REPORT OF INFILTRATION FEASIBILITY STUDY FOR PROPOSED UNDERGROUND BASIN TO ACCOMMODATE THE PROPOSED RESIDENTIAL BUILDINGS, APN487-260-02/03/04/05, FIR AVENUE MORENO VALLEY, RIVERSIDE COUNTY, CALIFORNIA

PROJECT NO.: 1465-01

REPORT NO.: 1

MAY 13, 2022

SUBMITTED TO:

VIGOROUS DEVELOPMENT

MR. STEVEN HAN / MR. KURT YUE

C/O WINSTON LIU

PREPARED BY:

HILLTOP GEOTECHNICAL, INC.

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May 13, 2022

Vigorous Development
Attn: Mr. Steven Han/Mr. Kurt Yue
Fir Avenue
Moreno Valley, CA

Project No.: 1465-01
Report No.:1

C/O: Winston Liu, Project Civil Engineer

Attention: Mr. Steven Han/Mr. Kurt Yue

Subject: **Report of Infiltration Feasibility Study for Proposed Underground Basin to Accommodate the Proposed Residential Buildings, APN 487-260-02/03/04/05, Fir Avenue, Moreno Valley, Riverside County, California.**

References: 1. **TL Group Corp.**, January 15, 2022, *Conceptual Grading Plan, Tract No. 32194, Fir Ave., City of Moreno Valley, CA 92555, Scale 1":40'.*

2. **Riverside County Flood Control and Water Conservation District**, September 2011, *Riverside County- Low Impact Development BMP Design Handbook Appendix A.*

Mr. Steven Han/Mr. Kurt Yue,

In accordance with your request, we have performed infiltration testing for the subject property. This testing was performed in general accordance with procedures established by the Riverside County Flood Control and Water Conservation District.

A report of our findings is included herein and follows the general format for WQMP testing established by the Riverside County FCWCD.

The findings of this study indicate that the project site is suitable for the proposed infiltration basins provided the recommendations presented in the attached report are incorporated into design of the project and implemented during construction of the project.

We appreciate the opportunity to provide geotechnical services on this project. Should you have any questions regarding this submittal, please do not hesitate to contact us.

Respectfully submitted,
HILLTOP GEOTECHNICAL, INC.

REGISTERED PROFESSIONAL ENGINEER
SHAOFU CHEN
C76834
CIVIL
STATE OF CALIFORNIA

Luis Gomez
Staff Geologist

S. Mack Chen, P.E. C76834/C.E.G. 2688
Principal Engineer/Geologist

CERTIFIED ENGINEERING GEOLOGIST
Shaofu Chen
2688
STATE OF CALIFORNIA

Attachment:
Plate No. 1, Site Plan and Test Locations
Plate No. 2, Subsurface Exploration Legend
Plate Nos. 3 and 4, Subsurface Exploration Log
Plate Nos. 5 through 8, Infiltration Data Sheet

Distribution:
(1) Via Email to (Winston Liu winstonliu@wwwldc.com)

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REPORT OF INFILTRATION FEASIBILITY STUDY FOR PROPOSED UNDERGROUND BASIN TO ACCOMMODATE THE PROPOSED RESIDENTIAL BUILDINGS, APN487-260-002/03/04/05, FIR AVENUE MORENO VALLEY, RIVERSIDE COUNTY, CALIFORNIA

LOCATION OF THE PROJECT SITE

The subject property is located south of Fir Avenue to the south of the intersection of Fir Avenue and Willowbrook Lane in the City of Moreno Valley, Riverside County, California. The subject property was a rectangular shape and consists of approximately 8.59 acres of vacant land as shown on the Reference No. 1 'Conceptual Grading Plan' noted on the first page of the cover letter for this report.

SITE CONDITIONS

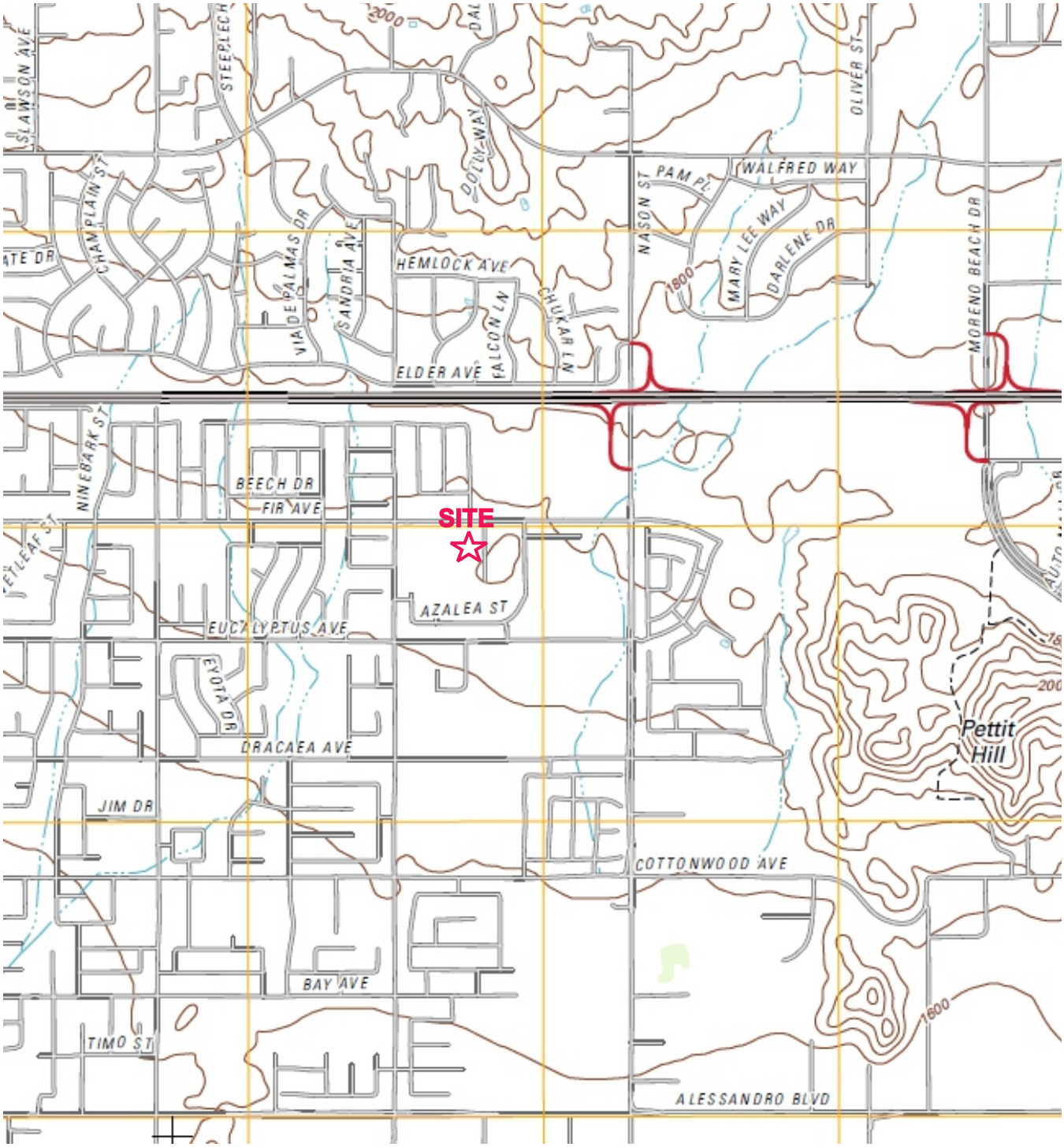
During the time of our drilling and field testing, the subject site was vacant and was relatively flat in nature on the north and west portion of the subject site. A gentle hill was located on the southeastern potion of the property. The subject site had few scattered trees and native grass vegetation at the time of this study. The infiltration locations were chosen by TL Group Corp. The approximate infiltration test locations are shown on the 'Site Plan and Test Location Plan,' Plate No. 1.

LOCATION OF INFILTRATION TESTS

Three soil borings were drilled via a truck mounted drill rig to depths of 20 feet and 6 feet below the existing ground surface (bgs). The boring was excavated to 20 feet bgs to determine the groundwater depth at the site. The groundwater was encountered at depth of 19 feet bgs. To meet a minimum of 10 feet separation from groundwater, two borings were drilled to 6 feet bgs and above the bedrock surface. Two eight-inch diameter borings were extended to depths of 6 feet bgs. These borings were then converted to infiltration tests by inserting 3" diameter perforated sleeved PVC pipe and then removing the auger. Two inches of gravel was added to the bottom of the borings prior to the percolation pipe placement.

SOIL CHARACTERISTICS OF THE SUBJECT SITE

- The soil characteristics for the subject site are defined as favorable.



SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2

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Source: Copied from USGS Topo Map- Sunnymead Quadrangle 2012

HILLTOP GEOTECHNICAL INCORPORATED

SITE LOCATION MAP

APN 487-260-002/003/004/005, Fir Avenue
Moreno Valley, CA 92555

By: MC	Date: 5/2022
Project No.: 1465-01.1	**Figure 1**

- Silty fine to medium grained sands were encountered at all of two test locations.

- The topography of the existing ground surface is generally flat on a majority of the property with a gently sloping hill on the southeastern portion. In general, the slope ratios are less than 1 percent to 15 percent.

- Per the on-site soil conditions, the proposed stormwater retention systems are feasible.

Soil Profile

The earth materials encountered on the subject site during the field exploration was identified as alluvium and granitic bedrock.

Alluvium was encountered within all of the three borings during our infiltration feasibility study. The alluvium was encountered from ground surface to approximately seven feet in depth and consisted of silty fine to medium grained sand (SM) which was brown in color and was medium dense in consistency.

The alluvium was overlying granitic bedrock, The granitic bedrock was highly to moderately weathered in nature. The bedrock was phaneritic in texture with mostly observable phenocrysts and was a light gray to gray color. The rock varied in weathered state from highly weathered to moderately weathered with depth and was moderately soft to very hard.

Groundwater

Groundwater was encountered at a depth of 19 feet below ground surface. Historical well data was found using the California Department of Water Resources Well Data Library (https://wdl.water.ca.gov/waterdatalibrary/), which showed a destroyed well (Well No.339389N1171702W001) approximately 1.5 miles to the northwest of the subject site at showing the highest water level to be 204.8 feet bgs in 2016 at an elevation of 1,790.8 feet Mean Sea Level (MSL). An active state monitoring well (Well No.339347N1172403W001) approximately 2.5 miles to the west shows a water level

of 55.7 feet bgs at an elevation of 1,621.6 feet above MSL. The elevation at the subject site is approximately 1,710 feet above MSL.

Infiltration testing was conducted following the guidelines set forth in the Riverside County- Low Impact Development BMP Design Handbook Appendix A. The stormwater retention facility should have at least 10 feet above the groundwater level.

INFILTRATION TEST PROCEDURES

a) Test Method: Infiltration testing was conducted in general accordance with shallow infiltration test method in the Riverside – Low Impact Development BMP Design Handbook Appendix A.

b) Drilling: Two boreholes were approximately eight inches in diameter, drilled by a truck mounted drill rig with eight-inch diameter augers. Testing was performed in silty fine to coarse sand. After drilling, approximately 2 inches of gravel was placed at the bottom of the test hole and perforated, and sleeved three-inch diameter PVC pipe was inserted into each bore hole.

c) Soaking Period: The test holes were pre-soaked by filling each borehole to the ground surface on April 14, 2022. Pre-soaking took place for two consecutive measurements. The two tests showed six inches of water seeped away in less than 25 minutes for two consecutive readings. Each test was run for additional hour with measurements taken every 10 minutes. Tests TP-1 and TP-2 were tested on April 14, 2022.

d) Measurement of the infiltration rate: Measurements were taken with a precision of 0.1 inches using a water indicator.

TEST RESULTS

The infiltration rates were converted to infiltration rates by use of the Porchet Method and revealed the infiltration rates to be moderate. The final infiltration rates obtained are presented below in Table 1:

Table 1: Final Infiltration Rates

Infiltration Test #	Tested Infiltration Rate (in/hr)
TP-1	2.07
TP-2	1.96

DISCUSSION

The rates presented above were generally as anticipated with respect to the on-site soils. The earth materials for infiltration testing consist mainly of sandy silt with few medium to coarse sands which resulted in fast rates.

Field infiltration tests are subject to many factors that affect the infiltration rate, including soil texture, the condition of the soil surface, soil-moisture tension or the degree of saturation, the temperature of the water and soil, the percentage of entrapped air in the soil, and the head of the applied water.

RECOMMENDATIONS

Based on the Riverside County Guidelines, a factor of safety should be applied to the infiltration rates. A factor of safety of 3 was applied to the rates below in Table 2.

Table 2 Recommended Design Infiltration Rates

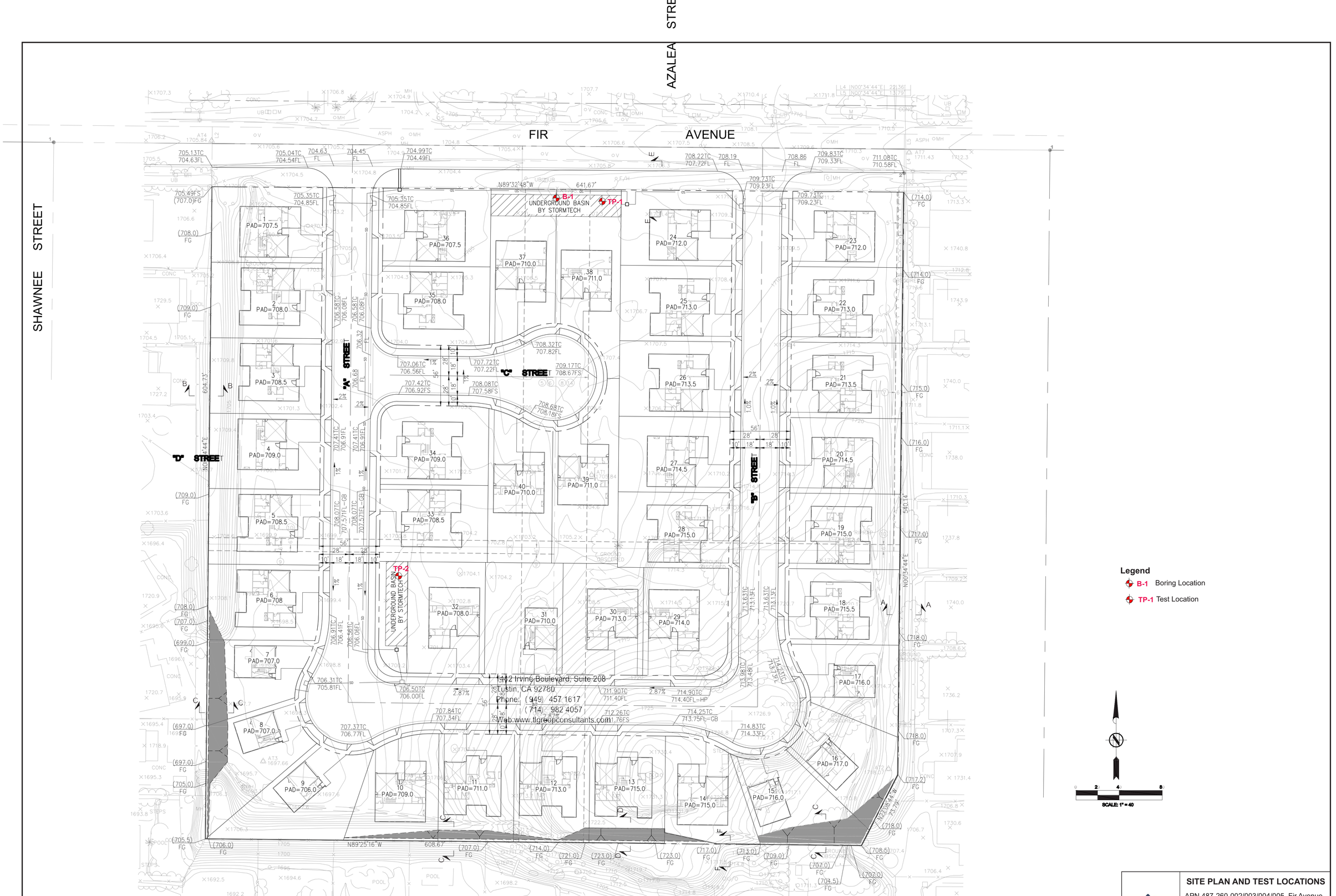
Infiltration Test #	Tested Infiltration Rate (in/hr)	Recommended Design Infiltration Rate w/ Factor of Safety (3) (in/hr)
TP-1	2.07	0.69
TP-2	1.96	0.65

For conservative purpose, the design infiltration rate of **0.65** inches per hour should be used for the proposed stormwater retention systems. The infiltration rate is considered suitable for adequate infiltration of stormwater, provided the proposed stormwater retention systems are sized accordingly.

Caution should be used in determining an infiltration rate for the proposed stormwater retention systems. Eventual siltation, from windblown silt, water-borne silt from irrigation and precipitation runoff, and the accumulation of organic material in surface soils due to landscape grass and plant growth, can drastically reduce infiltration rates over time. We recommend that suitable methods to prevent siltation be considered in the project design.

CLOSURE

Findings of this report were prepared in accordance with generally accepted professional engineering principles and practice in the field of soil mechanics. The conclusions are based on results of field exploration and testing. If conditions are encountered during construction that appear to be different than those indicated by this report, this firm should be notified.



Legend

B-1 Boring Location

TP-1 Test Location

SITE PLAN AND TEST LOCATIONS	
APN 487-260-002/003/004/005, Fir Avenue Moreno Valley, CA 92555	
By: MC	Date: 5/2022
Project No.: 1465-01	**Plate No. 1**

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SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION SYSTEM
Visual-Manual Procedure (ASTM D2488-09a)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
Coarse-Grained Soils* More than 50 % Retained on No. 4 Sieve	Gravels 50 % or more of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels	GW	Well Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
			GP	Poorly Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines	GM	Silty Gravels, Gravel-Sand-Silt Mixtures**
			GC	Clayey Gravel, Gravel-Sand-Clay Mixtures**
	Sands More than 50 % of Coarse Fraction Passes No. 4 Sieve	Clean Sands	SW	Well Graded Sands and Gravely Sands, Little or no Fines
			SP	Poorly Graded Sands and Gravelly Sands, Little or no Fines
		Sands with Fines	SM	Silty Sands, Sand-Silt Mixtures**
			SC	Clayey Sands, Sand-Clay Mixtures**
Fine Grained Soils* 50 % or more Passes No. 200 Sieve	Silts and Clays Liquid Limits 50 % or less		ML	Inorganic Silts, Sandy Silts, Rock Flour
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic silty Clays of Low Plasticity
	Silts and Clays Liquid Limits Greater than 50 %		MH	Inorganic Silts, Micaceous or Diatomaceous silts, Plastic Silts
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Clays of Medium to High Plasticity
Highly Organic Soils			PT	Peat, Muck, or Other Highly Organic Soils

CONSISTENCY / RELATIVE DENSITY

Reference: 'Foundation Engineering', Peck, Hansen, Thornburn, 2nd Edition.

Standard Penetration Test
Granular Soils

Penetration Resistance, N, (Blows / Foot)	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

Standard Penetration Test
Cohesive Soils

Penetration Resistance, N, (Blows / Foot)	Consistency	Unconfined Compressive Strength, (Tons / Sq. Ft.)
		< 0.25
< 2	Very Soft	0.25 - 0.5
2 - 4	Soft	0.5 - 1.0
5 - 8	Firm (Medium Stiff)	1.0 - 2.0
9 - 15	Stiff	2.0 - 4.0
16 - 30	Very Stiff	> 4.0
> 31	Hard	

* Based on material passing the 3-inch sieve.

** More than 12% passing the No. 200 sieve; 5% to 12% passing No. 200 sieve requires use of duel symbols (i.e., SP-SM., GP-GM, SP-SC, GP-GC, etc.); Border line classifications are designated as CH/Cl, GM/SM, SP/SW, etc.

U.S. Standard Sieve Size 12" 3" 3/4" #4 #10 #40 #200

Unified Soil Classification Designation	Boulders	Cobbles	Gravel		Sand			Silt and Clay
			Coarse	Fine	Coarse	Medium	Fine	

Moisture Condition

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible moisture.
Wet	Visible free water, usually below the water table.

Material Quantity

Trace	< 5 %
Few	5 - 10%
Little	15 - 25%
Some	30 - 45 %
Mostly	50-100%

Other Symbols

C - Core Sample
S - SPT Sample
B - Bulk Sample
CK - Chunk Sample
R - Ring Sample
N - Nuclear Gauge Test
∇ - Water Table

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

HILLTOP GEOTECHNICAL INCORPORATED

Project Name:	Steven Han Moreno Valley Infiltration				
Project No.	1465-01.1	Date:	4/14/2022	Logged By:	LG
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	1720 ± 10
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	20.0

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1			SM			Qa		ALLUVIUM: Silty fine to coarse sand, trace gravel; Light brown; Slightly Moist; Loose to medium dense.
7								QUARTZ DIORITE TO GRANODIORITE: Highly weathered to moderatly weathered granitic bedrock; Light gray to gray; Phaneritic texture; Moist; Firm to hard.
19							Y	Groundwater encountered. Constant depth of 19 feet.
20								Bottom of boring 20 feet. Groundwater encountered at 19 feet. Backfilled with excavated materials.

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Plate No. 3

HILLTOP GEOTECHNICAL INCORPORATED

SUBSURFACE EXPLORATION LOG
BORING NO. B-2

Project Name: Steven Han Moreno Valley Infiltration

Project No.	1465-01.1	Date:	4/14/2022	Logged By:	LG
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	1720 ± 10
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	6.0

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1			SM			Qa		ALLUVIUM: Silty fine to coarse sand, trace gravel; Light brown; Slightly Moist; Loose to medium dense.
6								Bottom of boring 6 feet. No groundwater encountered. Converted to TP-1, backfilled when testing complete.

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Plate No. 4

HILLTOP GEOTECHNICAL INCORPORATED

SUBSURFACE EXPLORATION LOG
BORING NO. B-3

Project Name: Steven Han Moreno Valley Infiltration

Project No.	1465-01.1	Date:	4/14/2022	Logged By:	LG
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	1720 ± 10
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	6.0

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1			SM			Qa		ALLUVIUM: Silty fine to coarse sand, trace gravel; Light brown; Slightly Moist; Loose to medium dense.
6								Bottom of boring 6 feet. No groundwater encountered. Converted to TP-2, backfilled when testing complete.

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Plate No. 5

HILLTOP GEOTECHNICAL INCORPORATED

PERCOLATION DATA SHEET

Project Name: Han-Yue Basin Infil Mo Vally

Project Number: 1465-01

Test Hole Number: TP-1

Date Tested: 4/14/22

Depth of Boring in feet: 6.0

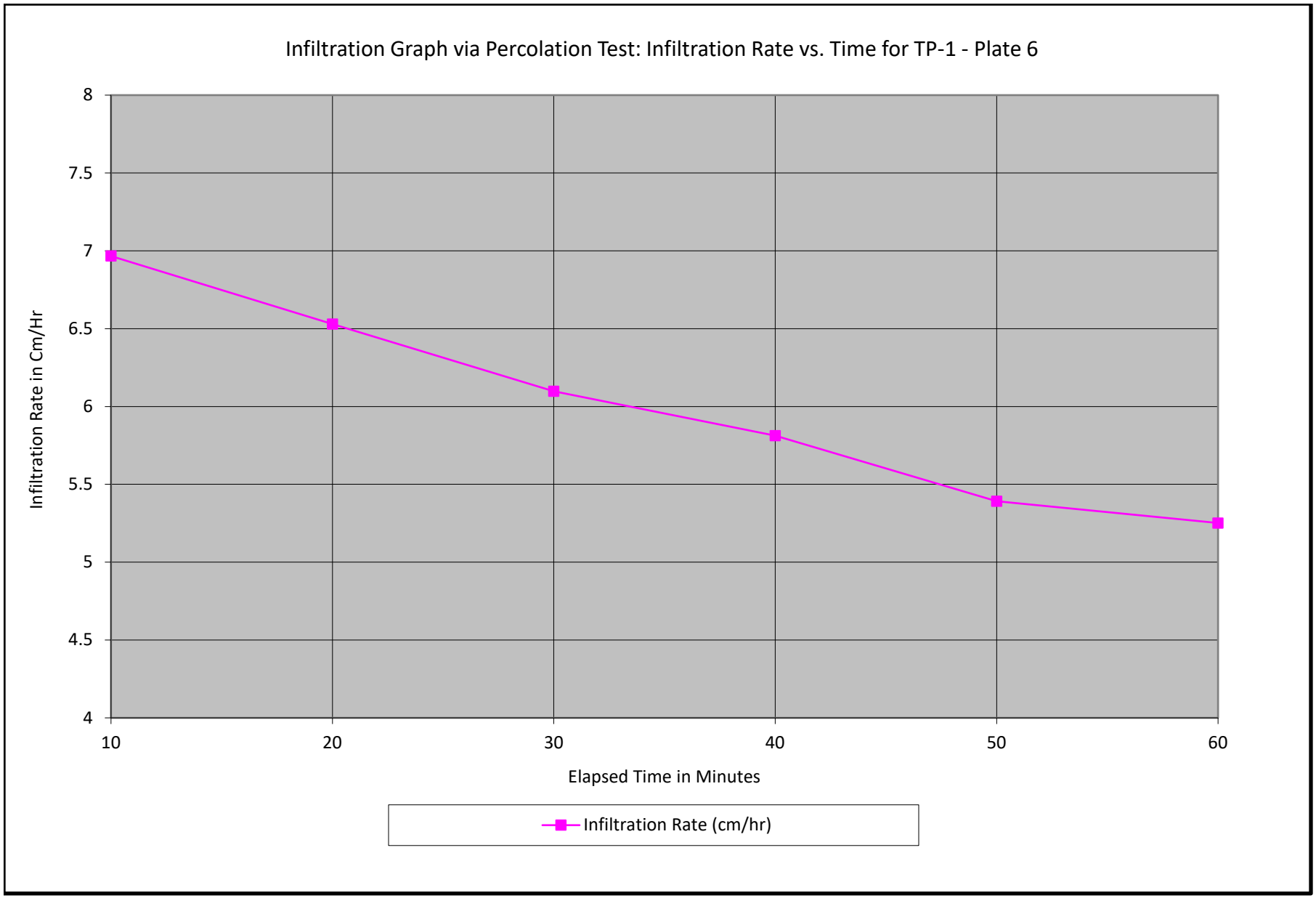
Tested By: LG

Radius of boring feet: 0.33

Hours Presaturation 0.83

Depth of Bottom (ft) Outter	Time Initial	Time Final	Time Interval (minutes)	Depth of Water - Initial (ft)	Depth of Water - Final (ft)	Change in Water Level (ft)	$H_{average}$ (ft)	Rate, It (In/Hr)	Rate, It (Cm/Hr)
6.00	11:20	11:45	25.0	0.98	2.83	1.85	4.09	1.99	5.05
6.00	11:45	12:10	25.0	1.00	2.71	1.71	4.15	1.81	4.60
6.00	12:15	12:25	10.0	1.00	2.10	1.10	4.45	2.74	6.97
6.00	12:25	12:35	10.0	1.00	2.04	1.04	4.48	2.57	6.53
6.00	12:35	12:45	10.0	1.00	1.98	0.98	4.51	2.40	6.10
6.00	12:45	12:55	10.0	1.00	1.94	0.94	4.53	2.29	5.81
6.00	12:55	13:05	10.0	1.00	1.88	0.88	4.56	2.12	5.39
6.00	13:05	13:15	10.0	1.00	1.85	0.85	4.57	2.07	5.25

Plate No. 6



Hilltop Geotechnical, Inc.

Infiltrometer Graph
TP-1

1455-01.2
Plate No. 7

HILLTOP GEOTECHNICAL INCORPORATED

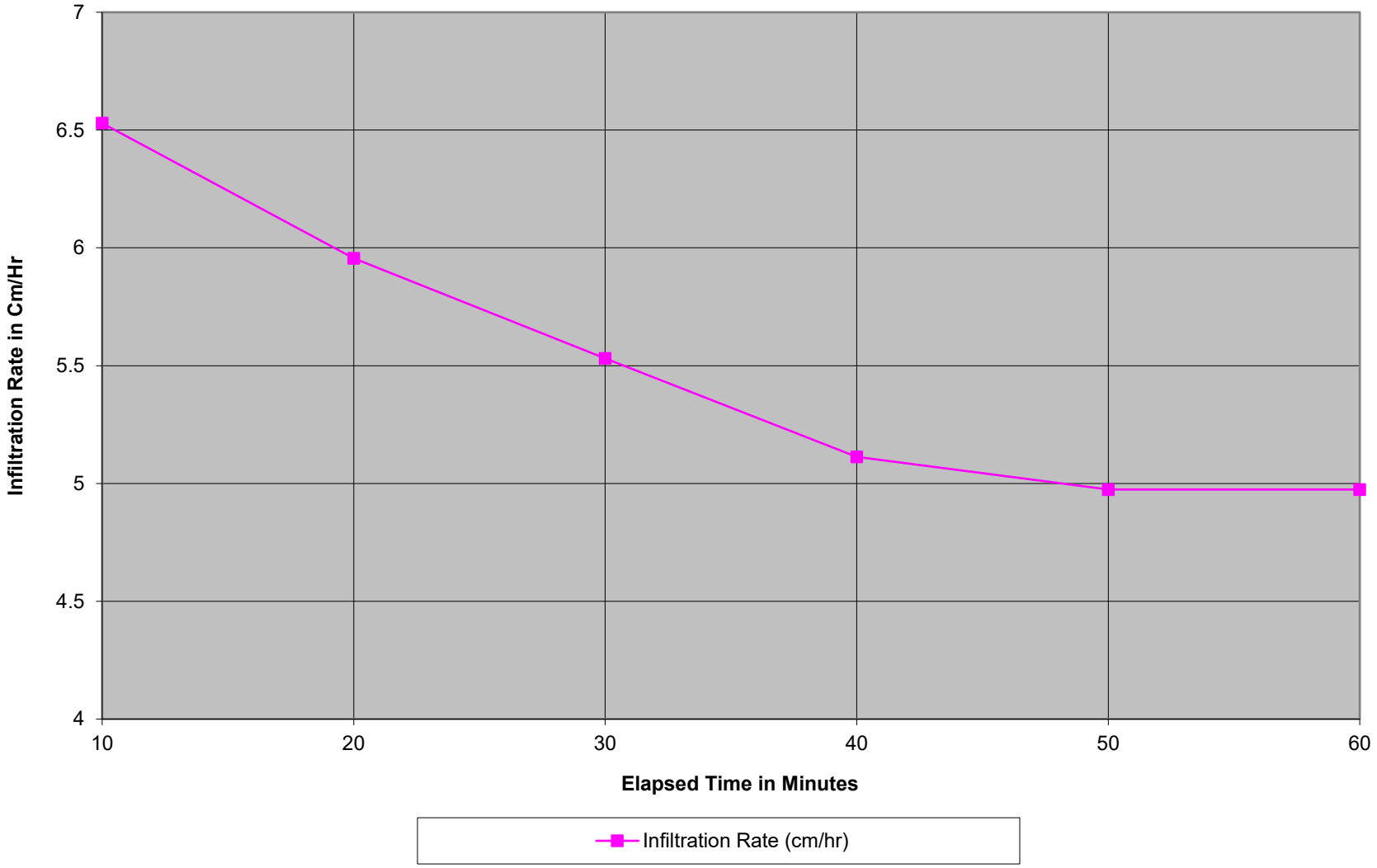
PERCOLATION DATA SHEET

Project Name:	Han-Yue Basin Infil Mo Vally	Project Number:	1465-01
Test Hole Number:	TP-1	Date Tested:	4/14/22
Depth of Boring in feet:	6.0	Tested By:	LG
Radius of boring feet:	0.33	Hours Presaturation	0.83

Depth of Bottom (ft) Outter	Time Initial	Time Final	Time Interval (minutes)	Depth of Water - Initial (ft)	Depth of Water - Final (ft)	Change in Water Level (ft)	$H_{average}$ (ft)	Rate, It (In/Hr)	Rate, It (Cm/Hr)
6.00	11:25	11:50	25.0	1.00	3.00	2.00	4.00	2.19	5.57
6.00	11:50	12:15	25.0	1.00	2.85	1.85	4.07	2.00	5.08
6.00	12:20	12:30	10.0	1.00	2.04	1.04	4.48	2.57	6.53
6.00	12:30	12:40	10.0	1.00	1.96	0.96	4.52	2.34	5.96
6.00	12:40	12:50	10.0	1.00	1.90	0.90	4.55	2.18	5.53
6.00	12:50	13:00	10.0	1.00	1.83	0.83	4.58	2.01	5.11
6.00	13:00	13:10	10.0	1.00	1.81	0.81	4.59	1.96	4.97
6.00	13:10	13:20	10.0	1.00	1.81	0.81	4.59	1.96	4.97

Plate No. 8

Infiltration Graph via Percolation Test: Infiltration Rate vs. Time for TP-2 - Plate 8



PRELIMINARY HYDROLOGY & HYDRAULIC STUDY

FOR

TRACT MAP 38480
(PEN22-0187, LST 22-0047)

SOUTH SIDE OF FIRE AVENUE
CITY OF MORENO VALLEY
COUNTY OF RIVERSIDE, CALIFORNIA

Prepared For Owner/Developer:

VIGOROUS DEVLOPMENT LLC
17114 Ridge Park Drive.
Hacienda Heights, CA 91745
Contact: Kurt Yue / Steven Han
(626) 679-0825

Prepared By:

W&W LAND DESIGN CONSULTANTS
2335 W. Foothill Blvd., Suite #1
Upland, CA 91786
Ph: (909) 608-7118
Fax: (909) 946-1137

September 20, 2022
Revised on January 18, 2023

Project job No. 2204

TABLE OF CONTENTS

Section I Introduction

The following hydrology study has been prepared for residential subdivision Tract 38480 project, which is located at the Southside of Fir Avenue, in the City of Moreno Valley, County of Riverside, California. The subject site is approximately 8.894 acres and proposed for the development of 37 single family residential lot subdivision. An onsite storm drains systems including bio filtrations, catch basins, storm drainpipes and curb gutters will be constructed to convey the runoff produced by the proposed development project. An onsite storm water quality bio infiltration with pretreatment will be constructed to treat onsite storm water runoffs. The general location of the site is illustrated on the Vicinity Map in the Appendix A of this report.

Section II Methodology

For both, the existing and proposed conditions, the peak storm discharge for the drainage sub-areas (see hydrology maps in the Appendix C of this report) was calculated using the Riverside County Hydrology Manual (1978 April). The rational Method Equation, using CIVILD Software, was used to calculate the 10-year and 100-year storm event. The peak 10-year storm runoff is calculated to size the catch basin, parkway culverts and storm drainpipes. The peak 100-year storm runoff is calculated to demonstrate the runoff from 100-year storm event is contained within the street right-of-way. The peak 10-year storm runoff is calculated to demonstrate the runoff from 10-year storm event is contained within the street curb. Per City of Moreno Valley Street Capacity Design Policy, all local streets will have a 12' wide travel path during 100-yeat storm event. The street capacities calculations are calculated by using Flowmaster software. The stormwater Quality BMPs was calculated by using Riverside County Storm Water Quality Best Management Practice Design Handbook (2006, July)

Section III Project Description

Existing Site Conditions

The existing tributary area is approximately 8.89 acres site tributary area of natural dirt area. Most of the site (subarea E-1) drains overland towards southwesterly sheet flow to an existing drainage inlet located at southwest corner of the project site, the drainage inlet was designed and constructed per adjacent Tract 27251 and connected into an existing storm drain system to Jackdaw Street. Subarea E-2, as slope runoff, drains toward southeasterly to an existing concrete v-gutter connected into lot 56 of Tract 27251, the v-gutter tied into existing storm drainpipes to Rose Bud Lane. Refer to the "Existing Hydrology Map" in Appendix C for an illustration of the existing drainage zones.

The following table illustrates the data and results for the existing 10-year and 100-year storm events. All calculations can be found in Appendix D of this report.

Drainage Area	Area (Ac.)	10 Year Peak Flow (CFS)	100 Year Peak Flow (CFS)	Time of Concentration (Min.)
E-1	7.91	7.54	13.01	22.5 Min.
E-2	0.98	1.42	2.34	11.1 Min.
Total	8.89	8.96	15.35	

Proposed Site Conditions

In the proposed condition, the project site can be integrated into one drainage zone with total 8.89 acres of disturbed areas. Sub area A-1 to A-8 will drain to two proposed catch basins with storm drainpipes system, then to proposed water quality bio-filtration BMP structural eventually tie into existing 24" RCP at southwesterly of the project site, the existing 24" RCP was crossing into lot 45 of Tract 27251, was pre-designed and constructed for our project tract home development. Refer to the "Proposed Hydrology Map" in Appendix C for an illustration of the proposed drainage zones.

The following table illustrates the data and results for the proposed 10-year and100-year storm events. All calculations can be found in Appendix E of this report.

Drainage Area	Area (Ac.)	10 Year Peak Flow (CFS)	100 Year Peak Flow (CFS)	Time of Concentration (Min.)
A-1 to A-4 CB #1	4.87	6.88	11.24	---
A-5 to A-8 CB #2	4.02	6.01	6.73	---
Total Area	8.89	12.58	20.52	14.74 Min.

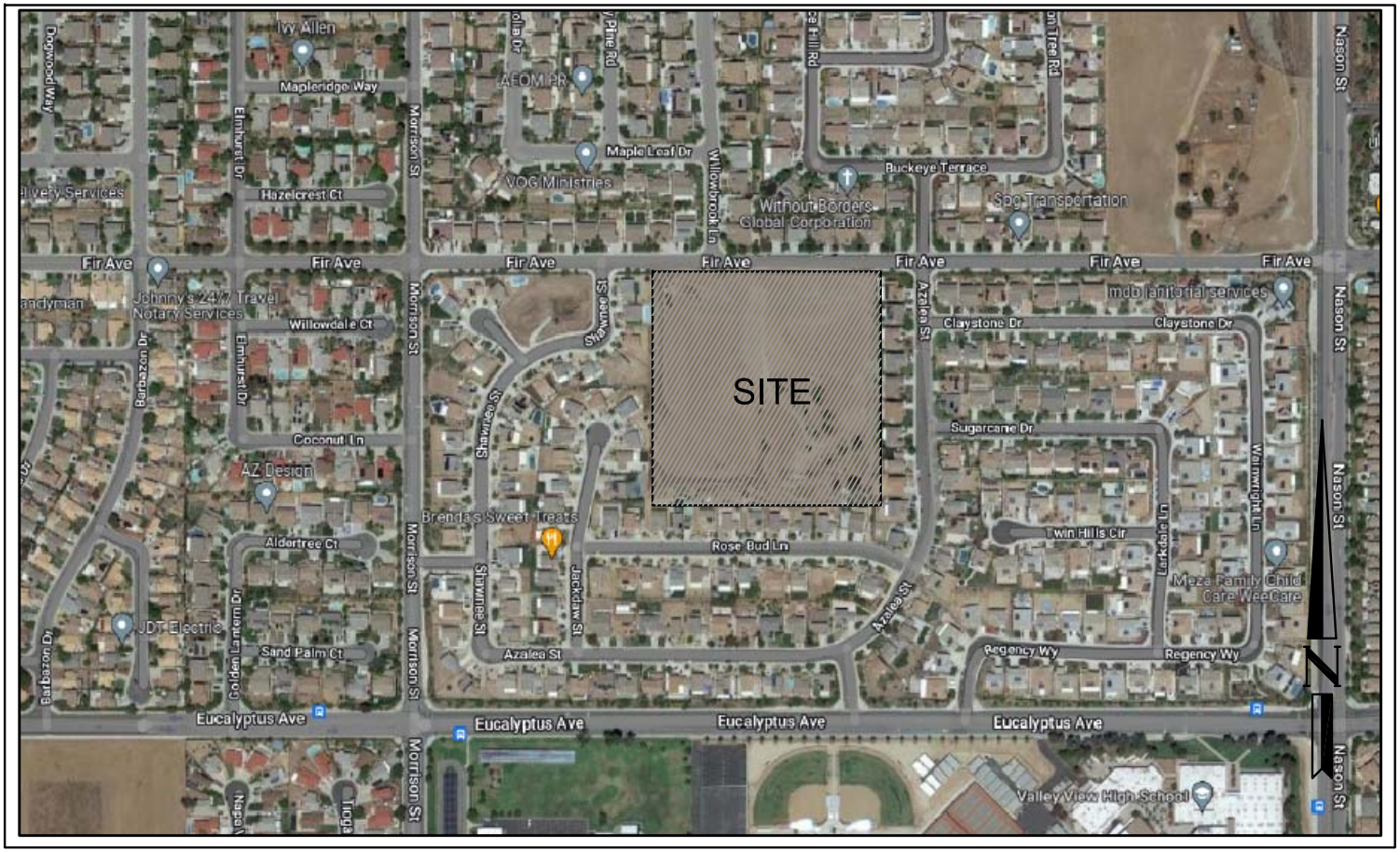
In summary, total runoff will be increased after project development. After development, about 3.62 cfs will be increased per 10-year storm event and 5.17 cfs will be increased per 100-year storm event; the existing 24" RCP was crossing into lot 45 of Tract 27251, was pre-designed and constructed for our project tract home development. The existing 24" RCP storm drainpipe in normal depth calculation capacity is 21.76 CFS, greater than 100-year peak flow 20.52 CFS in proposed condition. Therefore, the existing 24" RCP had sufficient capacity to handle the peak flow from development site. Refer to the "Hydraulic Calculations" in Appendix F for existing 24" RCP storm drain capacity calculations

Findings

After development, more impervious surface will cover the proposed site than before. A proposed onsite storm drain systems will be constructed to convey the runoff produced by the proposed development project. An onsite storm water quality infiltration trench will be constructed; it will treat the first flush of runoff. Calculation of infiltration trench can be found in Appendix F of this report. The calculations within this report substantiate that the development can be constructed as shown on the proposed plans with no detrimental effect to surrounding properties.

