



*LOCUST XC, LLC*

## **APPENDIX C**

### **HYDROLOGY AND WATER QUALITY MANAGEMENT PLAN**



## **PRELIMINARY HYDROLOGY REPORT**

**FOR**

**LOCUST AVE. DISTRIBUTUION CENTER**

**2889 N LOCUST AVENUE  
RIALTO, CA**

**CITY OF RIALTO**

**Date: December 21, 2021**

**PLANS PREPARED UNDER THE SUPERVISION OF:**

---

Fred Cornwell, P.E. - R.C.E 45591

Date



## Table of Contents

1.0	INTRODUCTION .....	1
2.0	EXISTING DRAINAGE CONDITIONS .....	1
3.0	PROPOSED DRAINAGE CONDITIONS .....	1
4.0	HYDROLOGICAL AND SOIL DATA .....	1
5.0	HYDROLOGY RESULTS .....	1
6.0	WATER QUALITY .....	2
7.0	FLOOD PLAIN DESIGNATION .....	2
8.0	METHODOLOGY .....	2
9.0	HYDRAULICS .....	2
10.0	RESULTS .....	2
11.0	CONCLUSION .....	3
12.0	VICINITY MAP .....	4
13.0	SOIL AND RAINFALL DATA TABLES .....	5
	APPENDICES .....	6
	APPENDIX A: EXISTING RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES. .....	7
	APPENDIX B: PROPOSED RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES.....	13
	APPENDIX C: PROPOSED HYDROGRAPH METHOD & BASIN ROUTING, 100 YEAR STORM FREQUENCY OUTPUT FILE.....	26
	APPENDIX D: STORAGE VOLUME & OUTFLOW CALCULATIONS AND Ybar CALCULATIONS .....	35
	EXHIBITS .....	36
	EXHIBIT A: EXISTING CONDITION HYDROLOGY MAP .....	37
	EXHIBIT B: PROPOSED CONDITION HYDROLOGY MAP .....	38
	EXHIBIT C: FIRM MAP .....	39
	EXHIBIT D: WQMP SITE PLAN.....	40

## **1.0 INTRODUCTION**

The purpose of this report is to present the hydrology analysis and drainage calculations for a proposed Locust Ave. industrial development located in the City of Rialto, California. The site proposes to construct an industrial building with an approximately 96,000 square feet footprint on approximately 4.7 net acres. This report will determine the existing and proposed storm water runoff rates from the Project site, provide analysis of the impacts to adjacent and downstream properties and facilities, and determine how to protect the building from 100-yr flood. This project is considered an "Industrial/Commercial Development".

## **2.0 EXISTING DRAINAGE CONDITIONS**

The subject site is currently vacant barren land with exposed rock outcroppings and fronts on Locust Ave. to the west. It is surrounded by industrial to the north and south and residential to the east. The site drains from the north to the south and somewhat to the east. The low point on our site is near the southeasterly corner being approximately 10' lower than the street elevation. The site to the north drains onto the proposed project and our property drains onto the property to the south. The Master Plan of Drainage (MPD) shows that the properties to the east of Locust Ave. are tabulated to drain southerly and easterly to a system in Maple Ave. There is an existing 102" storm drain in Locust Ave. but our site is not tributary to that system.

## **3.0 PROPOSED DRAINAGE CONDITIONS**

Drainage for the proposed site will be conveyed via sheet flow and gutters to three catch basins, with filters, which connect to storage pipes located along the southern portion of the site. The storage pipes will collect the drainage and allow to infiltrate. The project proposes to install a bypass storm drain that will collect the off-site flows coming from the north and outlet them at the low point along the southerly boundary. The outlet will have energy dissipating devices that will dissipate the flows as to mimic the historic flow pattern. The on-site infiltration pipes will be sized to contain and infiltrate up to the 100 year storm event. This will assure that the proposed project will have no adverse effect on the neighboring property because it will eliminate all historic flows that were coming from the vacant site. The storage pipe facility will be modeled as a flow through basin with the outlet flows being the infiltrated amount.

## **4.0 HYDROLOGICAL AND SOIL DATA**

References used in this report were the following:

- San Bernardino County Flood Control District, Hydrology Manual, dated August 1986.
- NOAA Atlas 14, Volume 6, Version 2, Point Precipitation Frequency Estimates.

Based on the hydrological soils group designation the site consists of soil group "A". The soil group designation is presented in the enclosed "Hydrologic Soils Group Map" at the end of this Section.

- Slope of Intensity Duration Curve = 0.6

The point precipitation frequency estimates for the project site are presented at the end of this Section.

## **5.0 HYDROLOGY RESULTS**

The results of the 2, 25 and 100-year storm events for both the existing and proposed conditions are shown on the hydrology maps in this report. We have also prepared a unit hydrograph for the proposed 100 year storm event which will be utilized in the basin routing model.

## **6.0 WATER QUALITY**

The water quality as shown in the project's WQMP and described Section 3.0, will utilize the inlet filters and infiltration facility as the water quality BMP's. More information on the water quality is shown on the WQMP Site Plan (Exhibit D)

## **7.0 FLOOD PLAIN DESIGNATION**

The site falls within a Zone "X" designation under the FEMA Map 06071C7920H, dated August 28, 2008. Zone X (Shaded) represents areas determined to be outside the 0.2% annual chance floodplain.

## **8.0 METHODOLOGY**

The San Bernardino County Rational and Unit Hydrograph Methods described in the San Bernardino County Hydrology Manual were utilized to determine the storm flows. The San Bernardino County Unit Hydrograph Method was used to provide hydrological information for routing of the proposed basin. The Computer Software Programs used was Advanced Engineering Software (AES) Rational Tabling Version 15.0 for the Rational Method and the small area hydrograph module CH1 – v1.8 for the Hydrograph Routing to size the basins.

This report will analyze the 2, 25 & 100 year storms for the rational method and the 100 year storm for the basin routing.

## **9.0 HYDRAULICS**

### **ON-SITE:**

The storage facility consists of six 96" CMP pipes that are connected via 24" HDPE pipes at 20' o.c. This will allow the flows to fill all the pipes during storm events before being infiltrated.

The results are shown in Appendix D. These outflows will be modeled in the basin routing for the 100 year storm event.

The pipe flows and catch basin hydraulics will be analyzed using the rational method flows in the Final Hydrology report.

### **OFF-SITE:**

The Master Plan of Drainage (MPD) shows an existing 39" pipe, labeled "XC4-5X in Maple Ave. and a proposed 54" pipe, labeled as "C4-5". The flows exiting our site will go through the neighboring property to the south and onto Summit Ave., then go easterly to the drainage facilities in Maple Ave.

## **10.0 RESULTS**

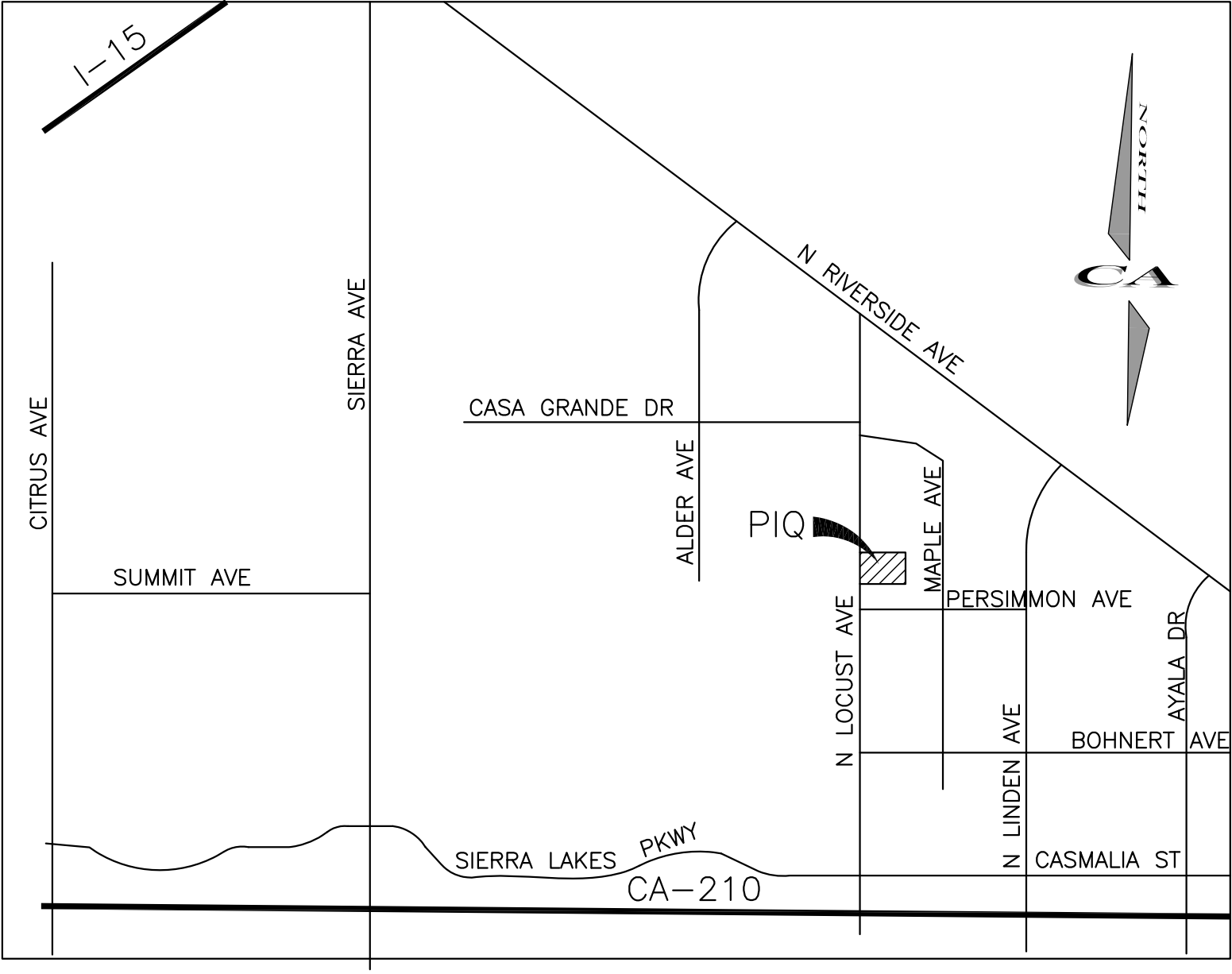
### **RIALTO DISTRIBUTION CENTER - HYDROLOGY STUDY**

It is shown in Appendix "C" that the storm flows for the 100 year storm event are completely contained in the storage facility and infiltrated on-site. The maximum depth in the pipes is shown in the basin routing output to be 6.40'.

## **11.0 CONCLUSION**

The results show that the 100 year storm will be collected and infiltrated.

## **12.0 VICINITY MAP**

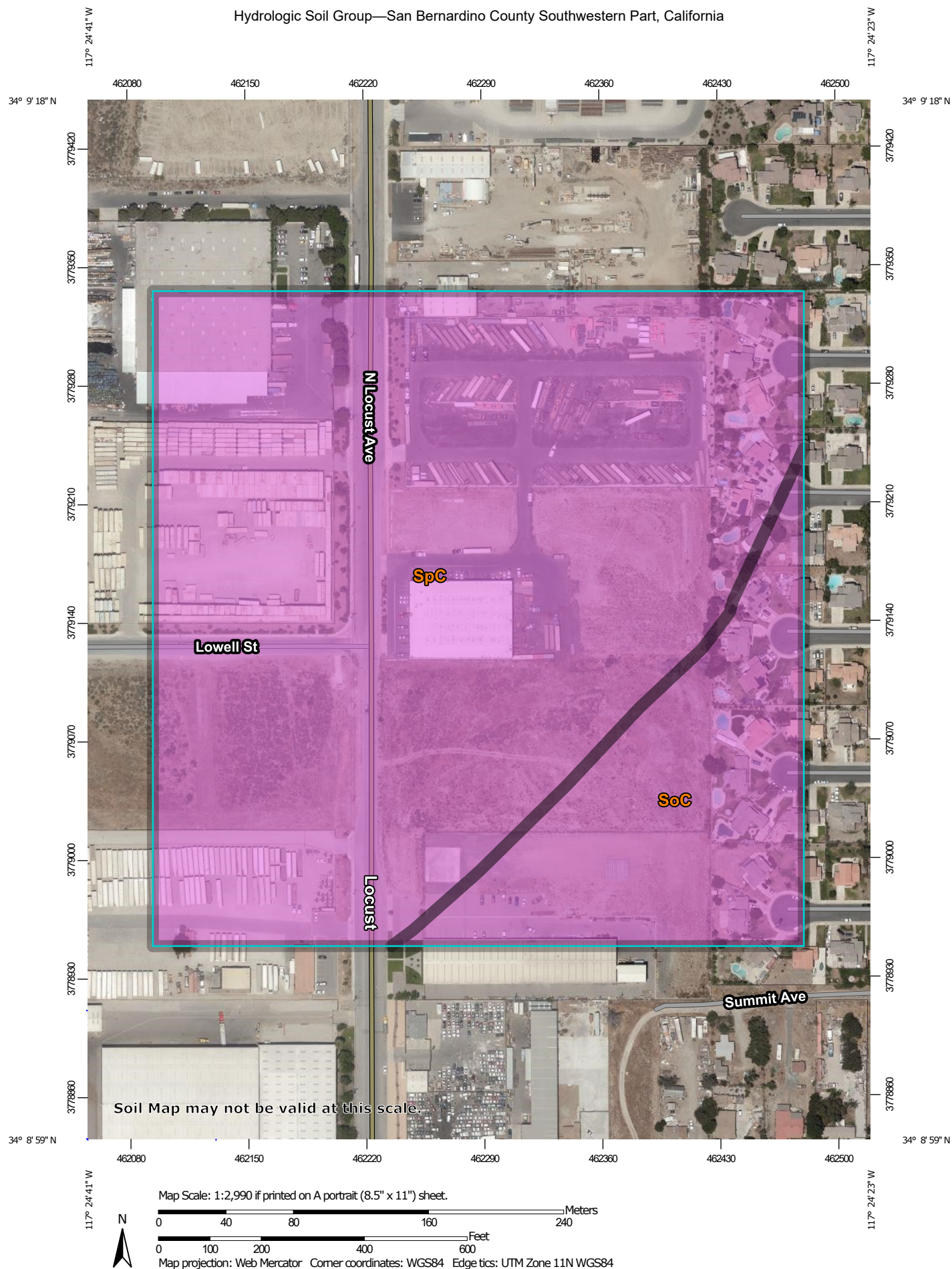


**VICINITY MAP**

**NOT TO SCALE**

## **13.0 SOIL AND RAINFALL DATA TABLES**

# Hydrologic Soil Group—San Bernardino County Southwestern Part, California





## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines

 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California  
 Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Apr 1, 2018—Jun 30, 2018

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	A	7.3	19.8%
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	A	29.7	80.2%
<b>Totals for Area of Interest</b>			<b>37.1</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher



**NOAA Atlas 14, Volume 6, Version 2**  
**Location name: Rialto, California, USA\***  
**Latitude: 34.1518°, Longitude: -117.4097°**  
**Elevation: 1619.97 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



### POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF\\_tabular](#) | [PF\\_graphical](#) | [Maps\\_&\\_aerials](#)

