Appendix F:
Hydrology Study and Water Quality Management Plan

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F.1 - Hydrology Report

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HYDROLOGY REPORT

APN: 032-181-18&20

Project Name:

Highland and Valencia Development
415 S. Highland Ave
Fullerton, CA 92835

Prepared for:

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Prepared on:

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September 11, 2020

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I. INTRODUCTION

PURPOSE

The purpose of this hydrology report is to analyze and compare the existing drainage pattern to the proposed drainage pattern assuming a 100-year storm frequency. This study also evaluates the pre & post-development hydrological conditions of the site and examines measures to reduce stormwater runoff from the site to the public street. The nearest storm drain for the project is about a quarter-mile east of the project site.

The study is intended to identify potential changes to the watershed from the proposed development and identify appropriate mitigation measures for the post-development hydrology. The Water Quality Management Plan (W Q M P) was prepared for a runoff water quality control program that will adequately address the applicable National Pollutant Discharge Elimination System (NPDES) permit (referred to as the MS4 Permit or the Public Storm Drain Permit), Model Water Quality Management Plan requirements (WQMP), and DAMP requirements.

PROJECT LOCATION

The proposed site is located at 415 South Highland Avenue in the city of Fullerton, California. The property is bounded by residential apartments on the west and Alley on the north, Highland Avenue on the east, and Valencia avenue on the south.

APN 031-181-18 – A roughly "L"-shaped parcel at the northeastern corner of (the N-S trending) Highland Avenue and (the generally E-W trending) Valencia Drive, and engulfing the roughly E-W trending rectangular APN 031-181-20 (the other site parcel) to its northeast. The parcel consists mainly of a fenced roughly N-S trending rectangular-shaped asphalt-paved parking lot almost occupying the entire western arm of the roughly "L"-shaped parcel; a roughly trapezoid-shaped unpaved lawn yard in the eastern main portion of the southern arm of the roughly "L"-shaped parcel; and asphalt-paved parking lots/driveways for the carwash facility (occupying APN 031-181-20) in between above two parcel main features.
APN 031-181-20 (415 South Highland Avenue) - A roughly E-W trending rectangular parcel engulfed by APN 031-181-18 to its northeast; the parcel is generally improved with a single-story roughly N-S trending four-bay self-auto wash building occupying approximately its approximate east-central ¼; asphalt-paved driveways occupying approximately its eastern ¼ and its west-central ¼; and asphalt-paved parking spaces with self-auto interior vacuum cleaning devices in-between spaces.

The proposed site consists of 18 Dwelling units where 16 are of residential 1 to 2-bedroom condominiums and 2 shopkeeper's units. The site also includes hardscape, patio, fences, parking, trash enclosure, modular wetland system, grease interceptor, monuments, wet and dry utilities, and a private street.

FLOODING HAZARDS

Based on the Flood Insurance Rate Map prepared by The Federal Emergency Management Agency (FEMA MAP 06059C0131J), the site is protected by a levee system from the 1-percent or greater annual chance of flood hazard. See the attached map in Appendix A.

METHODOLOGY

The County of Orange Hydrology Manual, Rational Method was used to determine the flow rate for the 2-year, 10-year, and 100-year storm events. Information pertinent to Soil Type (Appendix B) as published in the manual was used. The nomograph (Appendix C) published in the manual was used to compute the time of concentration for each of the subareas per the Hydrology Manual. The non-mountainous formulas were used to develop the intensities for this study. The maximum loss rate (Fm) due to infiltration, which is a function of the soil type, and impervious fraction were computed for each subarea using the watershed data and the formulas from the Hydrology Manual. See Appendix D for calculations.

EXISTING CONDITION

The site is located at 415 South Highland Avenue in the City of Fullerton, California. Two properties (032-181-18 and 032-181-20) comprise the site. The site is bounded by West Valencia Drive to the south, South Highland Avenue to the east, a multi-family two-story residential structure to the west, and an Alley followed by a parking lot as well as a residential structure to the north. The location of the site and its relationship to the surrounding areas are shown in Figure 1, Site Location Map.

The site is semi-rectangular in shape and consists of 0.564 acres of land. The site is currently occupied by a car wash facility with an associated asphalt paved surface lot. Minor improvements related to the car wash facility were located west of the existing structure. The remaining portion of the site consists of an asphalt paved lot with limited underground utilities. A landscaped area is located at the southeast portion of the site. The site is also bounded by a masonry-built wall to the northwest.

The topography within the site is relatively flat with elevations approximately 147 to 151 feet above mean sea level (MSL), based on topographic survey. Site drainage appears to be directed as sheet flow towards the south and east to the adjacent streets. Vegetation within the site consists of grass within the southeast portion of the site and scattered trees near the west, south, and southeast border of the site.

Per the soil report dated November 9, 2018, soil materials encountered at the subject site mainly consisted of interlayered alluvial deposits. Locally undocumented artificial fill was observed within the southern portion and expected to be within the eastern portion of the site. The artificial fill was observed to the depth of 2 feet below the existing ground surface. Thicker amounts of artificial fill could be present within the site.

The artificial fill is comprised of medium brown silty sand and sandy silt. These materials are typically slightly damp and loose or medium stiff. Alluvial deposits were encountered below the artificial fill materials to the maximum depth of exploration, 51.5 feet below the ground surface. The alluvial soils are typically comprised of interlayered light, medium, and dark brown sandy clay, clayey sand, sand with clay,

and occasional sand layers. Silt and sandy silt deposits were also encountered generally below depths of 20 feet. All materials observed are generally moist and medium dense to dense/stiff to very stiff. Thus, the site is suitable for infiltration. However, due to the shallow groundwater table depth, it is not feasible to infiltrate the runoff. Therefore, Biofiltration is used – a stormwater treatment BMP.

- Area A-1(North side of the property) represents trash enclosure, Carwash, concrete gutter, private driveway, and a portion of asphalt vacant parcel. The site sheet flow toward the existing concrete gutter within the site that carries out the runoff to the existing gutter located in Alley. The gutter carries flow from east to west. See Exhibit E for the drainage pattern

- Area B-1 (South side of the property) which represents the landscape area, the portion of asphalt vacant parcel, and the driveway. The site sheet flows toward the existing sidewalk that carries out the runoff to the existing street.

  For drainage, pattern See Appendix E.

	Existing Hydrology Summary				
Areas	**AC**	**Nodes**	**Flow rate (cfs)**		
			2-yr	**10-yr**	**100-yr**
A-1	0.274	1-2	0.48	0.87	1.32
B-1	0.290	1-2	0.38	0.70	1.08

PROPOSED DEVELOPMENT

The site is relatively flat. The pre- and post-drainage patterns will remain the same, except the site will have a BMP system that will treat the 85th Percentile stormwater runoff with the MWS system. Most of the runoff is from the roof. The runoff from the roof, parking area, open space drive aisle area will be collected at various catch basins and trench drain. It will then be conveyed to the MWS system through a stormdrain pipe. The pump will pump out the treated stormwater to the proposed catch basin and then it will be conveyed to Highland Avenue through the curb outlet. Once the system at its capacity, then the runoff will follow the proposed drainage pattern. Stormwater will sheet flow to the existing streets.

The MWS system treats TSS, heavy metals, nutrients, hydrocarbons, and bacteria. The system includes the pretreatment chamber where it removes the trash, sediment, and, debris. With its innovative horizontal flow biofilter, the system can remove pollutants through a combination of physical, chemical, and biological filtration processes.

There are no existing storm drain systems near the property and therefore, the runoff will be collected at catchbasin located at the corner of Valencia Drive and Richman Avenue. From there, a runoff will be carried out by an existing storm drain system to the Coyote Creek that will eventually carry out the discharge to the San Gabriel River Reach 1 to Estuary.

For drainage, pattern See Appendix E.

- Area A-1 (North side of the property) represents Units 206-210, flat roof, patio, parking, and a portion of private drive aisle and Unit B1. The 85% percentile stormwater runoff from the roof, patio, the portion of private drive isle and parking will be conveyed to the various catch basins and trench drain through various downspouts and concrete gutter. Then the runoff will be carried to the MWS system by a 8" stormdrain pipe. The overflow from the catch basins will sheet flow towards an existing concrete gutter located at Alley. The gutter carries flow from east to west. See Exhibit E for the drainage pattern

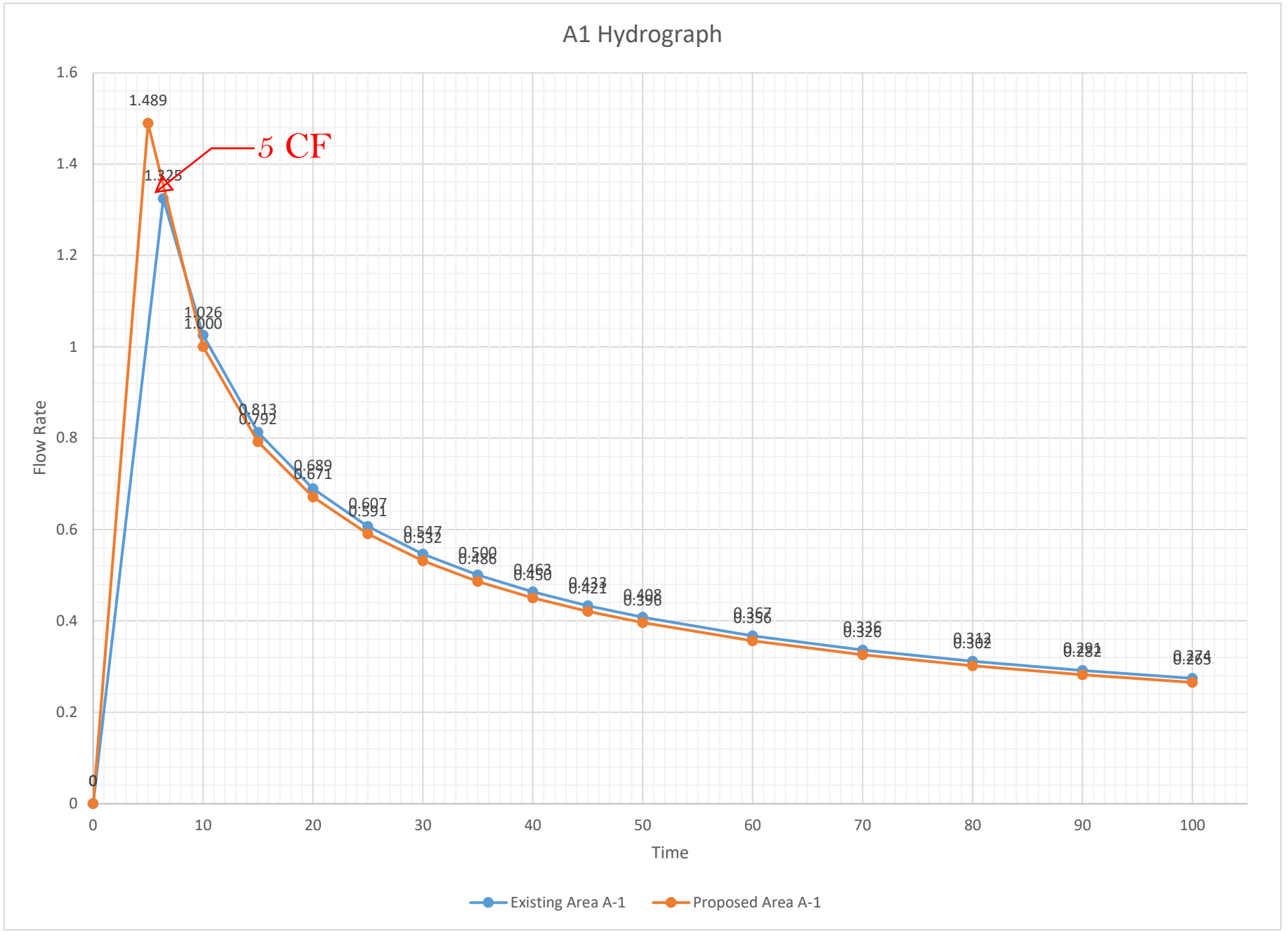
- Area B-1 (South side of the property) which represents Units 211-214, Unit C, Unit D, Unit E, Unit B2, Green roof, patio, and flat roof. The 85% percentile stormwater runoff from roof and parking will be conveyed to the various catch basins through various downspouts. Then it will be carried to the MWS system by the 8" stormdrain pipe. It will then be pumped out to Highland Avenue through a curb outlet. The overflow from the catch basins will sheet flow towards the street. See Exhibit E for the drainage pattern

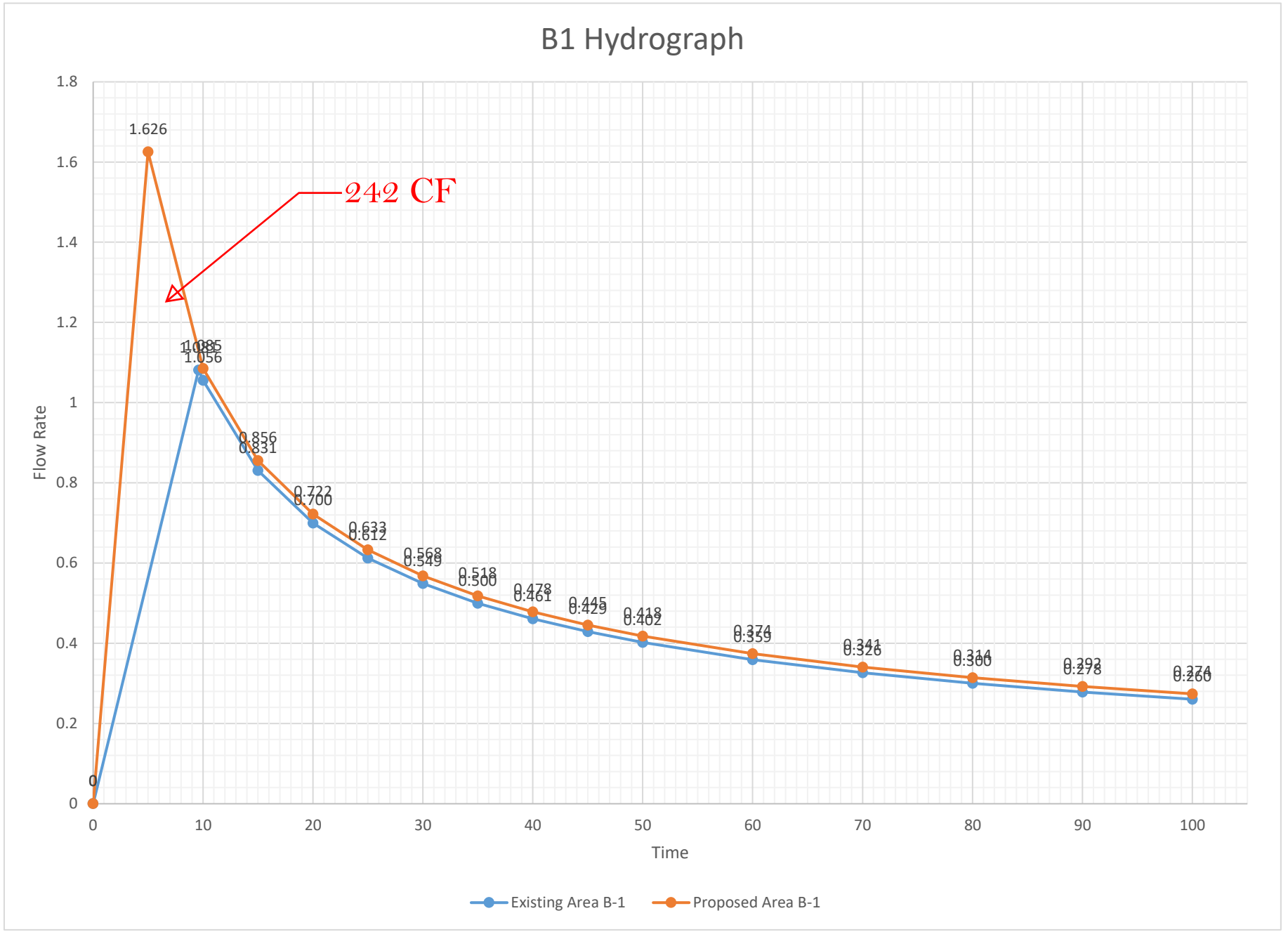
	Proposed Hydrology Summary				
Areas		**Nodes**	**Flow rate (cfs)**		
	AC		**2-yr**	**10-yr**	**100-yr**
A-1	0.268	1-2	0.54	0.98	1.49
B-1	0.296	1-2	0.58	1.06	1.63

HYDROGRAPH

The hydrograph exhibit was prepared to find the difference in the existing versus proposed condition for a 100-yr peak flow rate. The hydrograph shows that the proposed site adds in total 247 cubic feet of the additional peak runoff volume to the street. However, proposed catch basins, proposed concrete gutter, proposed stormdrain pipe, and Modular Wetland System can retain additional runoff before discharging to the street. The proposed MWS system also can treat more than 2,000 cubic feet of runoff volume within 24 hours. Therefore, this development will not have a negative impact on facilities. See hydrograph for Area A-1 and B-1

Areas	**(AC)**	**100-yr Storm Event**				
		Exist.		Prop.		Delta Volume
		Flow Rate (cfs)	Tc (min.)	Flow Rate (cfs)	Tc (min.)	cf
A-1	**0.268**	1.32	6.4	1.49	5	5
B-1	**0.296**	1.08	9.6	1.63	5	242


A1 Hydrograph
5 CF
1.489
1.325
1.026
1.000
0.813
0.792
0.689
0.671
0.607
0.591
0.547
0.532
0.500
0.488
0.463
0.450
0.433
0.421
0.408
0.398
0.367
0.356
0.336
0.326
0.312
0.302
0.291
0.282
0.274
0.265
0
Flow Rate
Time
Existing Area A-1
Proposed Area A-1


B1 Hydrograph
242 CF
Flow Rate
Time
Existing Area B-1
Proposed Area B-1
1.626
1.056
0.856
0.831
0.722
0.700
0.633
0.612
0.568
0.549
0.518
0.500
0.478
0.461
0.445
0.429
0.418
0.402
0.374
0.359
0.341
0.326
0.314
0.300
0.292
0.278
0.274
0.260
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
10
20
30
40
50
60
70
80
90
100

II. SUMMARY

The existing project site currently does not have any stormdrain, stormwater control measure, or any treatment system.

The runoff from the existing condition is divided into 2 parts. The north side of the project is draining to the Alley on the north and the south side of the project is draining to West Valencia Dr. However, in the proposed condition the runoff will sheet flow to Highland Avenue, Valencia Drive, and Alley once the MWS system is at its capacity. Since the runoffs from Alley, Highland Avenue and Valencia Drive drain to the same catch basin at the corner of Richman Ave and Valencia Drive, there will no concern with a diversion of flow.

The proposed drainage pattern remains the same except that the low flow (first flush -85th percentile storm) from the site will be captured at the proposed catch basins, and trench drain through various downspouts and concrete gutter. Then it will be carried to the Modular wetland system (biofiltration system) by a stormdrain pipe. Once the treatment takes place, it will be pumped out to the proposed catch basin. A 4" pipe then carries the runoff to Highland avenue via a curb outlet. The low and high flow from the site will sheet flow toward Valencia Avenue, High Land Avenue, and Alley.

Due to the proposed development, total site stormwater runoff for Q_{100} will increase by 0.72 CFS as impervious area increased. However, the storage from the pipe, concrete gutter, and MWS system will help reduce the peak flow rate by retaining the stormwater runoff. Also, the MWS can treat runoff of 0.115 cfs and a volume of 2518 cf within 24 hours.

Therefore, the site does not have any adverse impact on the reconstruction, as the proposed site provides the treatment. See the WQMP report for further inquiry.

Hydrology Summary

Areas	Nodes	Flow rate (cfs)					
		2 -yrs. (cfs)		10-yr (cfs)		100-yr (cfs)	
		Exist.	Prop.	Exist.	Prop.	Exist.	Prop.
A-1	**1-2**	0.48	0.54	0.87	0.98	1.32	1.49
B-1	**1-2**	0.38	0.58	0.7	1.06	1.08	1.63

Inlet Report

Designed runoff volume overall (0.115 cfs)

Drop Grate Inlet

Location	= Sag
Curb Length (ft)	= -0-
Throat Height (in)	= -0-
Grate Area (sqft)	= 0.50
Grate Width (ft)	= 1.00
Grate Length (ft)	= 1.00

Gutter

Slope, Sw (ft/ft)	= 0.050
Slope, Sx (ft/ft)	= 0.050
Local Depr (in)	= -0-
Gutter Width (ft)	= 1.00
Gutter Slope (%)	= -0-
Gutter n-value	= -0-

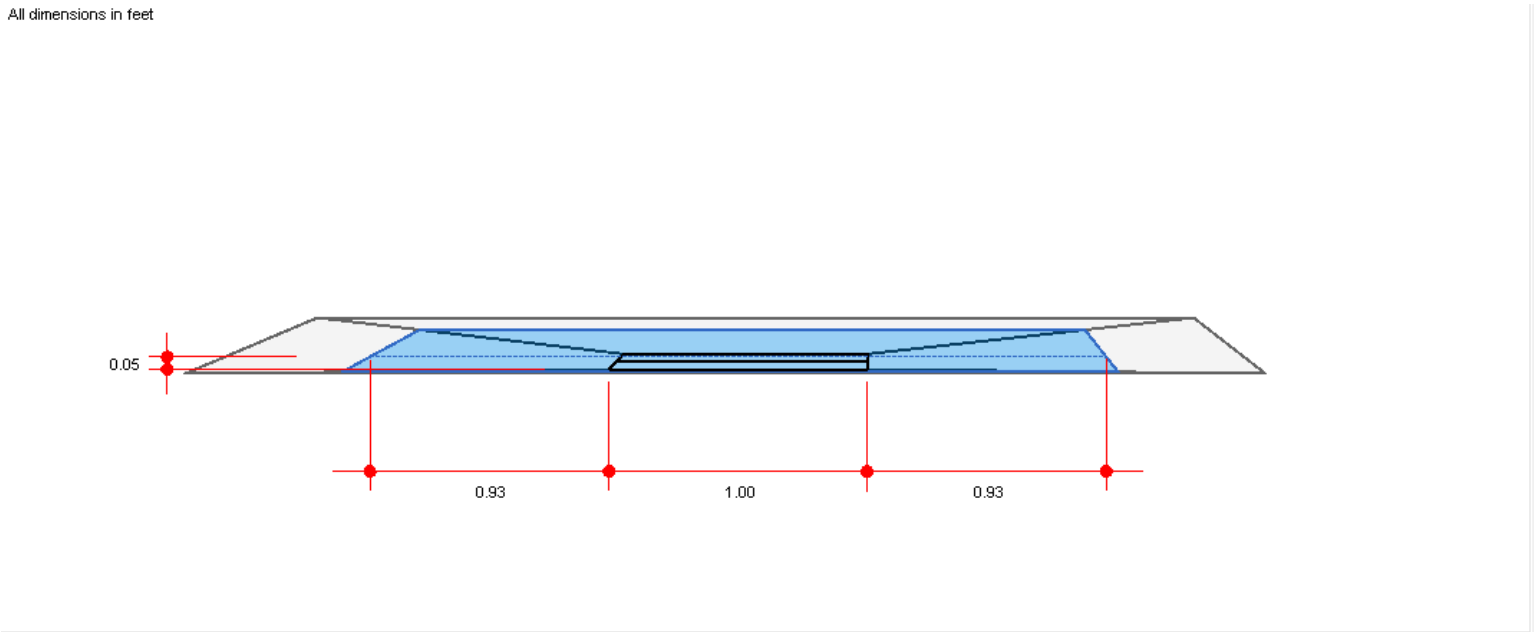
Calculations

Compute by:	Known Q
Q (cfs)	= 0.12

Highlighted

Q Total (cfs)	= 0.12
Q Capt (cfs)	= 0.12
Q Bypass (cfs)	= -0-
Depth at Inlet (in)	= 0.56
Efficiency (%)	= 100
Gutter Spread (ft)	= 2.85
Gutter Vel (ft/s)	= -0-
Bypass Spread (ft)	= -0-
Bypass Depth (in)	= -0-

The proposed catchbasins are only to capture the designed stormwater runoff volume. Once the MWS system is at its capacity, the runoff from the site will follow the proposed drainage pattern (sheet flows towards both streets and Alley).



VICINITY MAP

Proposed Mixed-Use Development
415 South Highland Avenue Fullerton, California

NOT TO SCALE

APPENDIX A: FEMA MAP

drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the National Agriculture Imagery Program, dated 2005.

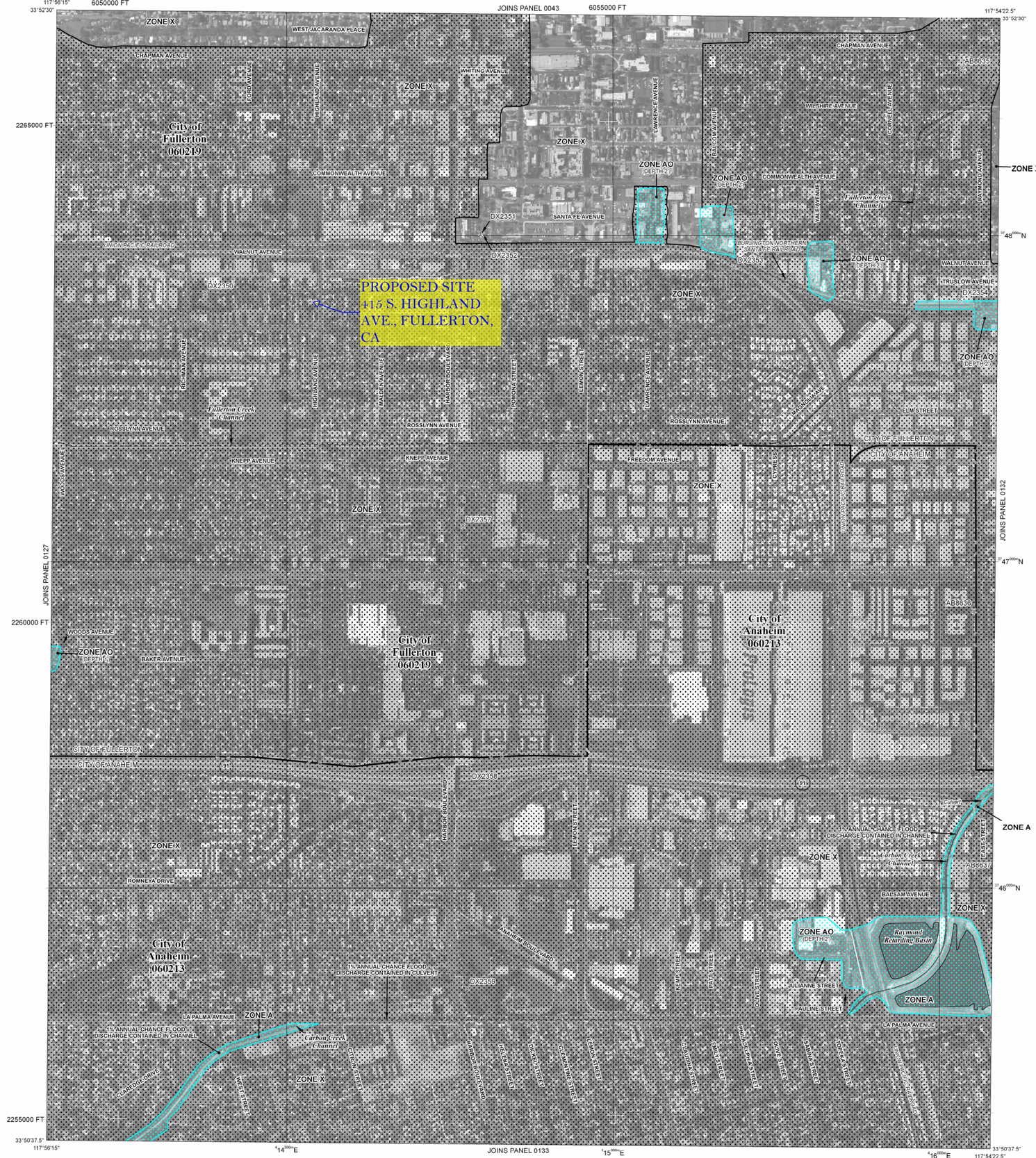
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4276000mN — 1000-meter Universal Transverse Mercator grid values, zone NAD 1983 UTM Zone 11N
- 600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 15, 1989

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
February 5, 1992 - November 3, 1993 - January 3, 1997 - February 18, 2004 - December 3, 2009 : for description of revisions, see Notice to Users page in the Flood Insurance Study report.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0131J

FIRM

FLOOD INSURANCE RATE MAP

ORANGE COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 131 OF 539

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

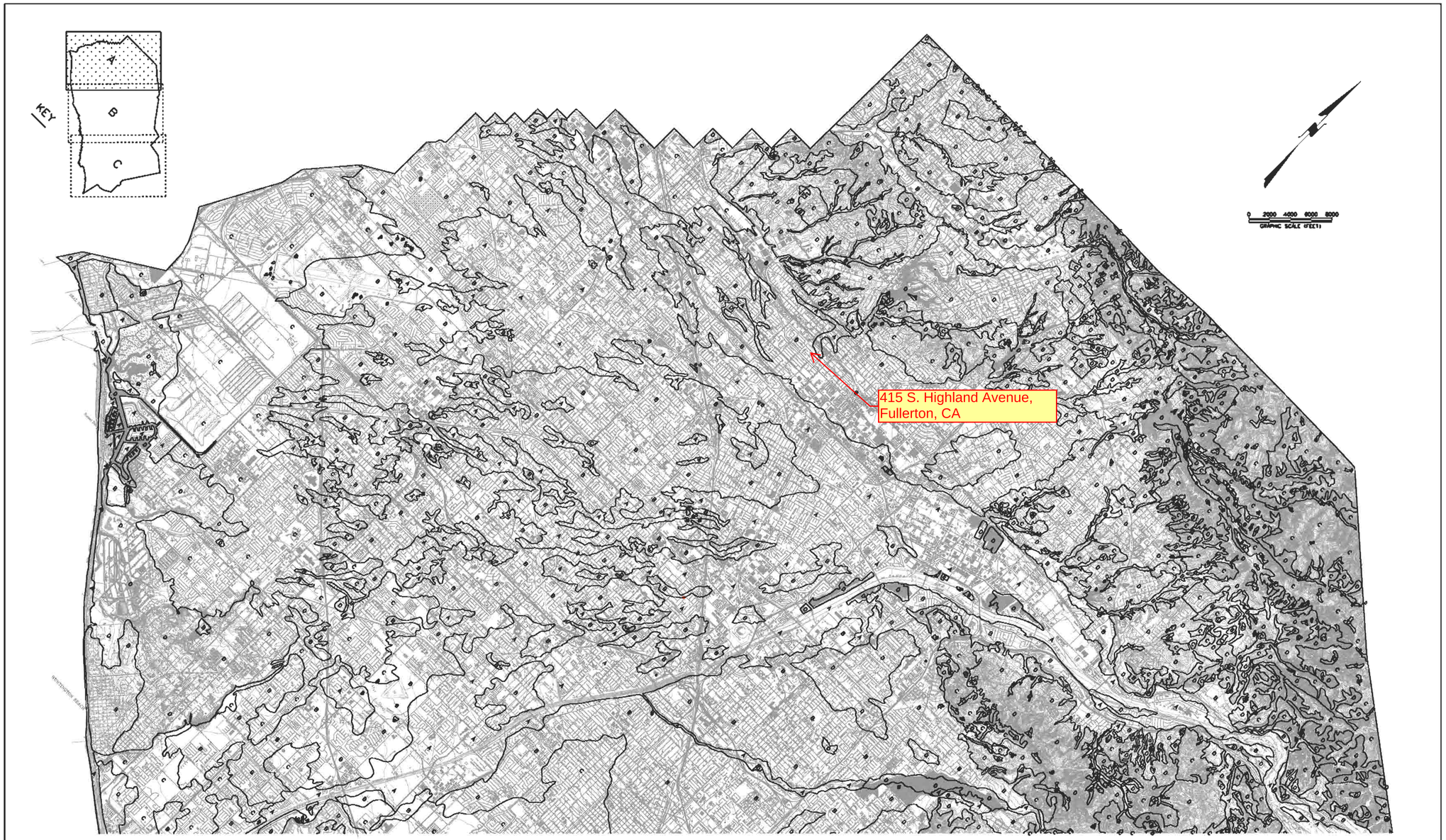
COMMUNITY	NUMBER	PANEL	SUFFIX
ANAHEIM, CITY OF	060213	0131	J
FULLERTON, CITY OF	060219	0131	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06059C0131J

MAP REVISED

APPENDIX B: SOIL INDEX MAP



ORANGE COUNTY
HYDROLOGY MANUAL

LEGEND
A B C D HYDROLOGIC SOIL GROUPS
HYDROLOGIC SOIL GROUP BOUNDARY

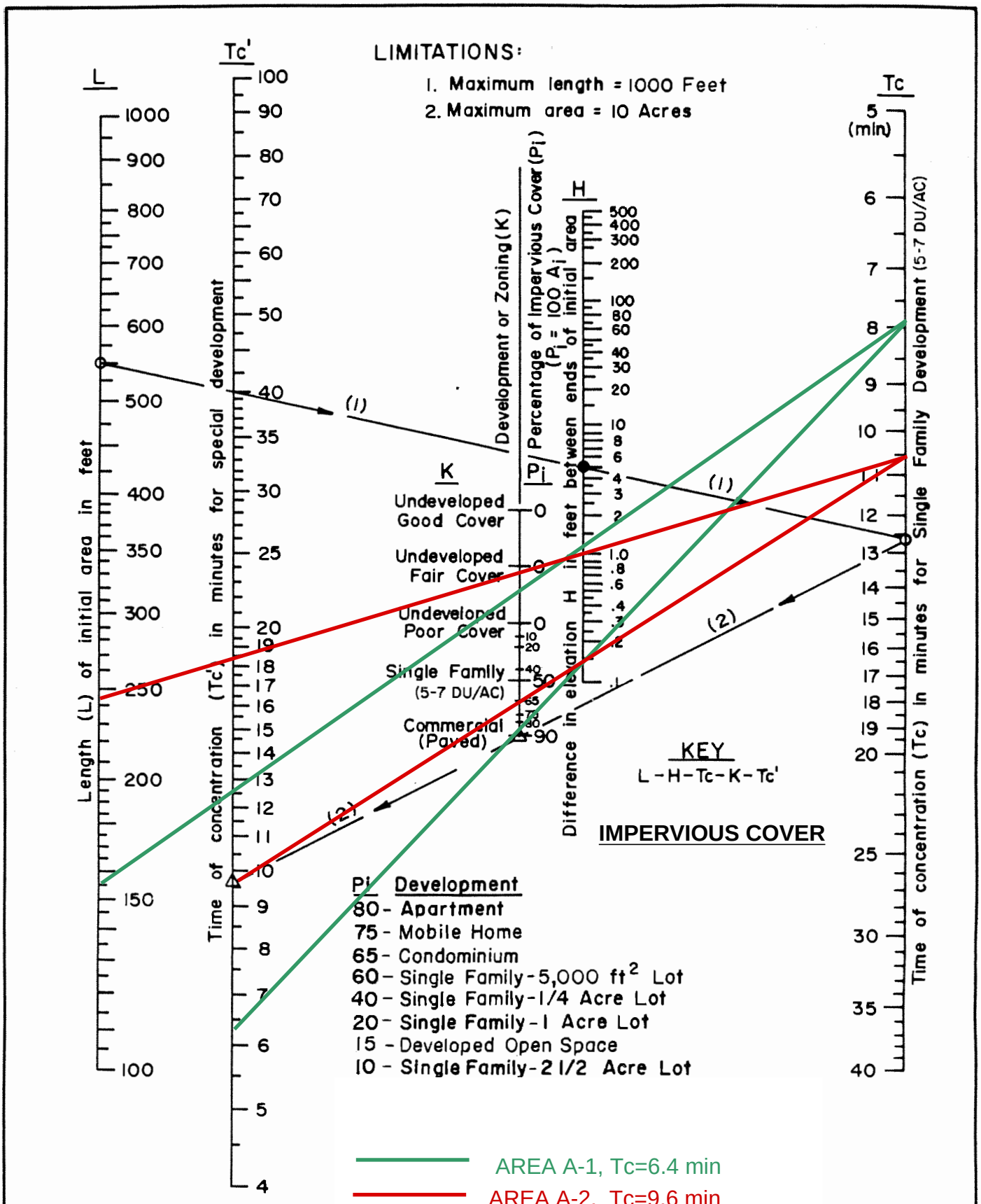
SOURCES:
BASE MAP - ORANGE COUNTY/RESOURCES & DEVELOPMENT MANAGEMENT DEPT GEOMATICS AND LAND INFORMATION SYSTEMS DIVISION
SOIL GROUPS - SOIL SURVEY OF ORANGE COUNTY AND WESTERN PART OF RIVERSIDE COUNTY, CALIFORNIA, USDA, SOIL CONSERVATION SERVICE, 1978.