APPENDIX A

VICINITY MAP

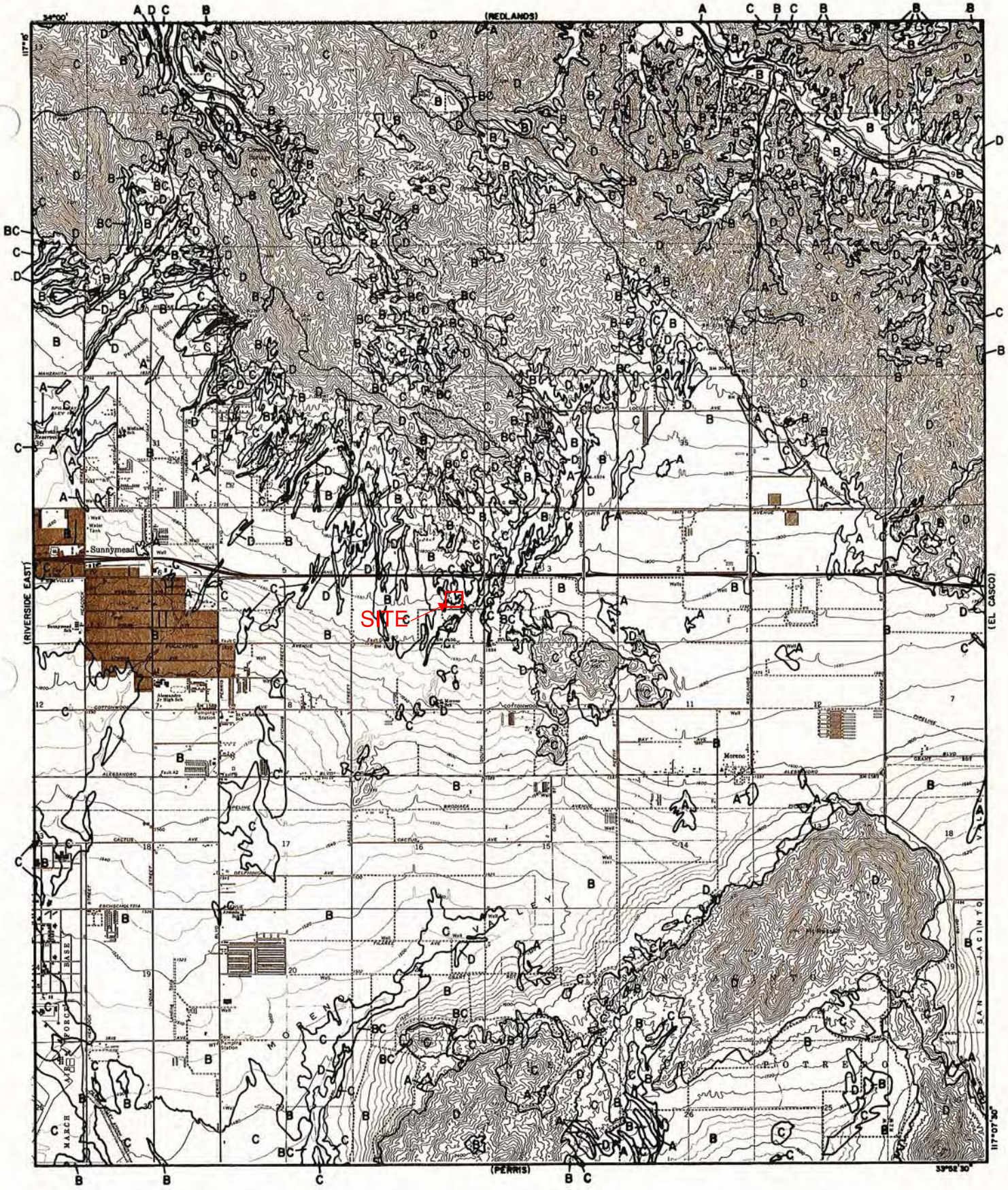


VICINITY MAP

NOT TO SCALE

APPENDIX B

Reference (Based on RCFC & WCD Hydrology Manual):
Hydrology Soils Group Map for Sunnymead (C1.17)
100 year, 1 hour Precipitation Plate (D-4.4)
Soil Group B-Runoff Coefficient Curves Plate (D-5.2)



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC&WCD

HYDROLOGY MANUAL

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR SUNNYMEAD

PLATE C-1.17

SITE

NOTES
1. Isohyetals based on NOAA Atlas 2, Volume XI – California, 1973

RCFC & WCD
HYDROLOGY MANUAL

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

100-YEAR — 1-HOUR PRECIPITATION

APPROVED: CHIEF ENGINEER R.E. NO. 6822
DATE
REVISED
DRAWN BY: A.A.S.
PLATE D-4.4
SHEET NO.
DR. NO.

I-100=1.2"

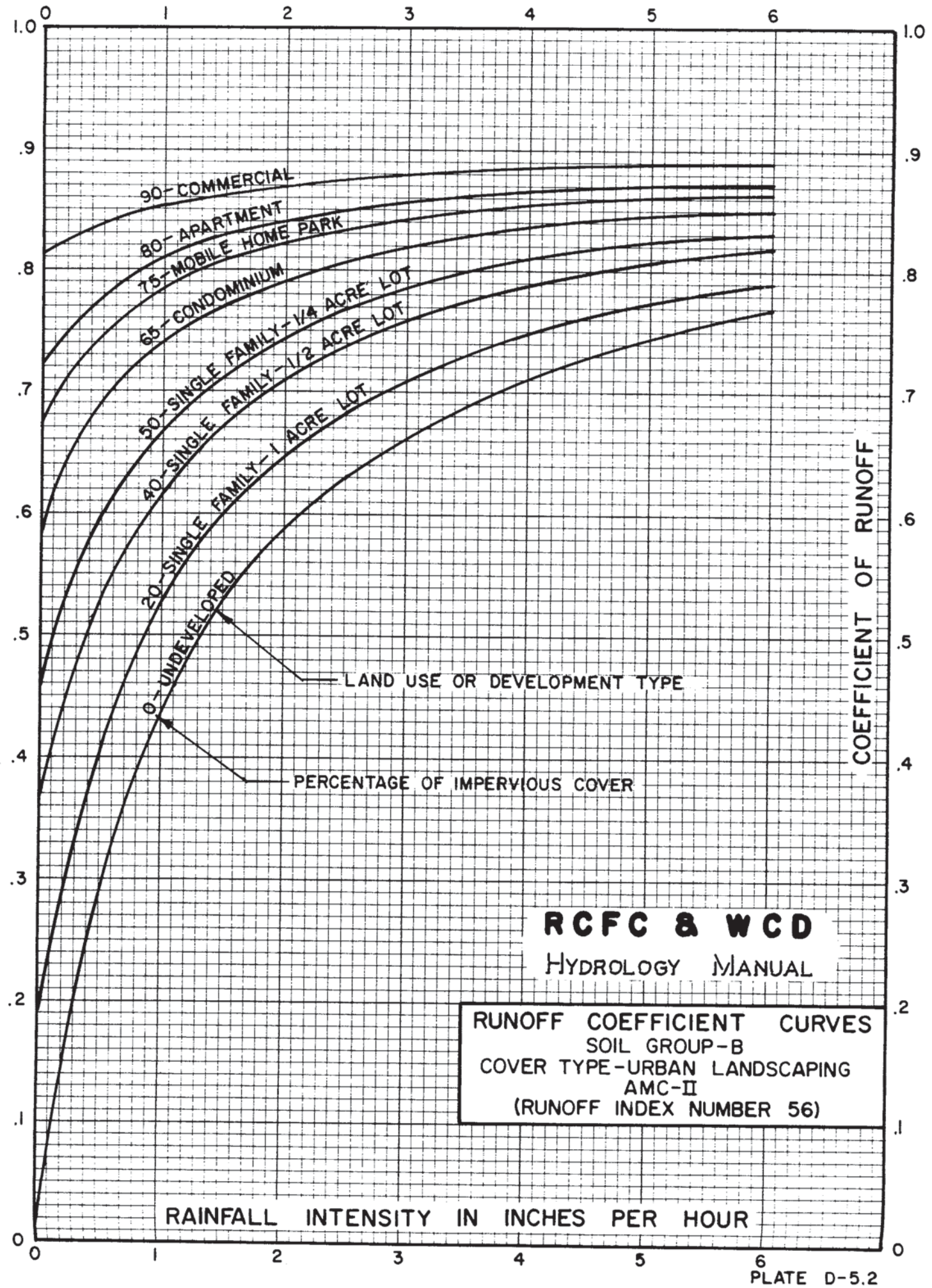

0
1
2
3
4
5
6
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
90- COMMERCIAL
80- APARTMENT
75- MOBILE HOME PARK
65- CONDOMINIUM
50- SINGLE FAMILY- 1/4 ACRE LOT
40- SINGLE FAMILY- 1/2 ACRE LOT
20- SINGLE FAMILY- 1 ACRE LOT
0- UNDEVELOPED
LAND USE OR DEVELOPMENT TYPE
PERCENTAGE OF IMPERVIOUS COVER
COEFFICIENT OF RUNOFF
RAINFALL INTENSITY IN INCHES PER HOUR
RCFC & WCD
HYDROLOGY MANUAL
RUNOFF COEFFICIENT CURVES
SOIL GROUP-B
COVER TYPE-URBAN LANDSCAPING
AMC-II
(RUNOFF INDEX NUMBER 56)

PLATE D-5.2

APPENDIX C

Existing Hydrology Map
Proposed Hydrology Map

EXISTING HYDROLOGY MAP

FOR TRACT 38480

C/L WILLOWBROOK LN

C/L FIR AVENUE

C/L AZALEA STREET

L=998'

L=252

E-1
7.91

E-2
0.98

387402.00 S.F.
8.894 ACRES

ELEV=1691.3
Q100=7.54 CFS
Q100=13.01 CFS
Tc=22.5 MIN.
102

101 ELEV=1722.4

103 ELEV=1722.0

104 ELEV=1705.0
Q100=1.42 CFS
Q100=2.34 CFS
Tc=11.1 MIN.

N

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40ft.

LEGEND

— — — —	TRACT BOUNDARY
▬▬▬▬	DRAINAGE AREA BOUNDARY
- - - -	DRAINAGE SUBAREA BOUNDARY
E-1 / 7.91	DRAINAGE AREA NUMBER / DRAINAGE AREA ACREAGE
(10)	NODE NUMBER
Q_{100}	100 YEAR STORM EVENT
Q_{25}	25 YEAR STORM EVENT
Tc	TIME OF CONCENTRATION
CB #2	CATCH BASIN #2

CITY OF MORENO VALLEY
COUNTY OF RIVERSIDE

W&W Land Design Consultants, Inc
Civil Engineering • Subdivision • Land Planning
2335 W. FOOTHILL BLVD., SUITE 1, UPLAND, CA 91786
TEL: (909) 608-7118 • FAX: (909) 946-1137

PROPOSED HYDROLOGY MAP

FOR TRACT 38480

C/L WILLOWBROOK LN

C/L TULIP TREE RD

C/L FIR AVE.

C/L SHAWNEE ST.

C/L AZALEA ST.

C/L "D" COURT

C/L "C" STREET

C/L "A" STREET

C/L "B" STREET

C/L JACKDAW ST

A-1 0.27

A-2 1.11

A-3 0.43

A-4 3.06

A-5 0.23

A-6 1.48

A-7 0.42

A-8 1.89

L=160'

L=152'

L=200'

L=192'

L=352'

L=355'

L=38'

L=10'

L=674'

L=838'

L=552'

(11) ELEV= 1708.9

(12) ELEV=1706.2
Q_{10}=0.54 CFS
Q_{100}=0.84 CFS

(15) ELEV= 1709.1

(16) ELEV=1706.2
Q_{10}=0.47 CFS
Q_{100}=0.74 CFS

(17) ELEV= 1713.2

(13) ELEV= 1713.2

(18) ELEV=1708.8
Q_{10}=0.82 CFS
Q_{100}=1.29 CFS

(14) ELEV=1708.8
Q_{10}=0.85 CFS
Q_{100}=1.34 CFS

(153) ELEV=1694.9
Q_{10}=12.58 CFS
Q_{100}=20.52 CFS

(151) ELEV=1702.9
Q_{10}=6.88 CFS
Q_{100}=11.24 CFS
C.B. #1

(152) ELEV=1702.9
Q_{10}=6.01 CFS
Q_{100}=9.73 CFS
CB #2

(154) ELEV=1672.5
Q_{10}=12.58 CFS
Q_{100}=20.52 CFS
Tc=14.74 MIN.

EXISTING 24" RCP PER CITY DWG #4-798

EXISTING 24" RCP PER CITY DWG #4-798

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

N

LEGEND

- TRACT BOUNDARY
- DRAINAGE AREA BOUNDARY
- DRAINAGE SUBAREA BOUNDARY
- E-1 / 7.91 — DRAINAGE AREA NUMBER / DRAINAGE AREA ACREAGE
- (10) — NODE NUMBER
- Q_{100} — 100 YEAR STORM EVENT
- Q_{25} — 25 YEAR STORM EVENT
- Tc — TIME OF CONCENTRATION
- CB #2 — CATCH BASIN #2

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COUNTY OF RIVERSIDE

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APPENDIX D

Hydrology Study

Existing Conditions-10 Year Storm Event
Existing Conditions-100 Year Storm Event

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 09/20/22 File:10E1.out

2204 Moreno Valley
Existing Condition
10 year storm event
Subarea E-1

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

English (in-lb) Units used in input data file

Program License Serial Number 6069

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.820(In/Hr)
Slope of intensity duration curve = 0.5000

++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 998.000(Ft.)
Top (of initial area) elevation = 1722.400(Ft.)
Bottom (of initial area) elevation = 1691.300(Ft.)

```
Difference in elevation =    31.100(Ft.)
Slope =    0.03116  s(percent)=       3.12
TC = k(0.710)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   22.500 min.
Rainfall intensity =      1.339(In/Hr) for a    10.0 year storm
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.712
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  79.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      7.538(CFS)
Total initial stream area =        7.910(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =            7.91 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  79.0
```

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 09/20/22 File:10E2.out

2204 Moreno Valley
Existing Condition
10 year storm event
Subarea E-2

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

English (in-lb) Units used in input data file

Program License Serial Number 6069

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.820(In/Hr)
Slope of intensity duration curve = 0.5000

++
Process from Point/Station 103.000 to Point/Station 104.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 252.000(Ft.)
Top (of initial area) elevation = 1722.000(Ft.)
Bottom (of initial area) elevation = 1705.000(Ft.)

```
Difference in elevation =    17.000(Ft.)
Slope =    0.06746  s(percent)=       6.75
TC = k(0.710)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.118 min.
Rainfall intensity =      1.905(In/Hr) for a    10.0 year storm
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.759
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  79.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      1.417(CFS)
Total initial stream area =        0.980(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =            0.98 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  79.0
```

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 09/20/22 File:100E1.out

2204 Moreno Valley
Existing Condition
100 year storm event
Subarea E-1

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

English (in-lb) Units used in input data file

Program License Serial Number 6069

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.200(In/Hr)
Slope of intensity duration curve = 0.5000

++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 998.000(Ft.)
Top (of initial area) elevation = 1722.400(Ft.)
Bottom (of initial area) elevation = 1691.300(Ft.)

```
Difference in elevation =    31.100(Ft.)
Slope =    0.03116  s(percent)=       3.12
TC = k(0.710)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   22.500 min.
Rainfall intensity =      1.960(In/Hr) for a   100.0 year storm
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.839
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  90.40
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =     13.010(CFS)
Total initial stream area =        7.910(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =            7.91 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  79.0
```

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 09/20/22 File:100E2.out

2204 Moreno Valley
Existing Condition
100 year storm event
Subarea E-2

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

English (in-lb) Units used in input data file

Program License Serial Number 6069

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.200(In/Hr)
Slope of intensity duration curve = 0.5000

++
Process from Point/Station 103.000 to Point/Station 104.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 252.000(Ft.)
Top (of initial area) elevation = 1722.000(Ft.)
Bottom (of initial area) elevation = 1705.000(Ft.)

```
Difference in elevation =    17.000(Ft.)
Slope =    0.06746  s(percent)=       6.75
TC = k(0.710)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.118 min.
Rainfall intensity =      2.788(In/Hr) for a   100.0 year storm
UNDEVELOPED (fair cover) subarea
Runoff Coefficient = 0.856
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  90.40
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      2.340(CFS)
Total initial stream area =        0.980(Ac.)
Pervious area fraction = 1.000
End of computations, total study area =            0.98 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number =  79.0
```

APPENDIX E

Hydrology Study

Proposed Conditions-10 Year Storm Event
Proposed Conditions-100 Year Storm Event

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 12/20/22 File:10A.out

2204 MORENO VALLEY
PROPSOED CONDITION
10 YEAR STORM EVENT
SUBAREA A

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

English (in-lb) Units used in input data file

Program License Serial Number 6069

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 0.820(In/Hr)
Slope of intensity duration curve = 0.5000

++
Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 160.000(Ft.)
Top (of initial area) elevation = 1708.900(Ft.)
Bottom (of initial area) elevation = 1706.200(Ft.)

```
Difference in elevation =     2.700(Ft.)
Slope =    0.01688  s(percent)=       1.69
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.718 min.
Rainfall intensity =      2.451(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.812
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      0.537(CFS)
Total initial stream area =        0.270(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station      151.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1706.200(Ft.)
End of street segment elevation =  1702.900(Ft.)
Length of street segment  =   355.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  16.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0130
 Manning's N from gutter to grade break =  0.0130
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      1.487(CFS)
Depth of flow =   0.229(Ft.), Average velocity =   1.917(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   5.111(Ft.)
Flow velocity =   1.92(Ft/s)
Travel time =    3.09 min.     TC =    9.80  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.797
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
```

```
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      2.028(In/Hr) for a    10.0 year storm
Subarea runoff =      1.795(CFS) for      1.110(Ac.)
Total runoff =      2.332(CFS)  Total area =       1.380(Ac.)
Street flow at end of street =      2.332(CFS)
Half street flow at end of street =      1.166(CFS)
Depth of flow =   0.259(Ft.), Average velocity =   2.077(Ft/s)
Flow width (from curb towards crown)=   6.593(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.380(Ac.)
Runoff from this stream =      2.332(CFS)
Time of concentration =    9.80 min.
Rainfall intensity =     2.028(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   192.000(Ft.)
Top (of initial area) elevation =  1713.200(Ft.)
Bottom (of initial area) elevation =  1708.800(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.02292  s(percent)=       2.29
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.798 min.
Rainfall intensity =      2.436(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.811
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      0.850(CFS)
Total initial stream area =        0.430(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station      151.000
```

**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 1708.800(Ft.)
End of street segment elevation = 1702.900(Ft.)
Length of street segment = 838.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 18.000(Ft.)
Distance from crown to crossfall grade break = 16.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 10.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0130
Manning's N from gutter to grade break = 0.0130
Manning's N from grade break to crown = 0.0130
Estimated mean flow rate at midpoint of street = 2.956(CFS)
Depth of flow = 0.285(Ft.), Average velocity = 1.954(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 7.937(Ft.)
Flow velocity = 1.95(Ft/s)
Travel time = 7.15 min. TC = 13.95 min.
Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.783
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.500; Impervious fraction = 0.500
Rainfall intensity = 1.701(In/Hr) for a 10.0 year storm
Subarea runoff = 4.074(CFS) for 3.060(Ac.)
Total runoff = 4.924(CFS) Total area = 3.490(Ac.)
Street flow at end of street = 4.924(CFS)
Half street flow at end of street = 2.462(CFS)
Depth of flow = 0.327(Ft.), Average velocity = 2.188(Ft/s)
Flow width (from curb towards crown)= 9.993(Ft.)

++
Process from Point/Station 14.000 to Point/Station 151.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 3.490(Ac.)
Runoff from this stream = 4.924(CFS)
Time of concentration = 13.95 min.

```
Rainfall intensity =     1.701(In/Hr)
Summary of stream data:

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


1        2.332      9.80                 2.028
2        4.924     13.95                 1.701
Largest stream flow has longer time of concentration
Qp =      4.924 + sum of
          Qb         Ia/Ib
           2.332 *    0.838 =      1.956
Qp =      6.879

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.332       4.924
Area of streams before confluence:
        1.380        3.490
Results of confluence:
Total flow rate =      6.879(CFS)
Time of concentration =    13.947 min.
Effective stream area after confluence =      4.870(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      151.000 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =  1702.900(Ft.)
Downstream point/station elevation =  1694.900(Ft.)
Pipe length  =    38.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.879(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     6.879(CFS)
Normal flow depth in pipe =    6.71(In.)
Flow top width inside pipe =    7.83(In.)
Critical depth could not be calculated.
Pipe flow velocity =     19.46(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    13.98 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      151.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
```

```
Stream flow area =      4.870(Ac.)
Runoff from this stream =      6.879(CFS)
Time of concentration =   13.98 min.
Rainfall intensity =     1.699(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =   152.000(Ft.)
Top (of initial area) elevation =  1709.100(Ft.)
Bottom (of initial area) elevation =  1706.200(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01908  s(percent)=       1.91
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.422 min.
Rainfall intensity =      2.506(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.813
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      0.469(CFS)
Total initial stream area =        0.230(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station      152.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1706.200(Ft.)
End of street segment elevation =  1702.900(Ft.)
Length of street segment  =   352.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  16.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0130
```

```
 Manning's N from gutter to grade break =  0.0130
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      1.767(CFS)
Depth of flow =   0.240(Ft.), Average velocity =   1.979(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   5.654(Ft.)
Flow velocity =   1.98(Ft/s)
Travel time =    2.96 min.     TC =    9.39  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.799
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      2.073(In/Hr) for a    10.0 year storm
Subarea runoff =      2.452(CFS) for      1.480(Ac.)
Total runoff =      2.921(CFS)  Total area =       1.710(Ac.)
Street flow at end of street =      2.921(CFS)
Half street flow at end of street =      1.460(CFS)
Depth of flow =   0.274(Ft.), Average velocity =   2.182(Ft/s)
Flow width (from curb towards crown)=   7.367(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.710(Ac.)
Runoff from this stream =      2.921(CFS)
Time of concentration =    9.39 min.
Rainfall intensity =     2.073(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       18.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   200.000(Ft.)
Top (of initial area) elevation =  1713.200(Ft.)
Bottom (of initial area) elevation =  1708.800(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.02200  s(percent)=       2.20
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.966 min.
Rainfall intensity =      2.407(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
```

```
Runoff Coefficient = 0.810
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      0.819(CFS)
Total initial stream area =        0.420(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station      152.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1708.800(Ft.)
End of street segment elevation =  1702.900(Ft.)
Length of street segment  =   674.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  16.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0130
 Manning's N from gutter to grade break =  0.0130
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      2.220(CFS)
Depth of flow =   0.257(Ft.), Average velocity =   2.008(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   6.527(Ft.)
Flow velocity =   2.01(Ft/s)
Travel time =    5.59 min.     TC =   12.56  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.787
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      1.792(In/Hr) for a    10.0 year storm
Subarea runoff =      2.667(CFS) for      1.890(Ac.)
Total runoff =      3.486(CFS)  Total area =       2.310(Ac.)
```

```
Street flow at end of street =      3.486(CFS)
Half street flow at end of street =      1.743(CFS)
Depth of flow =   0.290(Ft.), Average velocity =   2.205(Ft/s)
Flow width (from curb towards crown)=   8.148(Ft.)


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Process from Point/Station       18.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      2.310(Ac.)
Runoff from this stream =      3.486(CFS)
Time of concentration =   12.56 min.
Rainfall intensity =     1.792(In/Hr)
Summary of stream data:

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


1        2.921      9.39                2.073
2        3.486     12.56                1.792
Largest stream flow has longer time of concentration
Qp =      3.486 + sum of
          Qb         Ia/Ib
           2.921 *    0.864 =      2.525
Qp =      6.011

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.921       3.486
Area of streams before confluence:
        1.710        2.310
Results of confluence:
Total flow rate =      6.011(CFS)
Time of concentration =    12.560 min.
Effective stream area after confluence =      4.020(Ac.)


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Process from Point/Station      152.000 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =  1702.900(Ft.)
Downstream point/station elevation =  1694.900(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.011(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     6.011(CFS)
```

```
Normal flow depth in pipe =    3.99(In.)
Flow top width inside pipe =    8.94(In.)
Critical depth could not be calculated.
Pipe flow velocity =     31.76(Ft/s)
Travel time through pipe =    0.01 min.
Time of concentration (TC) =    12.56 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      152.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.020(Ac.)
Runoff from this stream =      6.011(CFS)
Time of concentration =   12.56 min.
Rainfall intensity =     1.792(In/Hr)
Summary of stream data:

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


1        6.879     13.98                 1.699
2        6.011     12.56                 1.792
Largest stream flow has longer time of concentration
Qp =      6.879 + sum of
          Qb         Ia/Ib
           6.011 *    0.948 =      5.699
Qp =     12.578

Total of 2 main streams to confluence:
Flow rates before confluence point:
       6.879       6.011
Area of streams before confluence:
        4.870        4.020


Results of confluence:
Total flow rate =     12.578(CFS)
Time of concentration =    13.979 min.
Effective stream area after confluence  =      8.890(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =  1694.900(Ft.)
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Downstream point/station elevation =  1672.500(Ft.)
Pipe length  =   552.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    12.578(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =    12.578(CFS)
Normal flow depth in pipe =   11.86(In.)
Flow top width inside pipe =   12.21(In.)
Critical depth could not be calculated.
Pipe flow velocity =     12.08(Ft/s)
Travel time through pipe =    0.76 min.
Time of concentration (TC) =    14.74 min.
End of computations, total study area =            8.89 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.500
Area averaged RI index number =  69.0
```

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 12/20/22 File:100A.out

2204 MORENO VALLEY
PROPSOED CONDITION
100 YEAR STORM EVENT
SUBAREA A

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

English (in-lb) Units used in input data file

Program License Serial Number 6069

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)
For the [Sunnymead-Moreno] area used.
10 year storm 10 minute intensity = 2.010(In/Hr)
10 year storm 60 minute intensity = 0.820(In/Hr)
100 year storm 10 minute intensity = 2.940(In/Hr)
100 year storm 60 minute intensity = 1.200(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.200(In/Hr)
Slope of intensity duration curve = 0.5000

++
Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 160.000(Ft.)
Top (of initial area) elevation = 1708.900(Ft.)
Bottom (of initial area) elevation = 1706.200(Ft.)

```
Difference in elevation =     2.700(Ft.)
Slope =    0.01688  s(percent)=       1.69
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.718 min.
Rainfall intensity =      3.586(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  84.40
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      0.843(CFS)
Total initial stream area =        0.270(Ac.)
Pervious area fraction = 0.500


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Process from Point/Station       12.000 to Point/Station      151.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1706.200(Ft.)
End of street segment elevation =  1702.900(Ft.)
Length of street segment  =   355.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  16.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0130
 Manning's N from gutter to grade break =  0.0130
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      2.362(CFS)
Depth of flow =   0.259(Ft.), Average velocity =   2.083(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   6.637(Ft.)
Flow velocity =   2.08(Ft/s)
Travel time =    2.84 min.     TC =    9.56  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.866
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
```

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Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  84.40
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      3.006(In/Hr) for a   100.0 year storm
Subarea runoff =      2.890(CFS) for      1.110(Ac.)
Total runoff =      3.733(CFS)  Total area =       1.380(Ac.)
Street flow at end of street =      3.733(CFS)
Half street flow at end of street =      1.866(CFS)
Depth of flow =   0.293(Ft.), Average velocity =   2.291(Ft/s)
Flow width (from curb towards crown)=   8.295(Ft.)


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Process from Point/Station       12.000 to Point/Station      151.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.380(Ac.)
Runoff from this stream =      3.733(CFS)
Time of concentration =    9.56 min.
Rainfall intensity =     3.006(In/Hr)


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Process from Point/Station       13.000 to Point/Station       14.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   192.000(Ft.)
Top (of initial area) elevation =  1713.200(Ft.)
Bottom (of initial area) elevation =  1708.800(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.02292  s(percent)=       2.29
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.798 min.
Rainfall intensity =      3.565(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  84.40
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      1.335(CFS)
Total initial stream area =        0.430(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station      151.000
```

**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 1708.800(Ft.)
End of street segment elevation = 1702.900(Ft.)
Length of street segment = 838.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 18.000(Ft.)
Distance from crown to crossfall grade break = 16.000(Ft.)
Slope from gutter to grade break (v/hz) = 0.020
Slope from grade break to crown (v/hz) = 0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line = 10.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0130
Manning's N from gutter to grade break = 0.0130
Manning's N from grade break to crown = 0.0130
Estimated mean flow rate at midpoint of street = 4.798(CFS)
Depth of flow = 0.324(Ft.), Average velocity = 2.175(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 9.880(Ft.)
Flow velocity = 2.18(Ft/s)
Travel time = 6.42 min. TC = 13.22 min.
Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.860
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3) = 84.40
Pervious area fraction = 0.500; Impervious fraction = 0.500
Rainfall intensity = 2.557(In/Hr) for a 100.0 year storm
Subarea runoff = 6.731(CFS) for 3.060(Ac.)
Total runoff = 8.066(CFS) Total area = 3.490(Ac.)
Street flow at end of street = 8.066(CFS)
Half street flow at end of street = 4.033(CFS)
Depth of flow = 0.373(Ft.), Average velocity = 2.454(Ft/s)
Flow width (from curb towards crown)= 12.316(Ft.)

++
Process from Point/Station 14.000 to Point/Station 151.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 3.490(Ac.)
Runoff from this stream = 8.066(CFS)
Time of concentration = 13.22 min.

```
Rainfall intensity =     2.557(In/Hr)
Summary of stream data:

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


1        3.733      9.56                 3.006
2        8.066     13.22                 2.557
Largest stream flow has longer time of concentration
Qp =      8.066 + sum of
          Qb         Ia/Ib
           3.733 *    0.850 =      3.174
Qp =     11.241

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.733       8.066
Area of streams before confluence:
        1.380        3.490
Results of confluence:
Total flow rate =     11.241(CFS)
Time of concentration =    13.219 min.
Effective stream area after confluence =      4.870(Ac.)


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Process from Point/Station      151.000 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =  1702.900(Ft.)
Downstream point/station elevation =  1694.900(Ft.)
Pipe length  =    38.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.241(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =    11.241(CFS)
Normal flow depth in pipe =    7.31(In.)
Flow top width inside pipe =   11.71(In.)
Critical depth could not be calculated.
Pipe flow velocity =     22.44(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    13.25 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      151.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
```

```
Stream flow area =      4.870(Ac.)
Runoff from this stream =     11.241(CFS)
Time of concentration =   13.25 min.
Rainfall intensity =     2.554(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =   152.000(Ft.)
Top (of initial area) elevation =  1709.100(Ft.)
Bottom (of initial area) elevation =  1706.200(Ft.)
Difference in elevation =     2.900(Ft.)
Slope =    0.01908  s(percent)=       1.91
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.422 min.
Rainfall intensity =      3.668(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.872
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  84.40
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      0.735(CFS)
Total initial stream area =        0.230(Ac.)
Pervious area fraction = 0.500


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Process from Point/Station       16.000 to Point/Station      152.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1706.200(Ft.)
End of street segment elevation =  1702.900(Ft.)
Length of street segment  =   352.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  16.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0130
```

```
 Manning's N from gutter to grade break =  0.0130
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      2.758(CFS)
Depth of flow =   0.270(Ft.), Average velocity =   2.156(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   7.163(Ft.)
Flow velocity =   2.16(Ft/s)
Travel time =    2.72 min.     TC =    9.14  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.867
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  84.40
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      3.074(In/Hr) for a   100.0 year storm
Subarea runoff =      3.943(CFS) for      1.480(Ac.)
Total runoff =      4.678(CFS)  Total area =       1.710(Ac.)
Street flow at end of street =      4.678(CFS)
Half street flow at end of street =      2.339(CFS)
Depth of flow =   0.310(Ft.), Average velocity =   2.416(Ft/s)
Flow width (from curb towards crown)=   9.173(Ft.)


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Process from Point/Station       16.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      1.710(Ac.)
Runoff from this stream =      4.678(CFS)
Time of concentration =    9.14 min.
Rainfall intensity =     3.074(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       18.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Initial area flow distance =   200.000(Ft.)
Top (of initial area) elevation =  1713.200(Ft.)
Bottom (of initial area) elevation =  1708.800(Ft.)
Difference in elevation =     4.400(Ft.)
Slope =    0.02200  s(percent)=       2.20
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.966 min.
Rainfall intensity =      3.522(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
```

```
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  84.40
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      1.288(CFS)
Total initial stream area =        0.420(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station      152.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1708.800(Ft.)
End of street segment elevation =  1702.900(Ft.)
Length of street segment  =   674.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  18.000(Ft.)
Distance from crown to crossfall grade break  =  16.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0130
 Manning's N from gutter to grade break =  0.0130
 Manning's N from grade break to crown =  0.0130
Estimated mean flow rate at midpoint of street =      3.565(CFS)
Depth of flow =   0.291(Ft.), Average velocity =   2.216(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   8.233(Ft.)
Flow velocity =   2.22(Ft/s)
Travel time =    5.07 min.     TC =   12.04  min.
 Adding area flow to street
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.862
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 3)  =  84.40
Pervious area fraction =  0.500; Impervious fraction =  0.500
Rainfall intensity =      2.679(In/Hr) for a   100.0 year storm
Subarea runoff =      4.365(CFS) for      1.890(Ac.)
Total runoff =      5.653(CFS)  Total area =       2.310(Ac.)
```

```
Street flow at end of street =      5.653(CFS)
Half street flow at end of street =      2.827(CFS)
Depth of flow =   0.329(Ft.), Average velocity =   2.456(Ft/s)
Flow width (from curb towards crown)=  10.120(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station      152.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      2.310(Ac.)
Runoff from this stream =      5.653(CFS)
Time of concentration =   12.04 min.
Rainfall intensity =     2.679(In/Hr)
Summary of stream data:

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


1        4.678      9.14                3.074
2        5.653     12.04                2.679
Largest stream flow has longer time of concentration
Qp =      5.653 + sum of
          Qb         Ia/Ib
           4.678 *    0.872 =      4.077
Qp =      9.730

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.678       5.653
Area of streams before confluence:
        1.710        2.310
Results of confluence:
Total flow rate =      9.730(CFS)
Time of concentration =    12.036 min.
Effective stream area after confluence =      4.020(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      152.000 to Point/Station      153.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =  1702.900(Ft.)
Downstream point/station elevation =  1694.900(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.730(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     9.730(CFS)
```

```
Normal flow depth in pipe =    5.33(In.)
Flow top width inside pipe =    8.85(In.)
Critical depth could not be calculated.
Pipe flow velocity =     35.75(Ft/s)
Travel time through pipe =    0.00 min.
Time of concentration (TC) =    12.04 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      152.000 to Point/Station      153.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      4.020(Ac.)
Runoff from this stream =      9.730(CFS)
Time of concentration =   12.04 min.
Rainfall intensity =     2.679(In/Hr)
Summary of stream data:

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


1       11.241     13.25                2.554
2        9.730     12.04                2.679
Largest stream flow has longer time of concentration
Qp =     11.241 + sum of
          Qb         Ia/Ib
           9.730 *    0.953 =      9.277
Qp =     20.518

Total of 2 main streams to confluence:
Flow rates before confluence point:
      11.241       9.730
Area of streams before confluence:
        4.870        4.020


