prior to the start of the rainy season (October 1st). Frequency: Quarterly	Vineyards Development Corporation
No	**N16. Retail Gasoline Outlets**	Not Applicable	
STRUCTURAL SOURCE CONTROL BMPs			

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
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** The phrase "NO DUMPING! DRAINS TO OCEAN", or an equally effective phrase approved by the City, will be stenciled on all major storm drain inlets within the project site to alert the public to the destination of pollutants discharged into storm water. Stencils shall be in place prior to release of certificate of occupancy.	Stenciling shall be inspected for legibility no later than the beginning of the rainy season on October 1st of each year. Stenciling must be re-stenciled to maintain legibility as necessary and when deemed necessary by the local inspecting agency. Frequency: Annually	Vineyards Development Corporation
No	**S2. Design and construct outdoor material storage areas to reduce pollution introduction**	Not Applicable	
Yes	**S3. Design and construct trash and waste storage areas to reduce pollution introduction**	Trash receptacles will be monitored and emptied by management of the Bowery. Trash will be taken from the interior trash rooms to the exterior trash storage areas at the time trash collection is set to occur. The four trash storage areas will drain into a water quality inlet to prevent discharge of spilled contaminants, consistent with local design standards. Frequency: Ongoing	Vineyards Development Corporation

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
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 & landscape design, water conservation, smart controllers, and source control** The Owner will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff. Includes implementation of efficient irrigation systems for common area landscaping including, but not limited to, provisions for water sensors and programmable irrigation cycles. This includes smart timers, rain sensors, and moisture shut-off valves.	In conjunction with routine maintenance, verify that landscape design continues to function properly by adjusting systems to eliminate overspray to hardscape areas and to verify that irrigation timing and cycle lengths are adjusted in accordance to water demands, given the time of year, weather, and day or nighttime temperatures. System testing shall occur twice per year. Water from testing/flushing shall be collected and properly disposed to the sewer system and shall not discharge to the storm drain system. Frequency: Monthly	Vineyards Development Corporation
No	**S5. Protect slopes and channels and provide energy dissipation**	Not Applicable	
Yes	**S6. Dock areas**	Sweep area routinely and before October 1 each year. Keep area clean of trash and debris at all times. Spills shall be cleaned up immediately. See also BMP N13. Frequency: Weekly	Vineyards Development Corporation
No	**S7. Maintenance bays**	Not Applicable	
No	**S8. Vehicle wash areas**	Not Applicable	
No	**S9. Outdoor processing areas**	Not Applicable	
No	**S10. Equipment wash areas**	Not Applicable	

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX			
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	S11. Fueling areas	Not Applicable	
No	S12. Hillside landscaping	Not Applicable	
Yes	S13. Wash water control for food preparation areas	Adequate signs shall be provided and appropriately placed stating the prohibition of discharging wash water to the storm drain system. Employees shall be trained in discharge and safety requirements outlined in State Health & Safety Code 27520. All cooking utensils shall be cleaned in appropriate wash stations. Frequency: Ongoing	Vineyards Development Corporation
No	S14. Community car wash racks	Not Applicable	

BMP INSPECTION & MAINTENANCE RESPONSIBILITY MATRIX		
BMP Name and BMP Implementation, Maintenance and Inspection Procedures	**Implementation, Maintenance, and Inspection Frequency and Schedule**	**Person or Entity with Operation & Maintenance Responsibility**
LOW IMPACT DEVELOPMENT BMPs		
Biotreatment BMP: Modular Wetland Systems (MWS) Modular Wetlands by Modular Wetlands Systems, Inc. are proprietary biotreatment systems that utilize multi-stage treatment processes. The pre-treatment chamber contains the first three stages of treatment, and includes a catch basin inlet filter to capture trash, debris, gross solids and sediments, a settling chamber for separating out larger solids, and a media filter cartridge for capturing fine TSS, metals, nutrients, and bacteria. Runoff then flows through the wetland chamber where treatment is achieved through a variety of physical, chemical, and biological processes. As storm water passes down through the planting soil, pollutants are filtered, adsorbed, biodegraded and sequestered by the soil and plants, functioning similar to bioretention systems. The discharge chamber at the end of the unit collects treated flows and discharges back into the storm drain system.	Inspect system at a minimum of once every six months, prior to the start of the rainy season (October 1), and after major storm events. Typical maintenance includes removing trash & debris from the catch basin screening filter (by hand), removal of sediment and solids in the settlement chamber (vacuum truck), replacement of the BioMediaGREENTM filter cartridge, and replacement of the BioMediaGREENTM drain down filter (if equipped). In addition, plants within the wetland chamber will require trimming in conjunction with landscape maintenance activities. See attached manufacturer's specifications for additional requirements. Frequency: 2x per year	Vineyards Development Corporation

Required Permits

Permits are not required for the implementation, operation, and maintenance of the BMPs.

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.

Waste Management

Any waste generated from maintenance activities will be disposed of properly. Wash water and other waste from maintenance activities is not to be discharged or disposed of into the storm drain system. Clippings from landscape maintenance (i.e. prunings) will be collected and disposed of properly off-site, and will not be washed into the streets, local area drains/conveyances, or catch basin inlets.

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

RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

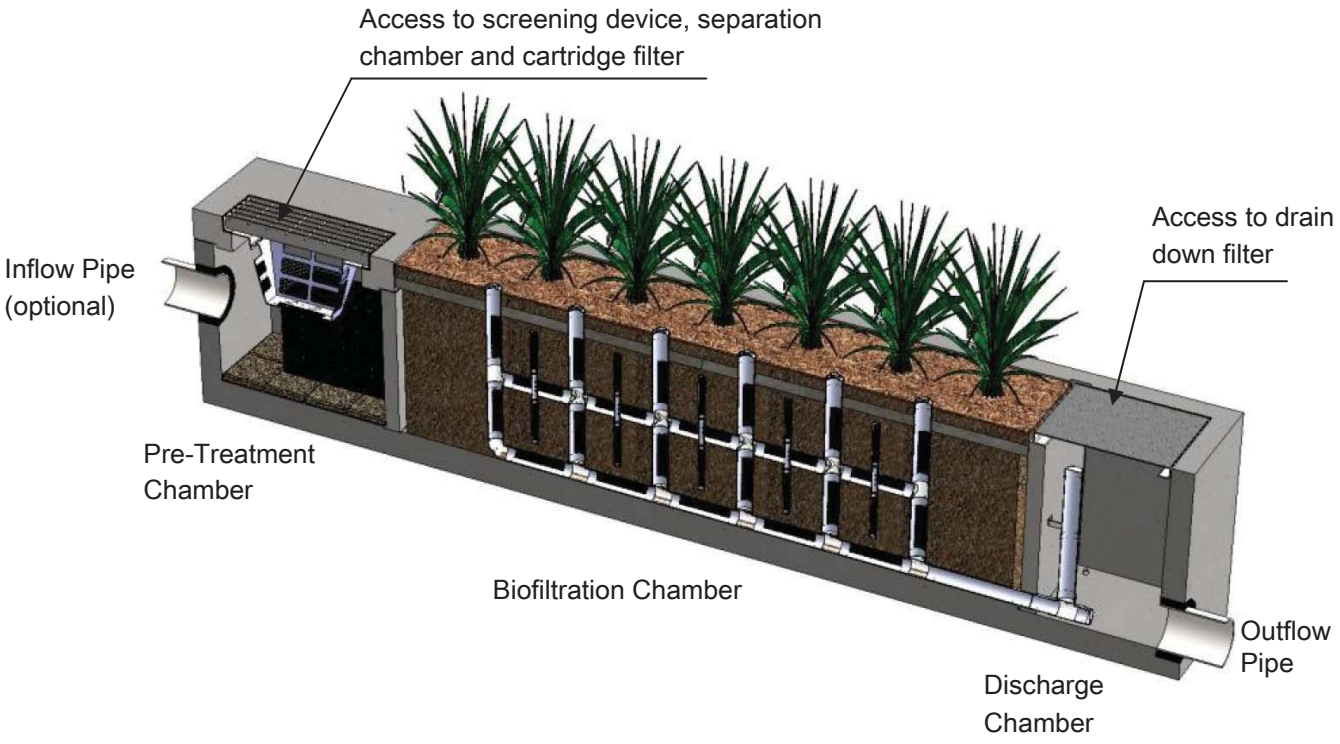
BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

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

System Diagram



Maintenance Procedures

Screening Device

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

Separation Chamber

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

Cartridge Filters

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

Drain Down Filter

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

Maintenance Notes

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

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

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

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

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

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

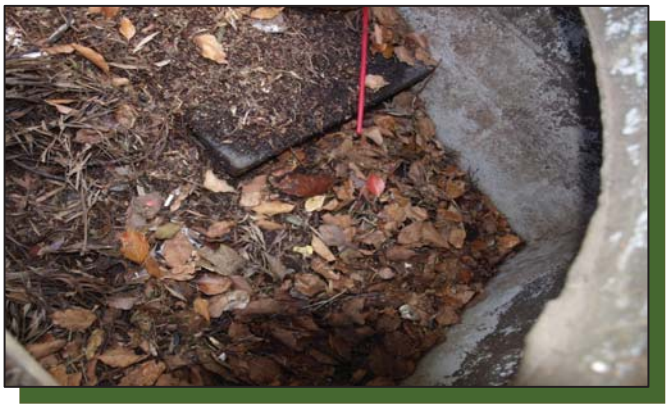
Maintenance Procedure Illustration

Screening Device

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

Separation Chamber

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



Cartridge Filters

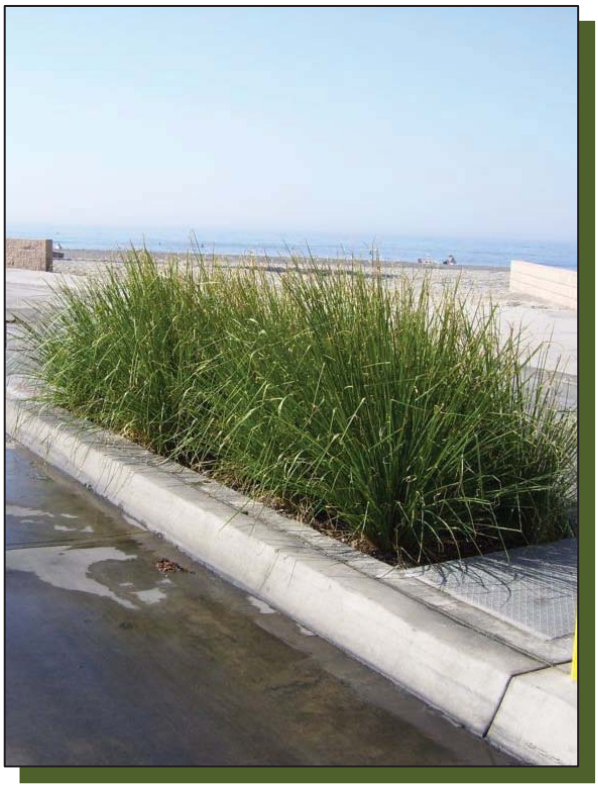
The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

Drain Down Filter

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

Trim Vegetation

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



Inspection Form

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

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

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

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

Weather Condition _____ Additional Notes _____

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

Inspection Checklist

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

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

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

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

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: _____

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

Maintenance Report

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

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

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

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

Weather Condition _____ Additional Notes _____

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

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

Comments:

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

APPENDIX E

CONDITIONS OF APPROVAL (PENDING ISSUANCE)

APPENDIX F

GEOTECHNICAL REPORT

June 14, 2019 Project No. 19063-01

Mr. Jeremy Ogulnick
RHW Holdings
240 Newport Center Drive, Suite 200
Newport Beach, CA 92660

Subject: ***Geotechnical EIR/Due-Diligence Level Report for the Proposed Mixed-Use Development, The Bowery, 2300 Red Hill Avenue, Santa Ana, California***

In accordance with your request, LGC Geotechnical, Inc. is providing this geotechnical EIR/due-diligence level report for the proposed mixed-use development located at 2300 Red Hill Avenue in the City of Santa Ana, California. The purpose of our study was to evaluate the existing onsite geotechnical conditions and to confirm that the site can be developed from a geotechnical perspective.

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

Respectfully,

LGC Geotechnical, Inc.

Ryan Douglas, RCE 84840
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
RYAN L. DOUGLAS
No. 84840
CIVIL
STATE OF CALIFORNIA

Dennis Boratynec, GE 2770
Vice President

REGISTERED PROFESSIONAL ENGINEER
DENNIS BORATYNEC
No. 2770
GEOTECHNICAL
STATE OF CALIFORNIA

RLD/DJB/CNJ/aca

Distribution: (4) Addressee (3 wet signed copies for agency submittal and 1 electronic copy)
(1) EPD Solutions, Inc. (electronic copy)
Attn: Mr. Jeremy Krout

TABLE OF CONTENTS

LIST OF TABLES, ILLUSTRATIONS, & APPENDICES

Tables

Figures

Appendices

1.0 INTRODUCTION

1.1 Purpose and Scope of Services

This report presents the results of our geotechnical EIR/due-diligence level report for the proposed mixed-use development located at 2300 Red Hill Avenue in the City of Santa Ana, California (see Site Location Map, Figure 1). The conceptual site plan by Architects Orange (AO, 2019) and site topo from Fuscoe Engineering (Fuscoe, 2019) was utilized as a base map for our Geotechnical Exploration Location Map (Figure 2).

The purpose of our study was to evaluate the existing onsite geotechnical conditions and to confirm that the site can be developed from a geotechnical perspective. As part of this report, we have: 1) reviewed available geotechnical reports, geologic maps, and satellite images pertinent to the site (Appendix A); 2) performed a limited subsurface geotechnical evaluation of the site consisting of the excavation of five small-diameter borings ranging in depth from approximately 5 to 50 feet below existing ground surface; 3) performed two field infiltration tests; 4) performed laboratory testing of select soil samples obtained during our subsurface evaluation; and 5) prepared this EIR/due-diligence level geotechnical evaluation report presenting our findings, conclusions and preliminary recommendations as it relates to the proposed mixed-use development.

The findings and conclusions presented herein should be considered preliminary and will need to be confirmed as part of a grading plan review report to be provided at a later date. It should be noted that LGC Geotechnical does not provide environmental consulting services.

1.2 Project Description

Based on the provided information and conceptual site plans by Architects Orange (AO, 2019), the proposed mixed-use development will consist of three parking structures along with at-grade retail and residential buildings. Parking Structure "A" will have 7 stories, Parking Structure "B" will have 6 stories and Parking Structure "C" will have 6-stories. The residential buildings are up to 7 stories high and amenity areas are planned within the residential and retail areas. Parking structures are anticipated to be reinforced concrete and the retail and residential structures are anticipated to be wood-framed.

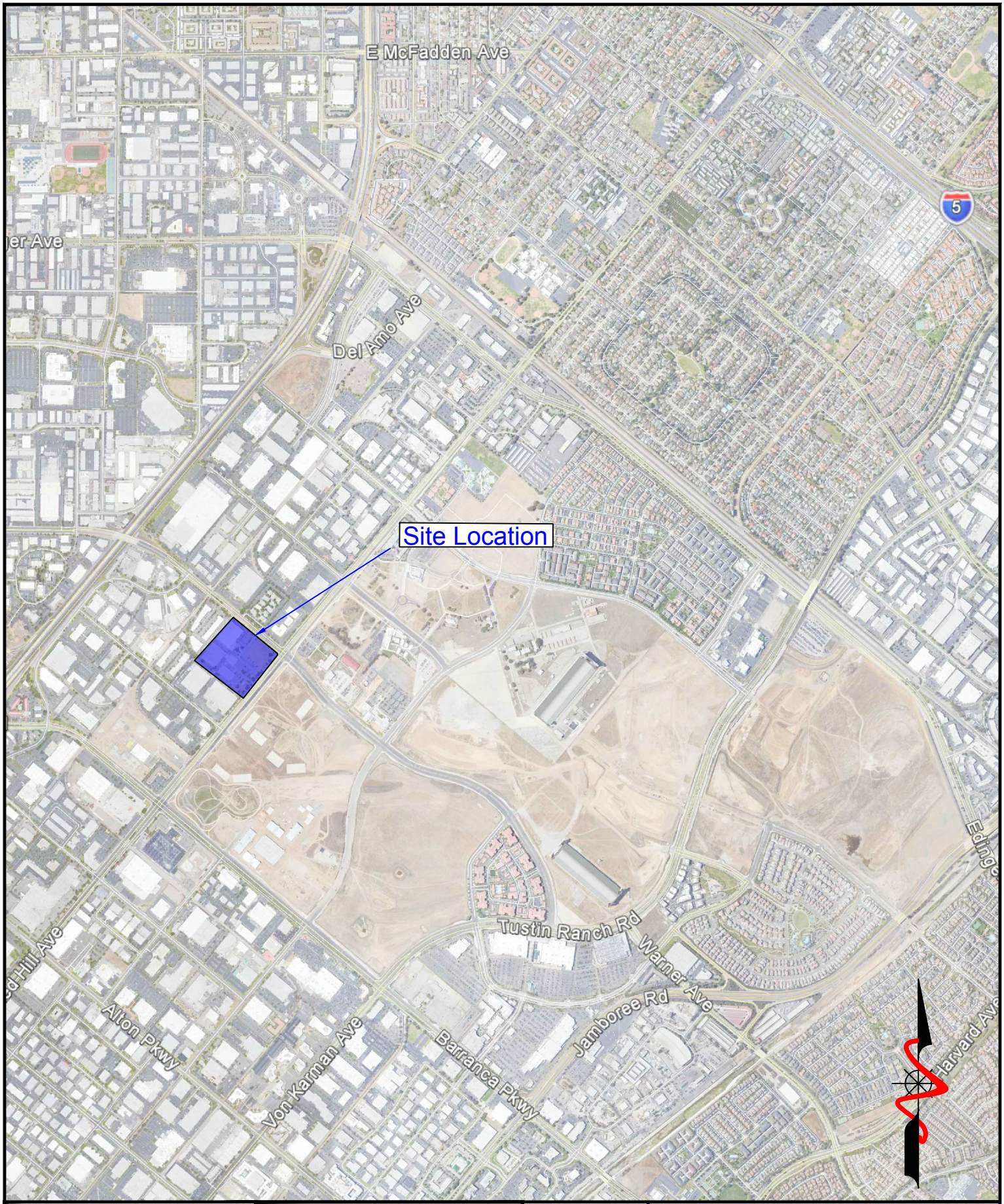
We anticipate finish grades will not vary significantly (± 4 feet) from current grade. Two on-grade swimming pools and spas are proposed in the courtyard areas and one rooftop swimming pool, spa and deck amenity area is proposed on the roof of Parking Structure "A". A number of courtyards with lounges and other amenities are also proposed. A retail plaza with multiple retail buildings and on-grade parking is proposed in the south eastern portion of the site adjacent to Redhill Avenue. Presented in Table 1 is a summary of our estimated structural (dead plus live) loads for the proposed 7-story mixed-use residential/retail structures and the proposed 7-story parking structures. Please note that structural loads and a preliminary grading plan were not provided to us at the time of this report.

TABLE 1

Estimated Structural Loads

Planned Structure	Column Loads (kips)	Wall Loads (kip/ft)
7-Story Parking Structure(s)	1200	-
7-Story Mixed-Use Structures	200	10

The preliminary recommendations given in this report are based upon the proposed layout and estimated structural loading information above. We understand that the project plans are currently being developed at this time; LGC Geotechnical should be provided with updated project plans and the actual structural loads when they become available, in order to either confirm or modify the recommendations provided herein. This may include but is not limited to additional subsurface borings/CPTs, laboratory testing and analysis to provide a design level geotechnical report.



LGC Geotechnical, Inc.

FIGURE 1
Site Location Map

PROJECT NAME	EPD - The Bowery, Santa Ana
PROJECT NO.	19063-01
ENG. / GEOL.	RLD
SCALE	Not to Scale
DATE	June 2019

1.3 Existing Conditions

The relatively flat site is approximately 15 acres and is bound in the north easterly direction by Warner Avenue, in the south easterly direction by Red Hill Avenue and in the south westerly and north westerly directions by existing commercial/industrial buildings (see Figure 1 – Site Location Map). The site currently consists of three large existing industrial buildings, associated at-grade parking and drive aisles, and turf covered open space. Existing elevations range from approximately 57 to 65 feet above mean sea level (msl). In general, the site drains from north to south.

1.4 Previous Site Geotechnical Information

Review of historic aerial photographs indicate that in 1946 the site was agricultural land with a small residence in the eastern corner of the property. Red Hill and Warner Avenue are constructed in their present locations. Army barracks related to the Naval Reservation are visible across Red Hill Avenue. By 1980, the Ricoh Electronics Building and its parking lot at 2300 Red Hill Avenue was constructed. Adjacent buildings to the northwest and southwest of the site were constructed. By 1994, the site was constructed to its present condition (Historic Aerials, 2019).

Review of previous geotechnical compaction reports indicates much of the site fill soils have been geotechnically observed and tested. Documentation consists of the following reports:

In 1979, G.A. Nicoll & Associates (Nicoll) performed geotechnical observation and testing for the Ricoh Electronics Building at 2300 Red Hill Avenue (Nicoll, 1979a and 1979b). Geotechnical observation was primarily for the over-excavation of the building pad, underground structures, and associated utilities. After the area was cleared of vegetation and debris, soils within the building pad were excavated to depths of approximately 5 feet below existing grade. Fill was placed in approximate 8-inch thick lifts and compacted with heavy compaction equipment. Where tested using ASTM Test Method D1556, compaction soils were found to meet the project requirement of at least 90 percent relative compaction, as determined by ASTM Test Method D1557. Nicoll concluded, based on their observation and testing, that fill soils were compacted to at least the minimum required relative compaction.

In 1981, Nicoll performed geotechnical observation and testing for the REZ Toner Building at 2310 Red Hill Avenue (Nicoll, 1981). Geotechnical observation was primarily for the over-excavation of the building pad. After the area was cleared of vegetation and debris, soils within the building footprint and mechanical pit areas were excavated. Fill was placed in approximate 8-inch thick lifts and compacted with heavy compaction equipment. Where tested using ASTM Test Method D1556, soils were found to meet the project requirement of at least 90 percent relative compaction, as determined by ASTM Test Method D1557. Up to approximately 16.5 feet of artificial fill was placed in the mechanical pit area and up to approximately 9 feet of fill was placed in the building pad area. Fill was placed up to 15 feet beyond the limit of the building foundations. Nicoll concluded, based on their observation and testing, that fill soils were compacted to at least the minimum required relative compaction.