### PF tabular

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
<b>Duration</b>	<b>Average recurrence interval (years)</b>									
	<b>1</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>1000</b>
<b>5-min</b>	<b>0.138</b> (0.115-0.168)	<b>0.183</b> (0.152-0.223)	<b>0.242</b> (0.200-0.295)	<b>0.289</b> (0.238-0.355)	<b>0.353</b> (0.281-0.450)	<b>0.403</b> (0.313-0.523)	<b>0.453</b> (0.343-0.603)	<b>0.504</b> (0.371-0.692)	<b>0.574</b> (0.405-0.822)	<b>0.629</b> (0.428-0.933)
<b>10-min</b>	<b>0.198</b> (0.165-0.240)	<b>0.262</b> (0.218-0.319)	<b>0.346</b> (0.287-0.422)	<b>0.414</b> (0.341-0.510)	<b>0.506</b> (0.402-0.644)	<b>0.577</b> (0.448-0.750)	<b>0.649</b> (0.492-0.865)	<b>0.723</b> (0.532-0.992)	<b>0.823</b> (0.581-1.18)	<b>0.901</b> (0.614-1.34)
<b>15-min</b>	<b>0.239</b> (0.199-0.290)	<b>0.317</b> (0.264-0.386)	<b>0.419</b> (0.347-0.511)	<b>0.501</b> (0.412-0.616)	<b>0.612</b> (0.486-0.779)	<b>0.698</b> (0.542-0.907)	<b>0.785</b> (0.595-1.05)	<b>0.874</b> (0.644-1.20)	<b>0.996</b> (0.702-1.43)	<b>1.09</b> (0.742-1.62)
<b>30-min</b>	<b>0.361</b> (0.300-0.438)	<b>0.479</b> (0.398-0.582)	<b>0.632</b> (0.524-0.771)	<b>0.757</b> (0.622-0.930)	<b>0.925</b> (0.734-1.18)	<b>1.05</b> (0.819-1.37)	<b>1.19</b> (0.898-1.58)	<b>1.32</b> (0.972-1.81)	<b>1.50</b> (1.06-2.15)	<b>1.65</b> (1.12-2.44)
<b>60-min</b>	<b>0.550</b> (0.458-0.668)	<b>0.730</b> (0.606-0.887)	<b>0.963</b> (0.798-1.17)	<b>1.15</b> (0.947-1.42)	<b>1.41</b> (1.12-1.79)	<b>1.61</b> (1.25-2.09)	<b>1.80</b> (1.37-2.40)	<b>2.01</b> (1.48-2.76)	<b>2.29</b> (1.62-3.28)	<b>2.51</b> (1.71-3.72)
<b>2-hr</b>	<b>0.832</b> (0.692-1.01)	<b>1.09</b> (0.905-1.32)	<b>1.42</b> (1.18-1.73)	<b>1.69</b> (1.39-2.08)	<b>2.05</b> (1.63-2.61)	<b>2.32</b> (1.81-3.02)	<b>2.60</b> (1.97-3.47)	<b>2.88</b> (2.12-3.96)	<b>3.27</b> (2.30-4.68)	<b>3.56</b> (2.42-5.28)
<b>3-hr</b>	<b>1.06</b> (0.885-1.29)	<b>1.39</b> (1.15-1.68)	<b>1.80</b> (1.49-2.19)	<b>2.13</b> (1.75-2.62)	<b>2.58</b> (2.05-3.28)	<b>2.92</b> (2.27-3.79)	<b>3.26</b> (2.47-4.34)	<b>3.61</b> (2.65-4.95)	<b>4.07</b> (2.87-5.83)	<b>4.43</b> (3.02-6.57)
<b>6-hr</b>	<b>1.58</b> (1.31-1.91)	<b>2.05</b> (1.70-2.49)	<b>2.65</b> (2.19-3.23)	<b>3.13</b> (2.57-3.85)	<b>3.77</b> (2.99-4.79)	<b>4.25</b> (3.30-5.52)	<b>4.73</b> (3.58-6.31)	<b>5.22</b> (3.84-7.16)	<b>5.87</b> (4.14-8.40)	<b>6.36</b> (4.33-9.44)
<b>12-hr</b>	<b>2.16</b> (1.79-2.62)	<b>2.81</b> (2.34-3.42)	<b>3.64</b> (3.02-4.44)	<b>4.30</b> (3.54-5.29)	<b>5.17</b> (4.11-6.58)	<b>5.82</b> (4.52-7.57)	<b>6.46</b> (4.90-8.62)	<b>7.11</b> (5.24-9.76)	<b>7.96</b> (5.62-11.4)	<b>8.61</b> (5.86-12.8)
<b>24-hr</b>	<b>2.94</b> (2.60-3.38)	<b>3.87</b> (3.42-4.47)	<b>5.05</b> (4.46-5.85)	<b>5.99</b> (5.24-6.98)	<b>7.21</b> (6.11-8.69)	<b>8.13</b> (6.74-9.99)	<b>9.02</b> (7.31-11.4)	<b>9.93</b> (7.82-12.9)	<b>11.1</b> (8.40-15.0)	<b>12.0</b> (8.77-16.7)
<b>2-day</b>	<b>3.60</b> (3.19-4.15)	<b>4.85</b> (4.29-5.59)	<b>6.45</b> (5.69-7.46)	<b>7.74</b> (6.77-9.02)	<b>9.47</b> (8.02-11.4)	<b>10.8</b> (8.94-13.3)	<b>12.1</b> (9.80-15.2)	<b>13.4</b> (10.6-17.4)	<b>15.3</b> (11.5-20.6)	<b>16.6</b> (12.2-23.2)
<b>3-day</b>	<b>3.86</b> (3.42-4.45)	<b>5.28</b> (4.67-6.09)	<b>7.16</b> (6.32-8.28)	<b>8.71</b> (7.62-10.2)	<b>10.8</b> (9.18-13.1)	<b>12.5</b> (10.4-15.4)	<b>14.2</b> (11.5-17.9)	<b>16.0</b> (12.6-20.7)	<b>18.4</b> (13.9-24.8)	<b>20.4</b> (14.9-28.4)
<b>4-day</b>	<b>4.12</b> (3.65-4.75)	<b>5.70</b> (5.04-6.58)	<b>7.82</b> (6.89-9.04)	<b>9.58</b> (8.38-11.2)	<b>12.0</b> (10.2-14.5)	<b>14.0</b> (11.6-17.2)	<b>16.0</b> (12.9-20.1)	<b>18.1</b> (14.3-23.4)	<b>21.1</b> (15.9-28.4)	<b>23.4</b> (17.1-32.7)
<b>7-day</b>	<b>4.72</b> (4.18-5.43)	<b>6.60</b> (5.83-7.61)	<b>9.13</b> (8.05-10.6)	<b>11.2</b> (9.84-13.1)	<b>14.2</b> (12.0-17.1)	<b>16.6</b> (13.7-20.4)	<b>19.0</b> (15.4-23.9)	<b>21.6</b> (17.0-28.0)	<b>25.2</b> (19.1-34.0)	<b>28.2</b> (20.6-39.3)
<b>10-day</b>	<b>5.09</b> (4.51-5.86)	<b>7.16</b> (6.34-8.27)	<b>9.97</b> (8.80-11.5)	<b>12.3</b> (10.8-14.4)	<b>15.6</b> (13.2-18.8)	<b>18.3</b> (15.2-22.5)	<b>21.0</b> (17.0-26.5)	<b>24.0</b> (18.9-31.0)	<b>28.1</b> (21.2-37.9)	<b>31.4</b> (22.9-43.8)
<b>20-day</b>	<b>6.09</b> (5.39-7.01)	<b>8.65</b> (7.65-9.98)	<b>12.2</b> (10.7-14.1)	<b>15.2</b> (13.3-17.7)	<b>19.4</b> (16.4-23.4)	<b>22.8</b> (18.9-28.0)	<b>26.4</b> (21.4-33.3)	<b>30.3</b> (23.8-39.2)	<b>35.7</b> (27.0-48.2)	<b>40.2</b> (29.4-56.1)
<b>30-day</b>	<b>7.10</b> (6.29-8.19)	<b>10.1</b> (8.94-11.7)	<b>14.3</b> (12.6-16.5)	<b>17.8</b> (15.6-20.8)	<b>22.9</b> (19.4-27.6)	<b>27.0</b> (22.4-33.3)	<b>31.4</b> (25.5-39.6)	<b>36.2</b> (28.5-46.8)	<b>42.9</b> (32.5-57.9)	<b>48.5</b> (35.4-67.6)
<b>45-day</b>	<b>8.49</b> (7.52-9.79)	<b>12.0</b> (10.6-13.9)	<b>16.9</b> (14.9-19.6)	<b>21.2</b> (18.5-24.7)	<b>27.3</b> (23.1-32.9)	<b>32.3</b> (26.8-39.7)	<b>37.7</b> (30.5-47.4)	<b>43.5</b> (34.3-56.3)	<b>51.8</b> (39.2-69.9)	<b>58.7</b> (43.0-82.0)
<b>60-day</b>	<b>9.88</b> (8.74-11.4)	<b>13.9</b> (12.3-16.0)	<b>19.4</b> (17.1-22.5)	<b>24.3</b> (21.2-28.3)	<b>31.3</b> (26.5-37.7)	<b>37.0</b> (30.7-45.6)	<b>43.2</b> (35.0-54.5)	<b>50.0</b> (39.4-64.7)	<b>59.8</b> (45.2-80.6)	<b>67.9</b> (49.6-94.7)

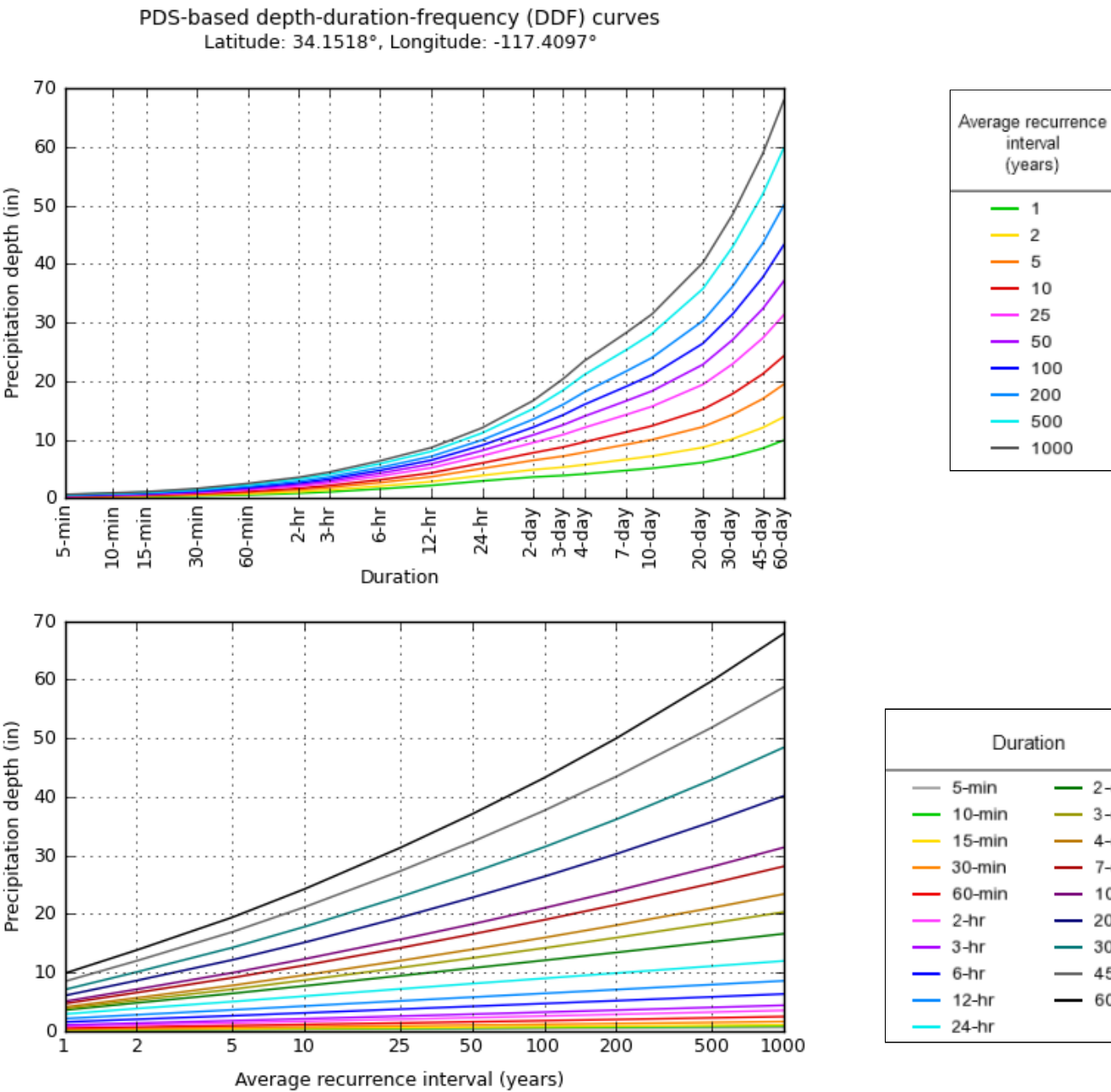
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

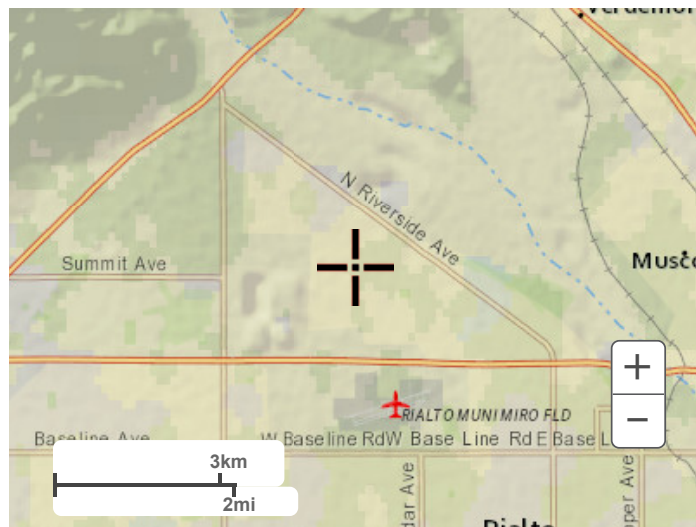
[Back to Top](#)

PF graphical



Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial





[Back to Top](#)

---

[US Department of Commerce](#)  
[National Oceanic and Atmospheric Administration](#)  
[National Weather Service](#)  
[National Water Center](#)  
1325 East West Highway  
Silver Spring, MD 20910  
Questions?: [HDSC.Questions@noaa.gov](mailto:HDSC.Questions@noaa.gov)

[Disclaimer](#)

## APPENDICES



# APPENDIX A: EXISTING RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES.

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)  
(c) Copyright 1983-2008 Advanced Engineering Software (aes)  
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*

\* EXISTING CONDITION \*  
\* 2 YR STORM \*  
\* \*  
\*\*\*\*\*

FILE NAME: 251-55EX.DAT  
TIME/DATE OF STUDY: 12:18 12/16/2021

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 2.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 2.00 1-HOUR INTENSITY(INCH/HOUR) = 0.6957  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT- / PARK- SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH LIP HIKE (FT) (FT) (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00 0.0313 0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<

>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

```

=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 485.00
ELEVATION DATA: UPSTREAM(FEET) = 1624.40 DOWNSTREAM(FEET) = 1608.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 16.658
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 1.501
SUBAREA Tc AND LOSS RATE DATA(AMC I):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF" A 2.64 0.95 1.000 35 16.66
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.95
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 1.31
TOTAL AREA(ACRES) = 2.64 PEAK FLOW RATE(CFS) = 1.31

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 359.00
ELEVATION DATA: UPSTREAM(FEET) = 1617.00 DOWNSTREAM(FEET) = 1607.50

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 15.357
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 1.576
SUBAREA Tc AND LOSS RATE DATA(AMC I):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF" A 2.07 0.95 1.000 35 15.36
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.95
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 1.17
TOTAL AREA(ACRES) = 2.07 PEAK FLOW RATE(CFS) = 1.17

=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 2.1 TC(MIN.) = 15.36
EFFECTIVE AREA(ACRES) = 2.07 AREA-AVERAGED Fm(INCH/HR)= 0.95
AREA-AVERAGED Fp(INCH/HR) = 0.95 AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS) = 1.17
=====
=====
END OF RATIONAL METHOD ANALYSIS

```

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* EXISTING CONDITION *
* 25 YR STORM *
* *
*****

```

FILE NAME: 251-55EX.DAT  
TIME/DATE OF STUDY: 12:17 12/16/2021

```

=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

USER SPECIFIED STORM EVENT(YEAR) = 25.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 25.00 1-HOUR INTENSITY(INCH/HOUR) = 1.3811  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF-WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL IN- / OUT- / SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER WIDTH (FT)	GEOMETRIES LIP (FT)	MANNING HIKE (FT)	FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```

*****
FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 485.00
ELEVATION DATA: UPSTREAM(FEET) = 1624.40 DOWNSTREAM(FEET) = 1608.80

```

```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 16.658
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 2.980
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A         2.64      0.76      1.000      55      16.66
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.76
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 5.27
TOTAL AREA(ACRES) = 2.64 PEAK FLOW RATE(CFS) = 5.27

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 359.00
ELEVATION DATA: UPSTREAM(FEET) = 1617.00 DOWNSTREAM(FEET) = 1607.50

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 15.357
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 3.128
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A         2.07      0.76      1.000      55      15.36
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.76
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 4.41
TOTAL AREA(ACRES) = 2.07 PEAK FLOW RATE(CFS) = 4.41
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 2.1 TC(MIN.) = 15.36
EFFECTIVE AREA(ACRES) = 2.07 AREA-AVERAGED Fm(INCH/HR)= 0.76
AREA-AVERAGED Fp(INCH/HR) = 0.76 AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS) = 4.41
=====
END OF RATIONAL METHOD ANALYSIS

```

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* EXISTING CONDITION *
* 100 YR STORM *
* *
*****

```

FILE NAME: 251-55EX.DAT  
TIME/DATE OF STUDY: 12:17 12/16/2021

```

=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 100.00 1-HOUR INTENSITY(INCH/HOUR) = 1.8000  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/PARK- SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH LIP HIKE (FT) (FT) (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00 0.0313 0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```

*****
FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 485.00
ELEVATION DATA: UPSTREAM(FEET) = 1624.40 DOWNSTREAM(FEET) = 1608.80

```

```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 16.658
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.883
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A        2.64      0.44      1.000      75      16.66
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.44
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 8.19
TOTAL AREA(ACRES) = 2.64 PEAK FLOW RATE(CFS) = 8.19

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 359.00
ELEVATION DATA: UPSTREAM(FEET) = 1617.00 DOWNSTREAM(FEET) = 1607.50

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 15.357
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.077
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A        2.07      0.44      1.000      75      15.36
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.44
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 6.79
TOTAL AREA(ACRES) = 2.07 PEAK FLOW RATE(CFS) = 6.79
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 2.1 TC(MIN.) = 15.36
EFFECTIVE AREA(ACRES) = 2.07 AREA-AVERAGED Fm(INCH/HR)= 0.44
AREA-AVERAGED Fp(INCH/HR) = 0.44 AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS) = 6.79
=====
END OF RATIONAL METHOD ANALYSIS

```

## APPENDIX B: PROPOSED RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES.

```
*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420
```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```
***** DESCRIPTION OF STUDY *****
* PROPOSED CONDITION *
* 2 YR STORM *
* *
*****
```

FILE NAME: 251-55PR.DAT  
TIME/DATE OF STUDY: 14:51 12/16/2021

```
=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--
```

USER SPECIFIED STORM EVENT(YEAR) = 2.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 2.00 1-HOUR INTENSITY(INCH/HOUR) = 0.6957  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/PARK- SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```
*****
```

```

FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 927.00
ELEVATION DATA: UPSTREAM(FEET) = 1623.80 DOWNSTREAM(FEET) = 1611.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 11.007
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 1.924
SUBAREA Tc AND LOSS RATE DATA(AMC I ):
DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
LAND USE              GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL            A      2.19    1.33    0.100    17    11.01
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 1.33
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 3.53
TOTAL AREA(ACRES) = 2.19 PEAK FLOW RATE(CFS) = 3.53

*****
FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 190.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 15.0 INCH PIPE IS 9.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 4.62
ESTIMATED PIPE DIAMETER(INCH) = 15.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 3.53
PIPE TRAVEL TIME(MIN.) = 0.69 Tc(MIN.) = 11.69
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 11.69
RAINFALL INTENSITY(INCH/HR) = 1.86
AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 2.19
TOTAL STREAM AREA(ACRES) = 2.19
PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.53

*****
FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 126.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.50 DOWNSTREAM(FEET) = 1616.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 5.000
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 3.090

```



```

SUBAREA Tc AND LOSS RATE DATA(AMC I ):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS  Tc
    LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A        0.67    1.33    0.100    17    5.00
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 1.33
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) =      1.78
TOTAL AREA(ACRES) =      0.67    PEAK FLOW RATE(CFS) =      1.78

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      3.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1611.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 414.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 9.0 INCH PIPE IS 6.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 4.91
ESTIMATED PIPE DIAMETER(INCH) = 9.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 1.78
PIPE TRAVEL TIME(MIN.) = 1.41 Tc(MIN.) = 6.41
LONGEST FLOWPATH FROM NODE      4.00 TO NODE      3.00 = 540.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.41
RAINFALL INTENSITY(INCH/HR) = 2.66
AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.67
TOTAL STREAM AREA(ACRES) = 0.67
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.78

*****
FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 474.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.80 DOWNSTREAM(FEET) = 1606.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.456
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 2.431
SUBAREA Tc AND LOSS RATE DATA(AMC I ):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS  Tc
    LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A        1.85    1.33    0.100    17    7.46
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 1.33
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) =      3.83
TOTAL AREA(ACRES) =      1.85    PEAK FLOW RATE(CFS) =      3.83

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      3.00 IS CODE = 31

```

```

-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.80 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 41.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 12.0 INCH PIPE IS 5.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 9.87
ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 3.83
PIPE TRAVEL TIME(MIN.) = 0.07 Tc(MIN.) = 7.53
LONGEST FLOWPATH FROM NODE 6.00 TO NODE 3.00 = 515.00 FEET.

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 7.53
RAINFALL INTENSITY(INCH/HR) = 2.42
AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 1.85
TOTAL STREAM AREA(ACRES) = 1.85
PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.83

** CONFLUENCE DATA **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	3.53	11.69	1.856	1.33( 0.13)	0.10	2.2	1.00
2	1.78	6.41	2.663	1.33( 0.13)	0.10	0.7	4.00
3	3.83	7.53	2.418	1.33( 0.13)	0.10	1.9	6.00