HYDROLOGIC CLASSIFICATION OF SOILS
ORANGE COUNTY, CALIFORNIA
PLATE A

APPENDIX C: TIME OF CONCENTRATION NOMOGRAPH

Highland Avenue

PRE-DEVELOPMENT



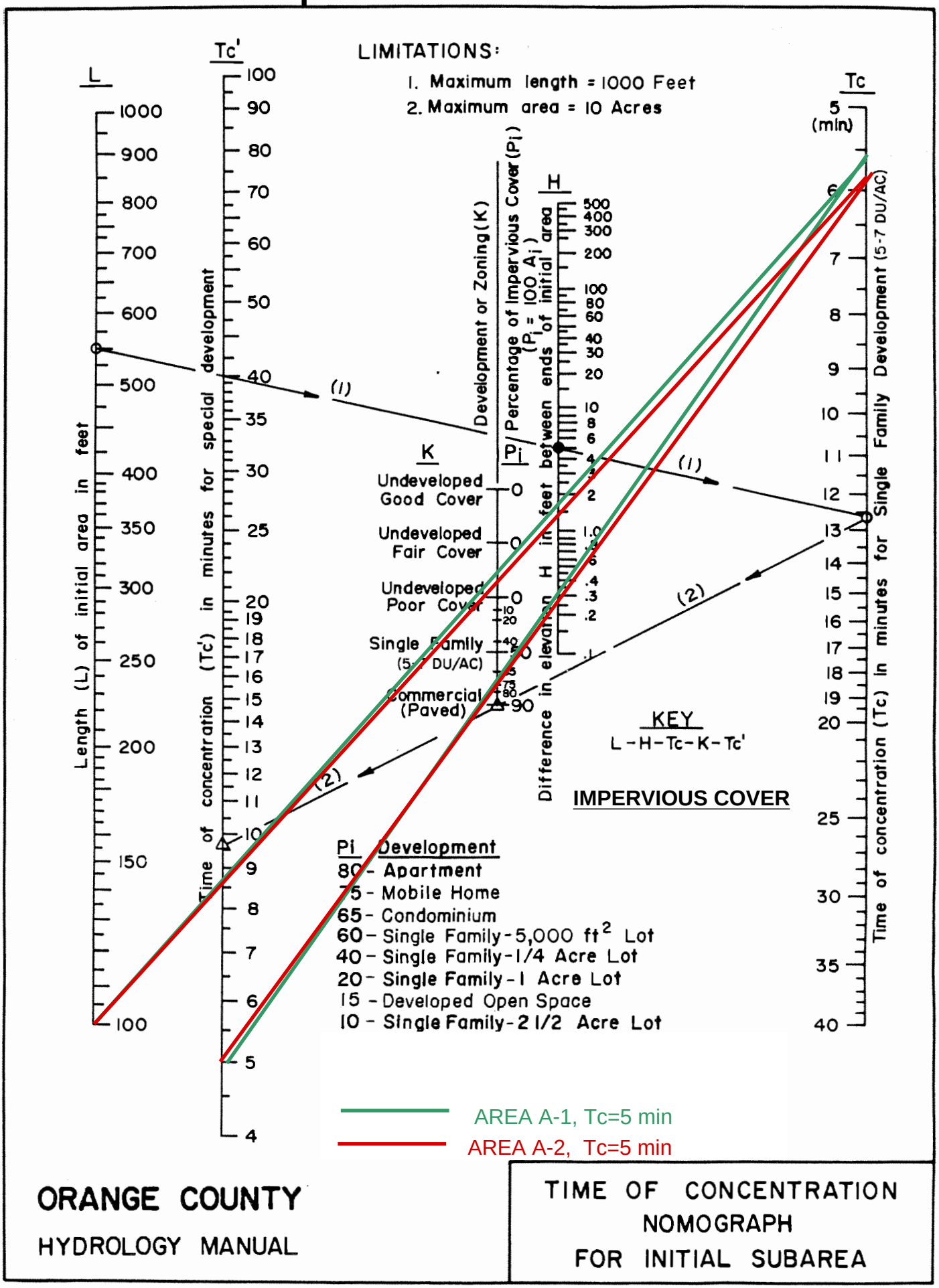
ORANGE COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

Highland Avenue

post-DEVELOPMENT



ORANGE COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

APPENDIX D: RATIONAL METHOD STUDY FORM

16056.00 HIGHLAND AND VALENCIA

Hydrology Summary

TOTAL AREA	24,567	ft^2	0.564	ac	
Soil Group	B				
Design Capture Stormdepth	0.90	in			
Green Terrace	1025	ft^2	0.024	ac	
Landscape	3060	ft^2	0.070	ac	
Total Pervious	**4,085**	**ft^2**	**0.094**	**ac**	16.6%
Total Impervious	20,482	ft^2	0.470	ac	83.4%
Design Intensity	0.260	in/hr	Worksheet D Graph		
Runoff coefficient	0.775				
Design Flowrate	***0.114***	***cfs***	See Calculations		

Development	**Area**		**Pervious**		**Impervious**		**Change in Impervious**	
	(ft^2)	ac	(ft^2)	(%)	(ft^2)	(%)	(ft^2)	(%)
Pre-Development	24,567	0.564	4,805	0.19559	19,762	80.44%		
Post-Development	24,567	0.564	4,085	0.16628	20,482	83.37%	720	3.64%

BIOFILTRATION	**Total Area**		**fraction**	**flow rate**	**System**	**Capacity**
	ft^2	ac	ac/ac	cfs		cfs
MWS System	24,567	0.564	1.000	0.114	M-W-S-L-4-8	0.115

EXISTING HYDROLOGY											
DMA	Areas		Pervious		Impervious		El1	El2	Length	Slope	TC
	(ft^2)	AC	(ft^2)	(%)	(ft^2)	(%)	ft	ft	ft		ft
A-1	11,917	0.274	0	0	11,917	1.000	145.8	143.88	160.79	0.012	6.4
A-2	12,650	0.290	4,804	0.380	7,846	0.620	145.36	142.89	244.06	0.010	9.6
Total Area	**24,567**	**0.564**									

PROPOSED HYDROLOGY											
DMA	Areas		Pervious		Impervious		El1	El2	Length	Slope	TC
	(ft^2)	AC	(ft^2)	(%)	(ft^2)	(%)	ft	ft	ft		ft
A-1	11,675	0.268	432	0.04	11,243	0.963	146.1	144.16	99.46	0.020	5
B-1	12,892	0.296	3,650	0.283	9,242	0.717					5
Total Area	**24,567**	**0.564**									

Hydrology Summary

Areas		Nodes	Flow rate (cfs)							
			2 -yr (cfs)		10-yr (cfs)		100-yr (cfs)			
	AC		Exist.	Prop.	Exist.	Prop.	Exist.	Prop.		0.872248
A-1	0.268	**1-2**	0.48	0.54	0.87	0.98	1.32	1.49		0.687659
B-1	0.296	**1-2**	0.38	0.58	0.7	1.06	1.08	1.63		
							2.4	3.12	0.72	

Areas	(AC)	100-yr Storm Event				
		Exist.		Prop.		Delta Volume
		Flow Rate (cfs)	Tc (min.)	Flow Rate (cfs)	Tc (min.)	cf
A-1	**0.268**	1.32	6.4	1.49	5	5
B-1	**0.296**	1.08	9.6	1.63	5	242

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue PRE- DEVELOPMENT 2-YEAR STORM RATIONAL METHOD STUDY	Calc'd By: T.G. Date: 9/9/2020 Checked By: P.G. Date: Page 1 of 1

Concentration Point	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.274	0.274	B	MIXED		6.40	1.965	0	0	0.48	160.79	0.0120		INITIAL SUBAREA
											244.06	0.0100		INITIAL SUBAREA
B-1 1-2	0.290	0.290	B	MIXED		9.60	1.557	0.114	0.114	0.38				

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue PRE- DEVELOPMENT 10-YEAR STORM RATIONAL METHOD STUDY	Calc'd By: T.G. Date: 9/9/2020 Checked By: P.G. Date: Page 1 of 1

Concentration Point	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.274	0.274	B	MIXED		6.40	3.524	0	0	0.87	160.79	0.0120		INITIAL SUBAREA
											244.06	0.0100		INITIAL SUBAREA
B-1 1-2	0.290	0.290	B	MIXED		9.60	2.793	0.114	0.114	0.70				

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue	Calc'd By: T.G.	Date: 9/9/2020
	PRE- DEVELOPMENT 100-YEAR STORM RATIONAL METHOD STUDY	Checked By: P.G.	Date:
			Page 1 of 1

Concentration Point	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.274	0.274	B	MIXED		6.40	5.371	0	0	1.32	160.79	0.0120		INITIAL SUBAREA
											244.06	0.0100		INITIAL SUBAREA
B-1 1-2	0.290	0.290	B	MIXED		9.60	4.258	0.114	0.114	1.08				

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue prop- DEVELOPMENT YEAR STORM RATIONAL METHOD STUDY	2-	Calc'd By: T.G. Date: 2/10/2021 Checked By: P.G. Date: Page 1 of 1

Concentration	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.268	0.268	B	MIXED		5.00	2.264	0.012	0.012	0.54	99.5	0.0200		INITIAL SUBAREA
B-1 1-2	0.296	0.296	B	MIXED		5.00	2.264	0.085	0.0849	0.58	299.03	0.0130		INITIAL SUBAREA

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue prop- DEVELOPMENT YEAR STORM RATIONAL METHOD STUDY	10-	Calc'd By: T.G. Date: 2/10/2021 Checked B P.G. Date: Page 1 of 1

Concentration	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.268	0.268	B	MIXED		5.00	4.060	0.012	0.012	0.98	99.46	0.0200		INITIAL SUBAREA
B-1 1-2	0.296	0.296	B	MIXED		5.00	4.060	0.085	0.0849	1.06	299.03	0.0130		INITIAL SUBAREA

RATIONAL METHOD STUDY FORM

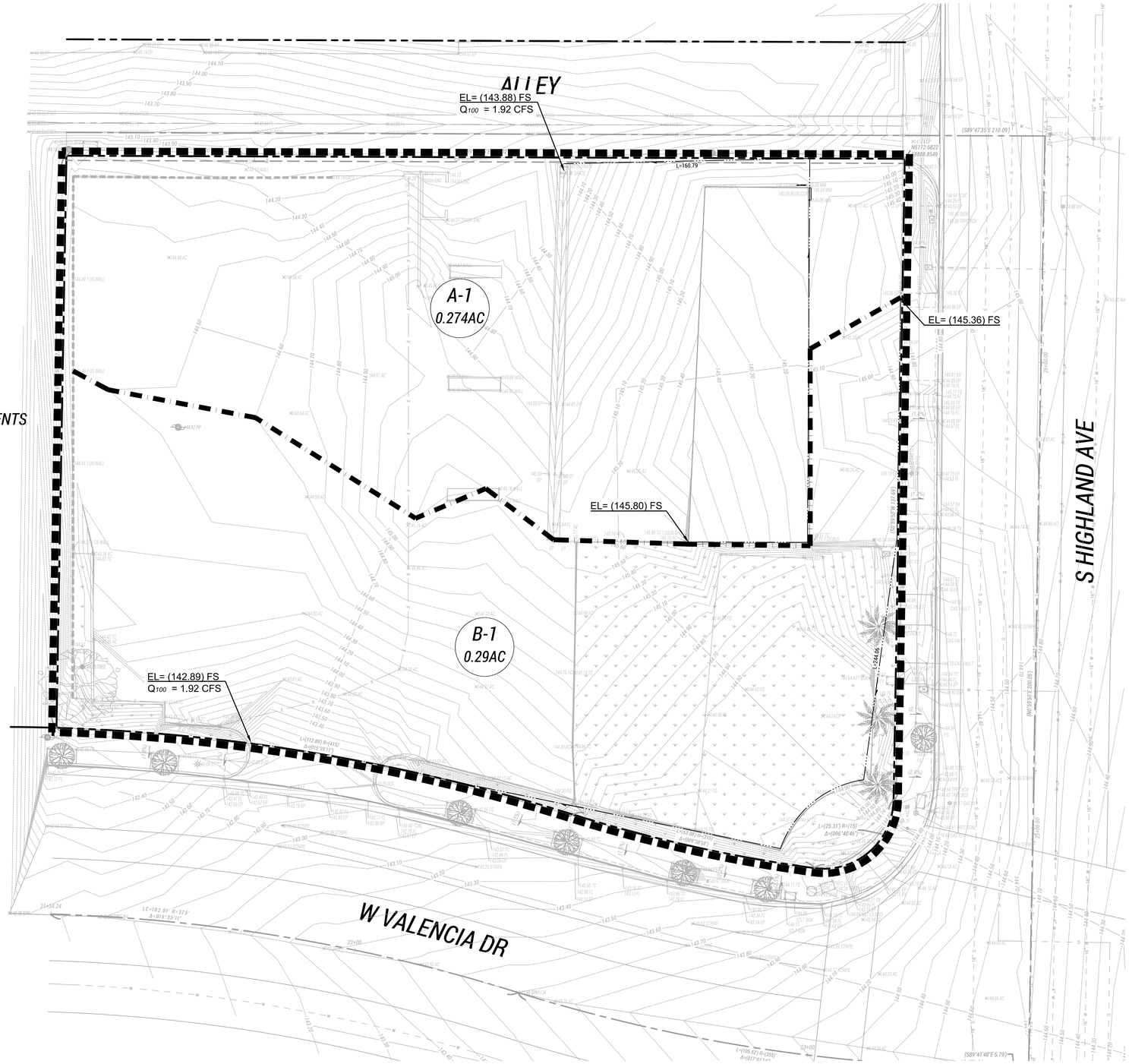
ORANGE COUNTY HYDROLOGY	Highland Avenue prop- DEVELOPMENT 100-YEAR STORM RATIONAL METHOD STUDY	Calc'd By: T.G. Date: 2/10/2021 Checked By: P.G. Date: Page 1 of 1

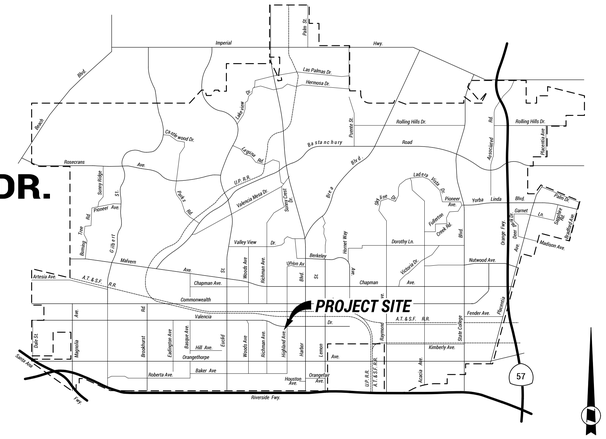
Concentration	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.268	0.268	B	MIXED		5.00	6.187	0.012	0.012	1.49	99.46	0.0200		INITIAL SUBAREA
B-1 1-2	0.296	0.296	B	MIXED		5.00	6.187	0.085	0.085	1.63	299.03	0.0130		INITIAL SUBAREA

APPENDIX E: HYDROLOGY MAPS

CITY OF FULLERTON

HIGHLAND & VALENCIA DEVELOPMENT
HYDROLOGY MAPS
415 S. HIGHLAND AVE. & 301 W. VALENCIA DR.
FULLERTON, CA 92832





LOCATION MAP A

HYDROLOGY INFORMATION

DRAINAGE AREA:	0.564 ACRE
DEV. TYPE:	RESIDENTIAL/COMMERCIAL
SOIL GROUP:	A (PER SOILS MAP)
Tc:	PER CALCULATIONS
FREQUENCY:	100-YR
METHOD:	ORANGE COUNTY HYDROLOGY MANUAL RATIONAL METHOD

LEGEND

- DRAINAGE AREA BOUNDARY
- SUB AREAS
- FLOW DIRECTION
- EXISTING PROPERTY LINE
- (1) — NODE NUMBER FOR HYDROLOGY CALCULATIONS
- A-1 / 0.313AC — SUB-DRAINAGE AREA NUMBER; AREA ACREAGE (AC)
- FS — FINISHED SURFACE
- EL — ELEVATION
- L — LENGTH OF FLOW
- CFS — CUBIC FEET PER SECOND

Hydrology Summary

Areas	Nodes	Flow rate (cfs)					
		2 -yr (cfs)		10-yr (cfs)		100-yr (cfs)	
		Exist.	Prop.	Exist.	Prop.	Exist.	Prop.
A-1	1-2	0.48	0.52	0.87	0.93	1.32	1.41
B-1	1-2	0.38	0.58	0.7	1.06	1.08	1.62

10 SCALE 0 10 20

CLIENT
McEb LLC
2400 E KATELLA AVE., SUITE 800
ANAHEIM, CA 92806

PROJECT NAME
HIGHLAND & VALENCIA DEVELOPMENT
415 S. HIGHLAND AVE.
FULLERTON, CA 92832

ENGINEER/ARCHITECT

IDS
IDS GROUP
1 PETERS CANYON ROAD, SUITE 130
IRVINE, CA. 92606
TEL: 949-387-8500, FAX: 949-387-0800

STAMP
MICHAEL LEED PROFESSIONAL ENGINEER PAUL NO. M. C 55577 CIVIL STATE OF CALIFORNIA

ISSUE

REV.	DESCRIPTION	DATE

KEY PLAN

THE BEARINGS SHOWN HEREON ARE BASED ON THE BEARING OF HIGHLAND AVENUE BEING N 0°59'50" E BETWEEN VALENCIA DRIVE AND ALLEY TO THE NORTH PER PARCEL MAP NO. 2010-124 BOOK 384 PAGE 43.

LOCAL BENCHMARK IN TOP OF NW CURB AT INTERSECTION OF HIGHLAND AND VALENCIA ELEVATION = 99.90 FT

PROJECT NO.	
PRINT DATE	
DRAWN BY	JW/KT
CHECKED BY	TG

SHEET TITLE
HYDROLOGY MAP - UNDEVELOPED

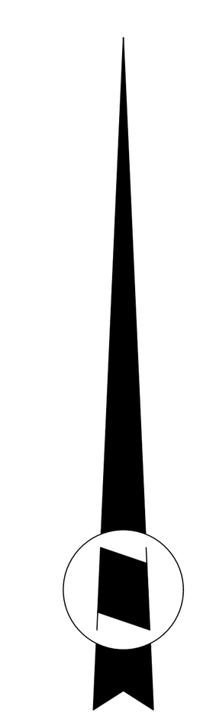
SHEET NUMBER
HYD-1

HYDROLOGY INFORMATION

DRAINAGE AREA:	0.564 ACRE
DEV. TYPE:	RESIDENTIAL/COMMERCIAL
SOIL GROUP:	A (PER SOILS MAP)
Tc:	PER CALCULATIONS
FREQUENCY:	100-YR
METHOD:	ORANGE COUNTY HYDROLOGY MANUAL RATIONAL METHOD

LEGEND

▬ ▬ ▬	DRAINAGE AREA BOUNDARY
▬ ǀ ▬ ǀ ▬	SUB AREAS
——— - - - ———	FLOW DIRECTION
——— — — ———	EXISTING PROPERTY LINE
(1)	NODE NUMBER FOR HYDROLOGY CALCULATIONS
A-1	SUB-DRAINAGE AREA NUMBER
0.313AC	AREA ACREAGE (AC)
FS	FINISHED SURFACE
EL	ELEVATION
L	LENGTH OF FLOW
CFS	CUBIC FEET PER SECOND



10 SCALE 0 10 20

CLIENT

McEb LLC

2400 E KATELLA AVE., SUITE 800
ANAHEIM, CA 92806

PROJECT NAME

HIGHLAND & VALENCIA DEVELOPMENT

415 S. HIGHLAND AVE.
FULLERTON, CA 92832

ENGINEER/ARCHITECT

IDS

IDS GROUP

1 PETERS CANYON ROAD, SUITE 130
IRVINE, CA. 92606
TEL: 949-387-8500, FAX: 949-387-0800

STAMP

REGISTERED PROFESSIONAL ENGINEER
PIETRO M. GAMBINO
C 55577
CIVIL
STATE OF CALIFORNIA

ISSUE

REV.	DESCRIPTION	DATE

KEY PLAN

PROJECT NO.	16056.00
PRINT DATE	02/12/2021
DRAWN BY	TC
CHECKED BY	RB

SHEET TITLE

HYDROLOGY MAP - DEVELOPED

SHEET NUMBER

HYD-2

F.2 - Water Quality Management Plan Report

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

Project Name:

Highland and Valencia Development
415 S. Highland Ave
Fullerton, CA 92835

Prepared for:

Greg McCafferty
McEb, LLC
2400 E. Katella Ave, Suite 800
Anaheim, CA 92806

Prepared by:

Tejal Gandhi
IDS Civil Engineers
1 Peters Canyon Road, Suite 130
Irvine, CA 92606
(949)387-8500

Updated February 12, 2021
July 9, 2020
December 17, 2018

Project Owner's Certification			
Planning Application No. (If applicable)		Grading Permit No.	
Tract/Parcel Map and Lot(s) No.		Building Permit No.	
Address of Project Site and APN (If no address, specify Tract/Parcel Map and Lot Numbers)			032-181-18 & 20

This Water Quality Management Plan (WQMP) has been prepared for McEb, LLC by IDS Civil Engineers. 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 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:			
Title	OWNER		
Company	McEb, LLC		
Address	2400 E. Katella Ave, Suite 800 Anaheim, CA 92806		
Email			
Telephone #	714-606-7208		
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	

Preparer (Engineer):			
Title	Project Engineer	PE Registration #	C79637
Company	IDS Civil Engineers		
Address	1 Peters Canyon Road, Suite 130, Irvine, CA 92606		
Email	Tejal.Gandhi@idsgi.com		
Telephone #	(949)387-8500 ext. 502		

I hereby certify that this Water Quality Management Plan is in compliance with, and meets the requirements set forth in, Order No. R8-2009-0030/NPDES No. CAS618030, of the Santa Ana Regional Water Quality Control Board.

Preparer Signature	Tejal Gandhi	Date	02/12/2021
Place Stamp Here			

Project Owner's Certification i

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

Provide discretionary or grading/building permit information and water quality conditions of approval, or permit issuance, applied to the project. If conditions are unknown, please request applicable conditions from staff. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available on the OC Planning website (ocplanning.net).*

Project Infomation			
Permit/Application No. (If applicable)		Grading or Building Permit No. (If applicable)	
Address of Project Site (or Tract Map and Lot Number if no address) and APN	415 S. Highland Ave Fullerton, CA 92835 032-181-18 032-181-20		
Water Quality Conditions of Approval or Issuance			
Water Quality Conditions of Approval or Issuance applied to this project. (Please list verbatim.)	N/A		
Conceptual WQMP			
Was a Conceptual Water Quality Management Plan previously approved for this project?	No, this is the conceptual WQMP		

Watershed-Based Plan Conditions	
Provide applicable conditions from watershed-based plans including WIHMPs and TMDLS.	HAS NOT BEEN APPROVED

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas.
- Land uses.
- Land cover.
- Design elements.
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the Technical Guidance Document (TGD) for information that must be included in the project description.*

Description of Proposed Project				
Development Category (From Model WQMP, Table 7.11-2; or -3):	Category 8: Significant redevelopment of the existing carwash and vacant land for the development of 14 condominiums and 2 shopkeepers' units			
Project Area (ft^2): 24,567 0.564 acres	Number of Dwelling Units: 20 Condominium – 18 Shopkeepers - 2		SIC Code: 1522	
Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	4,805	19.56	19,762	80.44
Post-Project Conditions	4,085	16.6	20,	83.4
Drainage Patterns/Connections	The site is relatively flat. The existing site sheet flows toward Alley, Valencia, and Highland Avenue. The pre-and post-drainage patterns will remain the same, except the site will treat the 85th percentile stormwater runoff with Modular Wetland System (Biofiltration System). The overflow from the site sheet flows discharges to the Valencia, Alley, and Highland via the various system. See the WQMP plan for the drainage pattern.			

Narrative Project Description: (Use as much space as necessary.)	**Existing:** APN 031-181-18 – A roughly "L"-shaped parcel at the northeastern corner of (the N-S trending) Highland Avenue and (the generally E-W trending) Valencia Drive, and engulfing the roughly E-W trending rectangular APN 031-181-20 (the other site parcel) to its northeast. The parcel consists mainly of a fenced roughly N-S trending rectangular-shaped asphalt-paved parking lot almost occupying the entire western arm of the roughly "L"-shaped parcel; a roughly trapezoid-shaped unpaved lawn yard in the eastern main portion of the southern arm of the roughly "L"-shaped parcel; and asphalt-paved parking lots/driveways for the carwash facility (occupying APN 031-181-20) in between above two parcel main features. APN 031-181-20 (415 South Highland Avenue) - A roughly E-W trending rectangular parcel engulfed by APN 031-181-18 to its northeast; the parcel is generally improved with a single-story roughly N-S trending four-bay self-auto wash building occupying approximately its approximate east-central ¼; asphalt-paved driveways occupying approximately its eastern ¼ and its west-central ¼; and asphalt-paved parking spaces with self-auto interior vacuum cleaning devices in-between spaces. The runoff from the existing condition is divided into 2 parts. The north side of the project is draining to the Alley on the north and the south side of the project is draining to West Valencia Drive. The proposed site consists of 20 mixed-use development Dwelling units - 18 Residential 1 to 2 Bedroom condominiums and 2 shopkeepers' units. The site also includes hardscape, patio, fences, parking, Trash enclosure, Modular wetland system, monuments, underground utilities, private driveway. The 85th percentile design flow rate for the entire site will be treated with Modular Wetland System since the majority of the runoff is from the roof. The stormwater runoff will be collected at various catch basins throughout the site. It will be then conveyed to the MWS system where the treatment will take place. The treated flow will be pumped to the proposed catch basin and then it will be carried to the street via curb drain. See the WQMP exhibit for the drainage pattern. Once the system at its capacity, then the runoff will follow the proposed drainage pattern. Stormwater will sheet flow to the existing streets. **<u>North side of the property</u>**- represents Units 206-210, flat roof, patio, parking, and a portion of private drive aisle and Unit B1. The 85% percentile stormwater runoff from the roof, patio, the portion of private drive isle, and parking will be conveyed to the various catch basins, trench drain through various downspouts, and concrete gutter. Then the

runoff will be carried to the MWS system by an 8" stormdrain pipe. The overflow from the catch basins will sheet flow towards the existing concrete gutter located at Alley. The gutter carries flow from east to west. See Exhibit E for the drainage pattern.

Southside of the property represents Units 211-214, Unit C, Unit D, Unit E, Unit B2, Green roof, patio, and flat roof. The 85% percentile stormwater runoff from roof and parking will be conveyed to the various catch basins through various downspouts. Then it will be carried to the MWS system by an 8" stormdrain pipe. It will then be pumped out to Highland Avenue through a curb outlet. The overflow from the catch basins will sheet flow towards the street.

There are no existing storm drain systems near the property and therefore, the runoff will be collected at catchbasin located at the corner of Valencia Drive and Richman Avenue. From there, a runoff will be carried out by an existing storm drain system to the Coyote Creek that will eventually carry out the discharge to the San Gabriel River Reach 1 to Estuary.

Note:

The runoff from the existing condition is divided into 2 parts. The north side of the project is draining to the Alley on the north and the south side of the project is draining to West Valencia Dr. However, in the proposed condition the runoff will sheet flow to Highland Avenue, Valencia Drive, and Alley once the MWS system is at its capacity. Since the runoffs from Alley and Valencia Drive drain to the same catch basin at the corner of Richman Ave and Valencia Drive, there will no concern with a diversion of flow.

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the Technical Guidance Document (TGD) for guidance.*

Pollutants of Concern			
Pollutant	Check One for each: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E ☒	N ☐	
Nutrients	E ☒	N ☐	
Heavy Metals	E ☐	N ☒	It is not a metal roof
Pathogens (Bacteria/Virus)	E ☒	N ☐	
Pesticides	E ☒	N ☐	
Oil and Grease	E ☒	N ☐	
Toxic Organic Compounds	E ☒	N ☐	
Trash and Debris	E ☒	N ☐	

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the Technical Guidance Document (TGD) for North Orange County or Section 2.2.3.2 for South Orange County.*

☒ No – Show map

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

Per the Susceptibility analysis San Gabriel River/Coyote Creek, the proposed site is not susceptible therefore HCOC does not exist and hydromodification does not need to be considered further.

II.4 Post Development Drainage Characteristics

Describe post-development drainage characteristics. *Refer to Section 2.2.4 in the Technical Guidance Document (TGD).*

Biofiltration System -

The site is relatively flat. The pre-and post-drainage patterns will remain the same, except the site will have a BMP system that will treat the stormwater runoff and discharges to Alley, Highland Ave, and Valencia Drive.

There are no existing storm drain systems near the property and therefore, the runoff will be collected at catchbasin located at the corner of Valencia Drive and Richman Avenue. From there, a runoff will be carried out by an existing storm drain system to the Coyote Creek that will eventually carry out the discharge to the San Gabriel River Reach 1 to Estuary.

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the Technical Guidance Document (TGD).*

Presently the property is owned and managed by Development Advisors.

The owner will be responsible for the maintenance of the best management practices outlined in this WQMP as well as sewer, water, and fire water lines. No portion of the project site or project will be transferred to a governmental agency. The property owner will follow the requirements outlined in the maintenance covenant which will be recorded against the property. None of the infrastructure constructed as a part of this project will be transferred to the City, County, State, or any other public entity.

If the property is sold or ownership transferred, the "Notice of Transfer of Responsibility" form in Appendix I shall be filed with the city.

Section III Site Description

III.1 Physical Setting

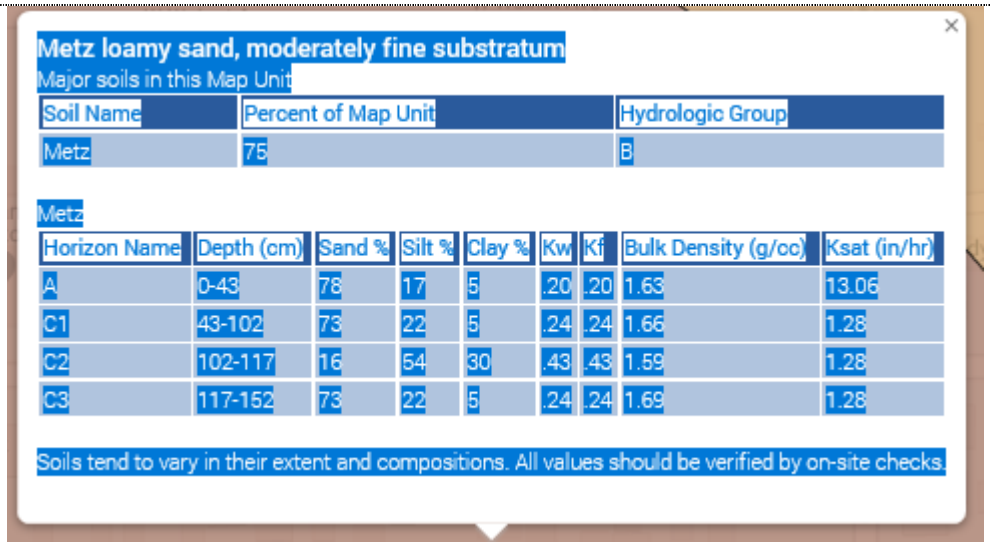
Fill out table with relevant information. *Refer to Section 2.3.1 in the Technical Guidance Document (TGD).*

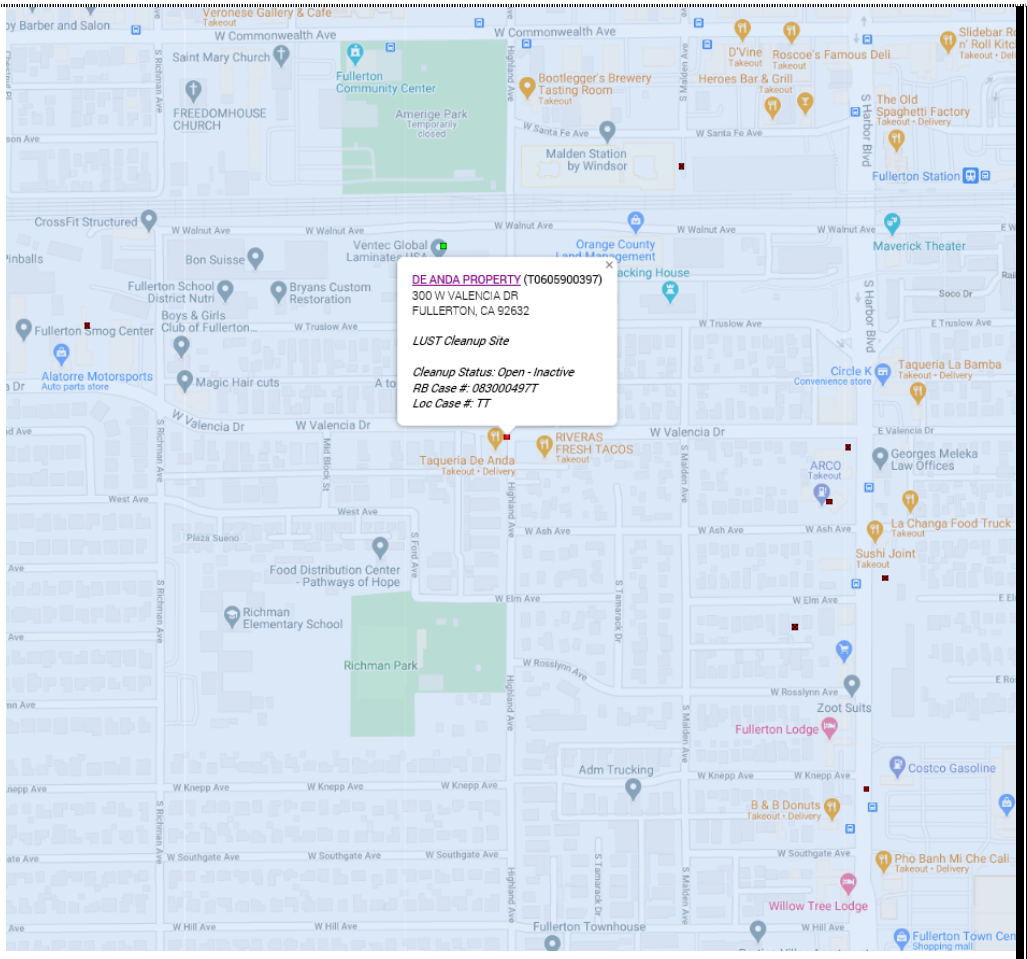
Name of Planned Community/Planning Area (if applicable)	Highland and Valencia Development
Location/Address	415 South Highland Ave Fullerton, CA 92835
General Plan Land Use Designation	Residential, Commercial (mixed-use)
Zoning	C-3
Acreage of Project Site	0.564
Predominant Soil Type	B

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.2 in the Technical Guidance Document (TGD).*

Site Characteristics	
Precipitation Zone	0.90 inch – 85th Percentile Rainfall – 24 hours
Topography	Flat / drains towards Alley, Valencia, and Highland Avenue

Drainage Patterns/Connections	The site is relatively flat. Drainage is directed as sheet flow toward Alley, Valencia, and Highland Avenue.
Soil Type, Geology, and Infiltration Properties	 **Metz loamy sand, moderately fine substratum** Major soils in this Map Unit Soil Name: Metz; Percent of Map Unit: 75; Hydrologic Group: B Metz Horizon Name / Depth (cm) / Sand % / Silt % / Clay % / Kw / Kf / Bulk Density (g/cc) / Ksat (in/hr) A / 0-43 / 78 / 17 / 5 / .20 / .20 / 1.63 / 13.06 C1 / 43-102 / 73 / 22 / 5 / .24 / .24 / 1.66 / 1.28 C2 / 102-117 / 16 / 54 / 30 / .43 / .43 / 1.59 / 1.28 C3 / 117-152 / 73 / 22 / 5 / .24 / .24 / 1.69 / 1.28 Soils tend to vary in their extent and compositions. All values should be verified by on-site checks. Per the percolation report dated November 9. 2018, the infiltration at the site would be too low to meet the minimum requirements. The heavily interlayered nature of the subsurface soil which has impeded infiltration was observed in all of the exploratory borings. See attachment G
Hydrogeologic (Groundwater) Conditions	Per North Orange County Mapped Depth to First Groundwater, the groundwater depth is more than 30 feet. However, it falls within Groundwater Protection Areas. Per the soil report dated November 9, 2018, Groundwater was not encountered during this firm's subsurface exploration reaching depths of approximately 51.5 feet below the existing ground surface. A review of the referenced CDMG Seismic Hazard Zone Report 03 indicates that historical high groundwater levels for the general site area have been recorded at approximately 45 feet below the existing ground surface
Geotechnical Conditions (relevant to infiltration)	Per the percolation report dated November 9. 2018, the infiltration at the site would be too low to meet the minimum requirements According to the State's GeoTracker website, the project is located adjacent to an open Leaking Underground Storage Tank (LUST) site. Potential contaminants of concern include gasoline. Additionally, the project is located within Plume Protection Boundaries (North Basin Groundwater Protection Project). Therefore, infiltration is prohibited.

	
Off-Site Drainage	N/A
Utility and Infrastructure Information	Highland Avenue - Water, Sewer, Gas (21" Sewer – OCSD) Valencia – Water and Gas

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the Technical Guidance Document (TGD).*

Receiving Waters	Coyote Creek, San Gabriel River
303(d) Listed Impairments	Ammonia, Diazinon, Indicator Bacteria, pH, Lead, Nickel, Oxygen, Dissolved
Applicable TMDLs	Metals
Pollutants of Concern for the Project	Suspended-Solid/ Sediment, Nutrients, Pathogens (Bacteria/Virus), Pesticides, Oil and Grease, Toxic Organic Compounds, Trash, and Debris
Environmentally Sensitive and Special Biological Significant Areas	N/A

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed to determine what performance criteria will apply to a project. These steps include:

If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used, and the project can evaluate participation in the approved regional or sub-regional opportunities. (Please ask your assigned planner or plan checker regarding whether your project is part of an approved WIHMP or equivalent.)

Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*

Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-3.2.2 of the Model WQMP.*

Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.	N/A	

Project Performance Criteria	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	N/A

Project Performance Criteria	
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	The following performance criteria for LID implementation are stated in both permits: • Priority Projects must infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume-DCV). ** • A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biotreatment may be provided for the remaining design capture volume. (Not needed) **The 85th Percentile, 24-hour storm event flowrate for the entire site will be treated by MWS System (Biofiltration). see Worksheet B Attachment E
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	N/A
Calculate LID design storm capture volume for Project.	See Attachment

IV.2. Site Design and Drainage

Describe site design and drainage including

- A narrative of site design practices utilized or rationale for not using practices.
- A narrative of how the site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP "BMP Exhibit."
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs.

Refer to Section 2.4.2 in the Technical Guidance Document (TGD).

Per the percolation report dated November 9. 2018, the infiltration at the site would be too low to meet the minimum requirements. According to the State's GeoTracker website, the project is located adjacent to an open Leaking Underground Storage Tank (LUST) site. Potential contaminants of concern include gasoline. Additionally, the project is located within Plume Protection Boundaries (North Basin Groundwater Protection Project). Thus, infiltration is prohibited. Therefore, the Biofiltration system- Modular Wetland System (MWS) BMP is used for the stormwater control measures.

The site is relatively flat. The pre-and post-drainage patterns will remain the same, except the site will have a BMP system that will treat the 85th Percentile stormwater runoff with the MWS system. Most of the runoff is from the roof. The runoff from the roof, parking area, open space drive aisle area will be collected at various catch basins and trench drain. It will then be conveyed to the MWS system through a stormdrain pipe. The pump will pump out the treated stormwater to Highland Avenue through the curb outlet. Once the system is at its capacity, Overflow from the trench drain and various catch basins will sheet flow to the Alley, Highland Avenue, and Valencia Drive. See the WQMP plan for the drainage pattern.

The MWS system treats TSS, heavy metals, nutrients, hydrocarbons, and bacteria. The system includes the pretreatment chamber where it removes the trash, sediment, and, debris. With its innovative horizontal flow biofilter, the system can remove pollutants through a combination of physical, chemical, and biological filtration processes.

There are no existing storm drain systems near the property and therefore, the runoff will be collected at catchbasin located at the corner of Valencia Drive and Richman Avenue. From there, a runoff will be carried out by an existing storm drain system to the Coyote Creek that will eventually carry out the discharge to the San Gabriel River Reach 1 to Estuary.

IV.3 LID BMP Selection and Project Conformance Analysis

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the Technical Guidance Document (TGD) for selecting LID BMPs and Section 2.4.3 in the Technical Guidance Document (TGD) for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls (HSCs) (NOT PROPOSED)

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

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

IV.3.2 Infiltration BMPs (NOT PROPOSED)

Identify infiltration BMPs to be used in the project. If the design volume cannot be met, state why.

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration Basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration BMPs. If not, document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

Per the percolation report dated November 9. 2018, the infiltration at the site would be too low to meet the minimum requirements. According to the State's GeoTracker website, the project is located adjacent to an open Leaking Underground Storage Tank (LUST) site. Potential contaminants of concern include gasoline. Additionally, the project is located within Plume Protection Boundaries (North Basin Groundwater Protection Project). Thus, infiltration is prohibited. Therefore, the Biofiltration system-Modular Wetland System (MWS) BMP is used for the stormwater control measures.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs –

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration and/or rainwater harvesting BMPs included.

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

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with evapotranspiration and/or rainwater harvesting BMPs in combination with infiltration BMPs. If not, the document below how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with these BMP categories.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs included. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☐
Stormwater planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated Swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems (BIO-7)	☒
Wet extended detention basin	☐
Dry extended detention basins	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Storm Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not, document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with these BMP categories.

See the Attachment C for Worksheet D: Capture Efficiency Method for Flow-Based BMPs

MWS system

Q=CIA = 0.775x0.26x0.564 = 0.114 cfs

The proposed Biofiltration System BMP is MWS-L-4-8 and it can treat 0.115cfs of stormwater runoff.

IV.3.5 Hydromodification Control BMPs – N/A

Describe hydromodification control BMPs. *See Section 5 of the Technical Guidance Document (TGD).* Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval (if applicable).

Hydromodification Control BMPs	
BMP Name	**BMP Description**

IV.3.6 Regional/Sub-Regional LID BMPs – (NOT PROPOSED)

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP.*

Regional/Sub-Regional LID BMPs
N/A

IV.3.7 Treatment Control BMPs -N/A

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. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	**BMP Description**

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Hazardous material is not stored onsite
N6	Local Industrial Permit Compliance	☐	☒	Residential/commercial project
N7	Spill Contingency Plan	☐	☒	Residential/commercial project
N8	Underground Storage Tank Compliance	☐	☐	
N9	Hazardous Materials Disclosure Compliance	☐	☒	Hazardous material is not stored onsite
N10	Uniform Fire Code Implementation	☒	☐	
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	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	Residential/commercial project

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if structural source controls were not used.