Results of confluence:
Total flow rate =     20.518(CFS)
Time of concentration =    13.247 min.
Effective stream area after confluence  =      8.890(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      153.000 to Point/Station      154.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =  1694.900(Ft.)
```

Downstream point/station elevation = 1672.500(Ft.)
Pipe length = 552.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 20.518(CFS)
Nearest computed pipe diameter = 18.00(In.)
Calculated individual pipe flow = 20.518(CFS)
Normal flow depth in pipe = 14.30(In.)
Flow top width inside pipe = 14.55(In.)
Critical depth could not be calculated.
Pipe flow velocity = 13.64(Ft/s)
Travel time through pipe = 0.67 min.
Time of concentration (TC) = 13.92 min.
End of computations, total study area = 8.89 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.500
Area averaged RI index number = 69.0

Appendix F

Hydraulic Calculations

Normal depth calculations for existing 24” RCP storm drainpipe

24" RCP Capacity
Worksheet for Circular Channel

Project Description	
Project File	c:\docume~1\admini~1\desktop\haestad\fmw\2204.fm2
Worksheet	24" RCP Capacity
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.008000	ft/ft
Depth	2.00	ft
Diameter	24.00	in

Results		
Discharge	20.23	cfs
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.6e-7	ft
Critical Depth	1.61	ft
Percent Full	100.00	
Critical Slope	0.008226	ft/ft
Velocity	6.44	ft/s
Velocity Head	0.64	ft
Specific Energy	2.64	ft
Froude Number	0.16e-3	
Maximum Discharge	21.76	cfs
Full Flow Capacity	20.23	cfs
Full Flow Slope	0.008000	ft/ft
Flow is subcritical.		

APPENDIX G

Reference Plans

City record dwg #4-798, sheet 5 of Tract 27251-1

NOTE:
CONTRACTOR SHALL PROTECT IN PLACE ALL UTILITIES CROSSING OR PARALLELING THE STORM DRAIN UNLESS OTHERWISE NOTED.

PROFILE: S.D. LINE 'C'

SCALE: HORIZ. 1" = 40', VERT. 1" = 4'

MAINTAINED BY CITY OF MORENO VALLEY

MAINTAINED BY RCFC&WCD

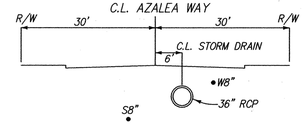
PRIVATELY MAINTAINED BY TR. 27251 H.O.A.

PLAN: S.D. LINE 'C'

SCALE: 1"=40'

NOTE:
FOR TRUE ELEVATIONS, ADD 1000 TO ALL CALL-OUTS

C.L. AZALEA WAY



SECTION AT STA. 2+50.00

SCALE: 1" = 10'

INFORMATIONAL NOTE:
ALL X-SECTION TAKEN LOOKING DOWN STREAM

AS BUILT
APPROVED BY:
DATE: 3/7/17

REGISTERED PROFESSIONAL ENGINEER — PAUL A. HUDDLESTON — No. 58020 — CIVIL — STATE OF CALIFORNIA

CONSTRUCTION NOTES

ITEM NO.	DESCRIPTION
(2)	INSTALL 24" REINFORCED CONCRETE PIPE PER RCFC & WCD SPECIFICATIONS (D-LOAD PER PROFILE)
(3)	INSTALL 30" REINFORCED CONCRETE PIPE PER RCFC & WCD SPECIFICATIONS (D-LOAD PER PROFILE)
(4)	INSTALL 36" REINFORCED CONCRETE PIPE PER RCFC & WCD SPECIFICATIONS (D-LOAD PER PROFILE)
(5)	INSTALL 48" REINFORCED CONCRETE PIPE PER RCFC & WCD SPECIFICATIONS (D-LOAD PER PROFILE)
(7)	CONSTRUCT CATCH BASIN NO. 1 PER RCFCD & WCD STD. CB100, (LENGTH AS SHOWN ON PLANS). SEE STREET PLAN FOR LOCAL DEPRESSION DETAIL.
(9)	CONSTRUCT CONC. DROP INLET PER RCFC & WCD STD. DWG. NO. CB110
(10)	CONSTRUCT MANHOLE NO. 1 PER RCFC & WCD STD. DWG. NO. MH251
(12)	CONSTRUCT JUNCTION STRUCTURE NO. 2 PER RCFC & WCD STD. DWG. NO. JS227 A =85°, B=24", C=5', D=36", L=6', E=5', F=1.3', G=1.2'
(17)	CONSTRUCT MANHOLE NO. 4 PER RCFC & WCD STD. DWG. NO. MH254 C-1: ANGLE A =45°; B=36", C=7.7', D1=36", D2=48" C-2: ANGLE A =45°; B=36", C=7.7', D1=36", D2=48" C-3: ANGLE A =45°; B=24", C=7', D1=30", D2=36" C-4: ANGLE A =46°; B=24", C=7', D1=30", D2=36" C-5: ANGLE A =45°; B=24", C=7', D1=24", D2=30"
(28)	INSTALL MANHOLE SHAFT SAFETY LEDGE PER APWA STD. 330-1.

SCALE: 1" = 40'

STORM DRAIN DATA

NO.	DELTA OR BRG.	RADIUS(ft)	LENGTH(ft)	TANGENT(ft)	REMARKS
(1)	N45°26'46"E	------	4.35	------	48" RCP
(2)	45°00'00"	25.00	19.63	10.36	48" RCP
(3)	N89°33'14"W	------	54.59	------	48" RCP
(4)	N89°33'14"W	------	140.37	------	36" RCP
(5)	90°00'00"	35.00	54.98	35.00	36" RCP
(6)	N00°26'46"E	------	7.26	------	36" RCP
(7)	N00°26'46"E	------	83.16	------	36" RCP
(8)	N00°26'46"E	------	163.42	------	36" RCP
(9)	11°47'10"	406.00	83.52	41.91	24" RCP
(10)	N12°13'56"E	------	100.03	------	24" RCP
(11)	78°12'50"	45.00	61.43	36.58	24" RCP
(12)	N89°59'02"W	------	147.08	------	24" RCP
(13)	N45°26'46"E	------	32.99	------	36" RCP
(14)	N60°28'56"W	------	23.22	------	36" RCP
(15)	N46°44'26"W	------	16.30	------	24" RCP
(16)	N45°26'46"E	------	33.88	------	24" RCP
(17)	36°56'56"	60.00	38.69	20.05	24" RCP
(18)	N89°33'14"W	------	39.02	------	24" RCP
(19)	46°27'28"	22.50	18.24	9.66	24" RCP

Underground Service Alert
Call: TOLL FREE 1-800 227-2600
TWO WORKING DAYS BEFORE YOU DIG

SEAL: REGISTERED PROFESSIONAL ENGINEER — RICHARD VALDEZ — No. 48060 — Exp. 12-31-07 — CIVIL — STATE OF CALIFORNIA

VSL civil engineering, land planning & surveying
40935 COUNTY CENTER DRIVE, TEMECULA, CA. 92591
TEL. (951) 296-3930 FAX. (951) 296-3931

SUBMITTED BY: RICHARD L VALDEZ
DATE: 11.1.2006 REGISTERED CIVIL ENGINEER NO.48060 Expires 12-31-07

BENCHMARK:

REVISIONS

REF.	DESCRIPTION	APPR.	APPR.	DATE

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
RECOMMENDED FOR APPROVAL BY: DATE: 2/15/07
APPROVED BY: DATE: 2-22-2007

CITY OF MORENO VALLEY APPROVALS
PREM KUMAR, ASSISTANT CITY ENGINEER, R.C.E. #C52463 EXP. 12/31/2008 — 1/24/07 DATE
CHRIS A. VOGT, PUBLIC WORKS DIRECTOR/CITY ENGINEER, R.C.E. #C44250 EXP. 06/30/2007 — 1/25/07 DATE

TRACT NO. 27251-1
STORM DRAIN IMPROVEMENT PLAN
SUNNYMEAD MAP LINE S-2 STAGE 2
S.D. LINE 'C' 1+00.00 TO 10+45.73/S.D. LINE: C-1, C-2, C-3, C-4 AND C-8

PROJECT NO. 4-0-00727
DRAWING NO. 4-798
SHEET NO. 5 OF 8

Designed By: TL | Drawn By: TL | Checked By: RV

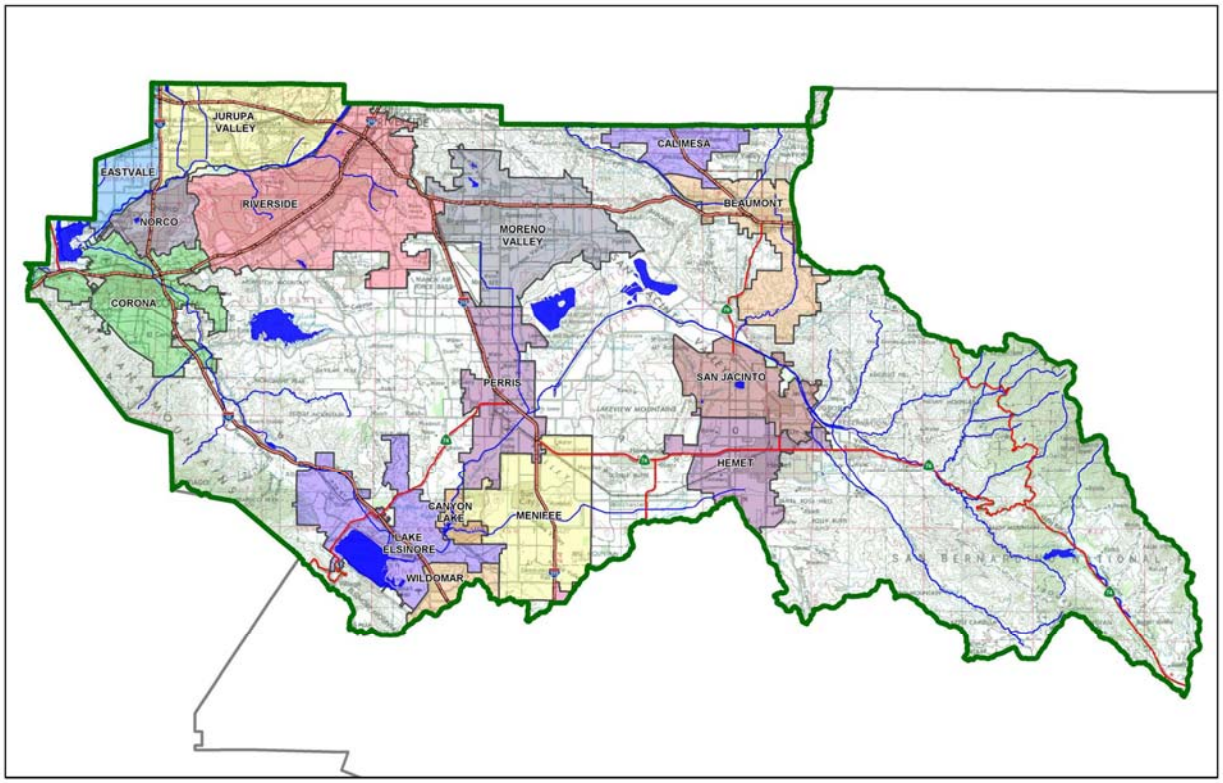
Preliminary Project Specific Water Quality Management Plan

*A Template for Projects located within the **Santa Ana Watershed** Region of Riverside County*

Project Title: FIR Avenue – 37 SFR Subdivision Development

Development No: APN: 487-260-002, 003, 004 & 005, South side of Fir Avenue, Moreno Valley, CA 92555

Design Review/Case No: PEN 22-0187 / LWQ22-0037



☒ **Preliminary**
☐ **Final**

Original Date Prepared: January 19, 2023

Revision Date(s):

Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**
Template revised June 30, 2016

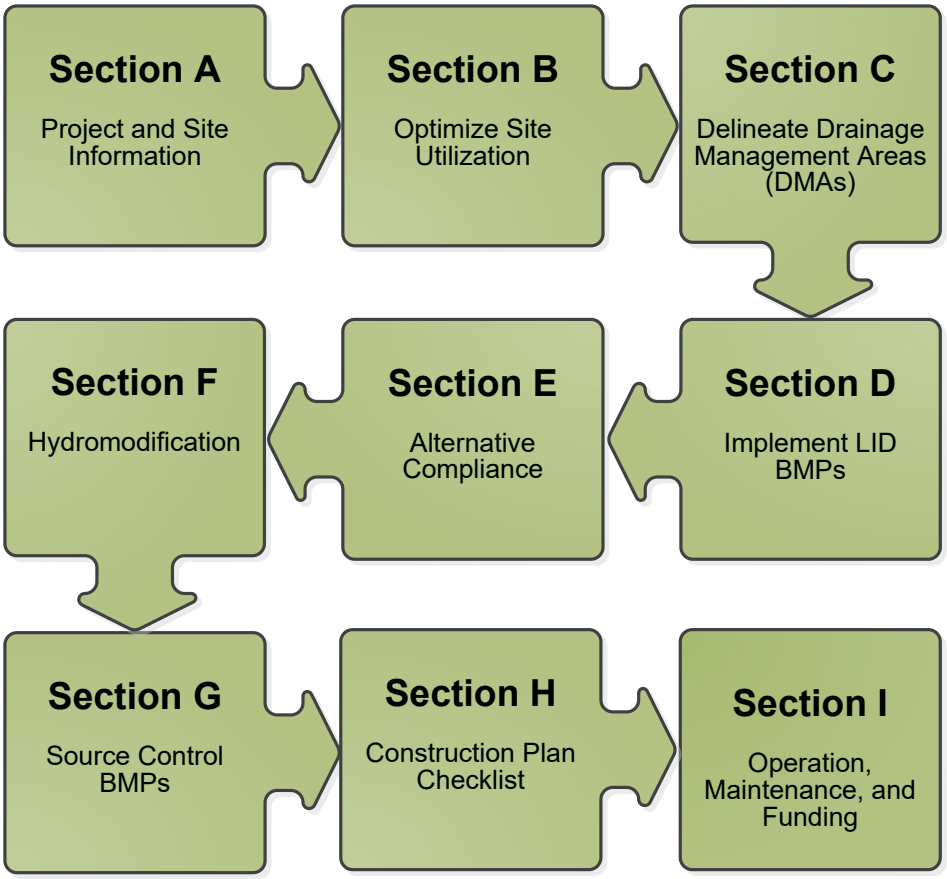
Contact Information:

Prepared for:
Vigorous Development, LLC
17114 Ridge Park Drive
Hacienda Heights, CA 91745
Phone: (626) 679-0825

Prepared by: W&W Land Design Consultants, Inc
2335 W. Foothill Blvd., Suite #1
Upland, CA 91786
Ph: (909) 608-7118
Fax: (909) 946-1137

A Brief Introduction

This Project-Specific WQMP Template for the **Santa Ana Region** has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your "how-to" manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand, and will help facilitate a well prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



OWNER'S CERTIFICATION

This Project-Specific WQMP has been prepared for **Vigorous Development, LLC** by **W&W Land Design Consultants** for the **FIR Avenue – 37 SFR Subdivision Development** project.

This WQMP is intended to comply with the requirements of **City of Moreno Valley, Riverside County Ordinance No. 827,** which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under **City of Moreno Valley** Water Quality Ordinance **(Municipal Code Section 8.10).**

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Owner's Signature	Date
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

Preparer's Signature	Date
Winston Liu	Principal Engineer
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure: C66242

OWNER'S CERTIFICATION

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"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Hua Han

Owner's Signature

01/18/2023

Date

Hua Han

Owner's Printed Name

Manager

Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

Preparer's Signature

12.27.2022

Date

Winston Liu

Preparer's Printed Name

Principal Engineer

Preparer's Title/Position

Preparer's Licensure: C66242

Table of Contents

List of Tables

List of Appendices

Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	37 lots Single Faily Residence Development
Planning Area:	8.89 acre
Community Name:	N/A
Development Name:	Tract 38480, FIR Avenue – 37 SFR Subdivision Development
PROJECT LOCATION	
Latitude & Longitude (DMS): 33.934205, -117.197380	
Project Watershed and Sub-Watershed: Santa Ana River & San Jacinto River	
Gross Acres: 8.897 AC	
APN(s): 487-260-002, 003, 004 & 005	
Map Book and Page No.: PM 8/39, RS 28/38	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Residential
Proposed or Potential SIC Code(s)	1521
Area of Impervious Project Footprint (SF)	391,922
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	286,897
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	**C**
What is the Water Quality Design Storm Depth for the project?	0.67 inches

A.1 Maps and Site Plans

In existing condition, the existing tributary area is approximately 8.89 acres site tributary area of natural dirt area. Most of the site drains overland towards southwesterly sheet flow to an existing drainage inlet located at southwest corner of the project site, the drainage inlet was designed and constructed per adjacent Tract 27251 and connected into an existing storm drain system to Jackdaw Street. Another subarea, as slope runoff, drains toward southeasterly to an existing concrete v-gutter connected into lot 56 of Tract 27251, the v-gutter tied into existing storm drainpipes to Rose Bud Lane.

In proposed condition, the project site can be integrated into one drainage zone with total 8.89 acres of disturbed areas. All sub areas will drain to two proposed catch basins with storm drainpipes system, then to proposed water quality Infiltration BMP structure eventually tie into existing 24" RCP at southwesterly of the project site, the existing 24" RCP was crossing into lot 45 of Tract 27251, was pre-designed and constructed for our project tract home development.

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling
- BMP Locations (Lat/Long)

A.2 Identify Receiving Waters

A map of the receiving waters could be found in Appendix 1 of this report.

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Perris Valley Storm Drain	None	None	Not a water body classified as RARE
San Jacinto River (Reach 3)	None	AGR/GWR REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Canyon Lake	Pathogens, Nutrients	MUN/AGR/GWR REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
San Jacinto River (Reach 1)	None	MUN/AGR/GWR REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Lake Elsinore	Nutrientssediment toxiaty, organic enrichment. Low dissolved oxygen, Unknown Toxicity, PCBs	REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Temescal Creek (Reach 6)	Indicator Bacteria	GWR REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Temescal Creek (Reach 5)	None	AGR/GWR/REC1/2 /WARM/WILD, RARE/MUN	Approx. 25 miles
Temescal Creek (Reach 4)	None	AGR/GWR/REC1/2/ WARM/WILD/RARE/MUN	Approx. 30 miles
Temescal Creek (Reach 3)	None	AGR//IND/GWR REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Temescal Creek (Reach 2)	None	AGR//IND/GWR REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Temescal Creek (Reach 1)	PH	REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Santa Ana River (Reach 3)	Pathogens, Copper, Lead	AGR/GWR/REC1/2/ WARM/WILD/RARE/MUN/SPWN	Approx. 50 miles
Prado Basin Management Zone	Pathogen, Hythents,	RARE/ REC1/2/WARM/WILD/MUN	Approx. 54 miles
Santa Ana River – (Reach 2)	None	RARE/AGR/GWR REC1/2/WARM/WILD/MUN	Approx. 60 miles
Santa Ana River – (Reach 1)	None	REC1/2/WARM/WILD/MUN	Not a water body classified as RARE
Tidal Prism of Santa Ana River and Newport Slough	None	RARE/MAR/COMM/ REC1/2/WILD/MUN	Approx. 70 miles

Pacific Ocean Nearshore	None	BIOL/NAV/COMM /REC1/2/RARE/WILD /SPWN/MAR/SHEL/MUN	Approx. 90 miles
Offshore	None	IND/NAV/COMM /REC1/2/RARE/WILD /SPWN/MAR/MUN	Approx. 95 miles

A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)* City of Moreno Valley Grading Permit	☒ Y	☐ N

Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, constraints might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. Opportunities might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Consideration of "highest and best use" of the discharge should also be considered. For example, Lake Elsinore is evaporating faster than runoff from natural precipitation can recharge it. Requiring infiltration of 85% of runoff events for projects tributary to Lake Elsinore would only exacerbate current water quality problems associated with Pollutant concentration due to lake water evaporation. In cases where rainfall events have low potential to recharge Lake Elsinore (i.e. no hydraulic connection between groundwater to Lake Elsinore, or other factors), requiring infiltration of Urban Runoff from projects is counterproductive to the overall watershed goals. Project proponents, in these cases, would be allowed to discharge Urban Runoff, provided they used equally effective filtration-based BMPs.

Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

Yes, through project development, post development will maintain existing drainage pattern to keep the runoff drain to existing 24" RCP storm drain system per adjacent Tract 27251 pre-designed & constructed.

Did you identify and protect existing vegetation? If so, how? If not, why?

No, project will be fully developed, and no existing vegetation needs to be protected. It will be proposed new vegetation area per development site plan in design.

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

Yes, project has been designed to use biofiltration system since the infiltration rate turned out to be 0.65 inch/hr after safety factor of 3 applied to infiltration field rate (Please refer to soil report for more detail).

Did you identify and minimize impervious area? If so, how? If not, why?

Yes, project has been designed into minimum width of proposed parking lots, drive aisles.

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

Yes, most drainage areas drain along proposed building back yard and side yards landscaping areas.

Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1][2]	Area (Sq. Ft.)	DMA Type
D1	Pavement street, asphalt & concrete sidewalks	90,790	D
Entire D2	-----	173,320	---
B1 [D2 (35%)]	Landscaping	60,662	D
D2 (65%)	Roof, pavement parking, asphalt concrete driveways	112,658	D
ENTIRE D3	-----	123,599	---
B2 [D3 (35%)]	Landscaping	43,260	D
D3 (65%)	Roof, pavement parking, asphalt concrete driveways	80,339	D
D4	Pavement street, asphalt & concrete sidewalks	15,670	D

[1]*Reference Table 2-1 in the WQMP Guidance Document to populate this column*
[2]*If multi-surface provide back-up*

Table C.2 Type 'A', Self-Treating Areas

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)

Table C.3 Type 'B', Self-Retaining Areas

Self-Retaining Area				**Type 'C' DMAs that are draining to the Self-Retaining Area**		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet)	Post-project surface type	Impervious fraction	Product		Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]	DMA name /ID	[D]	[C]/[D]

Table C.5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID
D1	Infiltration BMP
D2	Infiltration BMP
D3	Infiltration BMP
B1	Infiltration BMP
B2	Infiltration BMP

Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

If yes has been checked, Infiltration BMPs shall not be used for the site; proceed to section D.3

If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

Infiltration Feasibility

Table D.1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

Table D.1 Infiltration Feasibility

Does the project site…	YES	NO
…have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		X
If Yes, list affected DMAs:		
…have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
…have measured in-situ infiltration rates of less than 1.6 inches / hour?		X
If Yes, list affected DMAs:		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

D.2 Harvest and Use Assessment

Please check what applies*:*

☐ Reclaimed water will be used for the non-potable water demands for the project.

☐Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).

☒The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If none of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

☐LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).

☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
D1	☒	☐	☐	☐	☐
D2	☒	☐	☐	☐	☐
D3	☒	☐	☐	☐	☐
B1	☒	☐	☐	☐	☐
B2	☒	☐	☐	☐	☐
	☐	☐	☐	☐	☐

For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

D.5 LID BMP Sizing

Table D.3 DCV Calculations for LID BMPs (D-1)

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Cultec Re-Charger 902HD – BMP #1*		
	[A]		[B]	[C]	[A] x [C]			
D1	90,790	*Concrete or Asphalt*	*1.0*	*0.89*	*80,985*	*Design Storm Depth (in)*	*Design Capture Volume,* $\mathbf{V_{BMP}}$ *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D2	112,658	*Roofs*	*1.0*	*0.89*	*100,491*			
D3	80,339	*Roofs*	*1.0*	*0.89*	*71,662*			
B1	60,662	*Ornamental Landscaping*	*0.1*	*0.11*	*6,701*			
B2	43,260	Ornamental *Landscaping*	*0.1*	*0.11*	*4,778*			
	A_T = Σ[A] 387,709				Σ= [D] 264,617	[E] 0.67	$[F] = \frac{[D]x[E]}{12}$ 14,774	[G] 14,965

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Table D.4 DCV Calculations for LID BMPs (D-1)

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Contech Filterra bypass curb – BMP #2*		
	[A]		[B]	[C]	[A] x [C]			
D4	15,670	*Concrete or Asphalt*	*1.0*	*0.89*	*13,978*	*Design Storm Depth (in)*	*Design Capture Volume,* $\mathbf{V_{BMP}}$ *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	A_T = Σ[A] 15,670				Σ= [D] 13,978	[E] 0.67	$[F] = \frac{[D]x[E]}{12}$ 780	[G] 800

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

☒ LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

- *Or* -

☐ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

N/A

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

HCOC EXEMPTION 1: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration[1] of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐Y ☒N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration	n/a	n/a	n/a
Volume (Cubic Feet)	n/a	n/a	n/a

[1] Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Susceptibility Maps.

Does the project qualify for this HCOC Exemption? ☒ Y ☐ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:

Canyon Lake

Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and "housekeeping", that must be implemented by the site's occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. ***Identify Pollutant Sources*:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit*:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative*:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs:*** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures
Table G.2 DCV Calculations for LID BMPs (D-2)

Potential Sources of Runoff pollutants Permanent Structural Source Control BMPs Operational Source Control BMPs

"Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify. • Maintain and periodically repaint or replace inlet markings.

- **Provide stormwater pollution prevention information to new site owners, lessees, or operators.**
- **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
- **Include the following in leaseagreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."** [G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
A. On-site storm drain inlets Mark all inlets with the words	• Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.	• Maintain and periodically repaint or replace inlet markings. • Provide stormwater pollution prevention information to new site owners, lessees, or operators. • See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com • Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
D2. Landscape/Outdoor Pesticide Use	• State that final landscape plans will accomplish all of the following. • Preserve existing native trees, shrubs, and ground	• Maintain landscaping using minimum or no pesticides. • See applicable operational BMPs in "What you should know

	cover to the maximum extent possible. • Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution. Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions. • Consider using pest-resistant plants, especially adjacent to hardscape. • To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.	for…..Landscape and Gardening" at http://rcflood.org/stormwater/ • Provide IPM information to new owners, lessees and operators
P. Streets and sidewalks		• Sweep street and sidewalks regularly to prevent the accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect wash water containing any cleaning agent or degreaser and discharge to the sanitary sewer, not to a storm drain.

Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)
Infiltration BMP #1	Infiltration BMP #1	Conceptual Civil Plans sheet 7 – Preliminary WQMP Site Plan	33.934205, -117.197380

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

Maintenance Mechanism:

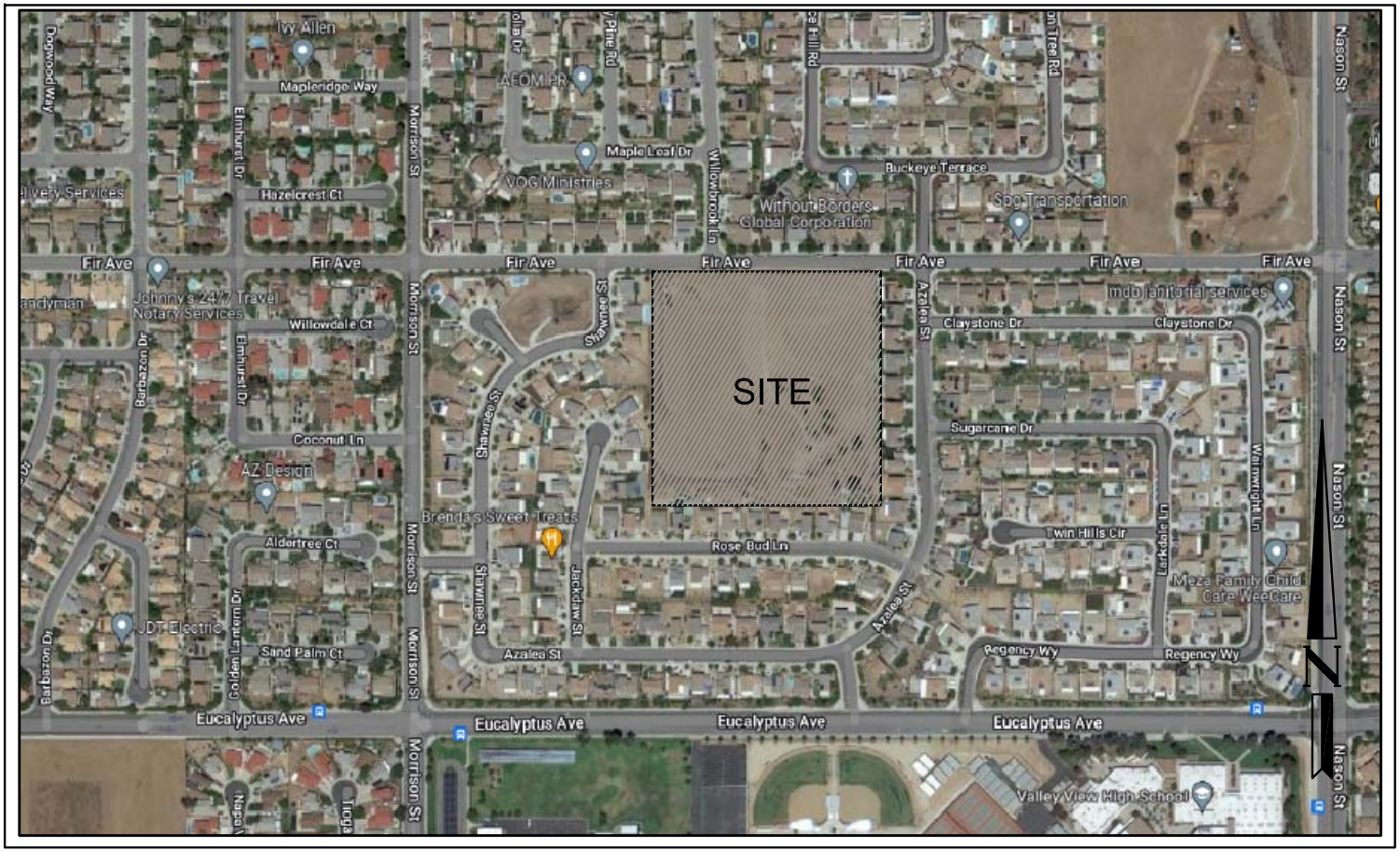
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☒ Y ☐ N

Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

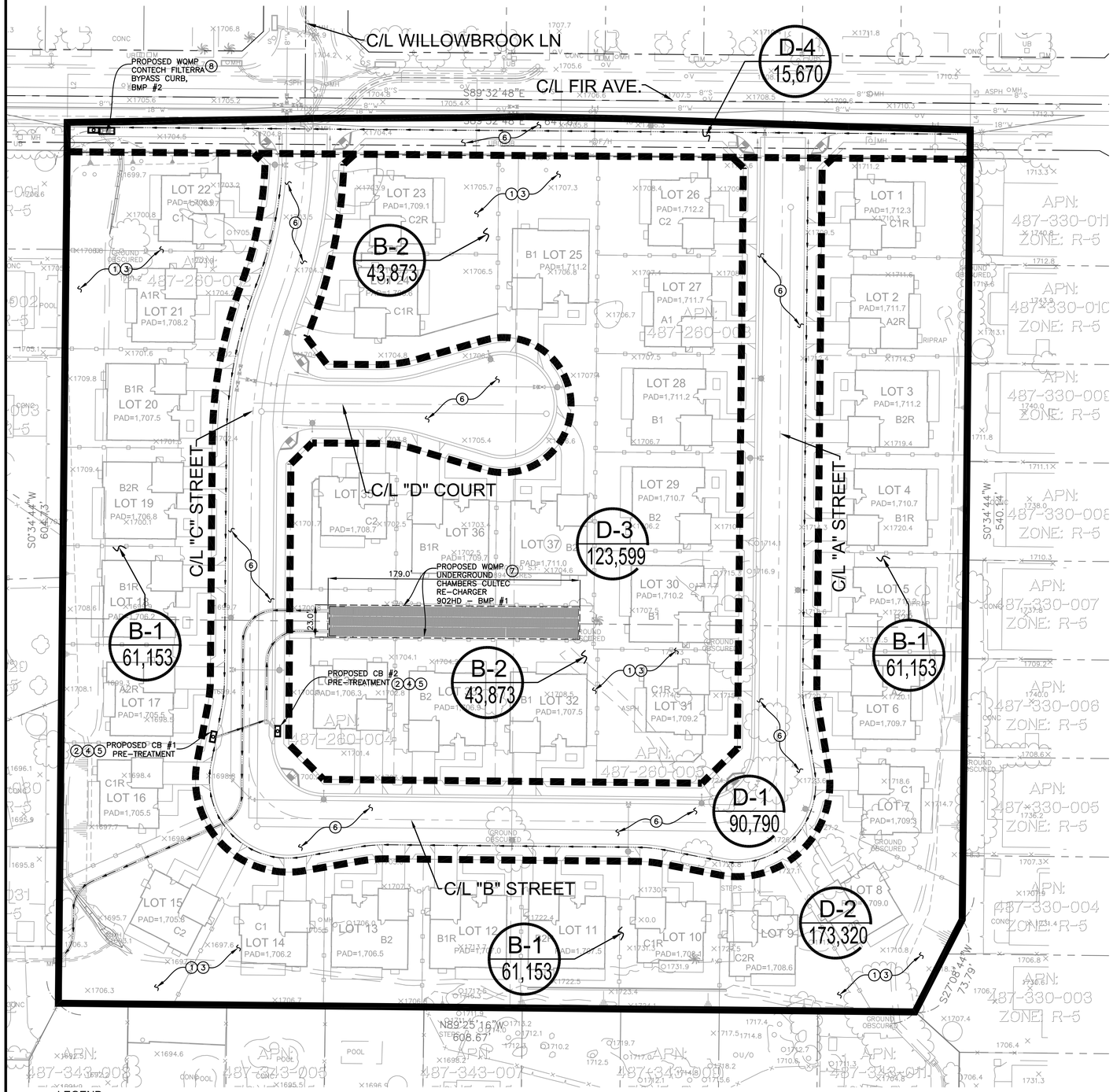
Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



VICINITY MAP

NOT TO SCALE



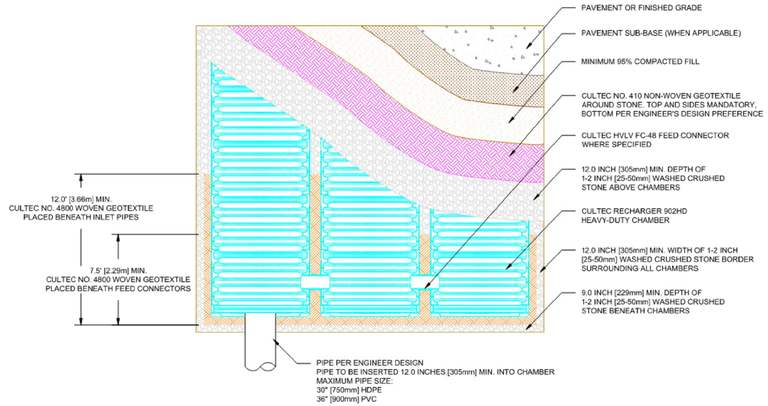
LEGEND

1. SD-12, EFFICIENT IRRIGATION
2. SD-13, STORM DRAIN SIGNAGE
3. SC-73, LANDSCAPE MAINTENANCE
4. SC-74, DRAINAGE SYSTEM MAINTENANCE
5. FLOGARD FILTER INSERT (PRE TREATMENT)
6. SE-7, STREET SWEEPING AND CVACUUMING
7. PROPOSED WQMP UNDERGROUND CHAMBERS CULTEC RE-CHARGER 902HD BMP #1
8. PROPOSED WQMP CONTECH FILTERRA BYAPASS CURB BMP #2

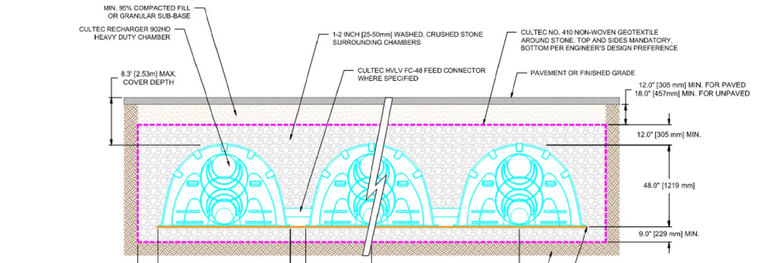
PROJECT BOUNDARY
DRAINAGE BOUNDARY FOR EACH BMP
FLOW LINE

A-2 / 1,190 — DRAINAGE MANAGEMENT AREA NUMBER / DRAINAGE AREA SQUARE FEET

CITY OF MORENO VALLEY
WATER QUALITY MANAGEMENT PLAN
FOR TENTATIVE TRACT MAP 38480



902HD 2.0 — **CULTEC RECHARGER 902HD HEAVY DUTY PLAN VIEW** (6)



NOTES:
1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   1.b. MAXIMUM PERMANENT (50 YEAR) COVER LOAD
   1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3435,20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   3.a THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

902HD 5.0 — **CULTEC RECHARGER 902HD HEAVY DUTY CROSS SECTION** (6)

NOTES:

1. ALL ONSITE DRAINAGE FACILITIES SUCH AS, CATCH BASIN INSERT, STORM DRAIN PIPES, INFILTRATION TRENCH WILL BE OWNED, OPERATED, AND MAINTAINED BY PROPERTY OWNER.

OWNER/DEVELOPER:

KURT YUE / STEVEN HAN
VIGOROUS DEVELOPMENT, LLC
17114 RIDGE PARK DRIVE
HACIENDA HEIGHTS
CA 91745
CELL: 626-679-0825

GRAPHIC SCALE
(IN FEET)
1 inch = 40 ft.

DRAINAGE MANAGEMENT AREAS (DMAs)

DMA NAME / ID	SURFACE TYPE (S)	AREA (SF)	DMA TYPE
D1	PAVEMENT STREET, ASPHALT CONCRETE SIDEWALKS	90,790	AREA DRAIN TO BMP #1
ENTIRE D2	---	173,320	---
B1 [D2 (35%)]	LANDSCAPE	60,662	SELF-RETAINING AREA
D2 (65%)	ROOF, PAVEMENT PARKING, ASPHALT CONCRETE DRIVEWAYS	112,658	AREA DRAIN TO BMP #1
ENTIRE D3	---	123,599	---
B2 [D3 (35%)]	LANDSCAPE	43,260	SELF-RETAINING AREA
D3 (65%)	ROOF, PAVEMENT PARKING, ASPHALT CONCRETE DRIVEWAYS	80,339	AREA DRAIN TO BMP #1
D4	PAVEMENT STREET, ASPHALT CONCRETE SIDEWALKS	15,670	AREA DRAIN TO BMP #2

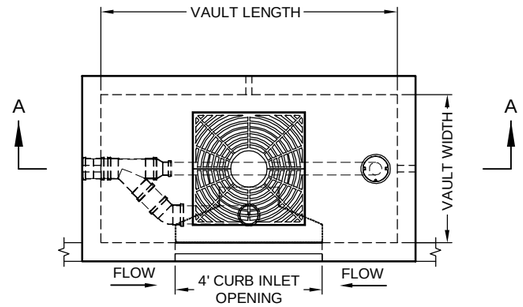
APN: 487-260-002, 003, 004 & 005 PEN22-187

REGISTERED PROFESSIONAL ENGINEER — ME-SONG LIU — No. 66242 — Exp. 06-30-24 — CIVIL — STATE OF CALIFORNIA

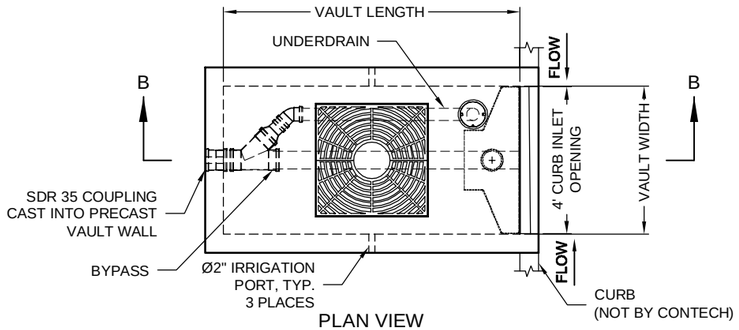
W&W Land Design Consultants, Inc
Civil Engineering • Subdivision • Land Planning
2335 W. FOOTHILL BLVD., SUITE 1, UPLAND, CA 91786
TEL: (909) 608-7118 • FAX: (909) 946-1137

CITY OF MORENO VALLEY
WATER QUALITY MANAGEMENT PLAN
37-LOTS RESIDENTIAL SUBDIVISION DEVELOPMENT
SOUTH SIDE OF FIR AVENUE, MORENO VALLEY, CA

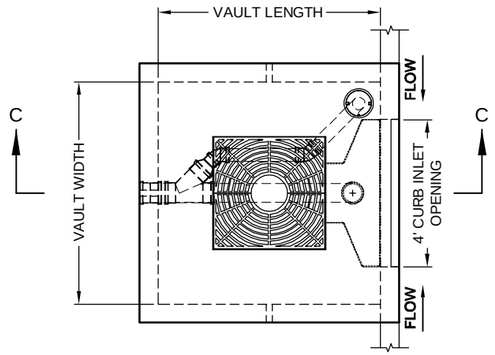
SHEET 7 OF 7



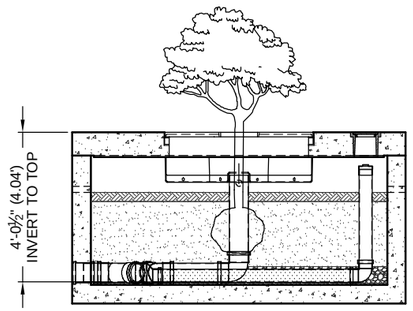
PLAN VIEW



PLAN VIEW

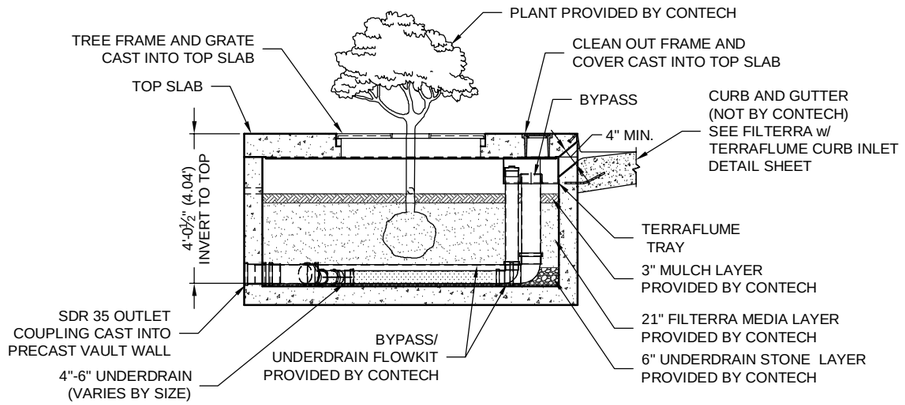


PLAN VIEW



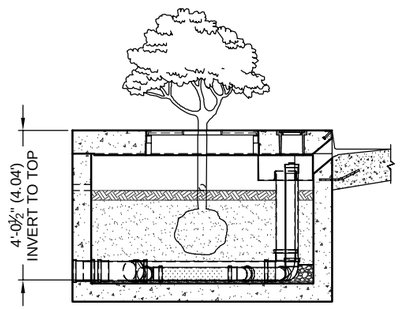
SECTION A-A

LONG SIDE INLET CONFIGURATION



SECTION B-B

SHORT SIDE INLET CONFIGURATION



SECTION C-C

SQUARE INLET CONFIGURATION

LONG SIDE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0604	ALL	6 x 4	6 x 4	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC078045	DE, MD, NJ, PA, VA, WV ONLY	7.83 x 4.5	7.83 x 4.5	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0804	N/A DE, MD, NJ, PA, VA, WV	8 x 4	8 x 4	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0806	ALL	8 x 6	8 x 6	10" SDR 35	2.37	4" SDR 35	(1) 4' x 4'
FTIBC1006	ALL	10 x 6	10 x 6	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
FTIBC1206	ALL	12 x 6	12 x 6	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC1307	ALL	13 x 7	13 x 7	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC1408	ALL	14 x 8	14 x 8	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC1509	OR,WA ONLY	15 x 9	15 x 9	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