```

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

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	8.23	6.41	2.663	1.33( 0.13)	0.10	3.4	4.00
2	8.45	7.53	2.418	1.33( 0.13)	0.10	3.9	6.00
3	7.63	11.69	1.856	1.33( 0.13)	0.10	4.7	1.00

```

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 8.45 Tc(MIN.) = 7.53
EFFECTIVE AREA(ACRES) = 3.93 AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33 AREA-AVERAGED Ap = 0.10
TOTAL AREA(ACRES) = 4.7
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 4.7 TC(MIN.) = 7.53
EFFECTIVE AREA(ACRES) = 3.93 AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33 AREA-AVERAGED Ap = 0.100
PEAK FLOW RATE(CFS) = 8.45

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
------------------	------------	--------------	------------------------	---------------------	----	---------------	-------------------

1	8.23	6.41	2.663	1.33( 0.13)	0.10	3.4	4.00
2	8.45	7.53	2.418	1.33( 0.13)	0.10	3.9	6.00
3	7.63	11.69	1.856	1.33( 0.13)	0.10	4.7	1.00

=====

=====

END OF RATIONAL METHOD ANALYSIS

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* PROPOSED CONDITION *
* 25 YR STORM *
* *
*****

```

FILE NAME: 251-55PR.DAT  
TIME/DATE OF STUDY: 14:51 12/16/2021

```

=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

USER SPECIFIED STORM EVENT(YEAR) = 25.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 25.00 1-HOUR INTENSITY(INCH/HOUR) = 1.3811  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF-WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL IN- / OUT- / SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER WIDTH (FT)	GEOMETRIES LIP (FT)	MANNING HIKE (FT)	FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```

*****
FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 927.00
ELEVATION DATA: UPSTREAM(FEET) = 1623.80 DOWNSTREAM(FEET) = 1611.00

```

```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 11.007
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 3.820
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL            A      2.19    0.98    0.100    32    11.01
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 7.34
TOTAL AREA(ACRES) = 2.19 PEAK FLOW RATE(CFS) = 7.34

*****
FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 190.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 18.0 INCH PIPE IS 12.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.47
ESTIMATED PIPE DIAMETER(INCH) = 18.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 7.34
PIPE TRAVEL TIME(MIN.) = 0.58 Tc(MIN.) = 11.59
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 11.59
RAINFALL INTENSITY(INCH/HR) = 3.70
AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 2.19
TOTAL STREAM AREA(ACRES) = 2.19
PEAK FLOW RATE(CFS) AT CONFLUENCE = 7.34

*****
FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 126.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.50 DOWNSTREAM(FEET) = 1616.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 5.000
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 6.134
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL            A      0.67    0.98    0.100    32     5.00
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 3.64
TOTAL AREA(ACRES) = 0.67 PEAK FLOW RATE(CFS) = 3.64

```

```

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      3.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1611.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 414.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 12.0 INCH PIPE IS 8.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.91
ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 3.64
PIPE TRAVEL TIME(MIN.) = 1.17 Tc(MIN.) = 6.17
LONGEST FLOWPATH FROM NODE 4.00 TO NODE 3.00 = 540.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.17
RAINFALL INTENSITY(INCH/HR) = 5.41
AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.67
TOTAL STREAM AREA(ACRES) = 0.67
PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.64

*****
FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 474.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.80 DOWNSTREAM(FEET) = 1606.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.456
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 4.826
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL            A      1.85    0.98    0.100    32    7.46
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 7.87
TOTAL AREA(ACRES) = 1.85 PEAK FLOW RATE(CFS) = 7.87

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      3.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.80 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 41.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 15.0 INCH PIPE IS 8.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 11.81

```

```

ESTIMATED PIPE DIAMETER(INCH) = 15.00    NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 7.87
PIPE TRAVEL TIME(MIN.) = 0.06    Tc(MIN.) = 7.51
LONGEST FLOWPATH FROM NODE 6.00 TO NODE 3.00 = 515.00 FEET.

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 7.51
RAINFALL INTENSITY(INCH/HR) = 4.80
AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 1.85
TOTAL STREAM AREA(ACRES) = 1.85
PEAK FLOW RATE(CFS) AT CONFLUENCE = 7.87

** CONFLUENCE DATA **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	7.34	11.59	3.705	0.98( 0.10)	0.10	2.2	1.00
2	3.64	6.17	5.409	0.98( 0.10)	0.10	0.7	4.00
3	7.87	7.51	4.804	0.98( 0.10)	0.10	1.9	6.00

```

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

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	16.68	6.17	5.409	0.98( 0.10)	0.10	3.4	4.00
2	17.31	7.51	4.804	0.98( 0.10)	0.10	3.9	6.00
3	15.84	11.59	3.705	0.98( 0.10)	0.10	4.7	1.00

```

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 17.31    Tc(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98    AREA-AVERAGED Ap = 0.10
TOTAL AREA(ACRES) = 4.7
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 4.7    TC(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR)= 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98    AREA-AVERAGED Ap = 0.100
PEAK FLOW RATE(CFS) = 17.31

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	16.68	6.17	5.409	0.98( 0.10)	0.10	3.4	4.00
2	17.31	7.51	4.804	0.98( 0.10)	0.10	3.9	6.00
3	15.84	11.59	3.705	0.98( 0.10)	0.10	4.7	1.00

```

=====
END OF RATIONAL METHOD ANALYSIS

```

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* PROPOSED CONDITION *
* 100 YR STORM *
* *
*****

```

FILE NAME: 251-55PR.DAT  
TIME/DATE OF STUDY: 14:52 12/16/2021

```

=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 100.00 1-HOUR INTENSITY(INCH/HOUR) = 1.8000  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF-WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL IN- / OUT- / SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER WIDTH (FT)	GEOMETRIES LIP (FT)	MANNING HIKE (FT)	FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```

*****
FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 927.00
ELEVATION DATA: UPSTREAM(FEET) = 1623.80 DOWNSTREAM(FEET) = 1611.00

```



```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 11.007
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.979
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A      2.19    0.74    0.100    52    11.01
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.74
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 9.67
TOTAL AREA(ACRES) = 2.19 PEAK FLOW RATE(CFS) = 9.67

*****
FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 190.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 21.0 INCH PIPE IS 13.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.91
ESTIMATED PIPE DIAMETER(INCH) = 21.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 9.67
PIPE TRAVEL TIME(MIN.) = 0.54 Tc(MIN.) = 11.54
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 11.54
RAINFALL INTENSITY(INCH/HR) = 4.84
AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 2.19
TOTAL STREAM AREA(ACRES) = 2.19
PEAK FLOW RATE(CFS) AT CONFLUENCE = 9.67

*****
FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 126.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.50 DOWNSTREAM(FEET) = 1616.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 5.000
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 7.994
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A      0.67    0.74    0.100    52     5.00
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.74
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 4.78
TOTAL AREA(ACRES) = 0.67 PEAK FLOW RATE(CFS) = 4.78

```

```

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1611.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 414.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 15.0 INCH PIPE IS 8.7 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 6.45
ESTIMATED PIPE DIAMETER(INCH) = 15.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 4.78
PIPE TRAVEL TIME(MIN.) = 1.07 Tc(MIN.) = 6.07
LONGEST FLOWPATH FROM NODE 4.00 TO NODE 3.00 = 540.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.07
RAINFALL INTENSITY(INCH/HR) = 7.12
AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.67
TOTAL STREAM AREA(ACRES) = 0.67
PEAK FLOW RATE(CFS) AT CONFLUENCE = 4.78

*****
FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 474.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.80 DOWNSTREAM(FEET) = 1606.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.456
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 6.290
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL      AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP    (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A        1.85    0.74    0.100    52    7.46
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.74
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 10.35
TOTAL AREA(ACRES) = 1.85 PEAK FLOW RATE(CFS) = 10.35

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.80 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 41.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 15.0 INCH PIPE IS 9.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 12.55

```

```

ESTIMATED PIPE DIAMETER(INCH) = 15.00    NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 10.35
PIPE TRAVEL TIME(MIN.) = 0.05    Tc(MIN.) = 7.51
LONGEST FLOWPATH FROM NODE 6.00 TO NODE 3.00 = 515.00 FEET.

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 7.51
RAINFALL INTENSITY(INCH/HR) = 6.26
AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 1.85
TOTAL STREAM AREA(ACRES) = 1.85
PEAK FLOW RATE(CFS) AT CONFLUENCE = 10.35

** CONFLUENCE DATA **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	9.67	11.54	4.839	0.74( 0.07)	0.10	2.2	1.00
2	4.78	6.07	7.116	0.74( 0.07)	0.10	0.7	4.00
3	10.35	7.51	6.263	0.74( 0.07)	0.10	1.9	6.00

```

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

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	21.81	6.07	7.116	0.74( 0.07)	0.10	3.3	4.00
2	22.72	7.51	6.263	0.74( 0.07)	0.10	3.9	6.00
3	20.87	11.54	4.839	0.74( 0.07)	0.10	4.7	1.00

```

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 22.72    Tc(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74    AREA-AVERAGED Ap = 0.10
TOTAL AREA(ACRES) = 4.7
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 4.7    TC(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR)= 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74    AREA-AVERAGED Ap = 0.100
PEAK FLOW RATE(CFS) = 22.72

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	21.81	6.07	7.116	0.74( 0.07)	0.10	3.3	4.00
2	22.72	7.51	6.263	0.74( 0.07)	0.10	3.9	6.00
3	20.87	11.54	4.839	0.74( 0.07)	0.10	4.7	1.00