Structural Source Control BMPs				
Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☒	☐	
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☐	☐	
S5	Protect slopes and channels and provide energy dissipation	☒	☐	
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☐	☒	Residential project
S7	Maintenance bays	☐	☒	Residential project
S8	Vehicle wash areas	☐	☒	Residential project
S9	Outdoor processing areas	☐	☒	Residential project
S10	Equipment wash areas	☐	☒	Residential project
S11	Fueling areas	☐	☒	Residential project
S12	Hillside landscaping	☐	☒	Residential project
S13	Wash water control for food preparation areas	☐	☒	Residential project
S14	Community car wash racks	☐	☒	Residential project

IV.4 Alternative Compliance Plan (If Applicable)

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

IV.4.1 Water Quality Credits - N/A

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the Technical Guidance Document (TGD) for calculation methods for applying water quality credits.*

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

Calculation of Water Quality Credits (if applicable)	N/A

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the Model WQMP.*

N/A

Section V Inspection/Maintenance Responsibility for BMPs

See Attachment D

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the funding mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Modular Wetland System **Biofiltration System**	OWNER	Inspect twice a year, once before the start of the rainy season. Replace Filter Media every 1-2-year, Trim vegetation as needed 6 to 12 months	6months The Owner is responsible for managing the system (can hire a manufacturer or contractor to maintain the system)

Section VI BMP Exhibit (Site Plan)

VI.1 BMP Exhibit (Site Plan)

Include a BMP Exhibit (Site Plan), at a size no less than 24" by 36," which includes the following minimum information:

- Insert in the title block (lower right hand corner) of BMP Exhibit: the WQMP Number (assigned by staff) and the grading/building or Planning Application permit numbers
- Project location (address, tract/lot number(s), etc.)
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Delineate the area being treated by each structural BMP
- GIS coordinates for LID and Treatment Control BMPs
- Drainage connections
- BMP details
- Preparer name and stamp

Please do not include any areas outside of the project area or any information not related to drainage or water quality. The approved BMP Exhibit (Site Plan) shall be submitted as a plan sheet on all grading and building plan sets submitted for plan check review and approval. The BMP Exhibit shall be at the same size as the rest of the plan sheets in the submittal and shall have an approval stamp and signature before plan check submittal.

VI.2 Submittal and Recordation of Water Quality Management Plan

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

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

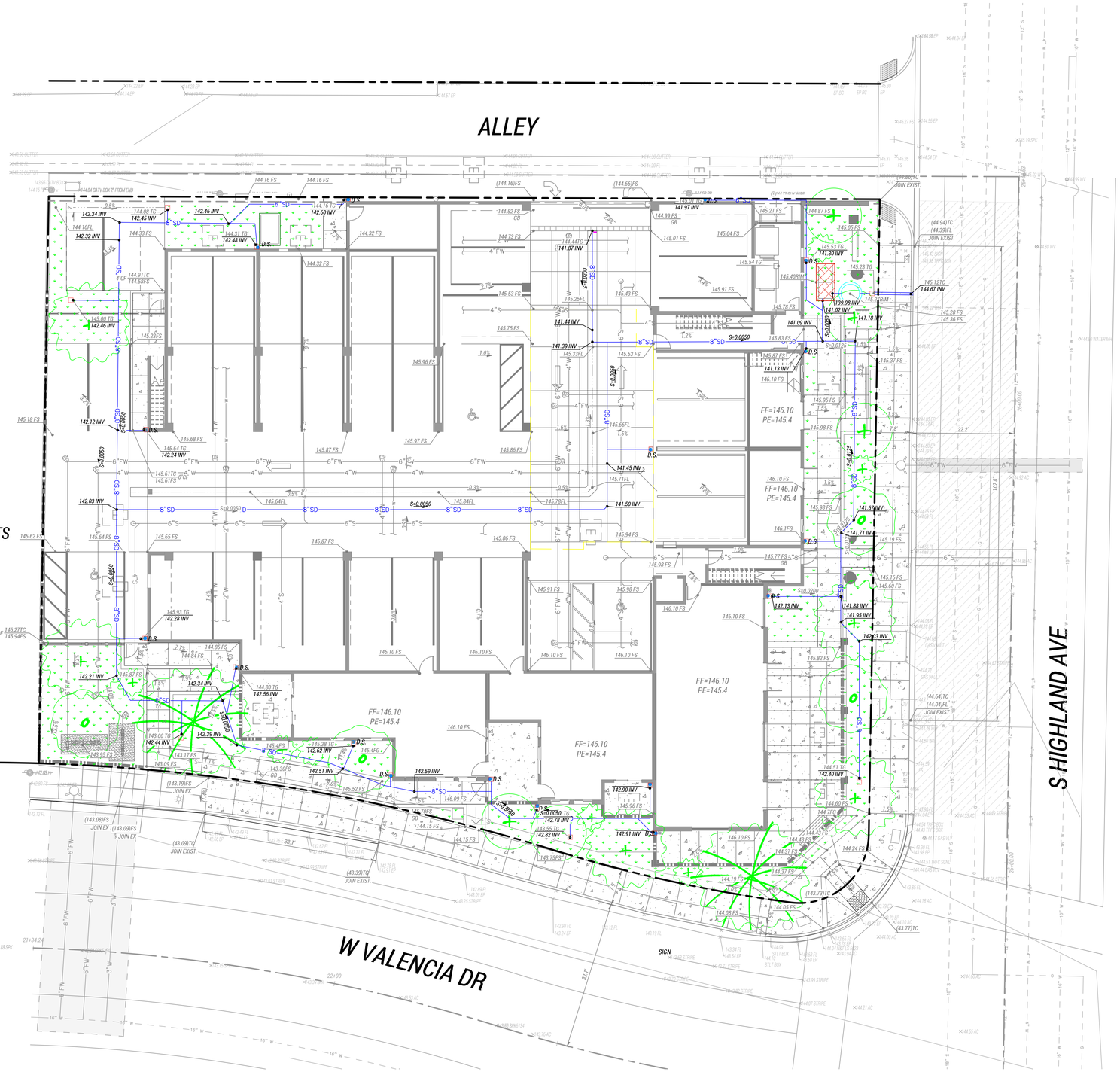
CITY OF FULLERTON

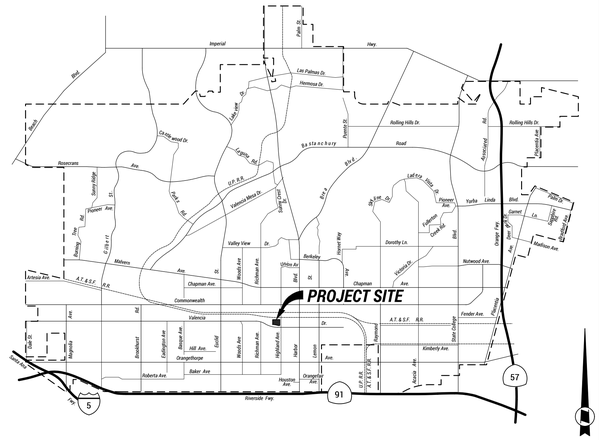
HIGHLAND & VALENCIA DEVELOPMENT

WATER QUALITY MANAGEMENT (WQMP)PLAN

415 S. HIGHLAND AVE. & 301 W. VALENCIA DR.

FULLERTON, CA 92832





NOT TO SCALE

LOCATION MAP A

NON-STRUCTURAL BMP'S

- N1- EDUCATION FOR PROPERTY OWNERS, TENANTS, AND OCCUPANTS
- N2- ACTIVITY RESTRICTIONS
- N4- BMP MAINTENANCE
- N11- COMMON AREA LITTER CONTROL
- N14- COMMON AREA CATCH BASIN INSPECTION
- N15- STREET SWEEPING PRIVATE STREETS AND PARKING LOTS

STRUCTURAL BMP'S

- PAVEMENT (IMPERVIOUS - 20,803 SF, 84.68%)
- LANDSCAPE AREA (PERVIOUS - 3,764 SF, 15.32%)
- STORMDRAIN BIOFILTRATION SYSTEM (MWS SYSTEM)
- PROPERTY LINE
- OPEN TO SKY
- CATCHBASIN STENCIL
- SURFACE DRAINAGE FLOW
- DOWNSPOUT
- A1 / 1,057AC — SITE AREA NUMBER / AREA ACREAGE (AC)

SUMMARY

TOTAL AREA	24,567	ft²	0.564	ac	
Soil Group	B				
Design Capture Stormdepth	0.90	in			
Green Terrace	1025	ft²	0.024	ac	
Landscape	3060	ft²	0.070	ac	
Total Pervious	**4,085**	**ft²**	**0.094**	**ac**	16.6%
Total Impervious	20,482	ft²	0.470	ac	83.4%
Design Intensity	0.260	in/hr	Worksheet D Graph		
Runoff coefficient	0.775				
Design Flowrate	***0.114***	***cfs***	See Calculations		

10 SCALE 0 10 20

CLIENT

McEb LLC

2400 E KATELLA AVE., SUITE 800
ANAHEIM, CA 92806

PROJECT NAME

HIGHLAND & VALENCIA DEVELOPMENT

415 S. HIGHLAND AVE.
FULLERTON, CA 92832

ENGINEER/ARCHITECT

IDS

IDS GROUP

1 PETERS CANYON ROAD, SUITE 130
IRVINE, CA. 92606
TEL: 949-387-8500, FAX: 949-387-0800

STAMP

MICHAEL LEED PROFESSIONAL ENGINEER PAUL NO. M. CAMPBELL C 55577 CIVIL STATE OF CALIFORNIA

ISSUE

REV.	DESCRIPTION	DATE

KEY PLAN

PROJECT NO.	16056.00
PRINT DATE	02/12/2021
DRAWN BY	TC
CHECKED BY	RB

SHEET TITLE

WQMP PLAN

SHEET NUMBER

C501

SPECIFICATIONS

FLOW-BASED

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

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

SITE SPECIFIC DATA

PROJECT NUMBER		11691	
PROJECT NAME		HIGHLAND & VALENCIA DEVELOPMENT	
PROJECT LOCATION		FULLERTON, CA	
STRUCTURE ID		N/A	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
N/A		0.114	
TREATMENT HGL AVAILABLE (FT)			N/K
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	141.02	PVC	8"
INLET PIPE 2	N/A	N/A	N/A
OUTLET PIPE	139.98	PVC	6"
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION	145.40	145.40	145.40
SURFACE LOAD	PEDESTRIAN	N/A	PEDESTRIAN
FRAME & COVER	36" X 36"	OPEN PLANTER	N/A
WETLANDMEDIA VOLUME (CY)			2.71
ORIFICE SIZE (DIA. INCHES)			ø1.53"

NOTES: PRELIMINARY NOT FOR CONSTRUCTION.

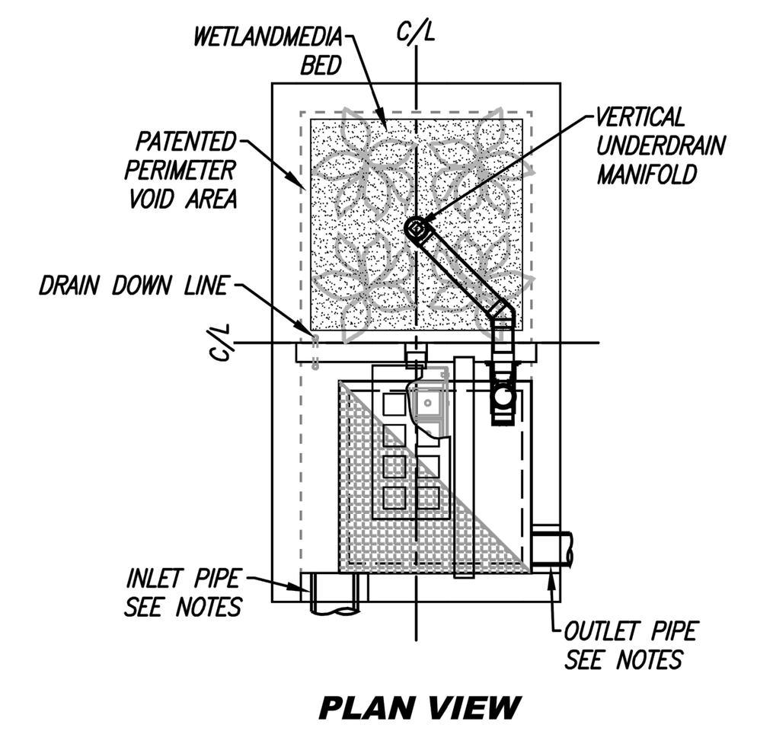
INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

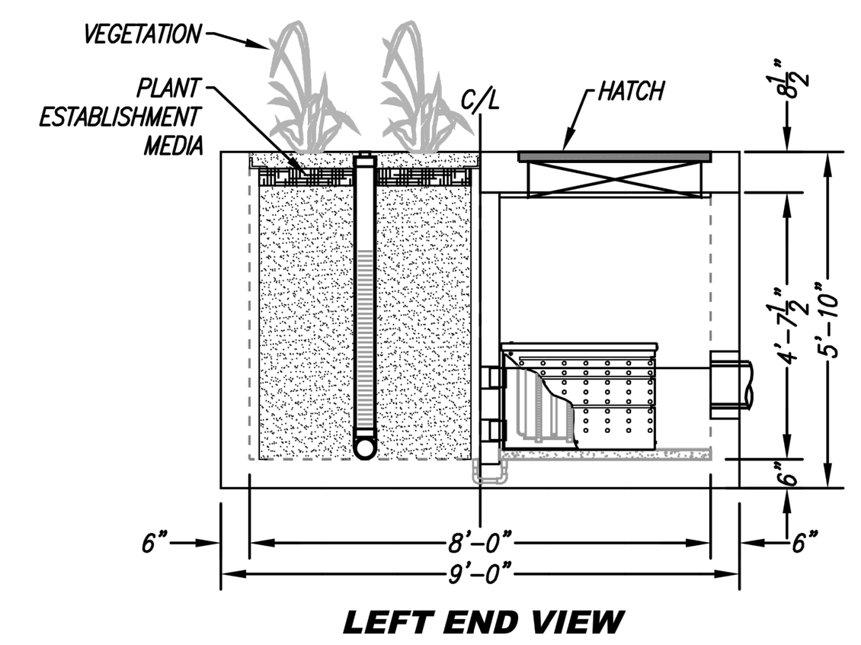
GENERAL NOTES

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

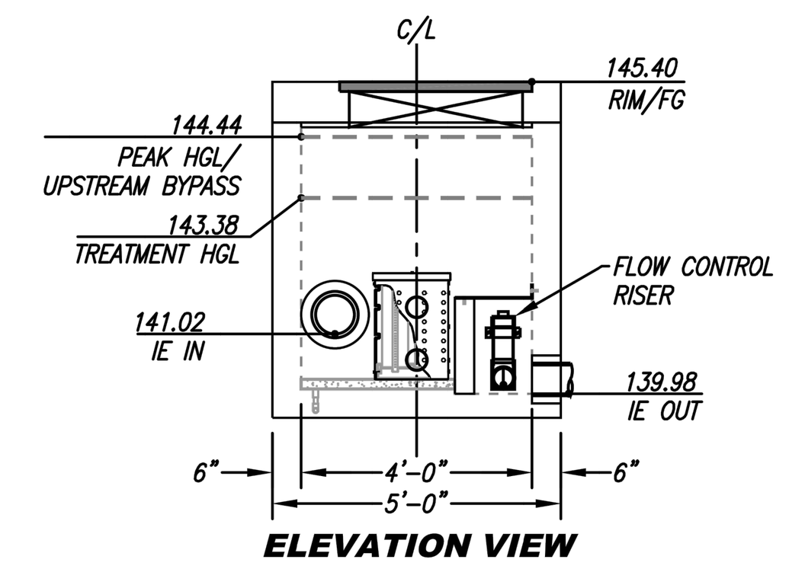
2/11/21MWOOLERY



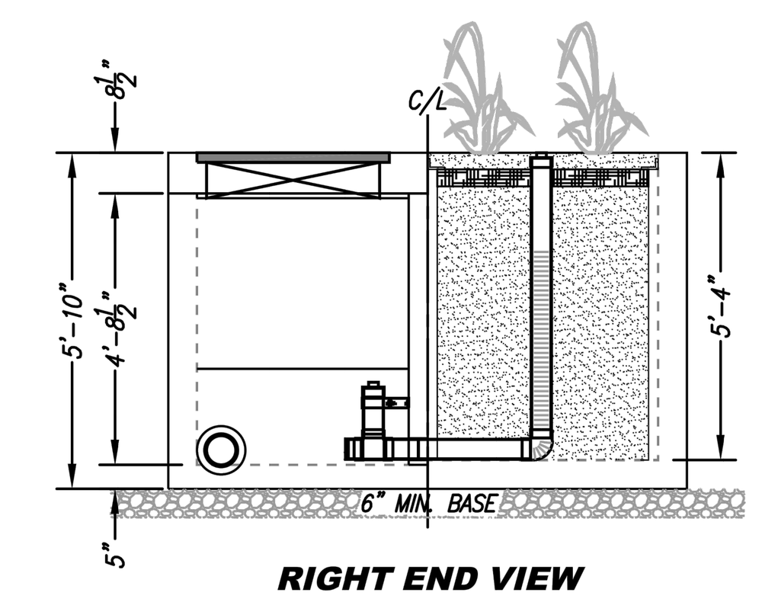
PLAN VIEW



LEFT END VIEW



ELEVATION VIEW



RIGHT END VIEW

TREATMENT FLOW (CFS)	0.114
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

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

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Bio Clean
A Forterra Company

MWS-L-4-8-5'-4"-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

CLIENT

McEb LLC

2400 E KATELLA AVE., SUITE 800
ANAHEIM, CA 92806

PROJECT NAME

HIGHLAND & VALENCIA DEVELOPMENT

415 S. HIGHLAND AVE.
FULLERTON, CA 92832

ENGINEER/ARCHITECT

IDS

IDS GROUP

1 PETERS CANYON ROAD, SUITE 130
IRVINE, CA. 92606
TEL: 949-387-8500, FAX: 949-387-0800

STAMP

REGISTERED PROFESSIONAL ENGINEER
PIETRO M. GAMBINO
C 55577
CIVIL
STATE OF CALIFORNIA

ISSUE

REV.	DESCRIPTION	DATE

KEY PLAN

PROJECT NO.	16056.00
PRINT DATE	02/12/2021
DRAWN BY	TC
CHECKED BY	RB

SHEET TITLE

WATER QUALITY MANAGEMENT PLAN DETAILS

SHEET NUMBER

C501.1

Section VII Educational Materials – Attachment A

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

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☐
Household Tips	☐	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☐		
Recycle at Your Local Used Oil Collection Center (North County)	☐		☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☐		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape, and Hardscape Drains	☒		☐
Tips for Projects Using Paint	☒		☐

Attachments

Attachment A

Educational Materials

Attachment B

303(d) Lists

				◦ Point Source				
4	Coyote Creek	River & Stream	40515010 / 18070104	• Ammonia ◦ Point Source	13 Miles	1996	5C	
				• Copper, Dissolved ◦ Source Unknown	13 Miles	2002	5B	2007
				• Diazinon ◦ Source Unknown	13 Miles	2006	5A	2019
				• Indicator Bacteria ◦ Source Unknown	13 Miles	1996	5A	2009
				• Lead ◦ Major Municipal Point Source-wet weather discharge	13 Miles	2002	5B	2007
				• Toxicity ◦ Point Source *This listing was made by USEPA for 2002.*	13 Miles	2002	5A	2008
				• pH ◦ Source Unknown	13 Miles	2006	5A	2019

and TGD, summarizes typical pollutants of concern for major land uses and project categories, including those that are proposed for the CollegeTown Specific Plan project.

Table 14 Anticipated and Potential Pollutants Generated by Land Use Type

Priority Project Categories and/or Project Features	*Suspended Solid/ Sediments*	*Nutrients*	*Heavy Metals*	*Pathogens (Bacteria/ Virus)*	*Pesticides*	*Oil & Grease*	*Toxic Organic Compounds*	*Trash & Debris*
High Density Residential Development	E	E	N	E	E	E	N	E
Attached Residential Development	E	E	N	E	E	E[b]	N	E
Commercial/Institutional Development	E[a]	E[a]	E[e]	E[c]	E[a]	E	E	E
Restaurants	E[a,b]	E[a]	E[b]	E	E[a]	E	N	E
Parking Lots	E	E[a]	E	E[d]	E[a]	E	E	E
Streets, Highways, & Freeways	E	E[a]	E	E[d]	E[a]	E	E	E

Note:
E = expected to be of concern N = not expected to be of concern.
Source: County of Orange. (2011, May 19). Technical Guidance Document for the Preparation of Conceptual/ Preliminary and/or Project Water Quality Management Plans (WQMPs). Table 2.1.
a Expected pollutant if landscaping exists on-site, otherwise not expected.
b Expected pollutant if the project includes uncovered parking areas, otherwise not expected.
c Expected pollutant if land use involves food or animal waste products, otherwise not expected.
d Bacterial indicators are routinely detected in pavement runoff.
e Expected if outdoor storage or metal roofs, otherwise not expected.

Bacteria/Pathogens. Elevated pathogens are typically caused by the transport of human or animal fecal wastes from the watershed. Runoff that flows over land such as urban runoff can mobilize pathogens, including bacteria and viruses. Even runoff from natural areas can contain pathogens (e.g., from wildlife, plant matter, and soils). Other sources of pathogens in urban areas include pets and leaky sanitary sewer pipes. The presence of pathogens in runoff can impair receiving waters. Total and fecal coliform, enterococcus bacteria, and *E. coli* bacteria are commonly used as indicators for pathogens due to the difficulty of monitoring pathogens directly.

Metals. The primary sources of trace metals in storm water are metals typically used in transportation, buildings and infrastructure and also paints, fuels, adhesives and coatings. Copper, lead, and zinc are the most prevalent metals typically found in urban runoff. Other trace metals, such as cadmium, chromium, mercury are typically not detected in urban runoff or are detected at very low levels.[16] Trace metals have the potential to cause toxic effects on aquatic life and are a potential source of groundwater contamination.

[16] Los Angeles County, Department of Public Works. (2000, September). Los Angeles County 1994–2000 Integrated Receiving Water Impacts Report. Retrieved January 27, 2009, from http://ladpw.org/WMD/npdes/IntTC.cfm

Nutrients. Nutrients are inorganic forms of phosphorous and nitrogen. The main sources of nutrients in urban areas include fertilizers in lawns, pet wastes, failing septic systems, and atmospheric deposition from automobiles and industrial operations. The most common impact of excessive nutrient input is eutrophication of the receiving water body, resulting in excessive algal production, hypoxia or anoxia, fish kills and potential releases of toxins from sediment due to changes in water chemistry profiles.

Oil and Grease. The most common sources of oil and grease in urban runoff stem from spilled fuels and lubricants, discharge of domestic and industrial wastes, atmospheric deposition, and runoff. Runoff can contain leachate from roads, breakdown of tires/rubber and deposition of automobile exhaust. Some petroleum hydrocarbons, such as polycyclic aromatic hydrocarbons (PAHs), can bioaccumulate in aquatic organisms and are toxic at low concentrations. Hydrocarbons can be measured in a variety of ways including petroleum hydrocarbons, oil and grease, or as individual groups such as PAHs. Hydrocarbons can persist in sediment for long periods of time in the environment and can result in adverse impacts on the diversity and abundance of benthic communities.

Organic Compounds. Organic compounds are carbon-based, and are typically found in pesticides, solvents, and hydrocarbons. Dirt, grease, and other particulates can also adsorb organic compounds in rinse water from cleaning objects, and can be harmful or hazardous to aquatic life either indirectly or directly.

Oxygen Demanding Substances. Oxygen-demanding substances include biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds, such as proteins, carbohydrates, fats, as well as ammonia and hydrogen sulfide. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions, resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds.

Pesticides. Pesticides (including herbicides) are chemical compounds commonly used to control insects, rodents, plant diseases, and weeds. Excessive application of a pesticide or impractical application of pesticides (i.e., right before rain events) may result in runoff containing toxic levels to receiving water bodies and the microorganisms.

Sediment. Sheet erosion and the transport and deposition of sediment in surface waters can be a significant form of pollution that may result in water quality problems. Increases in runoff velocities and volumes can cause excessive stream erosion and sediment transport altering the sediment equilibrium of a stream or channel. Excessive fine sediment, such as total suspended solids, can impair aquatic life through changes to the physical characteristics of the stream (light reduction, temperature changes, etc.).

Trash and Debris. Improperly disposed or handled trash such as paper, plastics and debris including the biodegradable organic matter such as leaves, grass cuttings, and food waste can accumulate on the ground surface where it can be entrained in urban runoff. The large amount of trash and debris can have significant negative impacts on the recreational value of water body. Excessive organic matter can create a high biochemical oxygen demand in a stream and lower its water quality.

Caltrans Water Quality Planning Tool

The Water Quality Planning Tool was created to help planners and designers comply with environmental permits. It uses a map interface to find information based on a project's location. **This application is being updated for digital accessibility and will continue to function while updates are in progress.**

Layers

- ☐ 303(d) List and TMDLs 2014-2016 (Legend)
- ☐ Areas of Special Biological Significance
- ☐ Arid and Semi-Arid Regions
- ☐ Caltrans Districts
- ☐ Caltrans Facilities
- ☐ Caltrans Tier 1 Monitoring Sites
- ☐ Calwater Watersheds
- ☐ Coastal Zone
- ☐ Counties
- ○ Geologic Map (Legend)
- ☐ High Risk Receiving Watersheds
- ☐ Monthly Precipitation
- ☐ MS4 Areas
- ☐ Post Miles
- ☐ Rainfall Distribution
- ☐ RWQCB Boundaries
- ○ USGS Topo Maps
- ☐ Watershed Boundary Dataset

Risk Level Determination

- ☐ Erosivity Index
- ☐ K Factor
- ☐ R Factor (calculations)
- ○ LS Factor
- ☑ Soil Details

Compliance Storm Events

- ○ 5-yr 24-hr North
- ○ 10-yr 24-hr North
- ○ 5-yr 24-hr South
- ○ 10-yr 24-hr South

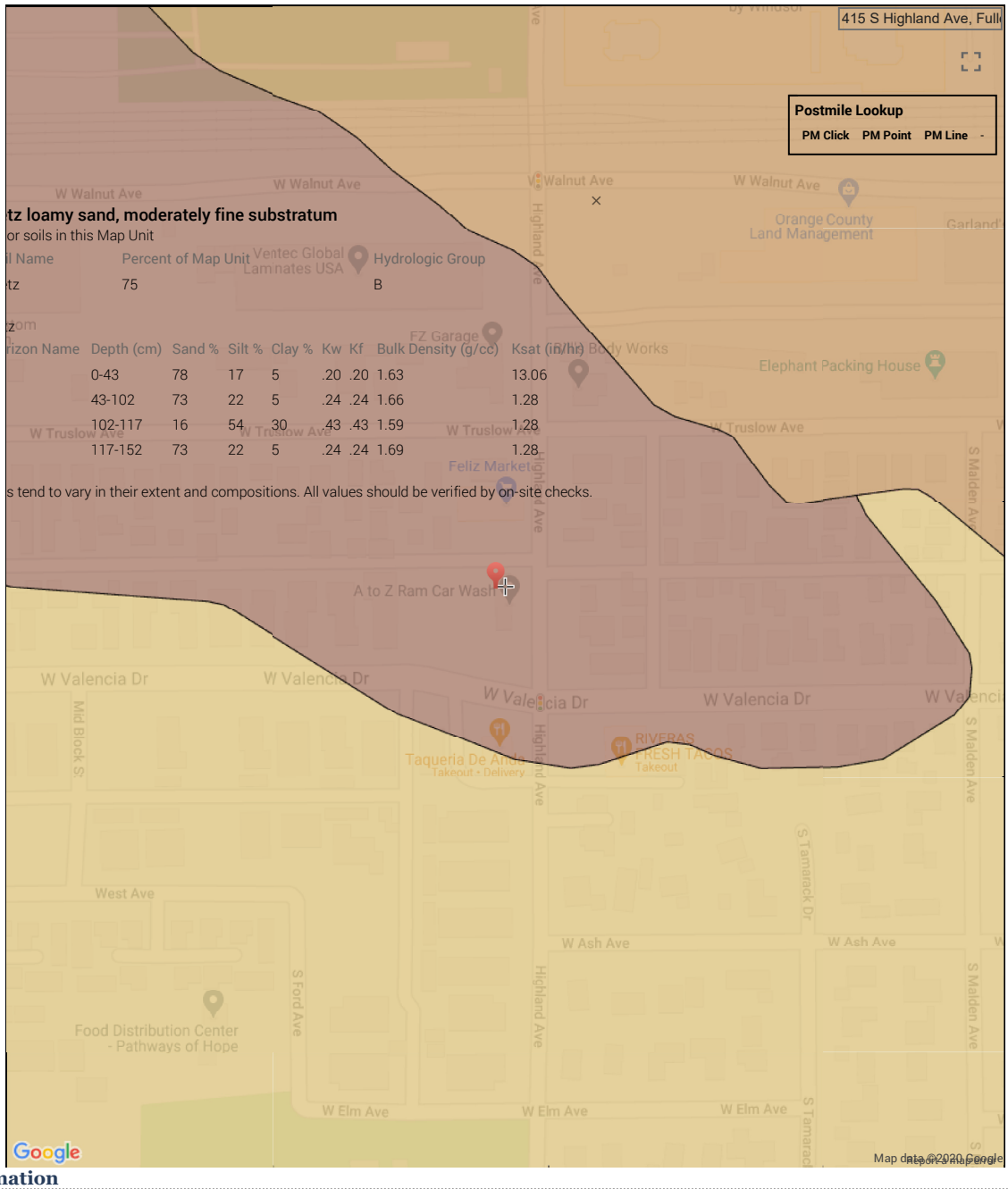
Distance and Area

☐ Measure Clear
Feet: 0
Acres: 0

Postmile Lookup

☑ Show postmile lookup

Information
Hover over a layer name for a description. Additional information, tables, coordinates, and links are below the map. Help



Watershed Information

CALWATER WATERSHED

Hydrologic Unit	SAN GABRIEL RIVER	Hydrologic Area	Anaheim	Hydrologic Sub-Area #	845.61
Hydrologic Sub-Area Name	undefined	Planning Watershed	4845610000	HSA Area (acres)	40937
Latitude, Longitude	33.8666, -117.9288				

WATERSHED BOUNDARY DATASET

Watershed	Lower San Gabriel River	Subwatershed	Fullerton Creek	Hydrologic Unit Code	180701060504
Average Annual Precipitation (inches)	13.8				

TMDLs & 303(d) Listed Water Bodies (2014 - 2016 List)

Key: Water body on 303(d) list Water body with a TMDL

Name	Pollutant	Size	Status
Artesia-Norwalk Drain	Indicator Bacteria	2.5 Miles	Being addressed with USEPA approved TMDL
Artesia-Norwalk Drain	Selenium	2.5 Miles	TMDL required
Coyote Creek	Copper, Dissolved	13.31 Miles	Being addressed with USEPA approved TMDL
Coyote Creek	Indicator Bacteria	13.31 Miles	Being addressed with USEPA approved TMDL
Coyote Creek	Iron	13.31 Miles	TMDL required
Coyote Creek	Malathion	13.31 Miles	TMDL required
Coyote Creek	pH	13.31 Miles	TMDL required
Coyote Creek	Toxicity	13.31 Miles	TMDL required
San Gabriel River Estuary	Copper	3.36 Miles	Being addressed with USEPA approved TMDL
San Gabriel River Estuary	Dioxin	3.36 Miles	TMDL required
San Gabriel River Estuary	Indicator Bacteria	3.36 Miles	Being addressed with USEPA approved TMDL
San Gabriel River Estuary	Nickel	3.36 Miles	TMDL required
San Gabriel River Estuary	Oxygen, Dissolved	3.36 Miles	TMDL required

Water Quality Objectives

The following waterbodies are in or near HSA 845.61. Click on the waterbody to get information on water quality objectives and beneficial uses

Waterbody Name	Beneficial Uses	Sediment-Sensitive Waterbody
Anaheim Bay	ALL	False
Agua Chinon Wash	GWR, REC1, REC2, WARM, WILD	False
Alamitos Bay - Los Cerritos Wetlands	AGR, AQUA, MUN, PROC	False
Alamitos Bay - San Gabriel River Estuary	COMM, EST, IND, MAR, MIGR, NAV, RARE, REC1, REC2, SHELL, SPWN, WILD	False
Aliso Creek	GWR, MUN, RARE, REC1, REC2, WARM, WILD	False
All other minor San Gabriel Mountain streams tributary to San Gabriel Valley	ALL	False
Anaheim Bay - Outer Bay	BIOL, MAR, NAV, RARE, REC1, REC2, SPWN, WILD	False
Anaheim Bay - Seal Beach National Wildlife Refuge	BIOL, EST, MAR, RARE, REC1, REC2, SPWN, WILD	False
Anaheim Lake - Lower Santa Ana River Basin	GWR, REC1, REC2, WARM, WILD	False
Arroyo Seco S. of Devil's Gates. (L)	MUN, REC1, REC2, WARM, WILD	False
Ballona Creek	MUN, REC1, REC2, WARM, WILD	False
Bee Canyon Wash	GWR, REC1, REC2, WARM, WILD	False
Bolsa Bay	BIOL, COMM, MAR, RARE, REC1, REC2, SHELL, SPWN, WILD	False
Bolsa Chica Ecological Reserve	BIOL, EST, MAR, RARE, REC1, REC2, SPWN, WILD	False
Bonita Creek	GWR, REC1, REC2, WARM, WILD	False
Borrego Canyon Wash	GWR, REC1, REC2, WARM, WILD	False
Carbon Canyon Creek	GWR, MUN, RARE, REC1, REC2, WARM, WILD	False
Compton Creek	GWR, MUN, REC1, REC2, WARM, WET, WILD	False
Coyote Creek (within Santa Ana Regional boundary) - San Gabriel River Drainage	MUN, REC1, REC2, WARM, WILD	False
Coyote Creek to Estuary	IND, MUN, PROC, RARE, REC1, REC2, WARM, WILD	False
Echo Lake	MUN, REC1, REC2, WARM, WILD	False
El Dorado Lakes	MUN, REC1, REC2, WARM, WET, WILD	False
Elysian Reservoir	IND, MUN, PROC, REC1, REC2, WARM, WILD	False
Hicks Canyon Wash	GWR, REC1, REC2, WARM, WILD	False
Ivanhoe Reservoir	IND, MUN, PROC, REC1, REC2, WARM, WILD	False
Jan Joaquin Freshwater Marsh Wetland (Inland)	BIOL, RARE, REC1, REC2, WARM, WILD	False
Laguna Canyon Wash	GWR, REC1, REC2, WARM, WILD	False
Lincoln Park Lake	MUN, REC1, REC2, WARM, WILD	False
Los Angeles River	GWR, IND, MUN, REC1, REC2, WARM, WILD	False
Los Cerritos Channel to Estuary	MUN, REC1, REC2, WARM, WILD	False
Los Cerritos Wetlands	COMM, EST, MIGR, NAV, RARE, REC1, REC2, SHELL, SPWN, WET, WILD	False
Lower Newport Bay	BIOL, COMM, MAR, NAV, RARE, REC1, REC2, SHELL, SPWN, WILD	False
Nearshore Zone - Poppy Street to Southeast Regional Boundary	BIOL, COMM, MAR, MUN, NAV, RARE, REC1, REC2, SHELL, SPWN, WILD	False
Nearshore Zone - San Gabriel River to Poppy Street in Corona Del Mar	COMM, IND, MAR, MUN, NAV, RARE, REC1, REC2, SHELL, SPWN, WILD	False
Offshore Zone - Water between Nearshore Zone and Limit of State Waters	COMM, IND, MAR, MUN, NAV, RARE, REC1, REC2, SPWN, WILD	False
Peters Canyon Wash	GWR, REC1, REC2, WARM, WILD	False
Rattlesnake Canyon Wash	GWR, REC1, REC2, WARM, WILD	False
Rio Hondo below Spreading Grounds	GWR, MUN, REC1, REC2, WARM, WILD	False
Rio Hondo to Spreading Grounds	GWR, MUN, REC1, REC2, WARM, WILD	False
San Diego Creek Reach 1 - below Jeffrey Road	REC1, REC2, WARM, WILD	False
San Diego Creek Reach 2 -above Jeffrey Road to Headwaters	GWR, REC1, REC2, WARM, WILD	False
San Gabriel River Estuary	COMM, EST, IND, MAR, MIGR, NAV, RARE, REC1, REC2, SHELL, SPWN, WILD	False
San Gabriel River, Firestone Blvd-Estuary	MUN, REC1, REC2, WARM, WILD	False
San Gabriel River, Whittier N-Firestone	GWR, IND, MUN, PROC, RARE, REC1, REC2, WARM, WILD	False
Sand Canyon Wash	GWR, REC1, REC2, WARM, WILD	False
Santa Ana River Reach 1 - Tidal Prism to 17th Street in Santa Ana	BIOL, REC1, WARM	False
Santa Ana River Reach 1- Tidal Prism to 17th Street in Santa Ana	REC2, WILD	False
Santa Ana River Reach 2 - 17th Street in Santa Ana to Prado Dam	AGR, GWR, RARE, REC1, REC2, WARM, WILD	False
Santa Ana River Salt Marsh	BIOL, EST, MAR, RARE, REC1, REC2, WILD	False
Serrano Creek	GWR, REC1, REC2, WARM, WILD	False
Silver Lake Reservoir	IND, MUN, PROC, REC1, REC2, WARM, WILD	False
Sims Pond	MUN, REC1, REC2, WARM, WET, WILD	False
Sunset Bay - Huntington Harbor	COMM, MAR, NAV, RARE, REC1, REC2, SPWN, WILD	False
Tidal Prism of Flood Control Channels Discharging to Coastal or Bay Waters	COMM, MAR, REC1, REC2, WILD	False
Tidal Prism of San Gabriel River - River Mouth to Marina Drive	COMM, EST, IND, MAR, RARE, REC1, REC2, SHELL, WILD	False
Tidal Prism of Santa Ana River (to within 1000' of Victoria St.) & Newport Slough	COMM, MAR, RARE, REC1, REC2, WILD	False
Upper Newport Bay	BIOL, COMM, EST, MAR, RARE, REC1, REC2, SHELL, SPWN, WILD	False

Caltrans Facilities

MAINTENANCE STATIONS

Name	Address

FREEWAYS AND HIGHWAYS

Route	Length (miles)
5	6.9
22	0.8
39	4.4
57	5.8
90	2.8
91	10.1
142	0.9
405	3.2
605	4.6

PARK & RIDE LOTS

Name	District	County	Route	Post Mile
STATE COLLEGE CHURCH OF CHRIST	12	ORA	91	5.3
BREA	12	ORA	57	20.9
FULLERTON	12	ORA	5	41.918

REST AREAS

Name	District	County	Route	Post Mile

Additional Information

Help for the Water Quality Planning Tool

TMDL information from the SWRCB

Construction General Permit information from the SWRCB

Groundwater Depth information from the California Department of Water Resouces

R Factor erosivity calculations

Attachment C

BMPs Fact Sheet/Summary

16056.00 HIGHLAND AND VALENCIA

Hydrology Summary

TOTAL AREA	24,567	ft^2	0.564	ac	
Soil Group	B				
Design Capture Stormdepth	0.90	in			
Green Terrace	1025	ft^2	0.024	ac	
Landscape	3060	ft^2	0.070	ac	
Total Pervious	**4,085**	**ft^2**	**0.094**	**ac**	16.6%
Total Impervious	20,482	ft^2	0.470	ac	83.4%
Design Intensity	0.260	in/hr	Worksheet D Graph		
Runoff coefficient	0.775				
Design Flowrate	***0.114***	***cfs***	See Calculations		

Development	**Area**		**Pervious**		**Impervious**		**Change in Impervious**	
	(ft^2)	ac	(ft^2)	(%)	(ft^2)	(%)	(ft^2)	(%)
Pre-Development	24,567	0.564	4,805	0.19559	19,762	80.44%		
Post-Development	24,567	0.564	4,085	0.16628	20,482	83.37%	720	3.64%

BIOFILTRATION	**Total Area**		**fraction**	**flow rate**	**System**	**Capacity**
	ft^2	ac	ac/ac	cfs		cfs
MWS System	24,567	0.564	1.000	0.114	M-W-S-L-4-8	0.115

EXISTING HYDROLOGY											
DMA	Areas		Pervious		Impervious		El1	El2	Length	Slope	TC
	(ft^2)	AC	(ft^2)	(%)	(ft^2)	(%)	ft	ft	ft		ft
A-1	11,917	0.274	0	0	11,917	1.000	145.8	143.88	160.79	0.012	6.4
A-2	12,650	0.290	4,804	0.380	7,846	0.620	145.36	142.89	244.06	0.010	9.6
Total Area	**24,567**	**0.564**									