In 1989, Lotus Consulting Engineers (Lotus) performed geotechnical observation and testing for the removal of an underground storage tank located between 2310 and 2320 Red Hill Avenue. The tank was removed, approximately 10 feet of crushed miscellaneous base followed by approximately 5 feet of onsite soils were placed in approximate 8-inch thick lists and compacted with heavy compaction equipment. Where tested, soils were found to meet the project requirement of at least 92 percent and 90 percent relative compaction for the crushed miscellaneous base and onsite soil, respectively, as determined by ASTM Test Method D1557. Lotus concluded, based on their observation and testing, that fill soils were compacted to at least the minimum required relative compaction.

In 1990, Nicoll performed geotechnical observation and testing for an addition to the Thermal Paper Plant at 2320 Red Hill Avenue (Nicoll, 1990). Geotechnical observation was primarily for the over-excavation of the building pad for a maintenance building addition. After the area was cleared of vegetation and debris, upper soils within the building addition pad were excavated approximately 10 to 13 feet below existing grade. The bottom was stabilized with approximately 24 inches of gravel prior to fill placement. Fill was placed in approximate 8-inch thick lifts and compacted with heavy compaction equipment. Where tested using ASTM Test Method D1556, soils were found to meet the project requirement of at least 90 percent relative compaction, as determined by ASTM Test Method D1557. Up to approximately 13 feet of artificial fill was placed and fill was placed up to 5 feet beyond the limit of the building foundations. Nicoll concluded, based on their observation and testing, that fill soils were compacted to at least the minimum required relative compaction.

1.5 Subsurface Exploration

A geotechnical field evaluation was performed by LGC Geotechnical. This program consisted of drilling and sampling five small-diameter borings.

The borings were drilled by CalPac Drilling under subcontract to LGC Geotechnical. The depth of the borings ranged from approximately 5 to 50 feet below existing grade. The upper approximate 5 feet were hand-augered due to potential utility line conflicts. An LGC Geotechnical representative observed the drilling operations, logged the borings, and collected soil samples for laboratory testing. The borings were performed using a B-61 truck-mounted drill rig equipped with 6-inch and 8-inch diameter hollow-stem augers. Driven soil samples were collected by means of the Standard Penetration Test (SPT) and Modified California Drive (MCD) sampler. The MCD is a split-barrel sampler with a tapered cutting tip and lined with a series of 1-inch tall brass rings. The SPT sampler (1.4-inch ID) and MCD sampler (2.4-inch ID, 3.0-inch OD) were driven using a 140-pound automatic hammer falling 30 inches to advance the sampler a total depth of 18 inches or until refusal. The raw blow counts for each 6-inch increment of penetration were recorded on the boring logs. Bulk samples were also collected and logged for laboratory testing at select depths. At the completion of drilling, the borings were backfilled with cement bentonite and the surface was replaced with asphalt cold-patch.

Infiltration testing was performed within two of the borings (I-1 through I-2) to depths of 5 feet below existing grade. An LGC Geotechnical staff geologist installed standpipes, backfilled the borings with crushed rock and pre-soaked the infiltration holes prior to testing. Infiltration

testing was performed per the County of Orange testing guidelines. The locations were subsequently backfilled with native soils at the completion of testing.

Boring logs are presented in Appendix B and their approximate locations are depicted on Figure 2.

1.6 Laboratory Testing

Representative driven and bulk samples were retained for laboratory testing during our field evaluation. Laboratory testing included in-situ unit weight and moisture content, fines content, Atterberg Limits (liquid limit and plastic limit), consolidation, laboratory compaction, expansion index, and corrosion (sulfate, chloride, pH, and minimum resistivity).

The following is a summary of the laboratory test results.

- Dry density of the samples collected ranged from approximately 91 pounds per cubic foot (pcf) to 126 pcf, with an average of 108 pcf. Field moisture contents ranged from approximately 14 percent to 36 percent, with an average of 22 percent.
- Four fines content (percent passing No. 200 sieve) tests ranging from approximately 47 percent to 93 percent. Based on the Unified Soils Classification System (USCS), three of the tested samples would be classified as "fine-grained" and one sample would be classified as "coarse-grained."
- Two Atterberg Limit (liquid limit and plastic limit) tests were performed. Results indicated Plasticity Index values ranging from 11 to 32.
- Two consolidation tests were performed. The stress vs. deformation plots are provided in Appendix C.
- One laboratory compaction test of a near surface sample indicated a maximum dry density of 122.5 pcf with an optimum moisture content of 12.0 percent.
- Two Expansion Index (EI) tests were performed. Results were EI values of 25 and 44, corresponding to "Low" expansion potential.
- Corrosion testing indicated soluble sulfate contents of approximately 0.1 percent or less, chloride content of 100 parts per million (ppm), pH value of 7.5, and minimum resistivity value of 515 ohm-cm.

A summary of the laboratory test results is presented in Appendix C.

2.0 GEOTECHNICAL CONDITIONS

2.1 Regional Geology

The subject site is generally located within the Peninsular Ranges Geomorphic Province of California, more specifically at the eastern edge of the Los Angeles Sedimentary Basin. The Los Angeles Basin is a northwest-plunging synclinal sedimentary deposit that is bounded to the south of the subject site by the broadly uplifted coastal mesa of Newport Beach and the San Joaquin Hills, to the north by the foothills of the Santa Ana mountain range. The site is located on young alluvial fan materials that include previous floodplain deposits. A channelized portion of the Peters Canyon Creek passes approximately two miles away from the site to the east. The creek drains into Upper Newport Bay located south of the site (Morton, 2004 & CDMG, 2001b).

2.2 Site-Specific Geology

The subject site covers a rectangular-shaped parcel on relatively flat alluvial flood plains, typical of the Los Angeles Basin. Based on our subsurface exploration and review of pertinent geologic literature and maps, the site is generally underlain by older artificial fill soils and Quaternary-aged young alluvial fan deposits.

It should be noted that geotechnical explorations are only representative of the location where they are performed and varying subsurface conditions may exist outside of each location. In addition, subsurface conditions can change over time. The soil descriptions provided above should not be construed to mean that the subsurface profile is uniform and that soil is homogeneous within the project area. A brief description of the materials encountered during drilling is presented in the following section, and the approximate boring locations are depicted on the Geotechnical Exploration Location Map (Figure 2). For details on the stratigraphy at the exploration locations, refer to the boring and test pit logs provided in Appendix B

2.2.1 Older Artificial Fill (Map Symbol – afo)

Older artificial fill was observed in the field explorations up to 7.5 feet below existing grade in borings HS-1 though HS-3. The fill was observed to consist of slightly moist to moist clays and silts with variable amounts of sand.

2.2.2 Quaternary Young Alluvial Fan Deposits (Map Symbol – Qyf)

Quaternary young alluvial fan deposits were observed underlying the older artificial fill. Where observed, the alluvial materials generally consisted of moist to wet, medium stiff to hard clays with variable sand content, as well as loose to medium dense, moist to wet clayey and silty sands to the maximum explored depth of approximately 50 feet below existing grade.

2.3 Landslides and Slope Stability

Document research and field observations do not indicate the presence of landslides on the site or in the immediate vicinity (Morton, 2004). Review of the Seismic Hazards Zone Map (CDMG, 2002b) and the Seismic Hazard Zone Report (CDMG, 2001a) for the Tustin 7.5 Minute Quadrangle indicates that the site is not located within a mapped area considered potentially susceptible to seismically-induced slope instability.

2.4 Groundwater

The measured depth of groundwater in our borings ranged from approximately 24 to 33 feet below existing grade. Historic high groundwater is estimated to be about 10 feet below existing grade (CDMG, 2001a).

It should be noted that higher localized and seasonal perched groundwater conditions may accumulate below the surface, and should be expected throughout the design life of the proposed improvements. In general, groundwater conditions below any given site may vary over time depending on numerous factors including seasonal rainfall and local irrigation among others.

2.5 Field Infiltration Testing

One field percolation test was performed in the area of the proposed infiltration trench, as directed by the project civil engineer, and the location is depicted on Figure 2 – Geotechnical Exploration Location Map. Test well installation consisted of placing a 3-inch diameter perforated PVC pipe in the excavated borehole and backfilling the annulus with crushed rock including the placement of approximately 2 inches of crushed rock at the bottom of the borehole. The infiltration test well was presoaked the day of installation and testing took place within 24 hours of presoaking. During the pre-test the water level was observed to drop less than 6 inches in 25 minutes for two consecutive readings. Therefore, the test procedure for fine-grained soils or "slow test" was followed. Test well installation and the estimation of infiltration rates were accomplished in general accordance with the guidelines set forth by the County of Orange (2013). In general, three-dimensional flow out of the test well (*percolation*), as observed in the field, is mathematically reduced to one-dimensional flow out of the bottom of the test well (*infiltration*). Infiltration tests are performed using relatively clean water, free of particulates, silt, etc. The results of our recent field infiltration testing are presented in Appendix D and summarized below.

TABLE 2

Summary of Field Infiltration Testing

Infiltration Test Identification	Approx. Depth Below Existing Grade (ft)	Observed Infiltration Rate* (in./hr.)	Measured Infiltration Rate** (in./hr.)
I-1	5	0.3	0.15

*Observed Infiltration Rates Do Not Include Factor of Safety.

**Measured Infiltration Rates Include a Factor of Safety of 2 in Order to Evaluate Feasibility.

The tested infiltration rates provided in this report are considered a general representation of the infiltration rates at the location of the proposed infiltration trench. Please note, the testing of infiltration rates is highly dependent upon the materials encountered at the point of testing (i.e. location and depth of testing). Varying subsurface conditions may exist outside of the test location which could alter the calculated infiltration rate.

2.6 Seismic Design Parameters

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2016 CBC. Since the site contains soils that are susceptible to liquefaction (refer to above Section "Liquefaction and Dynamic Settlement"), ASCE 7 which has been adopted by the CBC requires that site soils be assigned Site Class "F" and a site-specific response spectrum be performed. However, in accordance with Section 20.3.1 of ASCE 7, if the fundamental periods of vibration of the planned structure are equal to or less than 0.5 second, a site-specific response spectrum is not required and ASCE 7/2016 CBC site class and seismic parameters may be used in lieu of a site-specific response spectrum. **It should be noted that the seismic parameters provided herein are not applicable for any structure having a fundamental period of vibration greater than 0.5 second. Should the structural engineer determine that any of the proposed structures have a fundamental period of vibration greater than 0.5 seconds, a site-specific response spectrum will have to be prepared.**

Representative site coordinates of latitude 33.7099 degrees north and longitude -117.8395 degrees west were utilized in our analyses. The maximum considered earthquake (MCE) spectral response accelerations (S_{MS} and S_{M1}) and adjusted design spectral response acceleration parameters (S_{DS} and S_{D1}) for Site Class F modified to Site Class D for building structures with a period of vibration equal to or less than 0.5 second are provided in Table 3 on the following page.

TABLE 3

Seismic Design Parameters for Structures with a Period of Vibration ≤ 0.5 Second

Selected Parameters from 2016 CBC, Section 1613 - Earthquake Loads	Seismic Design Values
Site Class per Chapter 20 of ASCE 7	D*
Risk-Targeted Spectral Acceleration for Short Periods (S_S)**	1.508g
Risk-Targeted Spectral Accelerations for 1-Second Periods (S_1)**	0.558g
Site Coefficient F_a per Table 1613.3.3(1)	1.000
Site Coefficient F_v per Table 1613.3.3(2)	1.500
Site Modified Spectral Acceleration for Short Periods (S_{MS}) for Site Class D [Note: $S_{MS} = F_aS_S$]	1.508g
Site Modified Spectral Acceleration for 1-Second Periods (S_{M1}) for Site Class D [Note: $S_{M1} = F_vS_1$]	0.837g
Design Spectral Acceleration for Short Periods (S_{DS}) for Site Class D [Note: $S_{DS} = (^2/_3)S_{MS}$]	1.006g
Design Spectral Acceleration for 1-Second Periods (S_{D1}) for Site Class D [Note: $S_{D1} = (^2/_3)S_{M1}$]	0.558g
Mapped Risk Coefficient at 0.2 sec Spectral Response Period, C_{RS} (per ASCE 7)	1.001
Mapped Risk Coefficient at 1 sec Spectral Response Period, C_{R1} (per ASCE 7)	1.034

* Site is Class F, seismic parameters provided herein are only applicable for structure period ≤ 0.5 second, refer to discussion above.

** From SEAOC, 2019

Section 1803.5.12 of the 2016 CBC (per Section 11.8.3 of ASCE 7) states that the maximum considered earthquake geometric mean (MCE_G) Peak Ground Acceleration (PGA) should be used for liquefaction potential. The PGA_M for the site is equal to 0.565g (SEAOC, 2019).

A deaggregation of the PGA based on a 2,475-year average return period indicates that an earthquake magnitude of 6.9 at a distance of approximately 3.1 km from the site would contribute the most to this ground motion (USGS, 2008).

2.7 Faulting

The subject site is not located within a State of California Earthquake Fault Zone (i.e., Alquist-Priolo Earthquake Fault Act Zone) and no active faults are known to cross the site (CGS, 2018). A fault is considered "active" if evidence of surface rupture in Holocene time (the last approximately 11,000 years) is present. The possibility of damage due to ground rupture is considered low since no active faults are known to cross the site. The closest known active faults are associated with the San Joaquin Hills Fault, located approximately 1.5 miles from the site; and the Newport-Inglewood Fault Zone, approximately 8.4 miles southwest of the site; and the Elsinore Fault Zone, approximately 13.2 miles northeast of the site.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include ground lurching and shallow ground rupture, soil liquefaction, and dynamic settlement. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault and the onsite geology. A discussion of these secondary effects is provided in the following sections.

2.7.1 Liquefaction and Dynamic Settlement

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that loose, saturated, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction (Bray & Sancio, 2006). Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

Based on our review of the State of California Seismic Hazard Zone for liquefaction potential (CDMG, 2001b), the site is located within a liquefaction hazard zone. In general, site soils consist of medium to high plasticity clays and silts and are not susceptible to liquefaction (Bray & Sancio, 2006). However, based on our field data, relatively isolated loose to medium dense sand layers, generally located approximately 40 to 50 feet below existing grade, are considered susceptible to liquefaction. The recent encountered in-situ groundwater depth of 25 feet below existing grade and historic high groundwater depth of 10 feet below existing grade were both used in the liquefaction analysis. The liquefaction evaluation was performed using data from boring HS-2. Liquefaction potential was evaluated using the procedures outlined by Special Publication 117A (SCEC, 1999 & CGS, 2008) and based on the seismic criteria of the 2016 California Building Code (CBC) and historic high groundwater depth. Liquefaction induced settlement was estimated using the PGA_M per the 2016 CBC and a moment magnitude of 6.9 (USGS, 2008).

Based on the PGA_M and our preliminary liquefaction analysis, seismic settlement potential in the upper approximate 50 feet is estimated to be on the order of 2 inches or less. Differential seismic settlement can be estimated as 1-inch over a horizontal span of about 40 feet. Seismically induced settlements were estimated by the procedure outlined by Tokimatsu and Seed (1987). Liquefaction calculations are provided in Appendix E.

2.7.2 Lateral Spreading

Lateral spreading is a type of liquefaction induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements and such movement typically damages pipelines, utilities, bridges, and structures.

Site soils are generally medium to high plasticity clays and silts and are not susceptible to liquefaction (Bray & Sancio, 2006). However, relatively isolated loose to medium dense sand layers are present and considered susceptible to liquefaction. These isolated layers were generally encountered at depths greater than 40 feet below existing grade. Based on the relatively flat topography of the site, lack of a free face nearby and general lack of potentially liquefiable layers in the upper 40 feet, the potential for lateral spreading is considered low.

2.8 Expansion Potential

Based on the results of our recent laboratory testing and previous background reports, site soils are anticipated to have a “Low” to “High” expansion potential. Final expansion potential of site soils should be determined at the completion of grading. Results of expansion testing at finish grades will be utilized to confirm final foundation design.

3.0 CONCLUSIONS

Based on the results of our subsurface evaluation and understanding of the proposed redevelopment, it is our opinion that the proposed development is feasible from a geotechnical standpoint. A summary of our conclusions are as follows:

- The field explorations generally indicate medium stiff to hard fine-grained clays interbedded with layers of medium dense sands with varying fines content to the maximum explored depth of approximately 50 feet below existing grade.
- Approximately 7.5 feet of previously placed undocumented artificial fill over native alluvial fan deposits was observed during this subsurface evaluation. Previous reports indicate that older artificial fill may be present up to approximately 17 feet below existing grade. Older artificial fill soils are primarily clays and silts with variable amounts of sand. Native alluvial fan deposits are primarily medium stiff to hard clays with variable sand content, as well as loose to medium dense clayey and silty sands to the maximum explored depth of approximately 50 feet below exiting grade.
- The near-surface soils are generally loose, dry and collapsible and are not suitable for the planned improvements in their present condition; removal and recompaction will be required.
- Groundwater was encountered during our recent subsurface evaluation at depths ranging from approximately 24 to 33 feet below existing ground surface. Historic high groundwater for the site is about 10 feet below existing ground surface (CDMG, 2001a).
- The site is located within a State of California Seismic Hazard Zone for liquefaction potential (CDMG, 2001b). In general, site soils generally consist of medium to high plasticity clays and silts and are not susceptible to liquefaction (Bray & Sancio, 2006). However, based on our field data, relatively isolated loose to medium dense sand layers generally located approximately 40 to 50 feet below existing grade are considered susceptible to liquefaction. Based on the PGA_M and our preliminary liquefaction analysis, seismic settlement potential in the upper approximate 50 feet is estimated to be on the order of 2 inches or less. Differential seismic settlement can be estimated as 1-inch over a horizontal span of about 40 feet.
- Based on the relatively flat topography of the site, lack of a free face nearby and general lack of potentially liquefiable layers in the upper 40 feet, the potential for lateral spreading is considered low.
- Due to site liquefaction potential, a site-specific response spectrum (not provided herein) will be required for any proposed structure with a fundamental period of vibration greater than 0.5 second.
- The proposed development will likely be subjected to strong seismic ground shaking during its design life. The site is not located within a State of California Earthquake Fault Zone (i.e., Alquist-Priolo Earthquake Fault Act Zone) and no active faults are known to cross the site (CGS, 2018).
- Site contains soils with a “Low” to “High” expansion potential. Mitigation measures will be required for building foundations and flatwork.
- Based on Caltrans Corrosion Guidelines (2015), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm (0.2

percent) or greater. Based on the test results, soils are not considered corrosive using Caltrans criteria (Caltrans, 2015).

- Due to the upper approximate 20 feet of the site consisting of fine-grained clays, presence of shallow groundwater and site liquefaction potential, intentional infiltration of storm water is not considered recommended.
- Excavations into the existing site soils should be feasible with heavy construction equipment in good working order. We anticipate that the sandy and silty earth materials generated from the excavations will be generally suitable for re-use as compacted fill, provided they are relatively free of rocks larger than 8 inches in dimension, construction debris, and significant organic material.
- Site contains clayey soils with high fines content and expansion potential that are not suitable for backfill of retaining walls. Therefore, import of sandy soils meeting project recommendations will be required.

4.0 RECOMMENDATIONS

A design-level geotechnical report based on the project grading and foundation plans should be prepared in order to provide design-level geotechnical recommendations (as necessary) for the proposed development. Additional field work and laboratory testing will likely be required. Additional and/or modified geotechnical recommendations will also likely be required.

Based on our preliminary EIR/due-diligence level study, the following is a summary of our preliminary geotechnical recommendations.

- From a geotechnical perspective, the site is feasible for construction of the proposed mixed-use residential development, provided that the recommendations of the geotechnical consultant are followed and the grading is performed in general accordance with applicable plans, codes, and City of Santa Ana requirements. The site was evaluated to the 2016 California Building Code (CBC) standard.
- All undocumented fill and unsuitable soft alluvial deposits shall be removed to suitable competent native materials prior to placement of proposed artificial fill. Recommendations for removal and recompaction and removal depths will be provided in a subsequent comprehensive report.
- Native alluvial soils are generally considered fine grained, overconsolidated and moderately compressible clay soils that are anticipated to consolidate when building loads are applied. From a geotechnical perspective, onsite soils are anticipated to be suitable for use as general compacted fill (not retaining wall backfill) provided they are screened of organic materials, construction debris and any oversized material (8 inches in greatest dimension). It should be emphasized that soils in the upper approximate 10 to 20 feet above groundwater are generally well above optimum moisture content and will require significant moisture conditioning (drying back) to achieve adequate compaction.
- Due to the high moisture contents, soft and yielding soils near removal bottoms may be exposed to wet and pumping conditions. Crushed rock may be paced over the soft wet removal bottom soils to stabilize the subgrade and provide a base for the compaction of the required fill.
- Ideally, import soils should consist of non-corrosive (negligible sulfates and low chlorides) and predominantly granular soils with an Expansion Index (EI) of 20 or less. However, the minimum criteria for import soils may be changed by you. Potentially acceptable import soils should; therefore, not exceed sulfate levels of 1 percent by weight, chloride levels of 500 ppm or Expansion Indices of 130. It should be noted that increasing the minimum criteria for import soils such as sulfate content and Expansion Index would adversely affect the design of the foundations. Higher concrete compressive strengths and thicker more rigid slab sections would be needed to mitigate against expansive/corrosion imported soils.
- Due to the proximity of the proposed improvements to the property line in portions of the site, temporary shoring or "A-B-C" slot cuts may be required to achieve required earthwork removal and recompaction.
- Preliminary settlement estimates, based on our estimated building loads, are on the order of 2 to 4 inches for the parking structures and 1 to 2 inches for the apartment buildings. Please note that these are very preliminary estimates based on our estimated building loads. These assumptions must be verified based on additional subsurface work such as borings/CPTs and laboratory testing and re-

evaluated based on actual building/structure loads from the structural engineer. Please note the above settlement estimates are very preliminary and do not take into account earthwork removals, ground improvement (e.g., geopiers) or deep foundation systems.