```

=====
END OF RATIONAL METHOD ANALYSIS

```

## APPENDIX C: PROPOSED HYDROGRAPH METHOD & BASIN ROUTING, 100 YEAR STORM FREQUENCY OUTPUT FILE.

\*\*\*\*\*

### SMALL AREA UNIT HYDROGRAPH MODEL

=====

(C) Copyright 1989-2008 Advanced Engineering Software (aes)  
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

\*\*\*\*\*

-----  
Problem Descriptions:  
100 YEAR STORM BASIN ROUTING

-----

RATIONAL METHOD CALIBRATION COEFFICIENT = 1.10  
TOTAL CATCHMENT AREA(ACRES) = 4.70  
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.070  
LOW LOSS FRACTION = 0.080  
TIME OF CONCENTRATION(MIN.) = 7.51  
SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA  
USER SPECIFIED RAINFALL VALUES ARE USED  
RETURN FREQUENCY(YEARS) = 100  
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.45  
30-MINUTE POINT RAINFALL VALUE(INCHES) = 1.19  
1-HOUR POINT RAINFALL VALUE(INCHES) = 1.80  
3-HOUR POINT RAINFALL VALUE(INCHES) = 3.26  
6-HOUR POINT RAINFALL VALUE(INCHES) = 4.73  
24-HOUR POINT RAINFALL VALUE(INCHES) = 9.02

-----

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 3.58  
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = -0.05

\*\*\*\*\*

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	7.5	15.0	22.5	30.0
0.10	0.0036	0.83	.Q	.	.	.	.
0.23	0.0122	0.84	.Q	.	.	.	.
0.35	0.0209	0.84	.Q	.	.	.	.
0.48	0.0296	0.84	.Q	.	.	.	.
0.60	0.0383	0.85	.Q	.	.	.	.
0.73	0.0471	0.85	.Q	.	.	.	.
0.85	0.0559	0.85	.Q	.	.	.	.
0.98	0.0648	0.86	.Q	.	.	.	.
1.11	0.0736	0.86	.Q	.	.	.	.
1.23	0.0826	0.86	.Q	.	.	.	.

1.36	0.0916	0.87	.Q	.	.	.	.
1.48	0.1006	0.87	.Q	.	.	.	.
1.61	0.1096	0.88	.Q	.	.	.	.
1.73	0.1187	0.88	.Q	.	.	.	.
1.86	0.1279	0.89	.Q	.	.	.	.
1.98	0.1370	0.89	.Q	.	.	.	.
2.11	0.1463	0.89	.Q	.	.	.	.
2.23	0.1555	0.90	.Q	.	.	.	.
2.36	0.1649	0.90	.Q	.	.	.	.
2.48	0.1742	0.91	.Q	.	.	.	.
2.61	0.1836	0.91	.Q	.	.	.	.
2.73	0.1931	0.92	.Q	.	.	.	.
2.86	0.2026	0.92	.Q	.	.	.	.
2.98	0.2121	0.92	.Q	.	.	.	.
3.11	0.2217	0.93	.Q	.	.	.	.
3.23	0.2314	0.93	.Q	.	.	.	.
3.36	0.2411	0.94	.Q	.	.	.	.
3.48	0.2508	0.94	.Q	.	.	.	.
3.61	0.2606	0.95	.Q	.	.	.	.
3.73	0.2705	0.95	.Q	.	.	.	.
3.86	0.2804	0.96	.Q	.	.	.	.
3.98	0.2903	0.96	.Q	.	.	.	.
4.11	0.3004	0.97	.Q	.	.	.	.
4.23	0.3104	0.98	.Q	.	.	.	.
4.36	0.3206	0.98	.Q	.	.	.	.
4.48	0.3307	0.99	.Q	.	.	.	.
4.61	0.3410	0.99	.Q	.	.	.	.
4.73	0.3513	1.00	.Q	.	.	.	.
4.86	0.3617	1.01	.Q	.	.	.	.
4.99	0.3721	1.01	.Q	.	.	.	.
5.11	0.3826	1.02	.Q	.	.	.	.
5.24	0.3931	1.02	.Q	.	.	.	.
5.36	0.4038	1.03	.Q	.	.	.	.
5.49	0.4144	1.04	.Q	.	.	.	.
5.61	0.4252	1.04	.Q	.	.	.	.
5.74	0.4360	1.05	.Q	.	.	.	.
5.86	0.4469	1.06	.Q	.	.	.	.
5.99	0.4579	1.06	.Q	.	.	.	.
6.11	0.4689	1.07	.Q	.	.	.	.
6.24	0.4800	1.08	.Q	.	.	.	.
6.36	0.4912	1.09	.Q	.	.	.	.
6.49	0.5025	1.09	.Q	.	.	.	.
6.61	0.5138	1.10	.Q	.	.	.	.
6.74	0.5252	1.11	.Q	.	.	.	.
6.86	0.5367	1.12	.Q	.	.	.	.
6.99	0.5483	1.12	.Q	.	.	.	.
7.11	0.5600	1.13	.Q	.	.	.	.
7.24	0.5718	1.14	.Q	.	.	.	.
7.36	0.5836	1.15	.Q	.	.	.	.
7.49	0.5955	1.16	.Q	.	.	.	.
7.61	0.6076	1.17	.Q	.	.	.	.
7.74	0.6197	1.18	.Q	.	.	.	.
7.86	0.6319	1.19	.Q	.	.	.	.
7.99	0.6443	1.19	.Q	.	.	.	.
8.11	0.6567	1.21	.Q	.	.	.	.
8.24	0.6692	1.21	.Q	.	.	.	.
8.36	0.6819	1.23	.Q	.	.	.	.
8.49	0.6946	1.24	.Q	.	.	.	.
8.62	0.7075	1.25	.Q	.	.	.	.
8.74	0.7204	1.26	.Q	.	.	.	.
8.87	0.7335	1.27	.Q	.	.	.	.
8.99	0.7468	1.28	.Q	.	.	.	.
9.12	0.7601	1.30	.Q	.	.	.	.

9.24	0.7736	1.31	.Q	.	.	.	.
9.37	0.7872	1.32	.Q	.	.	.	.
9.49	0.8009	1.33	.Q	.	.	.	.
9.62	0.8148	1.35	.Q	.	.	.	.
9.74	0.8288	1.36	.Q	.	.	.	.
9.87	0.8430	1.38	.Q	.	.	.	.
9.99	0.8573	1.39	.Q	.	.	.	.
10.12	0.8718	1.41	.Q	.	.	.	.
10.24	0.8864	1.42	.Q	.	.	.	.
10.37	0.9012	1.44	.Q	.	.	.	.
10.49	0.9162	1.45	.Q	.	.	.	.
10.62	0.9314	1.48	.Q	.	.	.	.
10.74	0.9467	1.49	.Q	.	.	.	.
10.87	0.9623	1.52	. Q	.	.	.	.
10.99	0.9780	1.53	. Q	.	.	.	.
11.12	0.9940	1.56	. Q	.	.	.	.
11.24	1.0101	1.57	. Q	.	.	.	.
11.37	1.0265	1.60	. Q	.	.	.	.
11.49	1.0431	1.61	. Q	.	.	.	.
11.62	1.0600	1.65	. Q	.	.	.	.
11.74	1.0771	1.66	. Q	.	.	.	.
11.87	1.0945	1.70	. Q	.	.	.	.
11.99	1.1122	1.72	. Q	.	.	.	.
12.12	1.1314	2.00	. Q	.	.	.	.
12.24	1.1524	2.04	. Q	.	.	.	.
12.37	1.1737	2.08	. Q	.	.	.	.
12.50	1.1954	2.11	. Q	.	.	.	.
12.62	1.2174	2.15	. Q	.	.	.	.
12.75	1.2398	2.18	. Q	.	.	.	.
12.87	1.2626	2.23	. Q	.	.	.	.
13.00	1.2858	2.26	. Q	.	.	.	.
13.12	1.3094	2.31	. Q	.	.	.	.
13.25	1.3335	2.34	. Q	.	.	.	.
13.37	1.3581	2.41	. Q	.	.	.	.
13.50	1.3832	2.45	. Q	.	.	.	.
13.62	1.4089	2.52	. Q	.	.	.	.
13.75	1.4352	2.56	. Q	.	.	.	.
13.87	1.4621	2.65	. Q	.	.	.	.
14.00	1.4898	2.70	. Q	.	.	.	.
14.12	1.5183	2.82	. Q	.	.	.	.
14.25	1.5478	2.88	. Q	.	.	.	.
14.37	1.5782	3.00	. Q	.	.	.	.
14.50	1.6096	3.07	. Q	.	.	.	.
14.62	1.6422	3.23	. Q	.	.	.	.
14.75	1.6761	3.32	. Q	.	.	.	.
14.87	1.7114	3.52	. Q	.	.	.	.
15.00	1.7484	3.64	. Q	.	.	.	.
15.12	1.7875	3.92	. Q	.	.	.	.
15.25	1.8289	4.08	. Q	.	.	.	.
15.37	1.8734	4.53	. Q	.	.	.	.
15.50	1.9245	5.33	. Q	.	.	.	.
15.62	1.9836	6.10	. Q	.	.	.	.
15.75	2.0496	6.65	. Q	.	.	.	.
15.87	2.1248	7.91	. Q	.	.	.	.
16.00	2.2185	10.19	. Q	.	.	.	.
16.13	2.3898	22.94	. Q	.	.	.	.
16.25	2.5431	6.71	. Q	.	.	.	.
16.38	2.6072	5.68	. Q	.	.	.	.
16.50	2.6587	4.29	. Q	.	.	.	.
16.63	2.7004	3.77	. Q	.	.	.	.
16.75	2.7376	3.41	. Q	.	.	.	.
16.88	2.7715	3.15	. Q	.	.	.	.
17.00	2.8030	2.94	. Q	.	.	.	.

17.13	2.8324	2.75	. Q	.	.	.	.
17.25	2.8600	2.60	. Q	.	.	.	.
17.38	2.8864	2.48	. Q	.	.	.	.
17.50	2.9115	2.38	. Q	.	.	.	.
17.63	2.9356	2.28	. Q	.	.	.	.
17.75	2.9588	2.20	. Q	.	.	.	.
17.88	2.9812	2.13	. Q	.	.	.	.
18.00	3.0029	2.06	. Q	.	.	.	.
18.13	3.0225	1.74	. Q	.	.	.	.
18.25	3.0402	1.68	. Q	.	.	.	.
18.38	3.0573	1.63	. Q	.	.	.	.
18.50	3.0739	1.58	. Q	.	.	.	.
18.63	3.0901	1.54	. Q	.	.	.	.
18.75	3.1059	1.50	. Q	.	.	.	.
18.88	3.1212	1.47	.Q	.	.	.	.
19.00	3.1362	1.43	.Q	.	.	.	.
19.13	3.1508	1.40	.Q	.	.	.	.
19.25	3.1652	1.37	.Q	.	.	.	.
19.38	3.1792	1.34	.Q	.	.	.	.
19.50	3.1929	1.31	.Q	.	.	.	.
19.63	3.2064	1.29	.Q	.	.	.	.
19.76	3.2196	1.27	.Q	.	.	.	.
19.88	3.2326	1.24	.Q	.	.	.	.
20.01	3.2453	1.22	.Q	.	.	.	.
20.13	3.2579	1.20	.Q	.	.	.	.
20.26	3.2702	1.18	.Q	.	.	.	.
20.38	3.2823	1.16	.Q	.	.	.	.
20.51	3.2943	1.15	.Q	.	.	.	.
20.63	3.3060	1.13	.Q	.	.	.	.
20.76	3.3176	1.11	.Q	.	.	.	.
20.88	3.3290	1.10	.Q	.	.	.	.
21.01	3.3403	1.08	.Q	.	.	.	.
21.13	3.3514	1.07	.Q	.	.	.	.
21.26	3.3624	1.05	.Q	.	.	.	.
21.38	3.3732	1.04	.Q	.	.	.	.
21.51	3.3839	1.03	.Q	.	.	.	.
21.63	3.3944	1.01	.Q	.	.	.	.
21.76	3.4049	1.00	.Q	.	.	.	.
21.88	3.4152	0.99	.Q	.	.	.	.
22.01	3.4254	0.98	.Q	.	.	.	.
22.13	3.4354	0.97	.Q	.	.	.	.
22.26	3.4454	0.96	.Q	.	.	.	.
22.38	3.4553	0.95	.Q	.	.	.	.
22.51	3.4650	0.94	.Q	.	.	.	.
22.63	3.4747	0.93	.Q	.	.	.	.
22.76	3.4842	0.92	.Q	.	.	.	.
22.88	3.4937	0.91	.Q	.	.	.	.
23.01	3.5030	0.90	.Q	.	.	.	.
23.13	3.5123	0.89	.Q	.	.	.	.
23.26	3.5215	0.88	.Q	.	.	.	.
23.38	3.5306	0.88	.Q	.	.	.	.
23.51	3.5396	0.87	.Q	.	.	.	.
23.64	3.5485	0.86	.Q	.	.	.	.
23.76	3.5574	0.85	.Q	.	.	.	.
23.89	3.5661	0.84	.Q	.	.	.	.
24.01	3.5748	0.84	.Q	.	.	.	.
24.14	3.5792	0.00	Q	.	.	.	.

-----

Problem Descriptions:

=====

FLOW-THROUGH DETENTION BASIN MODEL

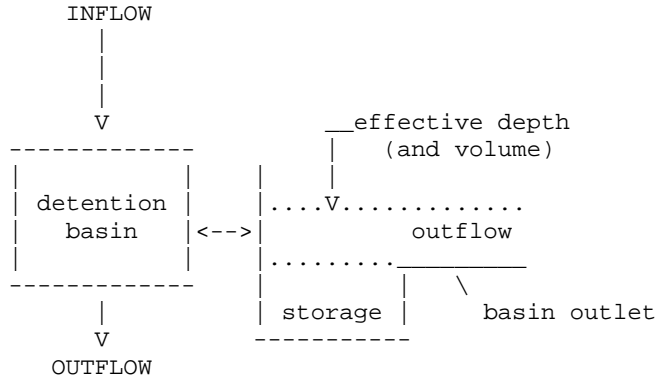
SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:

CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 7.510

DEAD STORAGE(AF) = 0.00

SPECIFIED DEAD STORAGE(AF) FILLED = 0.00

ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00



DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:

TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 10

*BASIN-DEPTH	STORAGE	OUTFLOW	**BASIN-DEPTH	STORAGE	OUTFLOW	*
(FEET)	(ACRE-FEET)	(CFS)	(FEET)	(ACRE-FEET)	(CFS)	
* 0.000	0.000	0.000	** 1.000	0.100	1.470	*
* 2.000	0.269	1.470	** 3.000	0.485	1.470	*
* 4.000	0.723	1.470	** 5.000	0.971	1.470	*
* 6.000	1.198	1.470	** 7.000	1.411	1.470	*
* 8.000	1.588	1.470	** 9.000	1.692	1.470	*

BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:

INTERVAL	DEPTH	{S-O*DT/2}	{S+O*DT/2}
NUMBER	(FEET)	(ACRE-FEET)	(ACRE-FEET)
1	0.00	0.00000	0.00000
2	1.00	0.09244	0.10765
3	2.00	0.26097	0.27617
4	3.00	0.47704	0.49224
5	4.00	0.71543	0.73063
6	5.00	0.96359	0.97879
7	6.00	1.19086	1.20606
8	7.00	1.40291	1.41811
9	8.00	1.58083	1.59603
10	9.00	1.68487	1.70007

WHERE S=STORAGE(AF);O=OUTFLOW(AF/MIN.);DT=UNIT INTERVAL(MIN.)

DETENTION BASIN ROUTING RESULTS:

NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

TIME	DEAD-STORAGE	INFLOW	EFFECTIVE	OUTFLOW	EFFECTIVE
(HRS)	FILLED(AF)	(CFS)	DEPTH(FT)	(CFS)	VOLUME(AF)
0.104	0.000	0.83	0.08	0.06	0.008



0.229	0.000	0.84	0.15	0.17	0.015
0.354	0.000	0.84	0.21	0.26	0.021
0.479	0.000	0.84	0.26	0.34	0.026
0.604	0.000	0.85	0.30	0.42	0.030
0.730	0.000	0.85	0.34	0.48	0.034
0.855	0.000	0.85	0.38	0.53	0.038
0.980	0.000	0.86	0.41	0.58	0.041
1.105	0.000	0.86	0.43	0.62	0.043
1.230	0.000	0.86	0.45	0.65	0.045
1.355	0.000	0.87	0.47	0.68	0.047
1.481	0.000	0.87	0.49	0.71	0.049
1.606	0.000	0.88	0.51	0.73	0.051
1.731	0.000	0.88	0.52	0.75	0.052
1.856	0.000	0.89	0.53	0.77	0.053
1.981	0.000	0.89	0.54	0.79	0.054
2.106	0.000	0.89	0.55	0.80	0.055
2.232	0.000	0.90	0.56	0.82	0.056
2.357	0.000	0.90	0.57	0.83	0.057
2.482	0.000	0.91	0.57	0.84	0.057
2.607	0.000	0.91	0.58	0.85	0.058
2.732	0.000	0.92	0.59	0.86	0.059
2.857	0.000	0.92	0.59	0.87	0.059
2.983	0.000	0.92	0.60	0.87	0.060
3.108	0.000	0.93	0.60	0.88	0.060
3.233	0.000	0.93	0.61	0.89	0.061
3.358	0.000	0.94	0.61	0.90	0.061
3.483	0.000	0.94	0.62	0.90	0.062
3.608	0.000	0.95	0.62	0.91	0.062
3.734	0.000	0.95	0.62	0.91	0.062
3.859	0.000	0.96	0.63	0.92	0.063
3.984	0.000	0.96	0.63	0.93	0.063
4.109	0.000	0.97	0.64	0.93	0.064
4.234	0.000	0.98	0.64	0.94	0.064
4.359	0.000	0.98	0.64	0.94	0.064
4.485	0.000	0.99	0.65	0.95	0.065
4.610	0.000	0.99	0.65	0.96	0.065
4.735	0.000	1.00	0.66	0.96	0.066
4.860	0.000	1.01	0.66	0.97	0.066
4.985	0.000	1.01	0.66	0.97	0.066
5.110	0.000	1.02	0.67	0.98	0.067
5.236	0.000	1.02	0.67	0.98	0.067
5.361	0.000	1.03	0.68	0.99	0.068
5.486	0.000	1.04	0.68	1.00	0.068
5.611	0.000	1.04	0.68	1.00	0.068
5.736	0.000	1.05	0.69	1.01	0.069
5.861	0.000	1.06	0.69	1.02	0.069
5.987	0.000	1.06	0.70	1.02	0.070
6.112	0.000	1.07	0.70	1.03	0.070
6.237	0.000	1.08	0.71	1.03	0.071
6.362	0.000	1.09	0.71	1.04	0.071
6.487	0.000	1.09	0.72	1.05	0.072
6.612	0.000	1.10	0.72	1.05	0.072
6.738	0.000	1.11	0.72	1.06	0.072
6.863	0.000	1.12	0.73	1.07	0.073
6.988	0.000	1.12	0.73	1.08	0.073
7.113	0.000	1.13	0.74	1.08	0.074
7.238	0.000	1.14	0.74	1.09	0.075
7.364	0.000	1.15	0.75	1.10	0.075
7.489	0.000	1.16	0.76	1.11	0.076
7.614	0.000	1.17	0.76	1.11	0.076
7.739	0.000	1.18	0.77	1.12	0.077
7.864	0.000	1.19	0.77	1.13	0.077
7.989	0.000	1.19	0.78	1.14	0.078

8.115	0.000	1.21	0.78	1.15	0.078
8.240	0.000	1.21	0.79	1.16	0.079
8.365	0.000	1.23	0.80	1.17	0.080
8.490	0.000	1.24	0.80	1.18	0.080
8.615	0.000	1.25	0.81	1.19	0.081
8.740	0.000	1.26	0.82	1.20	0.082
8.865	0.000	1.27	0.82	1.21	0.082
8.991	0.000	1.28	0.83	1.22	0.083
9.116	0.000	1.30	0.84	1.23	0.084
9.241	0.000	1.31	0.84	1.24	0.085
9.366	0.000	1.32	0.85	1.25	0.085
9.491	0.000	1.33	0.86	1.26	0.086
9.616	0.000	1.35	0.87	1.27	0.087
9.742	0.000	1.36	0.88	1.28	0.088
9.867	0.000	1.38	0.89	1.29	0.089
9.992	0.000	1.39	0.89	1.31	0.089
10.117	0.000	1.41	0.90	1.32	0.090
10.242	0.000	1.42	0.91	1.33	0.091
10.367	0.000	1.44	0.92	1.35	0.092
10.493	0.000	1.45	0.93	1.36	0.093
10.618	0.000	1.48	0.94	1.38	0.094
10.743	0.000	1.49	0.95	1.39	0.095
10.868	0.000	1.52	0.96	1.41	0.096
10.993	0.000	1.53	0.97	1.42	0.097
11.118	0.000	1.56	0.99	1.44	0.099
11.244	0.000	1.57	1.00	1.46	0.100
11.369	0.000	1.60	1.01	1.47	0.101
11.494	0.000	1.61	1.02	1.47	0.103
11.619	0.000	1.65	1.03	1.47	0.104
11.744	0.000	1.66	1.04	1.47	0.106
11.870	0.000	1.70	1.05	1.47	0.109
11.995	0.000	1.72	1.07	1.47	0.111
12.120	0.000	2.00	1.10	1.47	0.117
12.245	0.000	2.04	1.14	1.47	0.123
12.370	0.000	2.08	1.17	1.47	0.129
12.495	0.000	2.11	1.21	1.47	0.136
12.620	0.000	2.15	1.25	1.47	0.143
12.746	0.000	2.18	1.30	1.47	0.150
12.871	0.000	2.23	1.34	1.47	0.158
12.996	0.000	2.26	1.39	1.47	0.166
13.121	0.000	2.31	1.44	1.47	0.175
13.246	0.000	2.34	1.50	1.47	0.184
13.372	0.000	2.41	1.56	1.47	0.194
13.497	0.000	2.45	1.62	1.47	0.204
13.622	0.000	2.52	1.68	1.47	0.215
13.747	0.000	2.56	1.75	1.47	0.226
13.872	0.000	2.65	1.82	1.47	0.238
13.997	0.000	2.70	1.89	1.47	0.251
14.122	0.000	2.82	1.98	1.47	0.265
14.248	0.000	2.88	2.05	1.47	0.279
14.373	0.000	3.00	2.12	1.47	0.295
14.498	0.000	3.07	2.20	1.47	0.312
14.623	0.000	3.23	2.28	1.47	0.330
14.748	0.000	3.32	2.37	1.47	0.349
14.873	0.000	3.52	2.47	1.47	0.370
14.999	0.000	3.64	2.57	1.47	0.393
15.124	0.000	3.92	2.69	1.47	0.418
15.249	0.000	4.08	2.82	1.47	0.445
15.374	0.000	4.53	2.96	1.47	0.477
15.499	0.000	5.33	3.13	1.47	0.517
15.624	0.000	6.10	3.34	1.47	0.565
15.750	0.000	6.65	3.56	1.47	0.618
15.875	0.000	7.91	3.84	1.47	0.685

16.000	0.000	10.19	4.21	1.47	0.775
16.125	0.000	22.94	5.11	1.47	0.997
16.250	0.000	6.71	5.35	1.47	1.051
16.375	0.000	5.68	5.54	1.47	1.095
16.501	0.000	4.29	5.67	1.47	1.124
16.626	0.000	3.77	5.78	1.47	1.148
16.751	0.000	3.41	5.86	1.47	1.168
16.876	0.000	3.15	5.94	1.47	1.185
17.001	0.000	2.94	6.01	1.47	1.200
17.126	0.000	2.75	6.07	1.47	1.213
17.252	0.000	2.60	6.13	1.47	1.225
17.377	0.000	2.48	6.18	1.47	1.236
17.502	0.000	2.38	6.22	1.47	1.245
17.627	0.000	2.28	6.26	1.47	1.253
17.752	0.000	2.20	6.30	1.47	1.261
17.878	0.000	2.13	6.33	1.47	1.268
18.003	0.000	2.06	6.36	1.47	1.274
18.128	0.000	1.74	6.37	1.47	1.277
18.253	0.000	1.68	6.38	1.47	1.279
18.378	0.000	1.63	6.39	1.47	1.281
18.503	0.000	1.58	6.39	1.47	1.282
18.628	0.000	1.54	6.40	1.47	1.282
18.754	0.000	1.50	<u>6.40</u>	1.47	1.283
18.879	0.000	1.47	6.40	1.47	1.283
19.004	0.000	1.43	6.40	1.47	1.282
19.129	0.000	1.40	6.39	1.47	1.282
19.254	0.000	1.37	6.39	1.47	1.281
19.379	0.000	1.34	6.38	1.47	1.279
19.505	0.000	1.31	6.37	1.47	1.278
19.630	0.000	1.29	6.36	1.47	1.276
19.755	0.000	1.27	6.35	1.47	1.274
19.880	0.000	1.24	6.34	1.47	1.271
20.005	0.000	1.22	6.33	1.47	1.269
20.130	0.000	1.20	6.32	1.47	1.266
20.256	0.000	1.18	6.30	1.47	1.263
20.381	0.000	1.16	6.29	1.47	1.260
20.506	0.000	1.15	6.27	1.47	1.256
20.631	0.000	1.13	6.26	1.47	1.253
20.756	0.000	1.11	6.24	1.47	1.249
20.882	0.000	1.10	6.22	1.47	1.245
21.007	0.000	1.08	6.20	1.47	1.241
21.132	0.000	1.07	6.18	1.47	1.237
21.257	0.000	1.05	6.16	1.47	1.233
21.382	0.000	1.04	6.14	1.47	1.228
21.507	0.000	1.03	6.12	1.47	1.224
21.632	0.000	1.01	6.10	1.47	1.219
21.758	0.000	1.00	6.07	1.47	1.214
21.883	0.000	0.99	6.05	1.47	1.209
22.008	0.000	0.98	6.03	1.47	1.204
22.133	0.000	0.97	6.00	1.47	1.199
22.258	0.000	0.96	5.98	1.47	1.194
22.384	0.000	0.95	5.96	1.47	1.188
22.509	0.000	0.94	5.93	1.47	1.183
22.634	0.000	0.93	5.91	1.47	1.177
22.759	0.000	0.92	5.88	1.47	1.172
22.884	0.000	0.91	5.86	1.47	1.166
23.009	0.000	0.90	5.83	1.47	1.160
23.135	0.000	0.89	5.80	1.47	1.154
23.260	0.000	0.88	5.78	1.47	1.148
23.385	0.000	0.88	5.75	1.47	1.142
23.510	0.000	0.87	5.72	1.47	1.135
23.635	0.000	0.86	5.69	1.47	1.129
23.760	0.000	0.85	5.67	1.47	1.123

23.885	0.000	0.84	5.64	1.47	1.116
24.011	0.000	0.84	5.61	1.47	1.110
24.136	0.000	0.00	5.54	1.47	1.095
-----					

**APPENDIX D: STORAGE VOLUME & OUTFLOW CALCULATIONS AND  $\bar{Y}$ bar  
CALCULATIONS**

## **STORAGE PIPE CALCULATIONS**

LOCUST AVE.

VOLUME = 1250 LF - 96" DIA. PIPE INF. FACILITY

### **OUTFLOW:**

#### **INFILTRATION**

INFILTRATION RATE - 5.07 "/HR (WQMP Worksheet H)

FACILITY AREA - 12,500 SF

TOTAL INF. =  $5.07"/HR * (1/3600 \text{ SEC}/HR * 1/12 \text{ FT}/IN) * 12,500 = 1.47 \text{ CFS}$

OUTLET		STORAGE		
HEAD (h)	OUTLET FLOW			
	CFS	CF	AF	TOTAL
1	1.47	4375	0.10044	0.10044
2	1.47	7324	0.16814	0.26857
3	1.47	9412	0.21607	0.48464
4	1.47	10384	0.23838	0.72303
5	1.47	10810	0.24816	0.97119
6	1.47	9900	0.22727	1.19846
7	1.47	9237	0.21205	1.41051
8	1.47	7750	0.17792	1.58843
9	1.47	4532	0.10404	1.69247

## YBAR CALCULATIONS

DEVELOPED AREA A						
2 YEAR STORM						
P24 = 3.87 in.						
SUBAREA	ACRES	CN	S	Ia	Yj	Yj*Aj
A1	2.19	94	0.64	0.13	0.83	1.81
A2	0.67	94	0.64	0.13	0.83	0.55
A3	1.85	94	0.64	0.13	0.83	1.53
<b>TOTAL</b>	<b>4.71</b>					

$$Y = (\sum Y_j * A_j) / A \quad Y = 0.83$$