SHORT SIDE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0406	ALL	4 x 6	4 x 6	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0408	N/A DE, MD, NJ, PA, VA, WV	4 x 8	4 x 8	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC045078	DE, MD, NJ, PA, VA, WVONLY	4.5 x 7.83	4.5 x 7.83	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0608	ALL	6 x 8	6 x 8	10" SDR 35	2.37	4" SDR 35	(1) 4' x 4'
FTIBC0610	ALL	6 x 10	6 x 10	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
FTIBC0612	ALL	6 x 12	6 x 12	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC0713	ALL	7 x 13	7 x 13	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

SQUARE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0404	ALL	4 x 4	4'-0"	6" SDR 35	1.42	4" SDR 35	(1) 3' x 3'
FTIBC0606	ALL	6 x 6	6'-0"	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'

N/A = NOT AVAILABLE

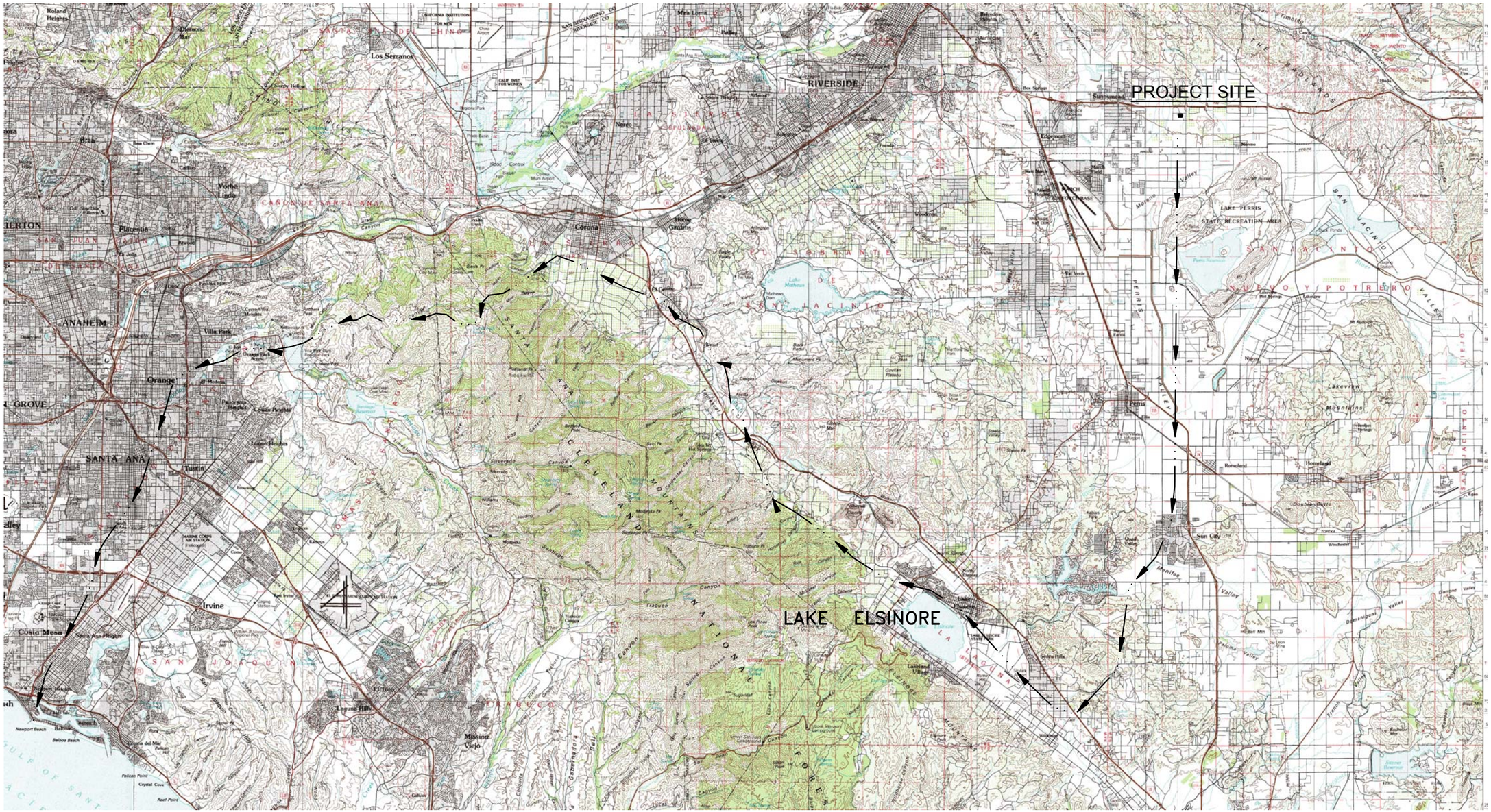
INTERNAL PIPE CONFIGURATION MAY VARY DEPENDING ON VAULT SIZE.

filterra

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 6,277,274; 6,569,321; 7,625,485; 7,425,261; 7,833,412; RELATED FOREIGN PATENTS.

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

FILTERRA
INTERNAL BYPASS CURB (FTIBC)
CONFIGURATION DETAIL



SCALE: 1"=2,000'

RECEIVING WATER MAP

FOR TENTATIVE TRACT MAP 38480

37 LOTS SINGLE FAMILY RESIDENTIAL

LEGEND

THE DRAINAGE PATHWAY

REGISTERED PROFESSIONAL ENGINEER
WEIDONG LIU
No. 66242
Exp. 06-30-24
CIVIL
STATE OF CALIFORNIA

CITY OF MORENO VALLEY
COUNTY OF RIVERSIDE

W&W Land Design Consultants, Inc
Civil Engineering • Subdivision • Land Planning
2335 W. FOOTHILL BLVD., SUITE 1, UPLAND, CA 91786
TEL: (909) 608-7118 • FAX: (909) 946-1137

Appendix 2: Construction Plans

Grading and Drainage Plans

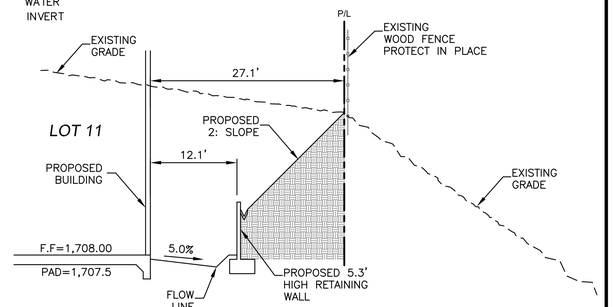
CONCEPTUAL GRADING DRAINAGE PLAN

EARTHWORK QUANTITIES	
RAW CUT	−45,520 CU. YDS.
RAW FILL	+35,580 CU. YDS.
SHRINKAGE (+18%)	+6,400 CU. YDS.
NET EXPORT	−3,540 CU. YDS.

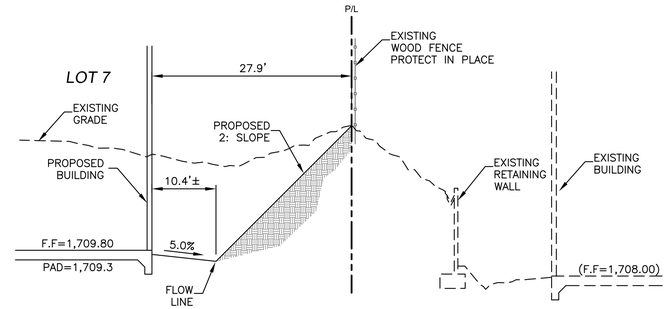
LEGEND:

- PROPERTY BOUNDARY
- LOT LINE
- CENTERLINE
- OFFSITE R/W
- EASEMENT LINE
- STORM DRAIN
- SEWER LINE
- WATER LINE
- EDF — EDGE OF DEEPENED FOOTING
- BTM — BOTTOM
- C/F — CUT FILL TRANSITION LINE
- PROPOSED DRAINAGE PATTERN
- EXISTING DRAINAGE PATTERN
- PROPOSED AC PAVEMENT
- PROPOSED 2:1 SLOPE
- 6' RTWL — INDICATES RETAINING WALL

TC	TOP OF CURB
FL	FLOWLINE
BW	BACK OF WALK
HP	HIGH POINT
PE	PAD ELEVATION
FF	FINISH FLOOR
FS	FINISH SURFACE
GB	GRADE BREAK
BSL	BUILDING SETBACK LINE
FG	PROPOSED FINISH GROUND
NG	EXISTING NATURAL GROUND
TF	TOP OF BLOCK WALL FOOTING
TG	TOP OF GRATE
SW	SEWER
WA	WATER
INV	INVERT



SECTION "A-A"
N.T.S.



SECTION "B-B"
N.T.S.

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

PEN22-187

REGISTERED PROFESSIONAL ENGINEER — WEIDONG LIU — No. 66242 — Exp. 06-30-24 — CIVIL — STATE OF CALIFORNIA

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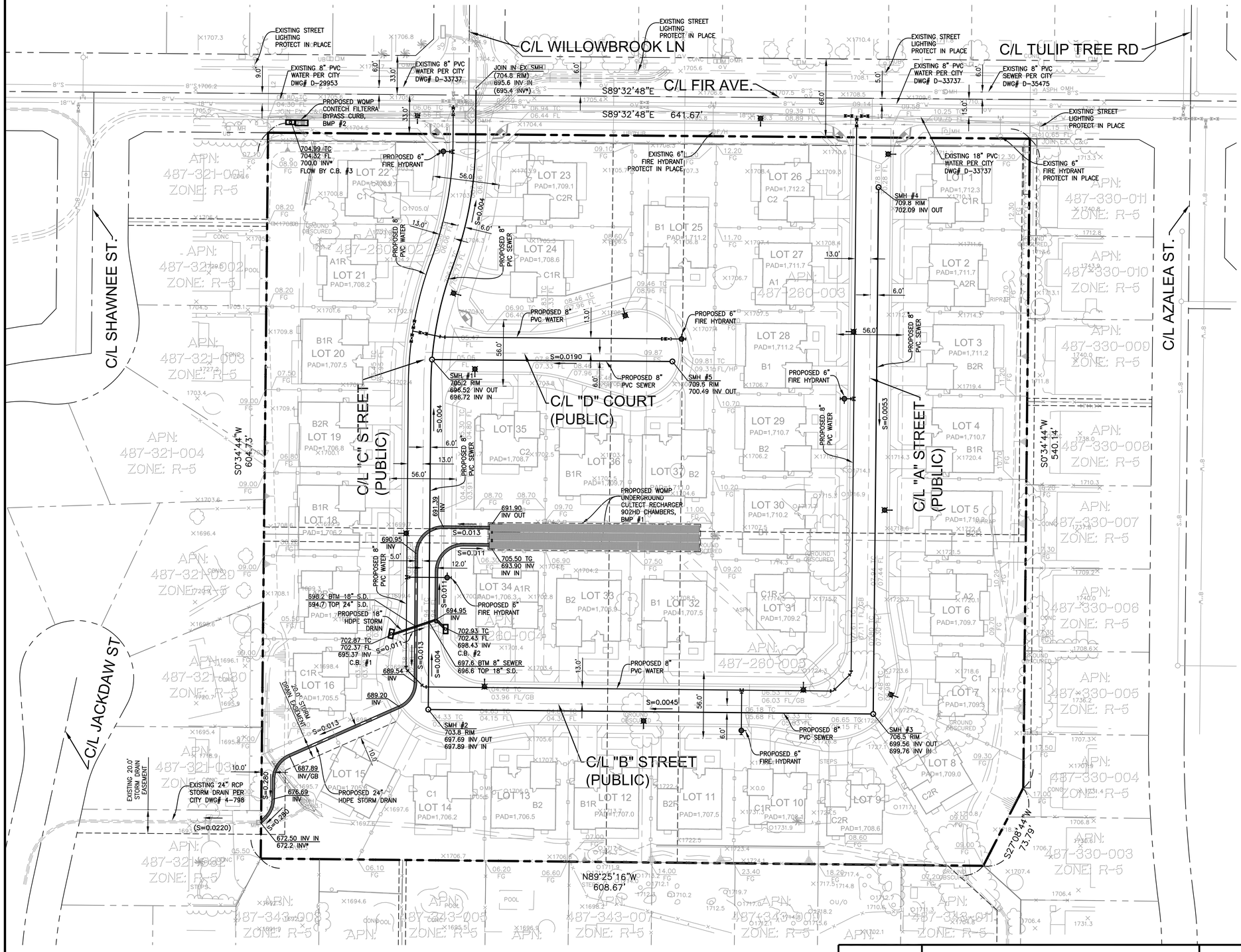
TEL: (909) 608-7118 • FAX: (909) 946-1137

CITY OF MORENO VALLEY

CONCEPTUAL GRADING DRAINAGE PLAN
37-LOTS RESIDENTIAL SUBDIVISION DEVELOPMENT
SOUTH SIDE OF FIR AVENUE, MORENO VALLEY, CA

SHEET 3 OF 7

CONCEPTUAL UTILITY PLAN



LEGEND

- PROPERTY BOUNDARY
- LOT LINE
- CENTERLINE
- OFFSITE R/W
- EASEMENT LINE
- SD — STORM DRAIN
- S — SEWER LINE
- W — WATER LINE
- PROPOSED FIRE HYDRANT
- PROPOSED WATER
- PROPOSED SEWER
- EXISTING FIRE HYDRANT
- WV — WATER VALVE
- PP — POWER POLE
- WM — WATER METER
- PB — PULL-BOX
- CO — SEWER CLEAN-OUT
- EXISTING STREET SIGNAL
- PARKING LIGHT
- IRR. WM — IRRIGATION WATER METER
- DDC — DOUBLE DETECTOR CHECK VAVLE
- SMH — SEWER MANHOLE
- CB — CATCH BASIN
- FDC — FIRE DETECTOR CHECK VAVLE
- PROPSOED STREET LIGHTING (MVLT-400A-2)

UTILITY + SERVICE AGENCIES:

WATER/SEWER
EASTERN MUNICIPAL WATER DISTRICT
(951)928-3777
WEBMASTER@EMWD.ORG

ELECTRIC
MORENO VALLEY UTILITY
14431 FREDERICK ST.,
MORENO VALLEY, CA 92553
(951)413-3500

TELEPHONE
VERIZON TELEPHONE

GAS
SOUTHERN CALIFORNIA GAS
JIM CARSON
FIELD PLANNING ASSOCIATE
25620 JEFFERSON AVE.,
MURRIETA, CA 92562

NOTES

* CONTRACTOR TO VERIFY THE ELEVATIONS OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION AND ADVISE THE DESIGN ENGINEER OF ANY CONFLICTS/VARIANCES

N

GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft.

PEN22-187

REGISTERED PROFESSIONAL ENGINEER — NE DONG LIU — No. 66242 Exp. 06-30-24 — CIVIL — STATE OF CALIFORNIA

W&W Land Design Consultants, Inc
Civil Engineering • Subdivision • Land Planning
2335 W. FOOTHILL BLVD., SUITE 1, UPLAND, CA 91786
TEL: (909) 608-7118 • FAX: (909) 946-1137

CITY OF MORENO VALLEY

CONCEPTUAL UTILITY PLAN
37-LOTS RESIDENTIAL SUBDIVISION DEVELOPMENT
SOUTH SIDE OF FIR AVENUE, MORENO VALLEY, CA

SHEET 4 OF 7

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

soil PACIFIC INC.
Geotechnical and Environmental Services

January 2, 2022
Project No. A-8880-21

TL Group Corp.
1442 Irvine Blvd., Suite 208
Tustin, CA 92780

SUBJECT: Soil and Foundation Evaluation Report
Proposed Residential Building Structures (8.89 Acres/ 40 Unit SFR)
APN 487-260-02/03/04 and 05, Moreno Valley, California

Dear Sir;

Pursuant to your authorization, we are pleased to submit our report for the subject project. Our evaluation was conducted in December 2021. This evaluation consists of field exploration; sub-surface soil sampling; laboratory testing; engineering evaluation and preparation of the following report containing a summary of our conclusions and recommendations.

The opportunity to be of service is appreciated. Should any questions arise pertaining to any portion of this report, please contact this firm in writing for further clarification.

Respectfully submitted,

Soil Pacific, Inc.

Yones Kabir
President

Hoss Eftekhari
RCE

REGISTERED PROFESSIONAL ENGINEER
HOSS EFTEKHARI
No. C50121
EXP. 6/30/23
CIVIL
STATE OF CALIFORNIA

675 N. Eckhoff, Suite A, Orange, CA 92868 ○Tel (714) 879-1203 ○Fax (714) 879-4812

Soil and Foundation Evaluation Report
Proposed Residential Building Structures (8.59 Acres/ 40 Unit SFR)
APN 487-260-02/03/04 and 05, Moreno Valley, California

Prepared For:

TL Group Corp.
1442 Irvine Blvd., Suite 208
Tustin, CA 92780

Prepared by:

SOIL PACIFIC INC.
675 N. ECKHOFF STREET, SUITE A
ORANGE, CALIFORNIA 92868
Tel. (714) 879 1203

January 2, 2022
Project No. A-8880-21

Table of Contents

Soil and Foundation Evaluation Report
Proposed Residential Building Structures (8.89 Acres/ 40 Unit SFR)
APN 487-260-02/03/04 and 05, **Moreno Valley, California**

LIMITATIONS

Between exploratory excavations and/or field testing locations, all subsurface deposits, consequent of their anisotropic and heterogeneous characteristics, can and will vary in many important geotechnical properties. The results presented herein are based on the information in part furnished by others and as generated by this firm, and represent our best interpretation of that data benefiting from a combination of our earthwork related construction experience, as well as our overall geotechnical knowledge. Hence, the conclusions and recommendations expressed herein are our professional opinions about pertinent project geotechnical parameters which influence the understood site use; therefore, no other warranty is offered or implied.

All the findings are subject to field modification as more subsurface exposures become available for evaluations. Before providing bids, contractors shall make thorough explorations and findings. Soil Pacific Inc., is not responsible for any financial gains or losses accrued by persons/firms or third party from this project.

In the event the contents of this report are not clearly understood, due in part to the usage of technical terms or wording, please contact the undersigned in writing for clarification.

SECTION 1.0
PRELIMINARY EVALUATION

1.1 Site Description

The subject site is identified as APN 487-260-02/03/04/05. The item site is within the eastern portion of the City of Moreno Valley, about ½ of a mile south of 60 freeway. It comprise of 8.897 Acres of vacant property, stripped of vegetation and pret for site grading to development. Surrounding parcels are mainly residential properties.

The subject property is located on the south side of Fir Avenue, approximately 1,282 feet west of the intersection of Fir Avenue and Nason Street. The subject property consists of four parcels of land totaling approximately 8.89-acres in size identified by the Riverside County Assessor as Assessor's Parcel Numbers (APNs) 487-260-002, 487-260-003, 487-260-004 and 487-260-005. A road easement runs through the center of the subject property in a north-south direction. No buildings were observed on-site. A concrete- masonry unit (CMU) retaining wall and an asphalt-paved driveway was located the southeastern portion of the subject property, and concrete swales are located along the western, southern, and eastern perimeters of the subject property. The northern perimeter of the subject property along Fir Avenue is bordered by a chain-link fence and locked gate. Site access is through Fir Avenue at the north as depicted on the plot plan A-1-1. The site elevation is about 1715 feet above the main sea level, with a sheet water flow toward the southwest.

1.2 Planned Land Use

It is understood that the proposed construction will consist of a newly designed 50 Unit Townhouse Complex, with associated driveway and parking area..

1.3 Field Exploration

Subsurface conditions were explored by exploring with seven hollow stem auger drill to a maximum depth of 12 feet. Based on this evaluation, the site is underlain by a relatively thin top soils mantel above the native sandy alluvial materials.

The top soils were, wet to damp at the time of sub-surafce exploration. Underlying soils are moderately dense in place. Earth materials underlying thin topsoils within the exploratory borings were granitic bedrock fragment and boulders. Encountered soils were classified and logged by the field engineer in accordance with the visual-manual procedures of the Unified Soil Classification System (USCS), ASTM Test Standard D2488. Following our exploration, borings were loosely backfilled with the soil cuttings. The approximate locations of the exploratory borings are shown on the Exploration Location Map Figure A-1-1. Descriptive boring logs are presented in Appendix A.

1.4 Laboratory Testing

1.4.1. Classification

Soils were classified visually according to the Unified Soil Classification System. Moisture content and dry density determinations were made for the samples taken at various depths in the exploratory excavations. Results of moisture-density and dry-density determinations, together with classifications, are shown on the boring logs, Appendix A.

1.4.2 Expansion

Encountered materials at the site (2-4 feet below grade) were mainly sandy and granular soils with trace of some silt. Soil expansion potential for the encountered sub-surficial materials to the explored depth is unlikely.

1.4.3 Direct Shear

Shear strength parameters are determined by means of strain-controlled, double plain, direct shear tests performed in general accordance with ASTM D-3080. Generally, three or more specimens are tested, each under a different normal load, to determine the effects upon shear resistance and displacement, and strength properties such as Mohr strength envelopes. The direct shear test is suited to the relatively rapid determination of consolidated drained strength properties because the drainage paths through the test specimen are short, thereby allowing excess pore pressure to be dissipated more rapidly than with other drained stress tests. The rate of deformation is determined from the time required for the specimen to achieve fifty percent consolidation at given normal stress. The test can be made on all soil materials and undisturbed, remolded or compacted materials. There is, however, a limitation on maximum particle size. Sample displacement during testing may range from 10 to 20 percent of the specimen's original diameter or length.

The sample's initial void ratio, water content, dry unit weight, the degree of saturation based on the specific gravity, and mass of the total specimen may also be computed. The shear test results are plotted on the attached shear test diagrams and unless otherwise noted on the shear test diagram, all tests are performed on undisturbed, saturated samples.

Address:	26681 FIR AVE
APN	487260004
City	MORENO VALLEY
Address	26681 FIR AVE
Fault Zone	This parcel is NOT WITHIN an Earthquake Fault Zone.
Liquefaction Zone	This parcel has NOT been EVALUATED by CGS for liquefaction hazards.

Source; Loma Linda University, City of Moreno Valley, County of Riverside, San Bernardino County, Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA

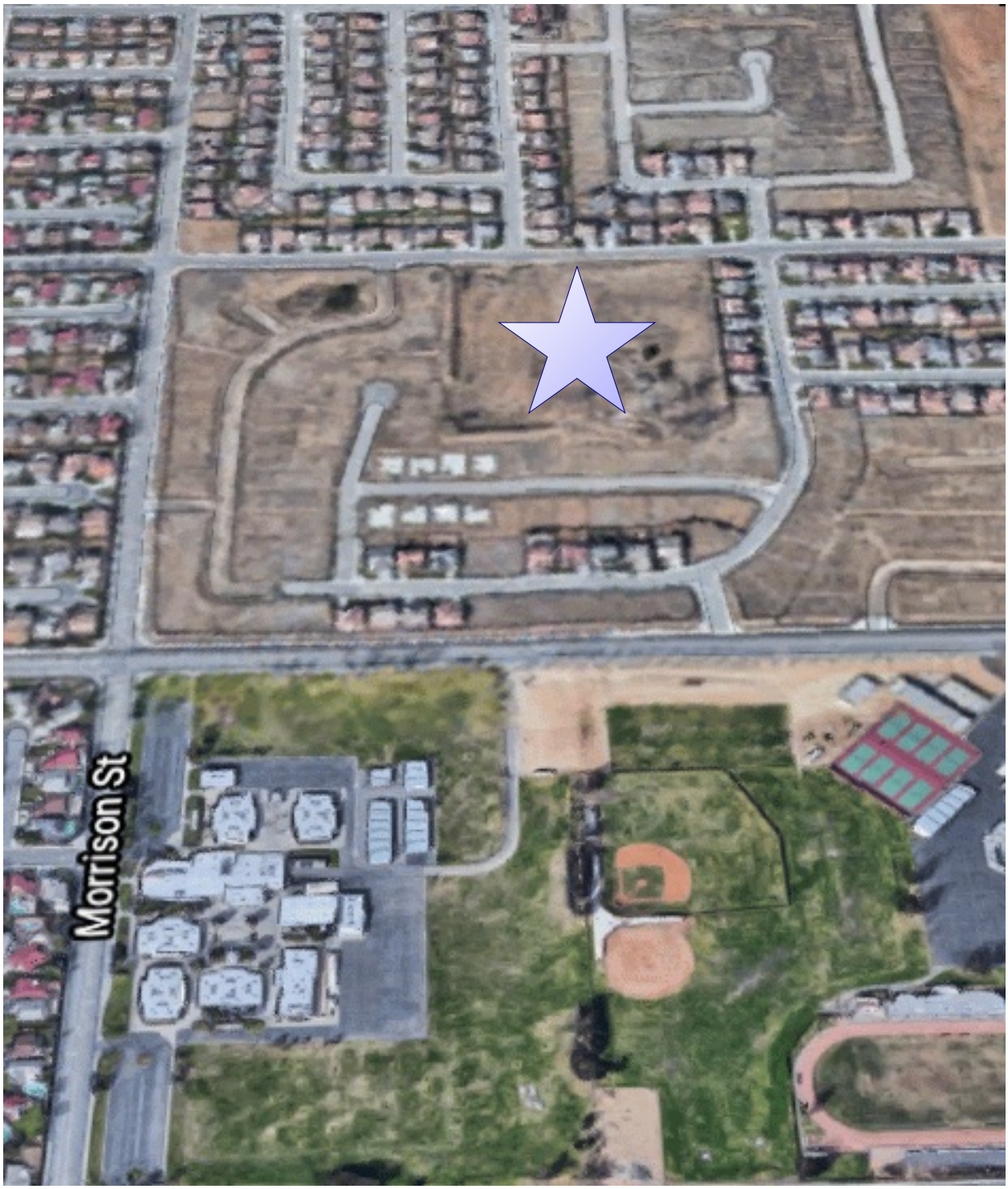


Figure 1: Site Aerial Photo.

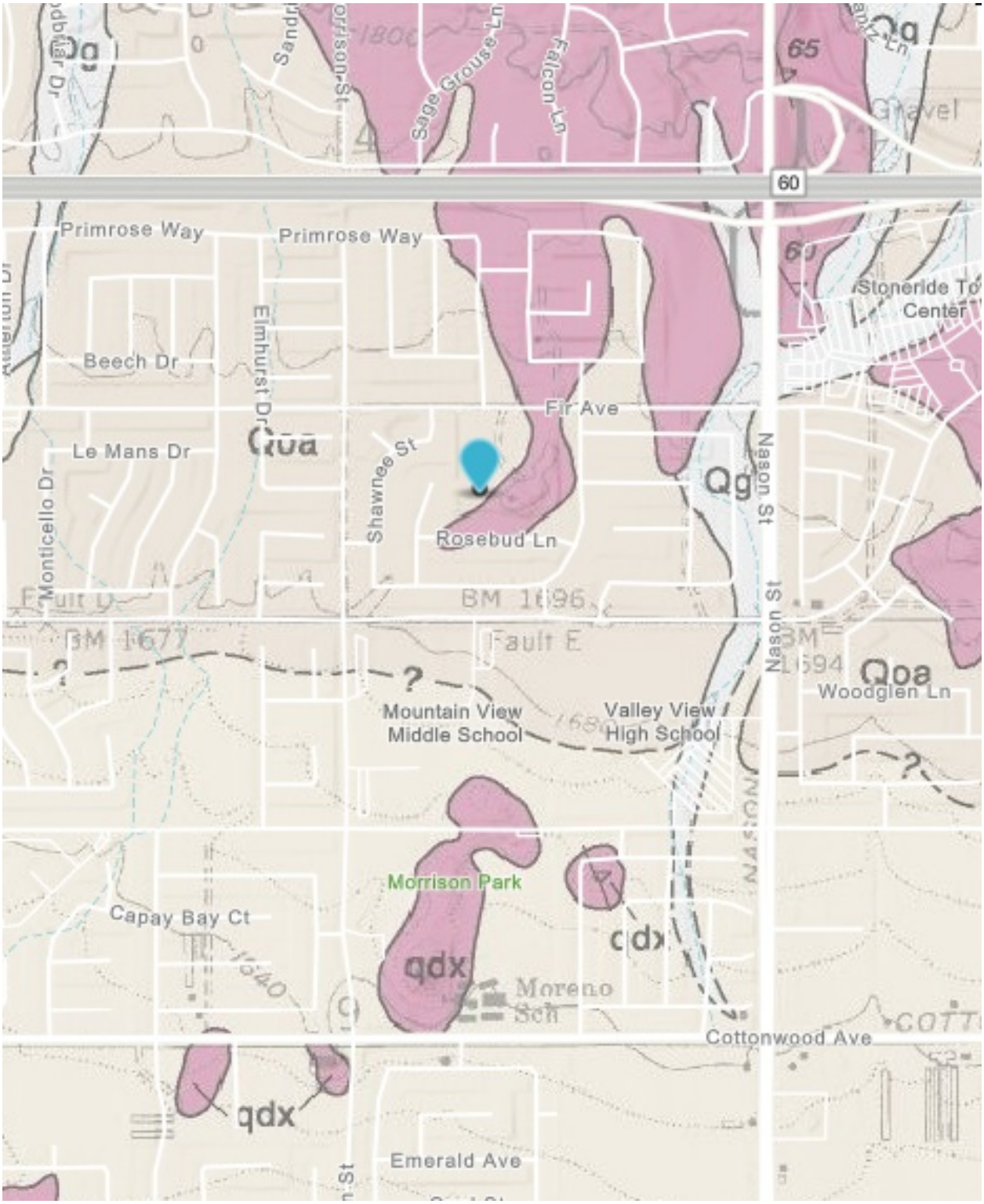


Figure 2: Site topographic and geologic map (USGS/AASG).

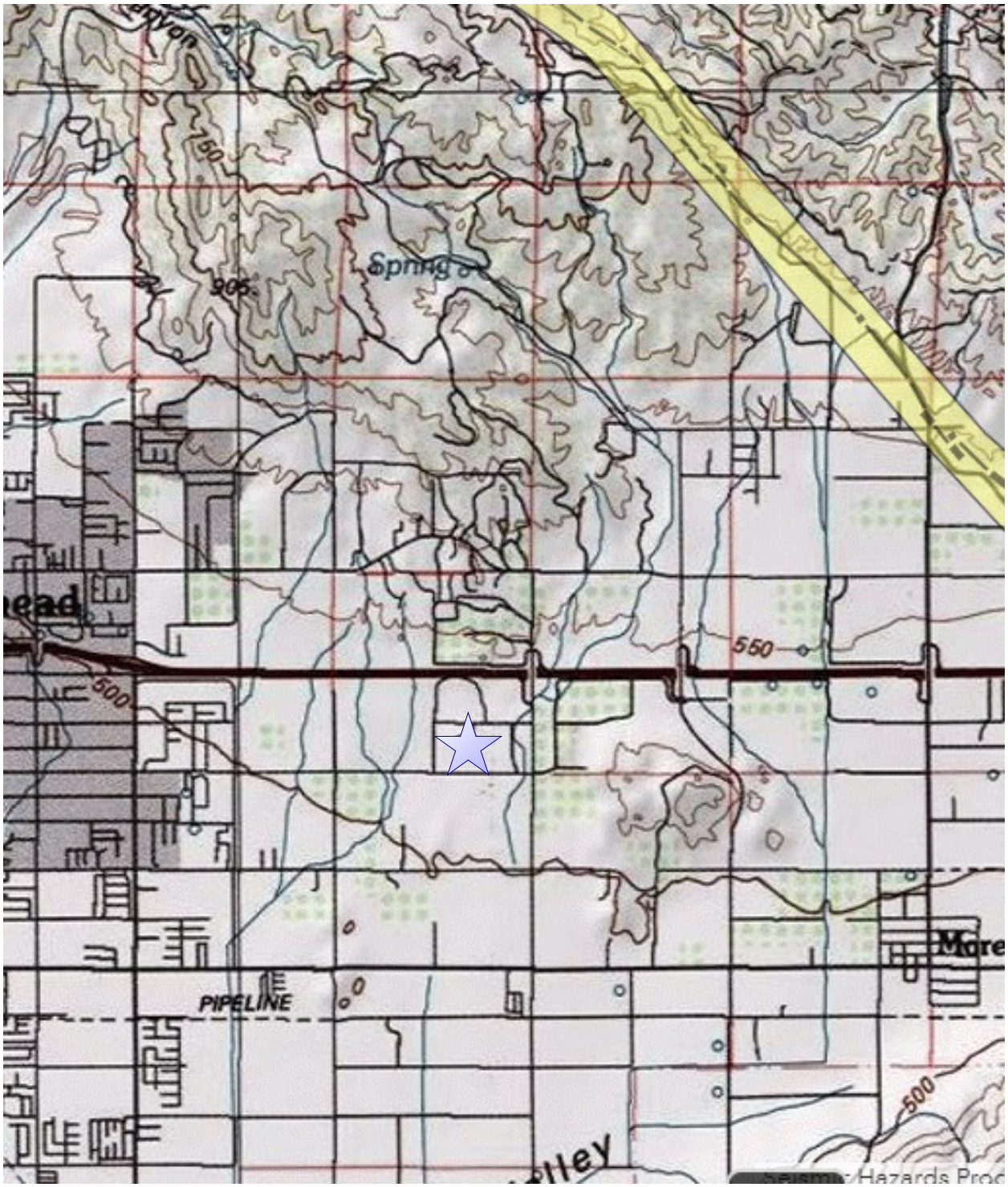


Figure 3: Site Topograhphic Map. Source: CGS

Section 2.0
Conclusions

The proposed construction is considered feasible from a soils engineering standpoint. All earthwork should be performed in accordance with applicable engineering recommendations presented herein or applicable Agency Codes, whichever are the most stringent.

2. 1 Earth Materials

The project site is located in the northern part of the Peninsular Ranges Province and is underlain by Cretaceous and older basement rocks. This part of the Peninsular Ranges Province is divided into the Perris block, located west of the San Jacinto fault and the San Jacinto Mountains block to the east. On the northern side of the San Jacinto fault zone is a thick section of Pliocene and Pleistocene continental sedimentary rocks, the upper part of the San Timoteo beds of Frick(1921). The area underlain by these rocks is termed the San Timoteo Badlands. Most of these beds consist of coarse-grained sandstone, conglomeratic sandstone, and conglomerate.

The subject site is located within older alluvial fan deposits driven from local terrains and plutonic rocks erosion. Geologic Map of the Sunnymead/ South ½ of Redlands Quadrangles, Thomas Debblee 2003.

Fill/ Topsoils

Fill/top soil mantel is relatively thin (1-2 feet). Top soils consists of light gray silty sand with some organic materials. These materials were wet to damp and relatively loose. Underlaying native materials are mainly fine sand with some clay and silty matrix and coarse grained sand at the a deeper elevation.

Native Materials (Qoa)

The Native sandy soils (“Qoa”Old Alluvial Fan silty sand and gravel deposits) were encountered at surficial elevation. Native soils were dense and firm in place.

2.2 Foundations

Proposed building complex footings will be placed and embedded into dense engineered fill that will be placed accordingly. Please refer to section 3.0.

2.3 Bearing Materials

All foundation shall be embedded into a similar materials as recommended. The subject parcel site will be overexcavated and graded for preparation and engineered fill that will support the proposed structures.

2.4 Groundwater

The site is located within a marginal distance of San Jacinto Groundwater basin (California Department of Water Resources, [CDWR], 2018). Groundwater depth and flow direction beneath the subject site can varies within the area is toward the south. Groundwater during our subsurface exploration program was not encountered.

2.5 CBC Seismic Design Parameters

Earthquake loads on earthen structures and buildings are a function of ground acceleration, which may be determined from the site-specific acceleration response spectrum. To provide the design team with the parameters necessary to construct the site-specific acceleration response spectrum for this project, we used computer application that is available on the United States Geological Survey (USGS) website, https://earthquake.usgs.gov/ws/designmaps/ or https://asce7hazardtool.online.

Based on our review of pertinent USGS maps, San Jacinto active fault is located within 2.5 miles north, northeast of the site. Southern California is seismically active with numerous faults capable of causing ground shaking at the site. The general location of active and potentially active faults within the southern California region can generate ground shaking at the site.

2.6 Chemical Contents

Chemical testing for detection of hydrocarbon or other potential contamination is beyond the scope of this report.

2.7 Liquefaction Study/ Secondary Seismic Hazard Zonation

Based on site investigation, encountered materials at the site are mainly composed of sand and gravel from fist size to boulders, the subject site does not have a potential for Liquefaction susceptibility.

Liquefaction occurs when seismically-induced dynamic loading of a saturated sand or silt causes pore water pressures to increase to levels where grain-to-grain contact pressure is significantly decreased and the soil material temporarily behaves as a viscous fluid. Liquefaction can cause settlement of the ground surface, settlement and tilting of engineered structures, flotation of buoyant buried structures and fissuring of the ground surface. A common manifestation of liquefaction is the formation of sand boils (short-lived fountains of soil and water emerges from fissures or vents and leave freshly deposited conical mounds of sand or silt on the ground surface).

Since the site has an average elevation of approximately 1715 feet above sea level, and since it does not lie in close proximity to an enclosed body of water, the probability of flooding from a tsunami or seiche is considered to be low. In addition, the site is not located within a designated tsunami inundation area.

Section 3.0
Recommendations

Based on our exploration and experience with similar projects, the proposed construction is considered feasible from a soils engineering standpoint providing the following recommendations are made a part of the plans and are implemented during construction.

3.1 Site Preparation and Excavations

If any unanticipated subsurface improvements (pipe lines, irrigation lines, etc.) are encountered during earthwork construction, this office should be informed and appropriate remedial recommendations would subsequently be provided.

3.2 Clearing and Site Preparation

Site grading is planned and will be performed. During this phase of construction any unanticipated subsurface excavation should be in accordance with the City of Moreno Valley or County of Riverside requirements. During earthwork construction, all remedial removals, and the general grading and construction procedures of the contractor should be observed, and the fill selectively tested by a representative of this office. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and if warranted, additional recommendations will be offered.

The following recommendations will be used in preparation of the grading plan.

1. The areas to receive compacted fill should be stripped of all vegetation, construction debris and trashes, non engineered fill, left in place incompetent material up to approved soils. If soft spots are encountered, a project soil engineer will evaluate the site conditions and will provide necessary recommendations.

2. The exposed grade should then be overexcavated to an approved competent soils depth estimated to be in order of 4 feet depth. The excavated area should be scarified to a minimum of 8 inches, adjusted to optimum moisture content, and reworked to achieve a minimum of 90 percent relative compaction.

3. Compacted fill should extend at least 5 feet beyond all perimeter footings or to a distance equal to the depth of the certified compacted fill, whichever is the greatest and feasible.

4. Compacted fill, consisting of on-site soil shall be placed in lifts not exceeding 6 inches in uncompacted thickness. The excavated onsite materials are considered satisfactory for reuse in the fill if the moisture content is near optimum. All organic material and construction debris should be removed and shall be segregated. Any imported fill should be observed, tested, and approved by the soils engineer prior to use as fill. Rocks larger than 6 inches in diameter should not be used in the fill.

5. The fill should be compacted to at least 90 percent of the maximum dry density for the material. The maximum density should be determined by ASTM Test Designation D 1557-00.

6. Field observation and compaction testing during the grading should be performed by a representative of Soil Pacific Inc. to assist the contractor in obtaining the required degree of compaction and the proper moisture content. Where compaction is less than required, additional compaction effort should be made with adjustment of the moisture content, as necessary, until a minimum of 90 percent relative compaction is obtained. The contractor is encouraged to survey the adjacent building wall and note any existing distress on the walls or building if there are any. In such case, the contractor must note the observed distress and notify the owner or occupant of adjacent buildings' owner/s in writing.

3.3 Stability of Temporary Cuts

The stability of temporary cuts required during removal process depends on many factors, including the slope angle, closeness of the adjacent building foundation or public property traffic, the shearing strength of the underlying materials, and the height of the cut and the length of time the excavation remains open and exposed to equipment vibrations and rainfall. The geotechnical consultant should be present to observe all temporary excavations at the site. The possibility of temporary excavations failing may be minimized by:

1) keeping the time between cutting and filling operations to a minimum;
2) limiting excavation length exposed at any one time; and,
3) shoring prior to cut.

3.4 Foundations

Considering the site specific condition, the following recommendations may be used in preparation of the design and construction of the foundation system.

3.4.1 Bearing Value

Allowable bearing value is 2500 psf. The bearing value may be increased by 1/3 when considering short duration seismic or wind loads.

An allowable frictional resistance of 0.35 may be used for design of concrete foundations poured on approved materials. When frictional and passive resistance are combined to compute the total lateral resistance, no reduction is needed to any of these two components.

3.4.2 Foundation Settlement

Based upon anticipated structural loads, the maximum total settlement for the proposed

foundation is not expected to exceed 1 inch at design load. Differential settlement between adjacent footings and lateral displacement of lateral resisting elements should not exceed 1/2 inch.

3.4.3 Concrete Type

In absence of soluble sulfate test and based on our experience within the property close to the shore only concrete Type V will be used in planning and construction.

3.4.4 Slabs-on-grade

If slabs-on-grade is desired to design then it should be a minimum of 5 inches in nominal thickness. Slab areas that are to be carpeted or tiled, or where the intrusion of moisture is objectionable, should be underlain by a moisture barrier consisting of 15-mil Visqueen, properly protected from the puncture by four inches of gravel per Calgreen requirements. The slab should be reinforced by rebars no. 3 at 18 inches on center and shall be tied to the foundation.

3.5 Utility Trench Backfill

Utility trenches backfill should be placed in accordance with Appendix D. It is the owners' and contractors' responsibility to inform subcontractors of these requirements and to notify Soil Pacific when backfill placement is to begin.

3.6 Seismic Design and Construction

Construction should be in conformance with seismic design parameters of the latest edition of California Building Code (C.B.C.) Please refer to the following table for related seismic design parameters.

SS (0.2 sec)	S1 (1.0 sec)	Soil Site Class	SDS (0.2 sec)	SD1 (1.0 sec)	PGAm	Seismic Design Cat
2.27	.81	D	1.59	1.43	.83	II

3.7 Retaining Wall Design Recommendations

If a conventional retaining wall is planned to envelop and cover the proposed decking cavity around the planned decking, then the following design criteria may be used.

1) The braced wall should be designed using at-rest pressure condition. The minimum equivalent fluid pressure, for lateral soil loads, of 40 pounds per cubic foot may be used for design for onsite non expansive granular soils conditions and level backfill (10:1 to 4:1 or less).

2) An allowable soil bearing pressure of 2000 lbs. per square foot may be used in design for footings embedded to approved native soils.