- The proposed parking structures will likely have to be supported on ground improvement (e.g., geopiers) or a deep foundation system (piles). This is a result of the anticipated column loads and the presence of fine-grained relatively compressible clay soils in the upper approximate 10 to 30 feet, which would result in long-term settlement beyond tolerable limits. However, due to the presence of isolated sandy layers to approximately 45 feet below existing ground surface and lack of a "bearing stratum" at depth, deep foundations are likely not feasible. We recommend the parking structures be supported on ground improvement such as Rammed Aggregate Piers (RAP), also known as geopiers. Additional field work, laboratory testing and analysis will have to be performed once actual building loads are known to further evaluate and confirm this.
- The proposed 5 and 7-story apartments will likely be supported on a rigid shallow conventional foundation system designed to resist site expansive soils and anticipated long-term static settlement provided recommended earthwork removal and re-compaction is performed. Foundation design should be based on the expansion index of the site soils. Additional field work, laboratory testing and analysis will have to be performed once actual building loads are known to further evaluate and confirm this.
- Due to potential elevated pedestrian walkway structures between the parking structure and apartment buildings, total and differential settlement of the proposed structures may have to be considered in order to maintain level transitions between the structures.
- Based on laboratory sulfate test results, the near surface soils are anticipated to be designated to a class "S1" per ACI 318, Table 19.3.1.1 with respect to sulfates. Concrete in direct contact with the onsite soils can be designed according to ACI 318, Table 19.3.2.1 using the "S1" sulfate classification.
- Geotechnical stability and integrity of the project site is reliant upon appropriate handling of surface water. Due to the low infiltration rate, shallow groundwater and site liquefaction potential, we strongly recommend against the intentional infiltration of storm water.
- Additional geotechnical subsurface evaluation must be performed in order to provide design-level geotechnical recommendations for the proposed development. Based on our preliminary study, we recommend performing additional field work consisting of Cone Penetration Test (CPT) soundings and additional borings or test pits. Further evaluation of required earthwork removals, soil settlement due to static building loads and liquefaction must be performed. Based on the results of our field evaluation and laboratory testing, updated and/or amended geotechnical conclusions and recommendations may be required.
- Final design level recommendations utilizing the site grading plans and structure loads should be provided as part of a comprehensive geotechnical report. Additional field work and laboratory testing, as mentioned above, should be anticipated.

5.0 LIMITATIONS

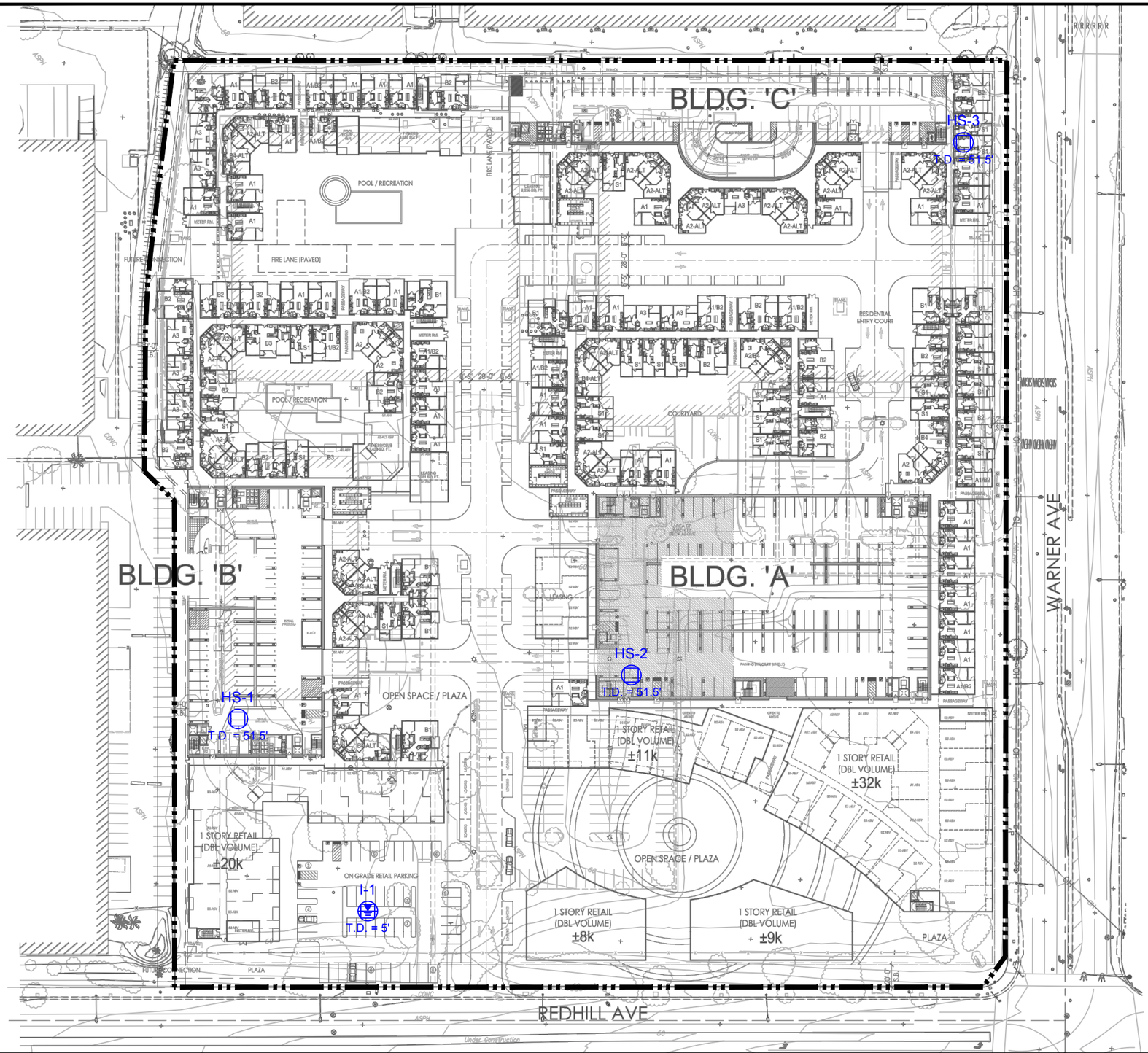
Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

This report is based on data obtained from limited observations of the site, which have been extrapolated to characterize the site. While the scope of services performed is considered suitable to adequately characterize the site geotechnical conditions relative to the proposed development, no practical evaluation can completely eliminate uncertainty regarding the anticipated geotechnical conditions in connection with a subject site. Variations may exist and conditions not observed or described in this report may be encountered during construction.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the other consultants and incorporated into the plans. The contractor should properly implement the recommendations during construction and notify the owner if they consider any of the recommendations presented herein to be unsafe, or unsuitable.

The findings of this report are valid as of the present date. However, changes in the conditions of a site can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. The findings, conclusions, and recommendations presented in this report can be relied upon only if LGC Geotechnical has the opportunity to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site. This report is intended exclusively for use by the client, any use of or reliance on this report by a third party shall be at such party's sole risk.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and modification.



LEGEND

LGC-HS-3 / T.D. = 50' — Approximate Location of Hollow Stem Auger Boring, with Total Depth in Feet

LGC-I-1 / T.D. = 5' — Approximate Location of Hollow Stem Auger Infiltration Boring,with Total Depth in Feet

Approximate Limits of This Project

SCALE: 1"=100'

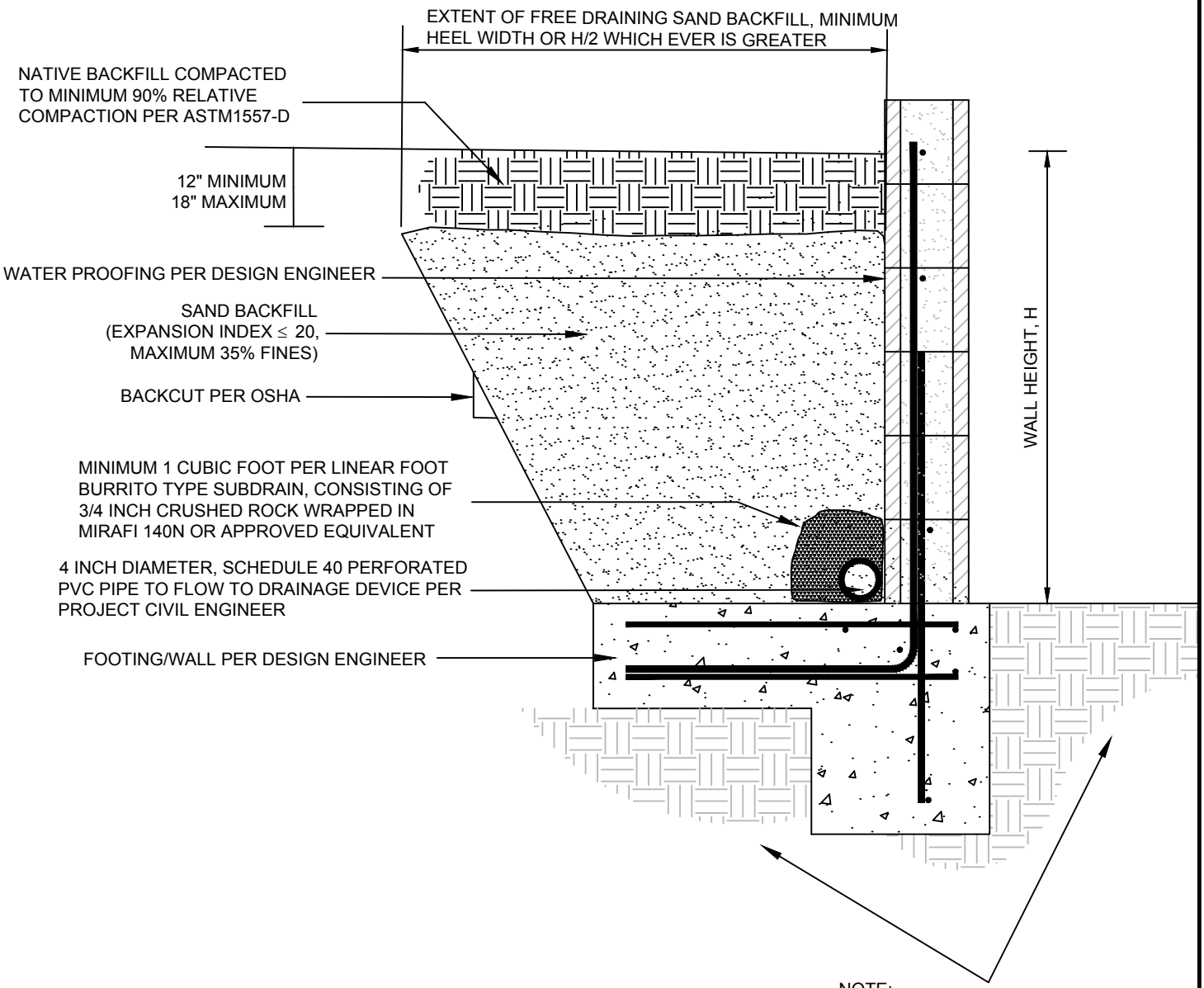
100' 0 100' 200'

LGC Geotechnical, Inc.

LGC Geotechnical, Inc.
131 Calle Iglesia, Ste. 200
San Clemente, CA 92672
TEL (949) 369-6141 FAX (949) 369-6142

FIGURE 2
Geotechnical Exploration Location Map

PROJECT NAME	The Bowery - Santa Ana
PROJECT NO.	19063-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 100'
DATE	June, 2019



LGC Geotechnical, Inc.

FIGURE 3
Retaining Wall Backfill Detail

PROJECT NAME	EPD - The Bowery, Santa Ana
PROJECT NO.	19063-01
ENG.	RLD
SCALE	Not to Scale
DATE	June 2019

Appendix A
References

APPENDIX A

References

American Society of Civil Engineers (ASCE), 2013, Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-10, Third Printing, 2013.

Architects Orange (AO), 2019, Conceptual Site Plan, The Bowery, Warner Avenue and Redhill Avenue, Santa Ana, California, dated March 26, 2019.

Bray, J.D., and Sancio, R. B., 2006, Assessment of liquefaction susceptibility of fine-grained soils, *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, pp. 1165-1177, dated September 2006.

California Building Standards Commission, 2016, California Building Code, California Code of Regulations Title 24, Volumes 1 and 2, dated July 2016.

California Department of Conservation, Division of Mines and Geology (CDMG), 2001a, Seismic Hazard Evaluation of the Tustin 7.5-Minute Quadrangles, Orange County, California, Seismic Hazard Zone Report 97-20, Revised 2001.

_____, 2001b, State of California Seismic Hazard Zones, Tustin Quadrangle, Official Revised Map Released: January 17, 2001.

California Geological Survey (CGS), 2008, California Geological Survey Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards in California, dated September 11, 2008.

_____, 2018, Earthquake Fault Zones, Special Publication 42, Revised 2018.

Caltrans, 2015, Corrosion Guidelines, Version 2.1, dated January 2015.

Fuscoe Engineering, Inc. (Fuscoe), 2019, Site Topo, The Bowery, Santa Ana, received June 4, 2019.

G.A. Nicoll & Associates (Nicoll), 1979a, Building Pad Certification, Ricoh Electronics Building, 2300 Red Hill Avenue, Warner & Red Hill Avenue, Santa Ana, California, Project No. 1993-51, dated June 12, 1979.

_____, 1979b, Final Grading Report, Ricoh Electronics Building, 2300 Red Hill Avenue, Warner & Red Hill Avenue, Santa Ana, California, Project No. 1993-52, dated December 17, 1979.

_____, 1981, Building Pad Verification Report, REI Toner Building, 2310 Red Hill Avenue, Red Hill and Warner Avenue, Santa Ana, California, Project No. 2415-51, dated September 14, 1981.

_____, 1990, Rough Grading Report, Addition to Thermal Paper Plant, 2320 Red Hill Avenue, Santa Ana, California, Project No. 4111-04, dated February 20, 1990.

References

Historical Aerials, 2017, viewed June 11, 2019, Aerials viewed from: 1946, 1952, 1963, 1972, 1980, 1994 and 2012, https://www.historicaerials.com/

Lew, et al, 2010, Seismic Earth Pressures on Deep Basements, Structural Engineers Association of California (SEAOC) Convention Proceedings.

Lotus Consulting Engineers, 1989, Tank Excavation Backfill Report, Grading Permit No. 0346, Ricoh Corporation, 2310 Red Hill Avenue, Santa Ana, California, dated February 23, 1989.

Morton, et al., 2004, Preliminary Digital Geological Map of the 30' X 60' Santa Ana Quadrangle, southern California, version 2.0, U.S. Geological Survey, dated 2004.

NCEER, 1997, "Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils", T. L. Youd and I. M. Idriss Editors, Technical Report NCEER-97-0022, NCEER, Buffalo, NY.

Southern California Earthquake Center (SCEC), 1999, "Recommended Procedure for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigation Liquefaction Hazards in California", Edited by Martin, G.R., and Lew, M., dated March 1999.

Tokimatsu, K., and Seed, H. B., 1987, "Evaluation of Settlements in Sands Due to Earthquake Shaking", Journal of Geotechnical Engineering, ASCE, Vol. 113, No. 8, pp. 861-878.

Structural Engineers Association of California (SEAOC), 2019, OSHPD Seismic Design Maps, Retrieved June 3, 2019, from: https://seismicmaps.org/

United States Geological Survey (USGS), 2008, Unified Hazard Tool, Dynamic: Conterminous U.S. 2008 (v3.3.1), Retrieved June 3, 2019, from: https://earthquake.usgs.gov/hazards/interactive/

Youd, T. L. et al., 2001, "Liquefaction Resistance of Soils, Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils", *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Vol. 127, No. 10, dated October 2001.

Youd, T.L., Hansen, C.B., Bartlett, S.F., 2002, Revised multilinear regression equations for prediction of lateral spread displacement, *Journal of Geotechnical and Geoenvironmental Engineering*, December 2002, pp. 1007-1017.

Appendix B
Boring Logs

Geotechnical Boring Log Borehole HS-1

Date: 5/7/2019	**Drilling Company:** Cal Pac Drilling
Project Name: The Bowery	**Type of Rig:** B-61
Project Number: 19063-01	**Drop:** 30" **Hole Diameter:** 6"
Elevation of Top of Hole: ~59' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 2

Logged By ARN
Sampled By ARN
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
55	0	B-1					CL	**@0' to 5' - Older Artificial Fill (afo)** @0' Approximately 5 inches AC over 5 inches AB. @1' - CLAY with Sand: brown, moist, stiff	CR
	5		R-1	4 4 6	115.2	14.2	CL	**@5' to T.D. - Quaternary Young Alluvial Fan Deposits (Qyf)** @5' - Sandy CLAY: brown, moist, stiff; scattered pebbles	
50			R-2	3 5 9	113.0	18.1	SC	@7.5' - Clayey SAND: brown, very moist, medium dense	
	10		R-3	2 4 9	109.2	19.0	ML	@10' - SILT with Sand: Gray-brown, very moist, stiff; slight chemical odor	
45	15		SPT-1	1 1 3		25.8		@15' - Sandy SILT: gray with red-orange, very moist, medium stiff	
40	20		R-4	3 4 6	100.1	26.5	CL	@20' - CLAY: gray and red-orange, very moist, stiff	
35		▽						@24' - Groundwater encountered	
	25		SPT-2	1 2 4		20.8		@25' - CLAY: brown, very moist to wet, stiff	
30	30								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
▽	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Last Edited: 5/29/2019

Geotechnical Boring Log Borehole HS-1

Date: 5/7/2019	**Drilling Company:** Cal Pac Drilling
Project Name: The Bowery	**Type of Rig:** B-61
Project Number: 19063-01	**Drop:** 30" **Hole Diameter:** 6"
Elevation of Top of Hole: ~59' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 2 of 2

Logged By ARN
Sampled By ARN
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	30		R-5	10 11 15	112.9	18.2	CL	@30' - CLAY: brown and light brown, very moist, very stiff	
25	35		SPT-3	5 5 9		19.8		@35' - Sandy CLAY: light pinkish brown, very moist, very stiff	
20	40		R-6	7 9 17	111.7	18.8	ML	@40' - Sandy SILT: gray-brown and gray mottled, very moist, very stiff	
15	45		SPT-4	3 5 6		27.1	SC	@45' - Clayey SAND: brown, wet, medium dense	
10	50		R-7	6 8 10	103.7	25.6	ML	@50' - Sandy SILT: reddish brown and gray, wet, very stiff	
5	55							Total Depth = 51.5' Groundwater Encountered at Approximately 24' Backfilled with Cement Bentonite and Capped with AC Cold-Patch 5/7/2019	
	60								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
▽	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole HS-2

Date: 5/7/2019	**Drilling Company:** Cal Pac Drilling
Project Name: The Bowery	**Type of Rig:** B-61
Project Number: 19063-01	**Drop:** 30" **Hole Diameter:** 6"
Elevation of Top of Hole: ~62' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 1 of 2

Logged By ARN
Sampled By ARN
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
60	0	B-1					CL	**@0' to 5' - <u>Older Artificial Fill (afo)</u>** @0' - Approximately 5 inches AC over 5 inches AB @1' - Below is CLAY with Sand: brown, moist, stiff	MD EI CR
	5		R-1	5 9 13	119.0	15.6	ML	@5' - SILT with SAND: brown, moist, very stiff **@7.5' to T.D. - <u>Quaternary Young Alluvial Fan Deposit (Qyf)</u>**	
55		B-2	R-2	3 4 5	114.7	17.8	SC	@7.5' - Clayey SAND: brown, very moist, loose; micaceous	CN -#200
	10		R-3	4 3 3	91.4	30.8	CH	@10' - Fat CLAY: dark yellowish brown, very moist, medium stiff	CN AL
50									
	15		SPT-1	1 2 3		29.1		@15' - Fat CLAY: dark gray with some brown mottle, very moist, medium stiff	-#200
45									
	20		R-4	3 4 6	93.0	29.2	CL	@20' - CLAY: olive gray and brown mottled, very moist, stiff	
40									
	25		SPT-2	1 1 4		22.7		@25' - CLAY: brown, reddish brown, and gray mottled, very moist, medium stiff	AL -#200
35									
	30								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
▽	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Last Edited: 5/29/2019

Geotechnical Boring Log Borehole HS-2

Date: 5/7/2019	**Drilling Company:** Cal Pac Drilling
Project Name: The Bowery	**Type of Rig:** B-61
Project Number: 19063-01	**Drop:** 30" **Hole Diameter:** 6"
Elevation of Top of Hole: ~62' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 2 of 2

Logged By ARN
Sampled By ARN
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
30	30		R-5	7 9 10	103.0	24.3	CL	@30' - CLAY: brown and light brown mottled, very moist, very stiff	
								@33.5' - Groundwater encountered	
25	35		SPT-3	6 7 9		17.8		@35' - Sandy CLAY: reddish brown, moist to very moist, very stiff	AL -#200
20	40		R-6	6 10 11	113.5	17.4	SM	@40' - Silty SAND: brown and gray mottled, moist to very moist, very stiff	
15	45		SPT-4	5 9 13		32.0	SC	@45' - Clayey SAND: brown, wet, medium dense	
10	50		R-7	5 10 12	112.9	16.8	CL	@50' - Sandy CLAY: brown to reddish brown, moist, very stiff	
5	55							Total Depth = 51.5' Groundwater Encountered at Approximately 33.5' Backfilled with Cement Bentonite and Capped with AC Cold Patch 5/7/2019	
	60								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole HS-3

Date: 5/7/2019 | **Drilling Company:** Cal Pac Drilling

Project Name: The Bowery | **Type of Rig:** B-61

Project Number: 19063-01 | **Drop:** 30" | **Hole Diameter:** 6"

Elevation of Top of Hole: ~62' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By ARN
Sampled By ARN
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
60	0		B-1				SC	**@0' to 5' - Older Artificial Fill (afo)** @0' - Approximately 4 inches AC over 5 inches AB @1' - Clayey SAND: brown, slightly moist, stiff	EI
55	5		R-1	6 8 12	120.0	13.8	SC	**@5' to T.D. - Quaternary Young Alluvial Fan Deposits (Qya)** @5' - Clayey SAND: brown and gray mottled, moist, medium dense	
			R-2	4 4 6	93.3	31.0	CL	@7.5' - Sandy CLAY: brown and gray mottled, very moist, stiff	
50	10		R-3	8 8 7	99.4	22.4	SC	@10' - Clayey SAND: brown and gray mottled, very moist, medium dense	
45	15		SPT-1	1 2 3		17.0	CL	@15' - CLAY: gray and brown mottled, moist, medium stiff; micaceous	
40	20		R-4	3 4 7	99.5	25.9		@20' - CLAY: olive gray and brown mottled, very moist, stiff	CN AL
35	25	▽	SPT-2	2 1 2		35.7		@25' - CLAY: brown and gray mottled, wet, medium stiff; groundwater encountered	
	30								

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
▽	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Last Edited: 5/29/2019

Geotechnical Boring Log Borehole HS-3

Date: 5/7/2019	**Drilling Company:** Cal Pac Drilling
Project Name: The Bowery	**Type of Rig:** B-61
Project Number: 19063-01	**Drop:** 30" **Hole Diameter:** 6"
Elevation of Top of Hole: ~62' MSL	**Drive Weight:** 140 pounds
Hole Location: See Geotechnical Map	Page 2 of 2

Logged By ARN
Sampled By ARN
Checked By RLD

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
30	30		R-5	6 8 10	116.7	17.3	CL	@30' - CLAY: reddish brown, moist to very moist, very stiff	.
	35		SPT-3	5 9 9		17.4		@35' - CLAY with Sand: brown with tan mottling, moist to very moist, very stiff	.
25	40		R-6	10 20 19	126.1	14.0		@40' - Sandy CLAY with some Gravel: brown, moist, hard; scattered coarse grained sand	.
20	45		SPT-4	4 10 11		19.1	SC	@45' - Clayey SAND: brown, wet, medium dense	.
15	50		R-7	5 9 13				@50' - No Recovery	.
10								Total Depth = 51.5' Groundwater Encountered at Approximately 25' Backfilled with Cement Bentonite and Capped with AC Cold-Patch on 5/7/2019	
55									
5									
60									

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE (CA Modified Sampler)
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE
	GROUNDWATER TABLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Appendix C
Laboratory Test Results

APPENDIX C

Laboratory Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Moisture and Density Determination Tests: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on driven samples obtained from the test borings. The results of these tests are presented on the boring logs in Appendix B. Where applicable, only moisture content was determined from SPT or disturbed samples.