$$Y_{bar} = 1 - Y \quad Y_{bar} = 0.17$$

DEVELOPED AREA A						
25 YEAR STORM						
P24 = 7.21 in.						
SUBAREA	ACRES	CN	S	Ia	Yj	Yj*Aj
A1	2.19	94	0.64	0.13	0.90	1.97
A2	0.67	94	0.64	0.13	0.90	0.60
A3	1.85	94	0.64	0.13	0.90	1.67
<b>TOTAL</b>	<b>4.71</b>					

$$Y = (\sum Y_j * A_j) / A \quad Y = 0.90$$

$$Y_{bar} = 1 - Y \quad Y_{bar} = 0.10$$

DEVELOPED AREA A						
100 YEAR STORM						
P24 = 9.02 in.						
SUBAREA	ACRES	CN	S	Ia	Yj	Yj*Aj
A1	2.19	94	0.64	0.13	0.92	2.01
A2	0.67	94	0.64	0.13	0.92	0.62
A3	1.85	94	0.64	0.13	0.92	1.70
<b>TOTAL</b>	<b>4.71</b>					

$$Y = (\sum Y_j * A_j) / A \quad Y = 0.92$$

$$Y_{bar} = 1 - Y \quad Y_{bar} = 0.08$$

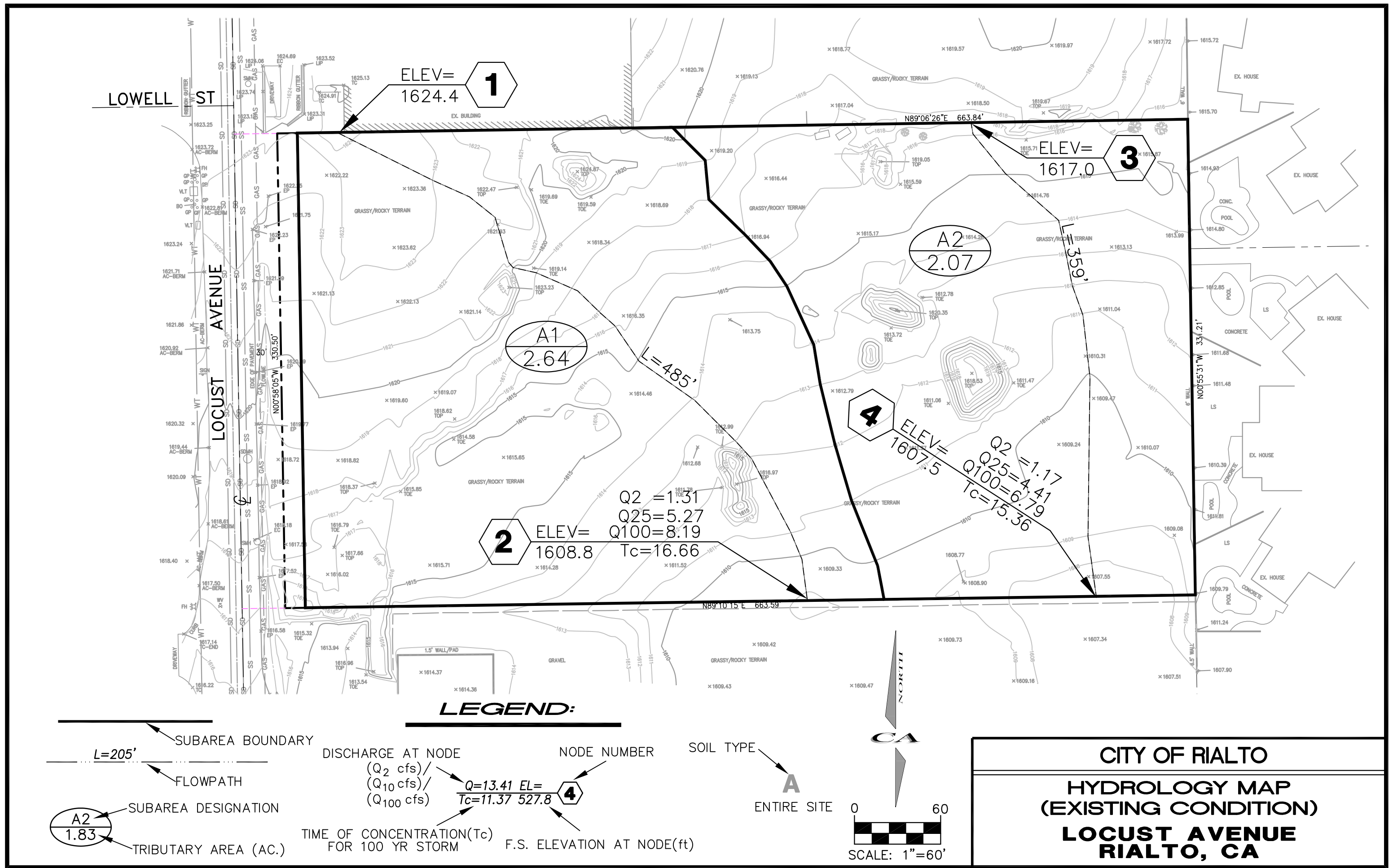
### DEFINITIONS:

CN - CURVE NUMBER OF HYDRAULIC SOIL COVER
S - ESTIMATE OF TOTAL SOIL CAPACITY
Ia - INITIAL ABSTRACTION
Yj - 24-HR STORM RUNOFF YIELD FRACTION
Ybar - CATCHMENT LOW LOSS FRACTION

## EXHIBITS



## **EXHIBIT A: EXISTING CONDITION HYDROLOGY MAP**



LOWELL ST

LOCUST AVENUE

ELEV= 1624.4 **1**

ELEV= 1617.0 **3**

A1  
2.64

A2  
2.07

**4**

**2**

ELEV= 1608.8  
Q2 = 1.31  
Q25 = 5.27  
Q100 = 8.19  
Tc = 16.66

ELEV= 1607.5  
Q2 = 1.17  
Q25 = 4.41  
Q100 = 6.79  
Tc = 15.36

**LEGEND:**

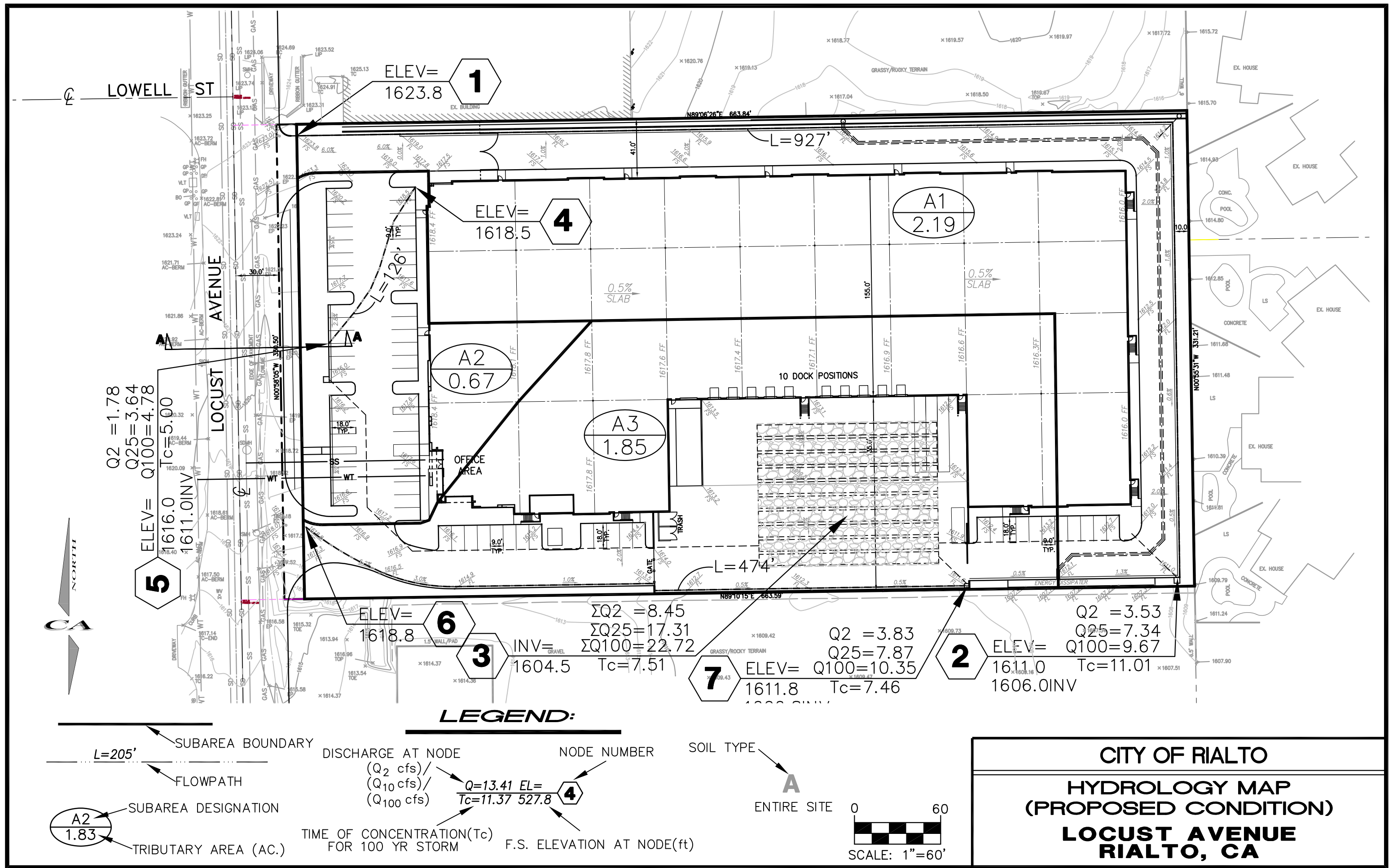
— L=205' — SUBAREA BOUNDARY  
— FLOWPATH —  
A2 1.83 SUBAREA DESIGNATION  
— TRIBUTARY AREA (AC.) —

DISCHARGE AT NODE  
(Q<sub>2</sub> cfs)/  
(Q<sub>10</sub> cfs)/  
(Q<sub>100</sub> cfs)  
Q=13.41 EL= 527.8 **4**  
Tc=11.37  
TIME OF CONCENTRATION(T<sub>c</sub>)  
FOR 100 YR STORM  
F.S. ELEVATION AT NODE(ft)

SOIL TYPE  
A  
ENTIRE SITE  
0 60  
SCALE: 1"=60'

**CITY OF RIALTO**  
**HYDROLOGY MAP**  
**(EXISTING CONDITION)**  
**LOCUST AVENUE**  
**RIALTO, CA**

## **EXHIBIT B: PROPOSED CONDITION HYDROLOGY MAP**



## EXHIBIT C: FIRM MAP



## NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

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

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

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

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

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

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

NGS Information Services  
NOAA, NINGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3242

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

**Base map** information shown on this FIRM was derived from digital orthophotography collected by the U.S. Department of Agriculture Farm Service Agency. This imagery was flown in 2005 and was produced with a 1-meter ground sample distance.

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

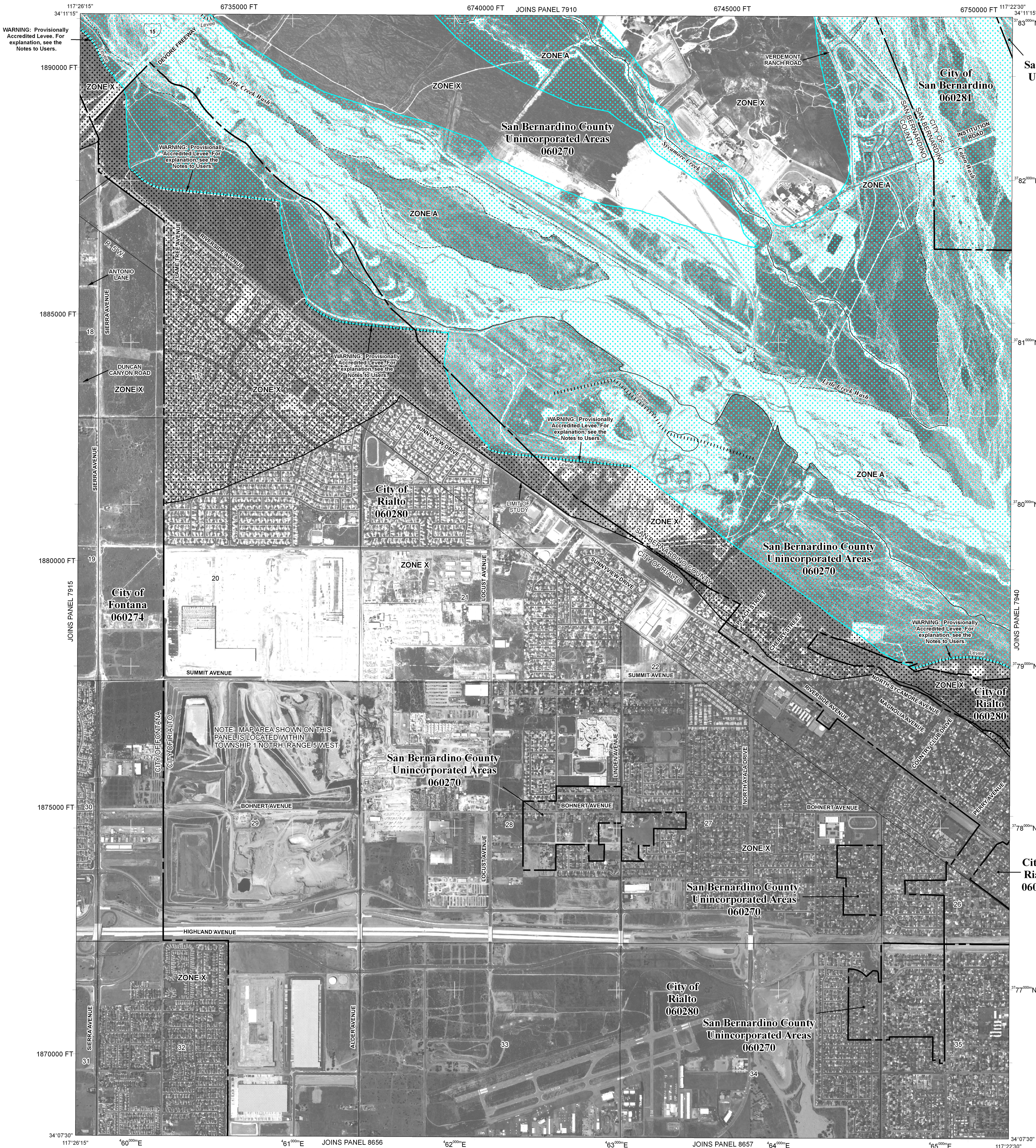
**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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

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

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

**WARNING:** This map contains levees, dikes, or other structures that have been provisionally accredited and mapped as providing protection from the 1-percent-annual-chance flood. To maintain accreditation, the levee owner or community is required to submit documentation necessary to comply with 44 CFR Section 65.10 by August 8, 2009. Because of the risk of overtopping or failure of the structure, communities should take proper precautions to protect lives and minimize damages in these areas, such as issuing an evacuation plan and encouraging property owners to purchase flood insurance.



## LEGEND

**SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

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

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

### FLOODWAY AREAS IN ZONE AE

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

### OTHER FLOOD AREAS

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

### OTHER AREAS

- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.

### COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

### OTHERWISE PROTECTED AREAS (OPAs)

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

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

\* Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 11N
- 5000-foot grid ticks: California State Plane coordinate system, zone V (FIPSZONE 0405), Lambert Conformal Conic projection
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile

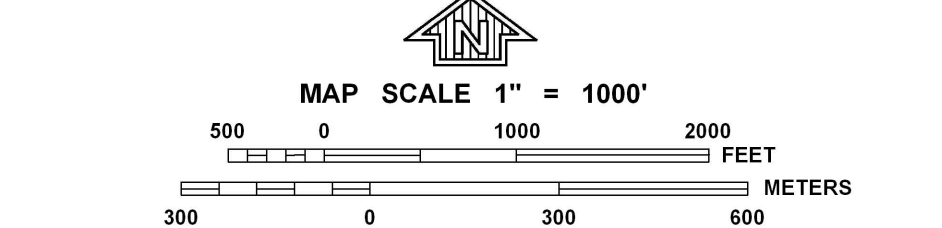
**MAP REPOSITORY**  
Refer to listing of Map Repositories on Map Index

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**  
August 28, 2008 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-538-6620.



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 7920H**

**FIRM**  
**FLOOD INSURANCE RATE MAP**

**SAN BERNARDINO COUNTY, CALIFORNIA AND INCORPORATED AREAS**  
**PANEL 7920 OF 9400**  
(SEE MAP INDEX FOR FIRM LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
FONTANA, CITY OF	060274	7920	H
RIALTO, CITY OF	060280	7920	H
SAN BERNARDINO COUNTY	060270	7920	H
SAN BERNARDINO, CITY OF	060281	7920	H

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

**MAP NUMBER**  
**06071C7920H**

**MAP REVISED**  
**AUGUST 28, 2008**

**Federal Emergency Management Agency**



## **EXHIBIT D: WQMP SITE PLAN**



PRELIMINARY  
WQMP SITE PLAN  
2889 N. LOCUST AVE.  
RIALTO, CA

PROJECT DATA:

TOTAL SITE AREA OF PROPOSED  
DEVELOPMENT: 4.71 AC (205,044 SF)

BUILDING AREA: 96,748 SF  
WALKWAYS / CONC. GUTTER / DOCK AREAS: 38,491 SF  
DRIVEWAYS / DRIVE AISLES / PARKING AREAS: 49,135 SF

20,670 SF LANDSCAPING PROVIDED  
(10.1% PERVIOUS AREA)

CURRENT USE: VACANT  
PROPOSED USE: INDUSTRIAL

WATERSHED:  
SANTA ANA RIVER

WQMP DCV CALCULATION

AREA 1

AREA = 4.71 AC (205,044 SF)  
RUNOFF COEFFICIENT (90% IMPERVIOUS)  
 $C = 0.858 * (.90)^3 - 0.78 * (.90)^2 + 0.774 * (.90) + .04 = 0.730$   
2YR 1 HR STORM = 0.730 IN  
 $P6 = 1.4807 * 0.730 = 1.0809$  IN  
 $DCV = 205,044 \text{ SF} * 0.730 * 1.0809 \text{ IN} / 12 \text{ IN/FT} * 1.963 = 26,466 \text{ CF}$

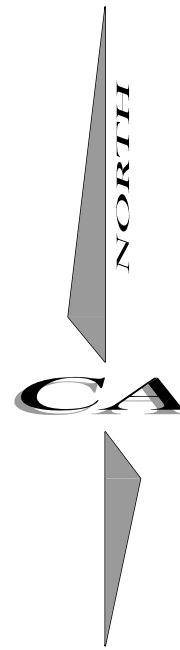
BMP VOLUME CALCULATION

BMP VOLUME  
PIPE CROSS SECTIONAL AREA =  $(50.26) * 10 \text{ CF/LF} = 502.60 \text{ CF/LF}$   
ROCK CROSS SECTIONAL AREA =  $248.70 \text{ CF/LF ROCK AREA} * 0.35 = 87.05 \text{ CF/LF}$   
TOTAL CROSS SECTIONAL AREA =  $589.65 \text{ CF/LF} * 125 \text{ LF} = 73,706 \text{ CF}$   
EFFECTIVE DEPTH =  $73,706 \text{ CF} / 12,500 \text{ SF BOTTOM} = 5.90'$

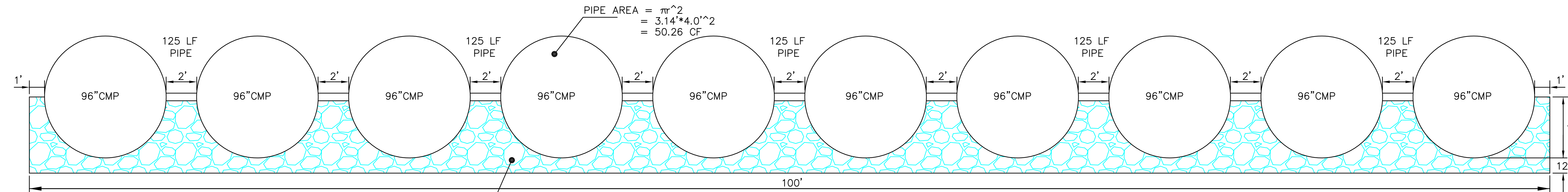
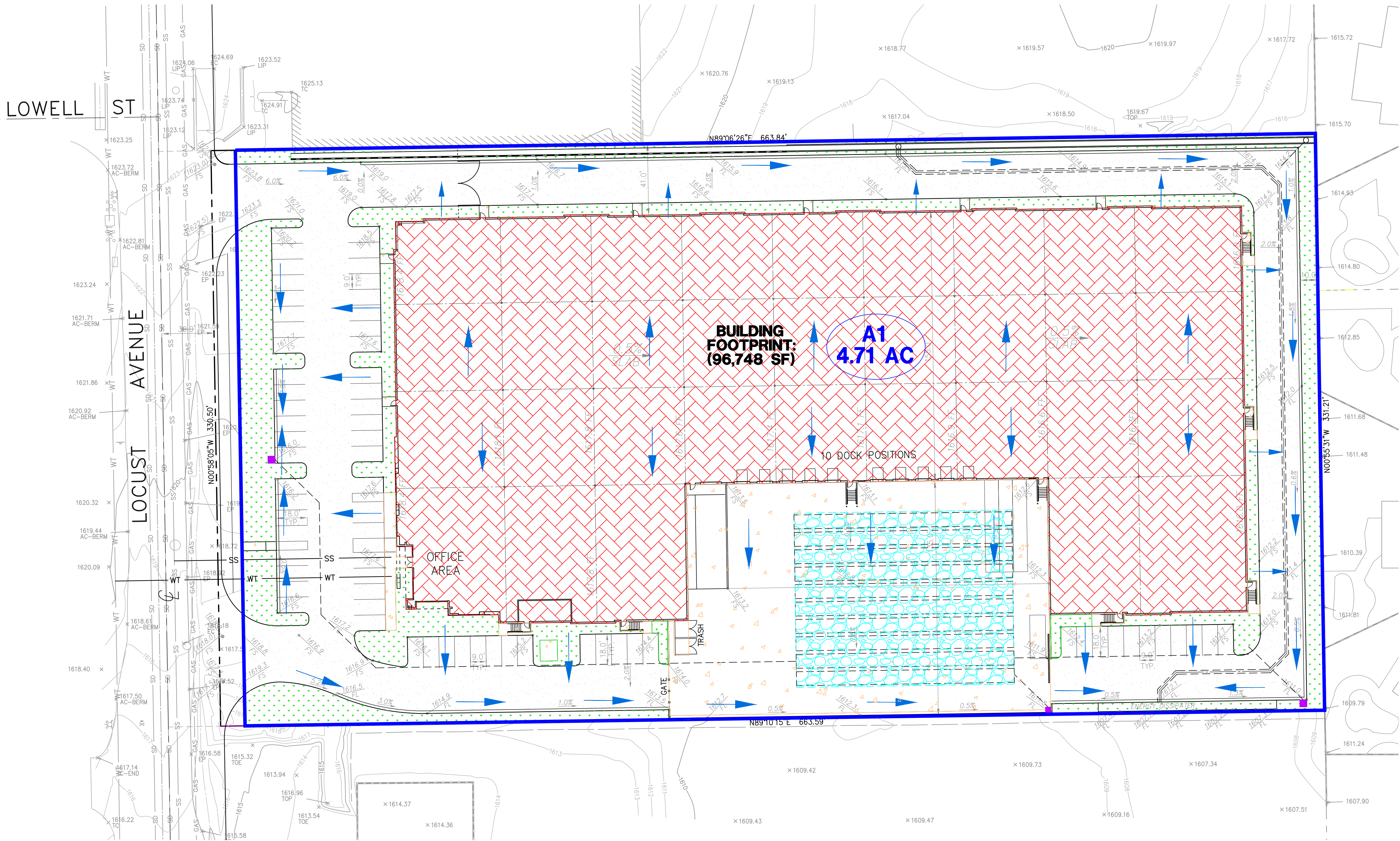
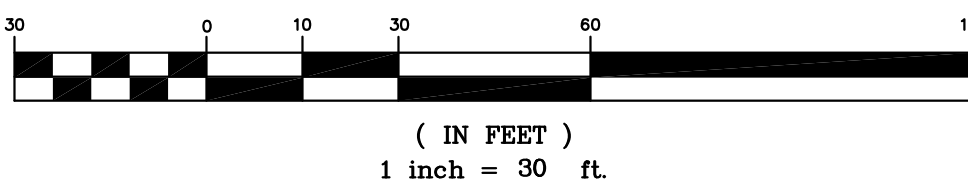
$V_{ret} = (P_{design} / 12 * S_{ainf} * T_{fill}) + (S_{ares} * D_{res} * N_{agg})$   
 $P_{design} = 15.5'' \text{ MEASURED} / 3.06 \text{ S.F.} = 5.07''/\text{HR}$   
 $S_{ainf} = 12,500 \text{ SF}$   
 $S_{ares} = 12,500 \text{ SF}$   
 $T_{fill} = 3 \text{ HRS}$   
 $D_{res} = \text{EFFECTIVE DEPTH} = 5.90'$   
 $N_{agg} = 1.0 \text{ (EFFECTIVE DEPTH ACCOUNTED FOR ROCK)}$   
 $V_{ret} = (5.07 / 12 * 12,500 * 3) + (12,500 * 5.90 * 1)$   
 $V_{ret} = 89,594 \text{ CF}$   
BMP VOLUME (89,594 CF) > DCV VOLUME (26,466 CF)

BMP LEGEND

- AREA 1**
- DRAINAGE AREAS
  - FLOW DIRECTION
  - UNDERGROUND INFILTRATION PIPE PER DETAIL HEREON
  - LANDSCAPE AREA EFFICIENT IRRIGATION  
LANDSCAPE AREA RUNOFF-MINIMIZING DESIGN
  - PROPOSED BUILDING
  - ASPHALT CONCRETE DRIVE AISLES
  - CONCRETE HARDSCAPE/ENHANCED PAVING
  - CATCH BASIN WITH INSERT FILTER & STORM DRAIN STENCIL SIGNAGE
  - TRASH ENCLOSURE



GRAPHIC SCALE



ROCK AREA =  $(\text{FACILITY AREA} - \text{PIPE AREA}) * 0.35$   
 $= (100 * 5) - (0.5 * 50.26 * 10) = 248.70 \text{ CF/LF}$   
 $248.70 \text{ CF/LF} * 125 \text{ LF} = 31,089 \text{ CF} * 0.35 = 10,881 \text{ CF}$

INFILTRATION BMP  
CROSS SECTION

1"=4'



FRED CORNWELL R.C.E. 45591 DATE

PREPARED BY:  
**CA ENGINEERING, INC.**  
Planning • Engineering • Surveying  
13821 NEWPORT AVE., STE 110  
TUSTIN, CA 92780  
949-724-9480 949-724-9484 FAX

DATE	BY	REVISION	DATE
Dec 28 2021			
JOB NO.			
251-55			
Sht. C-2			





## LOCUST AVENUE INDUSTRIAL PROJECT

2889 N. Locust Avenue  
Rialto, CA 92377

# Preliminary Water Quality Management Plan



### Prepared By:

Fred Cornwell, P.E.  
CA Engineering, Inc.  
13821 Newport Avenue, Suite 110  
Tustin, CA 92780  
949.724.9480 / [fcornwell@ca-eng.net](mailto:fcornwell@ca-eng.net)

### Prepared For:

Locust XC, LLC  
3010 Old Ranch Parkway, Suite 470  
Seal Beach, CA 90740  
562.795.0270

Date Prepared: December 21, 2021

# Preliminary Water Quality Management Plan

For:

## Locust Avenue Industrial Project

2889 N. Locust Avenue

Rialto, CA 92377

APN: 0239-193-11-0-000

Prepared for:

Locust XC, LLC

Gretchen Kendrick, Authorized Signatory

3010 Old Ranch Parkway, Suite 470

Seal Beach, CA 90740

(562) 795-0270 / [gretchenk@xebecrealty.com](mailto:gretchenk@xebecrealty.com)

Prepared by:

CA Engineering, Inc.

Fred Cornwell, P.E., RCE #45591

13821 Newport Avenue, Suite 110

Tustin, CA 92780

(949) 724-9480 (x2012) / [fcornwell@ca-eng.net](mailto:fcornwell@ca-eng.net)

Submittal Date: December 21, 2021

Approval Date: \_\_\_\_\_



## Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Locust XC, LLC by CA Engineering, Inc. The WQMP is intended to comply with the requirements of the City of Rialto and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	MC 2021-0058	Grading Permit Number(s):	Pending
Tract/Parcel Map Number(s):		Building Permit Number(s):	Pending
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0239-193-11-0-000
Owner's Signature			
Owner Name: Locust XC, LLC			
Title	Gretchen Kendrick, Authorized Signatory		
Company	Locust XC, LLC		
Address	3010 Old Ranch Parkway, Suite 470, Seal Beach, CA 90740		
Email	gretchenk@xebecrealty.com		
Telephone #	(562) 795-0270		
Signature		Date	

## Preparer's Certification

Project Data			
Permit/Application Number(s):	MC 2021-0058	Grading Permit Number(s):	Pending
Tract/Parcel Map Number(s):		Building Permit Number(s):	Pending
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0239-193-11-0-000

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

<b>Engineer:</b> Fred Cornwell, P.E.		<p>PE Stamp Below</p> 
Title	Principal	
Company	CA Engineering, Inc.	
Address	13821 Newport Avenue, Suite 110, Tustin, CA 92780	
Email	fcornwell@ca-eng.net	
Telephone #	(949) 724-9480 (x2012)	
Signature		
Date	12-21-2021	

# Table of Contents

<b>Section 1</b>	<b>Discretionary Permits .....</b>	<b>1-1</b>
<b>Section 2</b>	<b>Project Description.....</b>	<b>2-1</b>
2.1	Project Information.....	2-1
2.2	Property Ownership / Management .....	2-2
2.3	Potential Stormwater Pollutants .....	2-3
2.4	Water Quality Credits .....	2-4
<b>Section 3</b>	<b>Site and Watershed Description .....</b>	<b>3-1</b>
<b>Section 4</b>	<b>Best Management Practices .....</b>	<b>4-1</b>
4.1	Source Control BMP .....	4-1
4.1.1	Pollution Prevention .....	4-1
4.1.2	Preventative LID Site Design Practices .....	4-6
4.2	Project Performance Criteria.....	4-7
4.3	Project Conformance Analysis.....	4-12
4.3.1	Site Design Hydrologic Source Control BMP .....	4-14
4.3.2	Infiltration BMP .....	4-16
4.3.3	Harvest and Use BMP .....	4-18
4.3.4	Biotreatment BMP.....	4-19
4.3.5	Conformance Summary.....	4-23
4.3.6	Hydromodification Control BMP .....	4-24
4.4	Alternative Compliance Plan (if applicable) .....	4-25
<b>Section 5</b>	<b>Inspection &amp; Maintenance Responsibility Post Construction BMPs.....</b>	<b>5-1</b>
<b>Section 6</b>	<b>WQMP Attachments.....</b>	<b>6-1</b>
6.1.	Site Plan and Drainage Plan.....	6-4
6.2	Electronic Data Submittal .....	6-5
6.3	Post Construction.....	6-6
6.4	Other Supporting Documentation.....	6-7

## Forms

<b>Form 1-1</b>	<b>Project Information .....</b>	<b>1-1</b>
<b>Form 2.1-1</b>	<b>Description of Proposed Project .....</b>	<b>2-1</b>
<b>Form 2.2-1</b>	<b>Property Ownership/Management.....</b>	<b>2-2</b>
<b>Form 2.3-1</b>	<b>Pollutants of Concern .....</b>	<b>2-3</b>
<b>Form 2.4-1</b>	<b>Water Quality Credits .....</b>	<b>2-4</b>
<b>Form 3-1</b>	<b>Site Location and Hydrologic Features .....</b>	<b>3-1</b>
<b>Form 3-2</b>	<b>Hydrologic Characteristics.....</b>	<b>3-2</b>
<b>Form 3-3</b>	<b>Watershed Description.....</b>	<b>3-4</b>
<b>Form 4.1-1</b>	<b>Non-Structural Source Control BMP.....</b>	<b>4-2</b>
<b>Form 4.1-2</b>	<b>Structural Source Control BMP .....</b>	<b>4-4</b>
<b>Form 4.1-3</b>	<b>Site Design Practices Checklist.....</b>	<b>4-6</b>
<b>Form 4.2-1</b>	<b>LID BMP Performance Criteria for Design Capture Volume .....</b>	<b>4-7</b>
<b>Form 4.2-2</b>	<b>Summary of HCOC Assessment.....</b>	<b>4-8</b>

Form 4.2-3 HCOC Assessment for Runoff Volume .....	4-9
Form 4.2-4 HCOC Assessment for Time of Concentration .....	4-10
Form 4.2-5 HCOC Assessment for Peak Runoff.....	4-11
Form 4.3-1 Infiltration BMP Feasibility .....	4-13
Form 4.3-2 Site Design Hydrologic Source Control BMP .....	4-14
Form 4.3-3 Infiltration LID BMP .....	4-17
Form 4.3-4 Harvest and Use BMP .....	4-18
Form 4.3-5 Selection and Evaluation of Biotreatment BMP .....	4-19
Form 4.3-6 Volume Based Biotreatment – Bioretention and Planter Boxes w/Underdrains	4-20
Form 4.3-7 Volume Based Biotreatment- Constructed Wetlands and Extended Detention	4-21
Form 4.3-8 Flow Based Biotreatment .....	4-22
Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate .....	4-23
Form 4.3-10 Hydromodification Control BMP .....	4-24
Form 5-1 BMP Inspection and Maintenance .....	5-1

**APPENDICES INCLUDED IN SECTION 6.1 (Site Plan and Drainage Plan):**

Appendix A: Vicinity Map

Appendix B: Receiving Waters Map

Appendix C: San Bernardino County Project Site WAP Report

Appendix D: WQMP Site Plan

**APPENDICES INCLUDED IN SECTION 6.2 (Electronic Data Submittal):**

Appendix E: Link to Electronic Version of Final WQMP, Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement, Precise Grading Plans

**APPENDICES INCLUDED IN SECTION 6.3 (Post Construction):**

Appendix F: Operation and Maintenance (O & M) Plan

Appendix G: Record of BMP Implementation, Maintenance and Inspection

Appendix H: Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement

**APPENDICES INCLUDED IN SECTION 6.4 (Other Supporting Documentation):**

Appendix I: Kristar FloGard +PLUS Catch Basin Insert Filter Specification (Pretreatment for Infiltration)

Appendix J: BMP Fact Sheet— INF-7: Underground Infiltration Fact Sheet (from Orange County TGD for Project WQMPs)

**Appendix K: BMP Educational Materials**

- Industrial and Commercial Facilities Brochure (San Bernardino County Website)
- Commercial Landscape Maintenance Fact Sheet (San Bernardino County Website)
- Stormwater Management Practices for Commercial Landscape Maintenance Brochure (San Bernardino County Website)
- Commercial Trash Enclosures Brochure (San Bernardino County Website)
- Construction & Development Fact Sheet (San Bernardino County Website)
- Regulatory Information Fact Sheet (San Bernardino County Website)
- SC-11 Spill Prevention, Control & Cleanup
- SC-30 Outdoor Loading / Unloading
- SC-34 Waste Handling & Disposal
- SC-35 Safer Alternative Products
- SC-41 Building & Grounds Maintenance
- SC-42 Building Repair and Construction
- SC-43 Parking / Storage Area Maintenance
- SC-44 Drainage System Maintenance
- SD-10 Site Design & Landscape Planning
- SD-13 Storm Drain Signage

**Appendix L: NOAA Point Precipitation Frequency Estimate for 2 Year, 1 Hour Storm**

**Appendix M: TGR Geotechnical, Inc.'s Limited Geotechnical Investigation Report, 2889 Locust Avenue, Rialto, California, dated March 10, 2020**

**Appendix N: Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet (from Orange County TGD for Project WQMPs)**

**Appendix O: Hydrology and Hydraulics Report for 2889 N. Locust Avenue, Rialto, California, dated December 21, 2021**

## Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name		Locust Avenue Industrial Project			