3) A friction coefficient of .35 between concrete and natural or compacted soil and a passive bearing value of 360 lbs. per square foot per foot of depth, up to a maximum of 1000 pounds per square foot at the bottom excavation level may be employed to resist lateral loads. Any wall exceeding 6 feet height should be designed against static and seismic loads.

3.8 Concrete Driveway

1. The subgrade soils for all flatwork should be checked to have a minimum moisture content of 2 percentage points above the optimum moisture content to a depth of at least 18 inches.

2. Local irrigation and drainage should be diverted from all flatwork areas. Area drains and swales should be utilized to reduce the amount of subsurface water intrusion beneath the foundation and flatwork areas.

3. The concrete flatwork should have enough cold joints to prevent cracking. A minimum of rebar no. 4 placed at 18 inches on center must be used.

4. Surface and shrinkage cracking of the finished slab may be significantly reduced if a low slump and water-cement ratio are maintained during concrete placement. Excessive water added to concrete prior to placement is likely to cause shrinkage cracking.

5. Construction joints and saw cuts should be designed and implemented by the concrete contractor or design engineer based on the medium expansive soil conditions. Maximum joint spacing should not exceed 8 feet in any direction.

6. Patio or driveway subgrade soil should be compacted to a minimum of 90 percent to a depth of 18 inches. All run-off should be gathered in gutters and conducted off-site in a non-erosive manner. Planters located adjacent to footings should be sealed, and leach water intercepted.

3.9 Patio Slabs and Hardscape

It may be desirable to support new patio slabs and hardscape (patios, steps, walkways, etc.) on the existing surficial soils. These structures are not normally subject to building code requirements for structural support. In order to reduce the potential for distress due to potential settlement, it may be desirable to provide additional subgrade preparation and additional steel and concrete thickness for the proposed patio slabs and hardscape at the site. We recommend that patio slabs and hardscape be reinforced with a minimum of No.4 rebar spaced a maximum distance of 16 inches on center, each way. The upper 18 inches of existing surficial soils (depending on field conditions) to be used for slab support should be removed and recompacted to 90% of the maximum dry density as determined

by ASTM:D-1557. It should be noted that patio slabs/hardscape constructed to the preceding specification may be subject to distress over time. Periodic maintenance or replacement may be necessary.

3.10 Pavement Section Design

On site soil are mainly sandy materials. The parking and drive way areas must be included within proposed R&R areas and overexcavated /recompacted as directed on the Section 3.0 of this report. Pavement section design for the light traffic will be 4 inches of asphalt over 6 inches of Aggregate Base Class II property compacted to a minimum of 95% relative compaction. The driveway supporting the heavy trucks such as trash bins and fire engin will be paved by 5 inches of asphalt over 6 inches of aggregate class II.

3.11 Excavation

Calosha requires that any excavation exceeding 4 feet in vertical cut require shoring or 1:1 trim above the 4 feet vertical cut.

All temporary excavations shall conform to the requirements of CAL-OSHA (Title 8, Division 1, Subchapter 4, Article 6 “Excavations” Sections 1539 to 1547) as well as all specific worker safety requirements as enforced by the local Building Authority. Proposed excavation will require adequate shoring, and maintain drained in an appropriate manner to prevent the continual accumulation of water. All vertical cuts shall be inspected by this office, to verify geologic continuity.

3.12 On-site Infiltration

Based on our single wall infiltration testing using (Aka Inverse Borehole Method), on-site infiltration is feasible. On-site infiltration should be designed using an average rate of 4 inches per hour . The infiltration basin should be place within a minimum of 10 feet setback from any foundation, adjacent property, and or public ways.

3.13 Shrinkage and Subsidence

Volumetric changes in earth quantities will occur when excavated onsite soil materials are replaced as properly compacted fill. We estimate the existing surficial soils may shrink approximately 0% to 5% when removed and replaced as compacted fill. Subsidence due to the processing of excavations exposing competent deposits is anticipated to be negligible. 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. The project Civil Engineer should consider that the upper two feet shrinkage will be much higher than 5%, while the rate of shrinkage by depth will be lesser.

3.14 Observation and Testing

All grading and earthwork including trench backfill should be performed under the observation and testing of the consulting engineer for proper sub-grade preparation, selection of satisfactory materials, placement and compaction of all structural fill. Sufficient notification prior to stripping and earthwork construction is essential in order that the work will be adequately observed and tested.

Prior to initiation of grading, a meeting should be arranged by the developer and should be attended by representatives of the governmental agencies, contractors, consultants and the developer. Construction should be inspected at the following stages by the Geotechnical Consultant.

It is recommended that representative of **Soil Pacific, Inc.** be present to observe and test during the following stages of construction:

❒ Site grading to confirm proper removal of unsuitable materials and to observe and test the placement of fill.

❒ Inspection of all foundation excavations prior to placement of steel or concrete.

❒ During the placement of retaining wall subdrain and backfill materials.

❒ Inspection of all slab-on-grade areas prior to placement of sand, Visqueen.

❒ After trenches have been properly backfilled and compacted.

❒ When any unusual conditions are encountered.

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   b. USGS. Earthquakes in Southern California
   c. NavigateLA ;
   d. SCEDC.

APPENDIX A

Field Exploration

Log of Sub-surface Exploration

Boring B-1

Std. Pen	Drive Wt:	USCS Letter	Equipment Type: Sh-2800		Boring # B-1
Bulk/Bag	Drop:	Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	C/S	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		

Elev. (feet)	Moisture	Dry Reading		Description of Earth Materials
	8.1.2	112.3	SM / SP	Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense
5	5.5	114.2		Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.
	4.0	114.6	SW	Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.
10				
15				
20				End of subsurface exploration 12 feet.
25				
30				
35				
40				

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

Report Date:

Figure:

Log of Sub-surface Exploration

Boring B-2

Std. Pen	Drive Wt: Drop:	USCS Letter	Equipment Type: Sh-2800		Boring # B-2
Bulk/Bag		Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	C/S	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		

Elev. (feet)	Moisture	Dry Reading		Description of Earth Materials
0	6.4	113.0	SM	Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense
0	4.2	115.0	SP	
5	2.8.	118.0		Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.
10			SW	Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.
20				End of subsurface exploration 12 feet.

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

Report Date:

Figure:

Log of Sub-surface Exploration

Boring B-3

Std. Pen	Drive Wt:	USCS Letter	Equipment Type: Sh-2800		Boring # B-3
Bulk/Bag	Drop:	Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	C/S	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		

Elev. (feet)	Moisture	Dry Reading		Description of Earth Materials
0	6.4	113.0	SM	Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense
5			SP	Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.
	3.3	115.0	SW	Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.
10				
15				
20				End of subsurface exploration 12 feet.
25				
30				
35				
40				

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

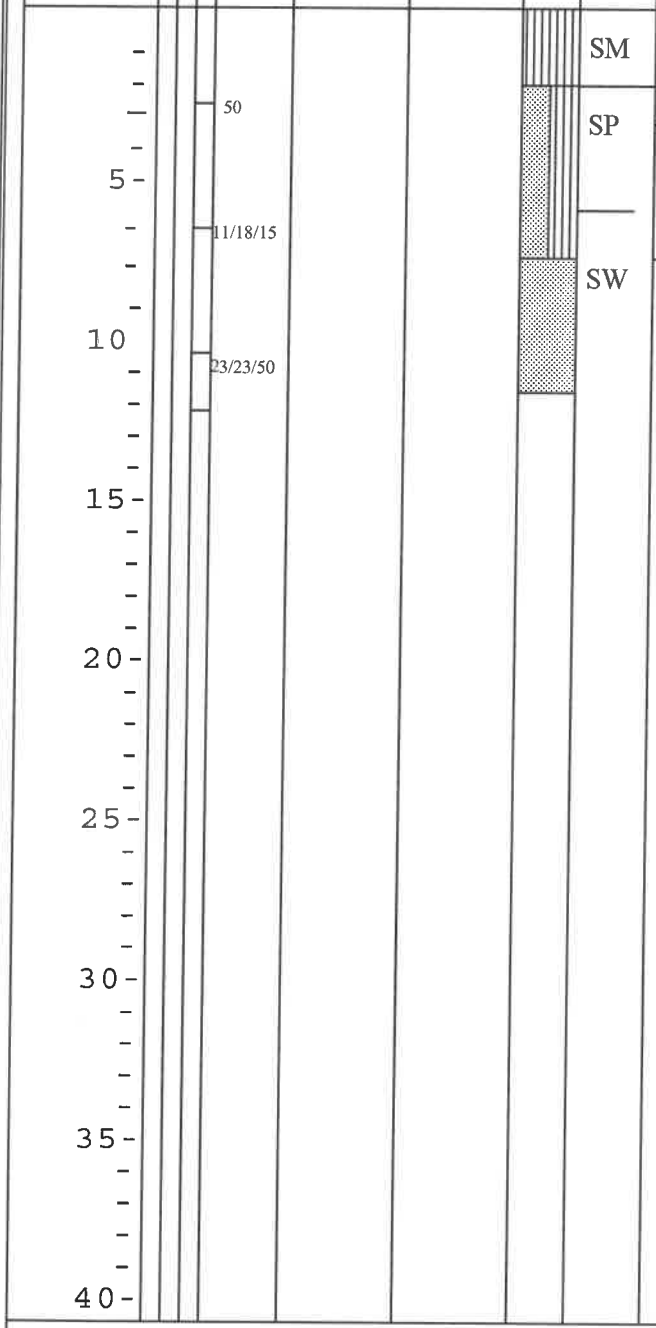
Report Date:

Figure:

Log of Sub-surface Exploration

Boring B-4

Std. Pen	Drive Wt:	USCS Letter	Equipment Type: Sh-2800		Boring # B-4
Bulk/Bag	Drop:	Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	C/S	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		



SM — Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense

SP — Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.

SW — Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.

End of subsurface exploration 12 feet.

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

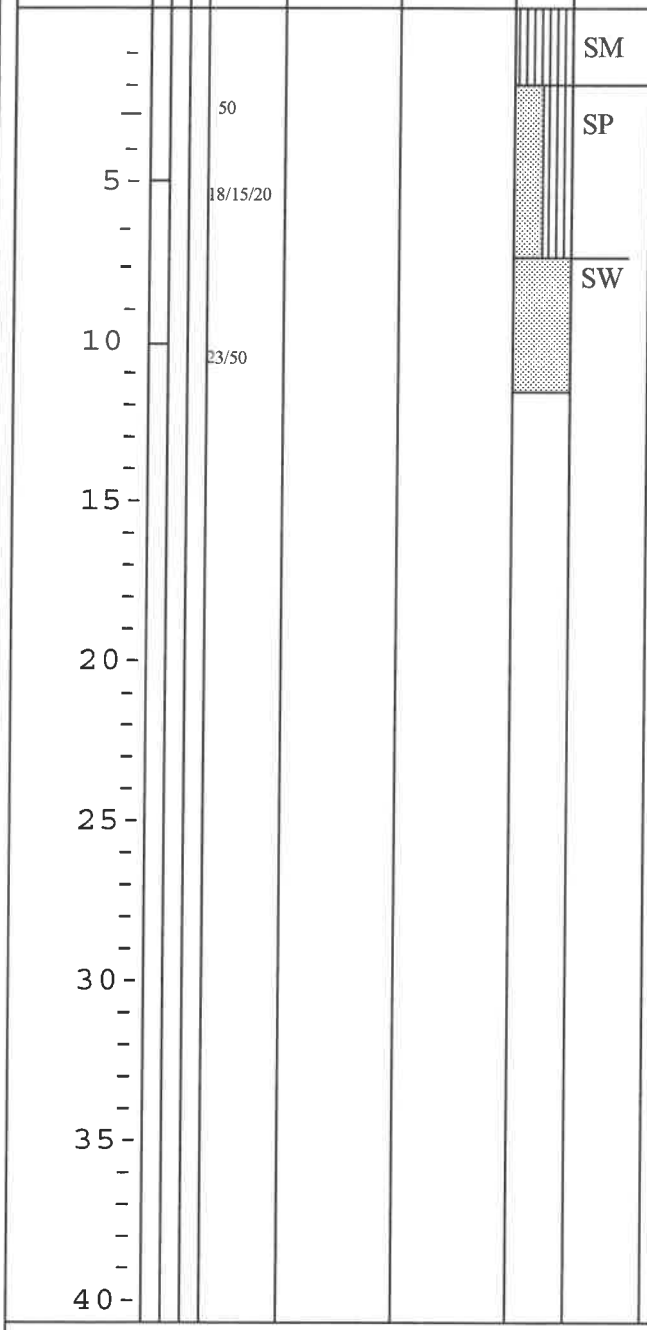
Report Date:

Figure:

Log of Sub-surface Exploration

Boring B-5

Std. Pen	Drive Wt:	USCS Letter	Equipment Type: Sh-2800		Boring # B-5
Bulk/Bag	Drop:	Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	C/S	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		



Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense

Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.

Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.

End of subsurface exploration 12 feet.

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

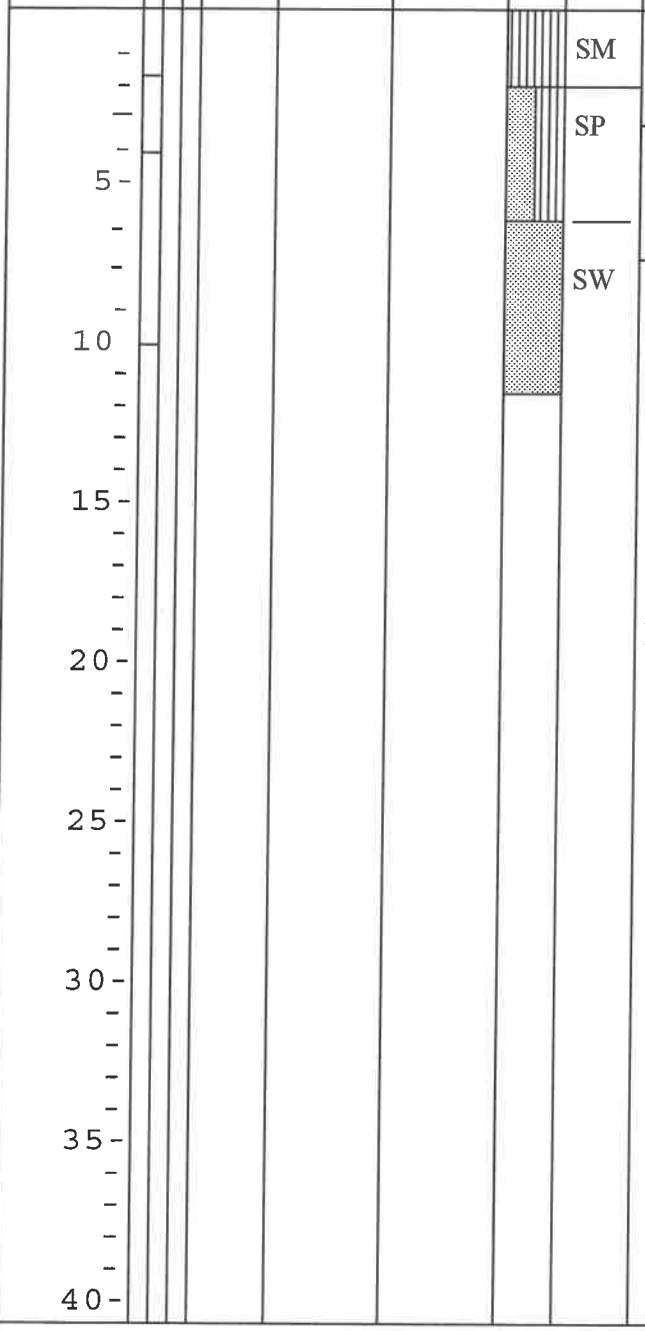
Report Date:

Figure:

Log of Sub-surface Exploration

Boring B-6

Std. Pen	Drive Wt:	USCS Letter	Equipment Type: Sh-2800		Boring # B-6
Bulk/Bag	Drop:	Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	C/S	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		



SM — Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense

SP — Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.

SW — Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.

End of subsurface exploration 12 feet.

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

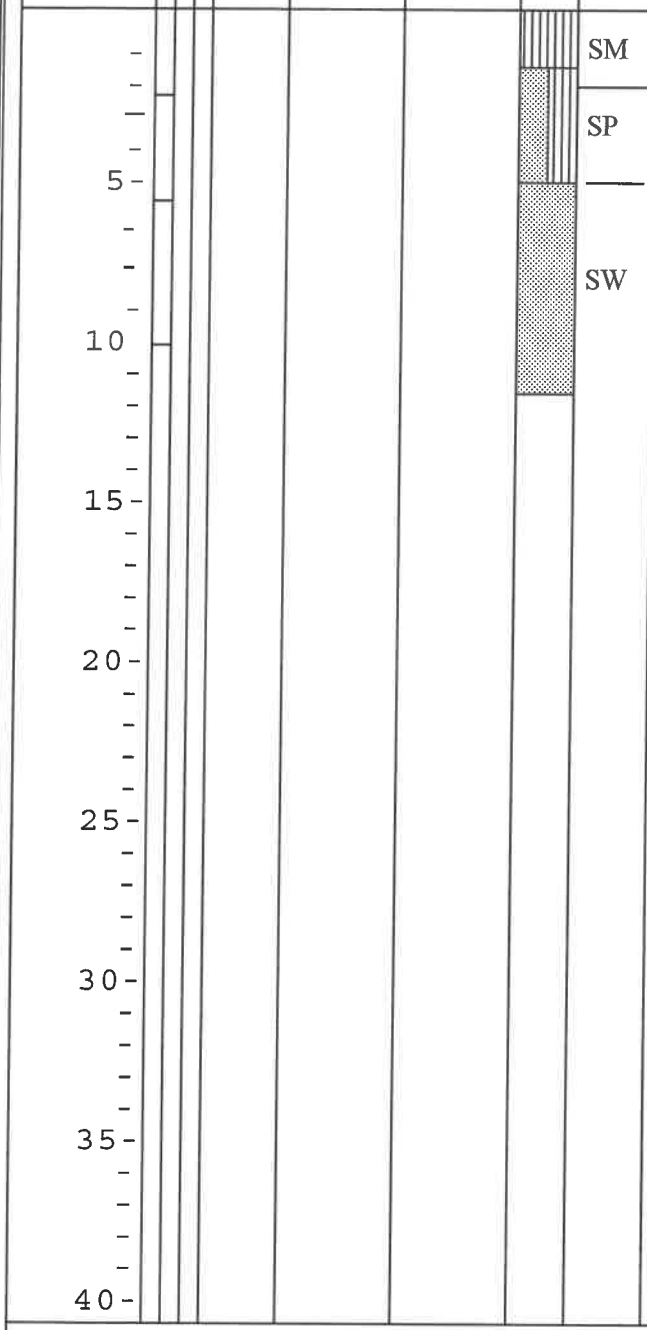
Report Date:

Figure:

Log of Sub-surface Exploration

Boring B-7

Std. Pen	Drive Wt:	USCS Letter	Equipment Type: Sh-2800		Boring # B-7
Bulk/Bag	Drop:	Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	C/S	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		



Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense

Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.

Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.

End of subsurface exploration 12 feet.

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

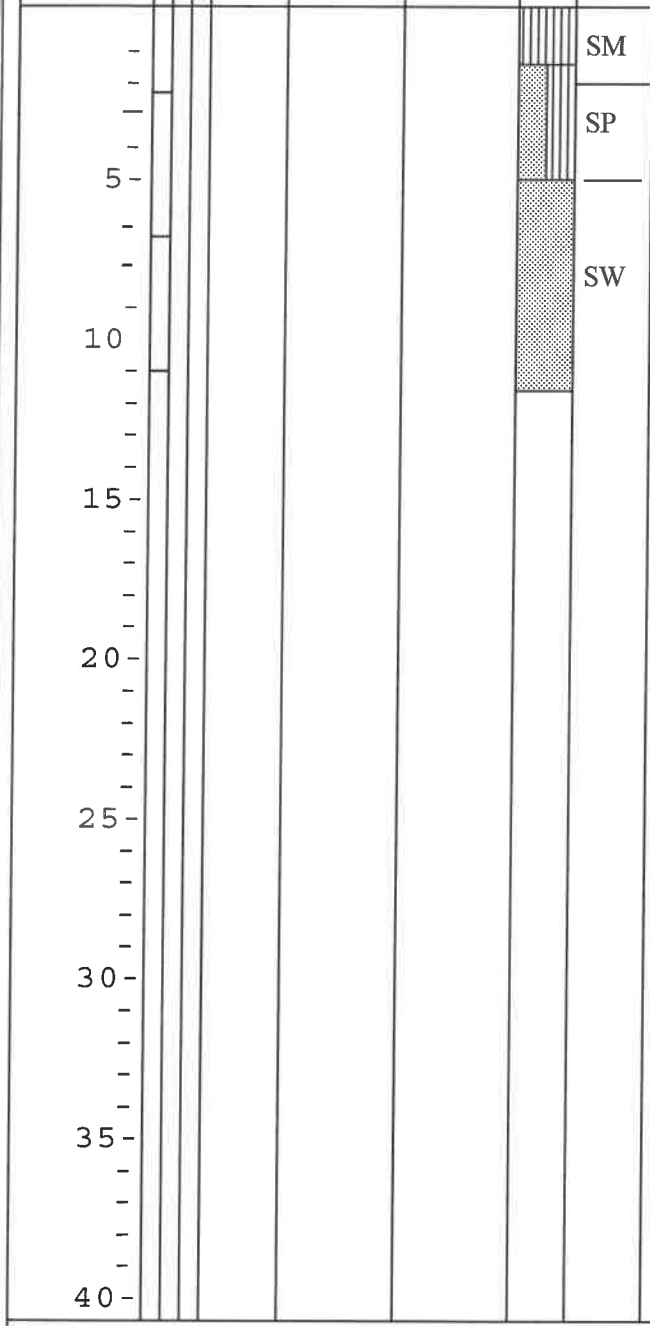
Report Date:

Figure:

Log of Sub-surface Exploration

Boring B-8

Std. Pen	Drive Wt:	USCS Letter	Equipment Type: Sh-2800		Boring # B-8
Bulk/Bag	Drop:	Graphic	Diameter: 4"	Logged by: Y.K.	Date:12/20/21
Ring	c/s	Laboratory	Depth: 12 feet	G.water: - feet	Backfilled:Y
Elev. (feet)	N	Moisture / Dry Reading	**Description of Earth Materials**		



SM — Top soils-Dark gray, gray fine to coarse grained silty sand, sand and gravel with trace of organic materilas, damp and moderately dense

SP — Native Materials: Brown, light brown fine togravelly sand with some silt and large pebbles. Damp and dense.

SW — Light brown, gravelly sand with some pebbels and bedrock fragments, dense and damp.

End of subsurface exploration 12 feet.

Log depicts conditions at the time and location drilled.

Soil Pacific Inc.

Geotechnical and Environmental Services

Project Name: 26681 Fir Avenue, Moreno Valley, California

Project Number: A-8880-21

Report Date:

Figure:

APPENDIX B

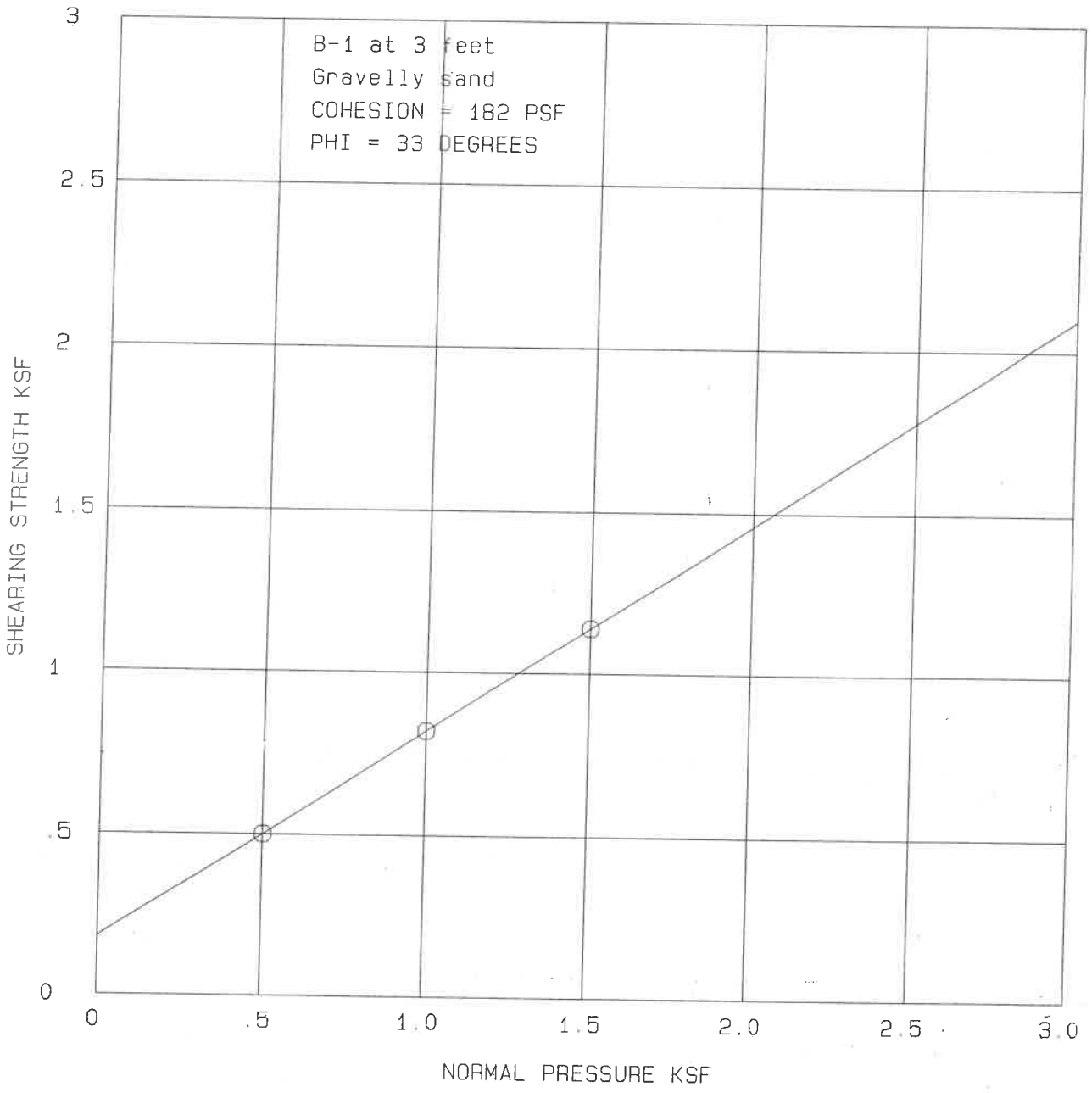
Laboratory

APPENDIX

SHEAR TEST DIAGRAM

J.O. A-8880-21

DATE 12/26/21



PLATE

APPENDIX

BEARING VALUE ANALYSIS

J.O. A-8880-21

DATE 12/26/21

COHESION = 182 PSF GAMA = 125 PCF PHI = 33 DEGREES

DEPTH OF FOOTING = 2 FEET

BREADTH OF FOOTING = 2 FEET

FOOTING TYPE = SQUARE

BEARING CAPACITY FACTORS

Nc = 38.6 Nq = 26.1 Ng = 29.5

FOOTING COEFFICIENTS

K1 = 1.2 K2 = .4

REFERENCE: TERZAGHI & PECK; 1967; 'SOIL MECHANICS IN ENGINEERING PRACTICE'; PAGES 217 TO 225.

FORMULA

ULIMATE BEARING = (K1 * Nc * C) + (K2 * GA * Ng * B) + (Nq * GA * D) = 17915.3

ALLOWABLE BEARING = $\frac{\text{ULTIMATE BEARING}}{3}$ = 5971.8

THE ALLOWABLE BEARING VALUE SHOULD NOT EXCEED 5971.8 PSF. DESIGN SHOULD CONSIDER EXPANSION INDEX.

PLATE

APPENDIX

TEMPORARY BACKCUT STABILITY

J.O. A-8880-21

DATE 12/26/21

COHESION = 128 PSF GAMA = 125 PCF PHI = 33 DEGREES

CUT HEIGHT = 4 FEET

SOIL TYPE = Silty sand/sand

BACKFILL ASSUMED TO BE LEVEL

PORE PRESSURE NOT CONSIDERED

FORMULA

$$\text{SAFETY FACTOR} = \frac{(C * L) + (GA * AREA * \cos(Z) * \tan(PHI))}{GA * AREA * \sin(Z)} = 1.57$$

$$Z = 45 + (PHI/2)$$

SINCE THE SAFETY FACTOR OF 1.57 IS GREATER THAN THE REQUIRED 1.25, THE TEMPORARY EXCAVATION IS CONSIDERED TO BE STABLE. THIS IS WITH A LEVEL AREA EQUAL TO THE LENGTH OF THE VERTICAL CUT ABOVE THE CUT.

PLATE

APPENDIX

BEARING VALUE ANALYSIS

J.O. A-8880-21

DATE 12/26/21

COHESION = 182 PSF GAMA = 125 PCF PHI = 33 DEGREES

DEPTH OF FOOTING = 2 FEET

BREADTH OF FOOTING = 1.5 FEET

FOOTING TYPE = CONTINUOUS

BEARING CAPACITY FACTORS

Nc = 38.6 Nq = 26.1 Ng = 29.5

FOOTING COEFFICIENTS

K1 = 1 K2 = .5

REFERENCE: TERZAGHI & PECK, 1967, 'SOIL MECHANICS IN ENGINEERING PRACTICE', PAGES 217 TO 225.

FORMULA

ULIMATE BEARING = (K1 * Nc * C) + (K2 * GA * Ng * B) + (Nq * GA * D) = 16324.3

ALLOWABLE BEARING = $\frac{\text{ULTIMATE BEARING}}{3}$ = 5441.4

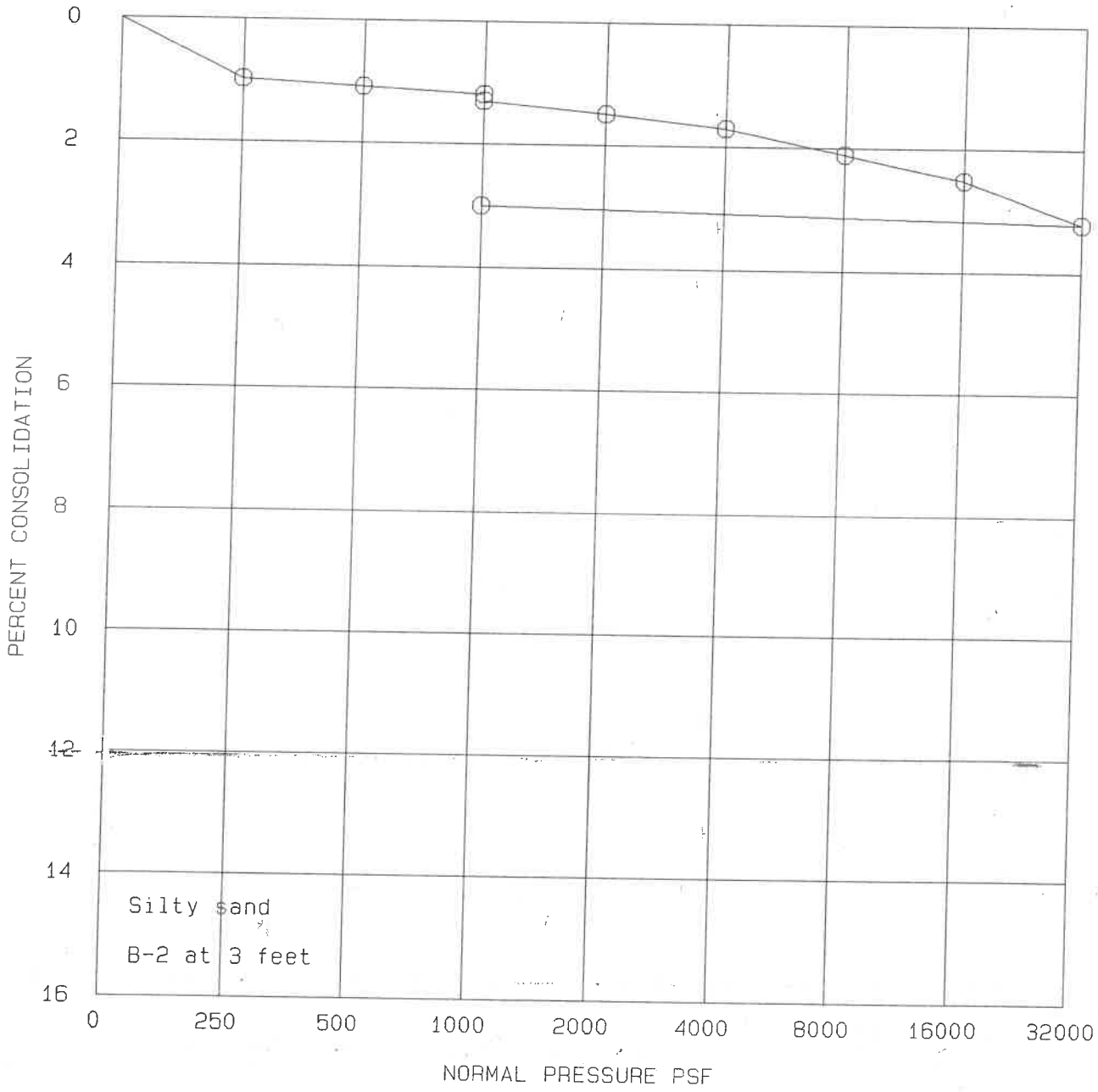
THE ALLOWABLE BEARING VALUE SHOULD NOT EXCEED 5441.4 PSF. DESIGN SHOULD CONSIDER EXPANSION INDEX.

PLATE

CONSOLIDATION PRESSURE CURVE

J.O. A-8880-21

DATE 12/26/21



PLATE

Earth Pressure Calculations

Soil Strength Parameters:

$\phi := 33$

$\gamma := 120$

Active :

$$Ka := \tan\left[\left(45 - \frac{\phi}{2}\right) \cdot \left(\frac{\pi}{180}\right)\right]^2$$

Active earth Presure $Ka = 0.295$

$Pa := Ka \cdot \gamma$

slope angle range, degrees

$Pa = 35.376$ LEVEL BACKFILL BEHIND WALL $Pa = 35.376$

$Pa18 := Pa \cdot 1.08$ 5:1 BACKFILL BEHIND WALL $Pa18 = 38.206$

$Pa18 := Pa \cdot 1.22$ 3:1 BACKFILL BEHIND WALL $Pa18 = 43.159$

$Pa39 := Pa \cdot 1.48$ 2:1 BACKFILL BEHIND WALL $Pa39 = 52.357$

Passive

$$Kp := \tan\left[\left(45 + \frac{\phi}{2}\right) \cdot \left(\frac{\pi}{180}\right)\right]^2 \qquad Kp = 3.392$$

Pasive Earth Presure

$Pp := Kp \cdot \gamma$

$Pp = 407.054$

Atrest

$$Kat := 1 - \sin\left(\phi \cdot \frac{\pi}{180}\right) \qquad Kat = 0.455$$

$Pat := Kat \cdot \gamma$

$Pat = 54.643$

Seismic lateral earth pressure

Free standing Wall

$\phi := 33 \cdot deg$ angle of internal friction of soil

$\delta := 17 \cdot deg$ angle of friction between soil and wall, (concrete or masonry)

PGAm := .83

h := 12 Height of wall

$$kh := \frac{\left[\left(\frac{2}{3}\right) PGAm\right]}{2}$$

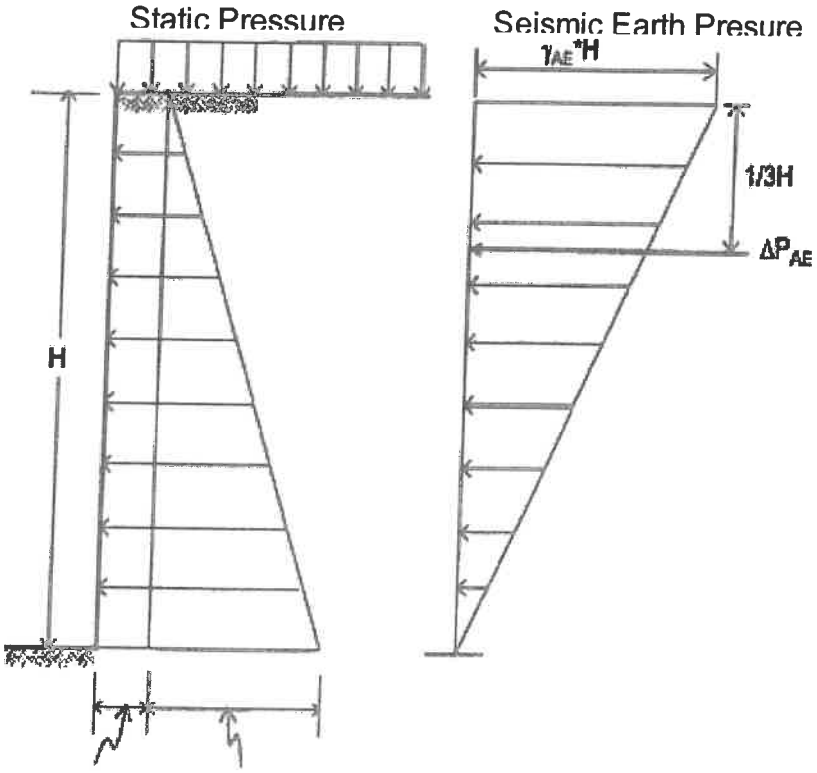
kh = 0.277

$\gamma := 120$ Soil Unit Weight

$$PaE := \frac{3}{8} \cdot \gamma \cdot h^2 \cdot kh$$

$PaE = 1.793 \times 10^3$ PLF

$$EFPs := 2 \cdot \frac{PaE}{h^2}$$



0.45q EFPxH(psf)

EFPs = 24.9 PCF seismic Lateral Force (retaining wall In excess of 6 feet)

q := 0 Surcharge Load should be added by structural justification

Project No.= A – 8880 – 21

Porchet Method, Aka Inverse Borehole Method B-2

$\Delta T := 25$ Time Interval 10 Minutes

$D0 := 10$ Initial Depth to Water, (inch)

$Df := 41$ Final Depth to Water, (inch)

$Dr := 144$ Total Depth of the Test Hole

$r := 5$ Test Hole Redius, Inch

$H0 := Dr - D0$ Initial height of water at the selected time interval

$H0 = 134$

$Hf := Dr - Df$ Final height of water at the selected time interval

$Hf = 103$

$\Delta H := H0 - Hf$ $\Delta H = \Delta D$Change in height over the time interval

$\Delta H = 31$

$$Havg := \frac{(H0 + Hf)}{2}$$

$Havg = 118.5$

The Conversion Equation is used:

$$IR := \frac{\Delta H \cdot (60 \cdot r)}{\Delta T \cdot (r + 2Havg)}$$

$IR = 1.537$ inch /Hour Infiltration rate without including factor of safety

Factor of safety 3

$$IRsafe := \frac{IR}{3}$$ $IRsafe := .5$ Design rate inches/hour

APPENDIX C

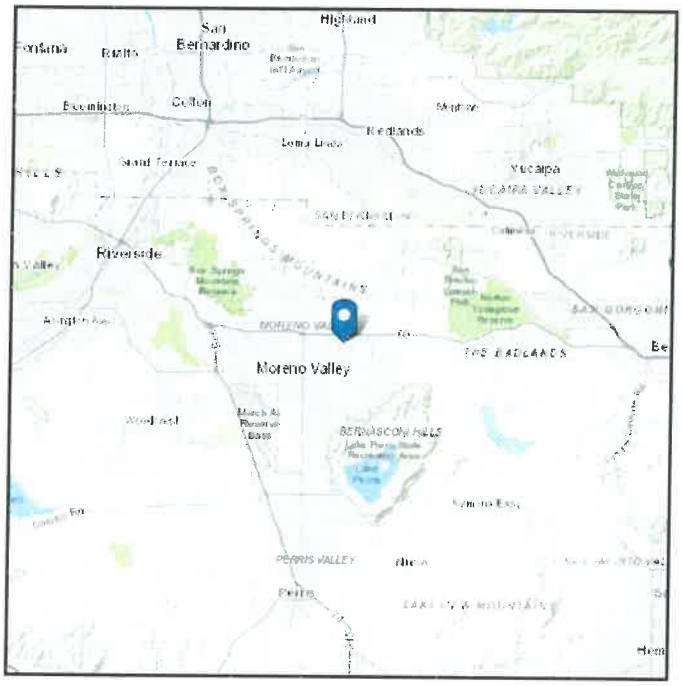
References

ASCE 7 Hazards Report

Address:
26681 Fir Ave
Moreno Valley, California
92555

Standard: ASCE/SEI 7-22
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 1715.63 m (NAVD 88)
Latitude: 33.934072
Longitude: -117.197477



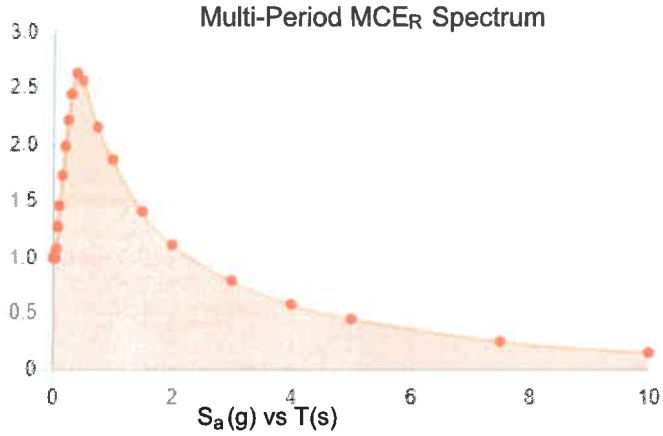
ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

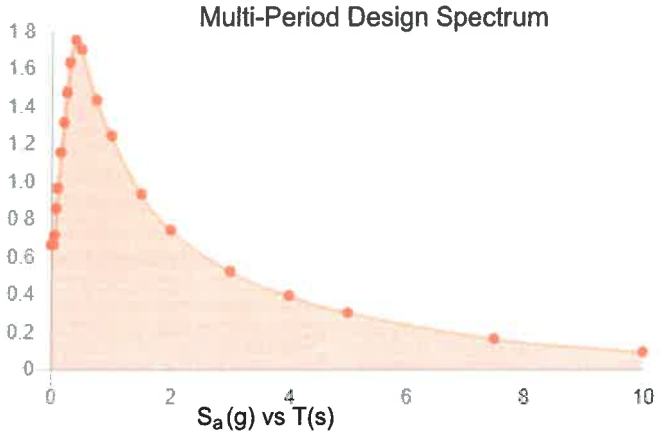
Seismic

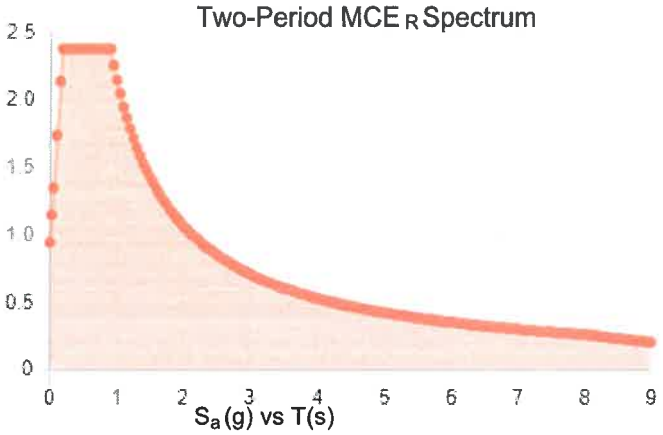
Site Soil Class:

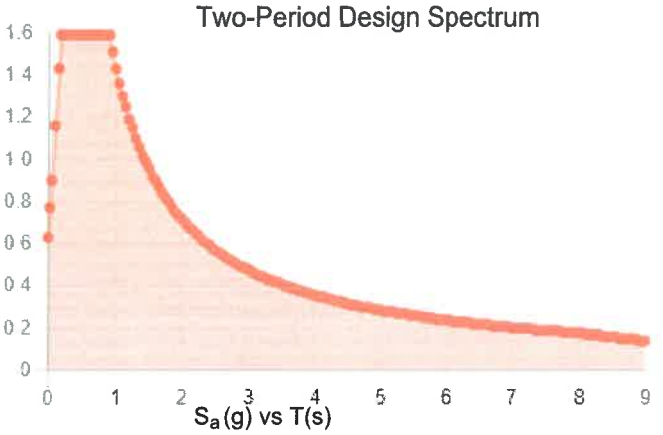
Results:

PGA_M :	0.83	T_L :	8
S_{MS} :	2.38	S_S :	2.27
S_{M1} :	2.15	S_1 :	0.81
S_{DS} :	1.59	S_{DC} :	
S_{D1} :	1.43	V_{S30} :	260









MCER Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: Sat Jan 01 2022

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE 7 standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

APPENDIX D

General Grading Specifications

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1. GENERAL INTENT

These specifications present general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of subdrains, and excavations. The recommendations contained in the geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations of the geotechnical report.

2.EARTHWORK OBSERVATION AND TESTING

Prior to the commencement of grading, a qualified geotechnical consultant (soils engineer and engineering geologist, and their representatives) shall be employed for the purpose of observing earthwork and testing the fills for conformance with the recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observation so that he may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep him apprised of work schedules and changes so that he may schedule his personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If in the opinion of the consultant, unsatisfactory conditions, such as questionable soil, poor moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be topped until the conditions are rectified. Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society of Testing and Materials tests method ASTM D 1557-00.

3.0 PREPARATION OF AREAS TO BE FILLED

3.1 Clearing and Grubbing: All brush, vegetation and debris shall be removed or piled and otherwise disposed of.

3.2 Processing: The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3.3 Overexcavation: Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such a depth that the surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, approved by the consultant.

3.4 Moisture Conditioning: Overexcavated and processed soils shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near optimum.

3.5 Recompaction: Overexcavated and processed soils which have been properly mixed and moisture- conditioned shall be recompacted to a minimum relative compaction of 90 percent.

3.6 Benching: Where fills are to be placed on ground with slopes steeper than 5: 1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm material, and shall be approved by the consultant. Other benches shall be excavated in firm material for a minimum width of 4 feet. Ground sloping flatter than 5 : 1 shall be benched or otherwise overexcavated when considered necessary by the consultant.

3.7 Approval: All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the consultant prior to fill placement.

4.0 FILL MATERIAL

4.1 General: Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the consultant. Soils of poor gradation, expansion, or strength characteristics shall be placed in areas designated by consultant or shall be mixed with other soils to serve as satisfactory fill material.

4.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fills, unless the location, materials, and disposal methods are specifically approved by the consultant. Oversize disposal operations shall be such that nesting of oversize material does not occur, and such that the oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet vertically of finish grade or within the range of future utilities or underground construction, unless specifically approved by the consultant.

4.3 Import: If importing of fill material is required for grading, the import material shall meet the requirements of Section 4. 1.

5.0 FILL PLACEMENT AND COMPACTION

5.1 Fill Lifts: Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 6 inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

5.2 Fill Moisture: Fill layers at a moisture content less than optimum shall be watered and mixed, and wet fill layers shall be aerated by scarification or shall be blended with drier material. Moisture-conditioning and mixing of fill layers shall continue until the fill material is at a uniform moisture content or near optimum.

5.3 Compaction of Fill: After each layer has been evenly spread, moisture conditioned, and mixed, it shall be uniformly compacted to not less than 90 percent of maximum dry density. Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or of proven reliability, to efficiently achieve the specified degree of compaction.

5.4 Fill Slopes: Compaction of slopes shall be accomplished, in addition to normal compacting procedures, by backfilling of slopes with sheepsfoot rollers at frequent increments of 2 to 3 feet in fill elevation gain, or by other methods producing satisfactory results. At the completion of grading, the relative compaction of the slope out to the slope face shall be at least 90 percent.

5.5 Compaction Testing: Field tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at an interval not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of embankment.

6.0 SUBDRAIN INSTALLATION

Subdrain systems, if required, shall be installed in approved ground to conform to the approximate alignment and details shown on the plans or herein. The subdrain location or materials shall not be changed or modified without the approval of the consultant. The consultant, however, may recommend and upon approval, direct changes in subdrain line, grade or material. All subdrains should be surveyed for line and grade after installation, and sufficient time shall be allowed for the surveys, prior to commencement of filling over the subdrains.

7.0 EXCAVATION

Excavation and cut slopes will be examined during grading. If directed by the consultant, further excavation or overexcavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

8.0 TRENCH BACKFILLS

8.1 Supervision: Trench excavations for the utility pipes shall be backfilled under engineering supervision.

8.2 Pipe Zone: After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

8.3 Fill Placement:'The onsite materials, or other soils approved by the engineer, shall be watered and mixed as necessary prior to placement in lifts over the sand backfill.

8.4 Compaction: The controlled backfill shall be compacted to at least 90 percent of the maximum laboratory density as determined by the ASTM compaction method described above.

8.5 Observation and 'Testing: Field density tests and inspection of the backfill procedures shall be made by the soil engineer during backfilling to see that the proper moisture content and uniform compaction is being maintained. The contractor shall provide test holes and exploratory pits as required by the soil engineer to enable sampling and testing.

FIR AVE

PL

B-1

B-5

Qoa
qdx

APN
487-260-002

APN
487-260-003

B-6

B-2

B-3

Qoa
qdx

B-7

APN
487-260-004

APN
487-260-005

B-4

B-8

Existing Residence

50 0 50 100Feet
Graphic Scale

LEGEND

	Soil Boring Location
Qoa	Older Surficial Sediments
qdx	Plutonic Rocks of Peninsular Ranges

soil PACIFIC Inc.
Geotechnical & Environmental Services
675 N. Eckhoff, Suite # A
Orange, CA 92868

Project Location:
26681 Fir Ave., Moreno Valley, CA
APN 487-260-002/3/4/5

GEOTECHNICAL PLAN

FIGURE-A-1-1	PROJECT NO.:A-8880-21
DATE :12/20/2021	SCALE: 1"=50'

REPORT OF INFILTRATION FEASIBILITY STUDY FOR PROPOSED UNDERGROUND BASIN TO ACCOMMODATE THE PROPOSED RESIDENTIAL BUILDINGS, APN487-260-02/03/04/05, FIR AVENUE MORENO VALLEY, RIVERSIDE COUNTY, CALIFORNIA

PROJECT NO.: 1465-01

REPORT NO.: 1

MAY 13, 2022

SUBMITTED TO:

VIGOROUS DEVELOPMENT

MR. STEVEN HAN / MR. KURT YUE

C/O WINSTON LIU

PREPARED BY:

HILLTOP GEOTECHNICAL, INC.

786 SOUTH GIFFORD AVENUE

SAN BERNARDINO, CA 92408

HILLTOP GEOTECHNICAL
INCORPORATED

786 S. GIFFORD AVENUE • SAN BERNARDINO • CA 92408
Phone **909-890-9079** • FAX 909-890-9055
hilltopg@hgeotech.com

May 13, 2022

Vigorous Development
Attn: Mr. Steven Han/Mr. Kurt Yue
Fir Avenue
Moreno Valley, CA

Project No.: 1465-01
Report No.:1

C/O: Winston Liu, Project Civil Engineer

Attention: Mr. Steven Han/Mr. Kurt Yue