Grain Size Distribution/Fines Content: Representative samples were dried, weighed, and soaked in water until individual soil particles were separated (per ASTM D421) and then washed on a No. 200 sieve (ASTM D1140). Where applicable, the portion retained on the No. 200 sieve was dried and then sieved on a U.S. Standard brass sieve set in accordance with ASTM D6913 (sieve) or ASTM D422 (sieve and hydrometer).

Sample Location	Description	% Passing # 200 Sieve
HS-2 @ 7.5 ft	Clayey Sand	47
HS-2 @ 15 ft	Clay	93
HS-2 @ 25 ft	Clay	88
HS-2 @ 35 ft	Sandy Clay	60

Atterberg Limits: The liquid and plastic limits ("Atterberg Limits") were determined per ASTM D4318 for engineering classification of fine-grained material and presented in the table below. The USCS soil classification indicated in the table below is based on the portion of sample passing the No. 40 sieve and may not necessarily be representative of the entire sample. The plots are provided in this Appendix.

Sample Location	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	USCS Soil Classification
HS-2 @ 10 ft	55	23	32	CH
HS-2 @ 25 ft	36	19	17	CL
HS-2 @ 35 ft	32	12	20	CL
HS-3 @ 20 ft	33	22	11	CL

Laboratory Test Results

Consolidation: Three consolidation tests were performed per ASTM D2435. A sample (2.4 inches in diameter and 1 inch in height) was placed in a consolidometer and increasing loads were applied. The sample was allowed to consolidate under "double drainage" and total deformation for each loading step was recorded. The percent consolidation for each load step was recorded as the ratio of the amount of vertical compression to the original sample height. The consolidation pressure curves are provided in this Appendix.

Laboratory Compaction: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM D1557. The results of this tests are presented in the table below.

Sample Location	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
HS-2 @ 0-5 ft	Brown clay with sand	122.5	12.0

Expansion Index: The expansion potential of select representative samples were evaluated by the Expansion Index Test per ASTM D4829.

Sample Location	Expansion Index	Expansion Potential*
HS-2 @ 0-5 ft	44	Low
HS-2 @ 0-5 ft	25	Low

* Per ASTM D4829

Soluble Sulfates: The soluble sulfate contents of a selected sample was determined by standard geochemical methods (CTM 417). The test results are presented in the table below.

Sample Location	Sulfate Content (%)
HS-1 @ 2-5 ft	0.06
HS-2 @ 0-5 ft	0.1

Chloride Content: Chloride content was tested per CTM 422. The results are presented below.

Sample Location	Chloride Content (ppm)
HS-2 @ 0-5 ft	100

Laboratory Test Results

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The results are presented in the table below.

Sample Location	pH	Minimum Resistivity (ohms-cm)
HS-2 @ 0-5 ft	7.5	515

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Santa Ana	Tested By:	R. Manning	Date:	05/17/19
Project No. :	19063-01	Input By:	G. Bathala	Date:	05/24/19
Boring No.:	HS-2	Checked By:	J. Ward		
Sample No.:	R-3	Depth (ft.)	10.0		
Soil Identification:	Dark yellowish brown fat clay (CH)				

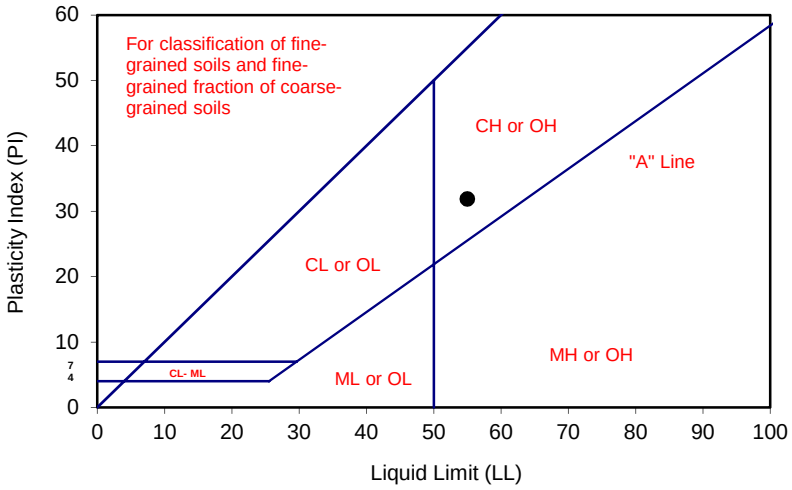
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	27	19	
Wet Wt. of Soil + Cont. (g)	18.81	18.15	23.51	23.29	23.87	
Dry Wt. of Soil + Cont. (g)	17.40	16.82	20.16	19.84	20.17	
Wt. of Container (g)	11.30	11.06	13.70	13.48	13.64	
Moisture Content (%) [Wn]	23.11	23.09	51.86	54.25	56.66	

Liquid Limit	**55**
Plastic Limit	**23**
Plasticity Index	**32**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 25.55

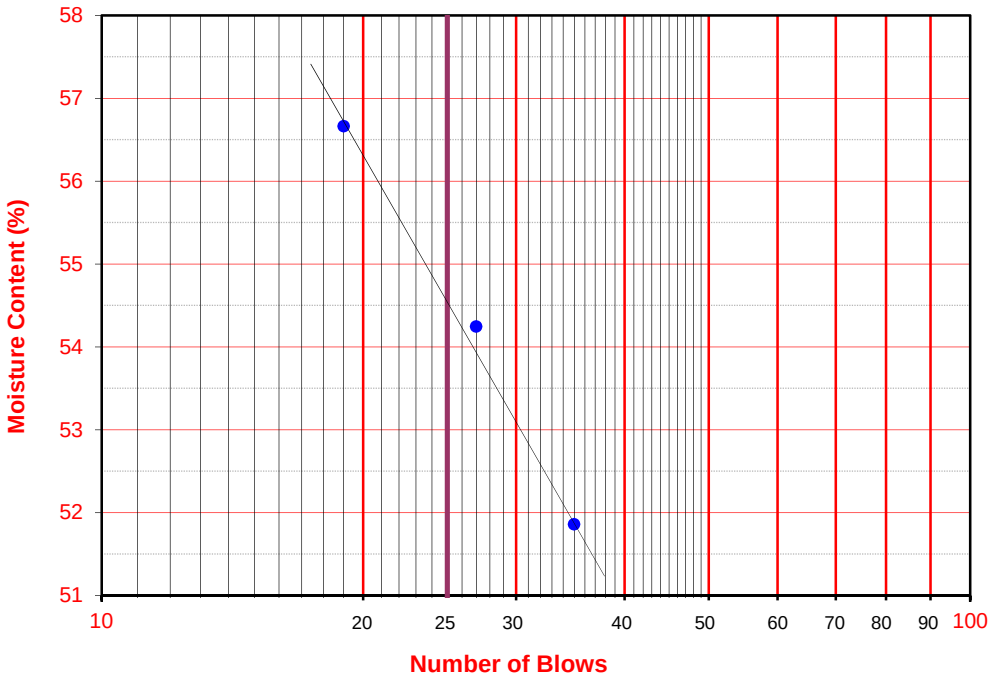
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation Multipoint - Wet
X	Dry Preparation Multipoint - Dry
X	Procedure A Multipoint Test
	Procedure B One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Santa Ana	Tested By:	R. Manning	Date:	05/16/19
Project No. :	19063-01	Input By:	G. Bathala	Date:	05/24/19
Boring No.:	HS-3	Checked By:	J. Ward		
Sample No.:	R-4	Depth (ft.)	20.0		
Soil Identification:	Olive gray and brown clay (CL)				

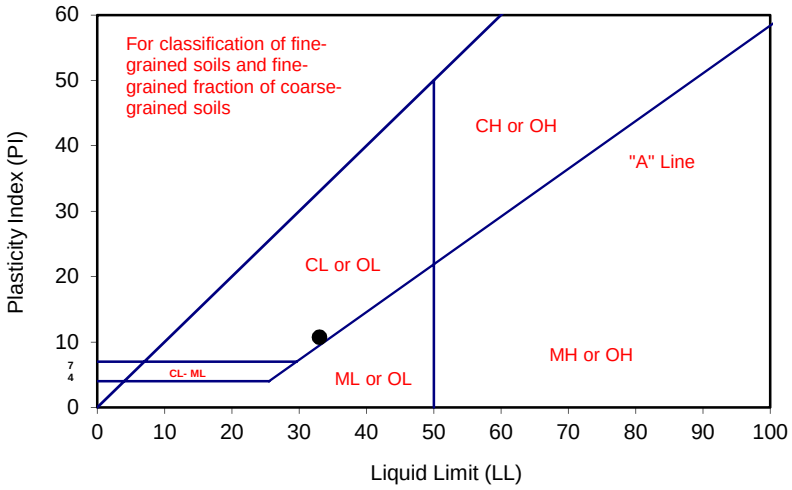
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	25	17	
Wet Wt. of Soil + Cont. (g)	19.64	19.57	23.88	24.13	23.91	
Dry Wt. of Soil + Cont. (g)	18.12	18.05	21.40	21.47	21.22	
Wt. of Container (g)	11.30	11.21	13.63	13.42	13.36	
Moisture Content (%) [Wn]	22.29	22.22	31.92	33.04	34.22	

Liquid Limit	**33**
Plastic Limit	**22**
Plasticity Index	**11**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 9.49

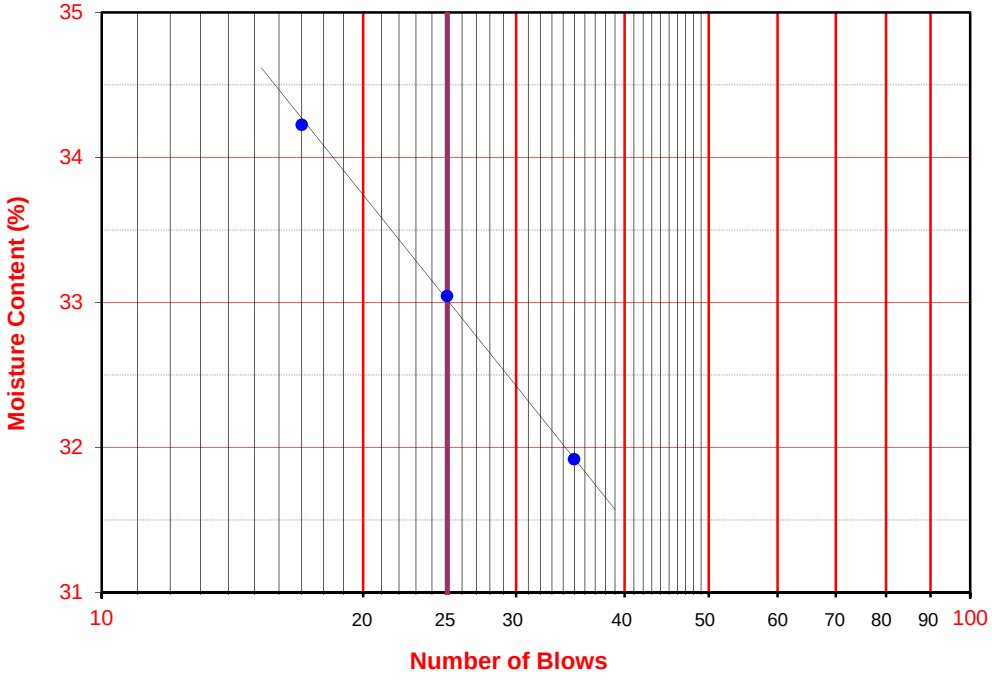
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$

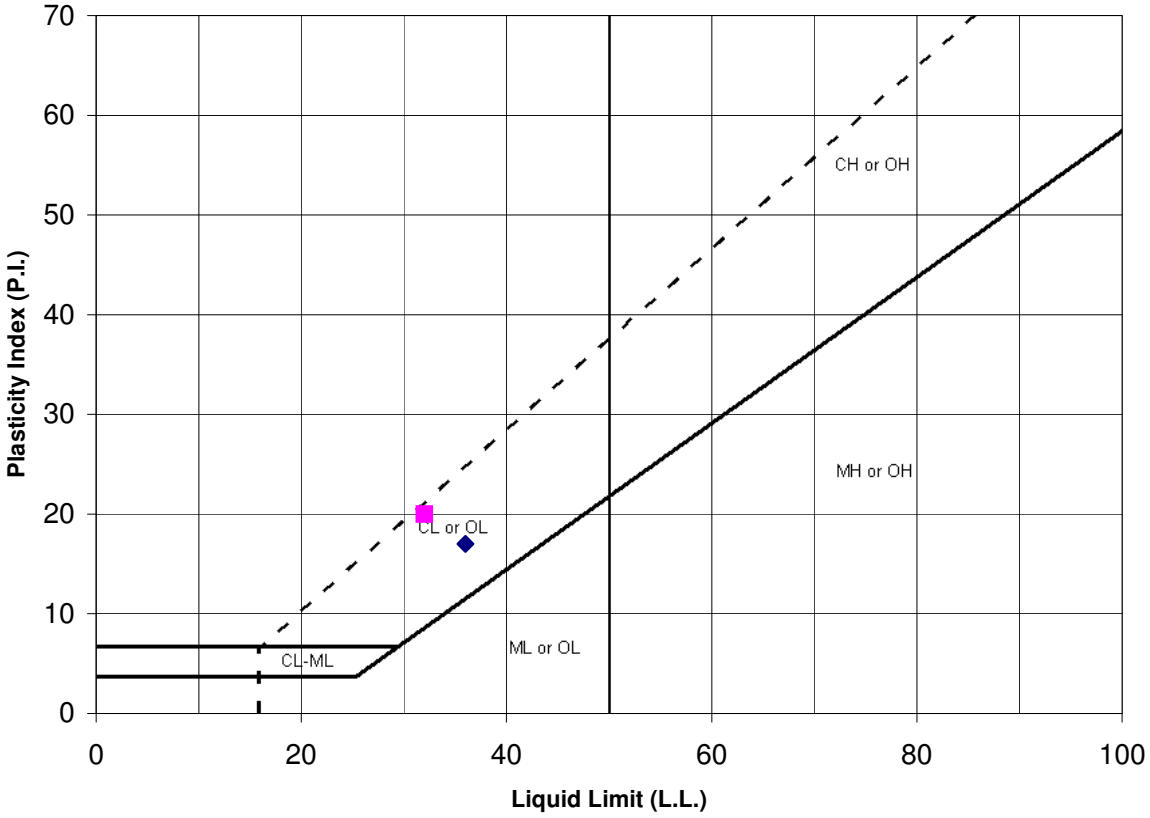


PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



PLASTICITY CHART - CLASSIFICATION OF FINE-GRAINED SOILS



Symbol	Location.:	Sample No.:	Depth (ft)	Passing No. 200 Sieve (%)	Liquid Limit (%) LL	Plastic Limit (%) PL	Plasticity Index (%) PI	USCS
◆	HS-2	SPT-2	25	-	36	19	17	CL
■	HS-2	SPT-3	35	-	32	12	20	CL

LGC Geotechnical, Inc.

ATTERBERG LIMITS
(ASTM D 4318)

Project Number: 19063-01
Date: May-19

The Bowery - Santa Ana

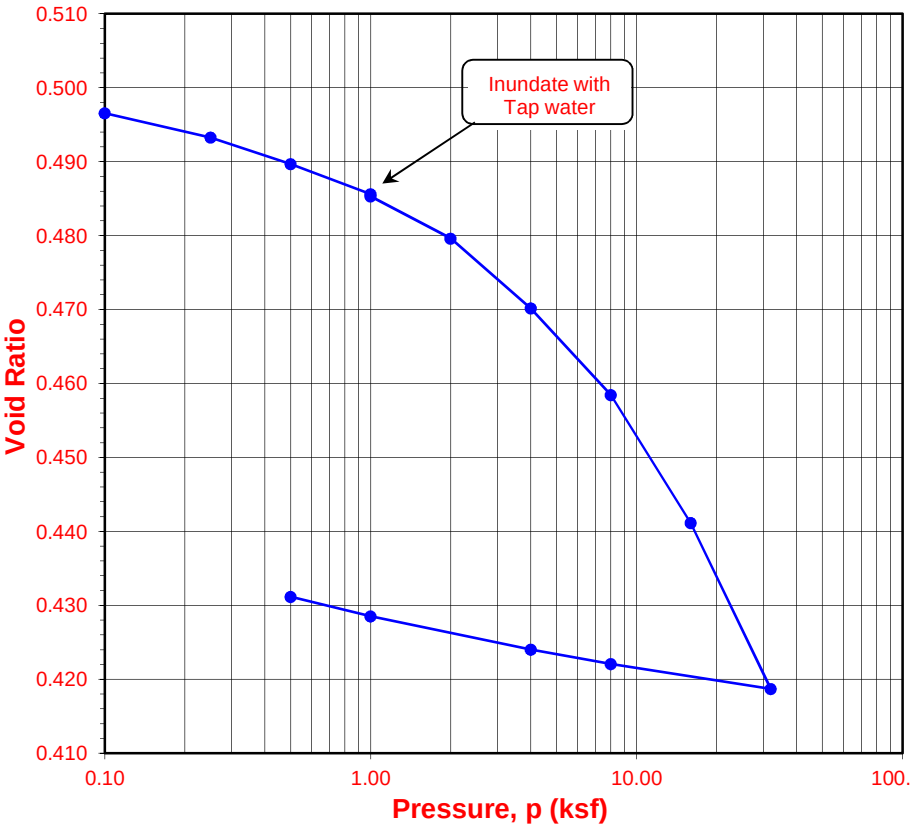
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name: Santa Ana
Project No.: 19063-01
Boring No.: HS-2
Sample No.: R-2
Soil Identification: Brown clayey sand (SC)

Tested By: G. Bathala Date: 05/16/19
Checked By: J. Ward Date: 05/30/19
Depth (ft.): 7.5
Sample Type: Ring

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	208.61
Weight of Ring (g)	42.93
Height after consol. (in.)	0.9539
Before Test	
Wt.Wet Sample+Cont. (g)	485.28
Wt.of Dry Sample+Cont. (g)	436.98
Weight of Container (g)	166.26
Initial Moisture Content (%)	17.8
Initial Dry Density (pcf)	116.9
Initial Saturation (%)	100
Initial Vertical Reading (in.)	0.3189
After Test	
Wt.of Wet Sample+Cont. (g)	274.60
Wt. of Dry Sample+Cont. (g)	258.15
Weight of Container (g)	69.53
Final Moisture Content (%)	11.29
Final Dry Density (pcf)	127.0
Final Saturation (%)	83
Final Vertical Reading (in.)	0.2652
Specific Gravity (assumed)	2.81
Water Density (pcf)	62.43