Project Owner Contact Name:		Gretchen Kendrick			
Mailing Address:	3010 Old Ranch Parkway, Suite 470 Seal Beach, CA 90740	E-mail Address:	gretchenk@xebecrealty.com	Telephone:	(562) 795-0270
Permit/Application Number(s):		MC 2021-0058	Tract/Parcel Map Number(s):		
Additional Information/Comments:		N/A			
Description of Project:		<p>The project site encompasses approximately 4.71 net acres (205,044 square feet) and is a rectangular-shaped parcel of vacant land covered by dirt, gravel, and stones. The site also has stockpiled soils and debris up to approximately 10 feet in height in the northwest, center, and western portions of the site. The site is bordered by industrial buildings to the north and south, single-family residences to the east, and Locust Avenue to the west.</p> <p>The proposed project will consist of one large industrial building and associated truck loading docks, parking areas, drive aisles, driveways, and walkways. The proposed building will have a total footprint area of 96,748 square feet, and the drive aisles, parking areas and remaining hardscape will occupy 87,626 square feet, for a total impervious area of 184,374 square feet, or 90% of the project site. The proposed project will also include 20,670 square feet of landscaping, for a total pervious area of 10% of the project site.</p> <p>The developed site will have one drainage area (DA1) measuring 205,044 square feet. A subsurface infiltration system will be constructed to retain and infiltrate on site storm water flows, and it will be located under the truck dock area to the south of the proposed building. The flows will be collected by catch basins and conveyed, via the on-site storm drain, to the underground infiltration system. The catch basins will have filter inserts installed to remove sediment, debris, and other pollutants of concern from the storm flows prior to the flows being infiltrated. The infiltration system will be sized to retain the 100-year storm runoff, and will consist of ten connected, 125 foot long, 96 inch perforated CMP pipes placed on a 100 foot wide gravel bed.</p> <p>There is one proposed trash enclosure which will be located as identified on the WQMP Site Plan attached hereto as Appendix D in Section 6.1. No streets, roads, or highway projects are planned to be constructed as part of the proposed project. There are no known materials or wastes that are anticipated to be used or produced at the proposed development that would be classified as "hazardous." Further, none of the materials to be used at the proposed development will be stored outside.</p> <p>The project will not violate any water quality standards because the project will be required to meet the City's NPDES permit discharge requirements.</p>			
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.		N/A			



## Section 2 Project Description

### 2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

Form 2.1-1 Description of Proposed Project					
<b>1</b> Development Category (Select all that apply):					
<input type="checkbox"/> Significant re-development involving the addition or replacement of 5,000 ft <sup>2</sup> or more of impervious surface on an already developed site	<input checked="" type="checkbox"/> New development involving the creation of 10,000 ft <sup>2</sup> or more of impervious surface collectively over entire site	<input type="checkbox"/> Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	<input type="checkbox"/> Restaurants (with SIC code 5812) where the land area of development is 5,000 ft <sup>2</sup> or more		
<input type="checkbox"/> Hillside developments of 5,000 ft <sup>2</sup> or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	<input type="checkbox"/> Developments of 2,500 ft <sup>2</sup> of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	<input checked="" type="checkbox"/> Parking lots of 5,000 ft <sup>2</sup> or more exposed to storm water	<input type="checkbox"/> Retail gasoline outlets that are either 5,000 ft <sup>2</sup> or more, or have a projected average daily traffic of 100 or more vehicles per day		
<input type="checkbox"/> Non-Priority / Non-Category Project <i>May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.</i>					
<b>2</b> Project Area (ft <sup>2</sup> ):	205,044	<b>3</b> Number of Dwelling Units:	0	<b>4</b> SIC Code:	4225
<b>5</b> Is Project going to be phased? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.</i>					
<b>6</b> Does Project include roads? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)</i>					

## 2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

### Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

All portions of the project and site are owned by Locust XC, LLC. The individual at Locust XC, LLC responsible for this project and all related water quality issues is an authorized signatory of the entity, Gretchen Kendrick. Ms. Kendrick's contact information is as follows: 3010 Old Ranch Parkway, Suite 470, Seal Beach, CA 90740; phone number (562) 795-0270; gretchenk@xebecrealty.com. All maintenance responsibilities, including the implementation and maintenance of BMPs for the Locust Avenue Industrial Project, shall be performed by Locust XC, LLC until such time as ownership of the property is transferred, at which time all BMP implementation and maintenance responsibilities shall be transferred to the new owner. No infrastructure will be transferred to a public agency after the project is complete. A property owner's association (POA) will not be formed for long-term maintenance of project stormwater facilities.

## 2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Bacteria and viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically caused by the transport of animal or human fecal wastes from the watershed.
Nutrients - Phosphorous	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Nutrients are inorganic substances, such as nitrogen and phosphorus. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Nutrients - Nitrogen	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Nutrients are inorganic substances, such as nitrogen and phosphorus. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Noxious Aquatic Plants	E <input type="checkbox"/>	N <input checked="" type="checkbox"/>	
Sediment	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Sediments are solid materials that are eroded from the land surface.
Metals	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	The primary source of metal pollution in stormwater is typically commercially available metals and metal products, as well as emissions from brake pad and tire tread wear associated with driving. Primary metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. Metals are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings.
Oil and Grease	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Trash/Debris	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape.
Pesticides / Herbicides	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Pesticides and herbicides are organic compounds used to destroy and/or prevent insects, rodents, fungi, weeds, etc.
Organic Compounds	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are found in solvents and hydrocarbons. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Sources of organic compounds may include waste handling areas and vehicle or landscape maintenance areas.
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	

## 2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits			
<b>1</b> Project Types that Qualify for Water Quality Credits: <i>Select all that apply</i>			
<input type="checkbox"/> Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects <input type="checkbox"/> Vertical density [20%] <input type="checkbox"/> 7 units/ acre [5%]	<input type="checkbox"/> Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	<input type="checkbox"/> Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
<input type="checkbox"/> Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	<input type="checkbox"/> Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	<input type="checkbox"/> In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	<input type="checkbox"/> Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
<b>2</b> Total Credit % 0 <i>(Total all credit percentages up to a maximum allowable credit of 50 percent)</i>			
Description of Water Quality Credit Eligibility (if applicable)	N/A		

## Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example.

Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet.***

Form 3-1 Site Location and Hydrologic Features			
Site coordinates take GPS measurement at approximate center of site	Latitude 34.1518	Longitude -117.4097	Thomas Bros Map page 575
<b>1</b> San Bernardino County climatic region: <input checked="" type="checkbox"/> Valley <input type="checkbox"/> Mountain			
<b>2</b> Does the site have more than one drainage area (DA): Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached			
<pre> graph BT     DA1[DA 1] --&gt; Outlet1[Outlet 1]     DA2[DA 2] --&gt; Outlet2[Outlet 2]           </pre>			
Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA		
DA1 DMA C flows to DA1 DMA A	Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property		
DA 1 to Outlet 1	The existing site has two drainage areas. DA 1 drains to the property to the south at Outlet 1, which is located at the approximate midpoint of the southern border of the site. Storm runoff is conveyed via sheet flow, and there are no drainage mitigation devices installed at the site.		
DA 2 to Outlet 2	DA 2 also drains to the property to the south. Outlet 2 is located near the southeast corner of the site. Storm runoff is conveyed via sheet flow, and there are no drainage mitigation devices installed at the site.		

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
<b>1</b> DMA drainage area (ft <sup>2</sup> )	114,848			
<b>2</b> Existing site impervious area (ft <sup>2</sup> )	0			
<b>3</b> Antecedent moisture condition <i>For desert areas, use <a href="http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf">http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</a></i>	AMC II			
<b>4</b> Hydrologic soil group <i>Refer to Watershed Mapping Tool – <a href="http://permitrack.sbcounty.gov/wap/">http://permitrack.sbcounty.gov/wap/</a></i>	HSG A			
<b>5</b> Longest flowpath length (ft)	485			
<b>6</b> Longest flowpath slope (ft/ft)	0.032			
<b>7</b> Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	Barren			
<b>8</b> Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good &gt;75%; Fair 50-75%; Poor &lt;50% Attach photos of site to support rating</i>	Poor			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 2				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
<b>1</b> DMA drainage area (ft <sup>2</sup> )	90,195			
<b>2</b> Existing site impervious area (ft <sup>2</sup> )	0			
<b>3</b> Antecedent moisture condition <i>For desert areas, use</i> <a href="http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf">http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</a>	AMC II			
<b>4</b> Hydrologic soil group <i>Refer to Watershed Mapping Tool –</i> <a href="http://permittrack.sbcounty.gov/wap/">http://permittrack.sbcounty.gov/wap/</a>	HSG A			
<b>5</b> Longest flowpath length (ft)	359			
<b>6</b> Longest flowpath slope (ft/ft)	0.026			
<b>7</b> Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	Barren			
<b>8</b> Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good &gt;75%; Fair 50-75%; Poor &lt;50% Attach photos of site to support rating</i>	Poor			

## Form 3-3 Watershed Description for Drainage Area

<p>Receiving waters</p> <p><i>Refer to Watershed Mapping Tool -</i>  <a href="http://permittrack.sbcounty.gov/wap/">http://permittrack.sbcounty.gov/wap/</a>  <i>See "Drainage Facilities" link at this website</i></p>	<p>Project site drains to the following receiving waters in the order listed:  Cactus Channel, Rialto Channel, Cactus Basin #5</p>
<p>Applicable TMDLs</p> <p><i>Refer to Local Implementation Plan</i></p>	<p>None</p>
<p>303(d) listed impairments</p> <p><i>Refer to Local Implementation Plan and Watershed Mapping Tool -</i>  <a href="http://permittrack.sbcounty.gov/wap/">http://permittrack.sbcounty.gov/wap/</a> and State Water Resources Control Board website -  <a href="http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml">http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml</a></p>	<p>None</p>
<p>Environmentally Sensitive Areas (ESA)</p> <p><i>Refer to Watershed Mapping Tool -</i>  <a href="http://permittrack.sbcounty.gov/wap/">http://permittrack.sbcounty.gov/wap/</a></p>	<p>None</p>
<p>Unlined Downstream Water Bodies</p> <p><i>Refer to Watershed Mapping Tool -</i>  <a href="http://permittrack.sbcounty.gov/wap/">http://permittrack.sbcounty.gov/wap/</a></p>	<p>None</p>
<p>Hydrologic Conditions of Concern</p>	<p><input type="checkbox"/> Yes Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal</p> <p><input checked="" type="checkbox"/> No</p>
<p>Watershed-based BMP included in a RWQCB approved WAP</p>	<p><input type="checkbox"/> Yes Attach verification of regional BMP evaluation criteria in WAP</p> <ul style="list-style-type: none"> <li>• More Effective than On-site LID</li> <li>• Remaining Capacity for Project DCV</li> <li>• Upstream of any Water of the US</li> <li>• Operational at Project Completion</li> <li>• Long-Term Maintenance Plan</li> </ul> <p><input checked="" type="checkbox"/> No</p>



## Section 4 Best Management Practices (BMP)

### 4.1 Source Control BMP

#### 4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner shall be familiar with the contents of this WQMP and shall provide BMP information materials to the occupants/tenants on management practices for commercial developments that contribute to the protection of stormwater quality. (See Appendix K in Section 6.4 for the applicable BMP Educational Materials.)
N2	Activity Restrictions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will implement use /activity restrictions for the project for the purpose of surface water quality protection through the use of lease terms. For example, automobile washing, maintenance, and repairs will not be allowed at the project site, and all staff shall be trained in prohibited discharges.
N3	Landscape Management BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will identify on-going landscape maintenance requirements consistent with applicable local stormwater quality ordinances that will include fertilizer and/or pesticide application restrictions and mowing and trimmings containment and disposal.
N4	BMP Maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will be responsible for implementation of each non- structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities per the maintenance narratives in Form 5-1 of this document.
N5	Title 22 CCR Compliance (How development will comply)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No hazardous materials are anticipated to be present at the proposed project, but if future tenants handle hazardous materials, the owner shall require Title 22 CCR compliance.
N6	Local Water Quality Ordinances	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will comply with any applicable local water quality ordinances.
N7	Spill Contingency Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will prepare a Spill Contingency Plan based on specified types of building or suite occupancies. The Plan will mandate stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.
N8	Underground Storage Tank Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No underground storage tanks are proposed.