Subject: **Report of Infiltration Feasibility Study for Proposed Underground Basin to Accommodate the Proposed Residential Buildings, APN 487-260-02/03/04/05, Fir Avenue, Moreno Valley, Riverside County, California.**

References: 1. **TL Group Corp.**, January 15, 2022, *Conceptual Grading Plan, Tract No. 32194, Fir Ave., City of Moreno Valley, CA 92555, Scale 1":40'.*

2. **Riverside County Flood Control and Water Conservation District**, September 2011, *Riverside County- Low Impact Development BMP Design Handbook Appendix A.*

Mr. Steven Han/Mr. Kurt Yue,

In accordance with your request, we have performed infiltration testing for the subject property. This testing was performed in general accordance with procedures established by the Riverside County Flood Control and Water Conservation District.

A report of our findings is included herein and follows the general format for WQMP testing established by the Riverside County FCWCD.

The findings of this study indicate that the project site is suitable for the proposed infiltration basins provided the recommendations presented in the attached report are incorporated into design of the project and implemented during construction of the project.

We appreciate the opportunity to provide geotechnical services on this project. Should you have any questions regarding this submittal, please do not hesitate to contact us.

Respectfully submitted,
HILLTOP GEOTECHNICAL, INC.

REGISTERED PROFESSIONAL ENGINEER
SHAOFU CHEN
C76834
CIVIL
STATE OF CALIFORNIA

Luis Gomez
Staff Geologist

S. Mack Chen, P.E. C76834/C.E.G. 2688
Principal Engineer/Geologist

CERTIFIED ENGINEERING GEOLOGIST
Shaofu Chen
2688
STATE OF CALIFORNIA

Attachment:
Plate No. 1, Site Plan and Test Locations
Plate No. 2, Subsurface Exploration Legend
Plate Nos. 3 and 4, Subsurface Exploration Log
Plate Nos. 5 through 8, Infiltration Data Sheet

Distribution:
(1) Via Email to (Winston Liu winstonliu@wwwldc.com)

TABLE OF CONTENTS

Section Title **Page No.**

REPORT OF INFILTRATION FEASIBILITY STUDY FOR PROPOSED UNDERGROUND BASIN TO ACCOMMODATE THE PROPOSED RESIDENTIAL BUILDINGS, APN487-260-002/03/04/05, FIR AVENUE MORENO VALLEY, RIVERSIDE COUNTY, CALIFORNIA

LOCATION OF THE PROJECT SITE

The subject property is located south of Fir Avenue to the south of the intersection of Fir Avenue and Willowbrook Lane in the City of Moreno Valley, Riverside County, California. The subject property was a rectangular shape and consists of approximately 8.59 acres of vacant land as shown on the Reference No. 1 'Conceptual Grading Plan' noted on the first page of the cover letter for this report.

SITE CONDITIONS

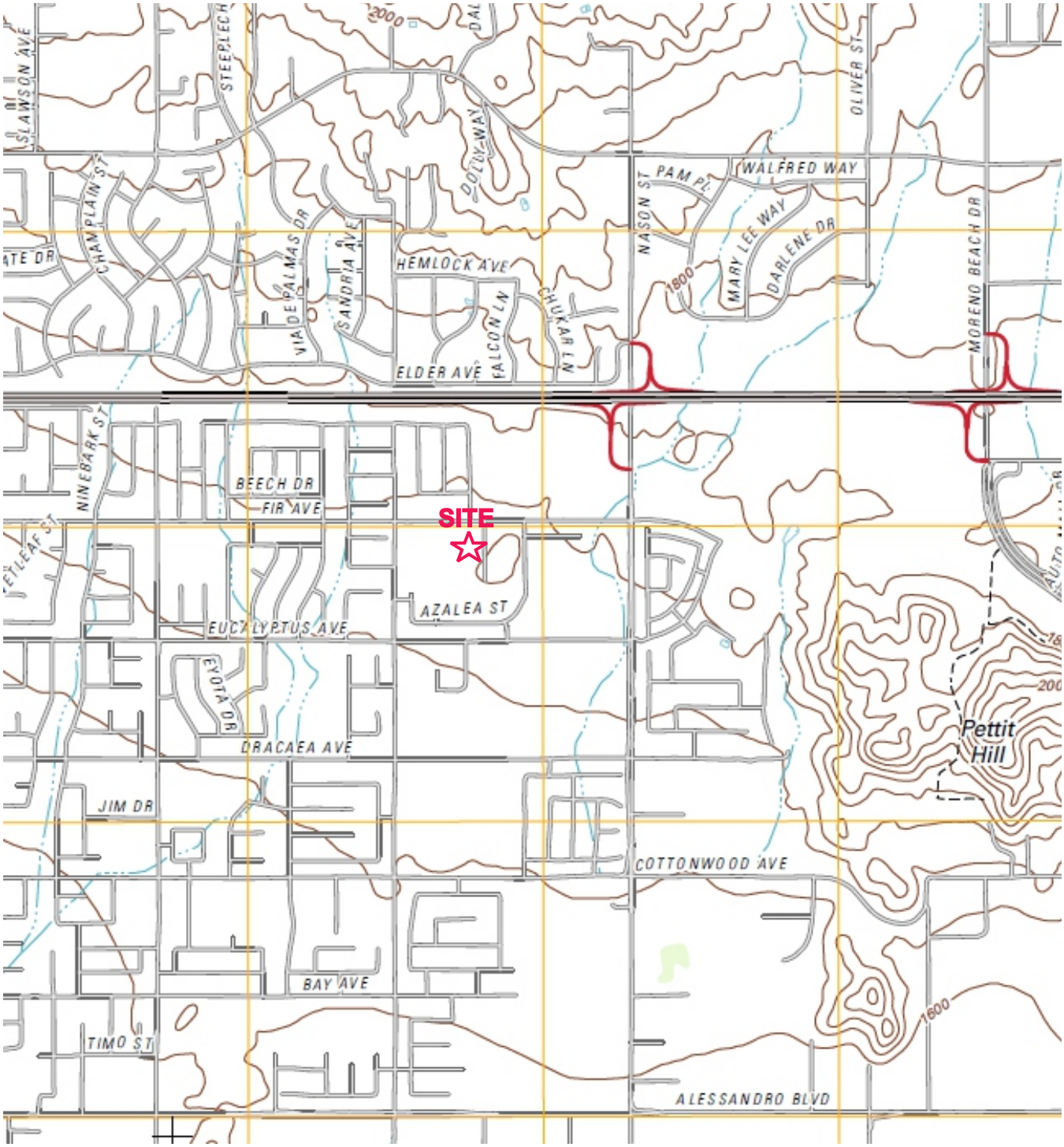
During the time of our drilling and field testing, the subject site was vacant and was relatively flat in nature on the north and west portion of the subject site. A gentle hill was located on the southeastern potion of the property. The subject site had few scattered trees and native grass vegetation at the time of this study. The infiltration locations were chosen by TL Group Corp. The approximate infiltration test locations are shown on the 'Site Plan and Test Location Plan,' Plate No. 1.

LOCATION OF INFILTRATION TESTS

Three soil borings were drilled via a truck mounted drill rig to depths of 20 feet and 6 feet below the existing ground surface (bgs). The boring was excavated to 20 feet bgs to determine the groundwater depth at the site. The groundwater was encountered at depth of 19 feet bgs. To meet a minimum of 10 feet separation from groundwater, two borings were drilled to 6 feet bgs and above the bedrock surface. Two eight-inch diameter borings were extended to depths of 6 feet bgs. These borings were then converted to infiltration tests by inserting 3" diameter perforated sleeved PVC pipe and then removing the auger. Two inches of gravel was added to the bottom of the borings prior to the percolation pipe placement.

SOIL CHARACTERISTICS OF THE SUBJECT SITE

- The soil characteristics for the subject site are defined as favorable.



SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2

1000 500 0 METERS 1000 2000

N

Source: Copied from USGS Topo Map- Sunnymead Quadrangle 2012

HILLTOP GEOTECHNICAL INCORPORATED

SITE LOCATION MAP

APN 487-260-002/003/004/005, Fir Avenue
Moreno Valley, CA 92555

By: MC	Date: 5/2022
Project No.: 1465-01.1	**Figure 1**

- Silty fine to medium grained sands were encountered at all of two test locations.

- The topography of the existing ground surface is generally flat on a majority of the property with a gently sloping hill on the southeastern portion. In general, the slope ratios are less than 1 percent to 15 percent.

- Per the on-site soil conditions, the proposed stormwater retention systems are feasible.

Soil Profile

The earth materials encountered on the subject site during the field exploration was identified as alluvium and granitic bedrock.

Alluvium was encountered within all of the three borings during our infiltration feasibility study. The alluvium was encountered from ground surface to approximately seven feet in depth and consisted of silty fine to medium grained sand (SM) which was brown in color and was medium dense in consistency.

The alluvium was overlying granitic bedrock, The granitic bedrock was highly to moderately weathered in nature. The bedrock was phaneritic in texture with mostly observable phenocrysts and was a light gray to gray color. The rock varied in weathered state from highly weathered to moderately weathered with depth and was moderately soft to very hard.

Groundwater

Groundwater was encountered at a depth of 19 feet below ground surface. Historical well data was found using the California Department of Water Resources Well Data Library (https://wdl.water.ca.gov/waterdatalibrary/), which showed a destroyed well (Well No.339389N1171702W001) approximately 1.5 miles to the northwest of the subject site at showing the highest water level to be 204.8 feet bgs in 2016 at an elevation of 1,790.8 feet Mean Sea Level (MSL). An active state monitoring well (Well No.339347N1172403W001) approximately 2.5 miles to the west shows a water level

of 55.7 feet bgs at an elevation of 1,621.6 feet above MSL. The elevation at the subject site is approximately 1,710 feet above MSL.

Infiltration testing was conducted following the guidelines set forth in the Riverside County- Low Impact Development BMP Design Handbook Appendix A. The stormwater retention facility should have at least 10 feet above the groundwater level.

INFILTRATION TEST PROCEDURES

a) Test Method: Infiltration testing was conducted in general accordance with shallow infiltration test method in the Riverside – Low Impact Development BMP Design Handbook Appendix A.

b) Drilling: Two boreholes were approximately eight inches in diameter, drilled by a truck mounted drill rig with eight-inch diameter augers. Testing was performed in silty fine to coarse sand. After drilling, approximately 2 inches of gravel was placed at the bottom of the test hole and perforated, and sleeved three-inch diameter PVC pipe was inserted into each bore hole.

c) Soaking Period: The test holes were pre-soaked by filling each borehole to the ground surface on April 14, 2022. Pre-soaking took place for two consecutive measurements. The two tests showed six inches of water seeped away in less than 25 minutes for two consecutive readings. Each test was run for additional hour with measurements taken every 10 minutes. Tests TP-1 and TP-2 were tested on April 14, 2022.

d) Measurement of the infiltration rate: Measurements were taken with a precision of 0.1 inches using a water indicator.

TEST RESULTS

The infiltration rates were converted to infiltration rates by use of the Porchet Method and revealed the infiltration rates to be moderate. The final infiltration rates obtained are presented below in Table 1:

Table 1: Final Infiltration Rates

Infiltration Test #	Tested Infiltration Rate (in/hr)
TP-1	2.07
TP-2	1.96

DISCUSSION

The rates presented above were generally as anticipated with respect to the on-site soils. The earth materials for infiltration testing consist mainly of sandy silt with few medium to coarse sands which resulted in fast rates.

Field infiltration tests are subject to many factors that affect the infiltration rate, including soil texture, the condition of the soil surface, soil-moisture tension or the degree of saturation, the temperature of the water and soil, the percentage of entrapped air in the soil, and the head of the applied water.

RECOMMENDATIONS

Based on the Riverside County Guidelines, a factor of safety should be applied to the infiltration rates. A factor of safety of 3 was applied to the rates below in Table 2.

Table 2 Recommended Design Infiltration Rates

Infiltration Test #	Tested Infiltration Rate (in/hr)	Recommended Design Infiltration Rate w/ Factor of Safety (3) (in/hr)
TP-1	2.07	0.69
TP-2	1.96	0.65

For conservative purpose, the design infiltration rate of **0.65** inches per hour should be used for the proposed stormwater retention systems. The infiltration rate is considered suitable for adequate infiltration of stormwater, provided the proposed stormwater retention systems are sized accordingly.

Caution should be used in determining an infiltration rate for the proposed stormwater retention systems. Eventual siltation, from windblown silt, water-borne silt from irrigation and precipitation runoff, and the accumulation of organic material in surface soils due to landscape grass and plant growth, can drastically reduce infiltration rates over time. We recommend that suitable methods to prevent siltation be considered in the project design.

CLOSURE

Findings of this report were prepared in accordance with generally accepted professional engineering principles and practice in the field of soil mechanics. The conclusions are based on results of field exploration and testing. If conditions are encountered during construction that appear to be different than those indicated by this report, this firm should be notified.

AZALEA STREET

FIR AVENUE

SHAWNEE STREET

B-1
UNDERGROUND BASIN BY STORMTECH

TP-1

TP-2
UNDERGROUND BASIN BY STORMTECH

N89°32'48"W 641.67'

N89°25'16"W 608.67'

N00°54'44"E 540.14'

N00°34'44"E 604.73'

"A" STREET

"B" STREET

"C" STREET

"D" STREET

"E" STREET

"F" STREET

1 PAD=707.5
2 PAD=708.0
3 PAD=708.5
4 PAD=709.0
5 PAD=708.5
6 PAD=708
7 PAD=707.0
8 PAD=707.0
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37 PAD=710.0
38 PAD=711.0
39 PAD=711.0
40 PAD=710.0

705.13TC 704.63FL
705.04TC 704.54FL
704.63 FL
704.45 FL
704.99TC 704.49FL
705.35TC 704.85FL
705.49FS (707.0)FG
(708.0) FG
(709.0) FG
706.58TC 706.08FL
706.32 FL
706.68 FL
707.06TC 706.56FL
707.72TC 707.22FL
707.42TC 706.92FS
708.08TC 707.58FS
708.32TC 707.82FL
709.17TC 708.67FS
708.68TC 708.18FS
707.41TC 706.91FL
708.07TC 707.57FL-GB
708.07TC 707.57FL-GB
706.91TC 706.41FL
706.56TC 706.06FL
706.31TC 705.81FL
706.50TC 706.00FL
707.84TC 707.34FL
707.37TC 706.77FL
708.22TC 707.72FL
708.19 FL
708.86 FL
709.83TC 709.33FL
711.08TC 710.58FL
709.73TC 709.23FL
(714.0) FG
(715.0) FG
(716.0) FG
(717.0) FG
(718.0) FG
711.90TC 711.40FL
714.90TC 714.40FL-HP
712.26TC 711.76FS
714.25TC 713.75FL-GB
714.83TC 714.33FL
713.63TC 713.13FL
713.98TC 713.48FL
714.23TC 713.73FL
(717.2) FG
(706.0) FG
(705.5) FG
(705.0) FG
(697.0) FG
(699.0) FG
(707.0) FG
(708.0) FG
(714.0) FG
(721.0) FG
(723.0) FG
(723.0) FG
(717.0) FG
(713.0) FG
(709.0) FG
(707.0) FG
(704.5) FG
(708.5) FG
(707.0) FG

1% 2% 2.87% 1.0%

28' 18' 18' 10' 56'

POOL STEPS

1442 Irvine Boulevard, Suite 208
Tustin, CA 92780
Phone: (949) 457 1617
(714) 982 4057
Web:www.tlgroupconsultants.com

Legend

B-1 Boring Location

TP-1 Test Location

SCALE: 1" = 40

HILLTOP GEOTECHNICAL INCORPORATED

SITE PLAN AND TEST LOCATIONS

APN 487-260-002/003/004/005, Fir Avenue
Moreno Valley, CA 92555

By: MC	Date: 5/2022
Project No.: 1465-01	**Plate No. 1**

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION SYSTEM
Visual-Manual Procedure (ASTM D2488-09a)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
Coarse-Grained Soils* More than 50 % Retained on No. 4 Sieve	Gravels 50 % or more of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels	GW	Well Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
			GP	Poorly Graded Gravels and Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines	GM	Silty Gravels, Gravel-Sand-Silt Mixtures**
			GC	Clayey Gravel, Gravel-Sand-Clay Mixtures**
	Sands More than 50 % of Coarse Fraction Passes No. 4 Sieve	Clean Sands	SW	Well Graded Sands and Gravely Sands, Little or no Fines
			SP	Poorly Graded Sands and Gravelly Sands, Little or no Fines
		Sands with Fines	SM	Silty Sands, Sand-Silt Mixtures**
			SC	Clayey Sands, Sand-Clay Mixtures**
Fine Grained Soils* 50 % or more Passes No. 200 Sieve	Silts and Clays Liquid Limits 50 % or less		ML	Inorganic Silts, Sandy Silts, Rock Flour
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic silty Clays of Low Plasticity
	Silts and Clays Liquid Limits Greater than 50 %		MH	Inorganic Silts, Micaceous or Diatomaceous silts, Plastic Silts
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Clays of Medium to High Plasticity
Highly Organic Soils			PT	Peat, Muck, or Other Highly Organic Soils

CONSISTENCY / RELATIVE DENSITY

Reference: 'Foundation Engineering', Peck, Hansen, Thornburn, 2nd Edition.

Standard Penetration Test
Granular Soils

Penetration Resistance, N, (Blows / Foot)	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
> 50	Very Dense

Standard Penetration Test
Cohesive Soils

Penetration Resistance, N, (Blows / Foot)	Consistency	Unconfined Compressive Strength, (Tons / Sq. Ft.)
		< 0.25
< 2	Very Soft	0.25 - 0.5
2 - 4	Soft	0.5 - 1.0
5 - 8	Firm (Medium Stiff)	1.0 - 2.0
9 - 15	Stiff	2.0 - 4.0
16 - 30	Very Stiff	> 4.0
> 31	Hard	

* Based on material passing the 3-inch sieve.

** More than 12% passing the No. 200 sieve; 5% to 12% passing No. 200 sieve requires use of duel symbols (i.e., SP-SM., GP-GM, SP-SC, GP-GC, etc.); Border line classifications are designated as CH/Cl, GM/SM, SP/SW, etc.

U.S. Standard Sieve Size 12" 3" 3/4" #4 #10 #40 #200

Unified Soil Classification Designation	Boulders	Cobbles	Gravel		Sand			Silt and Clay
			Coarse	Fine	Coarse	Medium	Fine	

Moisture Condition

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible moisture.
Wet	Visible free water, usually below the water table.

Material Quantity

Trace	< 5 %
Few	5 - 10%
Little	15 - 25%
Some	30 - 45 %
Mostly	50-100%

Other Symbols

C - Core Sample
S - SPT Sample
B - Bulk Sample
CK - Chunk Sample
R - Ring Sample
N - Nuclear Gauge Test
∇ - Water Table

SUBSURFACE EXPLORATION LOG
BORING NO. B-1

HILLTOP GEOTECHNICAL INCORPORATED

Project Name:	Steven Han Moreno Valley Infiltration				
Project No.	1465-01.1	Date:	4/14/2022	Logged By:	LG
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	1720 ± 10
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	20.0

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1			SM			Qa		ALLUVIUM: Silty fine to coarse sand, trace gravel; Light brown; Slightly Moist; Loose to medium dense.
7								QUARTZ DIORITE TO GRANODIORITE: Highly weathered to moderatly weathered granitic bedrock; Light gray to gray; Phaneritic texture; Moist; Firm to hard.
19							Y	Groundwater encountered. Constant depth of 19 feet.
20								Bottom of boring 20 feet. Groundwater encountered at 19 feet. Backfilled with excavated materials.

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Plate No. 3

HILLTOP GEOTECHNICAL INCORPORATED

SUBSURFACE EXPLORATION LOG
BORING NO. B-2

Project Name: Steven Han Moreno Valley Infiltration

Project No.	1465-01.1	Date:	4/14/2022	Logged By:	LG
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	1720 ± 10
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	6.0

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1			SM			Qa		ALLUVIUM: Silty fine to coarse sand, trace gravel; Light brown; Slightly Moist; Loose to medium dense.
6								Bottom of boring 6 feet. No groundwater encountered. Converted to TP-1, backfilled when testing complete.

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Plate No. 4

HILLTOP GEOTECHNICAL INCORPORATED

SUBSURFACE EXPLORATION LOG
BORING NO. B-3

Project Name: Steven Han Moreno Valley Infiltration

Project No.	1465-01.1	Date:	4/14/2022	Logged By:	LG
Type of Rig:	Hollow-Stem Auger	Drive Wt.:	140 lb	Elevation:	1720 ± 10
Drill Hole Dia.:	8 in.	Drop:	30 in.	Depth of Boring (ft.):	6.0

Depth (ft.)	Sample Type	Penetration Resistance	Soil Classification	Dry Density (lb/ft3)	Moisture Content (%)	Lithology	Groundwater	Description
1			SM			Qa		ALLUVIUM: Silty fine to coarse sand, trace gravel; Light brown; Slightly Moist; Loose to medium dense.
6								Bottom of boring 6 feet. No groundwater encountered. Converted to TP-2, backfilled when testing complete.

S - SPT Sample R - Ring Sample B - Bulk Sample N - Nuclear Gauge Test D - Disturbed Sample

N.R. - No Recovery

Plate No. 5

HILLTOP GEOTECHNICAL INCORPORATED

PERCOLATION DATA SHEET

Project Name: Han-Yue Basin Infil Mo Vally

Project Number: 1465-01

Test Hole Number: TP-1

Date Tested: 4/14/22

Depth of Boring in feet: 6.0

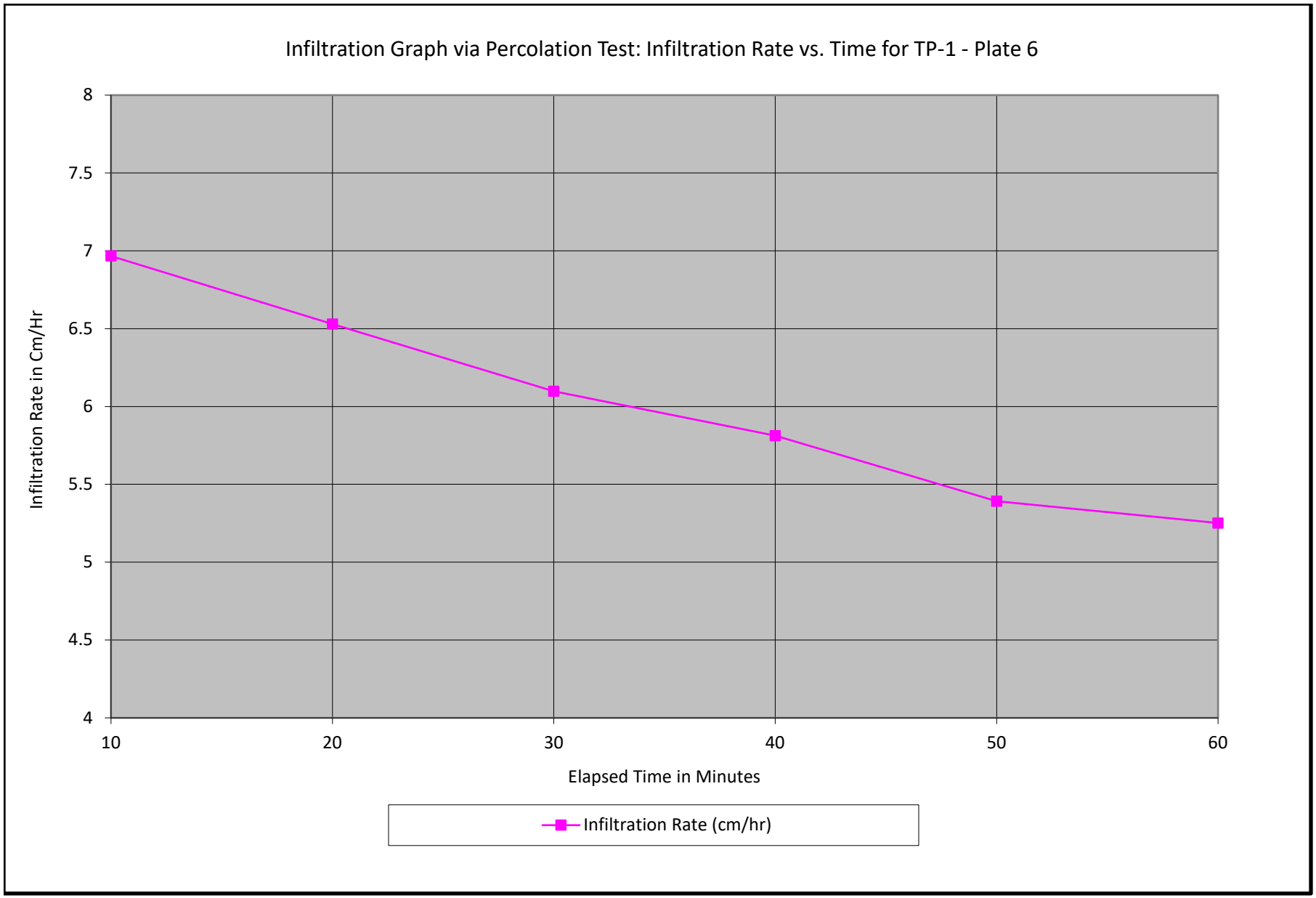
Tested By: LG

Radius of boring feet: 0.33

Hours Presaturation 0.83

Depth of Bottom (ft) Outter	Time Initial	Time Final	Time Interval (minutes)	Depth of Water - Initial (ft)	Depth of Water - Final (ft)	Change in Water Level (ft)	$H_{average}$ (ft)	Rate, It (In/Hr)	Rate, It (Cm/Hr)
6.00	11:20	11:45	25.0	0.98	2.83	1.85	4.09	1.99	5.05
6.00	11:45	12:10	25.0	1.00	2.71	1.71	4.15	1.81	4.60
6.00	12:15	12:25	10.0	1.00	2.10	1.10	4.45	2.74	6.97
6.00	12:25	12:35	10.0	1.00	2.04	1.04	4.48	2.57	6.53
6.00	12:35	12:45	10.0	1.00	1.98	0.98	4.51	2.40	6.10
6.00	12:45	12:55	10.0	1.00	1.94	0.94	4.53	2.29	5.81
6.00	12:55	13:05	10.0	1.00	1.88	0.88	4.56	2.12	5.39
6.00	13:05	13:15	10.0	1.00	1.85	0.85	4.57	2.07	5.25

Plate No. 6



Hilltop Geotechnical, Inc.

Infiltrometer Graph
TP-1

1455-01.2
Plate No. 7

HILLTOP GEOTECHNICAL INCORPORATED

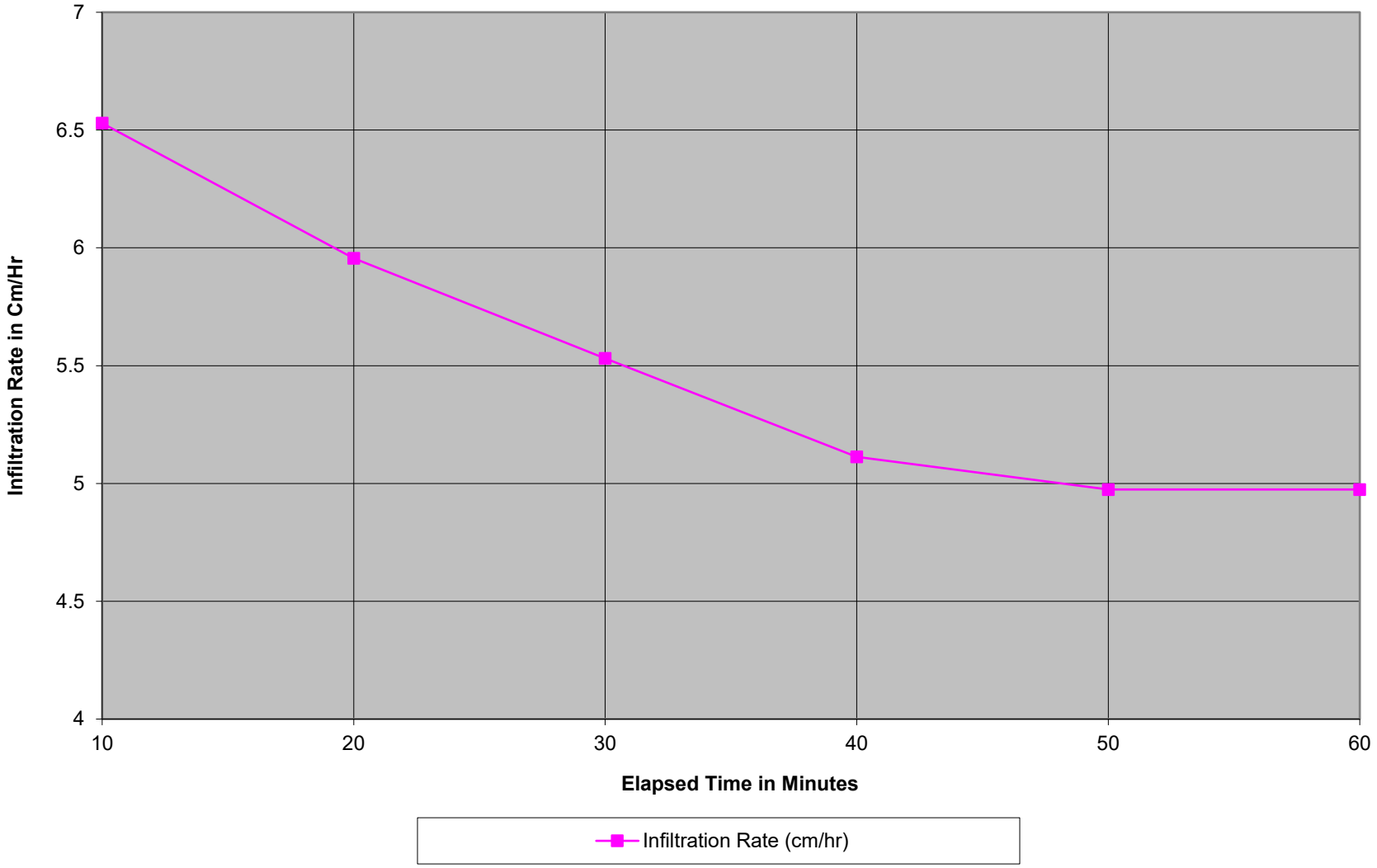
PERCOLATION DATA SHEET

Project Name:	Han-Yue Basin Infil Mo Vally	Project Number:	1465-01
Test Hole Number:	TP-1	Date Tested:	4/14/22
Depth of Boring in feet:	6.0	Tested By:	LG
Radius of boring feet:	0.33	Hours Presaturation	0.83

Depth of Bottom (ft) Outter	Time Initial	Time Final	Time Interval (minutes)	Depth of Water - Initial (ft)	Depth of Water - Final (ft)	Change in Water Level (ft)	$H_{average}$ (ft)	Rate, It (In/Hr)	Rate, It (Cm/Hr)
6.00	11:25	11:50	25.0	1.00	3.00	2.00	4.00	2.19	5.57
6.00	11:50	12:15	25.0	1.00	2.85	1.85	4.07	2.00	5.08
6.00	12:20	12:30	10.0	1.00	2.04	1.04	4.48	2.57	6.53
6.00	12:30	12:40	10.0	1.00	1.96	0.96	4.52	2.34	5.96
6.00	12:40	12:50	10.0	1.00	1.90	0.90	4.55	2.18	5.53
6.00	12:50	13:00	10.0	1.00	1.83	0.83	4.58	2.01	5.11
6.00	13:00	13:10	10.0	1.00	1.81	0.81	4.59	1.96	4.97
6.00	13:10	13:20	10.0	1.00	1.81	0.81	4.59	1.96	4.97

Plate No. 8

Infiltration Graph via Percolation Test: Infiltration Rate vs. Time for TP-2 - Plate 8



Appendix 4: Historical Site Conditions

Phase I Environmental Site Assessment or Other Information on Past Site Use

N/A

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

N/A

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	W&W Land Design Consultants, Inc	Date	1/19/2023
Designed by	Winston Liu, PE	Case No	LWQ22-0037
Company Project Number/Name	2204 Fir Avenue - Tract 38480 Moreno Valley		

BMP Identification

BMP NAME / ID: Cultec Re-Charger 902HD – BMP #1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.67 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
D1	90790	Concrete or Asphalt	1	0.89	80984.7			
D2	112658	Roofs	1	0.89	100490.9			
D3	80339	Roofs	1	0.89	71662.4			
B1	60662	Ornamental Landscaping	0.1	0.11	6700.6			
B2	43260	Ornamental Landscaping	0.1	0.11	4778.4			
	387709	Total			264617	0.67	14774.4	14,965

Notes:

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name	W&W Land Design Consultants, Inc	Date	1/19/2022
Designed by	Winston Liu, PE	Case No	LWQ22-0037
Company Project Number/Name	2204 Fir Avenue - Tract 38480 Moreno Valley		

BMP Identification

BMP NAME / ID: Contech Filterra bypass curb – BMP #2

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth, from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.67 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
D4	*15670*	*Concrete or Asphalt*	*1*	*0.89*	*13977.6*			
	15670		***Total***		**13977.6**	**0.67**	***780.4***	***800***

Notes:

R 07 W | R 06 W | R 05 W | R 04 W | R 03 W | R 02 W | R 01 W | R 01 E | R 02 E | R 03 E | R 04 E | R 05 E

T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S

06	05	04	03	02	01
07	08	09	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

0.85 MiraLoma
0.61 Riverside North
0.54 Riverside South
0.68 PigeonPass
0.66 MorenoEast
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PerrisReservoir
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.90 HurkeyCreek
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley

Santa Ana River Watershed
Santa Margarita Watershed

JURUPA VALLEY | EASTVALE | NORCO | CORONA | RIVERSIDE | MORENO VALLEY | CALIMESA | BEAUMONT | SAN JACINTO | PERRIS | CANYON LAKE | LAKE ELSINORE | WILDOMAR | MENIFEE | HEMET | MURRIETA | TEMECULA

N

Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011

CULTEC Stormwater Design Calculator

Date:	December 27, 2022

Project Number:	2204

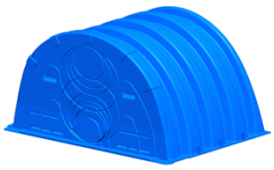
Project Information:

37 lots tract 38480
Fir Avenue
Moreno Valley
CA
USA

Calculations Performed By:

Winston Liu, PE
W&W Land Design Consultants, Inc
2335 W. Foothill Blvd., Suite #1
Upland CA
91786
USA
909-480-4306
winstonliu@wwldc.com

RECHARGER 902HD



Recharger 902HD Chamber Specifications

Height	**48.0**	inches
Width	**78.0**	inches
Length	**4.10**	feet
Installed Length	**3.67**	feet
Bare Chamber Volume	**63.47**	cu. feet
Installed Chamber Volume	**99.22**	cu. feet

Breakdown of Storage Provided by Recharger 902HD Stormwater System

Within Chambers	**9,156.24**	cu. feet
Within Feed Connectors	**2.74**	cu. feet
Within Stone	**5,805.61**	cu. feet
Total Storage Provided	**14,964.6**	**cu. feet**
Total Storage Required	14936.00	cu. feet

Materials List

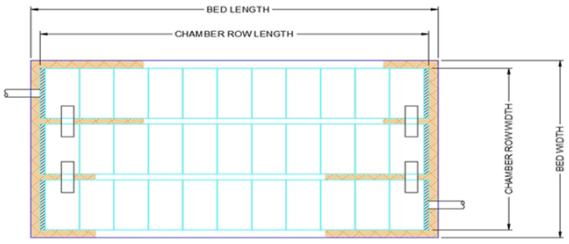
Recharger 902HD

Total Number of Chambers Required	**144**	**pieces**
Separator Row Chambers	**48**	pieces
Chamber Units	**144**	pieces
End Caps	**6**	pieces
HVLV FC-48 Feed Connectors	**4**	pieces
CULTEC No. 410 Non-Woven Geotextile	**1466**	sq. yards
CULTEC No. 4800 Woven Geotextile	**232**	feet
Stone	**538**	cu. yards

Separator Row Qty Included in Total

Based on 2 Internal Manifolds

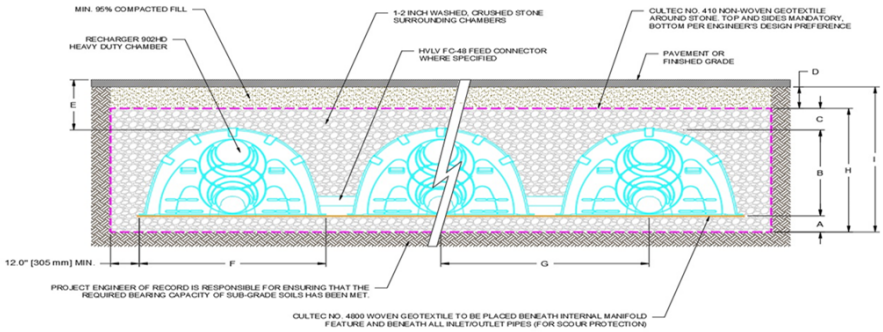
Bed Detail



Bed detail for reference only. Not project specific. Not to scale.

Bed Layout Information

Number of Rows Wide	**3**	pieces
Number of Chambers Long	**48**	pieces
Chamber Row Width	**21.00**	feet
Chamber Row Length	**177.00**	feet
Bed Width	**23.00**	feet
Bed Length	**179.00**	feet
Bed Area Required	**4117.05**	sq. feet
Length of Separator Row	**177.00**	feet



Conceptual graphic only. Not job specific.

Cross Section Table Reference

A	Depth of Stone Base	**9.0**	inches
B	Chamber Height	**48.0**	inches
C	Depth of Stone Above Units	**12.0**	inches
D	Depth of 95% Compacted Fill	**12.0**	inches
E	Max. Depth Allowed Above the Chamber	**8.33**	feet
F	Chamber Width	**78.0**	inches
G	Center to Center Spacing	**7.25**	feet
H	Effective Depth	**5.75**	feet
I	Bed Depth	**6.75**	feet

CULTEC RECHARGER 902HD® SPECIFICATIONS

GENERAL

CULTEC RECHARGER® 902HD CHAMBERS ARE DESIGNED FOR UNDERGROUND STORMWATER MANAGEMENT. THE CHAMBERS MAY BE USED FOR RETENTION, RECHARGING, DETENTION OR CONTROLLING THE FLOW OF ON-SITE STORMWATER RUNOFF.

CHAMBER PARAMETERS

1. THE CHAMBERS SHALL BE MANUFACTURED IN THE U.S.A. OR CANADA BY CULTEC, INC. OF BROOKFIELD, CT (CULTEC.COM, 203-775-4416).
2. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". THE LOAD CONFIGURATION SHALL INCLUDE:
   A. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   B. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   C. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
3. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
4. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   A. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   B. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   C. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95
5. THE CHAMBER SHALL BE STRUCTURAL FOAM INJECTION MOLDED OF BLUE VIRGIN HIGH MOLECULAR WEIGHT IMPACT-MODIFIED POLYPROPYLENE.
6. THE CHAMBER SHALL BE ARCHED IN SHAPE.
7. THE CHAMBER SHALL BE OPEN-BOTTOMED.
8. THE CHAMBER SHALL BE JOINED USING AN INTERLOCKING OVERLAPPING RIB METHOD. CONNECTIONS MUST BE FULLY SHOULDERED OVERLAPPING RIBS, HAVING NO SEPARATE COUPLINGS.