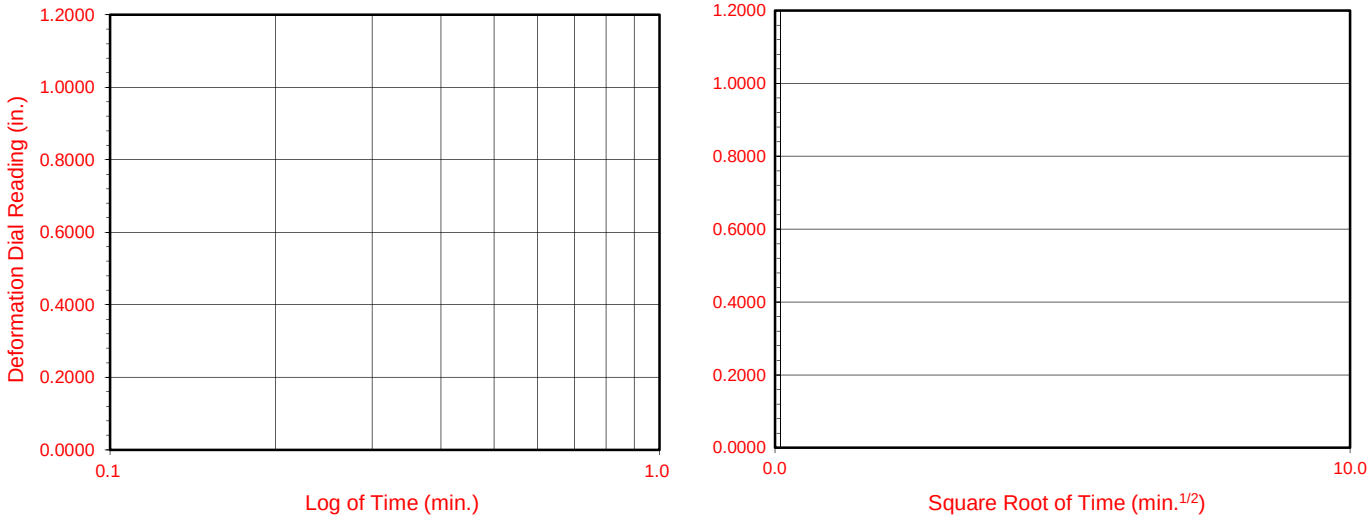


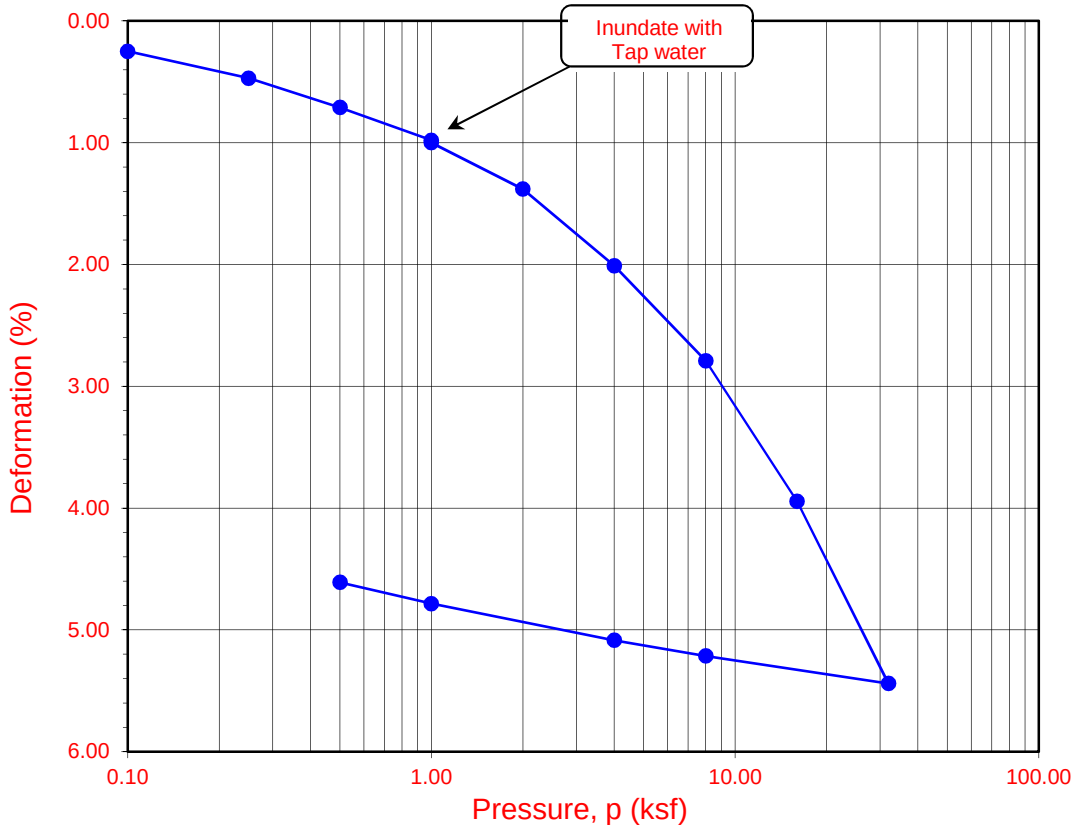
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.3164	0.9975	0.00	0.25	0.497	0.25
0.25	0.3138	0.9949	0.04	0.51	0.493	0.47
0.50	0.3109	0.9920	0.09	0.80	0.490	0.71
1.00	0.3071	0.9882	0.20	1.18	0.486	0.98
1.00	0.3069	0.9880	0.20	1.20	0.485	1.00
2.00	0.3013	0.9824	0.38	1.76	0.480	1.38
4.00	0.2929	0.9740	0.59	2.60	0.470	2.01
8.00	0.2825	0.9636	0.85	3.64	0.458	2.79
16.00	0.2684	0.9495	1.11	5.06	0.441	3.95
32.00	0.2505	0.9316	1.40	6.84	0.419	5.44
8.00	0.2555	0.9366	1.13	6.35	0.422	5.22
4.00	0.2582	0.9393	0.99	6.08	0.424	5.09
1.00	0.2630	0.9441	0.81	5.59	0.429	4.78
0.50	0.2652	0.9463	0.76	5.37	0.431	4.61

Time Readings

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

Time Readings





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
HS-2	**R-2**	**7.5**	**17.8**	**11.3**	**116.9**	**127.0**	**0.500**	**0.431**	**100**	**83**

Soil Identification: Brown clayey sand (SC)

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 19063-01

Santa Ana

05-19

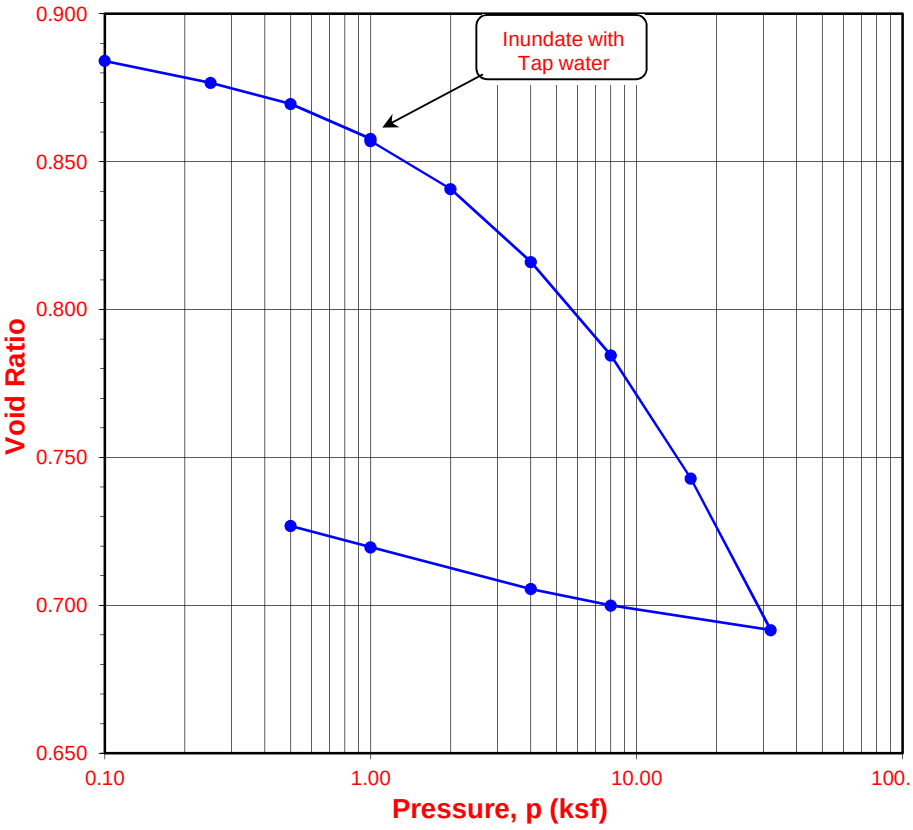
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name: Santa Ana
Project No.: 19063-01
Boring No.: HS-2
Sample No.: R-3
Soil Identification: Dark yellowish brown fat clay (CH)

Tested By: G. Bathala Date: 05/16/19
Checked By: J. Ward Date: 05/30/19
Depth (ft.): 10.0
Sample Type: Ring

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	196.83
Weight of Ring (g)	45.82
Height after consol. (in.)	0.9128
Before Test	
Wt.Wet Sample+Cont. (g)	335.46
Wt.of Dry Sample+Cont. (g)	265.78
Weight of Container (g)	39.40
Initial Moisture Content (%)	30.8
Initial Dry Density (pcf)	96.0
Initial Saturation (%)	100
Initial Vertical Reading (in.)	0.3011
After Test	
Wt.of Wet Sample+Cont. (g)	254.81
Wt. of Dry Sample+Cont. (g)	229.91
Weight of Container (g)	65.66
Final Moisture Content (%)	21.03
Final Dry Density (pcf)	107.9
Final Saturation (%)	89
Final Vertical Reading (in.)	0.2046
Specific Gravity (assumed)	2.91
Water Density (pcf)	62.43

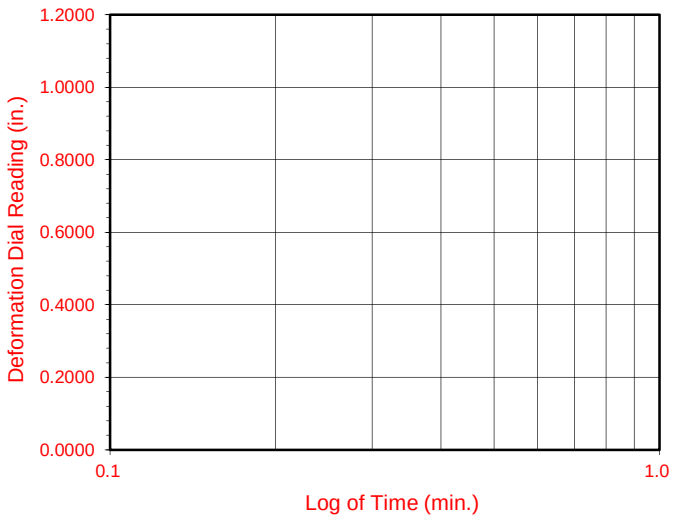


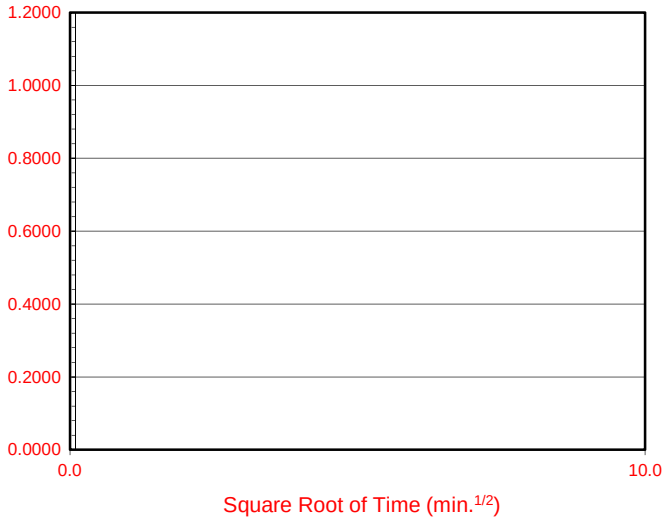
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.2970	0.9959	0.00	0.41	0.884	0.41
0.25	0.2920	0.9909	0.11	0.91	0.877	0.80
0.50	0.2868	0.9857	0.25	1.43	0.869	1.18
1.00	0.2790	0.9779	0.41	2.21	0.858	1.80
1.00	0.2786	0.9775	0.41	2.25	0.857	1.84
2.00	0.2679	0.9668	0.62	3.32	0.841	2.70
4.00	0.2529	0.9518	0.82	4.82	0.816	4.00
8.00	0.2341	0.9330	1.03	6.70	0.785	5.67
16.00	0.2095	0.9084	1.29	9.16	0.743	7.87
32.00	0.1795	0.8784	1.58	12.16	0.692	10.58
8.00	0.1860	0.8849	1.37	11.51	0.700	10.14
4.00	0.1902	0.8891	1.25	11.10	0.706	9.85
1.00	0.1998	0.8987	1.03	10.13	0.720	9.10
0.50	0.2046	0.9035	0.93	9.65	0.727	8.72

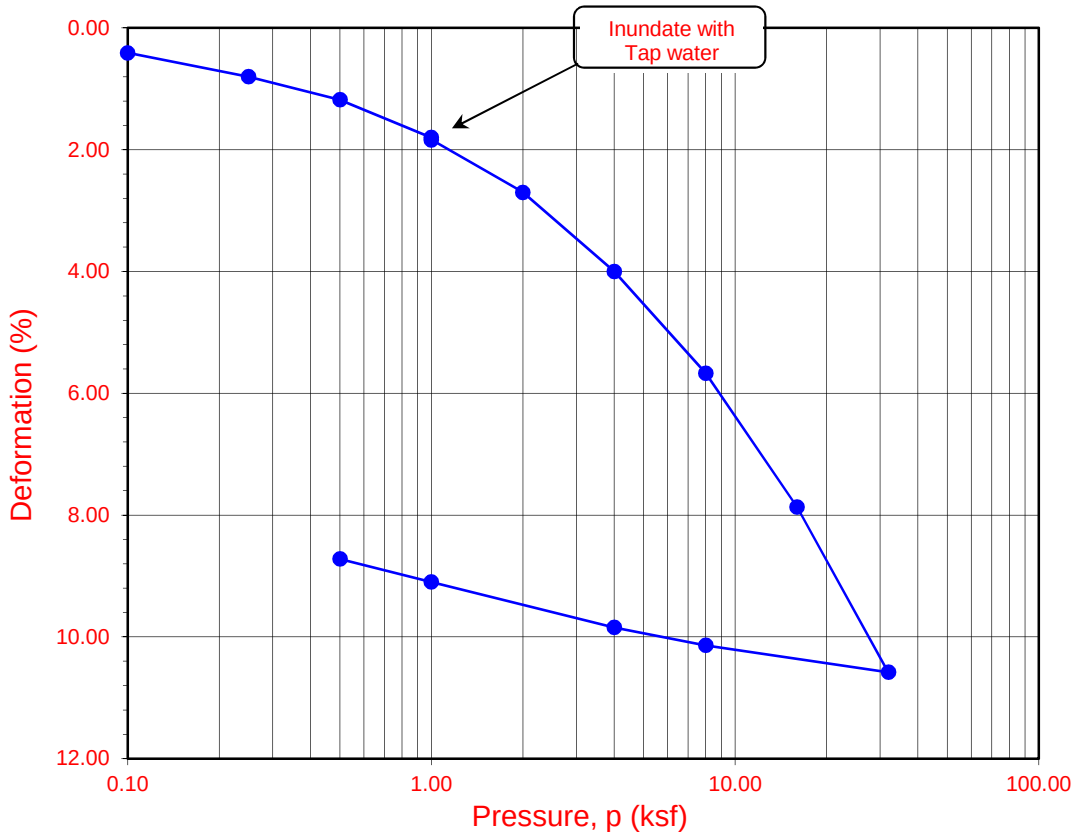
Time Readings

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

Time Readings







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
HS-2	**R-3**	**10.0**	**30.8**	**21.0**	**96.0**	**107.9**	**0.892**	**0.727**	**100**	**89**

Soil Identification: Dark yellowish brown fat clay (CH)

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 19063-01

Santa Ana

05-19

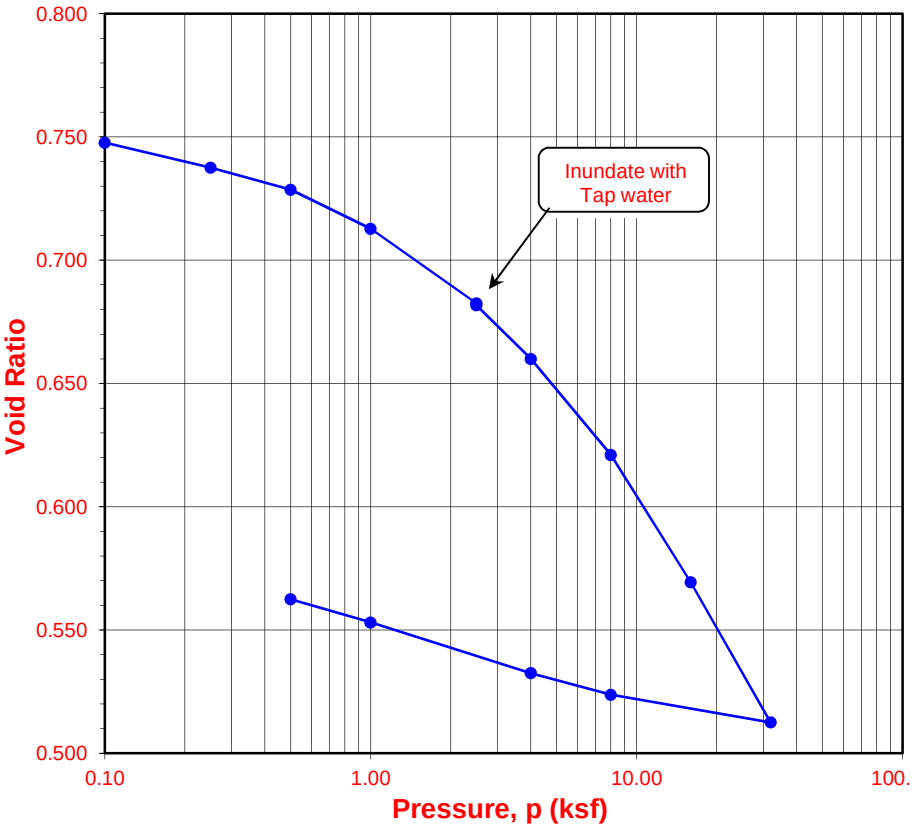
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name: Santa Ana
Project No.: 19063-01
Boring No.: HS-3
Sample No.: R-4
Soil Identification: Olive gray and brown clay (CL)

Tested By: G. Bathala Date: 05/22/19
Checked By: J. Ward Date: 06/05/19
Depth (ft.): 20.0
Sample Type: Ring

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	198.04
Weight of Ring (g)	46.12
Height after consol. (in.)	0.8908
Before Test	
Wt.Wet Sample+Cont. (g)	336.15
Wt.of Dry Sample+Cont. (g)	275.03
Weight of Container (g)	38.86
Initial Moisture Content (%)	25.9
Initial Dry Density (pcf)	100.4
Initial Saturation (%)	97
Initial Vertical Reading (in.)	0.3047
After Test	
Wt.of Wet Sample+Cont. (g)	228.04
Wt. of Dry Sample+Cont. (g)	203.37
Weight of Container (g)	38.08
Final Moisture Content (%)	20.70
Final Dry Density (pcf)	111.3
Final Saturation (%)	100
Final Vertical Reading (in.)	0.1905
Specific Gravity (assumed)	2.82
Water Density (pcf)	62.43

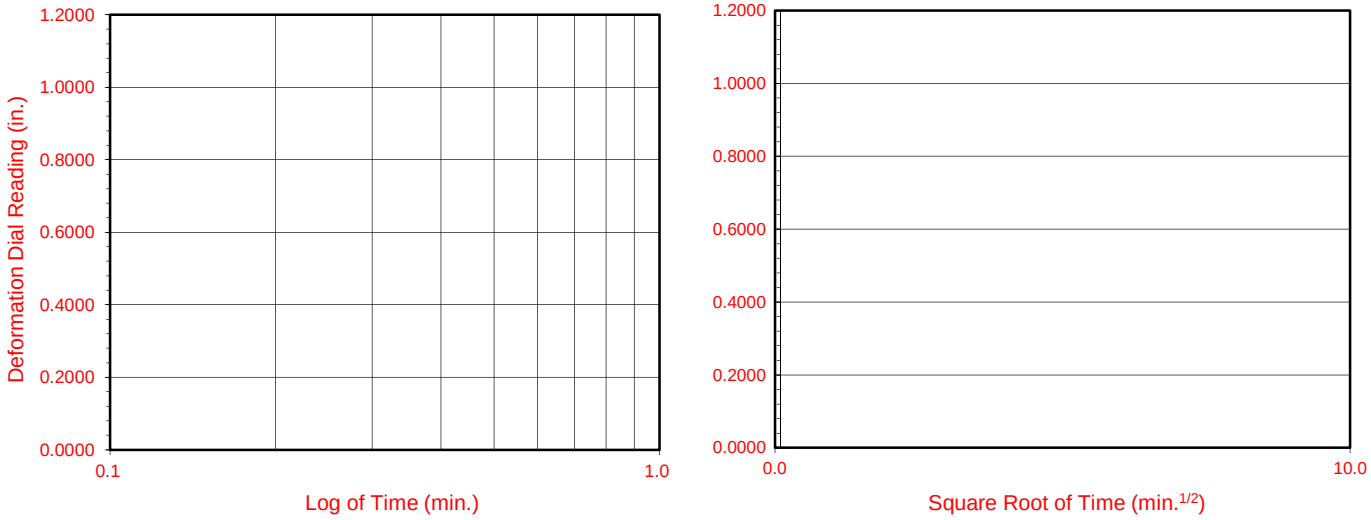


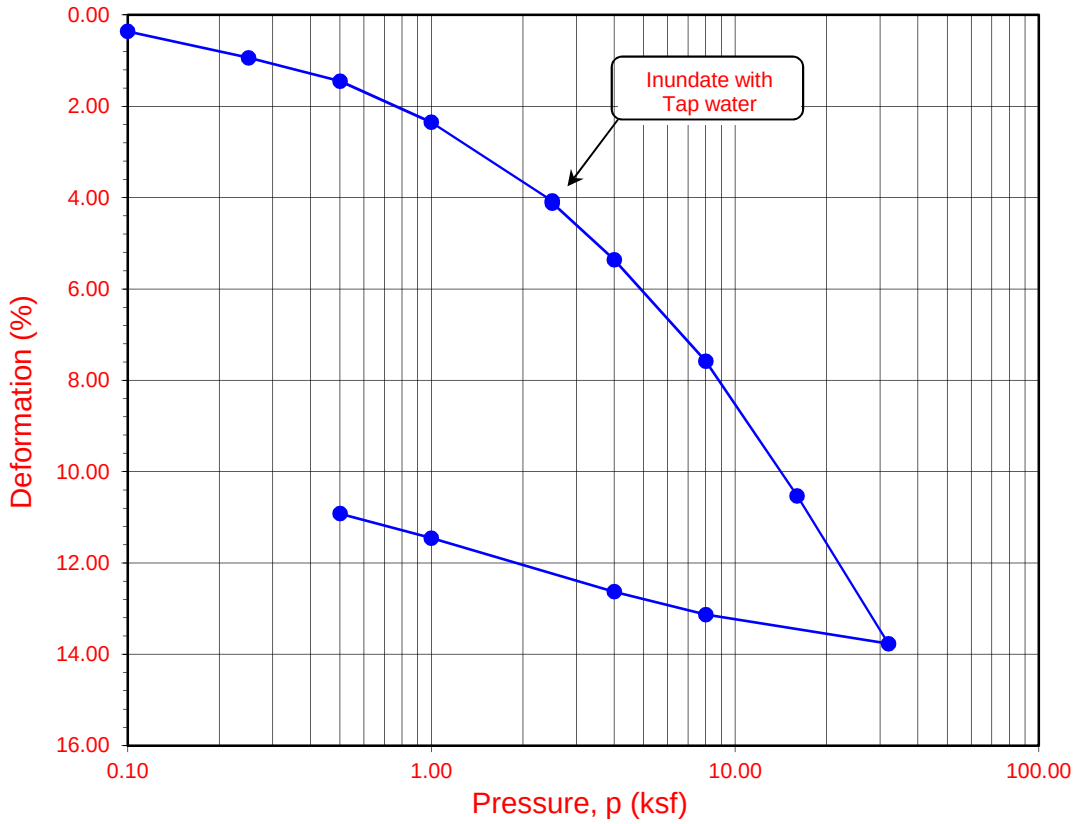
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.3011	0.9964	0.00	0.36	0.748	0.36
0.25	0.2950	0.9903	0.03	0.97	0.738	0.94
0.50	0.2896	0.9849	0.06	1.51	0.729	1.45
1.00	0.2800	0.9753	0.12	2.47	0.713	2.35
2.50	0.2615	0.9568	0.25	4.33	0.683	4.08
2.50	0.2610	0.9563	0.25	4.37	0.682	4.12
4.00	0.2476	0.9429	0.35	5.71	0.660	5.36
8.00	0.2236	0.9189	0.53	8.11	0.621	7.58
16.00	0.1920	0.8873	0.74	11.27	0.569	10.53
32.00	0.1572	0.8525	0.98	14.75	0.513	13.77
8.00	0.1660	0.8613	0.74	13.87	0.524	13.13
4.00	0.1719	0.8672	0.65	13.28	0.532	12.63
1.00	0.1849	0.8802	0.53	11.99	0.553	11.46
0.50	0.1905	0.8858	0.50	11.42	0.562	10.92