N9	Hazardous Materials Disclosure Compliance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	No hazardous materials are currently anticipated to be used or produced at the proposed project, but if future tenants handle hazardous materials on the site, the owner shall require hazardous materials disclosure compliance.

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner shall require all tenants to abide by the Uniform Fire Code.
N11	Litter/Debris Control Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will implement trash management and litter control procedures throughout the site aimed at reducing pollution of drainage water. The owner may contract with its landscape maintenance firm to provide this service during regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting/reporting trash disposal violations by tenants or businesses.
N12	Employee Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will prepare an education program manual (see N1) for future employees of businesses at the project, and will train the employees on such matters as the proper storage and use of pesticides, implementation of hazardous spill contingency plans, and prohibitions on non-stormwater discharges.
N13	Housekeeping of Loading Docks	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Keep all fluids indoors. Clean up spills immediately and keep spills from entering storm drain system. No direct discharges into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleaned up immediately and disposed of properly.
N14	Catch Basin Inspection Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	On-site catch basins shall be inspected, cleaned and maintained on an annual basis, in the early fall prior to the start of the rainy season, and before and after all major storms. Catch basins shall be monitored for evidence of illegal dumping on an as-needed frequency.
N15	Vacuum Sweeping of Private Streets and Parking Lots	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will ensure that the project's parking lots will be swept on a monthly basis, or more often if necessary, using a vacuum assisted sweeper.
N16	Other Non-structural Measures for Public Agency Projects	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. The project is not a Public Agency Project.
N17	Comply with all other applicable NPDES permits	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner shall comply with the statewide General Construction Permit during the entire period of construction by filing an NOI and SWPPP with the State Water Board and complying with all BMP implementation and reporting requirements. Following building occupation, the owner shall require all tenants needing coverage under the State's General Industrial Activities Permit to acquire coverage.

### Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Stencil or label storm drain inlets and catch basins with prohibitive language (such as: "No Dumping – Flows to Creek"). Maintain legibility of stencils and signs.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No outdoor material storage areas are proposed.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Trash storage areas will be paved with an impervious surface, designed to not allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements around the area, screened or walled to prevent off-site transport of trash, and provide solid roof or awning.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Irrigation systems shall include reducers or shut off valves triggered by a pressure drop. Timers will be used to avoid over watering and watering cycles shall be adjusted seasonally. Plants with similar watering requirements will be grouped, and native or drought tolerant species will be used where appropriate.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Landscaped areas will be finish-graded at a minimum of 1-2 inches below top of curb or sidewalk for increased retention of stormwater/irrigation water.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. The site has no slopes or channels.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The project does not propose below grade loading docks, and the runoff from the "dock high" loading area will not directly connect to the municipal storm drain system. The loading dock area will drain runoff to catch basins with insert filters for pre-treatment prior to the flows being retained on site and infiltrated.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No maintenance bays are proposed.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No vehicle wash areas are proposed.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No outdoor processing areas are proposed.

### Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No equipment wash areas are proposed.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No fueling areas are proposed.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No hillside landscaping is proposed (the site has no hills).
S14	Wash water control for food preparation areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No food preparation areas are proposed.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No community car wash racks are proposed.

## 4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Preventative LID Site Design Practices Checklist
<p>Site Design Practices</p> <p><i>If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets</i></p>
<p>Minimize impervious areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Explanation: The width of the drive aisles and sidewalks for the proposed development has been reduced to the maximum extent practicable. Further, landscaping is planned to be installed to the maximum extent practicable.</p>
<p>Maximize natural infiltration capacity: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Explanation: The site is underlain by soils with a design infiltration rate of 5.07 inches per hour, and all stormwater flows will be infiltrated on-site via an underground infiltration facility (after pretreatment utilizing catch basin inlet filters).</p>
<p>Preserve existing drainage patterns and time of concentration: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Explanation: The existing drainage patterns have been preserved to the maximum extent practicable.</p>
<p>Disconnect impervious areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Explanation: All impervious area runoff for a design storm event will be captured and directed into the underground retention/infiltration system which will disconnect impervious areas.</p>
<p>Protect existing vegetation and sensitive areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Explanation: There is essentially no existing vegetation at the site.</p>
<p>Re-vegetate disturbed areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Explanation: There is essentially no existing vegetation at the site. However, landscaping is proposed to the maximum extent practicable.</p>
<p>Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Explanation: The area where the underground infiltration facility is to be located will not be compacted more than is necessary.</p>
<p>Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Explanation: No vegetated drainage swales are proposed.</p>
<p>Stake off areas that will be used for landscaping to minimize compaction during construction : Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <p>Explanation: The proposed landscape areas will not be compacted more than is necessary.</p>

## 4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the  $P_6$  method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi<sup>2</sup>), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)		
1 Project area DA 1 (ft <sup>2</sup> ): 205,044	2 Imperviousness after applying preventative site design practices (Imp%): 90%	3 Runoff Coefficient (Rc): 0.73 $R_c = 0.858(Imp\%)^{1/3} - 0.78(Imp\%)^{1/2} + 0.774(Imp\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.73 <a href="http://hdsc.nws.noaa.gov/hdsc/pfds/so/sca_pfds.html">http://hdsc.nws.noaa.gov/hdsc/pfds/so/sca_pfds.html</a>		
5 Compute $P_6$ , Mean 6-hr Precipitation (inches): 1.0809 $P_6 = \text{Item 4} * C_1$ , where $C_1$ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)		
6 Drawdown Rate Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.		24-hrs <input type="checkbox"/> 48-hrs <input checked="" type="checkbox"/>
7 Compute design capture volume, DCV (ft <sup>3</sup> ): 26,466 $DCV = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$ , where $C_2$ is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

## Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☐ No ☒

Go to: <http://permittrack.sbcounty.gov/wap/>

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below  
(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)

If "No," then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft <sup>3</sup> )	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	<b>1</b> <i>Form 4.2-3 Item 12</i>	<b>2</b> <i>Form 4.2-4 Item 13</i>	<b>3</b> <i>Form 4.2-5 Item 10</i>
Post-developed	<b>4</b> <i>Form 4.2-3 Item 13</i>	<b>5</b> <i>Form 4.2-4 Item 14</i>	<b>6</b> <i>Form 4.2-5 Item 14</i>
Difference	<b>7</b> <i>Item 4 – Item 1</i>	<b>8</b> <i>Item 2 – Item 5</i>	<b>9</b> <i>Item 6 – Item 3</i>
Difference (as % of pre-developed)	<b>10</b> % <i>Item 7 / Item 1</i>	<b>11</b> % <i>Item 8 / Item 2</i>	<b>12</b> % <i>Item 9 / Item 3</i>



### Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: <u>Pre-developed DA</u>	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft <sup>2</sup> sum of areas of DMA should equal area of DA								
4a Curve Number (CN) use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								
Weighted Curve Number Determination for: <u>Post-developed DA</u>	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft <sup>2</sup> sum of areas of DMA should equal area of DA								
4b Curve Number (CN) use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								
5 Pre-Developed area-weighted CN:	7 Pre-developed soil storage capacity, S (in): $S = (1000 / \text{Item 5}) - 10$					9 Initial abstraction, I <sub>a</sub> (in): $I_a = 0.2 * \text{Item 7}$		
6 Post-Developed area-weighted CN:	8 Post-developed soil storage capacity, S (in): $S = (1000 / \text{Item 6}) - 10$					10 Initial abstraction, I <sub>a</sub> (in): $I_a = 0.2 * \text{Item 8}$		
11 Precipitation for 2 yr, 24 hr storm (in): Go to: <a href="http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html">http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html</a>								
12 Pre-developed Volume (ft <sup>3</sup> ): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 9})^2 / ((\text{Item 11} - \text{Item 9} + \text{Item 7}))]$								
13 Post-developed Volume (ft <sup>3</sup> ): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 10})^2 / ((\text{Item 11} - \text{Item 10} + \text{Item 8}))]$								
14 Volume Reduction needed to meet HCOC Requirement, (ft <sup>3</sup> ): $V_{HCOC} = (\text{Item 13} * 0.95) - \text{Item 12}$								

## Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA (For projects using the Hydrology Manual complete the form below)

Variables	Pre-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>				Post-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
<b>1</b> Length of flowpath (ft) <i>Use Form 3-2 Item 5 for pre-developed condition</i>								
<b>2</b> Change in elevation (ft)								
<b>3</b> Slope (ft/ft), $S_o = \text{Item 2} / \text{Item 1}$								
<b>4</b> Land cover								
<b>5</b> Initial DMA Time of Concentration (min) <i>Appendix C-1 of the TGD for WQMP</i>								
<b>6</b> Length of conveyance from DMA outlet to project site outlet (ft) <i>May be zero if DMA outlet is at project site outlet</i>								
<b>7</b> Cross-sectional area of channel (ft <sup>2</sup> )								
<b>8</b> Wetted perimeter of channel (ft)								
<b>9</b> Manning's roughness of channel (n)								
<b>10</b> Channel flow velocity (ft/sec) $V_{fps} = (1.49 / \text{Item 9}) * (\text{Item 7} / \text{Item 8})^{0.67} * (\text{Item 3})^{0.5}$								
<b>11</b> Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$								
<b>12</b> Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$								
<b>13</b> Pre-developed time of concentration (min):	<i>Minimum of Item 12 pre-developed DMA</i>							
<b>14</b> Post-developed time of concentration (min):	<i>Minimum of Item 12 post-developed DMA</i>							
<b>15</b> Additional time of concentration needed to meet HCOC requirement (min):	$T_{C-HCOC} = (\text{Item 13} * 0.95) - \text{Item 14}$							

# Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables	Pre-developed DA to Project Outlet (Use additional forms if more than 3 DMA)			Post-developed DA to Project Outlet (Use additional forms if more than 3 DMA)								
	DMA A	DMA B	DMA C	DMA A	DMA B	DMA C						
<b>1</b> Rainfall Intensity for storm duration equal to time of concentration $I_{peak} = 10^{(LOG \text{ Form 4.2-1 Item 4} - 0.6 LOG \text{ Form 4.2-4 Item 5} / 60)}$												
<b>2</b> Drainage Area of each DMA (Acres) <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>												
<b>3</b> Ratio of pervious area to total area <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>												
<b>4</b> Pervious area infiltration rate (in/hr) <i>Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP</i>												
<b>5</b> Maximum loss rate (in/hr) $F_m = \text{Item 3} * \text{Item 4}$ <i>Use area-weighted <math>F_m</math> from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>												
<b>6</b> Peak Flow from DMA (cfs) $Q_p = \text{Item 2} * 0.9 * (\text{Item 1} - \text{Item 5})$												
<b>7</b> Time of concentration adjustment factor for other DMA to site discharge point <i>Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)</i>	DMA A	n/a		n/a								
	DMA B		n/a		n/a							
	DMA C		n/a			n/a						
<b>8</b> Pre-developed $Q_p$ at $T_c$ for DMA A: $Q_p = \text{Item } 6_{DMAA} + [\text{Item } 6_{DMAB} * (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAB}) / (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAB}) * \text{Item } 7_{DMAA/2}] + [\text{Item } 6_{DMAC} * (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAC}) / (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAC}) * \text{Item } 7_{DMAA/3}]$	<b>9</b> Pre-developed $Q_p$ at $T_c$ for DMA B: $Q_p = \text{Item } 6_{DMAB} + [\text{Item } 6_{DMAA} * (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAA}) / (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAA}) * \text{Item } 7_{DMAB/1}] + [\text{Item } 6_{DMAC} * (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAC}) / (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAC}) * \text{Item } 7_{DMAB/3}]$		<b>10</b> Pre-developed $Q_p$ at $T_c$ for DMA C: $Q_p = \text{Item } 6_{DMAC} + [\text{Item } 6_{DMAA} * (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAA}) / (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAA}) * \text{Item } 7_{DMAC/1}] + [\text{Item } 6_{DMAB} * (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAB}) / (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAB}) * \text{Item } 7_{DMAC/2}]$									
<b>10</b> Peak runoff from pre-developed condition confluence analysis (cfs): <i>Maximum of Item 8, 9, and 10 (including additional forms as needed)</i>												
<b>11</b> Post-developed $Q_p$ at $T_c$ for DMA A: <i>Same as Item 8 for post-developed values</i>	<b>12</b> Post-developed $Q_p$ at $T_c$ for DMA B: <i>Same as Item 9 for post-developed values</i>		<b>13</b> Post-developed $Q_p$ at $T_c$ for DMA C: <i>Same as Item 10 for post-developed values</i>									
<b>14</b> Peak runoff from post-developed condition confluence analysis (cfs): <i>Maximum of Item 11, 12, and 13 (including additional forms as needed)</i>												