PROPOSED HYDROLOGY											
DMA	Areas		Pervious		Impervious		El1	El2	Length	Slope	TC
	(ft^2)	AC	(ft^2)	(%)	(ft^2)	(%)	ft	ft	ft		ft
A-1	11,675	0.268	432	0.04	11,243	0.963	146.1	144.16	99.46	0.020	5
B-1	12,892	0.296	3,650	0.283	9,242	0.717					5
Total Area	**24,567**	**0.564**									

Hydrology Summary

Areas		Nodes	Flow rate (cfs)							
			2 -yr (cfs)		10-yr (cfs)		100-yr (cfs)			
	AC		Exist.	Prop.	Exist.	Prop.	Exist.	Prop.		0.872248
A-1	0.268	**1-2**	0.48	0.54	0.87	0.98	1.32	1.49		0.687659
B-1	0.296	**1-2**	0.38	0.58	0.7	1.06	1.08	1.63		
							2.4	3.12	0.72	

Areas	(AC)	100-yr Storm Event				
		Exist.		Prop.		Delta Volume
		Flow Rate (cfs)	Tc (min.)	Flow Rate (cfs)	Tc (min.)	cf
A-1	**0.268**	1.32	6.4	1.49	5	5
B-1	**0.296**	1.08	9.6	1.63	5	242

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue PRE- DEVELOPMENT 2-YEAR STORM RATIONAL METHOD STUDY	Calc'd By: T.G. Date: 9/9/2020 Checked By: P.G. Date: Page 1 of 1

Concentration Point	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.274	0.274	B	MIXED		6.40	1.965	0	0	0.48	160.79	0.0120		INITIAL SUBAREA
											244.06	0.0100		INITIAL SUBAREA
B-1 1-2	0.290	0.290	B	MIXED		9.60	1.557	0.114	0.114	0.38				

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue PRE- DEVELOPMENT 10-YEAR STORM RATIONAL METHOD STUDY	Calc'd By: T.G. Date: 9/9/2020 Checked By: P.G. Date: Page 1 of 1

Concentration Point	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.274	0.274	B	MIXED		6.40	3.524	0	0	0.87	160.79	0.0120		INITIAL SUBAREA
											244.06	0.0100		INITIAL SUBAREA
B-1 1-2	0.290	0.290	B	MIXED		9.60	2.793	0.114	0.114	0.70				

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue	Calc'd By: T.G.	Date: 9/9/2020
	PRE- DEVELOPMENT 100-YEAR STORM RATIONAL METHOD STUDY	Checked By: P.G.	Date:
			Page 1 of 1

Concentration Point	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.274	0.274	B	MIXED		6.40	5.371	0	0	1.32	160.79	0.0120		INITIAL SUBAREA
											244.06	0.0100		INITIAL SUBAREA
B-1 1-2	0.290	0.290	B	MIXED		9.60	4.258	0.114	0.114	1.08				

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue prop- DEVELOPMENT YEAR STORM RATIONAL METHOD STUDY	2-	Calc'd By: T.G. Date: 2/10/2021 Checked By: P.G. Date: Page 1 of 1

Concentration	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.268	0.268	B	MIXED		5.00	2.264	0.012	0.012	0.54	99.5	0.0200		INITIAL SUBAREA
B-1 1-2	0.296	0.296	B	MIXED		5.00	2.264	0.085	0.0849	0.58	299.03	0.0130		INITIAL SUBAREA

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue prop- DEVELOPMENT YEAR STORM RATIONAL METHOD STUDY	10-	Calc'd By: T.G. Date: 2/10/2021 Checked B P.G. Date: Page 1 of 1

Concentration	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.268	0.268	B	MIXED		5.00	4.060	0.012	0.012	0.98	99.46	0.0200		INITIAL SUBAREA
B-1 1-2	0.296	0.296	B	MIXED		5.00	4.060	0.085	0.0849	1.06	299.03	0.0130		INITIAL SUBAREA

RATIONAL METHOD STUDY FORM

ORANGE COUNTY HYDROLOGY	Highland Avenue prop- DEVELOPMENT 100-YEAR STORM RATIONAL METHOD STUDY	Calc'd By: T.G. Date: 2/10/2021 Checked By: P.G. Date: Page 1 of 1

Concentration	AREA (Acres) Subarea	AREA (Acres) Total	Soil Type	Dev. Type	Tt min	Tc min	I in/hr	Fm in/hr	Fm avg	Q Total	Flow Path Length ft	Slope ft/ft	V ft/sec	Hydraulics and Notes
A-1 1-2	0.268	0.268	B	MIXED		5.00	6.187	0.012	0.012	1.49	99.46	0.0200		INITIAL SUBAREA
B-1 1-2	0.296	0.296	B	MIXED		5.00	6.187	0.085	0.085	1.63	299.03	0.0130		INITIAL SUBAREA

Modular Wetland System - Linear® Plants for Hardy Zone 10

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

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

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

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

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

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

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

WASHINGTON STATE DEPARTMENT OF ECOLOGY

July 2017

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

For the

MWS-Linear Modular Wetland

Ecology's Decision:

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

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

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

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

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

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

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

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

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

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

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

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

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

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

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

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

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

Application Documents:

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

Applicant's Use Level Request:

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

Applicant's Performance Claims:

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

Ecology Recommendations:

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

Findings of Fact:

<u>Laboratory Testing</u>

The MWS-Linear Modular wetland has the:

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

Field Testing

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

Issues to be addressed by the Company:

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

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

Contact Information:

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

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

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

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

Revision History

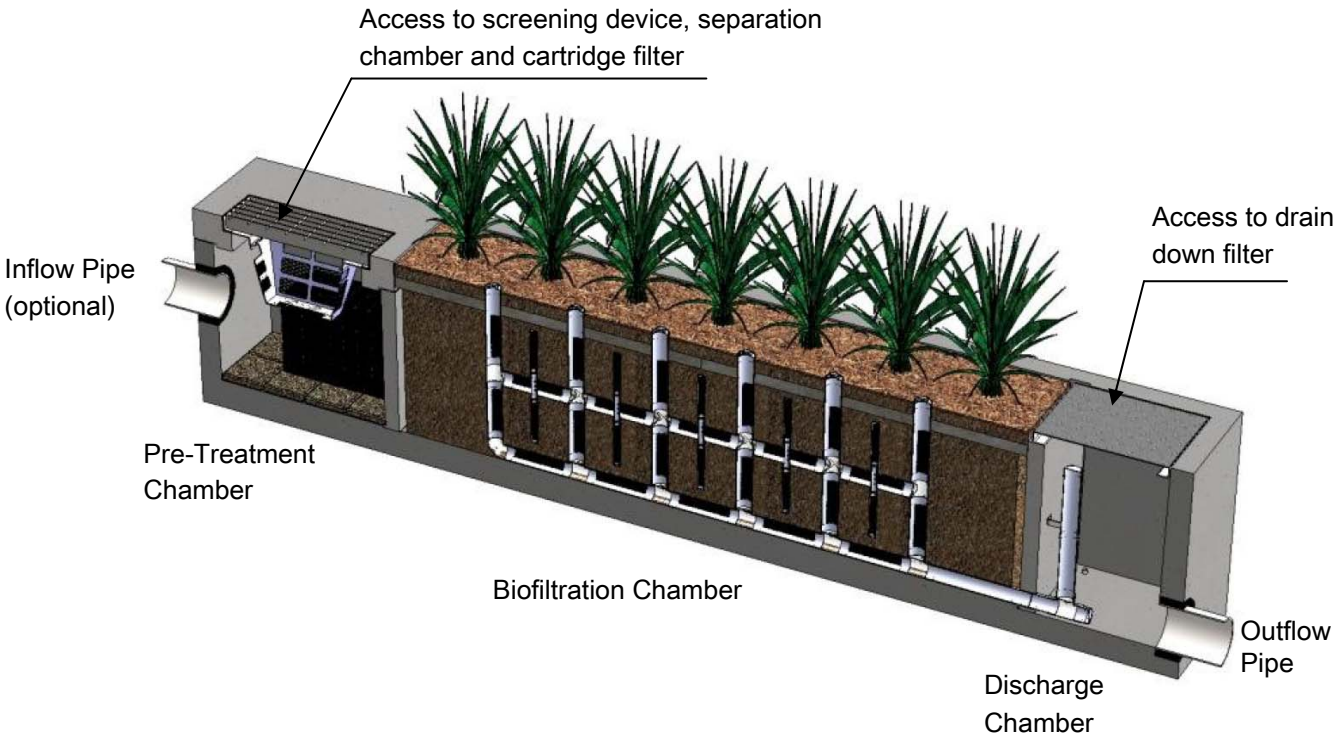
Date	**Revision**
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of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

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

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

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

Weather Condition _____ Additional Notes _____

Inspection Checklist

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

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

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

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

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes:

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

Attachment D

BMP O & M Plan

Project Name:

HIGHLAND AND VALENCIA DEVELOPMENT
415 S HIGHLAND AVENUE, FULLERTON, CA

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** These information materials will be provided to educate the residents/occupants/tenants on general housekeeping practices that contribute to the protection of stormwater quality. This will bring awareness to people about stormwater pollutants and their consequences. These materials will be initially developed and provided to first residents/occupants/tenants by the developer.	These materials will be initially developed and provided to the first residents/occupants/tenants by the OWNER	Owner
Yes	**N2. Activity Restrictions** The purpose of this restrictions list is to protect surface water quality. The developer must prepare the rules and regulations about the discharge of any pollutants. This includes no discharges of fertilizer, pesticides, and wastes to streets or storm drains, no blowing or sweeping of debris into streets or storm drains, no vehicle washing on-site, no vehicle repair/tire on site	This activity was initially prepared by the developer for surface water quality protection. The homeowner association will be responsible for enforcing the restrictions	Owner

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** Routine checkups and maintenance are required to minimize problem-related erosion, irrigation leakage. The owner will have to establish a more sustainable approach such as to conserve water, reduce pesticide, and fertilizer. All landscaped areas will be suppressed two inches below the top of the curb to retain nutrients, irrigation water, and small storms. Irrigation equipment shall be monitored monthly for proper operation to conserve water. Plants with low water requirements will be planted to reduce water and fertilizer needs	The Landscape Management program should be outlined by the Owner and its Owner responsibility to continually provide service to the landscape area weekly and visit the site monthly for any maintenance related issues.	Owner Can hire a Private Management company who can maintain the landscape area.
Yes	**N4. BMP Maintenance** Inspect twice a year, once before the start of the rainy season. Remove accumulated sediment or trash. For additional information see Manufactures maintenance, inspection, and cleaning brochure	6 Month See manufacture Inspection/Maintenance	Owner
Yes	**N11. Common Area Litter Control** Trash Dumpster enclosures shall be roofed, and areas shall be emptied weekly and cleaned as needed, no less than monthly. For additional information see BMP S-3, Design Trash Enclosures to Reduce Pollutant Introduction	Weekly	HOA

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	**N14. Common Area Catch Basin Inspection** Cleaning should take place in the late summer/early fall before the start of the rainy season. Drainage facilities include catch basins (storm drain inlets), area drain. The proposed catch basins and area drain shall be inspected quarterly, at a minimum. They will be cleaned whenever they are greater than 25% full of debris.	Starting and ending of the rainy season every year	Owner
Structural Source Control BMPs			

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Yes	**S4. Use Efficient Irrigation Systems and Landscape Design** The irrigation system will include devices to prevent low head drainage, overspray, and runoff using pressure regulating devices, check valves, flow sensors, proper spacing, low precipitation emission devices, and ET or water-based controllers. Check irrigation equipment monthly to ensure there are no leaks or excess runoff from landscaped areas. Adjust irrigation heads and timing as necessary to prevent over or under-watering of vegetation and excessive runoff from landscaped areas.	The Owner will be responsible for maintaining the irrigation system and checking the system quarterly. The Owner can hire a contractor to overlook the system	Owner

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		
Biofiltration BMPs **<u>Modular Wetland System</u>** - Inspect twice a year, once before the start of the rainy season. Remove accumulated sediment or trash. Replace Filter Media every 1-2-year, Trim vegetation as needed 6 to 12 months for additional information see Manufactures maintenance, inspection, and cleaning brochure.	6months The owner is responsible for managing the system (can hire manufacture or contractor to maintain the system)	Owner
Treatment Control BMPs		

Required Permits

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

1. Permits for connection to sanitary sewer and Firewater and Domestic water line
2. Grading Permits from the city
3. Encroachment permits

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

Forms to Record BMP Implementation, Maintenance, and Inspection

The form that will be used to record the 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.

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

Attachment E

Worksheets from County of Orange TGD

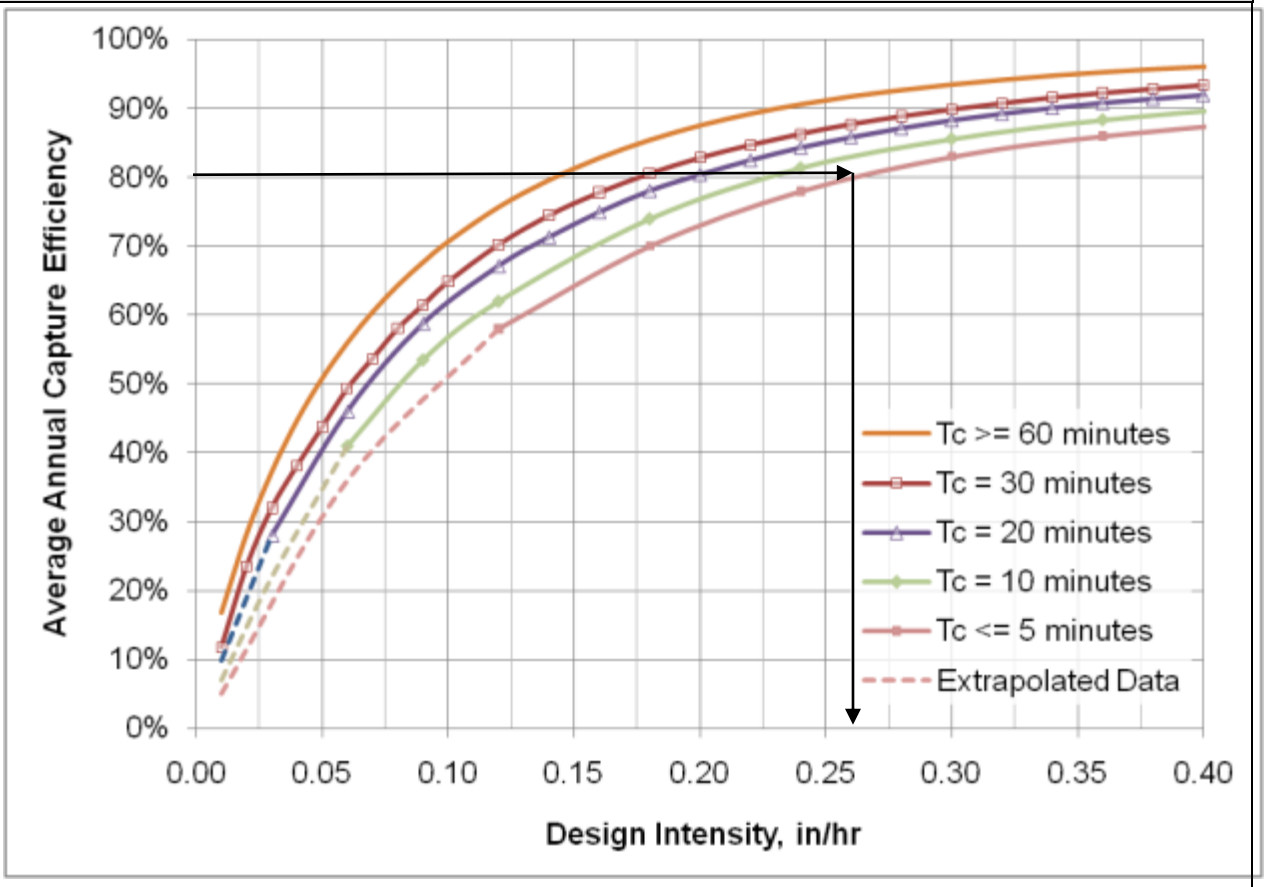
- Worksheet D_Capture Efficiency Method for Flow-Based BMPs
- Worksheet I_Summary of Groundwater-related Feasibility Criteria
- Worksheet -Infiltration BMP Feasibility Worksheet

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

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	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=	0.26	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	-	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	-	%
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=	-	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$	I_{design}=	0.26	in/hr
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.564	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.834	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.775	
4	Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$	Q_{design}=	0.114	cfs
Supporting Calculations				
Describe system: MWS – L-4-8 CAPACITY treatment flowrate = 0.115 cfs				
Provide time of concentration assumptions: Assume Tc=5 min. due to the roof drain (conservative approach)				

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Worksheet I: Summary of Groundwater-related Feasibility Criteria

1	Is project large or small? (as defined by Table VIII.2) circle one	Large		Small
2	What is the tributary area to the BMP?	A	0.564	acres
3	What type of BMP is proposed?	Biofiltration – Modular Wetland System (MWS)		
4	What is the infiltrating surface area of the proposed BMP?	A_{BMP}	N/A	sq-ft
5	What land use activities are present in the tributary area (list all) Residential and Commercial			
6	What land use-based risk category is applicable?	L	M	H
7	If M or H, what pretreatment and source isolation BMPs have been considered and are proposed (describe all): Modular Wetland System includes the pretreatment chamber. In this chamber, sediment and hydrocarbons are removed from the runoff before entering the biofiltration chamber.			
8	What minimum separation to mounded seasonally high groundwater applies to the proposed BMP? See Section VIII.2 (circle one)	5 ft		10 ft
9	Provide rationale for selection of applicable minimum separation to seasonally high mounded groundwater:			
10	What is separation from the infiltrating surface to seasonally high groundwater?	SHGWT	30	ft
11	What is separation from the infiltrating surface to mounded seasonally high groundwater?	Mounded SHGWT		ft
12	Describe assumptions and methods used for mounding analysis:			
13	Is the site within a plume protection boundary (See Figure	Y	N	N/A

Worksheet I: Summary of Groundwater-related Feasibility Criteria

	VIII.2)?	
14	Is the site within a selenium source area or other natural plume area (See Figure VIII.2)?	Y N N/A
15	Is the site within 250 feet of a contaminated site?	Y N N/A
16	If site-specific study has been prepared, provide citation and briefly summarize relevant findings:	
17	Is the site within 100 feet of a water supply well, spring, septic system?	Y N N/A
18	Is infiltration feasible on the site relative to groundwater-related criteria?	Y N
Provide rationale for feasibility determination:		

Note: if a single criterion or group of criteria would render infiltration infeasible, it is not necessary to evaluate every question in this worksheet.

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.	Yes	
Provide basis: The proposed site is within Plume Protection Boundaries (North Basin Groundwater Protection Project see Figure XVI-2f Attachment F). 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.		
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**?		
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?		
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.	Yes	
Provide basis: Per percolation test result (November 9, 2018), the infiltration rate is less than 0.09 in/hr. 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?**		
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?**		
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.			

Table 2.7: Infiltration BMP Feasibility Worksheet (continued)

Infiltration Screening Results (check box corresponding to result):		
8	Is there substantial evidence that infiltration from the project would result in a significant increase in I&I to the sanitary sewer that cannot be sufficiently mitigated? (See Appendix XVII) Provide narrative discussion and supporting evidence: Summarize findings of studies provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.	
9	If any answer from row 1-3 is yes: infiltration of any volume is **not feasible** within the DMA or equivalent. Provide basis: The proposed site is within Plume Protection Boundaries (North Basin Groundwater Protection Project see Figure XVI-2f Attachment F). Summarize findings of infeasibility screening	Row 1 - Yes
10	If any answer from row 4-7 is yes, infiltration is **permissible but is not presumed to be feasible for the entire DCV.** Criteria for designing biotreatment BMPs to achieve the maximum feasible infiltration and ET shall apply. Provide basis: Summarize findings of infeasibility screening	
11	If all answers to rows 1 through 11 are no, infiltration of the full DCV is potentially feasible, BMPs must be designed to infiltrate the full DCV to the maximum extent practicable.	

Attachment F

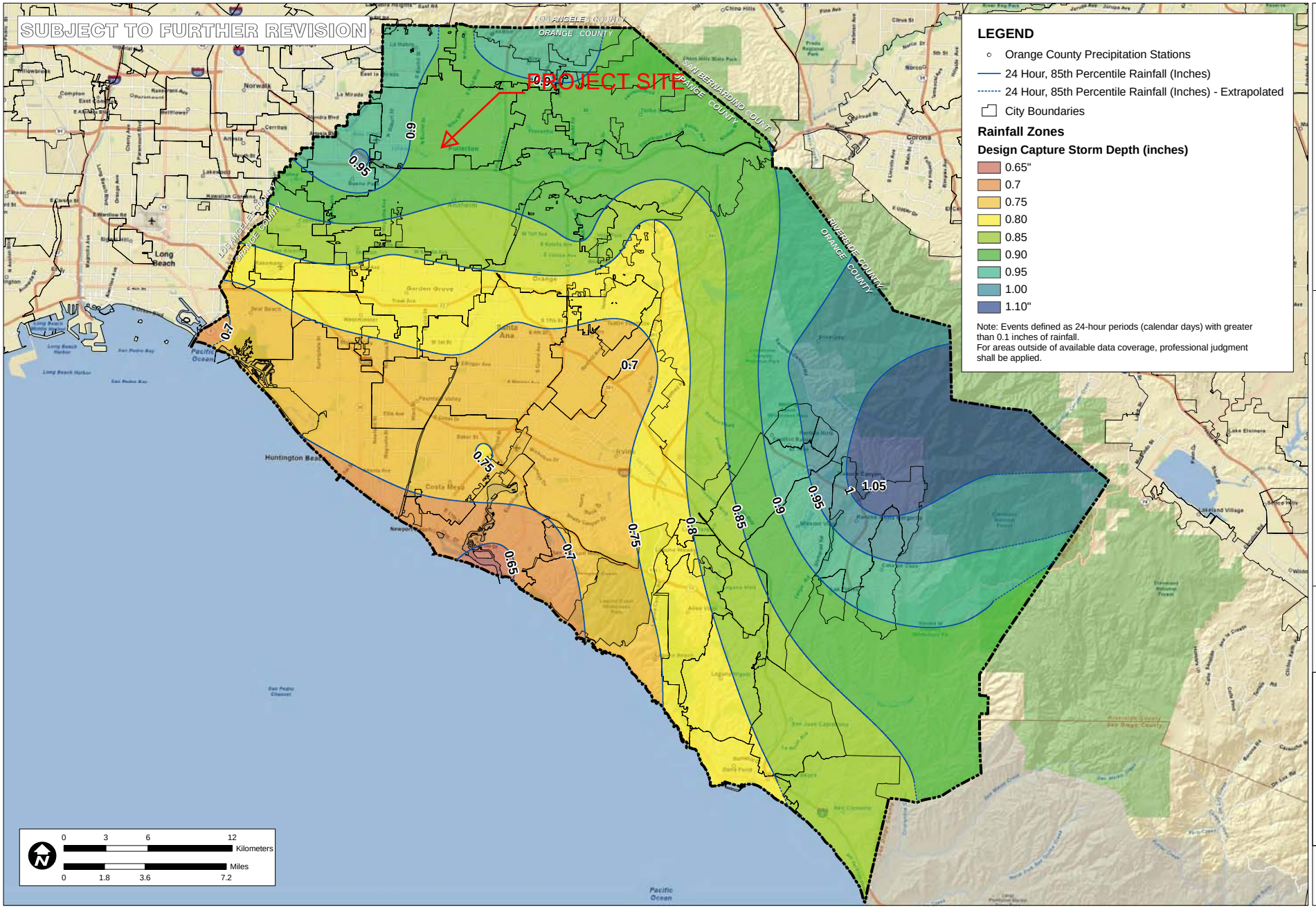
Reference Exhibits/Figures from County of Orange TGD

1. **XVI.1_Orange County Rainfall Zones**
2. **XVI.2_Infiltration Feasibility Constraint Maps**
3. **XVI.3_North Orange County Hydromodification Susceptibility Map Coyote Creek/San Gabriel River**
4. **Watershed Map**

XVI.1. Rainfall Zones Map

Figure XVI.1: Orange County Rainfall Zones Map

Exhibit on following page



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TITLE
RAINFALL ZONES

JOB
ORANGE COUNTY TECHNICAL GUIDANCE DOCUMENT
CA
ORANGE CO.

SCALE	1" = 1.6 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/29/10
JOB NO.	9526-E

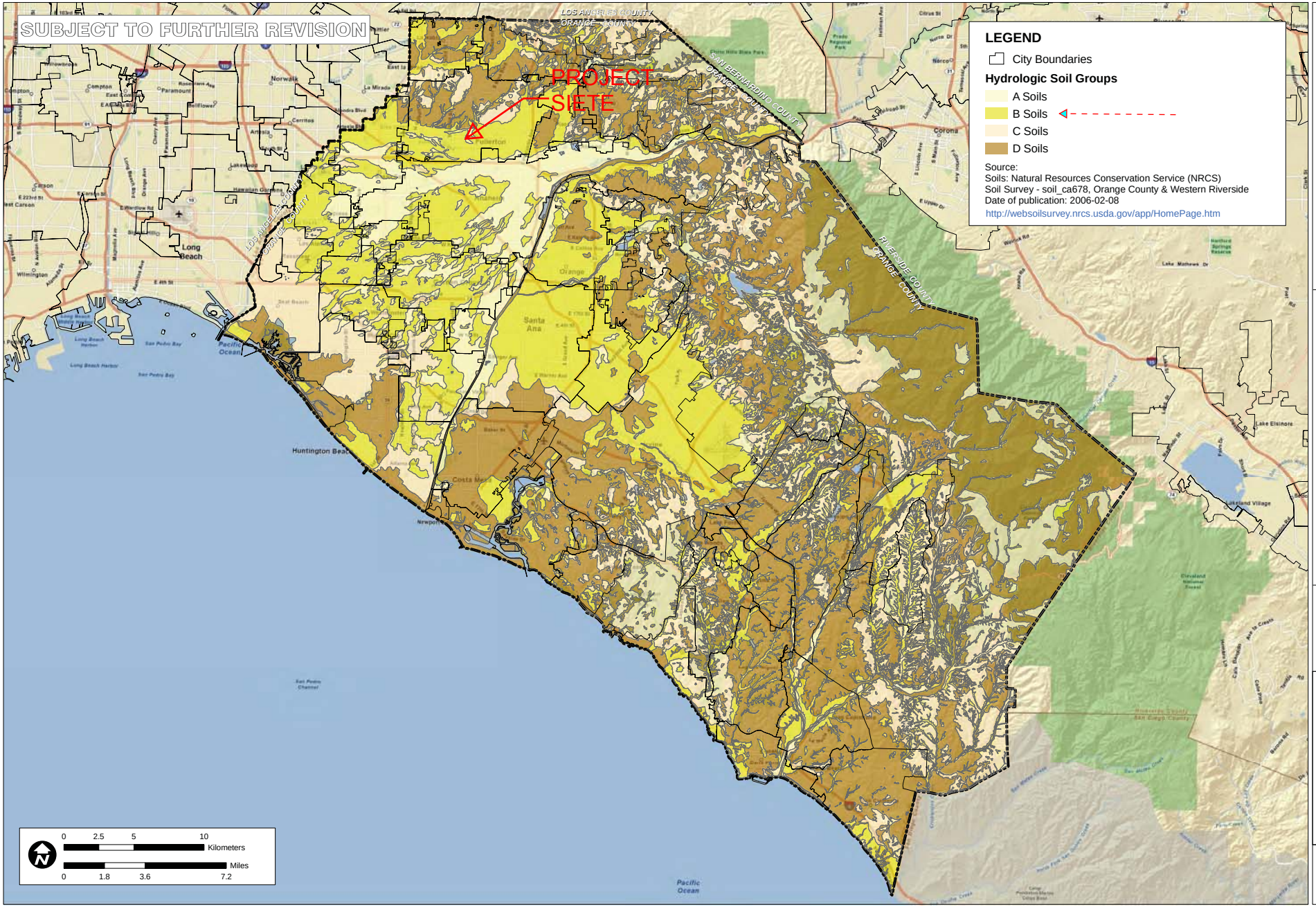
PACE
Advanced Water Engineering

FIGURE
XVI-1

XVI.2. Infiltration Feasibility Constraints Maps

Figure XVI.2: Infiltration Feasibility Constraints Maps

Exhibits start on following page



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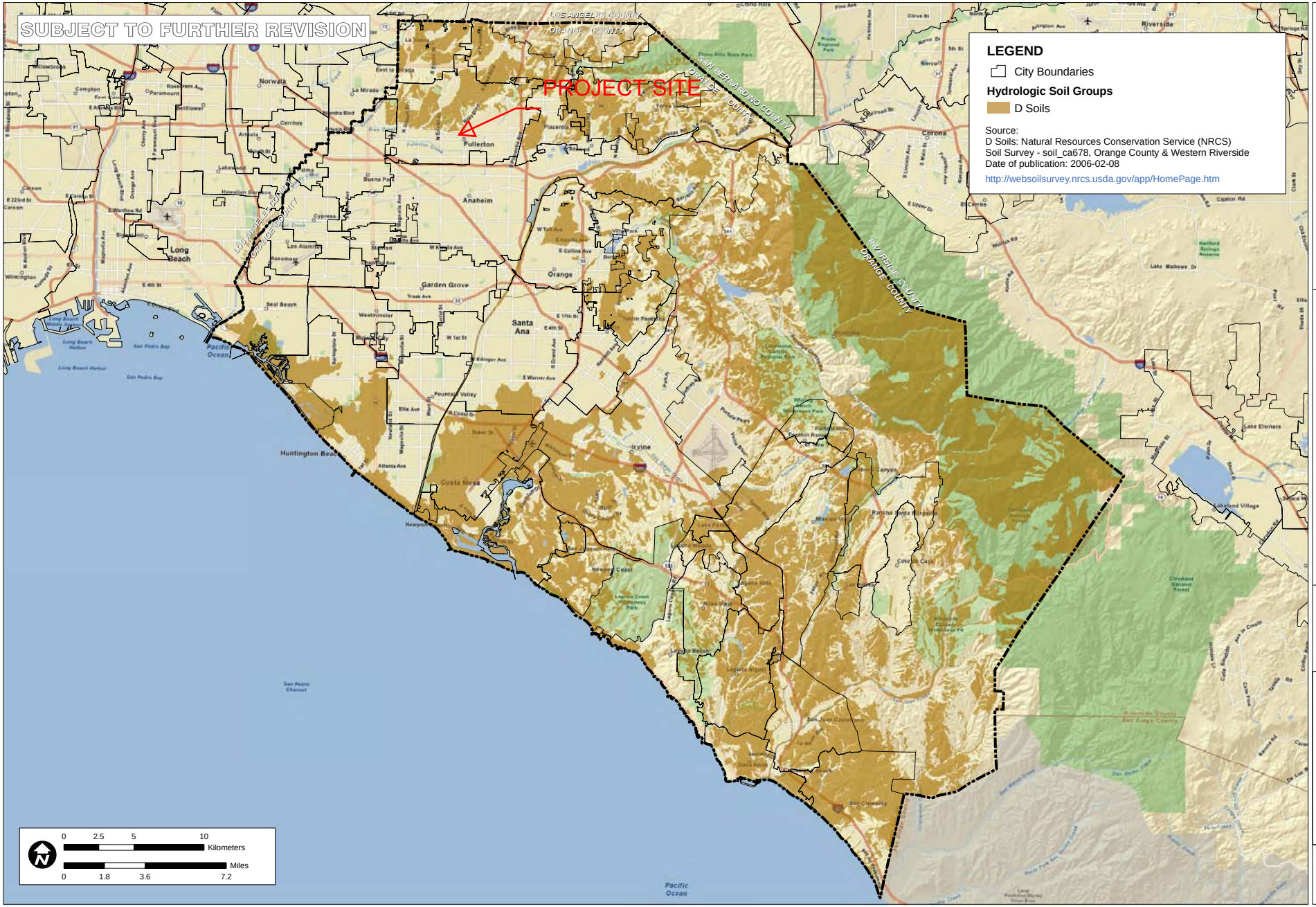
TITLE
NRCS HYDROLOGIC SOILS GROUPS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.6 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE
XVI-2a



TITLE
HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

ORANGE COUNTY
INFILTRATION STUDY

JOB
ORANGE CO. CA

SCALE	1" = 1.6 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E

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Advanced Water Engineering

FIGURE
XVI-2b

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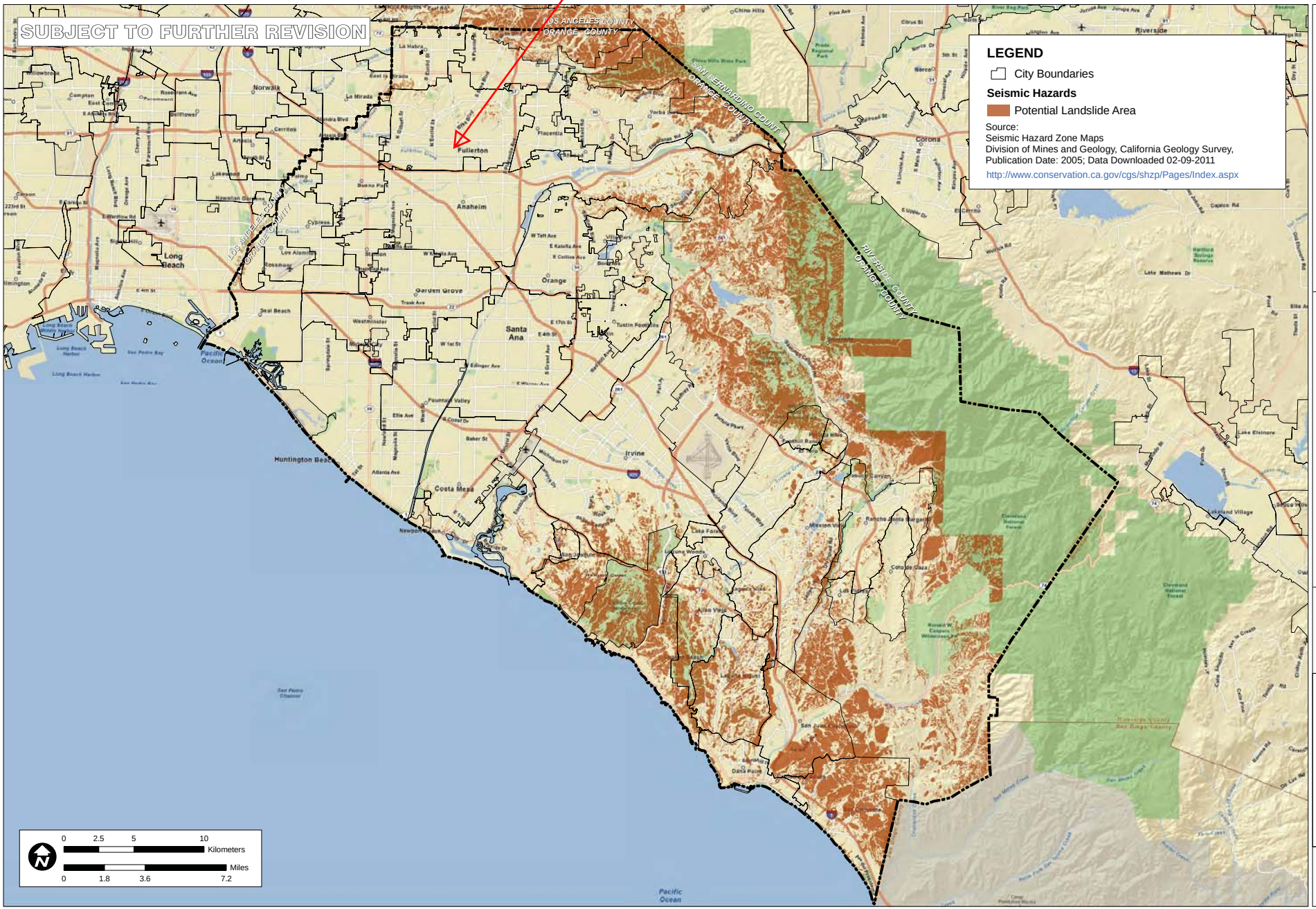

HYDROLOGIC SOIL GROUP
TYPE D NRCS SOIL SURVEY

TITLE

ORANGE COUNTY
INFILTRATION STUDY

JOB

CA

ORANGE CO.