Time Readings

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

Time Readings





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
HS-3	**R-4**	**20.0**	**25.9**	**20.7**	**100.4**	**111.3**	**0.754**	**0.562**	**97**	**100**

Soil Identification: Olive gray and brown clay (CL)

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 19063-01

Santa Ana

Appendix D
Infiltration Test Results

Infiltration Test Data Sheet

LGC Geotechnical, Inc

131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141

Project Name: The Bowery - Santa Ana
Project Number: 19063-01
Date: 5/8/2019
Boring Number: I-1

Test hole dimensions (if circular)	
Boring Depth (feet)*:	5
Boring Diameter (inches):	8
Pipe Diameter (inches):	2.75

*measured at time of test

Test pit dimensions (if rectangular)	
Pit Depth (feet):	
Pit Length (feet):	
Pit Breadth (feet):	

Minimum test Head (D_o):

(What the sounder tape should read) Boring Depth - (5 x Boring Radius) 3.4 ft

(Shallow) The value on the sounder tape should be close to this value during testing for **DEEP** testing fill to 4 feet below top of hole

*Pre-Test (Sandy Soil Criteria)**

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval (min)	Initial Depth to Water (feet)	Final Depth to Water (feet)	Total Change in Water Level (feet)	Greater Than or Equal to 0.5 feet (yes/no)
1	7:56	8:21	25.0	2.98	3.11	0.13	no
2	8:21	8:46	25.0	3.11	3.25	0.14	no

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

Main Test Data

Trial No.	Start Time (24:HR)	Stop Time (24:HR)	Time Interval, Δt (min)	Initial Depth to Water, D_o (feet)	Final Depth to Water, D_f (feet)	Change in Water Level, ΔD (feet)	Calculated Infiltration Rate(in/hr)
1	8:47	9:17	30.0	2.91	3.05	0.14	0.26
2	9:17	9:46	29.0	3.05	3.2	0.15	0.30
3	9:47	10:17	30.0	2.88	3.03	0.15	0.27
4	10:17	10:47	30.0	3.03	3.19	0.16	0.31
5	10:48	11:18	30.0	2.95	3.1	0.15	0.28
6	11:18	11:48	30.0	2.96	3.12	0.16	0.30
7	11:48	12:18	30.0	3.12	3.28	0.16	0.33
8	12:19	12:49	30.0	2.86	3.02	0.16	0.29
9	12:49	13:19	30.0	3.02	3.19	0.17	0.33
10	13:19	13:49	30.0	2.95	3.11	0.16	0.30
11	13:50	14:20	30.0	2.97	3.13	0.16	0.30
12	14:21	14:51	30.0	2.94	3.09	0.15	0.28

Calculated Infiltration Rate (No factors of safety)	**0.28**
Factor of Safety	**2.0**
Calculated Infiltration Rate (With Factor of Safety)	**0.14**

Sketch:

Notes:

Based on Guidelines from: Orange County 12/20/2013

Spreadsheet Revised on: 10/26/2016

LGC Geotechnical, Inc.

Appendix E
Liquefaction Analysis

LIQUEFACTION EVALUATION

Based on *Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils*, Technical Report NCEER-97-0022, December 31, 1997
and *Evaluation of Settlments in Sand due to Earthquake Shaking*, Tokimatsu and Seed, 1987

Seismic Event		**Profile Constants**		**Depth to GWT**		**Project Name**	The Bowery - Santa Ana
Moment Magnitude	6.9	Total Unit Weight (lb/ft^3)	120	During Investigation (ft)	25	**Project Number**	19063-01
Peak Ground Acceleration	0.57 g	Unit Weight of Water (lbs/ft^3)	62.4	During Design Event (ft)	10	**Boring**	HS-2

Determination of Cyclic Resitance Ratio

Sampling Data					During Investigation			Sampling Correction Factors											
		Blow Count		Thickness	Total Stress	Pore Pressure	Effective	Sampler	SPT	Overburden	Energy	Borehole	Rod Length	Sampler Type		Fines			
Depth (ft)	Depth (m)	SPT	Rings	(ft)	Stress (psf)	Pressure (psf)	Stress (psf)	Diameter	N_m	C_N	C_E	C_B	C_R	C_S	$(N_1)_{60}$	Content	$(N_1)_{60cs}$	K_σ	$CRR_{7.5}$
5	1.5		22	6.25	720	0	720	0.62	13.64	1.70	1.33	1.00	0.75	1.00	23.17	80	32.80	1.000	SPT >30 NF
7.5	2.3		9	2.5	1020	0	1020	0.62	5.58	1.43	1.33	1.00	0.75	1.00	7.96	47	14.56	1.000	0.157
10	3.0		6	3.75	1320	0	1320	0.62	3.72	1.26	1.33	1.00	0.75	1.00	4.67	93	10.60	1.000	0.115
15	4.6	5		5	1920	0	1920	1.00	5.00	1.04	1.33	1.00	0.85	1.10	6.48	93	12.78	1.000	0.138
20	6.1		10	5	2520	0	2520	0.62	6.20	0.91	1.33	1.00	0.95	1.00	7.13	88	13.56	0.964	0.141
25	7.6	5		5	3120	0	3120	1.00	5.00	0.82	1.33	1.00	0.95	1.10	5.68	88	11.82	0.924	0.118
30	9.1		19	5	3720	312	3408	0.62	11.78	0.78	1.33	1.00	0.95	1.00	11.65	88	18.98	0.907	0.186
35	10.7	16		5	4320	624	3696	1.00	16.00	0.75	1.33	1.00	1.00	1.10	17.59	60	26.11	0.890	0.269
40	12.2		21	5	4920	936	3984	0.62	13.02	0.72	1.33	1.00	1.00	1.00	12.54	35	19.98	0.875	0.189
45	13.7	22		5	5520	1248	4272	1.00	22.00	0.70	1.33	1.00	1.00	1.10	22.50	35	31.91	0.860	SPT >30 NF
50	15.2		22	2.5	6120	1560	4560	0.62	13.64	0.68	1.33	1.00	1.00	1.00	12.28	60	19.73	0.846	0.180

Determination of Cyclic Stress Ratio

Sampling Data					During Design Event							
		Blow Count			Total Stress	Pore Pressure	Effective					
Depth (ft)	Depth (m)	SPT	Rings	Thickness	Stress (psf)	Pressure (psf)	Stress (psf)	r_d	CSR	MSF	FS	Depth
5	1.52		22	6.25	600	0	600	0.99024	0.366883	1.238	Above GWT	5
7.5	2.29		9	2.5	900	0	900	0.98456	0.36478	1.238	Above GWT	7.5
10	3.05		6	3.75	1200	0	1200	0.97914	0.362772	1.238	Bray Clay	10
15	4.57	5		5	1800	312	1488	0.96856	0.434094	1.238	Bray Clay	15
20	6.10		10	5	2400	624	1776	0.9569	0.479095	1.238	Bray Clay	20
25	7.62	5		5	3000	936	2064	0.94183	0.507194	1.238	Bray Clay	25
30	9.14		19	5	3600	1248	2352	0.92058	0.522052	1.238	Bray Clay	30
35	10.67	16		5	4200	1560	2640	0.89062	0.524959	1.238	Bray Clay	35
40	12.19		21	5	4800	1872	2928	0.85103	0.516899	1.238	0.45	40
45	13.72	22		5	5400	2184	3216	0.80363	0.499945	1.238	Corr. SPT>30	45
50	15.24		22	2.5	6000	2496	3504	0.75271	0.477535	1.238	0.47	50

Liquefaction-Induced Settlement Analysis

Depth	Vol. Strain (%) SP117 Fig7.11	Settlement (in.)
5.0		
7.5		
10.0		
15.0		
20.0		
25.0		
30.0		
35.0		
40.0	1.60	1.0
45.0		
50.0	1.60	0.5
	Total =	**1.4**

APPENDIX G

2-YEAR HYDROLOGY CALCULATIONS

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2016 Advanced Engineering Software (aes)
            Ver. 23.0  Release Date: 07/01/2016  License ID 1355

                          Analysis prepared by:

                            fuscoe engineering
                             16795 Von Karman
                                Suite 100
                                Irvine, CA

 ************************* DESCRIPTION OF STUDY *************************
* Red Hill & Warner                                                      *
* Hydromodification Calculations                                         *
* Existing Condition - 2-year storm event                                *
 ************************************************************************

  FILE NAME: RED2EX.DAT
  TIME/DATE OF STUDY: 14:39 04/29/2019
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ==================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<        A1
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     65.50  DOWNSTREAM(FEET) =     60.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.177
```

A1

RED2EX

```
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.840
SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
COMMERCIAL                 C        0.94      0.25      0.100    50    7.18
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
SUBAREA RUNOFF(CFS) =      1.54
TOTAL AREA(ACRES) =      0.94   PEAK FLOW RATE(CFS) =      1.54

****************************************************************************
FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     60.60  DOWNSTREAM(FEET) =     60.00
CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.0037
CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  20.000
MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.621
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 C        0.59      0.25      0.100    50
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.96
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.51
AVERAGE FLOW DEPTH(FEET) =   0.25   TRAVEL TIME(MIN.) =   1.76
Tc(MIN.) =    8.94
SUBAREA AREA(ACRES) =     0.59       SUBAREA RUNOFF(CFS) =    0.85
EFFECTIVE AREA(ACRES) =      1.53     AREA-AVERAGED Fm(INCH/HR) =   0.03
AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       2.20

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) =  0.26   FLOW VELOCITY(FEET/SEC.) =   1.58
LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     490.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =    56.00  DOWNSTREAM(FEET) =    53.00
FLOW LENGTH(FEET) =   422.00   MANNING'S N =  0.010
DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.7 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   4.91
ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =       2.20
PIPE TRAVEL TIME(MIN.) =   1.43    Tc(MIN.) =   10.37
LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     912.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
```

A2

```
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.37
  RAINFALL INTENSITY(INCH/HR) =   1.49
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.53
  TOTAL STREAM AREA(ACRES) =       1.53
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.20

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    105.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<          A3
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     65.50  DOWNSTREAM(FEET) =     60.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.120
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.848
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                  C        0.89      0.25     0.100    50    7.12
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.46
  TOTAL AREA(ACRES) =      0.89   PEAK FLOW RATE(CFS) =      1.46

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<          A4
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     60.40  DOWNSTREAM(FEET) =     60.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   101.00   CHANNEL SLOPE =  0.0020
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.670
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  C        0.75      0.25     0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.01
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.22
  AVERAGE FLOW DEPTH(FEET) =   0.29   TRAVEL TIME(MIN.) =   1.38
  Tc(MIN.) =    8.50
  SUBAREA AREA(ACRES) =     0.75       SUBAREA RUNOFF(CFS) =    1.11
  EFFECTIVE AREA(ACRES) =      1.64     AREA-AVERAGED Fm(INCH/HR) =   0.03
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        1.6         PEAK FLOW RATE(CFS) =       2.43
```

```
 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.31   FLOW VELOCITY(FEET/SEC.) =   1.26
 LONGEST FLOWPATH FROM NODE    101.00 TO NODE    106.00 =     431.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    106.00 TO NODE    104.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    55.00  DOWNSTREAM(FEET) =    53.00
 FLOW LENGTH(FEET) =   182.00   MANNING'S N =  0.010
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.94
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       2.43
 PIPE TRAVEL TIME(MIN.) =   0.51    Tc(MIN.) =    9.01
 LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     613.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<                  A5
============================================================================
 MAINLINE Tc(MIN.) =    9.01
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.615
 SUBAREA LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  C        1.08      0.25      0.100    50
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    1.08      SUBAREA RUNOFF(CFS) =    1.55
 EFFECTIVE AREA(ACRES) =      2.72   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        2.7       PEAK FLOW RATE(CFS) =       3.89

****************************************************************************
 FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    9.01
 RAINFALL INTENSITY(INCH/HR) =   1.61
 AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =       2.72
 TOTAL STREAM AREA(ACRES) =       2.72
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.89

 ** CONFLUENCE DATA **
  STREAM       Q      Tc    Intensity   Fp(Fm)     Ap      Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        2.20   10.37    1.489  0.25( 0.03) 0.10       1.5     101.00
     2        3.89    9.01    1.615  0.25( 0.03) 0.10       2.7     101.00
```

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc    Intensity   Fp(Fm)     Ap      Ae      HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
      1        5.96    9.01    1.615  0.25( 0.02) 0.10        4.0      101.00
      2        5.78   10.37    1.489  0.25( 0.03) 0.10        4.2      101.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.96    Tc(MIN.) =     9.01
  EFFECTIVE AREA(ACRES) =       4.05   AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        4.2
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    104.00 =     912.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    53.00  DOWNSTREAM(FEET) =    52.00
  FLOW LENGTH(FEET) =   184.00   MANNING'S N =  0.010
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.70
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.96
  PIPE TRAVEL TIME(MIN.) =   0.54    Tc(MIN.) =    9.55
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    107.00 =    1096.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.55
  RAINFALL INTENSITY(INCH/HR) =   1.56
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       4.05
  TOTAL STREAM AREA(ACRES) =       4.25
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.96

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    109.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     61.50  DOWNSTREAM(FEET) =     59.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.674
```

A6

A6

RED2EX

```
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.650
SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
COMMERCIAL                 C        1.01      0.25      0.100    50    8.67
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
SUBAREA RUNOFF(CFS) =      1.48
TOTAL AREA(ACRES) =      1.01   PEAK FLOW RATE(CFS) =      1.48

****************************************************************************
FLOW PROCESS FROM NODE    109.00 TO NODE    110.00 IS CODE =  51
----------------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<                A7
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     59.60  DOWNSTREAM(FEET) =     57.60
CHANNEL LENGTH THRU SUBAREA(FEET) =   634.00   CHANNEL SLOPE =  0.0032
CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  20.000
MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.173
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 C        1.84      0.25      0.100    50
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.44
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.50
AVERAGE FLOW DEPTH(FEET) =   0.29   TRAVEL TIME(MIN.) =   7.05
Tc(MIN.) =   15.72
SUBAREA AREA(ACRES) =     1.84       SUBAREA RUNOFF(CFS) =    1.90
EFFECTIVE AREA(ACRES) =      2.85     AREA-AVERAGED Fm(INCH/HR) =   0.03
AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
TOTAL AREA(ACRES) =        2.8         PEAK FLOW RATE(CFS) =       2.94

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) =  0.30   FLOW VELOCITY(FEET/SEC.) =   1.61
LONGEST FLOWPATH FROM NODE    108.00 TO NODE    110.00 =     964.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE    110.00 TO NODE    111.00 IS CODE =  51
----------------------------------------------------------------------------
>>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
>>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<                A8
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =     57.60  DOWNSTREAM(FEET) =     56.90
CHANNEL LENGTH THRU SUBAREA(FEET) =   313.00   CHANNEL SLOPE =  0.0022
CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  20.000
MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.042
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 C        1.14      0.25      0.100    50
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.47
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.45
```

A8

```
 AVERAGE FLOW DEPTH(FEET) =   0.35   TRAVEL TIME(MIN.) =   3.61
 Tc(MIN.) =   19.33
 SUBAREA AREA(ACRES) =     1.14       SUBAREA RUNOFF(CFS) =    1.04
 EFFECTIVE AREA(ACRES) =      3.99     AREA-AVERAGED Fm(INCH/HR) =   0.03
 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
 TOTAL AREA(ACRES) =        4.0         PEAK FLOW RATE(CFS) =       3.65

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.35   FLOW VELOCITY(FEET/SEC.) =   1.46
 LONGEST FLOWPATH FROM NODE    108.00 TO NODE    111.00 =    1277.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    111.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    54.00  DOWNSTREAM(FEET) =    52.00
 FLOW LENGTH(FEET) =   192.00   MANNING'S N =  0.010
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.36
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       3.65
 PIPE TRAVEL TIME(MIN.) =   0.50    Tc(MIN.) =   19.83
 LONGEST FLOWPATH FROM NODE    108.00 TO NODE    107.00 =    1469.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   19.83
 RAINFALL INTENSITY(INCH/HR) =   1.03
 AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =       3.99
 TOTAL STREAM AREA(ACRES) =       3.99
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.65

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        5.96    9.55    1.562  0.25( 0.02) 0.10       4.0     101.00
     1        5.78   10.93    1.445  0.25( 0.03) 0.10       4.2     101.00
     2        3.65   19.83    1.026  0.25( 0.03) 0.10       4.0     108.00

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

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        8.66    9.55    1.562  0.25( 0.02) 0.10       6.0     101.00
     2        8.64   10.93    1.445  0.25( 0.03) 0.10       6.4     101.00
     3        7.73   19.83    1.026  0.25( 0.03) 0.10       8.2     108.00
```

```
 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       8.66    Tc(MIN.) =     9.55
 EFFECTIVE AREA(ACRES) =       5.97   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        8.2
 LONGEST FLOWPATH FROM NODE    108.00 TO NODE    107.00 =    1469.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    107.00 TO NODE    112.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    52.00  DOWNSTREAM(FEET) =    50.00
 FLOW LENGTH(FEET) =   206.00   MANNING'S N =  0.010
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.76
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       8.66
 PIPE TRAVEL TIME(MIN.) =   0.44    Tc(MIN.) =    9.99
 LONGEST FLOWPATH FROM NODE    108.00 TO NODE    112.00 =    1675.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    112.00 TO NODE    112.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    9.99
 RAINFALL INTENSITY(INCH/HR) =   1.52
 AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =       5.97
 TOTAL STREAM AREA(ACRES) =       8.24
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       8.66

****************************************************************************
 FLOW PROCESS FROM NODE    113.00 TO NODE    107.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
 ELEVATION DATA: UPSTREAM(FEET) =     61.20  DOWNSTREAM(FEET) =     59.10

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.502
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.669
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 C        1.39      0.25      0.100    50    8.50
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      2.06
 TOTAL AREA(ACRES) =      1.39   PEAK FLOW RATE(CFS) =      2.06
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     107.00 TO NODE     112.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     59.10  DOWNSTREAM(FEET) =     57.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   206.00   CHANNEL SLOPE =  0.0058
  CHANNEL BASE(FEET) =    0.00   "Z" FACTOR =  20.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.492
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        0.57      0.25      0.100    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.43
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.88
  AVERAGE FLOW DEPTH(FEET) =   0.25   TRAVEL TIME(MIN.) =   1.83
  Tc(MIN.) =   10.33
  SUBAREA AREA(ACRES) =     0.57       SUBAREA RUNOFF(CFS) =    0.75
  EFFECTIVE AREA(ACRES) =      1.96     AREA-AVERAGED Fm(INCH/HR) =   0.02
  AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        2.0         PEAK FLOW RATE(CFS) =       2.59

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.26   FLOW VELOCITY(FEET/SEC.) =   1.97
  LONGEST FLOWPATH FROM NODE    113.00 TO NODE    112.00 =     536.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     112.00 TO NODE     112.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.33
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.492
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "GRASS"                    C        0.66      0.25      1.000    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    0.66      SUBAREA RUNOFF(CFS) =    0.74
  EFFECTIVE AREA(ACRES) =      2.62   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.33
  TOTAL AREA(ACRES) =        2.6       PEAK FLOW RATE(CFS) =       3.33

****************************************************************************
  FLOW PROCESS FROM NODE     112.00 TO NODE     112.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.33
```

```
 RAINFALL INTENSITY(INCH/HR) =   1.49
 AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.33
 EFFECTIVE STREAM AREA(ACRES) =       2.62
 TOTAL STREAM AREA(ACRES) =       2.62
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.33

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        8.66    9.99    1.522  0.25( 0.02) 0.10       6.0     101.00
     1        8.64   11.38    1.412  0.25( 0.03) 0.10       6.4     101.00
     1        7.73   20.30    1.013  0.25( 0.03) 0.10       8.2     108.00
     2        3.33   10.33    1.492  0.25( 0.08) 0.33       2.6     113.00

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

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1       11.94    9.99    1.522  0.25( 0.04) 0.17       8.5     101.00
     2       11.98   10.33    1.492  0.25( 0.04) 0.17       8.7     113.00
     3       11.77   11.38    1.412  0.25( 0.04) 0.17       9.1     101.00
     4        9.93   20.30    1.013  0.25( 0.04) 0.15      10.9     108.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      11.98    Tc(MIN.) =    10.33
 EFFECTIVE AREA(ACRES) =       8.71   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.17
 TOTAL AREA(ACRES) =       10.9
 LONGEST FLOWPATH FROM NODE    108.00 TO NODE    112.00 =    1675.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    112.00 TO NODE    112.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE    114.00 TO NODE    115.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
 ELEVATION DATA: UPSTREAM(FEET) =     64.60  DOWNSTREAM(FEET) =     60.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   22.355
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  0.958
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL GOOD COVER
 "GRASS"                     C        1.50      0.25      1.000     56   22.35
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
```