9. THE NOMINAL CHAMBER DIMENSIONS OF THE CULTEC RECHARGER®902HD SHALL BE 48 INCHES (1219 MM) TALL, 78 INCHES (1981 MM) WIDE AND 4.25 FEET (1.30 M) LONG. THE INSTALLED LENGTH OF A JOINED RECHARGER 902HD SHALL BE 3.67 FEET (1.12 M).
10. MULTIPLE CHAMBERS MAY BE CONNECTED TO FORM DIFFERENT LENGTH ROWS. EACH ROW SHALL BEGIN AND END WITH A SEPARATELY FORMED CULTEC RECHARGER® 902HD END CAP. MAXIMUM INLET OPENING ON THE END CAP IS 30 INCHES (750 MM) HDPE OR 36 INCHES (900 MM) PVC.
11. THE CHAMBER SHALL HAVE TWO SIDE PORTALS TO ACCEPT CULTEC HVLV™ FC-48 FEED CONNECTORS TO CREATE AN INTERNAL MANIFOLD. MAXIMUM ALLOWABLE PIPE SIZE IN THE SIDE PORTAL IS 10 INCHES (250 MM) HDPE AND 12 INCHES (300 MM) PVC.
12. THE NOMINAL CHAMBER DIMENSIONS OF THE CULTEC HVLV™ FC-48 FEED CONNECTOR SHALL BE 12 INCHES (305 MM) TALL, 16 INCHES (406 MM) WIDE AND 49 INCHES (1245 MM) LONG.
13. THE NOMINAL STORAGE VOLUME OF THE RECHARGER 902HD CHAMBER SHALL BE 17.31 FT^3/ FT (1.61 M^3 / M) - WITHOUT STONE. THE NOMINAL STORAGE VOLUME OF A JOINED RECHARGER 902HD SHALL BE 63.47 FT^3 / UNIT (1.80 M^3 / UNIT) - WITHOUT STONE.
14. THE NOMINAL STORAGE VOLUME OF THE HVLV™ FC-48 FEED CONNECTOR SHALL BE 0.913 FT^3 / FT (0.085 M^3 / M) - WITHOUT STONE.
15. THE RECHARGER 902HD CHAMBER SHALL HAVE 5 CORRUGATIONS.
16. THE CHAMBER SHALL BE CAPABLE OF ACCEPTING A 6 INCH (150 MM) INSPECTION PORT OPENING AT THE TOP CENTER OF EACH CHAMBER, CENTERED ON THE CORRUGATION CREST.
17. THE CHAMBER SHALL BE MANUFACTURED IN A FACILITY EMPLOYING CULTEC'S QUALITY CONTROL AND ASSURANCE PROCEDURES.
18. MAXIMUM ALLOWABLE COVER OVER THE TOP OF THE CHAMBER SHALL BE 8.3 FEET (2.53 M).

END CAP PARAMETERS

1. THE CULTEC RECHARGER® 902HD END CAP (REFERRED TO AS 'END CAP') SHALL BE MANUFACTURED IN THE U.S.A. BY CULTEC, INC. OF BROOKFIELD, CT (CULTEC.COM, 203-775-4416).
2. THE END CAP SHALL BE TWIN-SHEET THERMOFORMED OF VIRGIN HIGH MOLECULAR WEIGHT POLYETHYLENE.
3. THE END CAP SHALL BE JOINED AT THE BEGINNING AND END OF EACH ROW OF CHAMBERS USING AN INTERLOCKING OVERLAPPING RIB METHOD. CONNECTIONS MUST BE FULLY SHOULDERED OVERLAPPING RIBS, HAVING NO SEPARATE COUPLINGS.
4. THE NOMINAL DIMENSIONS OF THE END CAP SHALL BE 48.5 INCHES (1231 MM) TALL, 78 INCHES (1982 MM) WIDE AND 9.7 INCHES (246 MM) LONG. WHEN JOINED WITH A RECHARGER 902HD CHAMBER, THE INSTALLED LENGTH OF THE END CAP SHALL BE 6.2 INCHES (157 MM).
5. THE NOMINAL STORAGE VOLUME OF THE END CAP SHALL BE 5.34 FT^3/ FT (0.50 M^3 / M) - WITHOUT STONE. THE NOMINAL STORAGE VOLUME OF AN INTERLOCKED END CAP SHALL BE 2.76 FT^3 / UNIT (0.08 M^3 / UNIT) - WITHOUT STONE.
6. MAXIMUM INLET OPENING ON THE END CAP IS 30 INCHES (750 MM) HDPE OR 36 INCHES (900 MM) PVC.
7. THE END CAP SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12.

CULTEC HVLV FC-48 FEED CONNECTOR PRODUCT SPECIFICATIONS

GENERAL

CULTEC HVLV FC-48 FEED CONNECTORS ARE DESIGNED TO CREATE AN INTERNAL MANIFOLD FOR CULTEC RECHARGER MODEL 902HD STORMWATER CHAMBERS.

FEED CONNECTOR PARAMETERS

1. THE FEED CONNECTOR SHALL BE MANUFACTURED BY CULTEC, INC. OF BROOKFIELD, CT. (203-775-4416 OR 1-800-428-5832)
2. THE FEED CONNECTOR SHALL BE VACUUM THERMOFORMED OF BLACK HIGH MOLECULAR WEIGHT HIGH DENSITY POLYETHYLENE (HMWHDPE).
3. THE FEED CONNECTOR SHALL BE ARCHED IN SHAPE.
4. THE FEED CONNECTOR SHALL BE OPEN-BOTTOMED.
5. THE NOMINAL DIMENSIONS OF THE CULTEC HVLV FC-48 FEED CONNECTOR SHALL BE 12 INCHES (305 mm) TALL, 16 INCHES (406 mm) WIDE AND 49 INCHES (1245 mm) LONG.
6. THE NOMINAL STORAGE VOLUME OF THE HVLV FC-48 FEED CONNECTOR SHALL BE 0.913 FT^3 / FT (0.085 m^3 / m) - WITHOUT STONE.
7. THE HVLV FC-48 FEED CONNECTOR SHALL HAVE 4 CORRUGATIONS.
8. THE HVLV FC-48 FEED CONNECTOR MUST BE FORMED AS A WHOLE UNIT HAVING TWO OPEN END WALLS AND HAVING NO SEPARATE END PLATES OR SEPARATE END WALLS. THE UNIT SHALL FIT INTO THE SIDE PORTALS OF THE CULTEC RECHARGER STORMWATER CHAMBER AND ACT AS CROSS FEED CONNECTIONS CREATING AN INTERNAL MANIFOLD.
9. THE FEED CONNECTOR SHALL BE DESIGNED TO WITHSTAND AASHTO HS-25 DEFINED LOADS WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS.
10. THE FEED CONNECTOR SHALL BE MANUFACTURED IN AN ISO 9001:2008 CERTIFIED FACILITY.

CULTEC NO. 410™ NON-WOVEN GEOTEXTILE

CULTEC NO. 410™ NON-WOVEN GEOTEXTILE MAY BE USED WITH CULTEC CONTACTOR® AND RECHARGER® STORMWATER INSTALLATIONS TO PROVIDE A BARRIER THAT PREVENTS SOIL INTRUSION INTO THE STONE.

GEOTEXTILE PARAMETERS

1. THE GEOTEXTILE SHALL BE PROVIDED BY CULTEC, INC. OF BROOKFIELD, CT. (203-775-4416 OR 1-800-428-5832)
2. THE GEOTEXTILE SHALL BE BLACK IN APPEARANCE.
3. THE GEOTEXTILE SHALL HAVE A TYPICAL WEIGHT OF 4.5 OZ/SY (142 G/M).
4. THE GEOTEXTILE SHALL HAVE A TENSILE STRENGTH VALUE OF 120 LBS (533 N) PER ASTM D4632 TESTING METHOD.
5. THE GEOTEXTILE SHALL HAVE AN ELONGATION @ BREAK VALUE OF 50% PER ASTM D4632 TESTING METHOD.
6. THE GEOTEXTILE SHALL HAVE A MULLEN BURST VALUE OF 225 PSI (1551 KPA) PER ASTM D3786 TESTING METHOD.
7. THE GEOTEXTILE SHALL HAVE A PUNCTURE STRENGTH VALUE OF 65 LBS (289 N) PER ASTM D4833 TESTING METHOD.
8. THE GEOTEXTILE SHALL HAVE A CBR PUNCTURE VALUE OF 340 LBS (1513 N) PER ASTM D6241 TESTING METHOD.
9. THE GEOTEXTILE SHALL HAVE A TRAPEZOID TEAR VALUE OF 50 LBS (222 N) PER ASTM D4533 TESTING METHOD.
10. THE GEOTEXTILE SHALL HAVE A AOS VALUE OF 70 U.S. SIEVE (0.212 MM) PER ASTM D4751 TESTING METHOD.
11. THE GEOTEXTILE SHALL HAVE A PERMITTIVITY VALUE OF 1.7 SEC-1 PER ASTM D4491 TESTING METHOD.
12. THE GEOTEXTILE SHALL HAVE A WATER FLOW RATE VALUE OF 135 GAL/MIN/SF (5500 L/MIN/SM) PER ASTM D4491 TESTING METHOD.
13. THE GEOTEXTILE SHALL HAVE A UV STABILITY @ 500 HOURS VALUE OF 70% PER ASTM D4355 TESTING METHOD.

CULTEC NO. 4800™ WOVEN GEOTEXTILE

CULTEC NO. 4800 WOVEN GEOTEXTILE IS DESIGNED AS A UNDERLAYMENT TO PREVENT SCOURING CAUSED BY WATER MOVEMENT WITHIN THE CULTEC CHAMBERS AND FEED CONNECTORS UTILIZING THE CULTEC MANIFOLD FEATURE. IT MAY ALSO BE USED AS A COMPONENT OF THE CULTEC SEPARATOR ROW TO ACT AS A BARRIER TO PREVENT SOIL/CONTAMINANT INTRUSION INTO THE STONE WHILE ALLOWING FOR MAINTENANCE.

GEOTEXTILE PARAMETERS

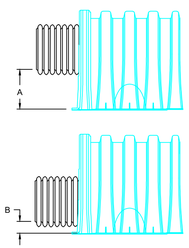
1. THE GEOTEXTILE SHALL BE PROVIDED BY CULTEC, INC. OF BROOKFIELD, CT. (203-775-4416 OR 1-800-428-5832)
2. THE GEOTEXTILE SHALL BE BLACK IN APPEARANCE.
3. THE GEOTEXTILE SHALL HAVE A TENSILE STRENGTH OF 550 X 550 LBS (2,448 X 2,448 N) PER ASTM D4632 TESTING METHOD.
4. THE GEOTEXTILE SHALL HAVE A ELONGATION @ BREAK RESISTANCE OF 20 X 20% PER ASTM D4632 TESTING METHOD.
5. THE GEOTEXTILE SHALL HAVE A WIDE WIDTH TENSILE RESISTANCE OF 5,070 X 5,070 LBS/FT (74 X 74 KN/M) PER ASTM D4595 TESTING METHOD.
6. THE GEOTEXTILE SHALL HAVE A WIDE WIDTH TENSILE RESISTANCE @ 2% STRAIN OF 960 X 1,096 LBS/FT (14 X 16 KN/M) PER ASTM D4595 TESTING METHOD.
7. THE GEOTEXTILE SHALL HAVE A WIDE WIDTH TENSILE RESISTANCE @ 5% STRAIN OF 2,740 X 2, 740 LBS/FT (40 X 40 KN/M) PER ASTM D4595 TESTING METHOD.
8. THE GEOTEXTILE SHALL HAVE A WIDE WIDTH TENSILE RESISTANCE @ 10% STRAIN OF 4,800 X 4,800 LBS/FT (70 X 70 KN/M) PER ASTM D4595 TESTING METHOD.
9. THE GEOTEXTILE SHALL HAVE A CBR PUNCTURE RESISTANCE OF 1,700 LBS (7,560 N) PER ASTM D6241 TESTING METHOD.
10. THE GEOTEXTILE SHALL HAVE A TRAPEZOIDAL TEAR RESISTANCE OF 180 X 180 LBS (801 X 801 N) PER ASTM D4533 TESTING METHOD.
11. THE GEOTEXTILE SHALL HAVE AN APPARENT OPENING SIZE OF 40 US STD. SIEVE (0.425 MM) PER ASTM D4751 TESTING METHOD.
12. THE GEOTEXTILE SHALL HAVE A PERMITTIVITY RATING OF 0.15 SEC-1 PER ASTM D4491 TESTING METHOD.
13. THE GEOTEXTILE SHALL HAVE A WATER FLOW RATING OF 11.5 GPM/FT2 (470 LPM/M2) PER ASTM D4491 TESTING METHOD.
14. THE GEOTEXTILE SHALL HAVE A UV RESISTANCE OF 80% @ 500 HRS. PER ASTM D4355 TESTING METHOD.

902HD 1.0

GENERAL NOTES

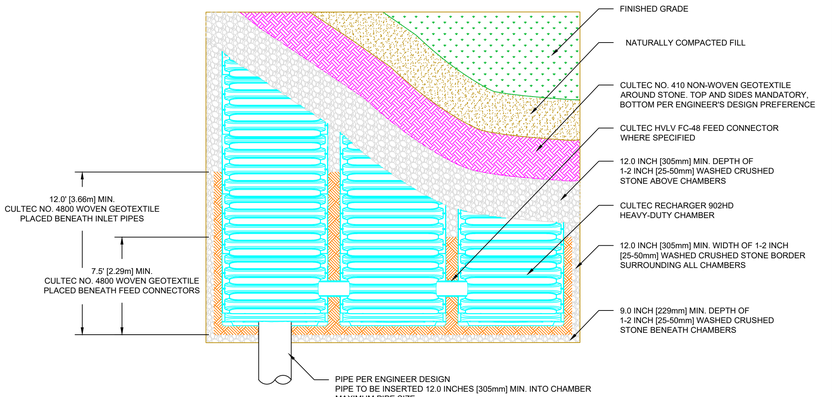
PIPE	A	B
6" [150 mm]	N/A	N/A
8" [200 mm]	N/A	N/A
10" [250 mm]	N/A	N/A
12" [300 mm]	29.50" [749 mm]	2.25" [57 mm]
15" [375 mm]	26.50" [673 mm]	2.25" [57 mm]
18" [450 mm]	23.50" [597 mm]	2.50" [64 mm]
24" [600 mm]	16.50" [420 mm]	3.00" [76 mm]

*THE TYPICAL INVERT TABLE ABOVE IS BASED ON THE INSIDE DIAMETER OF STANDARD CORRUGATED PLASTIC PIPE. THE HEAVY DUTY END CAP HAS PRE-MARKED TRIM LINES FOR PIPE DIAMETERS 12" (300mm), 15" (375mm), 18" (450mm) AND 24" (600mm). PIPES OF ANY SIZE AND MATERIAL UP TO 24" MAY BE PLACED AT CUSTOM LOCATIONS AND CUSTOM INVERTS. THE CROWN OF THE PIPE MUST REMAIN A MINIMUM OF 4" (100mm) FROM THE EDGE OF THE HEAVY DUTY END CAP.



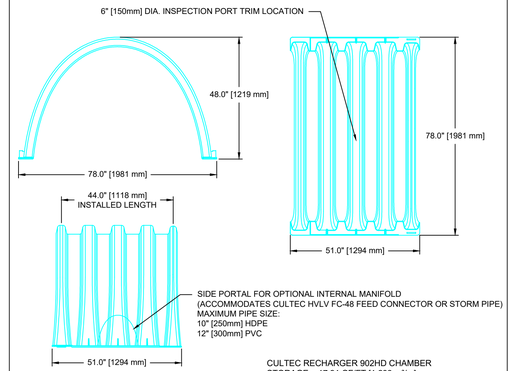
902HD 2.0

CULTEC RECHARGER 902HD HEAVY DUTY PLAN VIEW



902HD 3.0

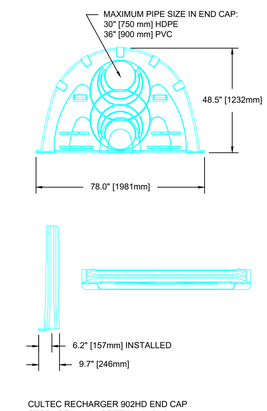
CULTEC RECHARGER 902HD HEAVY DUTY THREE VIEW



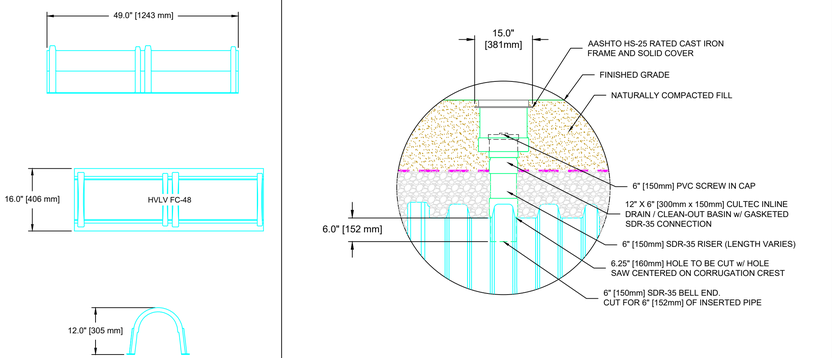
CULTEC RECHARGER 902HD CHAMBER
STORAGE = 17.31 CF/FT [1.608 m³/m]
INSTALLED LENGTH ADJUSTMENT = 0.58' [.176m]

902HD 4.0

CULTEC RECHARGER 902HD HEAVY DUTY END CAP THREE VIEW



CULTEC RECHARGER 902HD END CAP
STORAGE = 5.34 CF/FT [0.50m³/m]
INSTALLED LENGTH ADJUSTMENT = 0.29' [.08m]



NOTES:
1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

902HD 5.0

CULTEC RECHARGER 902HD HEAVY DUTY CROSS SECTION

902HD 6.0

CULTEC RECHARGER 902HD HEAVY DUTY TYPICAL INTERLOCK

NOTES:
1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
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   3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

902HD 7.0

CULTEC RECHARGER 902HD TYPICAL PIPE INVERTS

902HD 8.0

CULTEC HVLV FC-48 FEED CONNECTOR THREE VIEW

902HD 9.0

CULTEC INSPECTION PORT - ZOOM DETAIL

902HD 10.0

CULTEC INTERNAL MANIFOLD - OPTIONAL INSPECTION PORT DETAIL

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Subsurface Stormwater Management Systems
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Brookfield, CT 06804
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tech@cultec.com

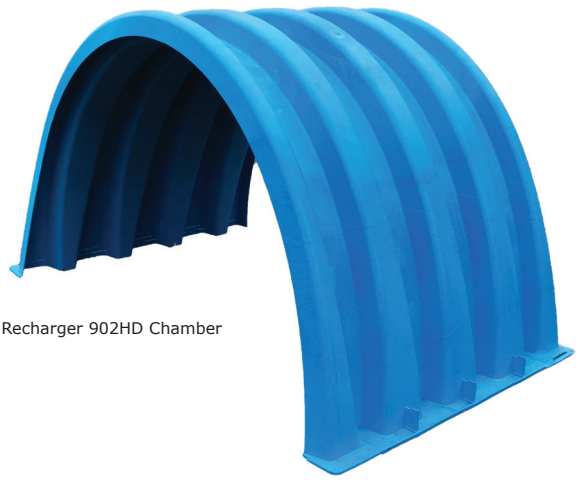
RECHARGER 902HD
DETAIL SHEET
NON-TRAFFIC APPLICATION

CULTEC STORMWATER CHAMBER

PROJECT NO:	-	DATE:	03/2020
DESIGNED BY:	TECH	CHECKED BY:	TECH
SCALE:	N.T.S.	SHEET NO:	2 OF 2

CULTEC RECHARGER® 902HD STORMWATER CHAMBER

The Recharger® 902HD is a 48" (1219 mm) tall, high capacity chamber. Typically when using this model, fewer chambers are required resulting in less labor and a smaller installation area. The Recharger® 902HD has the side portal internal manifold feature. HVLV® FC-48 Feed Connectors are inserted into the side portals to create the internal manifold.



Recharger 902HD Chamber

Recharger 902HD End Cap

Recharger 902HD Chamber	
Size (L x W x H)	4.25' x 78" x 48"
	1.30 m x 1981 mm x 1219 mm
Installed Length	3.67'
	1.12 m
Length Adjustment per Row - with two end caps installed	1.03'
	0.31 m
Length Adjustment per Row - when not using end caps	0.58'
	0.18 m
Chamber Storage	17.31 ft^3/ft
	1.61 m^3/m
	63.47 ft^3/unit
	1.80 m^3/unit
Min. Installed Storage	27.06 ft^3/ft
	2.53 m^3/m
	99.28 ft^3/unit
	2.81 m^3/unit
Min. Area Required	26.58 ft^2
	2.47 m^2
Chamber Weight	83.0 lbs
	37.65 kg
Shipping	15 chambers/skid
	1,370 lbs/skid
	14 skids/48' flatbed
Min. Center-to-Center Spacing	7.25'
	2.21 m
Max. Allowable Cover	8.3'
	2.53 m
Max. Allowable O.D. in Side Portal	10" HDPE, 12" PVC
	250 mm HDPE, 300 mm PVC
Compatible Feed Connector	HVLV FC-48 Feed Connector

Calculations are based on installed chamber length.
All above values are nominal.
Includes 12" (305 mm) stone above crown of chamber and typical stone surround at 7.25' (2.21 m) center-to-center spacing and stone foundation depth as listed in table.
Stone void calculated at 40%.

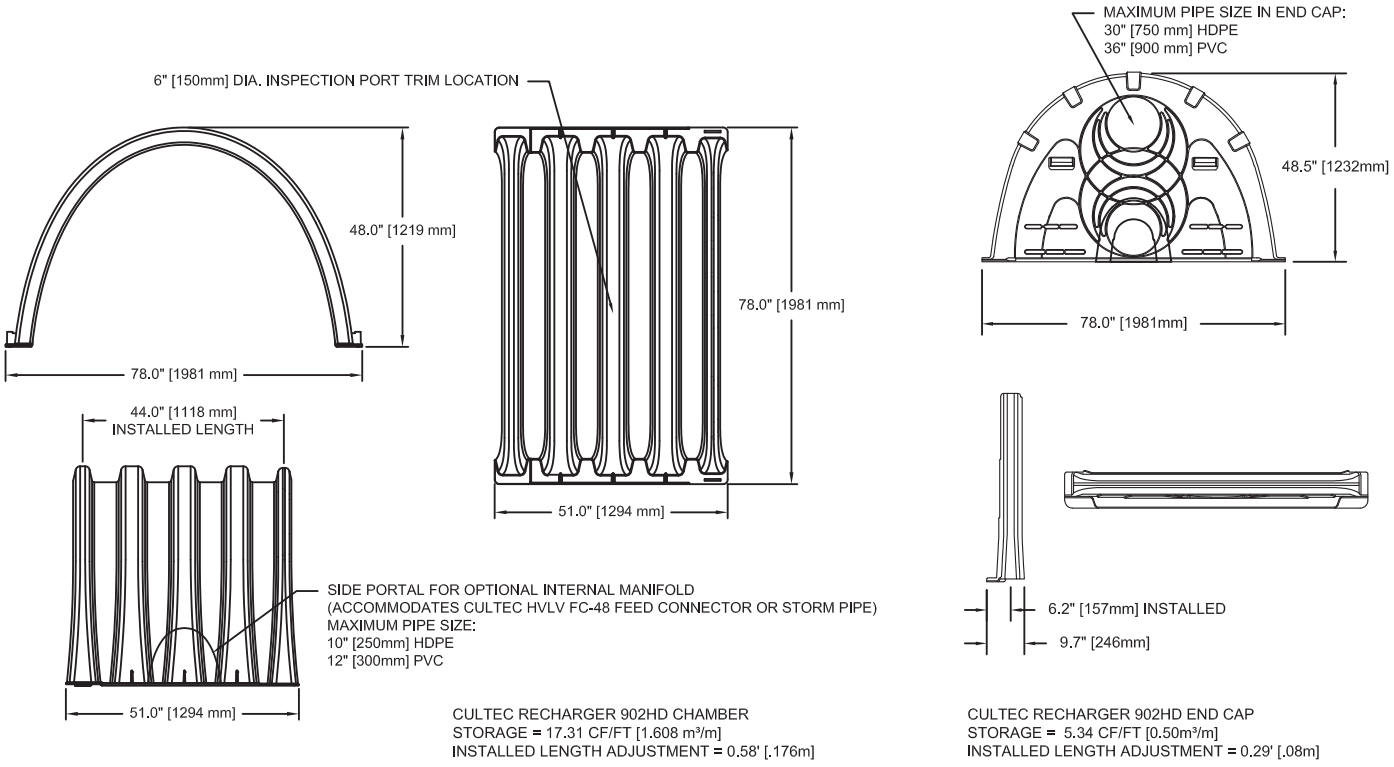
	Stone Foundation Depth		
	9"	12"	18"
	229 mm	305 mm	457 mm
Chamber and Stone Storage Per Chamber	99.28 ft^3	101.94 ft^3	107.26 ft^3
	2.81 m^3	2.89 m^3	3.04 m^3
Min. Effective Depth	5.75'	6.00'	6.5'
	1.75 m	1.83 m	1.98 m
Stone Required Per Chamber	3.32 yd^3	3.56 yd^3	4.05 yd^3
	2.54 m^3	2.72 m^3	3.06 m^3

Recharger 902HD End Cap	
Size (L x W x H)	9.7" x 78" x 48.5"
	246 mm x 1982 mm x 1231 mm
Installed Length	6.2"
	157 mm
End Cap Storage	5.34 ft^3/ft
	0.50 m^3/m
	2.76 ft^3/unit
	0.08 m^3/unit
Min. Installed Storage	19.88 ft^3/ft
	1.85 m^3/m
	10.28 ft^3/unit
	0.29 m^3/unit
End Cap Weight	52.0 lbs
	23.59 kg
Shipping	7 end caps/skid
	638 lbs/skid
	14 skids/48' flatbed
Max. Inlet Opening in End Cap	30" HDPE, 36" PVC
	750 mm HDPE, 900 mm PVC

Calculations are based on installed chamber length.
All above values are nominal.
Min. installed storage includes 9" (229 mm) stone base, 12" (305 mm) stone above crown of chamber and typical stone surround at 7.25' (2.21 m) center-to-center spacing.

For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

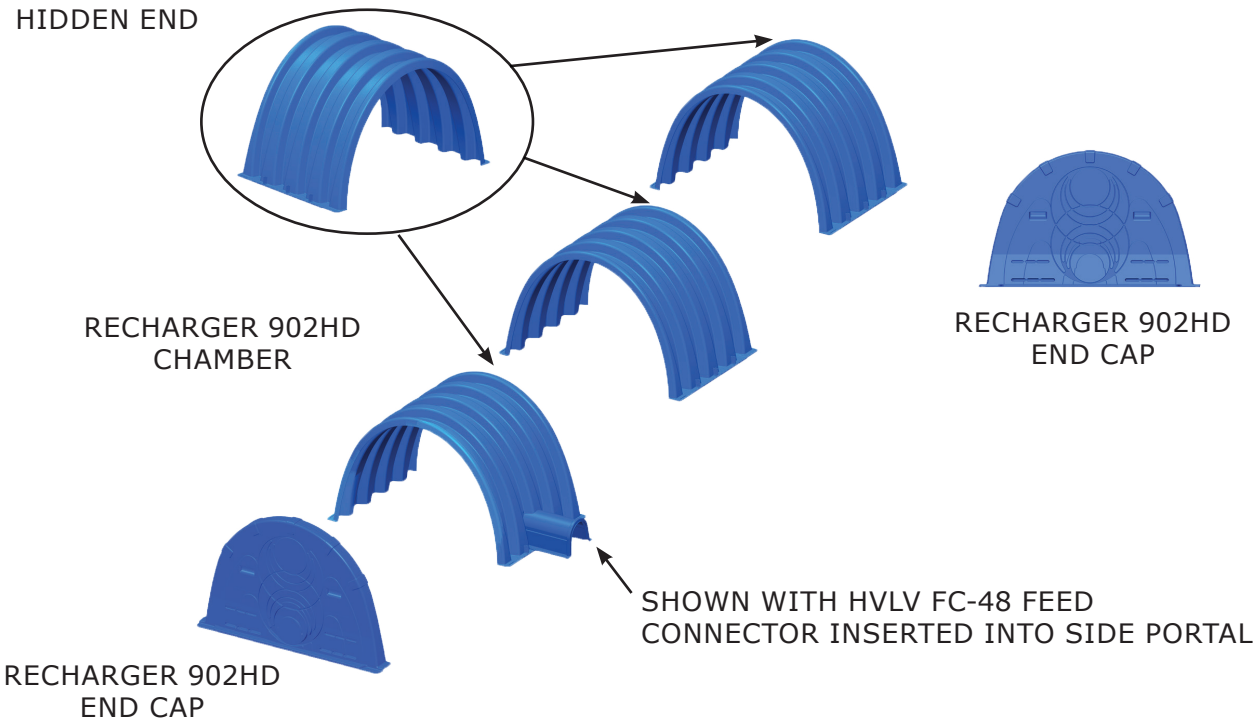
Three View Drawing



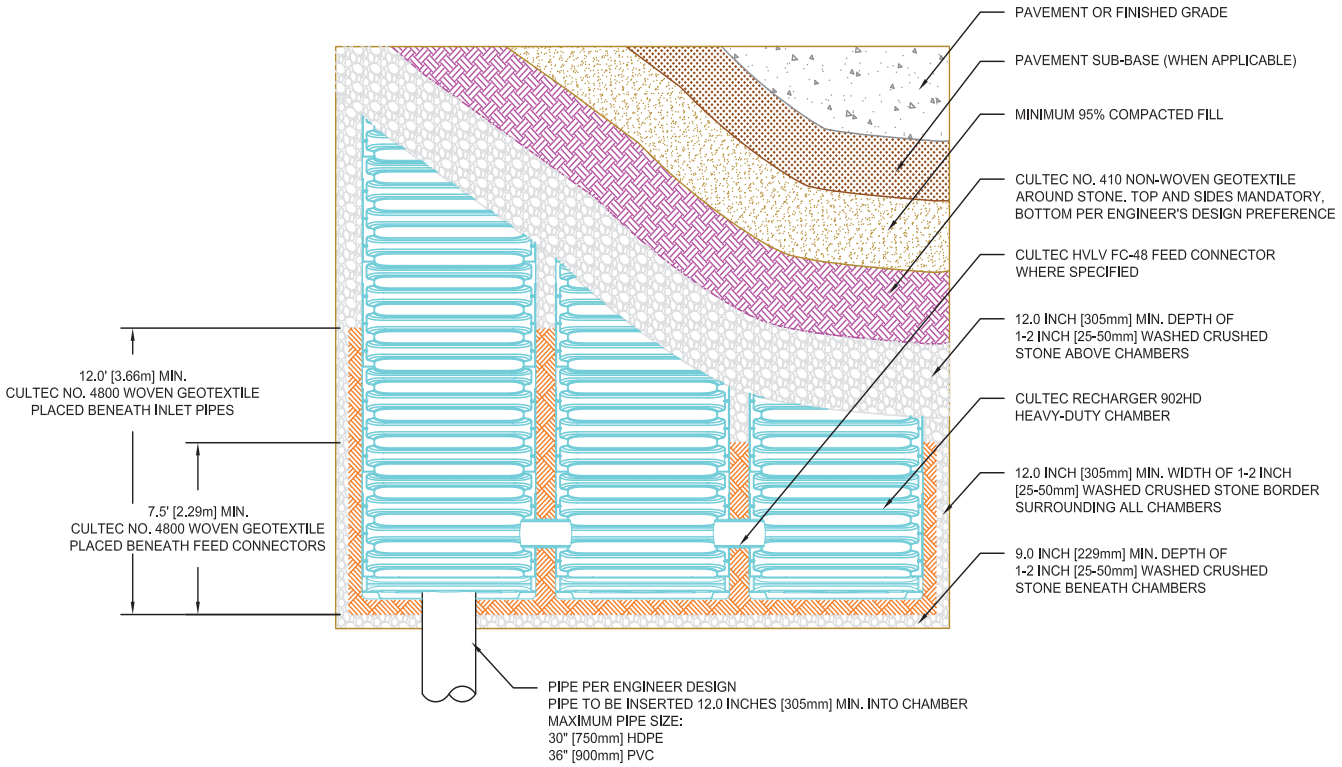
CULTEC RECHARGER 902HD CHAMBER
STORAGE = 17.31 CF/FT [1.608 m³/m]
INSTALLED LENGTH ADJUSTMENT = 0.58' [.176m]

CULTEC RECHARGER 902HD END CAP
STORAGE = 5.34 CF/FT [0.50m³/m]
INSTALLED LENGTH ADJUSTMENT = 0.29' [.08m]

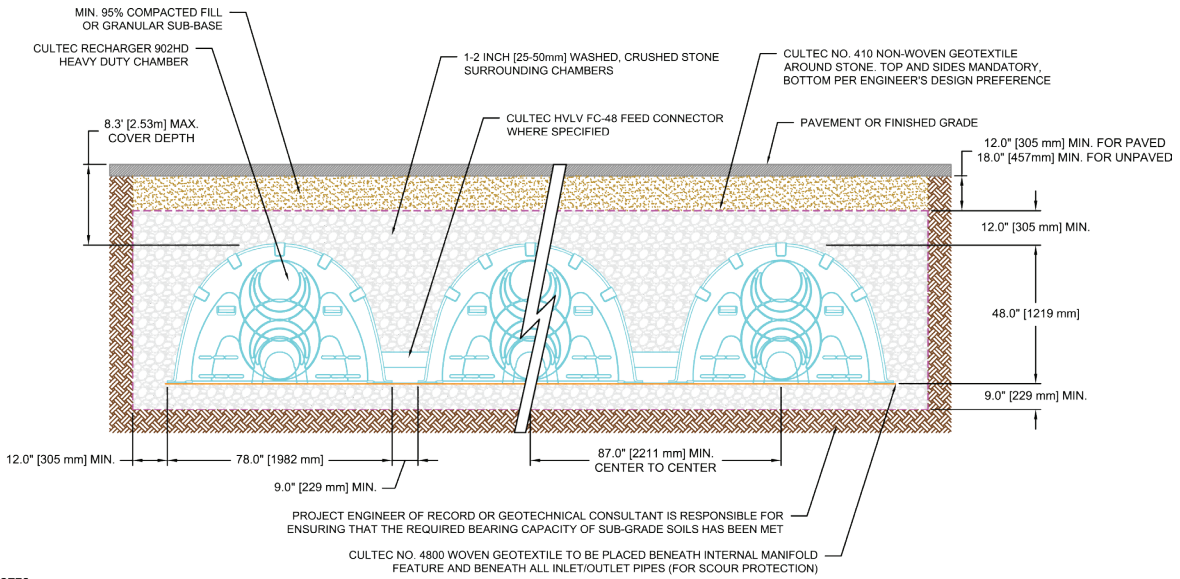
Typical Interlock Installation



Plan View Drawing



Typical Cross Section for Traffic Application



NOTES:

1. THE CHAMBERS SHALL BE DESIGNED AND TESTED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS." THE LOAD CONFIGURATION SHALL INCLUDE:
   - 1.a. INSTANTANEOUS AASHTO DESIGN TRUCK LIVE LOAD AT MINIMUM COVER
   - 1.b. MAXIMUM PERMANENT (50-YEAR) COVER LOAD
   - 1.c. 1-WEEK PARKED AASHTO DESIGN TRUCK LOAD
2. THE CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F3430-20 "STANDARD SPECIFICATION FOR CELLULAR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS"
3. THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE RESISTANCE TO THE LOADS AND LOAD FACTORS AS DEFINED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12, WHEN INSTALLED ACCORDING TO CULTEC'S RECOMMENDED INSTALLATION INSTRUCTIONS. THE STRUCTURAL DESIGN OF THE CHAMBERS SHALL INCLUDE THE FOLLOWING:
   - 3.a. THE CREEP MODULUS SHALL BE 50-YEAR AS SPECIFIED IN ASTM F3430
   - 3.b. THE MINIMUM SAFETY FACTOR FOR LIVE LOADS SHALL BE 1.75
   - 3.c. THE MINIMUM SAFETY FACTOR FOR DEAD LOADS SHALL BE 1.95

CULTEC RECHARGER® 902HD STORMWATER CHAMBER

Recharger® 902HD Bare Chamber Storage Volumes

Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft³/ft	m³/m	ft³	m³	ft³	m³
48	1219	0.020	0.002	0.073	0.002	63.470	1.797
47	1194	0.050	0.005	0.183	0.005	63.397	1.795
46	1168	0.070	0.007	0.257	0.007	63.213	1.790
45	1143	0.120	0.011	0.440	0.012	62.957	1.783
44	1118	0.160	0.015	0.587	0.017	62.517	1.770
43	1092	0.200	0.019	0.733	0.021	61.930	1.754
42	1067	0.220	0.020	0.807	0.023	61.197	1.733
41	1041	0.240	0.022	0.880	0.025	60.390	1.710
40	1016	0.270	0.025	0.990	0.028	59.510	1.685
39	991	0.270	0.025	0.990	0.028	58.520	1.657
38	965	0.290	0.027	1.063	0.030	57.530	1.629
37	940	0.300	0.028	1.100	0.031	56.467	1.599
36	914	0.310	0.029	1.137	0.032	55.367	1.568
35	889	0.330	0.031	1.210	0.034	54.230	1.536
34	864	0.340	0.032	1.247	0.035	53.020	1.502
33	838	0.350	0.033	1.283	0.036	51.773	1.466
32	813	0.350	0.033	1.283	0.036	50.490	1.430
31	787	0.360	0.033	1.320	0.037	49.207	1.394
30	762	0.370	0.034	1.357	0.038	47.887	1.356
29	737	0.380	0.035	1.393	0.039	46.530	1.318
28	711	0.390	0.036	1.430	0.040	45.137	1.278
27	686	0.390	0.036	1.430	0.040	43.707	1.238
26	660	0.400	0.037	1.467	0.042	42.277	1.197
25	635	0.400	0.037	1.467	0.042	40.810	1.156
24	610	0.410	0.038	1.503	0.043	39.343	1.114
23	584	0.410	0.038	1.503	0.043	37.840	1.072
22	559	0.410	0.038	1.503	0.043	36.337	1.029
21	533	0.420	0.039	1.540	0.044	34.833	0.986
20	508	0.420	0.039	1.540	0.044	33.293	0.943
19	483	0.420	0.039	1.540	0.044	31.753	0.899
18	457	0.430	0.040	1.577	0.045	30.213	0.856
17	432	0.430	0.040	1.577	0.045	28.637	0.811
16	406	0.440	0.041	1.613	0.046	27.060	0.766
15	381	0.440	0.041	1.613	0.046	25.447	0.721
14	356	0.450	0.042	1.650	0.047	23.833	0.675
13	330	0.450	0.042	1.650	0.047	22.183	0.628
12	305	0.450	0.042	1.650	0.047	20.533	0.582
11	279	0.450	0.042	1.650	0.047	18.883	0.535
10	254	0.460	0.043	1.687	0.048	17.233	0.488
9	229	0.460	0.043	1.687	0.048	15.547	0.440
8	203	0.460	0.043	1.687	0.048	13.860	0.393
7	178	0.460	0.043	1.687	0.048	12.173	0.345
6	152	0.470	0.044	1.723	0.049	10.487	0.297
5	127	0.470	0.044	1.723	0.049	8.763	0.248
4	102	0.480	0.045	1.760	0.050	7.040	0.199
3	76	0.480	0.045	1.760	0.050	5.280	0.150
2	51	0.480	0.045	1.760	0.050	3.520	0.100
1	25	0.480	0.045	1.760	0.050	1.760	0.050
Total		**17.310**	**1.608**	**63.470**	**1.797**	**63.470**	**1.797**

Calculations are based on installed chamber length of 3.67' (1.12 m).

Recharger® 902HD Bare End Cap Storage Volumes

Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft³/ft	m³/m	ft³	m³	ft³	m³
48	1219	0.039	0.004	0.020	0.0006	2.758	0.0781
47	1194	0.058	0.005	0.030	0.0008	2.738	0.0775
46	1168	0.058	0.005	0.030	0.0008	2.780	0.0767
45	1143	0.077	0.007	0.040	0.0011	2.678	0.0758
44	1118	0.097	0.009	0.050	0.0014	2.638	0.0747
43	1092	0.077	0.007	0.040	0.0011	2.588	0.0733
42	1067	0.097	0.009	0.050	0.0014	2.548	0.0722
41	1041	0.097	0.009	0.050	0.0014	2.498	0.0707
40	1016	0.097	0.009	0.050	0.0014	2.448	0.0693
39	991	0.097	0.009	0.050	0.0014	2.398	0.0679
38	965	0.097	0.009	0.050	0.0014	2.348	0.0665
37	940	0.116	0.011	0.060	0.0017	2.299	0.0651
36	914	0.097	0.009	0.050	0.0014	2.239	0.0634
35	889	0.097	0.009	0.050	0.0014	2.189	0.0620
34	864	0.116	0.011	0.060	0.0017	2.139	0.0606
33	838	0.097	0.009	0.050	0.0014	2.079	0.0589
32	813	0.097	0.009	0.050	0.0014	2.029	0.0574
31	787	0.116	0.011	0.060	0.0017	1.979	0.0560
30	762	0.097	0.009	0.050	0.0014	1.919	0.0543
29	737	0.135	0.013	0.070	0.0020	1.869	0.0529
28	711	0.097	0.009	0.050	0.0014	1.799	0.0509
27	686	0.116	0.011	0.060	0.0017	1.749	0.0495
26	660	0.116	0.011	0.060	0.0017	1.689	0.0478
25	635	0.097	0.009	0.050	0.0014	1.629	0.0461
24	609	0.116	0.011	0.060	0.0017	1.579	0.0447
23	584	0.116	0.011	0.060	0.0017	1.519	0.0430
22	559	0.135	0.013	0.070	0.0020	1.459	0.0413
21	533	0.116	0.011	0.060	0.0017	1.389	0.0393
20	508	0.116	0.011	0.060	0.0017	1.329	0.0376
19	483	0.116	0.011	0.060	0.0017	1.269	0.0359
18	457	0.116	0.011	0.060	0.0017	1.209	0.0342
17	432	0.116	0.011	0.060	0.0017	1.149	0.0325
16	406	0.135	0.013	0.070	0.0020	1.089	0.0308
15	381	0.116	0.011	0.060	0.0017	1.019	0.0289
14	356	0.116	0.011	0.060	0.0017	0.959	0.0272
13	330	0.116	0.011	0.060	0.0017	0.899	0.0255
12	305	0.135	0.013	0.070	0.0020	0.839	0.0238
11	279	0.116	0.011	0.060	0.0017	0.770	0.0218
10	254	0.135	0.013	0.070	0.0020	0.710	0.0201
9	229	0.135	0.013	0.070	0.0020	0.640	0.0181
8	203	0.135	0.013	0.070	0.0020	0.570	0.0161
7	178	0.135	0.013	0.070	0.0020	0.500	0.0141
6	152	0.116	0.011	0.060	0.0017	0.430	0.0122
5	127	0.135	0.013	0.070	0.0020	0.370	0.0105
4	102	0.135	0.013	0.070	0.0020	0.300	0.0085
3	76	0.155	0.014	0.080	0.0023	0.230	0.0065
2	51	0.135	0.013	0.070	0.0020	0.150	0.0042
1	25	0.155	0.014	0.080	0.0023	0.080	0.0023
Total		**5.338**	**0.496**	**2.758**	**0.0781**	**2.758**	**0.0781**

Calculations are based on installed chamber length of 6.2" (157 mm).

For more information, contact CULTEC at (203) 775-4416 or visit www.cultec.com.

CULTEC Recharger® 902HD Specifications

GENERAL

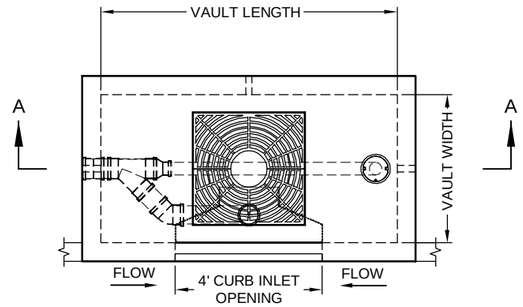
CULTEC Recharger® 902HD chambers are designed for underground stormwater management. The chambers may be used for retention, recharging, detention or controlling the flow of on-site stormwater runoff.

CHAMBER PARAMETERS

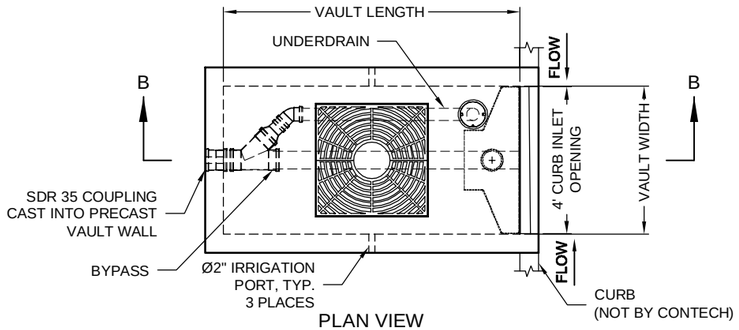
1. The chambers shall be manufactured in the U.S.A. or Canada by CULTEC, Inc. of Brookfield, CT (cultec.com, 203-775-4416).
2. The chambers shall be designed and tested in accordance with ASTM F2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers". The load configuration shall include:
    a. Instantaneous AASHTO Design Truck live load at minimum cover
    b. Maximum permanent (50-year) cover load
    c. 1-week parked AASHTO design truck load
3. The chambers shall meet the requirements of ASTM F3430-20 "Standard Specification for Cellular Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers".
4. The installed chamber system shall provide resistance to the loads and load factors as defined in the AASHTO LRFD Bridge Design Specifications Section 12.12, when installed according to CULTEC's recommended installation instructions. The structural design of the chambers shall include the following:
    a. The Creep Modulus shall be 50-year as specified in ASTM F3430
    b. The minimum safety factor for live loads shall be 1.75
    c. The minimum safety factor for dead loads shall be 1.95
5. The chamber shall be structural foam injection molded of blue virgin high molecular weight impact-modified polypropylene.
6. The chamber shall be arched in shape.
7. The chamber shall be open-bottomed.
8. The chamber shall be joined using an interlocking overlapping rib method. Connections must be fully shouldered overlapping ribs, having no separate couplings.
9. The nominal chamber dimensions of the CULTEC Recharger® 902HD shall be 48 inches (1219 mm) tall, 78 inches (1981 mm) wide and 4.25 feet (1.30 m) long. The installed length of a joined Recharger 902HD shall be 3.67 feet (1.12 m).
10. Multiple chambers may be connected to form different length rows. Each row shall begin and end with a separately formed CULTEC Recharger® 902HD End Cap. Maximum inlet opening on the end cap is 30 inches (750 mm) HDPE or 36 inches (900 mm) PVC.
11. The chamber shall have two side portals to accept CULTEC HVLV™ FC-48 Feed Connectors to create an internal manifold. Maximum allowable pipe size in the side portal is 10 inches (250 mm) HDPE and 12 inches (300 mm) PVC.
12. The nominal chamber dimensions of the CULTEC HVLV™ FC-48 Feed Connector shall be 12 inches (305 mm) tall, 16 inches (406 mm) wide and 49 inches (1245 mm) long.
13. The nominal storage volume of the Recharger 902HD chamber shall be 17.31 ft^3 / ft (1.61 m^3 / m) - without stone. The nominal storage volume of a joined Recharger 902HD shall be 63.47 ft^3 / unit (1.80 m^3 / unit) - without stone.
14. The nominal storage volume of the HVLV™ FC-48 Feed Connector shall be 0.913 ft^3 / ft (0.085 m^3 / m) - without stone.
15. The Recharger 902HD chamber shall have 5 corrugations.
16. The chamber shall be capable of accepting a 6 inch (150 mm) inspection port opening at the top center of each chamber, centered on the corrugation crest.
17. The units may be trimmed to custom lengths by cutting back to any corrugation.
18. The chamber shall be manufactured in a facility employing CULTEC's Quality Control and Assurance Procedures.
19. Maximum allowable cover over the top of the chamber shall be 8.3 feet (2.53 m).

END CAP PARAMETERS

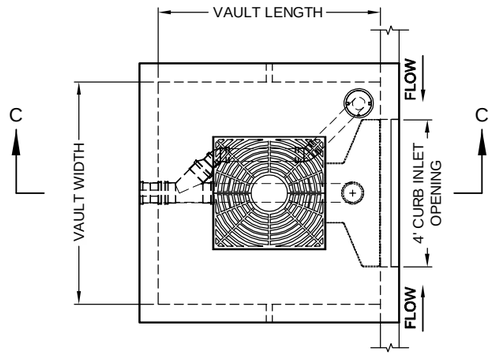
1. The CULTEC Recharger® 902HD End Cap (referred to as 'end cap') shall be manufactured in the U.S.A. by CULTEC, Inc. of Brookfield, CT (cultec.com, 203-775-4416).
2. The end cap shall be twin-sheet thermoformed of virgin high molecular weight polyethylene.
3. The end cap shall be joined at the beginning and end of each row of chambers using an interlocking overlapping rib method. Connections must be fully shouldered overlapping ribs, having no separate couplings.
4. The nominal dimensions of the end cap shall be 48.5 inches (1231 mm) tall, 78 inches (1982 mm) wide and 9.7 inches (246 mm) long. When joined with a Recharger 902HD Chamber, the installed length of the end cap shall be 6.2 inches (157 mm).
5. The nominal storage volume of the end cap shall be 5.34 ft^3 / ft (0.50 m^3 / m) - without stone. The nominal storage volume of an interlocked end cap shall be 2.76 ft^3 / unit (0.08 m^3 / unit) - without stone.
6. Maximum inlet opening on the end cap is 30 inches (750 mm) HDPE or 36 inches (900 mm) PVC.
7. The end cap shall provide resistance to the loads and load factors as defined in the AASHTO LRFD Bridge Design Specifications Section 12.12.



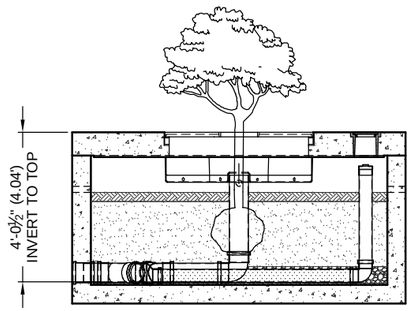
PLAN VIEW



PLAN VIEW

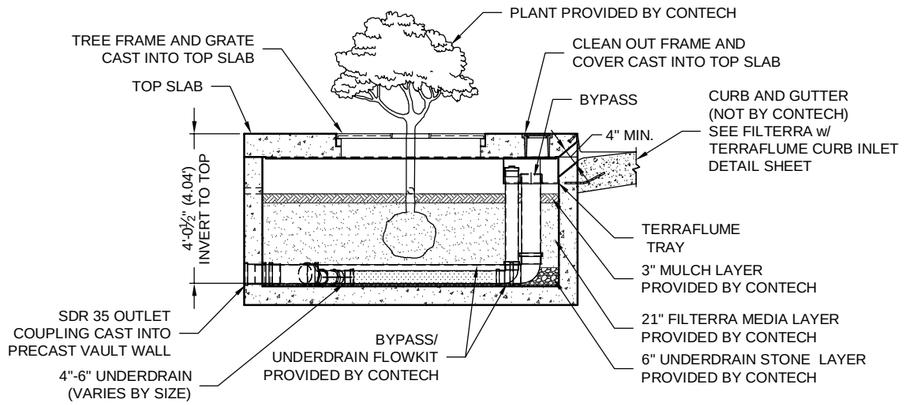


PLAN VIEW



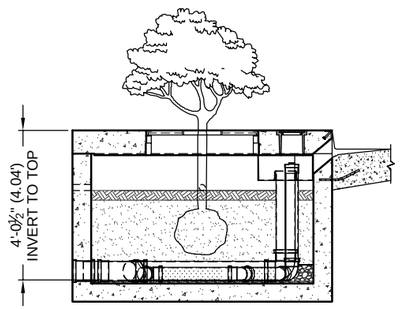
SECTION A-A

LONG SIDE INLET CONFIGURATION



SECTION B-B

SHORT SIDE INLET CONFIGURATION



SECTION C-C

SQUARE INLET CONFIGURATION

LONG SIDE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0604	ALL	6 x 4	6 x 4	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC078045	DE, MD, NJ, PA, VA, WV ONLY	7.83 x 4.5	7.83 x 4.5	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0804	N/A DE, MD, NJ, PA, VA, WV	8 x 4	8 x 4	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0806	ALL	8 x 6	8 x 6	10" SDR 35	2.37	4" SDR 35	(1) 4' x 4'
FTIBC1006	ALL	10 x 6	10 x 6	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
FTIBC1206	ALL	12 x 6	12 x 6	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC1307	ALL	13 x 7	13 x 7	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC1408	ALL	14 x 8	14 x 8	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC1509	OR,WA ONLY	15 x 9	15 x 9	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