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-2c

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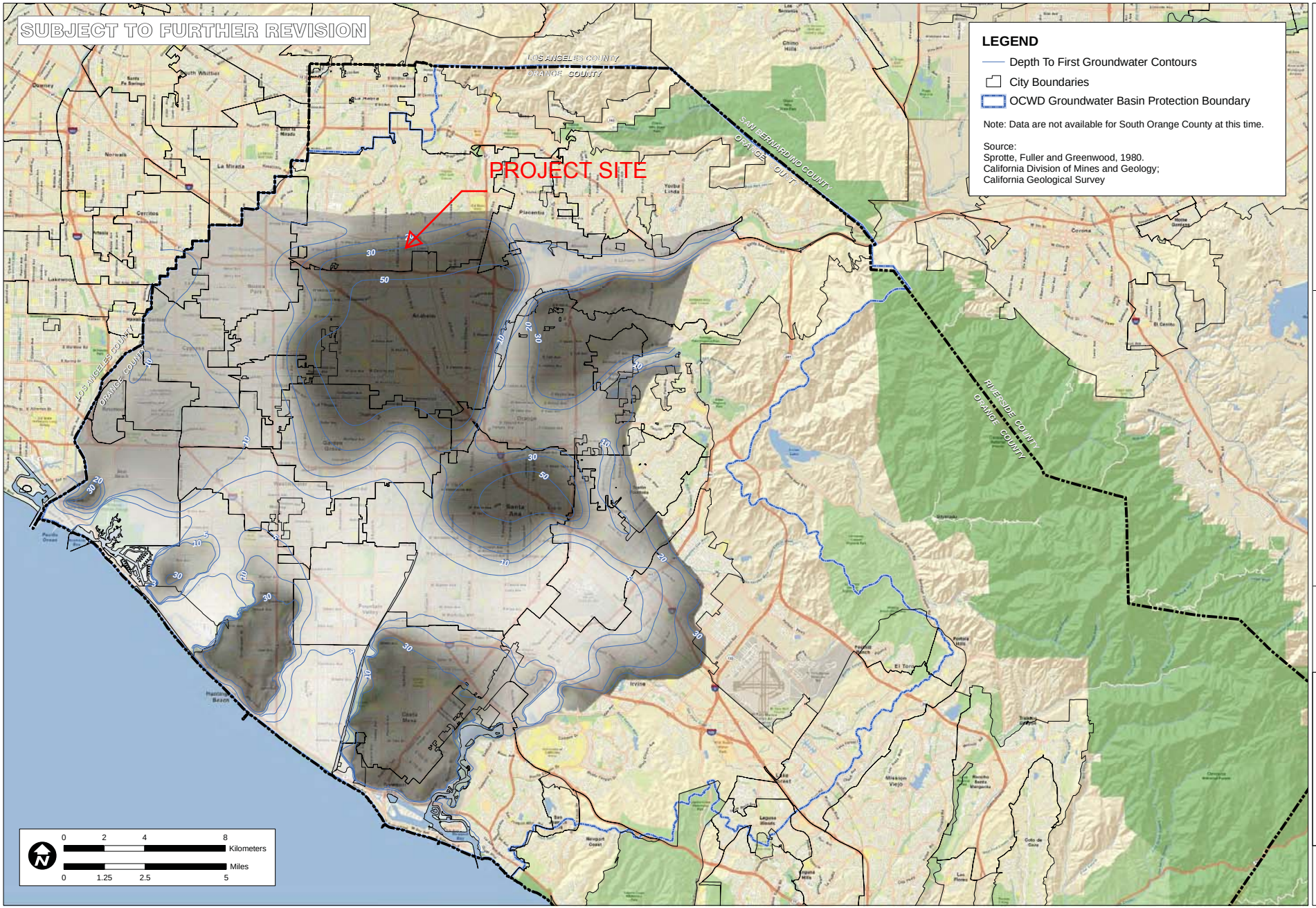

TITLE
NORTH ORANGE COUNTY
MAPPED DEPTH TO FIRST
GROUNDWATER

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-2d

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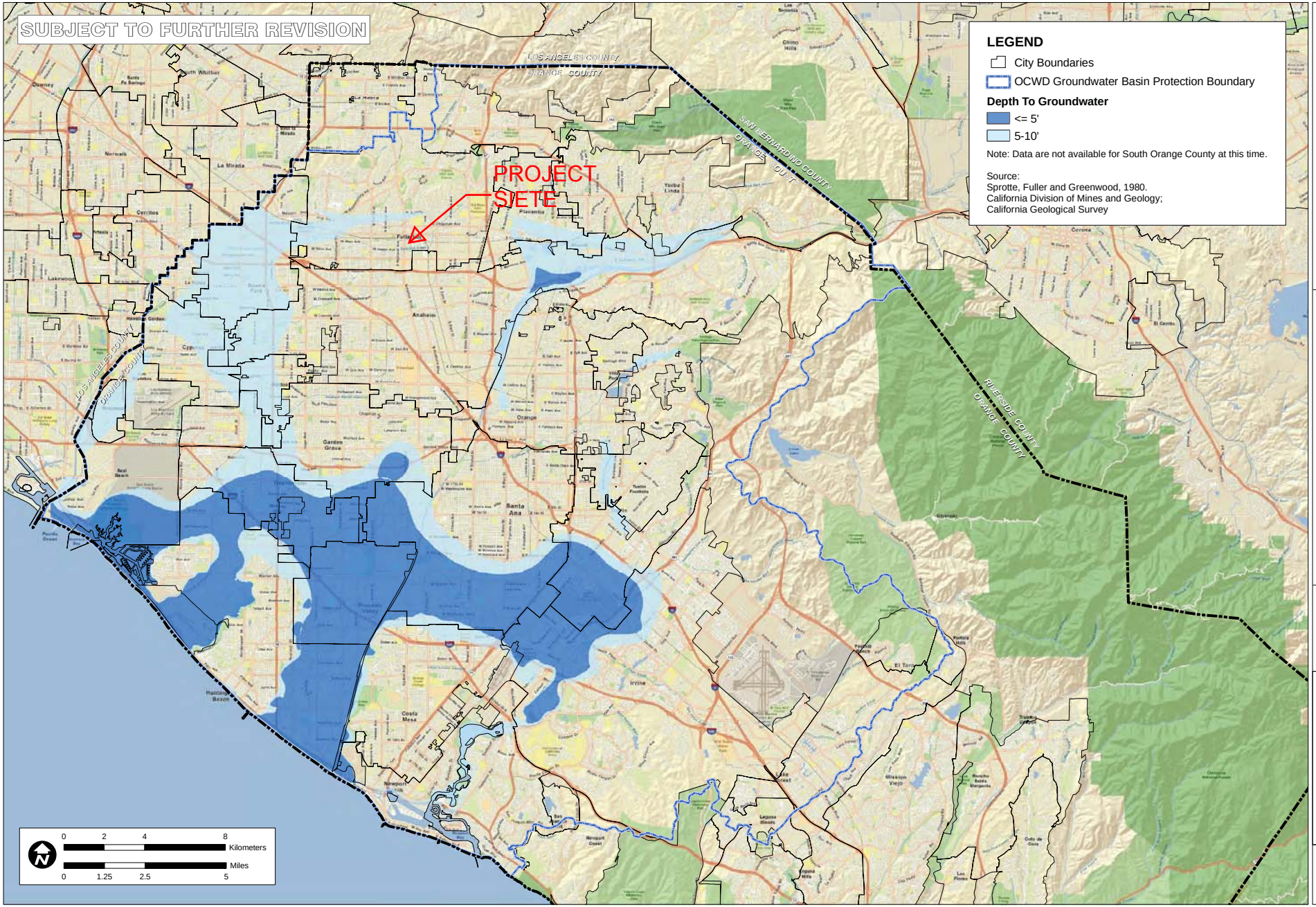

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TITLE
NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

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

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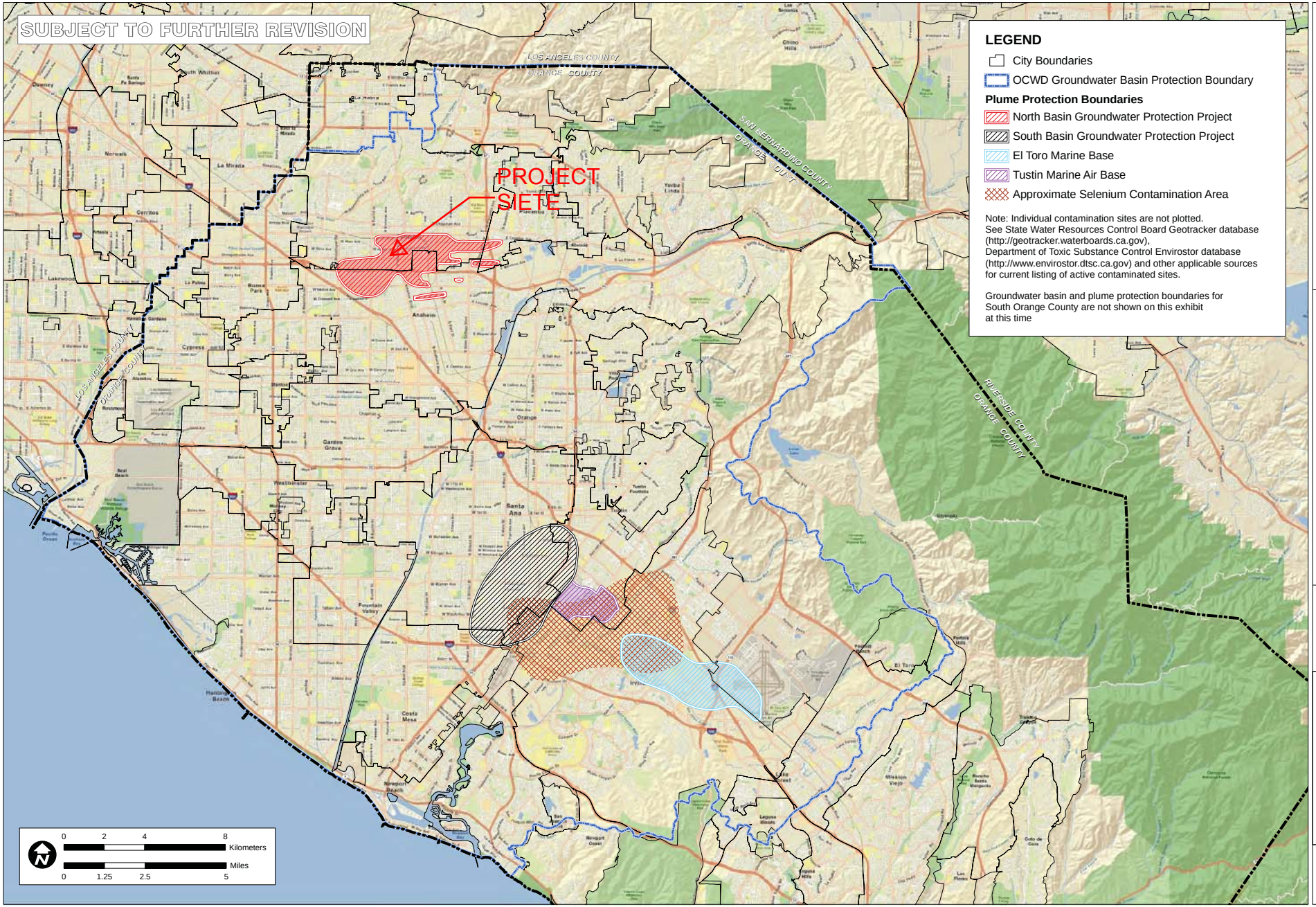
FIGURE
XVI-2e



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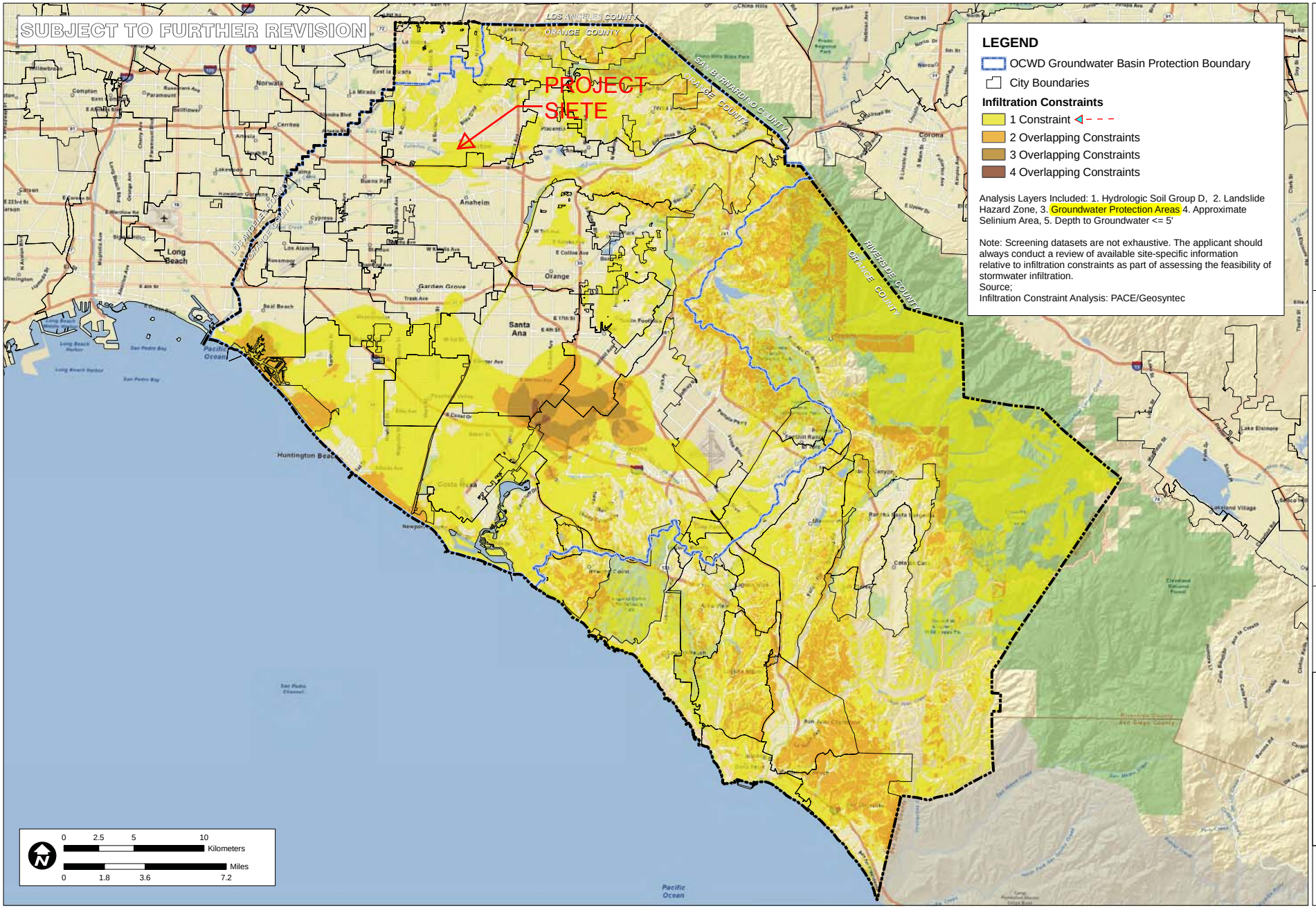
TITLE
NORTH ORANGE COUNTY GROUNDWATER PROTECTION AREAS

JOB
ORANGE COUNTY INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/23/10
JOB NO.	9526-E

PACE Advanced Water Engineering

FIGURE
XVI-2f



TITLE
INFILTRATION ANALYSIS
OVERLAPPING CONSTRAINT LOCATIONS

JOB
ORANGE COUNTY
INFILTRATION STUDY
CA
ORANGE CO.

SCALE	1" = 1.6 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/23/10
JOB NO.	9526-E

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Advanced Water Engineering

FIGURE
XVI-2g

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XVI.3. North Orange County Hydromodification Susceptibility Maps

Figure XVI.3: North Orange County Hydromodification Susceptibility Maps

Exhibits start on following page

PRELIMINARY MAP
SUBJECT TO FURTHER REVISION

Susceptibility

Potential Areas of Erosion, Habitat, & Physical Structure Susceptibility

Channel Type

Earth (Unstable)
Earth (Stabilized)
Stabilized

Tidel Influence

<= Mean High Water Line (4.28')

Water Body

Basin
Lake
Reservoir

Other Lands

Airport/Military

Los Angeles County

415 S. Highland Ave, Fullerton, CA

Channel in Retarding Basin

Anaheim Bay-Huntington Harbor Watershed

Santa River Watershed

Newport Bay-Newport Coastal Streams Watershed

Humble Reservoir
Orange County
Valencia Reservoir
Fullerton Reservoir
Loftus Diversion Channel Desilting Basin
Brea Creek Reservoir
Fullerton Reservoir
Fullerton Reservoir
Hillcrest Park Reservoir
Fullerton Airport
Placentia Retarding Basin
La Jolla Recharge Basin
Miller Retarding Basin
Kraemer Basin
Raymond Retarding Basin
Gilbert Retarding Basin
Crescent Retarding Basin
Cypress Retarding Basin
Rossmoor Retarding Basin
Los Alamitos Naval Air Station
Los Alamitos Retarding Basin
Seal Beach Naval Weapons Station
Pacific Ocean

0 8,000 16,000 Feet

TITLE: SUSCEPTIBILITY ANALYIS
SAN GABRIEL-COYOTE CREEK
ORANGE COUNTY
WATERSHED
MASTER PLANNING

JOB: ORANGE CO. CA

SCALE	1" = 8000'
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/30/10
JOB NO.	9526-E

PACE
Advanced Water Engineering

1

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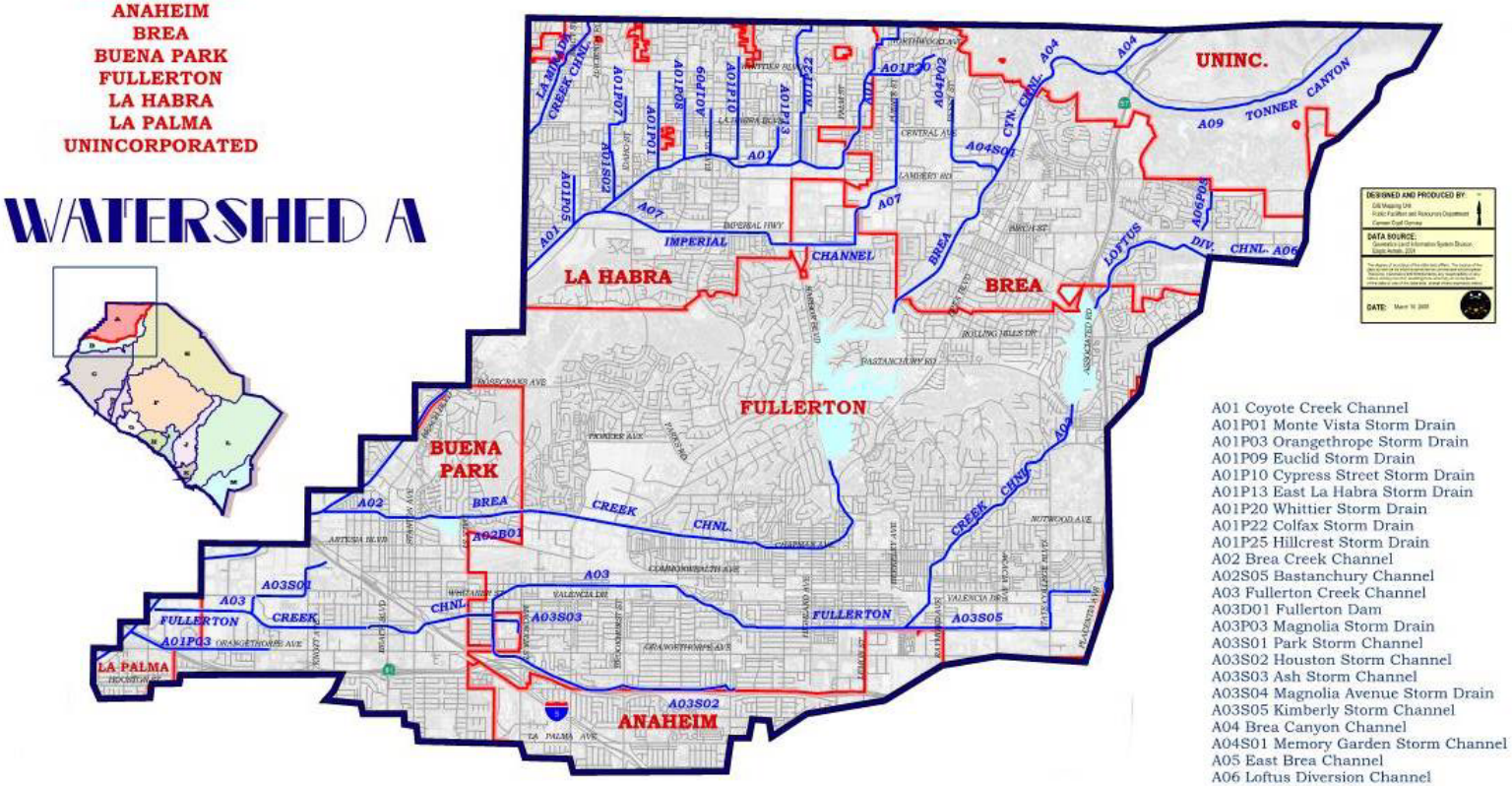
NOTICE

This drainage map has been prepared for information purposes only. The listed facilities have been determined from available information provided by public agencies, but may not be exact or up to date. The user of this map is responsible for verifying exact location, ownership and maintenance responsibilities of the drainage facilities. Additional information may be obtained from public plans and recorded deeds. Neither the County of Orange nor the Orange County Flood Control District (OCFCD) assumes any liabilities for inaccuracy of this map.

CITIES WITHIN THE WATERSHED:

ANAHEIM
BREA
BUENA PARK
FULLERTON
LA HABRA
LA PALMA
UNINCORPORATED

WATERSHED A



A01 Coyote Creek Channel
A01P01 Monte Vista Storm Drain
A01P03 Orangethrope Storm Drain
A01P09 Euclid Storm Drain
A01P10 Cypress Street Storm Drain
A01P13 East La Habra Storm Drain
A01P20 Whittier Storm Drain
A01P22 Colfax Storm Drain
A01P25 Hillcrest Storm Drain
A02 Brea Creek Channel
A02S05 Bastanchury Channel
A03 Fullerton Creek Channel
A03D01 Fullerton Dam
A03P03 Magnolia Storm Drain
A03S01 Park Storm Channel
A03S02 Houston Storm Channel
A03S03 Ash Storm Channel
A03S04 Magnolia Avenue Storm Drain
A03S05 Kimberly Storm Channel
A04 Brea Canyon Channel
A04S01 Memory Garden Storm Channel
A05 East Brea Channel
A06 Loftus Diversion Channel
A06P01 Val Verde Storm Drain
A06S01 East Fullerton Creek Channel
A07 Imperial Channel
A08 La Mirada Creek Channel
A09 Tonner Canyon Channel

Attachment G

Geotechnical Percolation Report/Soil report (for reference only)

ALBUS-KEEFE & ASSOCIATES, INC
GEOTECHNICAL CONSULTANTS

November 9, 2018
J.N.: 2761.00

Mr. Greg McCafferty
McEb LLC
2390 E. Orangewood, Suite 510
Anaheim, California 92806

Subject: **Geotechnical Investigation for Proposed Water Quality Improvements, Proposed Mixed-Use Multi-Family Residential and Commercial Development, 415 S Highland Avenue, Fullerton, California.**

Dear Mr. McCafferty,

Albus-Keefe & Associates, Inc. has completed a geotechnical investigation of the site for evaluation of the percolation characteristics of the site soils. The scope of this investigation consisted of the following:

- Exploratory drilling, soil sampling and test well installation
- Field percolation testing
- Laboratory testing of selected soil samples
- Engineering analysis of the data
- Preparation of this report

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Site Location and Description

The site is located at 415 South Highland Avenue in the City of Fullerton, California. Two properties (032-181-18 and 032-181-20) comprise the site. The site is bounded by West Valencia Drive to the south, South Highland Avenue to the east, a multi-family two-story residential structure to the west, and an alley way followed by a parking lot as well as a residential structure to the north. The location of the site and its relationship to the surrounding areas are shown on Figure 1, Site Location Map.

The site is semi-rectangular in shape and consists of 0.62 acres of land. The site is currently occupied by a car wash facility with an associated asphalt paved surface lot. Minor improvements related to the car wash facility were located west of the existing structure. The remaining portion of the site consists of an asphalt paved lot with limited underground utilities. A landscaped area is located at the southeast portion of the site. The site is also bounded by a masonry-built wall to the northwest.

© 2018 Google

N

SITE LOCATION MAP

McEb LLC
Proposed Mixed Use Development
415 S Highland Ave
Fullerton, California

NOT TO SCALE

FIGURE 1

Topography within the site is relatively flat with elevations approximately 147 to 151 feet above mean sea level (MSL), based on google earth. Site drainage appears to be directed as sheet flow towards the south and east to the adjacent streets. Vegetation within the site consist of grass within the southeast portion of the site and scattered trees near the west, south, and southeast border of the site.

Proposed Development

Based on the plans by IDS Group, the proposed development for the site will consist of 16 two- to three-story townhomes with a three-story commercial building located at the southeast portion of the property.

Improvements will also consist of interior driveways and parking areas, underground utilities, and landscaping. Structural or grading plans regarding the proposed mixed-use development were not provided to us at the time of this report. We anticipate the proposed mixed-use structure will be wood-framed structures with concrete slabs on grade yielding relatively light foundation loads.

SUMMARY OF FIELD AND LABORATORY WORK

Subsurface Investigation

Subsurface exploration for this investigation was conducted on October 3, 2018. Our exploration consisted of drilling three (3) exploratory borings utilizing a hollow-stem auger drill rig to depths ranging from approximately 21.5 to 51.5 feet below the existing ground surface (bgs). An engineer of *Albus-Keefe & Associates, Inc*. logged the exploratory excavations. Visual and tactile identifications were made of the materials encountered, and their descriptions are presented in the Exploration Logs in Appendix A. The approximate locations of the exploratory borings completed by this firm are shown on the enclosed Geotechnical Map, Plate 1.

Bulk, relatively undisturbed and Standard Penetration Test (SPT) samples were obtained at selected depths within the exploratory borings for subsequent laboratory testing. Relatively undisturbed samples were obtained using a 3-inch O.D., 2.5-inch I.D., California split-spoon soil sampler lined with brass rings. SPT samples were obtained from the boring using a standard, unlined SPT soil sampler. During each sampling interval, the sampler was driven 18 inches with successive drops of a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler was recorded for each six inches of advancement. The total blow count for the lower 12 inches of advancement per soil sample is recorded on the exploration log. Samples were placed in sealed containers or plastic bags and transported to our laboratory for analyses. Upon completion of sampling, borings B-1 and B-2 were backfilled with auger cuttings and capped with asphalt cold patch.

Boring B-3 was converted to the percolation test boring P-1 by installing a 3-inch-diameter casing in this boring. Well screens were installed from near the bottom of the borings to ground surface. The annular space of the well screen section was filled with gravel for depths covering the extent of our testing. The remaining annular space was then backfilled with native soils. After completion of

percolation test, the casing was removed and this boring was backfilled in the same manner as the other two borings, above.

Percolation Testing

Percolation testing was performed on October 3, 2018, in general conformance with the constant-head test procedures outlined in the referenced Well Permeameter Method (USBR 7300-89). A water hose attached to a water source on site was connected to an inline flowmeter to measure the water flow. The flowmeter is capable of measuring flow rates up to 13 gallons per minute and as low as 0.06 gallons per minute. A valve was connected in line with the flowmeter to control the flow rate. A filling hose was used to connect the flowmeter and the test well. Water was then introduced by the filling hose near the bottom of the test well. A water level meter with 1/100-foot divisions was used to measure the depths to water surface from the top of well casings.

Flow to the well was terminated upon either completion of testing of all the pre-determined water levels or if the flow rate exceeded the maximum capacity of the flowmeter. Measurements obtained during the percolation testing are provided on Appendix C, Plate C-1.

Laboratory Testing

Selected soil samples of representative earth materials were tested to assist in the formulation of conclusions and recommendations presented in this report. Tests consisted of in-situ moisture content and dry density, and particle size analysis. Results of laboratory testing relevant to percolation characteristics are presented in the Appendix B.

ANALYSIS OF DATA

Subsurface Conditions

Descriptions of the earth materials encountered during our investigation are summarized below and are presented in detail on the Exploration Logs presented in Appendix A.

Soil materials encountered at the subject site mainly consisted of interlayered alluvial deposits. Locally undocumented artificial fill was observed within the southern portion and expected to be within the eastern portion of the site. The artificial fill was observed to the depth of 2 feet below existing ground surface. Deeper portions of artificial fill could possibly be present within the site.

The artificial fill is comprised of medium brown silty sand and sandy silt. These materials are typically slightly damp and loose or medium stiff. Alluvial deposits were encountered below the artificial fill materials to the maximum depth of exploration, 51.5 feet below the ground surface. The alluvial soils are typically comprised of interlayered light, medium, and dark brown sandy clay, clayey sand, sand with clay, and occasional sand layers. Silt and sandy silt deposits were also encountered generally below depths of 20 feet. All materials observed are generally moist and medium dense to dense / stiff to hard.

Groundwater

Groundwater was not encountered during this firm's subsurface exploration reaching depths of approximately 51.5 feet below the existing ground surface.

A review of the referenced CDMG Seismic Hazard Zone Report 03 indicates that historical high groundwater levels for the general site area have been recorded at approximately 45 feet below the existing ground surface.

Percolation Data

An analysis was performed to evaluate permeability using the flow rate obtained at the end of the constant-head stage of field percolation testing. The analysis was performed in accordance with the procedures provided in the referenced USBR 7300-89. The procedure essentially uses a closed-form solution to the percolation out of a small-diameter well. Using this method, we calculated a composite permeability value for the head condition maintained in each well. Since the flow to the well was less than the lower limit of our equipment, the minimum flow rate of the equipment was used. The result is summarized in Table 1 below and the supporting analysis is included in Appendix C, Plate C-2.

TABLE 1
Summary of Back-Calculated Permeability Coefficient

Location	Total Depth of Well (ft)	Depth to Water in Well (ft)	Height of Water in Well (ft)	Static Flow Rate (gal./min.)	Estimated Permeability, ks (in/hr.)
P-1	10	5	5	<0.06	<0.09

CONCLUSIONS AND RECOMMENDATIONS

Based on our observations in the field, we anticipate that the infiltration at the site would be too low to meet the minimum requirements set by the Orange County Regional Water Quality Board. The heavily interlayered nature of the subsurface soils which have impeded infiltration was observed in all of the exploratory borings. Infiltration of storm water through the use of a shallow chamber system or dry well at the site is deemed unfeasible. Therefore, treatment of storm water will require other methods.

LIMITATIONS

This report is based on the geotechnical data as described herein. The materials encountered in our boring excavations and utilized in our laboratory testing for this investigation are believed representative of the project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil and bedrock materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions

and recommendations contained herein. As such, observations by a geotechnical consultant during the construction phase of the storm water infiltration systems are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein.

This report has been prepared for the exclusive use of **McEb LLC.** to assist the project consultants in the design of the proposed development. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling governmental agency.

We appreciate this opportunity to be of service to you. If you should have any questions regarding the contents of this report, please do not hesitate to call.

Sincerely,

ALBUS-KEEFE & ASSOCIATES, INC.

Mark Principe
Staff Engineer

Bidjan Ghahreman
Associate Engineer
G.E. 3111

Enclosures: Plate 1- Geotechnical Map
Appendix A - Exploratory Logs
Appendix B – Relevant Soil Laboratory Testing
Appendix C - Percolation Testing and Analyses

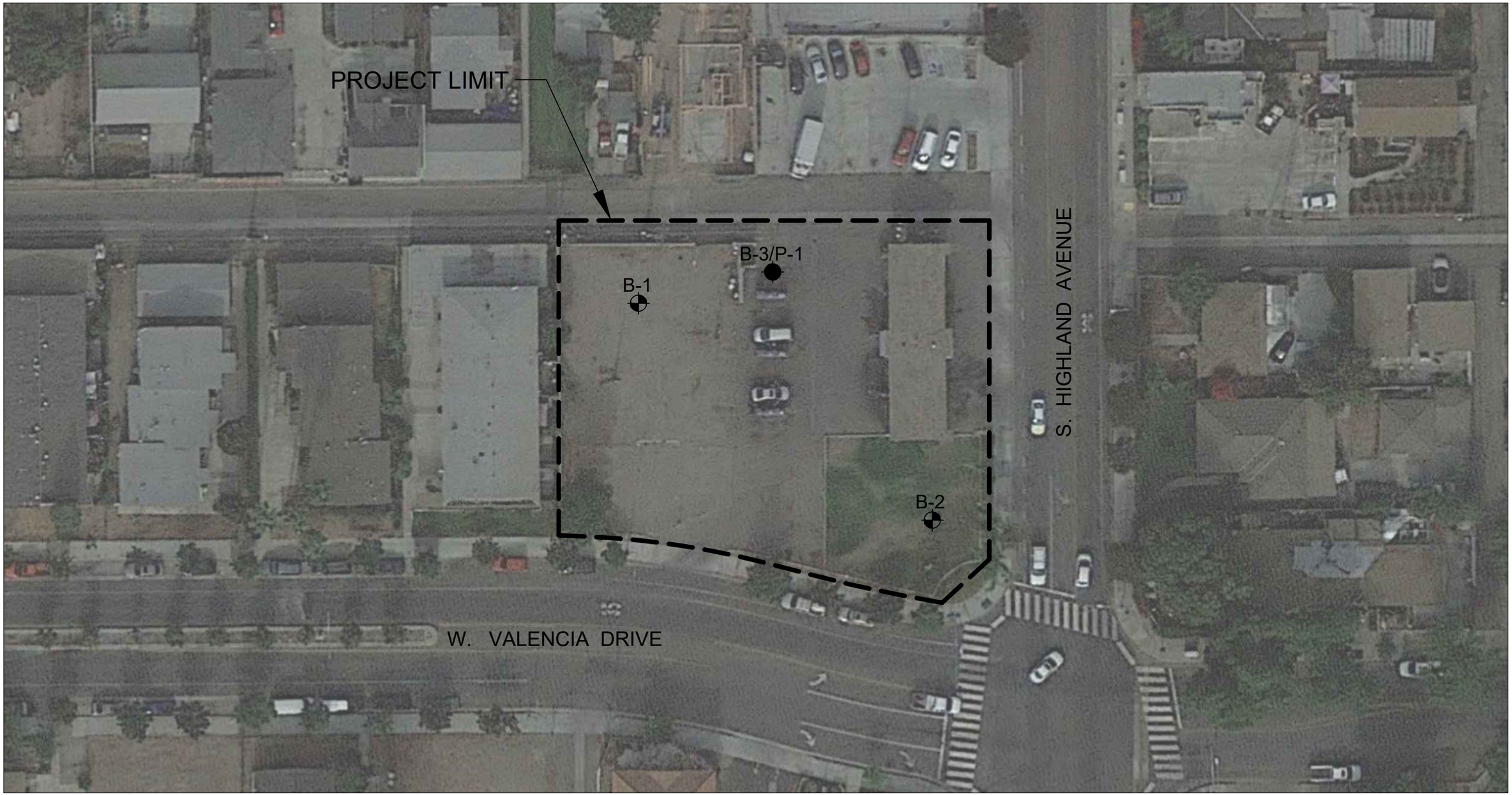
REFERENCES

Publications and Reports

CDMG, "Seismic Hazard Zone Report for the Anaheim 7.5-Minute Quadrangles, Orange County, California," Seismic Hazard Zone Report 03, 1998.

"Procedure for Performing Field Permeability Testing by the Well Permeameter Method", United States Department of The Interior, Bureau of Reclamation (USBR 7300-89).

Saxton, K.E., W.J. Rawls, J.S. Romberger, and R.I. Papendick. 1986, "Estimating generalized soil-water characteristics from texture", Soil Sci. Soc. Am. J. 50(4):1031-103



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EXPLANATION

(Locations Approximate)

- Exploratory Boring
- Exploratory Percolation Boring

APPROX. SCALE
1" = 40'

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

GEOTECHNICAL MAP

Job No.: 2761.00	Date: 10/23/18	Plate: 1

APPENDIX A

EXPLORATORY LOGS

EXPLORATION LOG

Project:		Location:
Address:		Elevation:
Job Number:	Client:	Date:
Drill Method:	Driving Weight:	Logged By:

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
5		**EXPLANATION** Solid lines separate geologic units and/or material types. Dashed lines indicate unknown depth of geologic unit change or material type change. **Solid black rectangle** in Core column represents California Split Spoon sampler (2.5in ID, 3in OD). **Double triangle** in core column represents SPT sampler. **Vertical Lines** in core column represents Shelby sampler. **Solid black rectangle** in Bulk column respresents large bag sample. **Other Laboratory Tests:** Max = Maximum Dry Density/Optimum Moisture Content EI = Expansion Index SO4 = Soluble Sulfate Content DSR = Direct Shear, Remolded DS = Direct Shear, Undisturbed SA = Sieve Analysis (1" through #200 sieve) Hydro = Particle Size Analysis (SA with Hydrometer) 200 = Percent Passing #200 Sieve Consol = Consolidation SE = Sand Equivalent Rval = R-Value ATT = Atterberg Limits							
10									
15									
20									

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-1
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 150.9
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Asphalt (AC): 4 Inches							DS RVal pH Resist Ch
		ALLUVIUM (Qal) Silty Sand (SM): Medium brown, moist, medium dense, fine grained sand, trace medium grained sand, micaceous, few clay.		25			8.6	95.7	
5		Clayey Sand (SC): Mottled light and medium to dark brown, moist, medium dense, fine grained sand, trace medium grained sand, nodules of clay present.		19			13.3	107.8	SO4 Consol ATT
10		Clayey Sand / Sandy Clay (SC/CL): Dark brown, moist, medium dense / very stiff, fine grained sand.		36			16.3	109.2	
15		Clayey Sand (SC): Medium brown, moist, medium dense, fine grained sand.		13					
20		Sand with Clay (SP-SC): Light brown, moist, medium dense, fine grained sand, lenses of sandy clay.		7					
		Silt (ML): Medium brown, very moist, stiff, few fine grained sand, micaceous, with clay.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-1
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 150.9
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Sand (SP): Grayish brown, moist, dense, fine to coarse grained sand.		20					
		Sandy Silt (ML): Medium grayish brown, moist, hard, fine grained sand, iron oxide staining.							
30		Silt (ML): Medium brown, moist, stiff, few fine sand, with clay, lenses of sandy silt / silty sand.		9					
		Clayey Sand (SC): Grayish brown, moist, medium dense, medium grained sand, lenses of sand.							
35		Sand (SP): Brown, moist, medium dense, medium to coarse grained sand, trace fines.		13					
		Sandy Clay (CL): Light grayish brown, moist, very stiff, lenses of sand, iron oxide staining.							
40				15					
		Clayey Sand (SC): Brownish gray, moist, dense, fine to medium grained sand.							
45				19					200
		Clay (CL): Brownish gray, moist, hard.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-1
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 150.9
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		@ 50 ft, with fine grained sand.		19			22.1		ATT
		Total Depth 51.5 feet. No Groundwater Encountered. Backfilled with Cuttings. Patched with A.C. Cold Patch.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-2
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 148.8
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ALLUVIUM (Qal) Silty Sand / Sandy Silt (SM/ML): Medium brown, slightly damp, loose / medium stiff, fine grained sand.							
		Sand with Silt (SP-SM): Tan to brown, moist, loose, fine grained sand, trace medium grained sand.		8	■		3.2	92.4	
		Clay (CL): Mottled light, medium, and dark brown, moist, medium stiff, fine grained sand, rootlets present, with sand, with silt.		10	■		17.6	93.1	Consol
5		Clayey Sand (SC): Medium brown, moist, loose, fine grained sand, possible pores, rootlets present.		13	■		17.8	100.6	
		Sandy Clay (CL): Medium brown light brown, moist, very stiff, fine to medium grained sand, trace coarse gravel, trace pores.							
10				26	■		17.7	108.8	
		Clayey Sand / Sandy Clay (SC/CL): Medium brown light brown, moist, medium dense / very stiff, fine grained sand.							
15				26	■		16.1	110.5	
		Sand with Clay (SP-SC): Brown, moist, dense, fine to medium grained sand, trace coarse grained sand.							
20				24	⧗				
		Total Depth 21.5 feet. No Groundwater Encountered. Backfilled with Cuttings.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-3
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 149.8
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Asphalt (AC): 4 Inches							
		ALLUVIUM (Qal) Sand with Clay (SP-SC): Light brown, moist, medium dense, fine grained sand.							
		@ 4 ft, Increased clay.							
5		Silty Sand / Clayey Sand (SM/SC): Mottled light brown and medium brown, moist, medium dense, fine to coarse grained sand.		19	■		13.3	107.8	Consol
		@ 6 ft, Medium brown.							
		@ 8 ft, Increased clay.							
10				27	■		13.2	111.6	SA Hydro
		Sandy Clay (CL): Medium brown, moist, stiff, fine grained sand, few silt.							
15				9	⧗				
		Sand with Silt (SP-SM): Reddish brown, moist, medium dense, lenses of sandy silt.							
20				16	⧗				
		Sandy Silt (ML): Medium brown, moist, very stiff, fine grained sand, iron oxide staining, few coarse grained sand, few clay.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-3
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 149.8
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

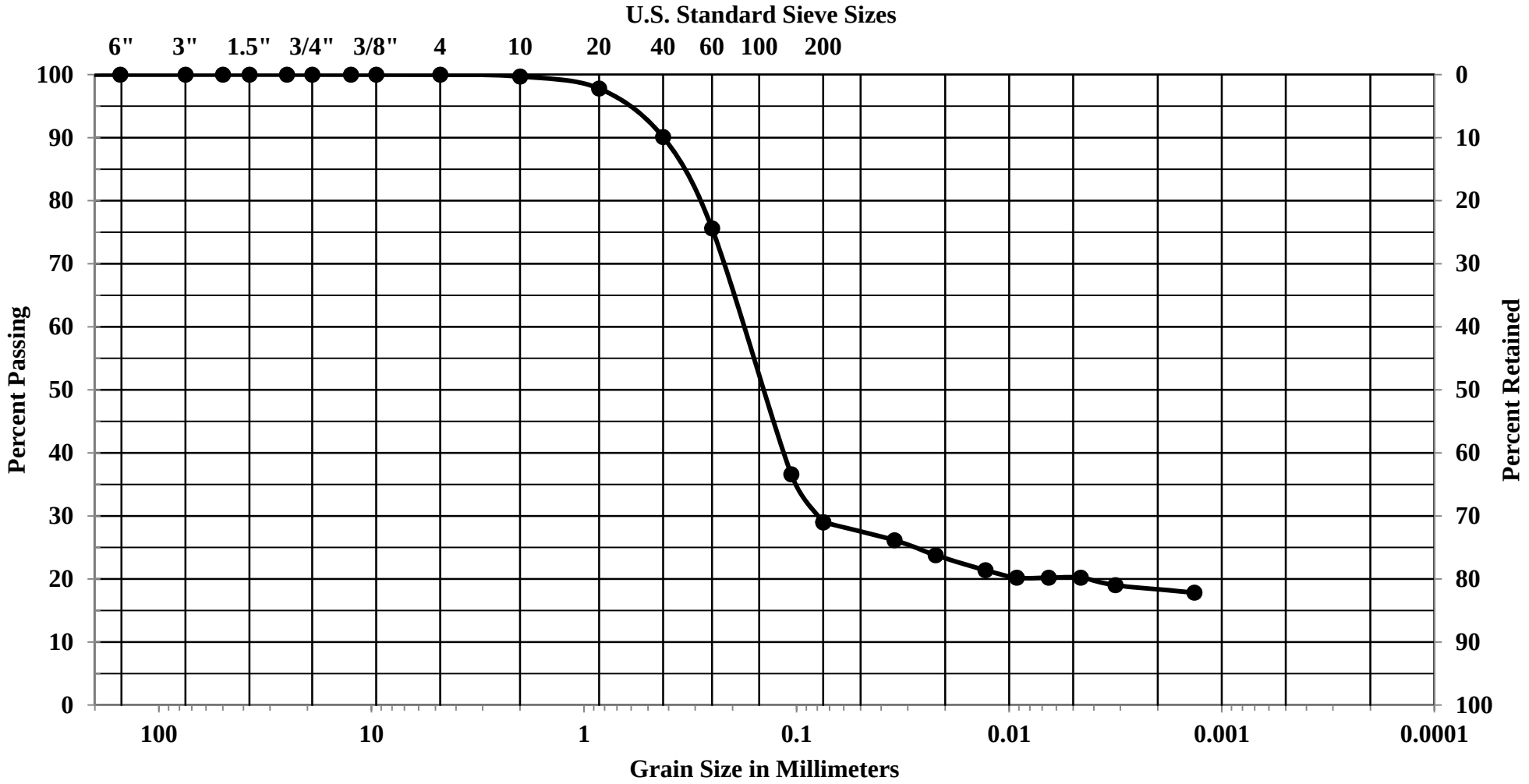
Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Sand (SP): Grayish brown, moist, medium dense, fine to medium grained sand.		19					
		Silt (ML): Medium grayish brown, moist, very stiff, with clay, few fine grained sand.							
30		@ 30 ft, Stiff.		7					
		Sand with Silt (SP-SM): Grayish brown, moist, dense, fine to coarse grained sand.							
35				24					
		Sand (SP): Grayish brown, moist, dense, fine to coarse grained sand.							
		Total Depth 36.5 feet. No Groundwater was Encountered. Backfilled with Cuttings. Patched with A.C. Cold Patch. Installed percolation well P-1 within Boring.							