A12


```
  SUBAREA RUNOFF(CFS) =      0.96
  TOTAL AREA(ACRES) =      1.50   PEAK FLOW RATE(CFS) =      0.96

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    115.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   22.35
  RAINFALL INTENSITY(INCH/HR) =   0.96
  AREA-AVERAGED Fm(INCH/HR) =  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =       1.50
  TOTAL STREAM AREA(ACRES) =       1.50
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.96

****************************************************************************
  FLOW PROCESS FROM NODE    116.00 TO NODE    115.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
```

A13

```
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   273.00
  ELEVATION DATA: UPSTREAM(FEET) =     61.50  DOWNSTREAM(FEET) =     60.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.116
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.714
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 C        0.36      0.25     0.100    50    8.12
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.55
  TOTAL AREA(ACRES) =      0.36   PEAK FLOW RATE(CFS) =      0.55

****************************************************************************
  FLOW PROCESS FROM NODE    115.00 TO NODE    115.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.12
  RAINFALL INTENSITY(INCH/HR) =   1.71
  AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       0.36
  TOTAL STREAM AREA(ACRES) =       0.36
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.55

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
```

```
                                                    RED2EX
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
    1        0.96   22.35    0.958  0.25( 0.25) 1.00       1.5     114.00
    2        0.55    8.12    1.714  0.25( 0.03) 0.10       0.4     116.00

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

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
    1        1.26    8.12    1.714  0.25( 0.16) 0.64       0.9     116.00
    2        1.26   22.35    0.958  0.25( 0.21) 0.83       1.9     114.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       1.26    Tc(MIN.) =     8.12
 EFFECTIVE AREA(ACRES) =       0.90   AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.64
 TOTAL AREA(ACRES) =        1.9
 LONGEST FLOWPATH FROM NODE    114.00 TO NODE    115.00 =     330.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    115.00 TO NODE    117.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    53.00  DOWNSTREAM(FEET) =    51.00
 FLOW LENGTH(FEET) =   174.00   MANNING'S N =  0.010
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.13
 ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.26
 PIPE TRAVEL TIME(MIN.) =   0.57    Tc(MIN.) =    8.68
 LONGEST FLOWPATH FROM NODE    114.00 TO NODE    117.00 =     504.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    117.00 TO NODE    117.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.68
 RAINFALL INTENSITY(INCH/HR) =   1.65
 AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.64
 EFFECTIVE STREAM AREA(ACRES) =       0.90
 TOTAL STREAM AREA(ACRES) =       1.86
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.26

****************************************************************************
 FLOW PROCESS FROM NODE    118.00 TO NODE    117.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   272.00
 ELEVATION DATA: UPSTREAM(FEET) =     62.30  DOWNSTREAM(FEET) =     58.50
```

```
 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.724
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.910
 SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 C        0.80      0.25      0.100    50    6.72
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      1.36
 TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      1.36

****************************************************************************
 FLOW PROCESS FROM NODE    117.00 TO NODE    117.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    6.72
 RAINFALL INTENSITY(INCH/HR) =   1.91
 AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =       0.80
 TOTAL STREAM AREA(ACRES) =       0.80
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.36

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        1.26    8.68    1.649  0.25( 0.16) 0.64       0.9     116.00
     1        1.26   22.92    0.945  0.25( 0.21) 0.83       1.9     114.00
     2        1.36    6.72    1.910  0.25( 0.03) 0.10       0.8     118.00

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

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        2.51    6.72    1.910  0.25( 0.09) 0.35       1.5     118.00
     2        2.43    8.68    1.649  0.25( 0.10) 0.39       1.7     116.00
     3        1.92   22.92    0.945  0.25( 0.15) 0.61       2.7     114.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       2.51    Tc(MIN.) =     6.72
 EFFECTIVE AREA(ACRES) =       1.50   AREA-AVERAGED Fm(INCH/HR) =  0.09
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.35
 TOTAL AREA(ACRES) =        2.7
 LONGEST FLOWPATH FROM NODE    114.00 TO NODE    117.00 =     504.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE    117.00 TO NODE    112.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    51.00  DOWNSTREAM(FEET) =    50.00
  FLOW LENGTH(FEET) =    86.00   MANNING'S N =  0.010
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.12
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.51
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    6.96
  LONGEST FLOWPATH FROM NODE    114.00 TO NODE    112.00 =     590.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    112.00 TO NODE    112.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
==============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.51    6.96    1.872  0.25( 0.09) 0.35       1.5     118.00
      2        2.43    8.92    1.624  0.25( 0.10) 0.39       1.7     116.00
      3        1.92   23.18    0.939  0.25( 0.15) 0.61       2.7     114.00
  LONGEST FLOWPATH FROM NODE    114.00 TO NODE    112.00 =     590.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       11.94    9.99    1.522  0.25( 0.04) 0.17       8.5     101.00
      2       11.98   10.33    1.492  0.25( 0.04) 0.17       8.7     113.00
      3       11.77   11.38    1.412  0.25( 0.04) 0.17       9.1     101.00
      4        9.93   20.30    1.013  0.25( 0.04) 0.15      10.9     108.00
  LONGEST FLOWPATH FROM NODE    108.00 TO NODE    112.00 =    1675.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.80    6.96    1.872  0.25( 0.05) 0.21       7.4     118.00
      2       13.84    8.92    1.624  0.25( 0.05) 0.21       9.3     116.00
      3       14.34    9.99    1.522  0.25( 0.05) 0.21      10.3     101.00
      4       14.36   10.33    1.492  0.25( 0.05) 0.21      10.5     113.00
      5       14.12   11.38    1.412  0.25( 0.05) 0.21      10.9     101.00
      6       11.95   20.30    1.013  0.25( 0.06) 0.23      13.3     108.00
      7       11.09   23.18    0.939  0.25( 0.06) 0.24      13.5     114.00
    TOTAL AREA(ACRES) =        13.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       14.36  Tc(MIN.) =   10.332
  EFFECTIVE AREA(ACRES) =     10.51  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.21
  TOTAL AREA(ACRES) =       13.5
  LONGEST FLOWPATH FROM NODE    108.00 TO NODE    112.00 =    1675.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1000.00 TO NODE   1000.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   10.33
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.492
```

A15 & A16 (to Warner)

RED2EX

SUBAREA LOSS RATE DATA(AMC I):

DEVELOPMENT TYPE/ LAND USE		SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN
NATURAL GOOD COVER "GRASS"	A15	C	0.10	0.25	1.000	56
NATURAL GOOD COVER "GRASS"	A16	C	0.52	0.25	1.000	56

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA AREA(ACRES) = 0.62 SUBAREA RUNOFF(CFS) = 0.69
EFFECTIVE AREA(ACRES) = 11.13 AREA-AVERAGED Fm(INCH/HR) = 0.06
AREA-AVERAGED Fp(INCH/HR) = 0.25 AREA-AVERAGED Ap = 0.25
TOTAL AREA(ACRES) = 14.1 PEAK FLOW RATE(CFS) = 14.36
NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

****

FLOW PROCESS FROM NODE 1000.00 TO NODE 1000.00 IS CODE = 81

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

A17 & A18 (to Red Hill)

==========

MAINLINE Tc(MIN.) = 10.33
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 1.492

SUBAREA LOSS RATE DATA(AMC I):

DEVELOPMENT TYPE/ LAND USE		SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN
NATURAL GOOD COVER "GRASS"	A17	C	0.39	0.25	1.000	56
NATURAL GOOD COVER "GRASS"	A18	C	0.16	0.25	1.000	56

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA AREA(ACRES) = 0.55 SUBAREA RUNOFF(CFS) = 0.62
EFFECTIVE AREA(ACRES) = 11.68 AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.25 AREA-AVERAGED Ap = 0.29
TOTAL AREA(ACRES) = 14.7 PEAK FLOW RATE(CFS) = 14.93

==========

END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 14.7 TC(MIN.) = 10.33
EFFECTIVE AREA(ACRES) = 11.68 AREA-AVERAGED Fm(INCH/HR)= 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.25 AREA-AVERAGED Ap = 0.289
PEAK FLOW RATE(CFS) = 14.93

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	13.88	6.96	1.872	0.25(0.08)	0.31	8.6	118.00
2	14.60	8.92	1.624	0.25(0.07)	0.30	10.5	116.00
3	14.93	9.99	1.522	0.25(0.07)	0.29	11.4	101.00
4	14.93	10.33	1.492	0.25(0.07)	0.29	11.7	113.00
5	14.61	11.38	1.412	0.25(0.07)	0.29	12.1	101.00
6	12.26	20.30	1.013	0.25(0.07)	0.29	14.5	108.00
7	11.40	23.18	0.939	0.25(0.08)	0.30	14.7	114.00

==========

==========

END OF RATIONAL METHOD ANALYSIS

```
**************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==========================================================================
         (C) Copyright 1989-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1355

                          Analysis prepared by:

                            fuscoe engineering
                             16795 Von Karman
                                Suite 100
                                Irvine, CA

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  Red Hill & Warner
  Hydromodification Calculations
  Existing Condition - 2-year Hydrograph
==========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1         14.69       28.90       69.(AMC II)     0.250       0.633

    TOTAL AREA (Acres) =     14.69

                                  _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.072

                                  _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.367
==========================================================================

 Problem Descriptions:
  Red Hill & Warner
  Hydromodification Calculations (calibration coefficient: 0.716 )
  Existing Condition - 2-year Hydrograph
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.72
    TOTAL CATCHMENT AREA(ACRES) =   14.69
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.072
    LOW LOSS FRACTION = 0.367
    TIME OF CONCENTRATION(MIN.) = 10.33
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05
```

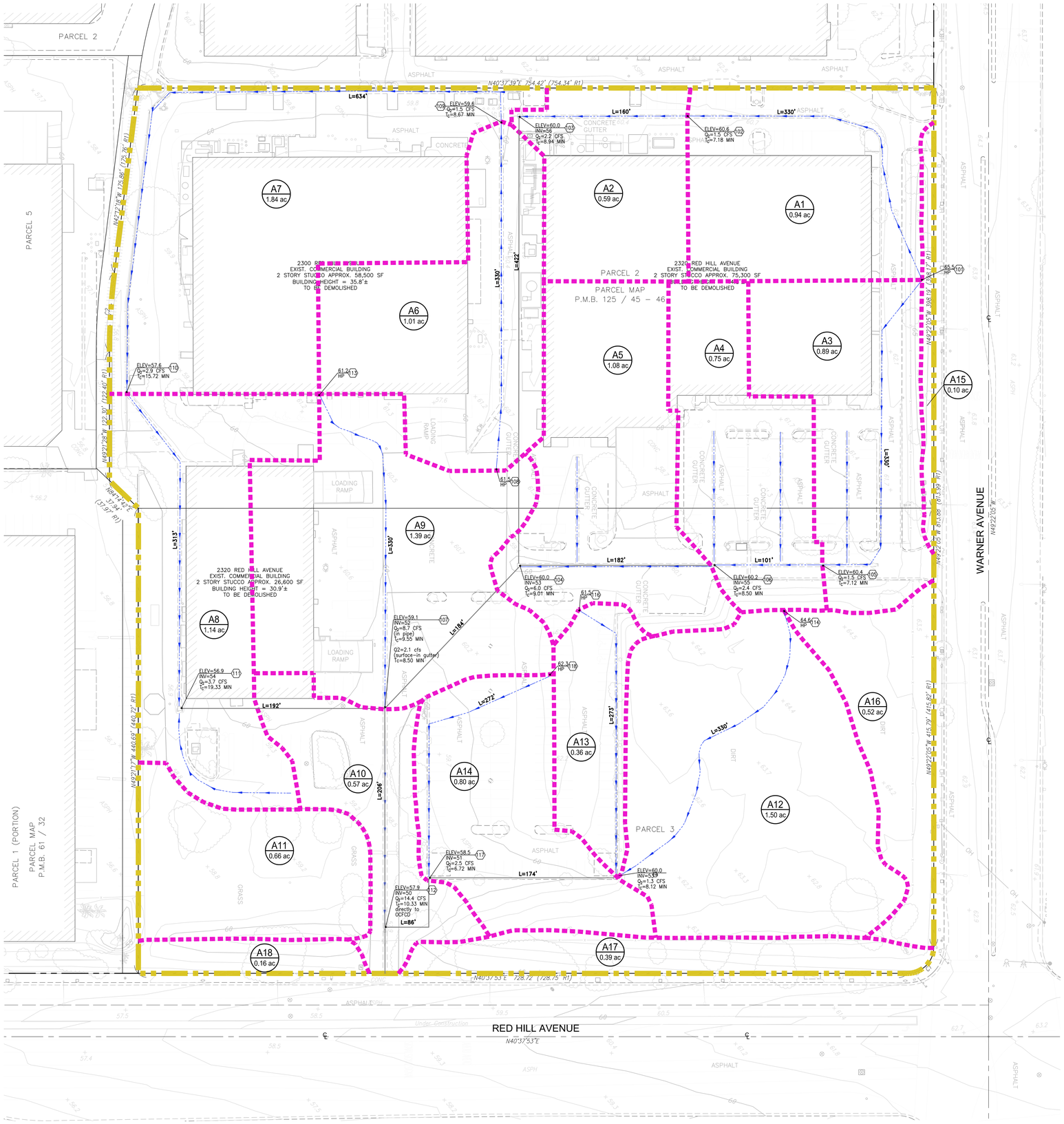
```
--------------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.24
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     1.27

********************************************************************************
  TIME      VOLUME        Q    0.         5.0       10.0       15.0       20.0
 (HOURS)     (AF)       (CFS)
--------------------------------------------------------------------------------
  0.16      0.0015      0.21  Q          .          .          .          .
  0.33      0.0046      0.21  Q          .          .          .          .
  0.51      0.0076      0.22  Q          .          .          .          .
  0.68      0.0107      0.22  Q          .          .          .          .
  0.85      0.0138      0.22  Q          .          .          .          .
  1.02      0.0169      0.22  Q          .          .          .          .
  1.19      0.0201      0.22  Q          .          .          .          .
  1.37      0.0233      0.22  Q          .          .          .          .
  1.54      0.0265      0.23  Q          .          .          .          .
  1.71      0.0297      0.23  Q          .          .          .          .
  1.88      0.0329      0.23  Q          .          .          .          .
  2.05      0.0362      0.23  Q          .          .          .          .
  2.23      0.0395      0.23  Q          .          .          .          .
  2.40      0.0428      0.23  Q          .          .          .          .
  2.57      0.0461      0.24  Q          .          .          .          .
  2.74      0.0495      0.24  Q          .          .          .          .
  2.92      0.0529      0.24  Q          .          .          .          .
  3.09      0.0563      0.24  Q          .          .          .          .
  3.26      0.0598      0.24  Q          .          .          .          .
  3.43      0.0633      0.25  Q          .          .          .          .
  3.60      0.0668      0.25  Q          .          .          .          .
  3.78      0.0703      0.25  Q          .          .          .          .
  3.95      0.0739      0.25  Q          .          .          .          .
  4.12      0.0775      0.25  Q          .          .          .          .
  4.29      0.0812      0.26  Q          .          .          .          .
  4.46      0.0848      0.26  Q          .          .          .          .
  4.64      0.0885      0.26  Q          .          .          .          .
  4.81      0.0923      0.26  Q          .          .          .          .
  4.98      0.0960      0.27  Q          .          .          .          .
  5.15      0.0999      0.27  Q          .          .          .          .
  5.33      0.1037      0.27  Q          .          .          .          .
  5.50      0.1076      0.28  Q          .          .          .          .
  5.67      0.1115      0.28  Q          .          .          .          .
  5.84      0.1155      0.28  Q          .          .          .          .
  6.01      0.1195      0.28  Q          .          .          .          .
  6.19      0.1236      0.29  Q          .          .          .          .
  6.36      0.1277      0.29  Q          .          .          .          .
  6.53      0.1318      0.29  Q          .          .          .          .
  6.70      0.1360      0.30  Q          .          .          .          .
  6.88      0.1402      0.30  Q          .          .          .          .
  7.05      0.1445      0.30  Q          .          .          .          .
  7.22      0.1489      0.31  Q          .          .          .          .
  7.39      0.1533      0.31  Q          .          .          .          .
  7.56      0.1577      0.32  Q          .          .          .          .
  7.74      0.1622      0.32  Q          .          .          .          .
  7.91      0.1668      0.32  Q          .          .          .          .
  8.08      0.1714      0.33  Q          .          .          .          .
  8.25      0.1761      0.33  Q          .          .          .          .
  8.42      0.1808      0.34  Q          .          .          .          .
  8.60      0.1856      0.34  Q          .          .          .          .
  8.77      0.1905      0.34  Q          .          .          .          .
  8.94      0.1955      0.35  Q          .          .          .          .
```

9.11	0.2005	0.36	Q . . . .
9.29	0.2056	0.36	Q . . . .
9.46	0.2108	0.37	Q . . . .
9.63	0.2161	0.37	Q . . . .
9.80	0.2214	0.38	Q . . . .
9.97	0.2269	0.39	Q . . . .
10.15	0.2324	0.39	Q . . . .
10.32	0.2381	0.40	Q . . . .
10.49	0.2438	0.41	Q . . . .
10.66	0.2497	0.42	Q . . . .
10.84	0.2557	0.42	Q . . . .
11.01	0.2618	0.43	Q . . . .
11.18	0.2680	0.44	Q . . . .
11.35	0.2744	0.45	Q . . . .
11.52	0.2809	0.46	Q . . . .
11.70	0.2876	0.48	Q . . . .
11.87	0.2944	0.48	Q . . . .
12.04	0.3014	0.50	.Q . . . .
12.21	0.3093	0.60	.Q . . . .
12.38	0.3181	0.64	.Q . . . .
12.56	0.3273	0.65	.Q . . . .
12.73	0.3367	0.67	.Q . . . .
12.90	0.3464	0.69	.Q . . . .
13.07	0.3564	0.72	.Q . . . .
13.25	0.3667	0.73	.Q . . . .
13.42	0.3773	0.76	.Q . . . .
13.59	0.3883	0.78	.Q . . . .
13.76	0.3997	0.82	.Q . . . .
13.93	0.4116	0.85	.Q . . . .
14.11	0.4241	0.91	.Q . . . .
14.28	0.4374	0.96	.Q . . . .
14.45	0.4515	1.03	. Q . . . .
14.62	0.4664	1.07	. Q . . . .
14.79	0.4822	1.16	. Q . . . .
14.97	0.4992	1.22	. Q . . . .
15.14	0.5178	1.39	. Q . . . .
15.31	0.5387	1.54	. Q . . . .
15.48	0.5614	1.65	. Q . . . .
15.66	0.5865	1.88	. Q . . . .
15.83	0.6218	3.08	. Q . . . .
16.00	0.6756	4.48	. Q . . . .
16.17	0.8137	14.93	. . . Q. .
16.34	0.9364	2.31	. Q . . . .
16.52	0.9651	1.72	. Q . . . .
16.69	0.9864	1.28	. Q . . . .
16.86	1.0035	1.11	. Q . . . .
17.03	1.0184	0.99	.Q . . . .
17.21	1.0317	0.87	.Q . . . .
17.38	1.0436	0.80	.Q . . . .
17.55	1.0546	0.75	.Q . . . .
17.72	1.0649	0.70	.Q . . . .
17.89	1.0746	0.66	.Q . . . .
18.07	1.0838	0.63	.Q . . . .
18.24	1.0918	0.49	Q . . . .
18.41	1.0986	0.47	Q . . . .
18.58	1.1051	0.45	Q . . . .
18.75	1.1114	0.43	Q . . . .
18.93	1.1173	0.41	Q . . . .
19.10	1.1231	0.40	Q . . . .
19.27	1.1286	0.38	Q . . . .
19.44	1.1340	0.37	Q . . . .

19.62	1.1392	0.36	Q	.	.	.	.
19.79	1.1442	0.35	Q	.	.	.	.
19.96	1.1491	0.34	Q	.	.	.	.
20.13	1.1539	0.33	Q	.	.	.	.
20.30	1.1585	0.32	Q	.	.	.	.
20.48	1.1630	0.31	Q	.	.	.	.
20.65	1.1674	0.30	Q	.	.	.	.
20.82	1.1717	0.30	Q	.	.	.	.
20.99	1.1759	0.29	Q	.	.	.	.
21.17	1.1800	0.28	Q	.	.	.	.
21.34	1.1840	0.28	Q	.	.	.	.
21.51	1.1879	0.27	Q	.	.	.	.
21.68	1.1917	0.27	Q	.	.	.	.
21.85	1.1955	0.26	Q	.	.	.	.
22.03	1.1992	0.26	Q	.	.	.	.
22.20	1.2029	0.25	Q	.	.	.	.
22.37	1.2064	0.25	Q	.	.	.	.
22.54	1.2100	0.24	Q	.	.	.	.
22.71	1.2134	0.24	Q	.	.	.	.
22.89	1.2168	0.24	Q	.	.	.	.
23.06	1.2202	0.23	Q	.	.	.	.
23.23	1.2234	0.23	Q	.	.	.	.
23.40	1.2267	0.23	Q	.	.	.	.
23.58	1.2299	0.22	Q	.	.	.	.
23.75	1.2330	0.22	Q	.	.	.	.
23.92	1.2361	0.22	Q	.	.	.	.
24.09	1.2392	0.21	Q	.	.	.	.
24.26	1.2407	0.00	Q	.	.	.	.