SHORT SIDE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0406	ALL	4 x 6	4 x 6	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0408	N/A DE, MD, NJ, PA, VA, WV	4 x 8	4 x 8	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC045078	DE, MD, NJ, PA, VA, WVONLY	4.5 x 7.83	4.5 x 7.83	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0608	ALL	6 x 8	6 x 8	10" SDR 35	2.37	4" SDR 35	(1) 4' x 4'
FTIBC0610	ALL	6 x 10	6 x 10	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
FTIBC0612	ALL	6 x 12	6 x 12	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC0713	ALL	7 x 13	7 x 13	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

SQUARE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0404	ALL	4 x 4	4'-0"	6" SDR 35	1.42	4" SDR 35	(1) 3' x 3'
FTIBC0606	ALL	6 x 6	6'-0"	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'

N/A = NOT AVAILABLE

INTERNAL PIPE CONFIGURATION MAY VARY DEPENDING ON VAULT SIZE.

filterra

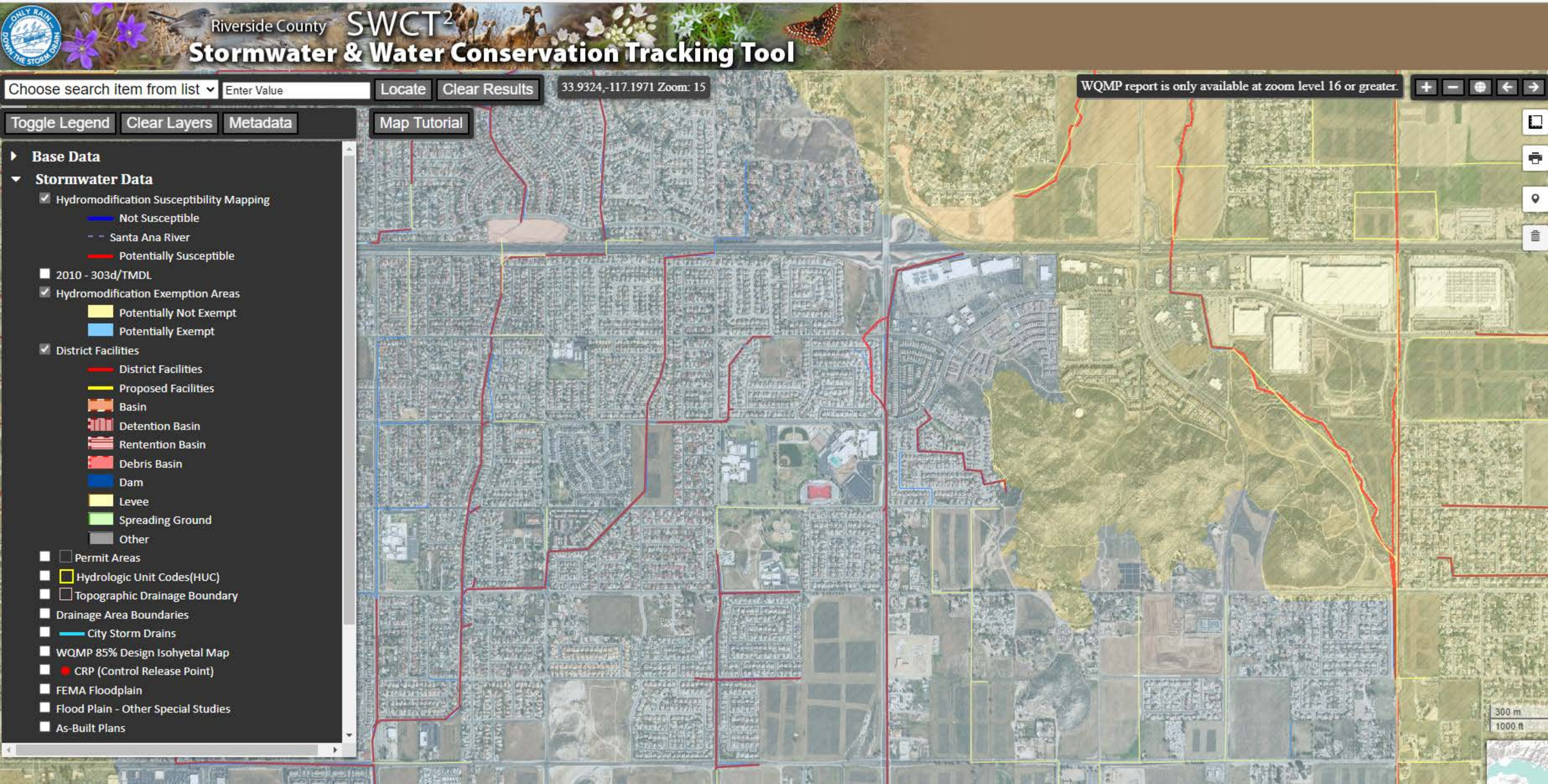
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 6,277,274; 6,569,321; 7,625,485; 7,425,261; 7,833,412; RELATED FOREIGN PATENTS.

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

FILTERRA
INTERNAL BYPASS CURB (FTIBC)
CONFIGURATION DETAIL

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern


Riverside County SWCT²
Stormwater & Water Conservation Tracking Tool
Choose search item from list
Enter Value
Locate
Clear Results
33.9324,-117.1971 Zoom: 15
WQMP report is only available at zoom level 16 or greater.
Toggle Legend
Clear Layers
Metadata
Map Tutorial
Base Data
Stormwater Data
Hydromodification Susceptibility Mapping
Not Susceptible
Santa Ana River
Potentially Susceptible
2010 - 303d/TMDL
Hydromodification Exemption Areas
Potentially Not Exempt
Potentially Exempt
District Facilities
District Facilities
Proposed Facilities
Basin
Detention Basin
Rentention Basin
Debris Basin
Dam
Levee
Spreading Ground
Other
Permit Areas
Hydrologic Unit Codes(HUC)
Topographic Drainage Boundary
Drainage Area Boundaries
City Storm Drains
WQMP 85% Design Isohyetal Map
CRP (Control Release Point)
FEMA Floodplain
Flood Plain - Other Special Studies
As-Built Plans
300 m
1000 ft

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

Appendix 8

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the 2014 SMR WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1on page 31 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
✠ A. **On-site storm drain inlets**	✠ **Locations of inlets.**	✠ **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	✠ **Maintain and periodically repaint or replace inlet markings.** ✠ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ✠ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ✠ **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
✠ B. **Interior floor drains and elevator shaft sump pumps**		✠ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	✠ **Inspect and maintain drains to prevent blockages and overflow.**
✠ C. **Interior parking garages**		✠ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	✠ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
✠ D1. **Need for future indoor & structural pest control**		✠ **Note building design features that discourage entry of pests.**	✠ **Provide Integrated Pest Management information to owners, lessees, and operators.**
✠ D2. **Landscape/ Outdoor Pesticide Use**	❑ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ❑ **Show self-retaining landscape areas, if any.** ❑ **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	**State that final landscape plans will accomplish all of the following.** ✠ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ✠ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** ✠ **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ✠ **Consider using pest-resistant plants, especially adjacent to hardscape. To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	✠ **Maintain landscaping using minimum or no pesticides.** ❑ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at http://www.rcflood.org/stormwater/Downloads/LandscapeGardenBrochure.pdf ❑ **Provide IPM information to new owners, lessees and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ E. **Pools, spas, ponds, decorative fountains, and other water features.**	❑ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)**	**If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	❑ **See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://www.rcflood.org/stormwater/Downloads/poolsandspas.pdf**
❑ F. **Food service**	❑ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ❑ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	❑ **Describe the location and features of the designated cleaning area.** ❑ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	❑ **See the brochure, "The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://www.rcflood.org/stormwater/downloads/FoodServ.pdf** **Provide this brochure to new site owners, lessees, and operators.**
✠ G. **Refuse areas**	✠ **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ✠ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ✠ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	❑ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ✠ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	✠ **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://www.rcflood.org/stormwater/Downloads/IndustrialCommercialFacilities.pdf
✠ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	✠ **Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** www.cchealth.org/groups/hazmat/	✠ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
✠ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at** http://www.rcflood.org/stormwater/downloads/OutdoorCleaningActivities.pdf ❑ **Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** **Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at** http://rcflood.org/stormwater/ **Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at** http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
✠ N. **Fire Sprinkler Test Water**		❑ **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	❑ **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ❑ **Boiler drain lines** ❑ **Condensate drain lines** ❑ **Rooftop equipment** ❑ **Drainage sumps** ❑ **Roofing, gutters, and trim.** ❑ **Other sources**		❑ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ❑ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ❑ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ❑ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ❑ **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.** ❑ **Include controls for other sources as specified by local reviewer.**	

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
✠ P. **Plazas, sidewalks, and parking lots.**			✠ **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

Bioretention Operations and Maintenance

General Requirements

Bioretention areas require annual plant, soil, and mulch layer maintenance to ensure optimum infiltration, storage, and pollutant removal capabilities. In general, bioretention maintenance requirements are typical landscape care procedures and include:

1. Watering: Plants should be selected to be drought tolerant and not require watering after establishment (2 to 3 years). Watering may be required during prolonged dry periods after plants are established.

2. Erosion control: Inspect flow entrances, ponding area, and surface overflow areas periodically, and replace soil, plant material, and/or mulch layer in areas if erosion has occurred (see Appendix E for guidance on facility inspection and Appendix F for a bioretention inspection and maintenance checklist). Properly designed facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems occur the following should be reassessed: (1) flow velocities and gradients within the cell, and (2) flow dissipation and erosion protection strategies in the pretreatment area and flow entrance. If sediment is deposited in the bioretention area, immediately determine the source within the contributing area, stabilize, and remove excess surface deposits.

3. Plant material: Depending on aesthetic requirements, occasional pruning and removing of dead plant material may be necessary. Replace all dead plants and if specific plants have a high mortality rate, assess the cause and, if necessary, replace with more appropriate species. Periodic weeding is necessary until plants are established. The weeding schedule should become less frequent if the appropriate plant species and planting density have been used and, as a result, undesirable plants excluded.

4. Nutrient and pesticides: The soil mix and plants are selected for optimum fertility, plant establishment, and growth. Nutrient and pesticide inputs should not be required and may degrade the pollutant processing capability of the bioretention area, as well as contribute pollutant loads to receiving waters. By design, bioretention facilities are located in areas where phosphorous and nitrogen levels are often elevated and these should not be limiting nutrients. If in question, have soil analyzed for fertility.

5. Mulch: Replace mulch annually in bioretention facilities where heavy metal deposition is likely (e.g., contributing areas that include industrial and auto dealer/repair parking lots and roads). In residential lots or other areas where metal deposition is not a concern, replace or add mulch as needed to maintain a 2 to 3 inch depth at least once every two years.

6. Soil: Soil mixes for bioretention facilities are designed to maintain long-term fertility and pollutant processing capability. Estimates from metal attenuation research suggest that metal accumulation should not present an environmental concern for at least 20 years in bioretention systems. Replacing mulch in bioretention facilities where heavy metal

deposition is likely provides an additional level of protection for prolonged performance. If in question, have soil analyzed for fertility and pollutant levels.

Maintenance Standards

A summary of the routine and major maintenance activities recommended for bioretention areas is shown in Table 5-1. Detailed Routine and major maintenance standards are listed in Tables 5-2 and 5-3.

Table 5-1: Bioretention Routine and Major Maintenance Quick Guide

Inspection and Maintenance Activities Summary	
Routine Maintenance	• Repair small eroded areas and ruts by filling with gravel. Overseed bare areas to reestablish vegetation • Remove trash and debris and rake surface soils to mitigate ponding • Remove accumulated fine sediments, dead leaves and trash to restore surface permeability • Remove any evidence of visual contamination from floatables such as oil and grease • Eradicate weeds and prune back excess plant growth that interferes with facility operation. Remove invasive vegetation and replace with non-invasive species • Remove sediment and debris accumulation near inlet and outlet structures to alleviate clogging • Clean and reset flow spreaders (if present) as needed to restore original function • Mow routinely to maintain ideal grass height and to suppress weeds • Periodically observe function under wet weather conditions
Major Maintenance	• Repair structural damage to flow control structures including inlet, outlet and overflow structures • Clean out under-drain, if present, to alleviate ponding. Replace media if ponding or loss of infiltrative capacity persists and revegetate • Regrade and revegetate to repair damage from severe erosion/scour channelization and to restore sheet flow • Take photographs before and after major maintenance (encouraged)

Table 5-2: Routine Maintenance – Bioretention

Defect or Problem	**Condition When Maintenance is Needed**	**Results Expected When Maintenance Is Performed**	**Frequency**
Erosion	Splash pads or spreader incorrectly placed; eroded or scoured areas due to flow channelization, or higher flows.	No erosion on surface of basin. No erosion or scouring evident. For ruts or bare areas less than 12 inches wide, damaged areas repaired by filling with crushed gravel. The grass will creep in over the rock in time.	Annually prior to wet season. After major storm events (>0.75 in/24 hrs) if spot checks of some basins indicate widespread damage/ maintenance needs
Standing Water	When water stands in the basin between storms and does not drain freely (with 36- 48 hours after storm event).	Water drains completely from basin as designed and surface is clear of trash and debris. Underdrains (if installed) are cleared.	
Loss of Surface Permeability	Accumulation of fine sediments, dead leaves, trash and other debris on surface	Surface permeability restored. Surface layer removed and replaced with fresh mulch.	
Visual Contaminants and Pollution	Any visual evidence of oil, gasoline, contaminants or other pollutants.	No visual contaminants or pollutants present.	Monthly (or as dictated by agreement between County and landscape contractor
Vegetation	Weeds, excessive plant growth, plants interfering with basin operation, plants diseased or dying	Basin tidy, plants healthy and pruned. Any plants that interfere with function are removed. Invasive or non-acclimated plants replaced.	
Inlet/Overflow	Inlet/outlet areas clogged with sediment and/or debris.	Material removed so that there is no clogging or blockage of the inlet or overflow area.	
Trash and Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (one standard garbage can).	Trash and debris removed and facility looks well kept.	

Table 5-3: Major Maintenance – Bioretention

Defect or Problem	**Condition When Maintenance is Needed**	**Results Expected When Maintenance Is Performed**	**Frequency**
Standing water	When water stands in the basin between storms and does not drain freely (with 36- 48 hours after storm event).	Filter media (sand, gravel, and topsoil) and vegetation removed and replaced.	Annually prior to wet season
Erosion/ Scouring	Bare spots greater than 12 inches	No erosion on surface of basin. Large bare areas are regraded and reseeded/replanted.	As needed

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information

Non-Stormwater Discharges SC-10

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

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Pollution Prevention

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

Suggested Protocols

Recommended Complaint Investigation Equipment

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms
  - Educational materials

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

Illicit Connections

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

Visual Inspection and Inventory

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for a day or two following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

Review Infield Piping

- A review of the "as-built" piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.
- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

Dye Testing

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

TV Inspection of Drainage System

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

Reporting

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Document and report annually the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

Training

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.
- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.
- When a responsible party is identified, educate the party on the impacts of his or her actions.

Spill Response and Prevention

- See SC11 Spill Prevention Control and Cleanup.

Other Considerations

- Many facilities do not have accurate, up-to-date schematic drawings.

Requirements

Costs (including capital and operation & maintenance)

- The primary cost is for staff time and depends on how aggressively a program is implemented.
- Cost for containment and disposal is borne by the discharger.
- Illicit connections can be difficult to locate especially if there is groundwater infiltration.
- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

Maintenance (including administrative and staffing)

- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

Supplemental Information

Further Detail of the BMP

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots

- Types and quantities (in some cases) of wastes
- Patterns in time of occurrence (time of day/night, month, or year)
- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Facilities subject to stormwater permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The State's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

Performance Evaluation

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Spill Prevention, Control & Cleanup SC-11

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	☑
Bacteria	
Oil and Grease	☑
Organics	☑

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

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- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

- Responsible parties

Training

- Educate employees about spill prevention and cleanup.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.

- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- A Spill Prevention Control and Countermeasure Plan (SPCC) is required for facilities that are subject to the oil pollution regulations specified in Part 112 of Title 40 of the Code of Federal Regulations or if they have a storage capacity of 10,000 gallons or more of petroleum. (Health and Safety Code 6.67)

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off' of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Vehicle and Equipment Cleaning SC-21

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Wash water from vehicle and equipment cleaning activities performed outdoors or in areas where wash water flows onto the ground can contribute toxic hydrocarbons and other organic compounds, oils and greases, nutrients, phosphates, heavy metals, and suspended solids to stormwater runoff. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during vehicle and equipment cleaning.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives

Pollution Prevention

- If possible, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. These businesses are better equipped to handle and properly dispose of the wash waters.

- Good housekeeping practices can minimize the risk of contamination from wash water discharges.

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Suggested Protocols

General

- Use biodegradable, phosphate-free detergents for washing vehicles as appropriate.
- Mark the area clearly as a wash area.
- Post signs stating that only washing is allowed in wash area.
- Provide trash container in wash area.
- Map on-site storm drain locations to avoid discharges to the storm drain system.
- Emphasize the connection between the storm drain system and runoff, help reinforce that car washing activities affect local water quality through storm drain stenciling programs.

Vehicle and Equipment Cleaning

- Have all vehicle washing done in areas designed to collect and hold the wash and rinse water or effluent generated. Recycle, collect or treat wash water effluent prior to discharge to the sanitary sewer system.
- If washing/cleaning must occur on-site, consider washing vehicle equipment inside the building or on an impervious surface to control the targeted constituents by directing them to the sanitary sewer.
- If washing must occur on-site and outdoor:
  - Use designated paved wash areas. Designated wash areas must be well marked with signs indicating where and how washing must be done. This area must be covered or bermed to collect the wash water and graded to direct the wash water to a treatment or disposal facility.
  - Do not conduct oil changes and other engine maintenance in the designated washing area. Perform these activities in a place designated for oil change and maintenance activities.
  - Cover the wash area when not in use to prevent contact with rain water.
- Install sumps or drain lines to collect wash water for treatment.
- Use hoses with nozzles that automatically turn off when left unattended.
- Do not permit steam cleaning wash water to enter the storm drain.
- Pressure and steam clean off-site to avoid generating runoff with high pollutant concentrations. If done on-site, no pressure cleaning and steam cleaning should be done in areas designated as wellhead protection areas for public water supply.

Disposal

- Consider filtering and recycling wash water.
- Discharge equipment wash water to the sanitary sewer, a holding tank, or a process treatment system, regardless of the washing method used.
- Collect all wash water from vehicle cleaning operations and (1) discharge to a sanitary sewer, holding tank, or process treatment system or (2) run through an enclosed recycling system.
- Collect and treat wash water at the facility and either recycle or discharge to the sanitary sewer system or collect and dispose of as an industrial waste.
- Discharge wash water to sanitary sewer after contacting local sewer authority to find out if pretreatment is required.

Training

- Train employees on proper cleaning and wash water disposal procedures and conduct "refresher" courses on a regular basis.
- Train staff on proper maintenance measures for the wash area.
- Train employees and contractors on proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

Spill Response and Prevention

- Keep the Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment, and trained personnel ready at all times to deal immediately with major spills.
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.

Other Considerations (Limitations and Regulations)

- Some municipalities may require pretreatment and monitoring of wash water discharges to the sanitary sewer.
- Steam cleaning can generate significant pollutant concentrations requiring that careful consideration be given to the environmental impacts and compliance issues related to steam cleaning.
- Most car washing best management practices are inexpensive, and rely more on good housekeeping practices (where vehicles are washed, planning for the collection of wash water) than on expensive technology. However, the construction of a specialized area for vehicle washing can be expensive. Also, for facilities that cannot recycle their wash water, the cost of pre-treating wash water through either structural practices or planning for

collection and hauling of contaminated water to sewage treatment plants can be cost-prohibitive.

Requirements

Costs

- Capital costs vary as follows depending on measures implemented:
  - Low cost ($2000-5,000) for berm construction
  - Medium cost ($10,000-30,000) for plumbing modifications (including re-routing discharge to sanitary sewer and installing simple sump)
  - High cost ($60,000-200,000) for on-site treatment and recycling
- O&M costs increase with increasing capital investment.

Maintenance

- Perform berm repair and patching.
- Sweep washing areas frequently to remove solid debris.
- Inspect and maintain sumps, oil/water separators, and on-site treatment/recycling units.

Supplemental Information

Design Considerations

Designated Cleaning Areas

- Washing operations outside should be conducted in a designated wash area having the following characteristics:
  - Paved with Portland cement concrete
  - Covered and bermed to prevent contact with stormwater and contain wash water
  - Sloped for wash water collections
  - Discharges wash water to the sanitary or recycle treatment process waste sewer, or to a dead-end sump
  - Equipped with an oil/water separator if necessary

Examples

The City of Palo Alto has an effective program for commercial vehicle service facilities. Many of the program's elements, including specific BMP guidance and lists of equipment suppliers, are applicable to industrial vehicle service facilities.

The U.S. Postal Service in West Sacramento has a new vehicle wash system that collects, filters, and recycles wash water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.

- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.

- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.

- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.

- Regulations may include adoption of substantial penalties for illegal dumping and disposal.

- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.

- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

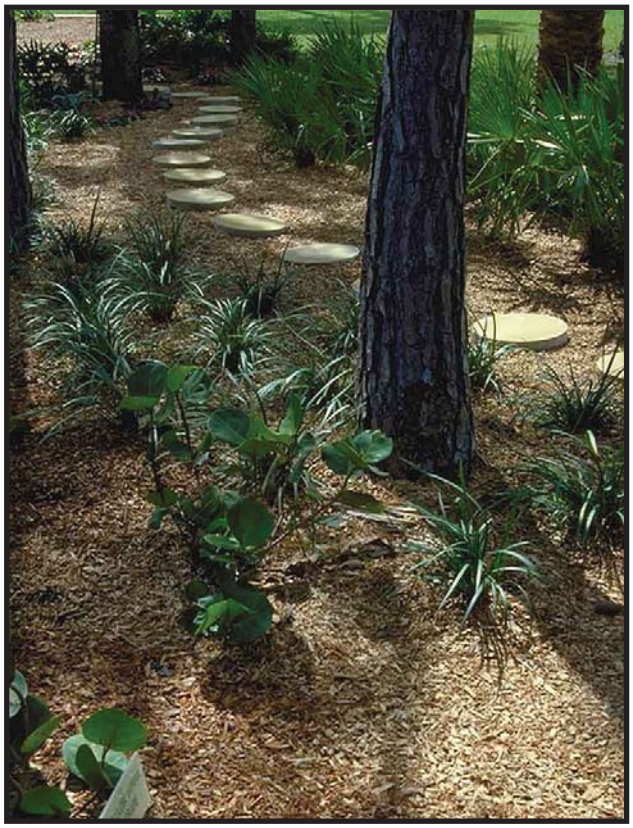
Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Site Design & Landscape Planning SD-10



Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “ redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

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barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING

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– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

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