APPENDIX B

RELEVANT SOIL LABORATORY TESTING

GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Job Number	Location	Depth	Description
2761.00	B-3	10	Silty Sand / Clayey Sand (SM/SC)

APPENDIX C

PERCOLATION TESTING AND ANALYSES

Field Percolation Testing - Constant Head

Client: McEb LLC

Job. No.: 2761.00

Date Tested: 10/3/2018

Test by: MP

Location: P-1

Top of Casing to Bottom of Well (ft): 10

Elev. of Ground Surface (ft): 149.8

Diam. of Test Hole (in): 8

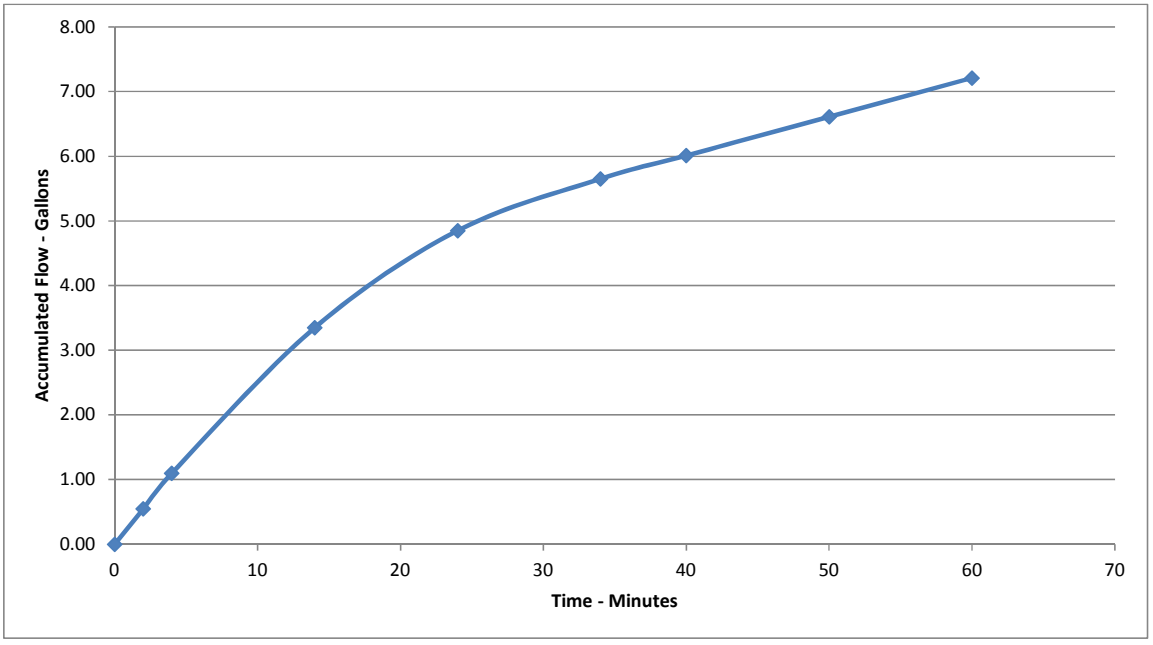
Diam. of Casing (in): 3

Ht. to Top of Casing (ft): 0

Water Tempurature (C°): 21

Constant Head

Elapsed Time (minutes)	Time	Depth to Water (ft)	Flow Rate (gal./min.)	Total Water Used (gal)
0	1:02	5.00	0.30	0.00
2	1:04	5.00	0.25	0.55
4	1:06	5.00	0.20	1.10
14	1:16	5.00	0.10	3.35
24	1:26	5.00	0.06	4.85
34	1:36	5.00	0.06	5.65
40	1:42	5.00	0.06	6.01
50	1:52	5.00	0.06	6.61
60	2:02	5.00	<0.06	7.21



INFILTRATION WELL DESIGN

Constant Head
USBR 7300-89 Method
J.N.: 2761.00
Client: McEb
Well No.: P-1

Low Water Table	Condition 1	
High Water Table & Water Below Bottom of Well	Condition 2	
High water Table with Water Above the Well Bottom	Condition 3	
		Units:
Enter Condition (1, 2 or 3):	1	
Ground Surface to Bottom of Well (h_1):	10	feet
Depth to Water (h_2):	5	feet
Height of Water in the Well (h_1-h_2=**h**):	5	feet
Radius of Well (**r**):	4.0	Inches
Minimum Volume Required:	1473.4	Gal.
Discharge Rate of Water Into Well for Steady-State Condition (**q**):	0.06	Gal/min.
Temperature (**T**):	21	Celsius
(Viscosity of Water @ Temp. T) / (Viscosity of water @ 20° C) (**V**):	0.9647	ft^3/min.
Unsaturated Distance Between the Water Surface in the Well and the Water table (T_u):		Ignore T_u
Factor of Safety:	1	
Coefficient of Permeability @ 20° C (k_{20}):	1.23E-04	ft/min.
Design k_{20}:	0.09	in./hr.

The presence or absence of a water table or impervious soil layer within a distance of less than three times that of the water depth in the well (measured from the water surface) will enable the water table to be classified as **Condition I**, **Condition II**, **Condtion III**.

Low Water Table-When the distance from the water surface in the test well to the ground water table, or to an impervious soil layer which is considered for test puposes to be equivalent to a water table, is greater than three times the depth of water in the well, classify as **Condition I**.

High Water Table-When the distance from the water surface in the test well to the ground water table or to an impervious layer is less than three times the depth of water in the well, a high water table condition exists. Use **Condition II** when the water table or impervious layer is below the well bottom. Use **Condition III** when the water table or impervious layer is above the well bottom.

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

November 9, 2018
J.N.: 2761.00

Mr. Greg McCafferty
McEb LLC
2390 E Orangewood, Suite 510
Anaheim, California 92806

Subject: **Highland & Valencia Mixed-Use Project Preliminary Geotechnical Investigation and Percolation Study, 415 S. Highland Ave., Fullerton, California.**

Dear Mr. McCafferty,

Pursuant to your request, ***Albus-Keefe & Associates, Inc***. is pleased to present to you our preliminary geotechnical investigation report, for the proposed mixed-use development at the subject site. This report presents the results of our aerial photo, subsurface exploration, laboratory testing, and engineering analyses. Conclusions relevant to the feasibility of the proposed site development are also presented herein based on the findings of our work.

We appreciate this opportunity to be of service to you. If you should have any questions regarding the contents of this report, please do not hesitate to call.

Sincerely,

ALBUS-KEEFE & ASSOCIATES, INC.

Patrick M. Keefe
Principal Engineering Geologist

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Figure 1 - Site Location Map
Plate 1 - Geotechnical Map

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1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purposes of our preliminary geotechnical investigation were to evaluate geotechnical conditions within the project area and to provide conclusions and recommendations relevant to the design and construction of the proposed improvements at the subject site. The scope of this investigation included the following:

- Review of historical aerial photographs;
- Review of published geologic and seismic data for the site and surrounding area;
- Exploratory drilling and soil sampling;
- Laboratory testing of selected soil samples;
- Engineering analyses of data obtained from our review, exploration, and laboratory testing;
- Evaluation of site seismicity, liquefaction potential, and settlement potential,
- Review of the site development plans provided to us at the time of our work.
- Preparation of this report

1.2 SITE LOCATION AND DESCRIPTION

The site is located at 415 South Highland Avenue in the City of Fullerton, California. Two properties (032-181-18 and 032-181-20) comprise the site. The site is bounded by West Valencia Drive to the south, South Highland Avenue to the east, a multi-family two-story residential structure to the west, and an alley way followed by a parking lot as well as a residential structure to the north. The location of the site and its relationship to the surrounding areas are shown on Figure 1, Site Location Map.

The site is semi-rectangular in shape and consists of 0.62 acres of land. The site is currently occupied by a car wash facility with an associated asphalt paved surface lot. Minor improvements related to the car wash facility were located west of the existing structure. The remaining portion of the site consist of an asphalt paved lot with limited underground utilities. A landscaped area is located at the southeast portion of the site. The site is also bounded by a masonry-built wall to the northwest.

Topography within the site is relatively flat with elevations approximately 147 to 151 feet above mean sea level (MSL), based on google earth. Site drainage appears to be directed as sheet flow towards the south and east to the adjacent streets. Vegetation within the site consist of grass within the southeast portion of the site and scattered trees near the west, south, and southeast border of the site.

© 2018 Google Earth

N

Site Location Map

McEb LLC
Proposed Mixed Use Development
415 South Highland Avenue
Fullerton, California

NOT TO SCALE

FIGURE 1

1.3 PROPOSED DEVELOPMENT

Based on the plans by IDS Group, the proposed development for the site will consist of 16 two- to three-story townhomes with a three-story commercial building located at the southeast portion of the property.

Improvements will also consist of interior driveways and parking areas, underground utilities, and landscaping. Structural or grading plans regarding the proposed mixed-use development were not provided to us at the time of this report. We anticipate the proposed mixed-use structure will be wood-framed structures with concrete slabs on grade yielding relatively light foundation loads.

2.0 INVESTIGATION

2.1 RESEARCH

We have reviewed the referenced geologic publications, maps, and historical aerial photos of the vicinity. Data from these sources were utilized to the development of some of our findings and conclusions presented in this report. Since 1953, the site appears to have been utilized for agricultural purposes. A structure is present at the southern portion of the property. In 1963, constructed residential and commercial structures are seen adjacent to the site property. In addition, the site is currently a vacant lot due to the residential structure at the southern portion of the site being demolished. In 1972, the site contains a structure on the northeastern portion of the property that appears to be present day car wash. Between 1980 to 1995, a possible structure appears on the south eastern portion of the site. In 2003, the possible structure within the southeastern portion of the site is no longer present, being replaced by landscaping. Between 2003 and 2018, there does not appear to be any major alterations to the site.

2.2 SUBSURFACE EXPLORATION

Subsurface exploration for this investigation was conducted on October 3, 2018. Our exploration consisted of drilling three (3) exploratory borings utilizing a hollow-stem auger drill rig to depths ranging from approximately 21.5 to 51.5 feet below the existing ground surface (bgs). An engineer of *Albus-Keefe & Associates, In*c. logged the exploratory excavations. Visual and tactile identifications were made of the materials encountered, and their descriptions are presented in the Exploration Logs in Appendix A. The approximate locations of the exploratory borings completed by this firm are shown on the enclosed Geotechnical Map, Plate 1. Upon completion of sampling, a 3-inch pipe was installed within exploratory boring B-3 for percolation testing. The boring was later backfilled and the pipe removed after testing. Details and results of percolation tests at the site are the subject of a separate report and are not included in the report in-hand.

Bulk, relatively undisturbed and Standard Penetration Test (SPT) samples were obtained at selected depths within the exploratory borings for subsequent laboratory testing. Relatively undisturbed samples were obtained using a 3-inch O.D., 2.5-inch I.D., California split-spoon soil sampler lined with brass rings. SPT samples were obtained from the boring using a standard, unlined SPT soil sampler. During each sampling interval, the sampler was driven 18 inches with successive drops of

a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler was recorded for each six inches of advancement. The total blow count for the lower 12 inches of advancement per soil sample is recorded on the exploration log. Samples were placed in sealed containers or plastic bags and transported to our laboratory for analyses. The borings were backfilled with auger cuttings upon completion of sampling and capped with asphalt cold patch.

2.3 LABORATORY TESTING

Selected samples obtained from our subsurface exploration were tested in our soil laboratory. Tests consisted of maximum dry density and optimum moisture content, in-situ moisture content and dry density, expansion index, corrosivity (pH. resistivity, and chloride) testing, soluble sulfate content, direct shear, consolidation/collapse potential, grain-size distribution analysis, R-value, percent passing No. 200 sieve, and Atterberg limits. A description of laboratory test criteria and test results are presented in Appendix B.

3.0 SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

Descriptions of the earth materials encountered during our investigation are summarized below and are presented in detail on the Exploration Logs presented in Appendix A.

Soil materials encountered at the subject site mainly consisted of interlayered alluvial deposits. Locally undocumented artificial fill was observed within the southern portion and expected to be within the eastern portion of the site. The artificial fill was observed to the depth of 2 feet below existing ground surface. Thicker amounts of artificial fill could possibly be present within the site.

The artificial fill is comprised of medium brown silty sand and sandy silt. These materials are typically slightly damp and loose or medium stiff. Alluvial deposits were encountered below the artificial fill materials to the maximum depth of exploration, 51.5 feet below the ground surface. The alluvial soils are typically comprised of interlayered light, medium, and dark brown sandy clay, clayey sand, sand with clay, and occasional sand layers. Silt and sandy silt deposits were also encountered generally below depths of 20 feet. All materials observed are generally moist and medium dense to dense / stiff to very stiff.

3.2 GROUNDWATER

Groundwater was not encountered during this firm's subsurface exploration reaching depths of approximately 51.5 feet below the existing ground surface.

A review of the referenced CDMG Seismic Hazard Zone Report 03 indicates that historical high groundwater levels for the general site area have been recorded at approximately 45 feet below the existing ground surface.

3.3 FAULTING

Based on our review of the referenced publications and seismic data, no active faults are known to project through or immediately adjacent the subject sites and the sites do not lie within an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. Table 3.1 presents a summary of known seismically active faults within 10 miles of the sites based on the 2008 USGS National Seismic Hazard Maps.

TABLE 3.1
Summary of Faults

Name	Dist. (miles)	Slip Rate (mm/yr.)	Preferred Dip (degrees)	Slip Sense	Rupture Top (km)	Fault Length (km)
Puente Hills (Coyote Hills)	0.37	0.7	26	thrust	2.8	17
Elsinore;W+GI	5.56	n/a	81	strike slip	0	83
Elsinore; W+GI+T+J+CM	5.56	n/a	84	strike slip	0	241
Elsinore;W	5.56	2.5	75	strike slip	0	46
Elsinore; W+GI+T	5.56	n/a	84	strike slip	0	124
Elsinore; W+GI+T+J	5.56	n/a	84	strike slip	0	199
Puente Hills (Santa Fe Springs)	6.81	0.7	29	thrust	2.8	11

4.0 ANALYSES

4.1 SEISMICITY

We have performed probabilistic seismic analyses utilizing the U.S. Seismic Design Maps web application by the U.S. Geological Survey (USGS). From our analyses, we obtain a PGA of 0.639 g in accordance with Figure 22-7 of ASCE 7-10. The Site Coefficient, F_{PGA}, for site class D at this range of PGA is 1.0. Therefore, the PGA_M = 1.0 x 0.639 g = 0.64 g. The mean event associated with a probability of exceedance of 2% over 50 years has a moment magnitude of 6.64 and the mean distance to the seismic source is 6.5 miles.

4.2 STATIC SETTLEMENT

Results of our subsurface investigation indicated limited amounts of fill were observed within the site. Visually, the artificial fill was noted to possess variable engineering characteristics with no documentation as to its placement. The artificial fill is not considered suitable for support of engineered fill or foundation loads in its existing state.

The near-surface alluvial soils exhibit slight to moderate compressibility. Provided rough grading and foundation support is designed in accordance with the recommendations provided herein and based on the anticipated foundation loads, total and differential settlements are anticipated to be less than 1 inch and ½ inch over 30 feet, respectively. The estimated magnitudes of settlement are considered within tolerable limits for the proposed structures.

4.3 LIQUEFACTION

We have performed engineering analyses to evaluate the potential for liquefaction at the site if the design earthquake event were to occur. Our analyses followed the guidelines presented in the CGS Special Publication 117A (2008) and the procedures by Youd, et al. (2001). These analyses are based on field test data and laboratory test results from this investigation.

Our liquefaction analyses were based on the soil profile from boring B-1 as provided on Plate C-1 (Appendix C). Historically high groundwater was assumed at a depth of 45 feet below the existing ground surface based on our discussion in Section 3.2. Fine-grained soils that do not have a Plasticity Index (PI) less than 12 and field moisture contents greater than 85% of liquid limit (LL) or soils with corrected blow counts greater than 30 per foot were assumed to be not susceptible to liquefaction. Based on our analysis, we confirmed that a thin layer below depths 45 feet has a factor of safety below 1.3 and as such, is prone to liquefaction during the design earthquake event. Details of the liquefaction analyses are shown on Plate C-2.

Analyses were performed to evaluate the potential magnitude of settlement resulting from seismic shaking of saturated soils with a liquefaction safety factor less than 1.3. The estimated settlement caused by soil liquefaction was evaluated for the site based on the empirical procedures developed by Tokimatsu and Seed (1987) and Ishihara and Yoshimine (1992), which compare the volumetric strain in the soil with the induced cyclic stress ratios/liquefaction safety factors. Taking the average of these three methods, we estimate a liquefaction-induced settlement of 0.22 inch. Liquefaction induced-settlement analyses are provided in Appendix C on Plate C-3.

In addition to liquefaction settlement, seismic-induced settlement can occur above groundwater table during a strong seismic event. We have estimated the dry seismic settlement using the Tokumatsu and Seed (1987) Method. The analyses indicate a total dry seismic settlement of 1.22 inch. Martin and Lew (1999) recommend that the dry seismic settlement estimate be multiplied by two to account for multi-direction shaking. Therefore, the total estimated dry seismic settlement is 2.45 inches. Details of seismic settlement above groundwater are shown on Plate C-4.

Seismic-induced differential settlement is not expected to exceed one half the total settlement according to Martin and Lew (1999). The differential dry seismic settlement can be less than one half the total dry seismic settlement at sites with relatively uniform soil conditions and deep sediments. We estimate that differential dry seismic settlement of the proposed structure will not exceed 1.2 inch in 30 horizontal feet during the design event.

5.0 CONCLUSIONS

5.1 FEASIBILITY OF PROPOSED DEVELOPMENT

From a geotechnical point of view, the proposed site development is considered feasible provided the recommendations presented in this report are incorporated into the design and construction of the project. Furthermore, it is also our opinion that the proposed development will not adversely impact the stability of adjoining properties. Key issues that could have significant fiscal impacts on the geotechnical aspects of the proposed site development are discussed in the following sections of this report.

5.2 GEOLOGIC HAZARDS

5.2.1 Ground Rupture

No known active faults are known to project through the subject sites nor do the sites lie within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. The closest known active fault is the Whittier fault located approximately 5.6 miles. Therefore, potential for ground rupture due to an earthquake beneath the sites is considered low.

5.2.2 Ground Shaking

The site is situated in a seismically active area that has historically been affected by generally moderate to occasionally high levels of ground motion. The site lies in relative close proximity to several seismically active faults; therefore, during the life of the proposed improvements, the property will probably experience similar moderate to occasionally high ground shaking from these fault zones, as well as some background shaking from other seismically active areas of the Southern California region. Potential ground accelerations have been estimated for the site and are presented in Section 4.1 of this report. Design and construction in accordance with the current California Building Code (CBC) requirements is anticipated to address the issues related to potential ground shaking.

5.2.3 Landsliding

Geologic hazards associated with landsliding are not anticipated at the site due to the relatively flat nature of the site. Furthermore, the site is not located within an area identified by the California Geologic Survey (CGS) as having potential for seismic slope instability.

5.2.4 Liquefaction

Engineering research of soil liquefaction potential (Youd, et al., 2001) indicates that generally three basic factors must exist concurrently in order for liquefaction to occur. These factors include:

- A source of ground shaking, such as an earthquake, capable of generating soil mass distortions.
- A relatively loose silty and/or sandy soil.
- A relative shallow groundwater table (within approximately 50 feet below ground surface) or completely saturated soil conditions that will allow positive pore pressure generation.

The liquefaction susceptibility of the onsite subsurface soils was evaluated by analyzing the potential concurrent occurrence of the above-mentioned three basic factors. The liquefaction evaluation for this site was completed under the guidance of Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards in California (CDMG, 2008). The site is located within a mapped liquefaction hazard zone by the California Geologic Survey. Historic groundwater is determined to at 45 feet below the existing ground surface.

Our analyses indicate liquefaction could lead to a total seismic settlement (saturated and dry) of the ground surface of up to approximately 2.7 inches due to seismic consolidation during liquefaction. The differential settlement due to seismic settlement would likely be on the order of ½ of the total seismic settlement or approximately 1.4 inch over 30 feet. Evaluations presented in reports for the adjacent sites indicate that lateral spreading is not a significant risk at the site.

Based on the State of California Special Publication 117A, hazards from liquefaction should be mitigated to the extent required to reduce seismic risk to "acceptable levels". The acceptable level of risk means, "that level that provides reasonable protection of the public safety" [California Code of Regulations Title 14, Section 3721 (a)]. The use of well-reinforced foundations, such as post-tensioned slabs, grade beams with structural slabs, or mat foundations have been proven to adequately provide basal support for similar structures during comparable liquefaction events.

5.3 STATIC SETTLEMENT

Provided rough grading is performed in accordance with the recommendations provided herein and based on the anticipated relatively light foundation loads, total and differential static settlements are anticipated to be less than approximately 1 inch and ½-inch over 30 feet, respectively, for the proposed structures. The estimated magnitudes of static settlements are considered within tolerable limits for the proposed structures. Our office should be provided with foundation plans and structural loads as soon as these become available, in order to confirm our assessment of static settlement.

5.4 EXCAVATION AND MATERIAL CHARACTERISTICS

The earth materials beneath the site are anticipated to be relatively easy to excavate with conventional heavy earthmoving equipment. Generally, the site materials possess moisture contents near or above optimum moisture content. As such, fill soils derived from onsite soils that exhibit elevated moisture contents may require blending or drying prior to compaction.

Buried debris, clarifiers and other underground improvements may be present beneath the site. If encountered during future rough grading, these improvements will require proper abandonment or removal.

5.5 SHRINKAGE AND SUBSIDENCE

Volumetric changes in earth quantities will occur when excavated onsite soil materials are replaced as properly compacted fill. We estimate that the near-surface earth materials will shrink approximately 5 to 20 percent with an anticipated average near 13 percent. The estimates of shrinkage and subsidence are intended as an aid for project engineers in determining earthwork

quantities. However, these estimates should be used with some caution since they are not absolute values. Contingencies should be made for balancing earthwork quantities based on actual shrinkage and subsidence that occurs during the grading process.

5.6 SOIL EXPANSION

Based on our laboratory test results and the USCS visual manual classification, the near-surface soils within the site are generally anticipated to possess a **Very Low** expansion potential. There is a possibility of a higher expansion potential due to the interlayered nature of the site. Additional testing for soil expansion will be required subsequent to rough grading and prior to construction of foundations and other concrete work to confirm these conditions.

6.0 RECOMMENDATIONS

6.1 EARTHWORK

6.1.1 General Earthwork and Grading Specifications

All earthwork and grading should be performed in accordance with applicable requirements of Cal/OSHA, applicable specifications of the Grading Codes of the City of Fullerton, California in addition to the recommendations presented herein.

6.1.2 Pre-Grade Meeting and Geotechnical Observation

Prior to commencement of grading, we recommend a meeting be held between the developer, City Inspector, grading contractor, civil engineer, and geotechnical consultant to discuss the proposed grading and construction logistics. We also recommend a geotechnical consultant be retained to provide soil engineering and engineering geologic services during site grading and foundation construction. This is to observe compliance with the design specifications and recommendations and to allow for design changes in the event that subsurface conditions differ from those anticipated. If conditions are encountered that appear to be different than those indicated in this report, the project geotechnical consultant should be notified immediately. Design and construction revisions may be required.

6.1.3 Site Clearing

All existing site improvements, including asphaltic concrete paving, structural foundations and underground utilities, should be removed from the areas to be developed prior to any grading activities. Existing underground utility lines within the project area that will be protected in place and that fall within a 1 to 1 (H:V) plane projected down from the edges of footings may be subject to surcharge loads. Under such conditions, this office should be made aware of these conditions for evaluation of potential surcharging. Supplemental recommendations may be required to protect such improvements in place.

The project geotechnical consultant should be notified at the appropriate times to provide observation services during clearing operations to verify compliance with the above recommendations. Voids created by clearing and excavation should be left open for observation by the geotechnical consultant. Should any unusual soil conditions or subsurface structures be

encountered during site clearing or grading that are not described or anticipated herein, these conditions should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations as needed.

The presence of the existing offsite improvements may limit removals of unsuitable materials adjacent the property lines. Special grading techniques, such as slot cutting, may be required adjacent to the property lines were offsite structures are nearby.

Temporary construction equipment (office trailers, power poles, etc.) should be positioned to allow adequate room for clearing and recommended ground preparation to be performed for proposed structures, pavements, and hardscapes.

6.1.4 Ground Preparation

In general, all artificial fill and near-surface compressible alluvium is considered unsuitable for support of proposed engineered fill and site improvements. These materials should be removed from proposed building pads and any other "structural" areas, and replaced as engineered compacted fill. The depth of removal is anticipated to be about 4 feet below existing grades. In addition to general removal of unsuitable soils above, the existing soils should be over-excavated to a depth of at least 2 foot below the bottom of footings for the structure. Locally deeper removal may be required in the areas of previously existing improvements. The actual depth of removal should be determined by the geotechnical consultant during grading.

Within the limits of pavement and free-standing retaining walls over 3 feet in height, the existing fill soils should be removed (approximately 2 feet in thickness) or to a minimum depth of 1 foot below subgrade or footing, whichever is deeper.

The removals should extend laterally a distance of at least 5 feet beyond the limits of the proposed structures or a 1:1 projection down and away from the bottom of the footings, whichever is greater. Removals for pavement and free-standing retaining walls may be limited to the edge of the foundations or pavement where lateral restrictions to removals are present such as property lines. The actual depth of removals should be verified by the geotechnical consultant during site grading.

Where removals are limited by existing structures, protected trees or property lines, special considerations may be required in the construction of affected improvements. Under such conditions, specific recommendations should be provided by this firm.

All removal excavations should be evaluated by the geotechnical consultant during grading to confirm the exposed conditions are as anticipated and to provide supplemental recommendations if required.

Following removals/overexcavation, the exposed grade should first be scarified to a depth of 6 inches, brought to at least 110 percent of the optimum moisture content, and then compacted to at least 90 percent of the laboratory standard (ASTM D 1557).

6.1.5 Fill Placement

Materials excavated from the site may be reused as fill provided they are free of deleterious materials and particles greater than 4 inches in maximum dimension (oversized materials). Asphaltic and concrete debris generated during site demolition can be incorporated within fill soils during earthwork operations provided they are reduced to no more than 4 inches in maximum dimension. Such materials should be mixed thoroughly with fill soils to prevent nesting. All fill should be placed in lifts no greater than 8 inches in loose thickness, moisture conditioned to at least 110 percent of the optimum moisture content, then compacted in place to at least 90 percent of the laboratory standard. Each lift should be treated in a similar manner. Subsequent lifts should not be placed until the project geotechnical consultant has approved the preceding lift.

Excavations into site materials may expose soils with very differing characteristics. If such differing materials are created through excavation, they should be blended to create a relatively uniform soil mix when reused as fill below the structures. The blending of each lift should be observed and approved by the geotechnical consultant prior to placement of additional lifts of fill.

6.1.6 Import Materials

If import materials are required to achieve the proposed finish grades, the proposed import soils should have an Expansion Index (EI, ASTM D 4829) less than 21 and possess negligible soluble sulfate concentrations. Import sources should be indicated to the geotechnical consultant prior to hauling the materials to the site so that appropriate testing and evaluation of the fill materials can be performed in advance.

6.1.7 Temporary Excavations

Temporary construction slopes or trench excavations in site materials may be cut vertically up to a height of 4 feet provided that no surcharging of the excavations is present. Temporary slopes over feet in height but no greater than 10 feet should be laid back to 1:1 (H:V) or flatter and evaluated by the geotechnical consultant.

Excavations should not be left open for prolonged periods of time. The project geotechnical consultant should observe all temporary cuts to confirm anticipated conditions and to provide alternate recommendations if conditions dictate. All excavations should conform to the requirements of CAL OSHA.

Where temporary excavations cannot accommodate a 1:1 layback or where surcharging occurs, shoring, slot cutting, underpinning, or other methods should be used. Specific recommendations for other options if considered should be provided by the geotechnical consultant based on review of the final design plans.

6.2 SEISMIC DESIGN PARAMETERS

For design of the project in accordance with Chapter 16 of the 2016 CBC, the following table presents the seismic design factors:

TABLE 6.1
2016 CBC Seismic Design Parameters

Parameter	Value
Site Class	D
Importance Factor	I, II, III
Mapped MCE_R Spectral Response Acceleration, short periods, S_S	1.724
Mapped MCE_R Spectral Response Acceleration, at 1-sec. period, S_1	0.625
Site Coefficient, Fa	1.0
Site Coefficient, Fv	1.5
Adjusted MCER Spectral Response Acceleration, short periods, S_{MS}	1.724
Adjusted MCER Spectral Response Acceleration, at 1-sec. period, S_{M1}	0.937
Design Spectral Response Acceleration, short periods, S_{DS}	1.149
Design Spectral Response Acceleration, at 1-sec. period, S_{D1}	0.625
MCE_R = Risk-Targeted Maximum Considered Earthquake	

6.3 FOUNDATION DESIGN

6.3.1 General

The following recommendations are provided for preliminary design purposes. These recommendations have been based on the site materials exposed during our investigation, our understanding of the proposed development, and the assumption that the recommendations presented herein are incorporated into the design and construction of the project. Our preliminary recommendations include conventional shallow spread footings and post-tension slabs on grade. Final recommendations should be provided by the project geotechnical consultant following review of final foundation plans as well as observation and testing of site materials during grading. Depending upon the design plans and actual site conditions, the recommendations provided herein may require modification.

6.3.2 Soil Expansion

The recommendations presented herein are based on soils with a **Very Low** expansion potential. Following site grading, additional testing of site soils should be performed by the project geotechnical consultant to confirm the basis of these recommendations. If site soils with higher expansion potentials are encountered or imported to the site, the recommendations contained herein may require modification.

6.3.3 Static and Seismic Settlement

Foundations should be designed for static total and differential settlement up to 1 inch and ½-inch over 30 feet, respectively. Seismic settlements could be up to 2.7 inches and 1.4 inch over 30 feet for total and differential settlements, respectively.

6.3.4 Allowable Bearing Value

A bearing value of 1,800 pounds per square foot (psf) can be used for continuous and isolated footings founded at a minimum depth of 12 inches below the lowest adjacent grade and having a minimum width of 12 inches and 24 inches, respectively. The bearing value may be increased by 230 psf and 650 psf for each additional foot in width and depth, respectively, up to a maximum value of 3,500 psf. Recommended allowable bearing values include both dead and live loads, and may be increased by one-third for wind and seismic forces.

6.3.5 Lateral Resistance

Provided site grading is performed in accordance with the recommendations provided by the project geotechnical consultant, a passive earth pressure of 220 pounds per square foot per foot of depth up to a maximum value of 1,100 pounds per square foot may be used to determine lateral bearing for beams. This value may be increased by one-third when designing for wind and seismic forces. A coefficient of friction of 0.31 times the dead load forces may also be used between concrete and the supporting soils to determine lateral sliding resistance. No increase in the coefficient of friction should be used when designing for wind and seismic forces.

Where lateral removals may be restricted, such as along property lines, the above-noted values should be reduced by 50%.

The above values are based on footings placed directly against compacted fill or competent native soils. In the case where footing sides are formed, all backfill against the footings should be compacted to at least 90 percent of the laboratory standard (ASTM D 1557).

6.3.6 Footings and Slabs on Grade

Exterior and interior continuous building footings should be founded at a minimum depth of 12 inches and 12 inches, respectively, below the lowest adjacent grade. All continuous footings should be reinforced with a minimum of four No. 4 bars, two top and two bottom. The structural engineer may require different reinforcement and should dictate if greater than the recommendations provided herein.

Interior isolated pad footings should be a minimum of 24 inches square and founded at minimum depths of 12 inches below the lowest adjacent final grade. Exterior isolated pad footings intended for support of patio covers or similar construction should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the lowest adjacent final grade.

Interior concrete slabs constructed on grade should be a nominal 4 inches thick and should be reinforced with 6-inch by 6-inch, W4 X W4 reinforcing wire mesh or No. 3 bars spaced 18 inches on center, each way. Care should be taken to ensure the placement of reinforcement at mid-slab height. Slabs on grade should be provided with stiffening beams in accordance with the WRI method. An Effective PI of 20 may be used in design of the slab system. As a minimum, stiffening beams should be provided at a spacing of 15 feet in each direction. The structural engineer may recommend a greater slab thickness and reinforcement based on proposed use and loading conditions and such recommendations should govern if greater than the recommendations presented herein.

Concrete floor slabs in areas to receive carpet, tile, or other moisture sensitive coverings should be underlain with a minimum of 10-mil moisture vapor retarder conforming to ASTM E 1745, Class A. The membrane should be properly lapped, sealed, and underlain with at least 2 inches of sand having a SE no less than 30. One inch of sand may be placed over the membrane to aid in the curing of the concrete and protection of the membrane. This vapor retarder system is anticipated to be suitable for most flooring finishes that can accommodate some vapor emissions. However, this system may emit more than 4 pounds of water per 1000 sq. ft. and therefore, may not be suitable for all flooring finishes. Additional steps should be taken if such vapor emission levels are too high for anticipated flooring finishes.

Special consideration should be given to slabs in areas to receive ceramic tile or other rigid, crack-sensitive floor coverings. Design and construction of such areas should mitigate hairline cracking as recommended by the structural engineer.

Block-outs should be provided around interior columns to permit relative movement and mitigate distress to the floor slabs due to differential settlement that will occur between column footings and adjacent floor subgrade soils as loads are applied.

Prior to placing concrete, subgrade soils below slab-on-grade areas should be thoroughly moistened to provide at least 110 percent of the optimum moisture content to a depth of 12 inches.

6.3.7 Post-Tension Slab

Perimeter edge beams should be founded at a minimum depth of 12 inches below the lowest adjacent final ground surface. If a post-tensioned mat is used, the outer 12 inches should be thickened to provide a minimum embedment of 8 inches below lowest grade, or to the depth of the underlying sand, whichever is deeper. Interior beams may be founded at a minimum depth of 12 inches below the tops of the finish floor slabs.

The thickness of the floor slab/mat should be determined by the project structural engineer; however, we recommend a minimum slab thickness of 4 inches. Design of the mat may be based on a modulus of subgrade reaction (Kv1) of 35 pounds per cubic inch (pci). The modulus is based on an effective loading area of 1 foot by 1 foot. The modulus may be adjusted for other effective loading areas using the equation provided below.

$k_b(pci) = 35\left\{\frac{b+1}{2b}\right\}^2$ where "b" is the effective width of loading (minimum dimension) in feet.

All dwelling area floor slabs constructed on-grade should be underlain with a minimum of 10-mil moisture vapor retarder conforming to ASTM E 1745, Class A. The membrane should be properly lapped, sealed, and underlain with at least two (2) inches of sand having a sand equivalent (SE) no less than 30. One inch of this sand may be placed over the membrane to aid in the uniform curing of the concrete slab. This vapor retarder system is anticipated to be suitable for most flooring finishes that can accommodate some vapor emissions. However, this system may emit more than 4 pounds of water per 1000 sq. ft. and therefore, may not be suitable for all flooring finishes. Additional steps should be taken if such vapor emission levels are too high for anticipated flooring finishes. Where a mat is utilized, the sand may be reduced to 2 inches provided the mat is at least 8 inches thick.

Prior to placing concrete, subgrade soils below slab-on-grade/mat areas should be thoroughly moistened to provide at least 110 percent of the optimum moisture content to a depth of 12 inches. Based on the guidelines provided in the "Design of Post-Tensioned Slabs-on-Ground" 3rd Edition by Post-Tensioning Institute, the em and ym values for expansive soil conditions are summarized in Table 6.2. These values also consider the estimated potential differential settlement due to seismic settlement discussed previously.

TABLE 6.2
PTI Design Parameters

Parameter	Value
Edge Lift Moisture Variation Distance, em	4.2 feet
Edge Lift, ym	0.946 inches
Center Lift Moisture Variation Distance, em	8.0 feet
Center Lift, ym	0.60 inches

6.3.8 Foundation Observations

Foundation excavations should be observed by the project geotechnical consultant to verify that they have been excavated into competent bearing soils and to the minimum embedment recommended above. These observations should be performed prior to placement of forms or reinforcement. The excavations should be trimmed neat, level and square. Loose, sloughed or moisture-softened materials and debris should be removed prior to placing concrete.

6.4 RETAINING AND SCREENING WALLS

6.4.1 General

The following preliminary design and construction recommendations are provided for general retaining and screen walls supported by engineered compacted fill or competent native soils. Final wall designs specific to the site development should be provided for review once completed. The structural engineer and architect should provide appropriate recommendations for sealing at all joints and applying moisture-proofing material on the back of the walls.

6.4.2 Allowable Bearing Value and Lateral Resistance

Design of retaining and screen walls may utilize the bearing and lateral resistance values provided in Section 0 and 6.3.5.

6.4.3 Footing Reinforcing and Wall Jointing

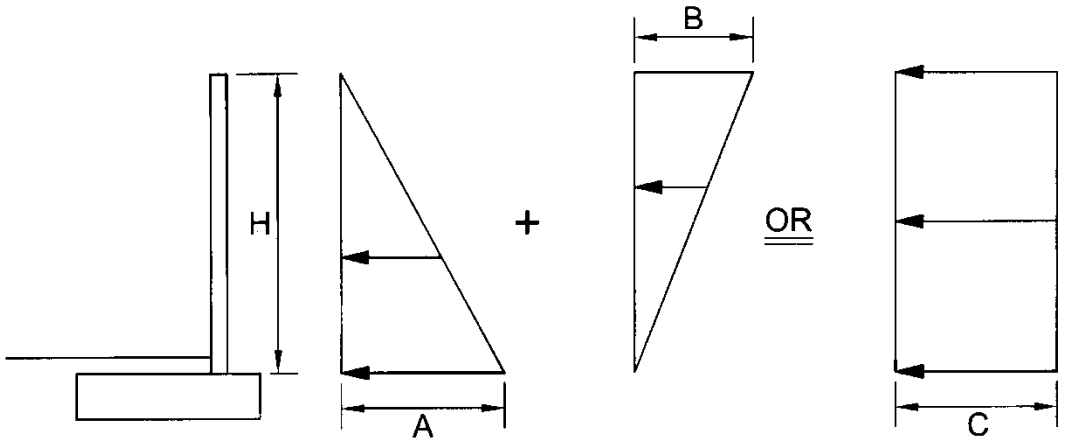
All continuous footings should be reinforced with a minimum of four No. 4 bars, two top and two bottom. The structural engineer may require different reinforcement and should dictate if greater than the recommendations herein.

Retaining and screen walls should be provided with cold joint through the wall stem at a spacing of approximately 20 feet on center. The joint should not continue through the footing.