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%	1446.2
10%	82.6
20%	31.0
30%	10.3
40%	10.3
50%	10.3
60%	10.3
70%	10.3
80%	10.3
90%	10.3



EXISTING CONDITION 2-YEAR STORM EVENT			
AREA (AC)	Q (CFS)	T_C (MIN)	VOLUME (AC–FT)
14.69	14.9 (total) 14.4 (directly to OCFCD)	10.33	1.241

ASSESSOR PARCEL NO.

430–222–07 & 16

SITE ADDRESS

2300, 2310 & 2320 RED HILL AVENUE
SANTA ANA, CALIFORNIA

APPLICANT/OWNER

VDC
240 NEWPORT CENTER DRIVE, SUITE 200
NEWPORT BEACH, CA 92660
TEL: 310.571.8227

CIVIL ENGINEER

FUSCOE ENGINEERING
16795 VON KARMAN, SUITE 100
IRVINE, CA 92606
TEL: 949.474.1960
FAX: 949.474.5315

ABBREVATIONS

AC	ACRE
AC–FT	ACRE–FOOT
CFS	CUBIC FEET PER SECOND
ELEV	ELEVATION
HP	HIGH POINT
L	LENGTH
MIN	MINUTES
Q_2	FLOW RATE – 2–YEAR STORM
S	SLOPE
T_C	TIME OF CONCENTRATION

LEGEND

- DRAINAGE BOUNDARY
- DRAINAGE SUB–BOUNDARY
- XX — NODE
- L=XXX' — TIME OF CONCENTRATION FLOW PATH / FLOW PATH LENGTH
- XX / X.XXac — DRAINAGE BOUNDARY DESIGNATION AND AREA

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

PREPARED BY:
FUSCOE ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 ◦ fax 949.474.5315
www.fuscoe.com

HYDROLOGY MAP
EXISTING CONDITION
2-YEAR STORM EVENT
RED HILL & WARNER APARTMENTS
CITY OF SANTA ANA, CALIFORNIA

PROJECT NO. 1719.001
SHEET 1 OF 1

201X–XX–XX | CITY OF SANTA ANA – RED HILL & WARNER APARTMENTS – EXISTING HYDROLOGY MAP – 2–YEAR | PLAN SET: X

F:\PROJECTS\1154\003_SUPPORT FILES\REPORTS\HYDROLOGY_SUPPORTING DOCUMENTS\HYDROLOGY MAP\1154–003HYD EX2YR.DWG (04–30–19 1:42:26PM) Plotted by: Susan Williams

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2016 Advanced Engineering Software (aes)
            Ver. 23.0  Release Date: 07/01/2016  License ID 1355

                        Analysis prepared by:

                          fuscoe engineering
                           16795 Von Karman
                              Suite 100
                              Irvine, CA

 ************************* DESCRIPTION OF STUDY *************************
* Red Hill & Warner                                                     *
* Hydromodification Calculations                                        *
* Proposed Condition - 2-year storm event                               *
 ************************************************************************

  FILE NAME: RED2PR.DAT
  TIME/DATE OF STUDY: 09:55 04/30/2019
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     65.00  DOWNSTREAM(FEET) =     63.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.692
```

```
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.548
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 C        0.68      0.25     0.200    50    9.69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.92
  TOTAL AREA(ACRES) =      0.68   PEAK FLOW RATE(CFS) =      0.92

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.69
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.548
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        0.85      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.85      SUBAREA RUNOFF(CFS) =    1.15
  EFFECTIVE AREA(ACRES) =      1.53   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.5       PEAK FLOW RATE(CFS) =       2.06

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    56.00  DOWNSTREAM(FEET) =    54.00
  FLOW LENGTH(FEET) =   297.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.88
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.06
  PIPE TRAVEL TIME(MIN.) =   1.28    Tc(MIN.) =   10.97
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     627.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.97
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.442
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        0.93      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.93      SUBAREA RUNOFF(CFS) =    1.17
  EFFECTIVE AREA(ACRES) =      2.46   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
```

```
  TOTAL AREA(ACRES) =        2.5       PEAK FLOW RATE(CFS) =       3.08

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.97
  RAINFALL INTENSITY(INCH/HR) =   1.44
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       2.46
  TOTAL STREAM AREA(ACRES) =       2.46
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.08

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    104.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     65.00  DOWNSTREAM(FEET) =     63.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.692
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.548
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 C        0.51      0.25     0.200    50    9.69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.69
  TOTAL AREA(ACRES) =      0.51   PEAK FLOW RATE(CFS) =      0.69

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    103.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    56.00  DOWNSTREAM(FEET) =    54.00
  FLOW LENGTH(FEET) =   313.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.90
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.69
  PIPE TRAVEL TIME(MIN.) =   1.80    Tc(MIN.) =   11.49
  LONGEST FLOWPATH FROM NODE    101.00 TO NODE    103.00 =     643.00 FEET.

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

```
  MAINLINE Tc(MIN.) =   11.49
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.404
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        0.49      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.49      SUBAREA RUNOFF(CFS) =    0.60
  EFFECTIVE AREA(ACRES) =      1.00   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       1.22

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.49
  RAINFALL INTENSITY(INCH/HR) =   1.40
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.00
  TOTAL STREAM AREA(ACRES) =       1.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.22

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =     65.00  DOWNSTREAM(FEET) =     63.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.692
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.548
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 C        0.32      0.25     0.200    50    9.69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.43
  TOTAL AREA(ACRES) =      0.32   PEAK FLOW RATE(CFS) =      0.43

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    103.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    56.00  DOWNSTREAM(FEET) =    54.00
  FLOW LENGTH(FEET) =   407.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   3.9 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.33
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.43
  PIPE TRAVEL TIME(MIN.) =   2.91    Tc(MIN.) =   12.60
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    103.00 =     737.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.60
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.332
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        1.13      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    1.13      SUBAREA RUNOFF(CFS) =    1.30
  EFFECTIVE AREA(ACRES) =      1.45   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.5       PEAK FLOW RATE(CFS) =       1.67

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.60
  RAINFALL INTENSITY(INCH/HR) =   1.33
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       1.45
  TOTAL STREAM AREA(ACRES) =       1.45
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.67

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.08   10.97    1.442  0.25( 0.05) 0.20       2.5     101.00
      2        1.22   11.49    1.404  0.25( 0.05) 0.20       1.0     101.00
      3        1.67   12.60    1.332  0.25( 0.05) 0.20       1.5     105.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.86   10.97    1.442  0.25( 0.05) 0.20       4.7     101.00
      2        5.83   11.49    1.404  0.25( 0.05) 0.20       4.8     101.00
      3        5.66   12.60    1.332  0.25( 0.05) 0.20       4.9     105.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =       5.86    Tc(MIN.) =    10.97
  EFFECTIVE AREA(ACRES) =       4.68   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        4.9
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    103.00 =     737.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    54.00  DOWNSTREAM(FEET) =    52.50
  FLOW LENGTH(FEET) =   216.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.09
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.86
  PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =   11.68
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    107.00 =     953.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.68
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.391
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        2.13      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    2.13      SUBAREA RUNOFF(CFS) =    2.57
  EFFECTIVE AREA(ACRES) =      6.81   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        7.0       PEAK FLOW RATE(CFS) =       8.22

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    52.50  DOWNSTREAM(FEET) =    51.00
  FLOW LENGTH(FEET) =   240.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.33
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.22
  PIPE TRAVEL TIME(MIN.) =   0.75    Tc(MIN.) =   12.43
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    108.00 =    1193.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
```

```
  MAINLINE Tc(MIN.) =   12.43
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.342
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        3.64      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    3.64      SUBAREA RUNOFF(CFS) =    4.23
  EFFECTIVE AREA(ACRES) =     10.45   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =       10.7       PEAK FLOW RATE(CFS) =      12.15

****************************************************************************
  FLOW PROCESS FROM NODE    108.00 TO NODE    109.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    51.00  DOWNSTREAM(FEET) =    50.00
  FLOW LENGTH(FEET) =   202.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  16.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.34
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.15
  PIPE TRAVEL TIME(MIN.) =   0.63    Tc(MIN.) =   13.06
  LONGEST FLOWPATH FROM NODE    105.00 TO NODE    109.00 =    1395.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    109.00 TO NODE    109.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.06
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.305
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 C        4.01      0.25     0.200    50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    4.01      SUBAREA RUNOFF(CFS) =    4.53
  EFFECTIVE AREA(ACRES) =     14.46   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =       14.7       PEAK FLOW RATE(CFS) =      16.33
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.7  TC(MIN.) =     13.06
  EFFECTIVE AREA(ACRES) =     14.46  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =      16.33

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
      1       16.33   13.06    1.305  0.25( 0.05) 0.20      14.5     101.00
      2       16.06   13.58    1.276  0.25( 0.05) 0.20      14.6     101.00
      3       15.43   14.73    1.217  0.25( 0.05) 0.20      14.7     105.00
============================================================================
```

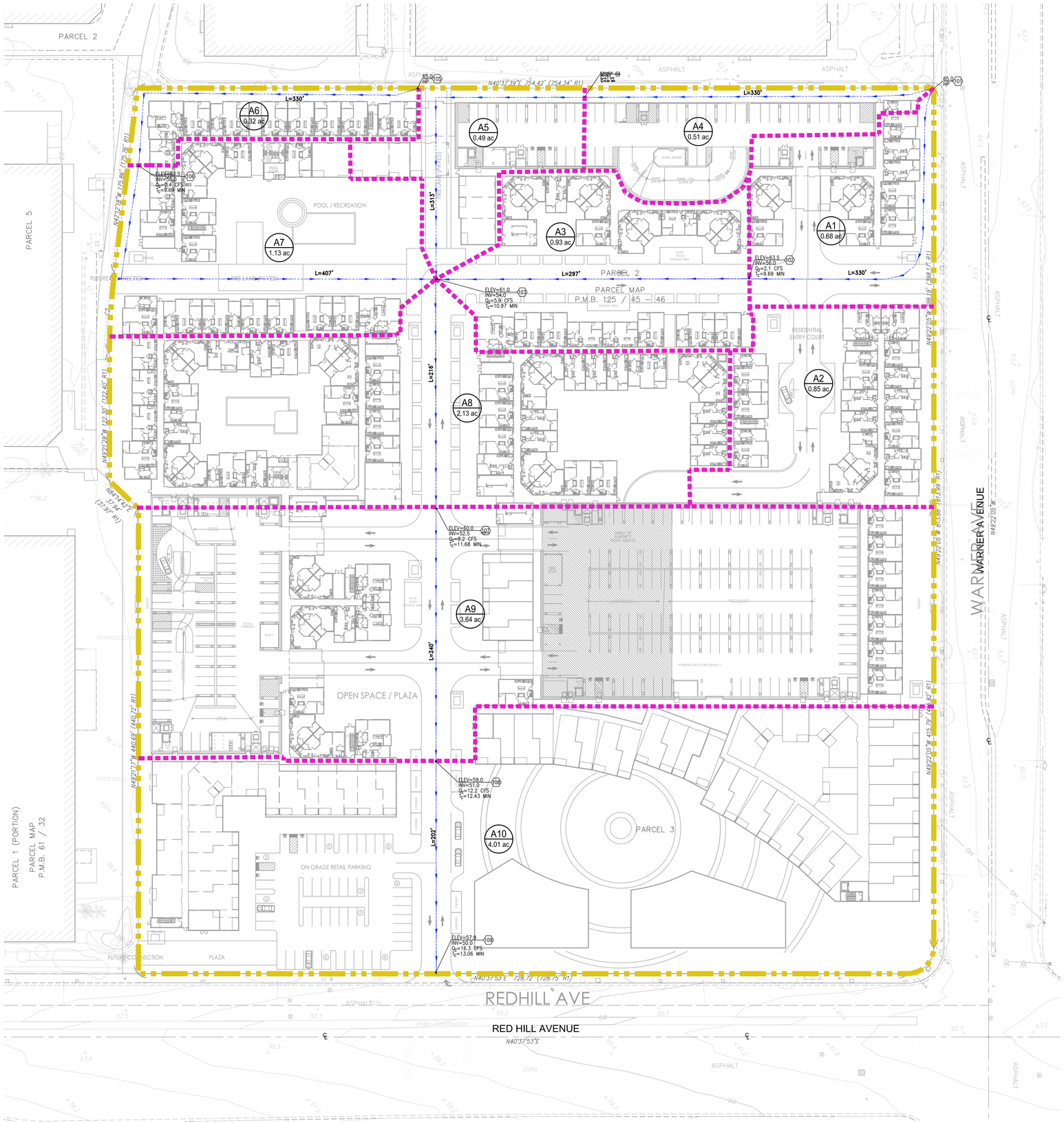
```
**************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==========================================================================
         (C) Copyright 1989-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1355

                          Analysis prepared by:

                            fuscoe engineering
                             16795 Von Karman
                                Suite 100
                                Irvine, CA

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  Red Hill & Warner
  Hydromodification Calculations
  Proposed Condition - 2-year hydrograph
==========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1         14.69       20.00       69.(AMC II)     0.250       0.712

    TOTAL AREA (Acres) =     14.69

                                  _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.050

                                  _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.288
==========================================================================

 Problem Descriptions:
  Red Hill & Warner
  Hydromodification Calculations (calibration coefficient: 0.889)
  Proposed Condition - 2-year hydrograph
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.89
    TOTAL CATCHMENT AREA(ACRES) =   14.69
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.050
    LOW LOSS FRACTION = 0.288
    TIME OF CONCENTRATION(MIN.) = 13.06
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05
```

```
--------------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.70
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.81

********************************************************************************
  TIME      VOLUME        Q    0.         5.0       10.0       15.0       20.0
 (HOURS)     (AF)       (CFS)
--------------------------------------------------------------------------------
  0.11      0.0014      0.30  Q          .          .          .          .
  0.33      0.0067      0.30  Q          .          .          .          .
  0.55      0.0121      0.30  Q          .          .          .          .
  0.76      0.0176      0.30  Q          .          .          .          .
  0.98      0.0231      0.31  Q          .          .          .          .
  1.20      0.0286      0.31  Q          .          .          .          .
  1.42      0.0342      0.31  Q          .          .          .          .
  1.63      0.0399      0.32  Q          .          .          .          .
  1.85      0.0456      0.32  Q          .          .          .          .
  2.07      0.0513      0.32  Q          .          .          .          .
  2.29      0.0571      0.33  Q          .          .          .          .
  2.50      0.0630      0.33  Q          .          .          .          .
  2.72      0.0689      0.33  Q          .          .          .          .
  2.94      0.0749      0.33  Q          .          .          .          .
  3.16      0.0810      0.34  Q          .          .          .          .
  3.38      0.0871      0.34  Q          .          .          .          .
  3.59      0.0933      0.35  Q          .          .          .          .
  3.81      0.0995      0.35  Q          .          .          .          .
  4.03      0.1059      0.35  Q          .          .          .          .
  4.25      0.1122      0.36  Q          .          .          .          .
  4.46      0.1187      0.36  Q          .          .          .          .
  4.68      0.1252      0.36  Q          .          .          .          .
  4.90      0.1319      0.37  Q          .          .          .          .
  5.12      0.1386      0.37  Q          .          .          .          .
  5.33      0.1453      0.38  Q          .          .          .          .
  5.55      0.1522      0.38  Q          .          .          .          .
  5.77      0.1592      0.39  Q          .          .          .          .
  5.99      0.1662      0.39  Q          .          .          .          .
  6.20      0.1733      0.40  Q          .          .          .          .
  6.42      0.1806      0.40  Q          .          .          .          .
  6.64      0.1879      0.41  Q          .          .          .          .
  6.86      0.1954      0.42  Q          .          .          .          .
  7.08      0.2029      0.42  Q          .          .          .          .
  7.29      0.2106      0.43  Q          .          .          .          .
  7.51      0.2184      0.44  Q          .          .          .          .
  7.73      0.2263      0.44  Q          .          .          .          .
  7.95      0.2343      0.45  Q          .          .          .          .
  8.16      0.2425      0.46  Q          .          .          .          .
  8.38      0.2508      0.47  Q          .          .          .          .
  8.60      0.2593      0.47  Q          .          .          .          .
  8.82      0.2679      0.48  Q          .          .          .          .
  9.03      0.2767      0.49  Q          .          .          .          .
  9.25      0.2856      0.50  .Q         .          .          .          .
  9.47      0.2947      0.51  .Q         .          .          .          .
  9.69      0.3040      0.52  .Q         .          .          .          .
  9.91      0.3135      0.53  .Q         .          .          .          .
 10.12      0.3232      0.55  .Q         .          .          .          .
 10.34      0.3332      0.56  .Q         .          .          .          .
 10.56      0.3433      0.57  .Q         .          .          .          .
 10.78      0.3538      0.58  .Q         .          .          .          .
 10.99      0.3645      0.60  .Q         .          .          .          .
 11.21      0.3754      0.62  .Q         .          .          .          .
```

11.43	0.3867	0.64	.Q . . . .
11.65	0.3983	0.65	.Q . . . .
11.86	0.4103	0.68	.Q . . . .
12.08	0.4226	0.69	.Q . . . .
12.30	0.4367	0.88	.Q . . . .
12.52	0.4527	0.90	.Q . . . .
12.73	0.4692	0.94	.Q . . . .
12.95	0.4863	0.96	.Q . . . .
13.17	0.5040	1.01	. Q . . . .
13.39	0.5225	1.04	. Q . . . .
13.61	0.5417	1.10	. Q . . . .
13.82	0.5619	1.14	. Q . . . .
14.04	0.5831	1.22	. Q . . . .
14.26	0.6058	1.31	. Q . . . .
14.48	0.6305	1.43	. Q . . . .
14.69	0.6569	1.50	. Q . . . .
14.91	0.6858	1.71	. Q . . . .
15.13	0.7179	1.87	. Q . . . .
15.35	0.7556	2.32	. Q . . . .
15.56	0.7979	2.38	. Q . . . .
15.78	0.8502	3.44	. Q . . . .
16.00	0.9263	5.02	. Q . . .
16.22	1.1183	16.33	. . . . Q .
16.44	1.2891	2.66	. Q . . . .
16.65	1.3317	2.07	. Q . . . .
16.87	1.3645	1.58	. Q . . . .
17.09	1.3911	1.37	. Q . . . .
17.31	1.4140	1.18	. Q . . . .
17.52	1.4342	1.07	. Q . . . .
17.74	1.4527	0.99	.Q . . . .
17.96	1.4698	0.92	.Q . . . .
18.18	1.4852	0.80	.Q . . . .
18.39	1.4984	0.66	.Q . . . .
18.61	1.5100	0.63	.Q . . . .
18.83	1.5209	0.59	.Q . . . .
19.05	1.5314	0.57	.Q . . . .
19.27	1.5413	0.54	.Q . . . .
19.48	1.5508	0.52	.Q . . . .
19.70	1.5599	0.50	Q . . . .
19.92	1.5687	0.48	Q . . . .
20.14	1.5772	0.46	Q . . . .
20.35	1.5854	0.45	Q . . . .
20.57	1.5933	0.43	Q . . . .
20.79	1.6009	0.42	Q . . . .
21.01	1.6084	0.41	Q . . . .
21.22	1.6156	0.40	Q . . . .
21.44	1.6227	0.39	Q . . . .
21.66	1.6295	0.38	Q . . . .
21.88	1.6362	0.37	Q . . . .
22.09	1.6428	0.36	Q . . . .
22.31	1.6492	0.35	Q . . . .
22.53	1.6554	0.34	Q . . . .
22.75	1.6615	0.34	Q . . . .
22.97	1.6675	0.33	Q . . . .
23.18	1.6734	0.32	Q . . . .
23.40	1.6792	0.32	Q . . . .
23.62	1.6848	0.31	Q . . . .
23.84	1.6904	0.31	Q . . . .
24.05	1.6958	0.30	Q . . . .
24.27	1.6985	0.00	Q . . . .

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%	1449.7
10%	117.5
20%	39.2
30%	26.1
40%	13.1
50%	13.1
60%	13.1
70%	13.1
80%	13.1
90%	13.1



PROPOSED CONDITION 2-YEAR STORM EVENT			
AREA (AC)	Q (CFS)	T_C (MIN)	VOLUME (AC–FT)
14.69	16.3	13.06	1.699

ASSESSOR PARCEL NO.

430–222–07 & 16

SITE ADDRESS

2300, 2310 & 2320 RED HILL AVENUE
SANTA ANA, CALIFORNIA

APPLICANT/OWNER

VDC
240 NEWPORT CENTER DRIVE, SUITE 200
NEWPORT BEACH, CA 92660
TEL: 310.571.8227

CIVIL ENGINEER

FUSCOE ENGINEERING
16795 VON KARMAN, SUITE 100
IRVINE, CA 92606
TEL: 949.474.1960
FAX: 949.474.5315

ABBREVIATIONS

AC	ACRE
AC–FT	ACRE–FOOT
CFS	CUBIC FEET PER SECOND
ELEV	ELEVATION
HP	HIGH POINT
L	LENGTH
MIN	MINUTES
Q_{25}	FLOW RATE – 2–YEAR STORM
S	SLOPE
T_C	TIME OF CONCENTRATION

LEGEND

- DRAINAGE BOUNDARY
- DRAINAGE SUB–BOUNDARY
- (XX) NODE
- TIME OF CONCENTRATION FLOW PATH
- L=XXX' FLOW PATH LENGTH
- XX / X.XXac DRAINAGE BOUNDARY DESIGNATION AND AREA

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

PREPARED BY:
FUSCOE ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 ◦ fax 949.474.5315
www.fuscoe.com

HYDROLOGY MAP
PROPOSED CONDITION
2-YEAR STORM EVENT
RED HILL & WARNER APARTMENTS
CITY OF SANTA ANA, CALIFORNIA

PROJECT NO. 1719.001
SHEET 1 OF 1

201X–XX–XX | CITY OF SANTA ANA – RED HILL & WARNER APARTMENTS | PLAN SET: X

F:\PROJECTS\1154\003_SUPPORT FILES\REPORTS\HYDROLOGY_SUPPORTING DOCUMENTS\HYDROLOGY MAP\1154–003HYD PROPR.DWG (04–30–19 – 1:32:41PM) Plotted by: Susan Williams