6.4.4 Active Earth Pressure

Static and seismic earth pressures for level and 2:1 (H:V) backfill conditions are provided in the Table 6.3. Seismic earth pressures provided herein are based on the method provided by Seed & Whitman (1970) using a peak ground acceleration (PGA) of 0.40g. This acceleration is based on a 10% probability of exceedance in 50 years. Based on the 2016 CBC, walls that retain less than 6 feet need not be designed for seismic earth pressures. The values provided in the following table are based on typical site materials on drained backfill conditions and do not consider hydrostatic pressure. Retaining walls should be designed to support adjacent surcharge loads imposed by other nearby footings or traffic loads in addition to the earth pressure.

TABLE 6.3
SEISMIC EARTH PRESSURES



Active Earth Pressure Values

Value	Backfill Condition	
	Level	**2H:1V Slope**
A	37H	65H
B	13H	13H
C	25H	39H

Note:
H is in feet and resulting pressure is in psf. Design may utilize either the sum of the static component and the seismic component force diagrams or the total force diagram above. SEAOSC has suggested using a load factor of 1.7 for the static component and 1.0 for the seismic component. The actual load factors should be determined by the structural engineer.

6.4.5 Drainage and Moisture-Proofing

Retaining walls should be constructed with a perforated pipe and gravel subdrain to prevent entrapment of water in the backfill. The perforated pipe should consist of 4-inch-diameter, ABS SDR-35 or PVC Schedule 40 with the perforations laid down. The pipe should be embedded in ¾- to 1½-inch open-graded gravel wrapped in filter fabric. The gravel should be at least one foot wide and extend at least one foot up the wall above the footing and drainage outlet. Drainage gravel and piping should not be placed below outlets and weepholes. Filter fabric should consist of Mirafi 140N, or equal. Outlet pipes should be directed to positive drainage devices.

The use of weepholes may be considered in locations where aesthetic issues from potential nuisance water are not a concern. Weepholes should be 2 inches in diameter and provided at least every 6 feet on center. Where weepholes are used, perforated pipe may be omitted from the gravel subdrain.

Retaining walls supporting backfill should also be coated with a moisture-proofing compound or covered with such material to inhibit infiltration of moisture through the walls. Moisture-proofing material should cover any portion of the back of wall that will be in contact with soil and should lap over and cover the top of footing. A drainage panel should be provided between the water proofing and soil backfill. The panel should extend from the top of the subdrain gravel to within 12 inches of finish grade. The top of footing should be finished smooth with a trowel to inhibit the infiltration of water through the wall. The project structural engineer should provide specific recommendations for moisture-proofing, water stops, and joint details.

6.4.6 Footing Observations

Footing excavations should be observed by the project geotechnical consultant to verify that they have been excavated into competent bearing soils and to the minimum embedment recommended herein. These observations should be performed prior to placement of forms or reinforcement. The excavations should be trimmed neat, level, and square. Loose, sloughed or moisture-softened materials and debris should be removed prior to placing concrete.

6.4.7 Retaining Wall Backfill

Onsite soils may be used to backfill retaining walls. The project geotechnical consultant should approve all backfill used for retaining walls. Wall backfill should be moisture-conditioned to slightly over the optimum moisture content; placed in lifts no greater than 12 inches in thickness, and then mechanically compacted with appropriate equipment to at least 90 percent of the laboratory standard. Hand-operated compaction equipment should be used to compact the backfill placed immediately adjacent the wall to avoid damage to the wall. Flooding or jetting of backfill material is not recommended.

6.5 EXTERIOR FLATWORK

Exterior flatwork should be a minimum 4 inches thick. Cold joints or saw cuts should be provided at least every 7 feet in each direction. Special jointing detail should be provided in areas of block-outs, notches, or other irregularities to avoid cracking at points of high stress. Subgrade soils below flatwork should be moistened to achieve a minimum of 110 percent of optimum moisture content to a depth of 12 inches. Moistening should be accomplished by lightly spraying the area over a period

of a few days just prior to pouring concrete. The geotechnical consultant should observe and verify the density and moisture content of subgrade soils prior to pouring concrete to ensure that the required compaction and pre-moistening recommendations have been met.

Drainage from flatwork areas should be directed to local area drains or other appropriate collection devices designed to carry runoff water to the street or other approved drainage structures. Flatwork adjacent entry points to structures should have a minimum slope of 1% away from the structure.

6.6 CONCRETE MIX DESIGN

Laboratory testing of near-surface soils for soluble sulfate content indicates soluble sulfate concentration of up to 0.000%. We recommend following the procedures provided in ACI 318, Section 4.3, Table 4.3.1 for **negligible** sulfate exposure. Upon completion of rough grading, an evaluation of as-graded conditions and further laboratory testing should be completed for the site to confirm or modify the recommendations provided in this section.

6.7 CORROSION

Results of preliminary testing of soils for pH, chloride content, and minimum resistivity indicate the site is potentially **Moderately Corrosive** to metals that are in contact or close proximity to onsite soils. As such, specific recommendations should be obtained from a corrosion specialist if construction will include metals that will be buried below ground surface at the site.

6.8 PRELIMINARY PAVEMENT DESIGN

6.8.1 Preliminary Pavement Structural Sections

Based on the soil conditions present at the site and estimated traffic index, preliminary pavement structural sections are recommended in the table below. Considering soil variability at the site, "R-value" of 25 was utilized for the near-surface soil in this preliminary pavement design. The sections provided below are for planning purposes only and should be re-evaluated subsequent to site grading. Final pavement sections should be based on actual R-value testing of in-place soils and analysis of anticipated traffic.

6.8.2 Subgrade Preparation

Prior to placement of pavement elements, subgrade soils should be moisture-conditioned to at least 110 percent of the optimum moisture content then compacted to at least 90 percent of the laboratory determined maximum dry density. Areas observed to pump or yield under vehicle traffic should be removed and replaced with firm and unyielding compacted soil or aggregate base materials.

TABLE 6.4
PRELIMINARY PAVEMENT STRUCTURAL SECTIONS

Location	Traffic Index	Asphaltic Concrete (inches)	Portland Cement Concrete (inches)	Concrete Pavers (mm)	Aggregate Base (inches)
Entryway and Driveway	5.5	3.0 4.0	-- --	-- --	9.0 6.0
		--	--	80	10.0
		--	6.5	--	--
Parking Stalls	N/A	3.0	--	--	6.0

6.8.3 Aggregate Base

Aggregate base should be moisture conditioned to slightly over the optimum moisture content, placed in lifts no greater than 6 inches in thickness, then compacted to at least 95 percent of the laboratory standard (ASTM D 1557). Aggregate base materials should be Class 2 Aggregate Base conforming to Section 26-1 of the latest edition of the Caltrans Standard Specifications, Crushed Aggregate Base conforming to Section 200-2.2 of the latest edition of the Standard Specifications for Public Works Construction (Greenbook) or Crushed Miscellaneous Base conforming to Section 200-2.4 of the Greenbook.

6.8.4 Asphaltic Concrete

Aggregate base should be moisture conditioned to slightly over the optimum moisture content, placed in lifts no greater than 6 inches in thickness, then compacted to at least 95 percent of the laboratory standard (ASTM D 1557). Aggregate base materials should be Class 2 Aggregate Base conforming to Section 26-1 of the latest edition of the Caltrans Standard Specifications, Crushed Aggregate Base conforming to Section 200-2.2 of the latest edition of the Standard Specifications for Public Works Construction (Greenbook) or Crushed Miscellaneous Base conforming to Section 200-2.4 of the Greenbook.

6.8.5 Portland Cement Concrete

Portland cement concrete used to construct concrete paving should conform to Section 201 of the Greenbook and should have a minimum compressive strength of 3,250 pounds per square inch (psi) at 28 days. Reinforcement and jointing of concrete pavement sections should be designed according to the minimum recommendations provided by the Portland Cement Association (PCA). For rigid pavement, transverse and longitudinal contraction joints should be provided at spacing no greater than 15 feet. Score joints may be constructed by saw cutting to a depth of ¼ of the slab thickness. Expansion/cold joints may be used in lieu of score joints. Such joints should be properly sealed and provided with a key or dowels. Where traffic will traverse over edges of concrete paving (not including joints), the edges should be thickened by 20% of the design thickness toward the edge over a horizontal distance of 5 feet.

Trash pickup areas should be provided with a concrete slab where the bins will be picked up and extend at least 3 feet past the front wheel landing areas. The slab should be at least 6.5 inches thick and be reinforced with No. 4 bars spaced at 24 inches on centers, both ways. The slabs should be provided transverse and longitudinal joints spacing as specified above. Dowels or a keyway should be provided at all cold joints.

6.9 POST GRADING CONSIDERATIONS

6.9.1 Site Drainage and Irrigation

The ground immediately adjacent to foundations should be provided with positive drainage away from the structures in accordance with 2016 CBC, Section 1804.3. No rain or excess water should be allowed to pond against structures such as walls, foundations, flatwork, etc.

Excessive irrigation water can be detrimental to the performance of the proposed site development. Water applied in excess of the needs of vegetation will tend to percolate into the ground. Such percolation can lead to nuisance seepage and shallow perched groundwater. Seepage can form on slope faces, on the faces of retaining walls, in streets, or other low-lying areas. These conditions could lead to adverse effects such as the formation of stagnant water that breeds insects, distress or damage of trees, surface erosion, slope instability, discoloration and salt buildup on wall faces, and premature failure of pavement. Excessive watering can also lead to elevated vapor emissions within buildings that can damage flooring finishes or lead to mold growth inside the home.

Key factors that can help mitigate the potential for adverse effects of overwatering include the judicious use of water for irrigation, use of irrigation systems that are appropriate for the type of vegetation and geometric configuration of the planted area, the use of soil amendments to enhance moisture retention, use of low-water demand vegetation, regular use of appropriate fertilizers, and seasonal adjustments of irrigation systems to match the water requirements of vegetation. Specific recommendations should be provided by a landscape architect or other knowledgeable professional.

6.9.2 Utility Trenches

Trench excavations should be constructed in accordance with the recommendations contained in Section 6.1.7 of this report. Trench excavations must also conform to the requirements of Cal/OSHA.

Trench backfill materials and compaction criteria should conform to the requirements of the local municipalities. As a minimum, utility trench backfill should be compacted to at least 90 percent of the laboratory standard. Trench backfill should be brought to moisture content slightly over optimum, placed in lifts no greater than 12 inches in thickness, and then mechanically compacted with appropriate equipment to at least 90 percent of the laboratory standard. The project geotechnical consultant should perform density testing, along with probing, to test compaction. Site conditions are generally not suitable for jetting of trench backfill and jetting should not be completed without prior approval from the project geotechnical consultant.

Within shallow trenches (less than 18 inches deep) where pipes may be damaged by heavy compaction equipment, imported clean sand having a SE of 30 or greater may be utilized. The sand

should be placed in the trench, thoroughly watered, and then compacted with a vibratory compactor. For utility trenches located below a 1:1 (H:V) plane projecting downward from the outside edge of the adjacent footing base or crossing footing trenches, concrete or slurry should be used as trench backfill.

6.10 PLAN REVIEW AND CONSTRUCTION SERVICES

We recommend *Albus-Keefe & Associates, Inc*. be engaged to review any future development plans, including civil plans (grading plans), foundation plans, and proposed structural loads, prior to construction. This is to verify that the assumptions of this report are valid and that the preliminary conclusions and recommendations contained in this report have been properly interpreted and are incorporated into the project plans and specifications. If we are not provided the opportunity to review these documents, we take no responsibility for misinterpretation of our preliminary conclusions and recommendations.

We recommend that a geotechnical consultant be retained to provide soil engineering services during construction of the project. These services are to observe compliance with the design, specifications or recommendations, and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

If the project plans change significantly from the assumed development described herein, the project geotechnical consultant should review our preliminary design recommendations and their applicability to the revised construction. If conditions are encountered during construction that appear to be different than those indicated in this report or subsequent design reports, the project geotechnical consultant should be notified immediately. Design and construction revisions may be required.

7.0 LIMITATIONS

This report is based on the proposed development and geotechnical data as described herein. The materials encountered on the project site and utilized in our laboratory testing for this investigation are believed representative of the total project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil and bedrock materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observation and testing by a geotechnical consultant during the grading and construction phases of the project are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein.

This report has been prepared for the exclusive use of **McEb LLC** and their project consultants in the planning and design of the proposed development. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling governmental agency.

Respectfully submitted,

ALBUS-KEEFE & ASSOCIATES, INC.

Mark Principe
Staff Engineer

Bidjan Ghahreman
Associate Engineer
G.E. 3111

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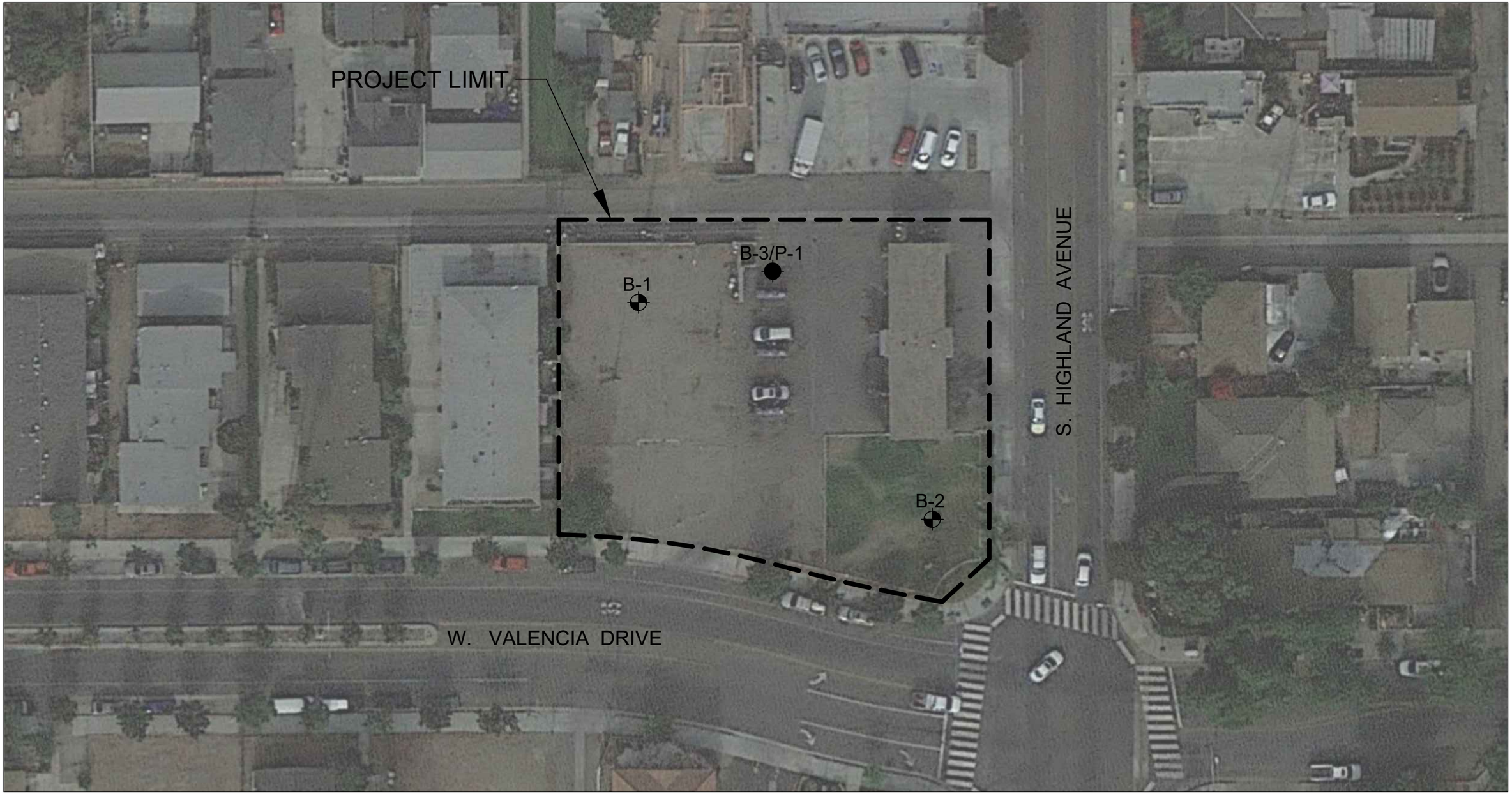
Plans

Highland & Valencia Mixed-Use, 415 S. Highland Ave., Fullerton, CA 92832, prepared by IDS Group, dated May 18, 2018, Project No. 16x056



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EXPLANATION

(Locations Approximate)

- Exploratory Boring
- Exploratory Percolation Boring

APPROX. SCALE
1" = 40'

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

GEOTECHNICAL MAP

Job No.: 2761.00	Date: 11/9/18	Plate: 1

APPENDIX A

EXPLORATION LOGS

EXPLORATION LOG

Project:		Location:
Address:		Elevation:
Job Number:	Client:	Date:
Drill Method:	Driving Weight:	Logged By:

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
5		**EXPLANATION** Solid lines separate geologic units and/or material types. Dashed lines indicate unknown depth of geologic unit change or material type change. **Solid black rectangle** in Core column represents California Split Spoon sampler (2.5in ID, 3in OD). **Double triangle** in core column represents SPT sampler. **Vertical Lines** in core column represents Shelby sampler. **Solid black rectangle** in Bulk column respresents large bag sample. **Other Laboratory Tests:** Max = Maximum Dry Density/Optimum Moisture Content EI = Expansion Index SO4 = Soluble Sulfate Content DSR = Direct Shear, Remolded DS = Direct Shear, Undisturbed SA = Sieve Analysis (1" through #200 sieve) Hydro = Particle Size Analysis (SA with Hydrometer) 200 = Percent Passing #200 Sieve Consol = Consolidation SE = Sand Equivalent Rval = R-Value ATT = Atterberg Limits							
10									
15									
20									

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-1
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 150.9
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Asphalt (AC): 4 Inches							DS RVal pH Resist Ch
		ALLUVIUM (Qal) Silty Sand (SM): Medium brown, moist, medium dense, fine grained sand, trace medium grained sand, micaceous, few clay.		25			8.6	95.7	
5		Clayey Sand (SC): Mottled light and medium to dark brown, moist, medium dense, fine grained sand, trace medium grained sand, nodules of clay present.		19			13.3	107.8	SO4 Consol ATT
10		Clayey Sand / Sandy Clay (SC/CL): Dark brown, moist, medium dense / very stiff, fine grained sand.		36			16.3	109.2	
15		Clayey Sand (SC): Medium brown, moist, medium dense, fine grained sand.		13					
20		Sand with Clay (SP-SC): Light brown, moist, medium dense, fine grained sand, lenses of sandy clay.		7					
		Silt (ML): Medium brown, very moist, stiff, few fine grained sand, micaceous, with clay.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-1
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 150.9
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Sand (SP): Grayish brown, moist, dense, fine to coarse grained sand.		20					
		Sandy Silt (ML): Medium grayish brown, moist, hard, fine grained sand, iron oxide staining.							
30		Silt (ML): Medium brown, moist, stiff, few fine sand, with clay, lenses of sandy silt / silty sand.		9					
		Clayey Sand (SC): Grayish brown, moist, medium dense, medium grained sand, lenses of sand.							
35		Sand (SP): Brown, moist, medium dense, medium to coarse grained sand, trace fines.		13					
		Sandy Clay (CL): Light grayish brown, moist, very stiff, lenses of sand, iron oxide staining.							
40				15					
		Clayey Sand (SC): Brownish gray, moist, dense, fine to medium grained sand.							
45				19					200
		Clay (CL): Brownish gray, moist, hard.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-1
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 150.9
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		@ 50 ft, with fine grained sand.		19			22.1		ATT
		Total Depth 51.5 feet. No Groundwater Encountered. Backfilled with Cuttings. Patched with A.C. Cold Patch.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-2
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 148.8
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ALLUVIUM (Qal) Silty Sand / Sandy Silt (SM/ML): Medium brown, slightly damp, loose / medium stiff, fine grained sand.							
		Sand with Silt (SP-SM): Tan to brown, moist, loose, fine grained sand, trace medium grained sand.		8	■		3.2	92.4	
		Clay (CL): Mottled light, medium, and dark brown, moist, medium stiff, fine grained sand, rootlets present, with sand, with silt.		10	■		17.6	93.1	Consol
5		Clayey Sand (SC): Medium brown, moist, loose, fine grained sand, possible pores, rootlets present.		13	■		17.8	100.6	
		Sandy Clay (CL): Medium brown light brown, moist, very stiff, fine to medium grained sand, trace coarse gravel, trace pores.							
10				26	■		17.7	108.8	
		Clayey Sand / Sandy Clay (SC/CL): Medium brown light brown, moist, medium dense / very stiff, fine grained sand.							
15				26	■		16.1	110.5	
		Sand with Clay (SP-SC): Brown, moist, dense, fine to medium grained sand, trace coarse grained sand.							
20				24	⧗				
		Total Depth 21.5 feet. No Groundwater Encountered. Backfilled with Cuttings.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-3
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 149.8
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Asphalt (AC): 4 Inches							
		ALLUVIUM (Qal) Sand with Clay (SP-SC): Light brown, moist, medium dense, fine grained sand.							
		@ 4 ft, Increased clay.							
5		Silty Sand / Clayey Sand (SM/SC): Mottled light brown and medium brown, moist, medium dense, fine to coarse grained sand.		19	■		13.3	107.8	Consol
		@ 6 ft, Medium brown.							
		@ 8 ft, Increased clay.							
10				27	■		13.2	111.6	SA Hydro
		Sandy Clay (CL): Medium brown, moist, stiff, fine grained sand, few silt.							
15				9	⧗				
		Sand with Silt (SP-SM): Reddish brown, moist, medium dense, lenses of sandy silt.							
20				16	⧗				
		Sandy Silt (ML): Medium brown, moist, very stiff, fine grained sand, iron oxide staining, few coarse grained sand, few clay.							

EXPLORATION LOG

Project: Highland & Valencia Mixed-Use Project		Location: B-3
Address: 415 S Highland Ave, Fullerton, CA		Elevation: 149.8
Job Number: 2761.00	Client: McEb LLC	Date: 10/3/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Sand (SP): Grayish brown, moist, medium dense, fine to medium grained sand.		19					
		Silt (ML): Medium grayish brown, moist, very stiff, with clay, few fine grained sand.							
30		@ 30 ft, Stiff.		7					
		Sand with Silt (SP-SM): Grayish brown, moist, dense, fine to coarse grained sand.							
35				24					
		Sand (SP): Grayish brown, moist, dense, fine to coarse grained sand.							
		Total Depth 36.5 feet. No Groundwater was Encountered. Backfilled with Cuttings. Patched with A.C. Cold Patch. Installed percolation well P-1 within Boring.							

APPENDIX B

LABORATORY TEST RESULTS

LABORATORY TESTING PROGRAM

Soil Classification

Soils encountered within the exploratory borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D 2488). The samples were re-examined in the laboratory and classifications reviewed and then revised where appropriate. The assigned group symbols are presented on the Exploration Logs provided in Appendix A.

In-Situ Moisture Content and Dry Density

Moisture content and dry density of in-place soil materials were determined in representative strata. Test data are summarized on the Exploration Logs, Appendix A.

Atterberg Limits

Atterberg Limits (Liquid Limit, Plastic Limit, and Plasticity Index) were performed in accordance with Test Method ASTM D-4318. Pertinent test values are presented within Table B-1.

Maximum Dry Density and Optimum Moisture Content

Maximum dry density and optimum moisture content were performed on a representative sample of the site materials obtained from our field explorations. The test was performed in accordance with ASTM D 1557. Pertinent test values are given in Table B-1.

Expansion Potential

An Expansion Index test was performed on a selected sample in accordance with ASTM D 4829. The test result and expansion potential are presented on Table B-1.

Direct Shear

The Coulomb shear strength parameters, angle of internal friction and cohesion, were determined for a bulk sample obtained from one our borings. The tests were performed in general conformance with Test Method ASTM D 3080. The samples were undisturbed or remolded to 90 percent of maximum dry density and 2 percentage points over optimum. Three specimens were prepared for each test, artificially saturated, and then sheared under varied loads at an appropriate constant rate of strain. Results are graphically presented on Plate B-5.

Consolidation

Consolidation tests were performed for selected soil samples in general conformance with ASTM D 2435. Axial loads were applied in several increments to a laterally restrained 1-inch-high sample. Loads were applied in geometric progression by doubling the previous load, and the resulting deformations were recorded at selected time intervals. The specific test samples were inundated at selected loads to evaluate the effects of a sudden increase in moisture content (hydro-consolidation potential). Results of the tests are graphically presented on Plates B-2 to B-4.

Soluble Sulfate Content

A chemical analysis was performed on a selected sample to determine soluble sulfate content. This test was performed in our soil laboratory in accordance with California Test Method No 417. The test result is included on Table B-1.

Particle Size Analyses

Particle size analyses were performed on representative samples of site materials in accordance with ASTM D 422. The results are presented graphically on the attached Plate B-1.

Corrosion

Select samples were tested for minimum resistivity, chloride, and pH in accordance with California Test Method 643. Results of these tests are provided in Table B-1.

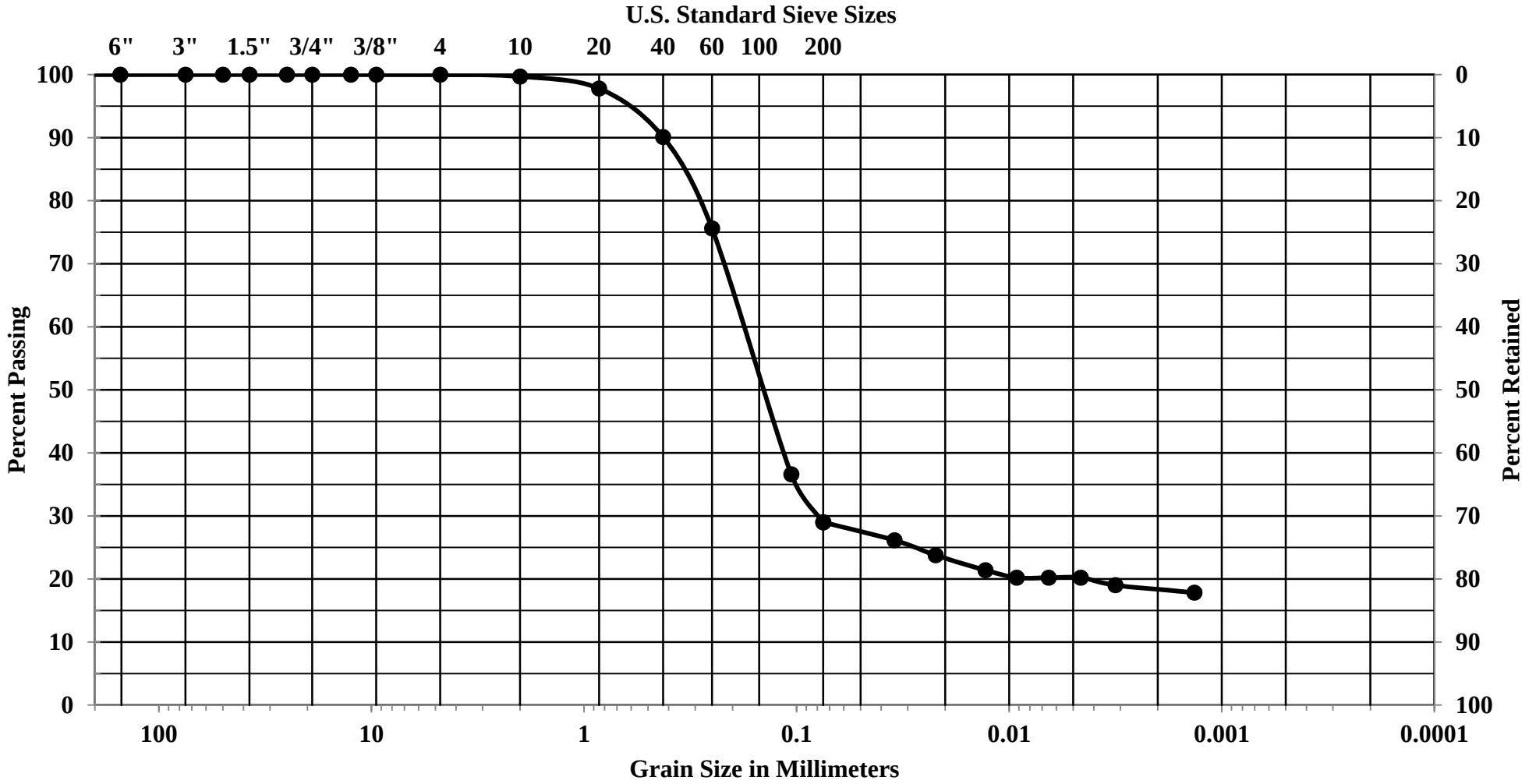
TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

Boring No.	Sample Depth (ft.)	Soil Description	Test Results	
B-1	0-5	Silty Sand (SM)	Maximum Dry Density: Optimum Moisture Content: PH: Resistivity: Chloride: Expansion Index: Expansion Potential: R-Value:	122.0 pcf 12.0 % 7.86 5900 ohm-cm 3.7 ppm 4 Very Low 68
B-1	6	Clayey Sand (SC)	Soluble Sulfate Content: Sulfate exposure: Liquid Limit: Plasticity Index:	0 % Negligible 28 9
B-1	45	Clayey Sand (SC)	Passing No. 200 Sieve:	13.5 %
B-1	50	Clay (CL)	Liquid Limit: Plasticity Index:	31 12

Note: Additional laboratory test results are provided on the boring logs provided in Appendix A.

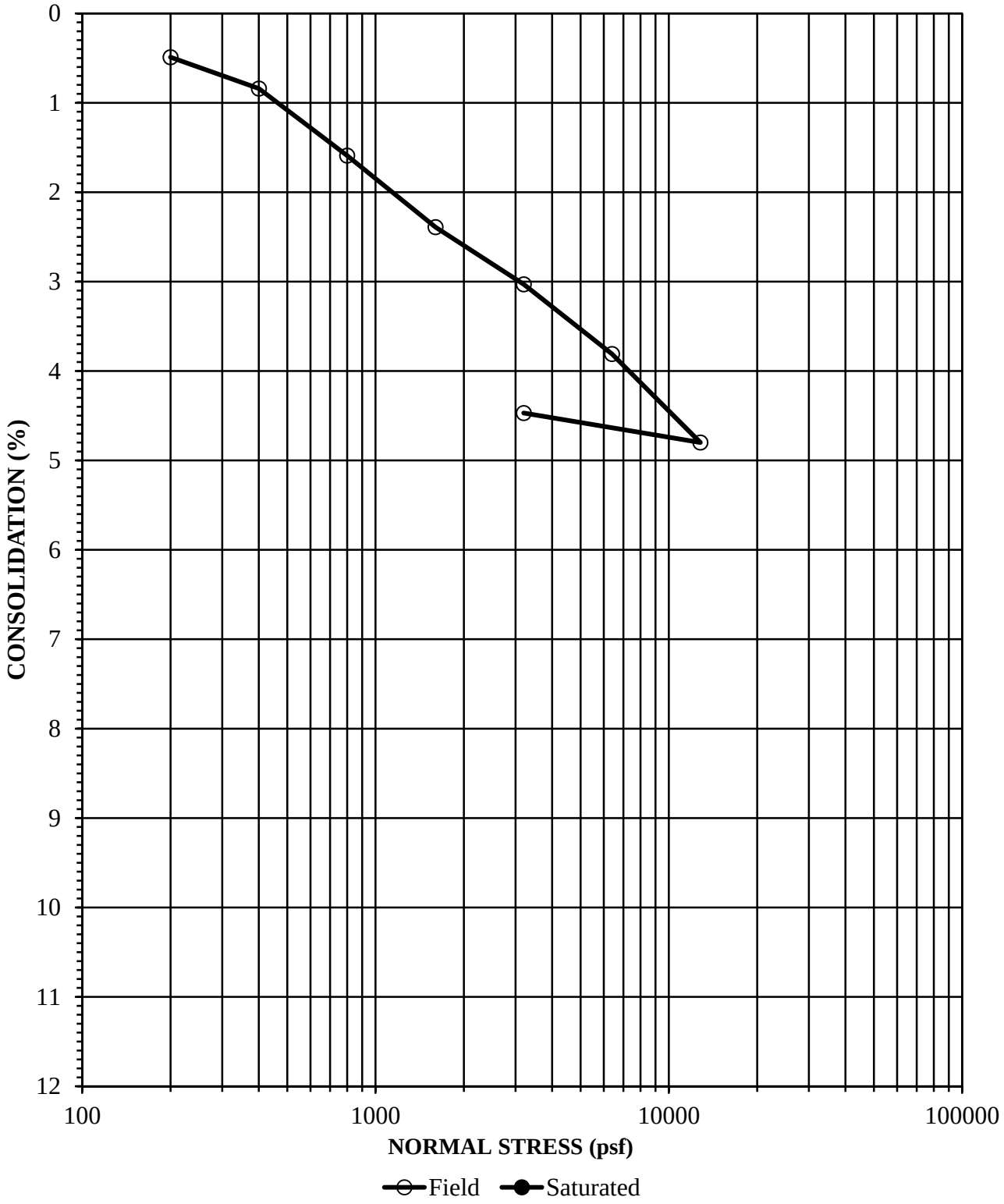
GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Job Number	Location	Depth	Description
2761.00	B-3	10	Silty Sand / Clayey Sand (SM/SC)

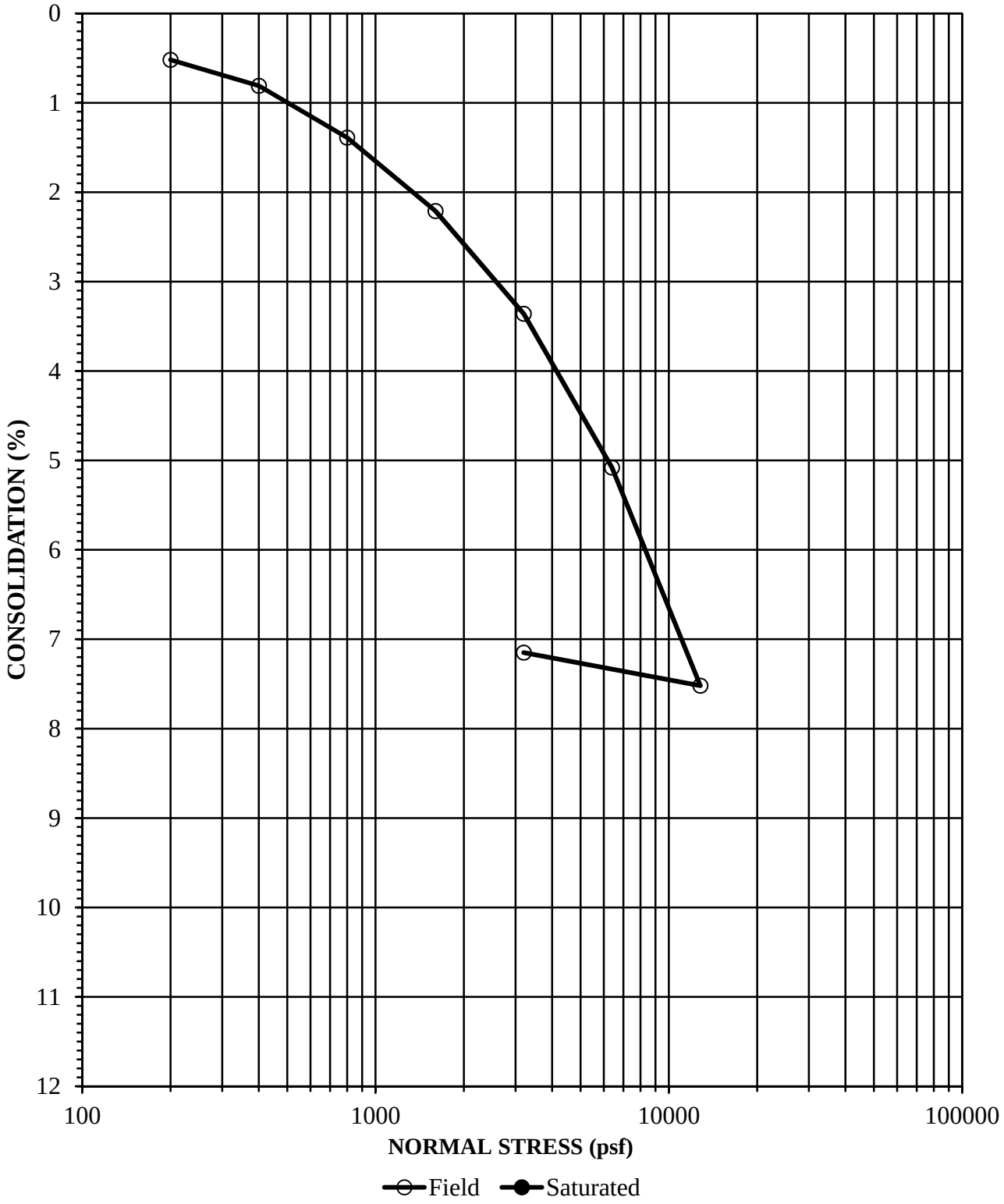
CONSOLIDATION



Job Number	Location	Depth	Description
2761.00	B-1	6	Clayey Sand (SC)

Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Concent (%)
107.8	13.9	12.1

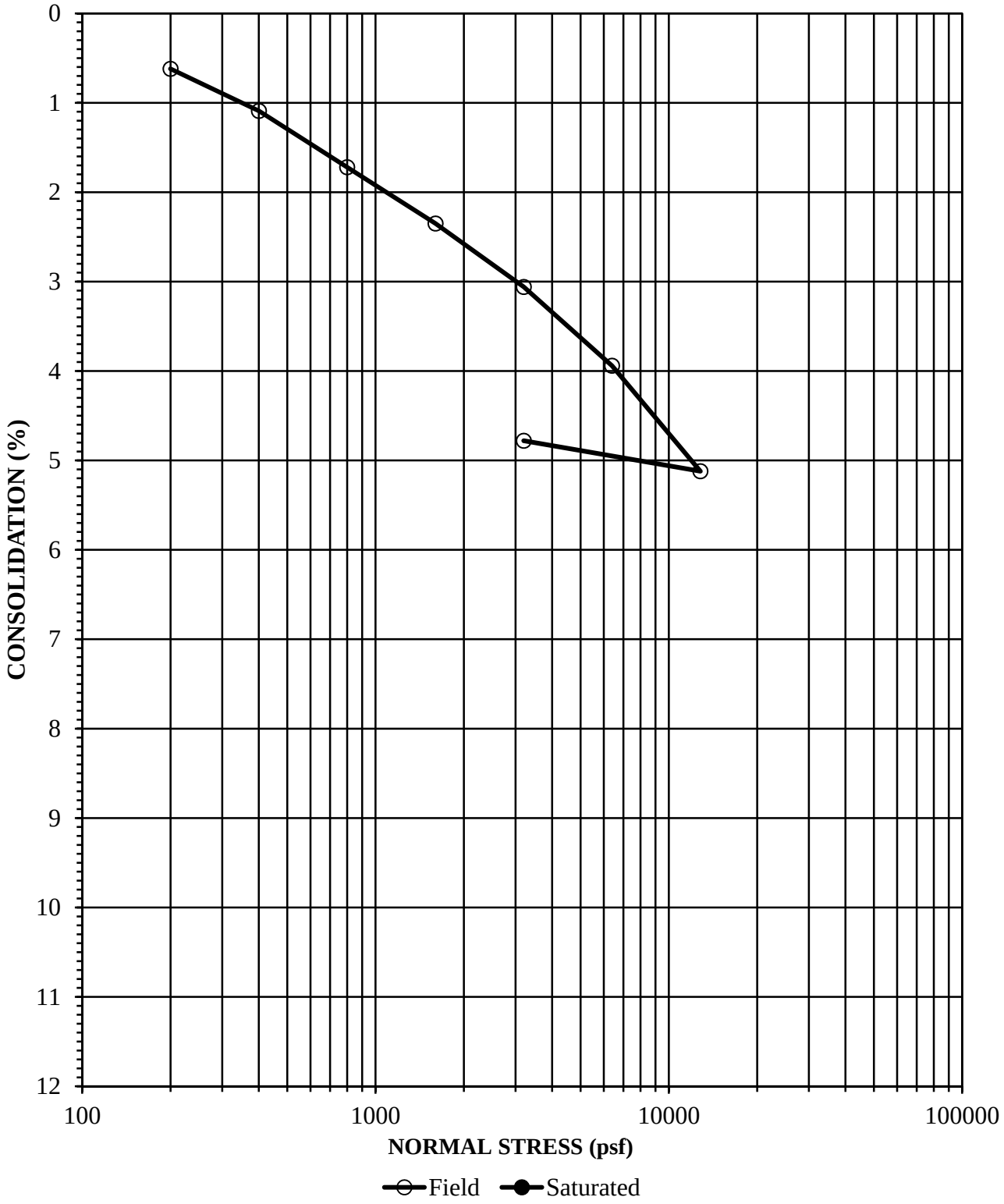
CONSOLIDATION



Job Number	Location	Depth	Description
2761.00	B-2	4	Clay (CL)

Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Concent (%)
93	21.2	12.8

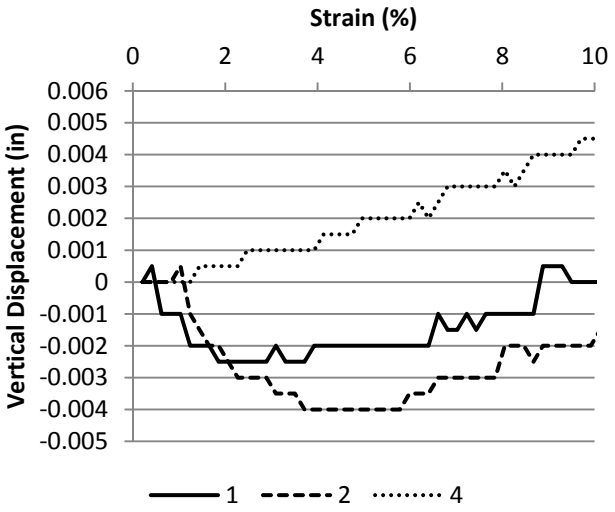
CONSOLIDATION

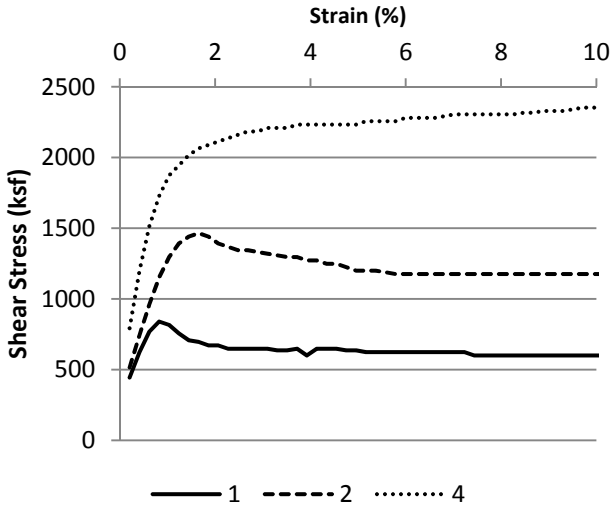


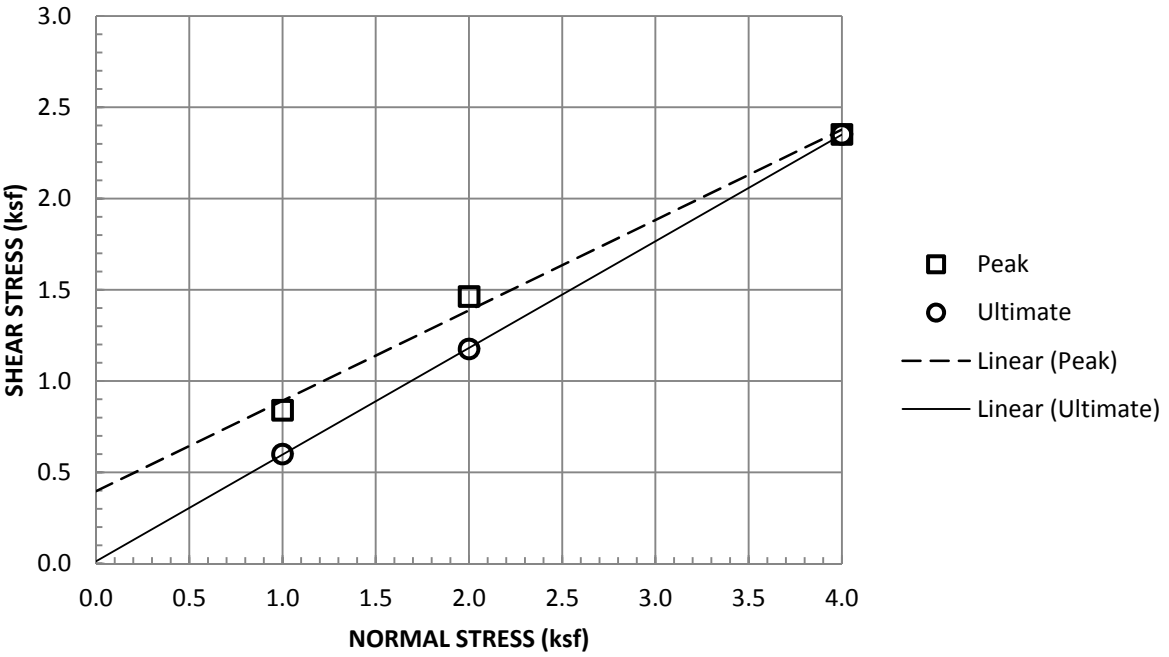
Job Number	Location	Depth	Description
2761.00	B-3	5	Silty Sand / Clayey Sand (SM/SC)

Initial Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Concent (%)
109.2	16.5	14.6

DIRECT SHEAR







Sample Type:	Remolded 90% of 122 @ 12%, Saturated		
Normal Stress (ksf)	1	2	4
Peak Shear Stress (ksf)	0.84	1.464	2.352
Peak Displacement (in)	0.003	0.004	0.005
Ultimate Shear Stress (ksf)	0.6	1.176	2.352
Ultimate Displacement (in)	0.25	0.25	0.25
Initial Dry Density (pcf)	109.8	109.8	109.8
Initial Moisture Content (%)	12	12	12
Final Moisture Content (%)	16.1	15.9	16.2
Strain Rate (in/min)	0.01		

Job Number	Location	Depth	Description
2761.00	B-1	0-5	Silty Sand (SM)

APPENDIX C

LIQUEFACTION ANALYSES

TABLE C-1

ANALYSIS OF LIQUEFACTION POTENTIAL
BORING: B-1 (2%PE in 50 yrs; FS=1.3)

Client: McEb
J.N. 2761.00
Site: Fullerton

Hammer Type (D,S,A)	A	[Ce= D 0.75, S 0.95, A Hammer Efficiency]		
Boring Diameter, ID (in)	4			
Site Acceleration (g)	0.639	PGAm w/o MSF		
for a Magnitude (Mw) of	6.64	Corresponding to 2%PE in 50 yrs		
and MSF of	1.43		Analysis Type:	General
Depth to High GW	45.0	ft.	FS for Liquefaction:	1.3
Depth to GW during invest.	51.0	ft.	FS for Liqu. Settlement:	1.3
Hammer Efficiency	81.1	%	PI Threshold for Liquefaction:	12
Sublayer Thickness	1.0	ft.	Min. Moisture Cnt for Liqu. (%LL)	85
Depth of Analysis	50.0	ft.	Max FS for Plotting:	5.0

Layer Label (Auto)	Depth Interval (ft) Top	Depth Interval (ft) Bottom	Layer Mid-Depth (ft)	Soil Type (USCS)	Fines <#200 Sieve (%)	LL (%)	PI	M (%)	Field Nf (bls/ft)	Sample Type SPT/CA	Soil Wet Density (pcf)
1	0.0	6.0	3.0	SM	13			8.6	25	CA	104
2	6.0	9.0	7.5	SC	20	28	9	13.3	19	CA	122
3	9.0	13.0	11.0	CL/SC	40			16.3	36	CA	127
4	13.0	18.0	15.5	SC	20			20	13	SPT	127
5	18.0	21.0	19.5	SP-SC	10				7	SPT	127
6	21.0	24.0	22.5	ML	60				7	SPT	127
7	24.0	26.0	25.0	SP	1				20	SPT	127
8	26.0	28.0	27.0	ML	60				20	SPT	127
9	28.0	34.0	31.0	ML	60				9	SPT	127
10	34.0	36.0	35.0	SC	20				13	SPT	127
11	36.0	39.0	37.5	SP	1				13	SPT	127
12	39.0	43.0	41.0	CL	60				15	SPT	127
13	43.0	46.0	44.5	SC	13.5				19	SPT	127
14	46.0	48.0	47.0	CL	60	31	12		19	SPT	127
15	48.0	50.0	49.0	CL	60	31	12		19	SPT	127

TABLE C-2
ANALYSIS OF LIQUEFACTION POTENTIAL
BORING: B-1 (2%PE in 50 yrs; FS=1.3)

Client: McEb
J.N. 2761.00
Site: Fullerton

SM

Hammer Type (D,S,A)	A		
Boring Diameter, ID (in)	4		
Site Acceleration (g)	0.639		
for a Magnitude (Mw) of	6.64		
and MSF of	1.43		
Depth to High GW	45	ft.	FS for Liquefaction: 1.3
Depth to GW during invest.	51	ft.	FS for Liqu. Settlement: 1.3
Hammer Efficiency	81.1	%	PI Threshold for Liquefaction: 12
Sublayer Thickness	1	ft.	Moisture Cnt Threshold for Liqu. (%LL) 85
Depth of Boring	50	ft.	

Notes: Underlined numbers are estimated values.
(1) Based on current groundwater conditions at the time of investigation.
(2) Based on assumed/proposed high groundwater conditions.
(3) Kσ=1.0

(4) A Layer is located above historically high groundwater
B Factor of Saftey is greater than the specified value of FS=1.3
C The $(N_1)_{60\text{-}cs}$ is greater than 30 blows per foot
D PI > 12 or the in situ moisture content (M%) < 85% LL

Reference: 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", ASCE Journal of Geotechnical and Geoenvironmental Engineering, Vol.127, No.10, pp.817-833, October, 2001.

Layer Label	Depth Interval (ft) Top	Depth Interval (ft) Bottom	Layer Mid-Depth (ft)	Soil Type (USCS)	Fines <#200 Sieve (%)	LL (%)	PI	M (%)	Field Nf (bls/ft)	Sample Type SPT/CA	Soil Wet Density (pcf)	Total Stress (psf)(1)	Effec. Stress (psf)(1)	C_n	C_e	C_b	C_r	C_L	$(N_1)_{60}$ (lbs/ft)	α	β	$(N_1)_{60\text{-}cs}$ (lbs/ft)	Effec. Stress (psf)(2)	R_d	CRR (M=7.5)	Kσ	CSR	FS (3)	To Liquefy Y/N?	Reason(4) not Liquifiable
																												1.30		
1	0.0	1.0	0.5	SM	13			8.6	25	CA	104	52	52	1.7	1.35	1.00	0.75	1.0	24.1	1.9	1.04	26.9	52	1.00	NA	1.00	0.42	NA	N	A
1	1.0	2.0	1.5	SM	13			8.6	25	CA	104	156	156	1.7	1.35	1.00	0.75	1.0	24.1	1.9	1.04	26.9	156	1.00	NA	1.00	0.42	NA	N	A
1	2.0	3.0	2.5	SM	13			8.6	25	CA	104	259	259	1.7	1.35	1.00	0.75	1.0	23.6	1.9	1.04	26.3	259	0.99	NA	1.00	0.42	NA	N	A
1	3.0	4.0	3.5	SM	13			8.6	25	CA	104	363	363	1.6	1.35	1.00	0.75	1.0	22.7	1.9	1.04	25.5	363	0.99	NA	1.00	0.42	NA	N	A
1	4.0	5.0	4.5	SM	13			8.6	25	CA	104	467	467	1.5	1.35	1.00	0.75	1.0	21.9	1.9	1.04	24.6	467	0.99	NA	1.00	0.42	NA	N	A
1	5.0	6.0	5.5	SM	13			8.6	25	CA	104	570	570	1.5	1.35	1.00	0.75	1.0	21.2	1.9	1.04	23.9	570	0.99	NA	1.00	0.42	NA	N	A
2	6.0	7.0	6.5	SC	20	28	9	13.3	19	CA	122	793	793	1.4	1.35	1.00	0.80	1.0	16.0	3.6	1.08	20.9	793	0.99	NA	1.00	0.40	NA	N	A
2	7.0	8.0	7.5	SC	20	28	9	13.3	19	CA	122	915	915	1.3	1.35	1.00	0.80	1.0	15.5	3.6	1.08	20.3	915	0.98	NA	1.00	0.40	NA	N	A
2	8.0	9.0	8.5	SC	20	28	9	13.3	19	CA	122	1037	1037	1.3	1.35	1.00	0.80	1.0	14.9	3.6	1.08	19.7	1037	0.98	NA	1.00	0.40	NA	N	A
3	9.0	10.0	9.5	CL/SC	40			16.3	36	CA	127	1205	1205	1.2	1.35	1.00	0.85	1.0	38.9	5.0	1.20	51.7	1205	0.98	NA	1.00	0.40	NA	N	A
3	10.0	11.0	10.5	CL/SC	40			16.3	36	CA	127	1332	1332	1.2	1.35	1.00	0.85	1.0	37.6	5.0	1.20	50.2	1332	0.98	NA	1.00	0.40	NA	N	A
3	11.0	12.0	11.5	CL/SC	40			16.3	36	CA	127	1459	1459	1.2	1.35	1.00	0.85	1.0	36.4	5.0	1.20	48.7	1459	0.97	NA	1.00	0.40	NA	N	A
3	12.0	13.0	12.5	CL/SC	40			16.3	36	CA	127	1586	1586	1.1	1.35	1.00	0.85	1.0	35.3	5.0	1.20	47.4	1586	0.97	NA	1.00	0.40	NA	N	A
4	13.0	14.0	13.5	SC	20			20	13	SPT	127	1715	1715	1.1	1.35	1.00	0.85	1.2	19.5	3.6	1.08	24.7	1715	0.97	NA	1.00	0.40	NA	N	A
4	14.0	15.0	14.5	SC	20			20	13	SPT	127	1842	1842	1.1	1.35	1.00	0.85	1.2	18.9	3.6	1.08	24.1	1842	0.97	NA	1.00	0.40	NA	N	A
4	15.0	16.0	15.5	SC	20			20	13	SPT	127	1969	1969	1.0	1.35	1.00	0.85	1.2	18.4	3.6	1.08	23.5	1969	0.96	NA	1.00	0.40	NA	N	A
4	16.0	17.0	16.5	SC	20			20	13	SPT	127	2096	2096	1.0	1.35	1.00	0.90	1.2	18.9	3.6	1.08	24.1	2096	0.96	NA	1.01	0.40	NA	N	A
4	17.0	18.0	17.5	SC	20			20	13	SPT	127	2223	2223	1.0	1.35	1.00	0.90	1.2	18.4	3.6	1.08	23.5	2223	0.96	NA	1.00	0.40	NA	N	A
5	18.0	19.0	18.5	SP-SC	10				7	SPT	127	2350	2350	0.9	1.35	1.00	0.90	1.2	9.7	0.9	1.02	10.7	2350	0.96	NA	0.99	0.40	NA	N	A
5	19.0	20.0	19.5	SP-SC	10				7	SPT	127	2477	2477	0.9	1.35	1.00	0.90	1.2	9.4	0.9	1.02	10.5	2477	0.96	NA	0.98	0.40	NA	N	A
5	20.0	21.0	20.5	SP-SC	10				7	SPT	127	2604	2604	0.9	1.35	1.00	0.90	1.2	9.2	0.9	1.02	10.3	2604	0.95	NA	0.97	0.40	NA	N	A
6	21.0	22.0	21.5	ML	60				7	SPT	127	2731	2731	0.9	1.35	1.00	0.90	1.2	9.0	5.0	1.20	15.8	2731	0.95	NA	0.96	0.40	NA	N	A
6	22.0	23.0	22.5	ML	60				7	SPT	127	2858	2858	0.9	1.35	1.00	0.95	1.2	9.2	5.0	1.20	16.1	2858	0.95	NA	0.95	0.40	NA	N	A
6	23.0	24.0	23.5	ML	60				7	SPT	127	2985	2985	0.8	1.35	1.00	0.95	1.2	9.0	5.0	1.20	15.8	2985	0.95	NA	0.94	0.40	NA	N	A
7	24.0	25.0	24.5	SP	1				20	SPT	127	3112	3112	0.8	1.35	1.00	0.95	1.2	25.2	0.0	1.00	25.2	3112	0.94	NA	0.93	0.40	NA	N	A
7	25.0	26.0	25.5	SP	1				20	SPT	127	3239	3239	0.8	1.35	1.00	0.95	1.2	24.6	0.0	1.00	24.6	3239	0.94	NA	0.93	0.40	NA	N	A
8	26.0	27.0	26.5	ML	60				20	SPT	127	3366	3366	0.8	1.35	1.00	0.95	1.2	24.1	5.0	1.20	33.9	3366	0.94	NA	0.92	0.40	NA	N	A
8	27.0	28.0	27.5	ML	60				20	SPT	127	3493	3493	0.8	1.35	1.00	0.95	1.2	23.6	5.0	1.20	33.3	3493	0.94	NA	0.91	0.38	NA	N	A
9	28.0	29.0	28.5	ML	60				9	SPT	127	3620	3620	0.8	1.35	1.00	0.95	1.2	10.4	5.0	1.20	17.5	3620	0.93	NA	0.90	0.38	NA	N	A
9	29.0	30.0	29.5	ML	60				9	SPT	127	3747	3747	0.7	1.35	1.00	1.00	1.2	10.7	5.0	1.20	17.9	3747	0.93	NA	0.90	0.38	NA	N	A
9	30.0	31.0	30.5	ML	60				9	SPT	127	3874	3874	0.7	1.35	1.00	1.00	1.2	10.5	5.0	1.20	17.6	3874	0.93	NA	0.89	0.38	NA	N	A
9	31.0	32.0	31.5	ML	60				9	SPT	127	4001	4001	0.7	1.35	1.00	1.00	1.2	10.3	5.0	1.20	17.4	4001	0.92	NA	0.88	0.38	NA	N	A
9	32.0	33.0	32.5	ML	60				9	SPT	127	4128	4128	0.7	1.35	1.00	1.00	1.2	10.1	5.0	1.20	17.1	4128	0.91	NA	0.88	0.38	NA	N	A
9	33.0	34.0	33.5	ML	60				9	SPT	127	4255	4255	0.7	1.35	1.00	1.00	1.2	9.9	5.0	1.20	16.9	4255	0.90	NA	0.87	0.38	NA	N	A
10	34.0	35.0	34.5	SC	20				13	SPT	127	4382	4382	0.7	1.35	1.00	1.00	1.2	14.1	3.6	1.08	18.8	4382	0.89	NA	0.86	0.38	NA	N	A
10	35.0	36.0	35.5	SC	20				13	SPT	127	4509	4509	0.7	1.35	1.00	1.00	1.2	13.8	3.6	1.08	18.5	4509	0.89	NA	0.86	0.36	NA	N	A
11	36.0	37.0	36.5	SP	1				13	SPT	127	4636	4636	0.6	1.35	1.00	1.00	1.2	13.6	0.0	1.00	13.6	4636	0.88	NA	0.85	0.36	NA	N	A
11	37.0	38.0	37.5	SP	1				13	SPT	127	4763	4763	0.6	1.35	1.00	1.00	1.2	13.3	0.0	1.00	13.3	4763	0.87	NA	0.84	0.36	NA	N	A
11	38.0	39.0	38.5	SP	1				13	SPT	127	4890	4890	0.6	1.35	1.00	1.00	1.2	13.1	0.0	1.00	13.1	4890	0.86	NA	0.84	0.36	NA	N	A
12	39.0	40.0	39.5	CL	60				15	SPT	127	5017	5017	0.6	1.35	1.00	1.00	1.2	14.9	5.0	1.20	22.8	5017	0.85	NA	0.83	0.36	NA	N	A
12	40.0	41.0	40.5	CL	60				15	SPT	127	5144	5144	0.6	1.35	1.00	1.00	1.2	14.6	5.0	1.20	22.5	5144	0.85	NA	0.83	0.36	NA	N	A
12	41.0	42.0	41.5	CL	60				15	SPT	127	5271	5271	0.6	1.35	1.00	1.00	1.2	14.4	5.0	1.20	22.2	5271	0.84	NA	0.82	0.34	NA	N	A
12	42.0	43.0	42.5	CL	60				15	SPT	127	5398	5398	0.6	1.35	1.00	1.00	1.2	14.1	5.0	1.20	22.0	5398	0.83	NA	0.82	0.34	NA	N	A
13	43.0	44.0	43.5	SC	13.5				19	SPT	127	5525	5525	0.6	1.35	1.00	1.00	1.2	17.6	2.0	1.04	20.4	5525	0.82	NA	0.81	0.34	NA	N	A
13	44.0	45.0	44.5	SC	13.5				19	SPT	127	5652	5652	0.6	1.35	1.00	1.00	1.2	17.4	2.0	1.04	20.1	5652	0.81	NA	0.81	0.34	NA	N	A
13	45.0	46.0	45.5	SC	13.5				19	SPT	127	5779	5779	0.6	1.35	1.00	1.00	1.2	17.1	2.0	1.04	19.8	5747	0.81	0.21	0.80	0.34	0.72	Y	
14	46.0	47.0	46.5	CL	60	31	12		19	SPT	127	5906	5906	0.5	1.35	1.00	1.00	1.2	16.8	5.0	1.20	25.2	5812	0.80	NA	0.80	0.34	NA	N	D
14	47.0	48.0	47.5	CL	60	31	12		19	SPT	127	6033	6033	0.5	1.35	1.00	1.00	1.2	16.6	5.0	1.20	24.9	5877	0.79	NA	0.79	0.34	NA	N	D
15	48.0	49.0	48.5	CL	60	31	12		19	SPT	127	6160	6160	0.5	1.35	1.00	1.00	1.2	16.3	5.0	1.20	24.6	5941	0.78	NA	0.79	0.34	NA	N	D
15	49.0	50.0	49.5	CL	60	31	12		19	SPT	127	6287	6287	0.5	1.35	1.00	1.00	1.2	16.1	5.0	1.20	24.3	6006	0.77	NA	0.78	0.34	NA	N	D

TABLE C-3
LIQUEFACTION INDUCED SETTLEMENT
BORING B-1 (2%PE in 50 yrs; FS=1.3)

Client: McEb

J.N. 2761.00

Site: Fullerton

Notes:

(1) Effective ER=55% normalized standard penetration resistance for clean sands, $(N_1)_{60\text{-}cs}$*1.1 (Seed, 1994).

(2) Volumetric strain (Ishihara and Yoshimine, 1992) using $(N_1)_{55\text{-}cs}$.

(3) Volumetric strain (Tokimatsu and Seed, 1987) using $(N_1)_{60\text{-}cs}$.

									Total δ (in.)	0.23	0.20	0.22
Depth Interval (ft)		Soil layer thickness (ft)	Fines <#200 Sieve (%)	$(N_1)_{60\text{-}cs}$	$(N_1)_{55\text{-}cs}$ (1)	FS	IY Percent ε_v (2)	CSR*	TS Percent ε_v (3)	IY δ (in.)	TS δ (in.)	Ave δ (in.)
Top	Bottom											
0.00	1.00	1.00	13	26.9	29.6	NA	0.00	0.42	NA	NA	NA	0
1.00	2.00	1.00	13	26.9	29.6	NA	0.00	0.42	NA	NA	NA	0
2.00	3.00	1.00	13	26.3	29.0	NA	0.00	0.42	NA	NA	NA	0
3.00	4.00	1.00	13	25.5	28.0	NA	0.00	0.42	NA	NA	NA	0
4.00	5.00	1.00	13	24.6	27.1	NA	0.00	0.42	NA	NA	NA	0
5.00	6.00	1.00	13	23.9	26.3	NA	0.00	0.42	NA	NA	NA	0
6.00	7.00	1.00	20	20.9	23.0	NA	0.00	0.40	NA	NA	NA	0
7.00	8.00	1.00	20	20.3	22.3	NA	0.00	0.40	NA	NA	NA	0
8.00	9.00	1.00	20	19.7	21.7	NA	0.00	0.40	NA	NA	NA	0
9.00	10.00	1.00	40	51.7	56.9	NA	0.00	0.40	NA	NA	NA	0
10.00	11.00	1.00	40	50.2	55.2	NA	0.00	0.40	NA	NA	NA	0
11.00	12.00	1.00	40	48.7	53.6	NA	0.00	0.40	NA	NA	NA	0
12.00	13.00	1.00	40	47.4	52.1	NA	0.00	0.40	NA	NA	NA	0
13.00	14.00	1.00	20	24.7	27.1	NA	0.00	0.40	NA	NA	NA	0
14.00	15.00	1.00	20	24.1	26.5	NA	0.00	0.40	NA	NA	NA	0
15.00	16.00	1.00	20	23.5	25.8	NA	0.00	0.40	NA	NA	NA	0
16.00	17.00	1.00	20	24.1	26.5	NA	0.00	0.40	NA	NA	NA	0
17.00	18.00	1.00	20	23.5	25.9	NA	0.00	0.40	NA	NA	NA	0
18.00	19.00	1.00	10	10.7	11.8	NA	0.00	0.40	NA	NA	NA	0
19.00	20.00	1.00	10	10.5	11.5	NA	0.00	0.40	NA	NA	NA	0
20.00	21.00	1.00	10	10.3	11.3	NA	0.00	0.40	NA	NA	NA	0
21.00	22.00	1.00	60	15.8	17.3	NA	0.00	0.40	NA	NA	NA	0
22.00	23.00	1.00	60	16.1	17.7	NA	0.00	0.40	NA	NA	NA	0
23.00	24.00	1.00	60	15.8	17.4	NA	0.00	0.40	NA	NA	NA	0
24.00	25.00	1.00	1	25.2	27.7	NA	0.00	0.40	NA	NA	NA	0
25.00	26.00	1.00	1	24.6	27.1	NA	0.00	0.40	NA	NA	NA	0
26.00	27.00	1.00	60	33.9	37.3	NA	0.00	0.40	NA	NA	NA	0
27.00	28.00	1.00	60	33.3	36.7	NA	0.00	0.38	NA	NA	NA	0
28.00	29.00	1.00	60	17.5	19.2	NA	0.00	0.38	NA	NA	NA	0
29.00	30.00	1.00	60	17.9	19.7	NA	0.00	0.38	NA	NA	NA	0
30.00	31.00	1.00	60	17.6	19.4	NA	0.00	0.38	NA	NA	NA	0
31.00	32.00	1.00	60	17.4	19.1	NA	0.00	0.38	NA	NA	NA	0
32.00	33.00	1.00	60	17.1	18.8	NA	0.00	0.38	NA	NA	NA	0
33.00	34.00	1.00	60	16.9	18.6	NA	0.00	0.38	NA	NA	NA	0
34.00	35.00	1.00	20	18.8	20.7	NA	0.00	0.38	NA	NA	NA	0
35.00	36.00	1.00	20	18.5	20.4	NA	0.00	0.36	NA	NA	NA	0
36.00	37.00	1.00	1	13.6	14.9	NA	0.00	0.36	NA	NA	NA	0
37.00	38.00	1.00	1	13.3	14.7	NA	0.00	0.36	NA	NA	NA	0
38.00	39.00	1.00	1	13.1	14.4	NA	0.00	0.36	NA	NA	NA	0
39.00	40.00	1.00	60	22.8	25.1	NA	0.00	0.36	NA	NA	NA	0
40.00	41.00	1.00	60	22.5	24.8	NA	0.00	0.36	NA	NA	NA	0
41.00	42.00	1.00	60	22.2	24.5	NA	0.00	0.34	NA	NA	NA	0
42.00	43.00	1.00	60	22.0	24.2	NA	0.00	0.34	NA	NA	NA	0
43.00	44.00	1.00	14	20.4	22.4	NA	0.00	0.34	NA	NA	NA	0
44.00	45.00	1.00	14	20.1	22.1	NA	0.00	0.34	NA	NA	NA	0
45.00	46.00	1.00	14	19.8	21.8	0.7	1.93	0.34	1.67	0.23	0.20	0.22
46.00	47.00	1.00	60	25.2	27.7	NA	0.00	0.34	NA	NA	NA	0
47.00	48.00	1.00	60	24.9	27.4	NA	0.00	0.34	NA	NA	NA	0
48.00	49.00	1.00	60	24.6	27.1	NA	0.00	0.34	NA	NA	NA	0
49.00	50.00	1.00	60	24.3	26.8	NA	0.00	0.34	NA	NA	NA	0

TABLE C-4
ANALYSIS OF DRY SEISMIC SETTLEMENT POTENTIAL
BORING B-1 (2%PE in 50 yrs; FS=1.3)

Client: McEb
J.N. 2761.00
Site: Fullerton

GW Depth: 45 feet
EQ Magnitude 6.64
MSF 1.43

														Total Seismic Settlement of Unsaturated Soil w/ FS=2.0 (in):	2.45
														Subtotal Seismic Settlement of Unsaturated Soil (in)	1.22
														Total Thickness of Unsaturated Soil (ft)	45.0

Layer Mid-Depth (ft.)	**Soil Type**	**Eff. Stress σ'_{vo}(tsf)**	**Clean Sand $(N_1)_{60}$**	**CSR**	**(psf) τ_{avg} Avg. Shear Stress**	**(tsf) σ_m' Mean Bulk Stress**	**(tsf) G_{max} Max. Dyn.Shr. Mod.**	**γ_{eff} (G_{eff}/G_{max})**	**Eff. Cyclic Shr.Strain γ_{eff}**	**Eff. Cyclic Shr.Strain γ_{eff} (%)**	**Volume Strain (%)**	**EQ Mag. Factor**	**Layer Thickness (ft.)**	**Estimated Dry Sand Seismic Settlement (in.)**
									Fig.11		Fig.13			
0.5	SM	0.03	26.9	0.42	21.8	0.02	172.1	6.33E-05	1.04E-04	1.04E-02	6.80E-03	1.43	1.0	0.001
1.5	SM	0.08	26.9	0.42	65.3	0.05	298.0	1.10E-04	2.82E-04	2.82E-02	1.85E-02	1.43	1.0	0.002
2.5	SM	0.13	26.3	0.42	108.9	0.08	382.1	1.43E-04	5.23E-04	5.23E-02	3.54E-02	1.43	1.0	0.003
3.5	SM	0.18	25.5	0.42	152.5	0.12	447.0	1.71E-04	8.82E-04	8.82E-02	6.24E-02	1.43	1.0	0.005
4.5	SM	0.23	24.6	0.42	196.0	0.15	501.4	1.95E-04	1.88E-03	1.88E-01	1.39E-01	1.43	1.0	0.012
5.5	SM	0.29	23.9	0.42	239.6	0.19	548.6	2.18E-04	2.27E-03	2.27E-01	1.75E-01	1.43	1.0	0.015
6.5	SC	0.40	20.9	0.40	317.3	0.26	619.2	2.56E-04	1.52E-03	1.52E-01	1.36E-01	1.43	1.0	0.011
7.5	SC	0.46	20.3	0.40	366.1	0.30	658.6	2.78E-04	2.18E-03	2.18E-01	2.02E-01	1.43	1.0	0.017
8.5	SC	0.52	19.7	0.40	414.9	0.34	694.5	2.99E-04	3.04E-03	3.04E-01	2.93E-01	1.43	1.0	0.025
9.5	CL/SC	0.60	51.7	0.40	482.2	0.39	1029.1	2.34E-04	7.37E-04	7.37E-02	2.24E-02	1.43	1.0	0.002
10.5	CL/SC	0.67	50.2	0.40	532.9	0.43	1071.2	2.49E-04	7.80E-04	7.80E-02	2.37E-02	1.43	1.0	0.002
11.5	CL/SC	0.73	48.7	0.40	583.7	0.47	1110.2	2.63E-04	7.61E-04	7.61E-02	2.31E-02	1.43	1.0	0.002
12.5	CL/SC	0.79	47.4	0.40	634.4	0.52	1146.8	2.77E-04	7.14E-04	7.14E-02	2.17E-02	1.43	1.0	0.002
13.5	SC	0.86	24.7	0.40	685.8	0.56	961.6	3.57E-04	1.59E-03	1.59E-01	1.17E-01	1.43	1.0	0.010
14.5	SC	0.92	24.1	0.40	736.6	0.60	988.3	3.73E-04	1.83E-03	1.83E-01	1.39E-01	1.43	1.0	0.012
15.5	SC	0.98	23.5	0.40	787.4	0.64	1013.6	3.88E-04	2.09E-03	2.09E-01	1.64E-01	1.43	1.0	0.014
16.5	SC	1.05	24.1	0.40	838.2	0.68	1054.3	3.98E-04	2.19E-03	2.19E-01	1.66E-01	1.43	1.0	0.014
17.5	SC	1.11	23.5	0.40	889.0	0.72	1077.6	4.13E-04	2.43E-03	2.43E-01	1.91E-01	1.43	1.0	0.016
18.5	SP-SC	1.17	10.7	0.40	939.8	0.76	855.6	5.49E-04	8.03E-03	8.03E-01	1.37E+00	1.43	1.0	0.115
19.5	SP-SC	1.24	10.5	0.40	990.6	0.80	871.6	5.68E-04	8.10E-03	8.10E-01	1.41E+00	1.43	1.0	0.118
20.5	SP-SC	1.30	10.3	0.40	1041.4	0.85	886.9	5.87E-04	8.17E-03	8.17E-01	1.44E+00	1.43	1.0	0.121
21.5	ML	1.37	15.8	0.40	1092.2	0.89	1046.6	5.22E-04	4.78E-03	4.78E-01	6.36E-01	1.43	1.0	0.053
22.5	ML	1.43	16.1	0.40	1143.0	0.93	1077.9	5.30E-04	4.30E-03	4.30E-01	5.64E-01	1.43	1.0	0.047
23.5	ML	1.49	15.8	0.40	1193.8	0.97	1095.8	5.45E-04	3.97E-03	3.97E-01	5.32E-01	1.43	1.0	0.045
24.5	SP	1.56	25.2	0.40	1244.6	1.01	1304.5	4.77E-04	1.97E-03	1.97E-01	1.42E-01	1.43	1.0	0.012
25.5	SP	1.62	24.6	0.40	1295.4	1.05	1321.1	4.90E-04	2.15E-03	2.15E-01	1.59E-01	1.43	1.0	0.013
26.5	ML	1.68	33.9	0.40	1346.2	1.09	1496.6	4.50E-04	1.54E-03	1.54E-01	6.79E-02	1.43	1.0	0.006
27.5	ML	1.75	33.3	0.38	1327.2	1.14	1515.5	4.38E-04	1.39E-03	1.39E-01	6.34E-02	1.43	1.0	0.005
28.5	ML	1.81	17.5	0.38	1375.4	1.18	1246.9	5.52E-04	3.24E-03	3.24E-01	3.78E-01	1.43	1.0	0.032
29.5	ML	1.87	17.9	0.38	1423.7	1.22	1277.9	5.57E-04	3.29E-03	3.29E-01	3.71E-01	1.43	1.0	0.031
30.5	ML	1.94	17.6	0.38	1471.9	1.26	1293.2	5.69E-04	3.52E-03	3.52E-01	4.05E-01	1.43	1.0	0.034
31.5	ML	2.00	17.4	0.38	1520.2	1.30	1308.1	5.81E-04	3.74E-03	3.74E-01	4.41E-01	1.43	1.0	0.037
32.5	ML	2.06	17.1	0.38	1568.5	1.34	1322.7	5.93E-04	3.97E-03	3.97E-01	4.77E-01	1.43	1.0	0.040
33.5	ML	2.13	16.9	0.38	1616.7	1.38	1337.0	6.05E-04	4.20E-03	4.20E-01	5.14E-01	1.43	1.0	0.043
34.5	SC	2.19	18.8	0.38	1665.0	1.42	1405.2	5.92E-04	3.71E-03	3.71E-01	3.86E-01	1.43	1.0	0.032
35.5	SC	2.25	18.5	0.36	1623.1	1.47	1418.5	5.72E-04	3.08E-03	3.08E-01	3.29E-01	1.43	1.0	0.028
36.5	SP	2.32	13.6	0.36	1668.8	1.51	1297.8	6.43E-04	4.98E-03	4.98E-01	7.98E-01	1.43	1.0	0.067
37.5	SP	2.38	13.3	0.36	1714.5	1.55	1307.8	6.55E-04	5.23E-03	5.23E-01	8.42E-01	1.43	1.0	0.071
38.5	SP	2.44	13.1	0.36	1760.2	1.59	1317.6	6.68E-04	5.46E-03	5.46E-01	8.85E-01	1.43	1.0	0.074
39.5	CL	2.51	22.8	0.36	1805.9	1.63	1603.2	5.63E-04	2.51E-03	2.51E-01	2.04E-01	1.43	1.0	0.000
40.5	CL	2.57	22.5	0.36	1851.7	1.67	1616.4	5.73E-04	2.58E-03	2.58E-01	2.12E-01	1.43	1.0	0.000
41.5	CL	2.64	22.2	0.34	1792.0	1.71	1629.3	5.50E-04	2.13E-03	2.13E-01	1.78E-01	1.43	1.0	0.000
42.5	CL	2.70	22.0	0.34	1835.2	1.75	1642.0	5.59E-04	2.17E-03	2.17E-01	1.84E-01	1.43	1.0	0.000
43.5	SC	2.76	20.4	0.34	1878.3	1.80	1620.5	5.80E-04	2.36E-03	2.36E-01	2.18E-01	1.43	1.0	0.018
44.5	SC	2.83	20.1	0.34	1921.5	1.84	1631.4	5.89E-04	2.39E-03	2.39E-01	2.23E-01	1.43	1.0	0.019

Attachment H

Technical Guidance Document Tables

1. **Table 2.1: Anticipated and Potential Pollutants Generated by Land Use Type**
2. **Table 2.2: Summary of the Approved 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for North Orange**
3. **Table 2.4: Summary of the Status of TMDLs for Waterbodies in Regions 8 and 9**

Table 2.1: Anticipated and 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
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 ft²	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

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.

Table 2.2: Summary of the Approved 2010 303(d) Listed Water Bodies and Associated Pollutants of Concern for North Orange County

Region	Water Body	Bacteria Indicators/ Pathogens	Metals	Nutrients	Pesticides	Toxicity	Trash	Salinity/ TDS/ Chlorides	Turbidity	Other Organics
Region 8 Santa Ana	Anaheim Bay		X		X	X				X
	Bolsa Chica Channel		X							
	Buck Gully Creek	X								
	Coyote Creek	X		X	X	X				
	Huntington Beach State Park									X
	Huntington Harbor	X	X		X	X				X
	Los Trancos Creek (Crystal Cove Creek)	X								
	Newport Bay, Lower					X				X
	Newport Bay, Upper (Ecological Reserve)					X				X
	San Diego Creek, Reach 1	X								
	San Diego Creek, Reach 2									
	San Gabriel River, Reach 1	X								
	Seal Beach	X								X
	Silverado Creek	X						X		

On October 11, 2011, the 2010 303(d) list was approved by USEPA Region 9. Project proponents should consult the most recent 303(d) list located on the State Water Resources Control Board website[10].

Table 2.4: Summary of the Status of TMDLs for Waterbodies in Regions 8 and 9

Region	Water Body	Pollutant				
		Bacteria Indicators/ Pathogens	Metals	Nutrients	Pesticides	Turbidity/ Siltation
Region 8 Santa Ana	Newport Bay, Lower	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs	Implementation Phase
	Newport Bay, Upper (Ecological Reserve)	Implementation Phase	Technical TMDLs	Implementation Phase	Technical TMDLs	Implementation Phase
	San Diego Creek, Reach 1		Technical TMDLs	Implementation Phase	Technical TMDLs and Implementation Phase	Implementation Phase
	San Diego Creek, Reach 2		Technical TMDLs	Implementation Phase		Implementation Phase
	Coyote Creek/San Gabriel River		Technical TMDLs[1]			
Region 9 San Diego	Aliso Creek (20 Miles) Pacific Ocean Shoreline, Laguna Beach HSAs	Implementation Phase				
	Dana Point Harbor Pacific Ocean Shoreline HSAs	Implementation Phase or In Progress				
	Pacific Ocean Shoreline, San Clemente HA	In Progress				
	San Juan Creek (mouth)	Implementation Phase				

[1]This TMDL was adopted by the Los Angeles Regional Water Quality Control Board (Region 4), however, it applies to the areas of Orange County that drain to Coyote Creek and San Gabriel River.

Attachment I

Notice of Transfer of Responsibility