<b>15</b> Peak runoff reduction needed to meet HCOC Requirement (cfs): $Q_{p-HCOC} = (\text{Item 14} * 0.95) - \text{Item 10}$												

## 4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS<sub>4</sub> Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS<sub>4</sub> Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is “Yes,” provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2).

**Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment.**

## Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

<sup>1</sup> Would infiltration BMP pose significant risk for groundwater related concerns?

Yes ☐ No ☒

*Refer to Section 5.3.2.1 of the TGD for WQMP*

If Yes, Provide basis: (attach)

<sup>2</sup> Would installation of infiltration BMP significantly increase the risk of geotechnical hazards?

Yes ☐ No ☒

(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

<sup>3</sup> Would infiltration of runoff on a Project site violate downstream water rights?

Yes ☐ No ☒

If Yes, Provide basis: (attach)

<sup>4</sup> Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils?

Yes ☐ No ☒

If Yes, Provide basis: (attach)

<sup>5</sup> Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)?

Yes ☐ No ☒

If Yes, Provide basis: (attach)

<sup>6</sup> Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses?

Yes ☐ No ☒

*See Section 3.5 of the TGD for WQMP and WAP*

If Yes, Provide basis: (attach)

<sup>7</sup> Any answer from Item 1 through Item 3 is "Yes":

Yes ☐ No ☒

*If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.*

<sup>8</sup> Any answer from Item 4 through Item 6 is "Yes":

Yes ☐ No ☒

*If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.*

<sup>9</sup> All answers to Item 1 through Item 6 are "No":

*Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Hydrologic Source Control BMP.*

### 4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

<b>Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)</b>			
<b>1</b> Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If yes, complete Items 2-5; If no, proceed to Item 6	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
<b>2</b> Total impervious area draining to pervious area (ft <sup>2</sup> )			
<b>3</b> Ratio of pervious area receiving runoff to impervious area			
<b>4</b> Retention volume achieved from impervious area dispersion (ft <sup>3</sup> ) $V = \text{Item 2} * \text{Item 3} * (0.5/12)$ , assuming retention of 0.5 inches of runoff			
<b>5</b> Sum of retention volume achieved from impervious area dispersion (ft <sup>3</sup> ): 0 $V_{\text{retention}} = \text{Sum of Item 4 for all BMPs}$			
<b>6</b> Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
<b>7</b> Ponding surface area (ft <sup>2</sup> )			
<b>8</b> Ponding depth (ft)			
<b>9</b> Surface area of amended soil/gravel (ft <sup>2</sup> )			
<b>10</b> Average depth of amended soil/gravel (ft)			
<b>11</b> Average porosity of amended soil/gravel			
<b>12</b> Retention volume achieved from on-lot infiltration (ft <sup>3</sup> ) $V_{\text{retention}} = (\text{Item 7} * \text{Item 8}) + (\text{Item 9} * \text{Item 10} * \text{Item 11})$			
<b>13</b> Runoff volume retention from on-lot infiltration (ft <sup>3</sup> ): 0 $V_{\text{retention}} = \text{Sum of Item 12 for all BMPs}$			

### Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

<b>14</b> Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 15-20. If no, proceed to Item 21</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
<b>15</b> Rooftop area planned for ET BMP (ft <sup>2</sup> )			
<b>16</b> Average wet season ET demand (in/day) <i>Use local values, typical ~ 0.1</i>			
<b>17</b> Daily ET demand (ft <sup>3</sup> /day) <i>Item 15 * (Item 16 / 12)</i>			
<b>18</b> Drawdown time (hrs) <i>Copy Item 6 in Form 4.2-1</i>			
<b>19</b> Retention Volume (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Item 17 * (Item 18 / 24)</i>			
<b>20</b> Runoff volume retention from evapotranspiration BMPs (ft <sup>3</sup> ): 0 <i>V<sub>retention</sub> = Sum of Item 19 for all BMPs</i>			
<b>21</b> Implementation of Street Trees: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 22-25. If no, proceed to Item 26</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
<b>22</b> Number of Street Trees			
<b>23</b> Average canopy cover over impervious area (ft <sup>2</sup> )			
<b>24</b> Runoff volume retention from street trees (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches</i>			
<b>25</b> Runoff volume retention from street tree BMPs (ft <sup>3</sup> ): 0 <i>V<sub>retention</sub> = Sum of Item 24 for all BMPs</i>			
<b>26</b> Implementation of residential rain barrel/cisterns: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 27-29; If no, proceed to Item 30</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
<b>27</b> Number of rain barrels/cisterns			
<b>28</b> Runoff volume retention from rain barrels/cisterns (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Item 27 * 3</i>			
<b>29</b> Runoff volume retention from residential rain barrels/Cisterns (ft <sup>3</sup> ): 0 <i>V<sub>retention</sub> = Sum of Item 28 for all BMPs</i>			
<b>30</b> Total Retention Volume from Site Design Hydrologic Source Control BMPs: 0 <i>Sum of Items 5, 13, 20, 25 and 29</i>			

### 4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).



**Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)**

<b>1</b> Remaining LID DCV not met by site design HSC BMP (ft <sup>3</sup> ): 26,466 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$			
BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs	DA 1 DMA BMP Type Underground Infiltration	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
<b>2</b> Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods	15.5		
<b>3</b> Infiltration safety factor See TGD Section 5.4.2 and Appendix D	3.06		
<b>4</b> Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	5.07		
<b>5</b> Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	48		
<b>6</b> Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	N/A		
<b>7</b> Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	N/A		
<b>8</b> Infiltrating surface area, $SA_{BMP}$ (ft <sup>2</sup> ) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	12,500		
<b>9</b> Amended soil depth, $d_{media}$ (ft) Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details	N/A		
<b>10</b> Amended soil porosity	N/A		
<b>11</b> Gravel depth, $d_{media}$ (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	N/A		
<b>12</b> Gravel porosity	0.35		
<b>13</b> Duration of storm as basin is filling (hrs) Typical ~ 3hrs	3		
<b>14</b> Above Ground Retention Volume (ft <sup>3</sup> ) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	N/A		
<b>15</b> Underground Retention Volume (ft <sup>3</sup> ) Volume determined using manufacturer's specifications and calculations	89,594 (See WQMP Site Plan)		
<b>16</b> Total Retention Volume from LID Infiltration BMPs: 89,594 (ft <sup>3</sup> ) (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
<b>17</b> Fraction of DCV achieved with infiltration BMP: 338% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
<b>18</b> Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.			

### 4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

<b>Form 4.3-4 Harvest and Use BMPs (DA 1)</b>			
<b>1</b> Remaining LID DCV not met by site design HSC or infiltration BMP (ft <sup>3</sup> ): 0 <i>V<sub>unmet</sub> = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 - Form 4.3-3 Item 16</i>			
BMP Type(s) <i>Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>2</b> Describe cistern or runoff detention facility			
<b>3</b> Storage volume for proposed detention type (ft <sup>3</sup> ) <i>Volume of cistern</i>			
<b>4</b> Landscaped area planned for use of harvested stormwater (ft <sup>2</sup> )			
<b>5</b> Average wet season daily irrigation demand (in/day) <i>Use local values, typical ~ 0.1 in/day</i>			
<b>6</b> Daily water demand (ft <sup>3</sup> /day) <i>Item 4 * (Item 5 / 12)</i>			
<b>7</b> Drawdown time (hrs) <i>Copy Item 6 from Form 4.2-1</i>			
<b>8</b> Retention Volume (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))</i>			
<b>9</b> Total Retention Volume (ft <sup>3</sup> ) from Harvest and Use BMP 0 <i>Sum of Item 8 for all harvest and use BMP included in plan</i>			
<b>10</b> Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.</i>			

### 4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)			
<b>1</b> Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft <sup>3</sup> ): 0 Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9		List pollutants of concern Copy from Form 2.3-1.	
<b>2</b> Biotreatment BMP Selected  <i>(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)</i>	<b>Volume-based biotreatment</b> <i>Use Forms 4.3-6 and 4.3-7 to compute treated volume</i>		<b>Flow-based biotreatment</b> <i>Use Form 4.3-8 to compute treated volume</i>
	<input type="checkbox"/> Bioretention with underdrain <input type="checkbox"/> Planter box with underdrain <input type="checkbox"/> Constructed wetlands <input type="checkbox"/> Wet extended detention <input type="checkbox"/> Dry extended detention		<input type="checkbox"/> Vegetated swale <input type="checkbox"/> Vegetated filter strip <input type="checkbox"/> Proprietary biotreatment
<b>3</b> Volume biotreated in volume based biotreatment BMP (ft <sup>3</sup> ): Form 4.3-6 Item 15 + Form 4.3-7 Item 13	<b>4</b> Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft <sup>3</sup> ): Item 1 – Item 3		<b>5</b> Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % Item 4 / Item 1
<b>6</b> Flow-based biotreatment BMP capacity provided (cfs): Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)			
<b>7</b> Metrics for MEP determination: <ul style="list-style-type: none"> <li>• Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: <input type="checkbox"/> If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.</li> </ul>			

## Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type (Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)	DA    DMA BMP Type	DA    DMA BMP Type	DA    DMA BMP Type (Use additional forms for more BMPs)
<b>1</b> Pollutants addressed with BMP <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP</i>			
<b>2</b> Amended soil infiltration rate <i>Typical ~ 5.0</i>			
<b>3</b> Amended soil infiltration safety factor <i>Typical ~ 2.0</i>			
<b>4</b> Amended soil design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$			
<b>5</b> Ponded water drawdown time (hr) <i>Copy Item 6 from Form 4.2-1</i>			
<b>6</b> Maximum ponding depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>7</b> Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$			
<b>8</b> Amended soil surface area (ft <sup>2</sup> )			
<b>9</b> Amended soil depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>10</b> Amended soil porosity, $n$			
<b>11</b> Gravel depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>12</b> Gravel porosity, $n$			
<b>13</b> Duration of storm as basin is filling (hrs) <i>Typical ~ 3hrs</i>			
<b>14</b> Biotreated Volume (ft <sup>3</sup> ) $V_{biotreated} = \text{Item 8} * [(\text{Item 7}/2) + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$			
<b>15</b> Total biotreated volume from bioretention and/or planter box with underdrains BMP: <i>Sum of Item 14 for all volume-based BMPs included in this form</i>			

## Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type <i>Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.</i>	DA      DMA BMP Type		DA      DMA BMP Type <i>(Use additional forms for more BMPs)</i>	
	Forebay	Basin	Forebay	Basin
<b>1</b> Pollutants addressed with BMP forebay and basin <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP</i>				
<b>2</b> Bottom width (ft)				
<b>3</b> Bottom length (ft)				
<b>4</b> Bottom area (ft <sup>2</sup> ) $A_{bottom} = \text{Item 2} * \text{Item 3}$				
<b>5</b> Side slope (ft/ft)				
<b>6</b> Depth of storage (ft)				
<b>7</b> Water surface area (ft <sup>2</sup> ) $A_{surface} = (\text{Item 2} + (2 * \text{Item 5} * \text{Item 6})) * (\text{Item 3} + (2 * \text{Item 5} * \text{Item 6}))$				
<b>8</b> Storage volume (ft <sup>3</sup> ) <i>For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i> $V = \text{Item 6} / 3 * [\text{Item 4} + \text{Item 7} + (\text{Item 4} * \text{Item 7})^{0.5}]$				
<b>9</b> Drawdown Time (hrs) <i>Copy Item 6 from Form 2.1</i>				
<b>10</b> Outflow rate (cfs) $Q_{BMP} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) / (\text{Item 9} * 3600)$				
<b>11</b> Duration of design storm event (hrs)				
<b>12</b> Biotreated Volume (ft <sup>3</sup> ) $V_{biotreated} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) + (\text{Item 10} * \text{Item 11} * 3600)$				
<b>13</b> Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : <i>(Sum of Item 12 for all BMP included in plan)</i>				

### Form 4.3-8 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type <i>Vegetated swale, vegetated filter strip, or other comparable proprietary BMP</i>	DA     DMA BMP Type	DA     DMA BMP Type	DA     DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>1</b> Pollutants addressed with BMP <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5</i>			
<b>2</b> Flow depth for water quality treatment (ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>3</b> Bed slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>4</b> Manning's roughness coefficient			
<b>5</b> Bottom width (ft) $b_w = (\text{Form 4.3-5 Item 6} * \text{Item 4}) / (1.49 * \text{Item 2}^{1.67} * \text{Item 3}^{0.5})$			
<b>6</b> Side Slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>7</b> Cross sectional area (ft <sup>2</sup> ) $A = (\text{Item 5} * \text{Item 2}) + (\text{Item 6} * \text{Item 2}^2)$			
<b>8</b> Water quality flow velocity (ft/sec) $V = \text{Form 4.3-5 Item 6} / \text{Item 7}$			
<b>9</b> Hydraulic residence time (min) <i>Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>10</b> Length of flow based BMP (ft) $L = \text{Item 8} * \text{Item 9} * 60$			
<b>11</b> Water surface area at water quality flow depth (ft <sup>2</sup> ) $SA_{top} = (\text{Item 5} + (2 * \text{Item 2} * \text{Item 6})) * \text{Item 10}$			

### 4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)	
1	Total LID DCV for the Project DA-1 (ft <sup>3</sup> ): 26,466 <i>Copy Item 7 in Form 4.2-1</i>
2	On-site retention with site design hydrologic source control LID BMP (ft <sup>3</sup> ): 0 <i>Copy Item 30 in Form 4.3-2</i>
3	On-site retention with LID infiltration BMP (ft <sup>3</sup> ): 89,594 <i>Copy Item 16 in Form 4.3-3</i>
4	On-site retention with LID harvest and use BMP (ft <sup>3</sup> ): 0 <i>Copy Item 9 in Form 4.3-4</i>
5	On-site biotreatment with volume based biotreatment BMP (ft <sup>3</sup> ): 0 <i>Copy Item 3 in Form 4.3-5</i>
6	Flow capacity provided by flow based biotreatment BMP (cfs): 0 <i>Copy Item 6 in Form 4.3-5</i>
7	<p>LID BMP performance criteria are achieved if answer to any of the following is "Yes":</p> <ul style="list-style-type: none"> <li>Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>  <i>If yes, sum of Items 2, 3, and 4 is greater than Item 1</i></li> <li>Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>  <i>If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3-5 Item 6 and Items 2, 3 and 4 are maximized</i></li> <li>On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>  <i>If yes, Form 4.3-1 Items 7 and 8 were both checked yes</i></li> </ul>
8	<p>If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:</p> <ul style="list-style-type: none"> <li>Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: <input type="checkbox"/>  <i>Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, <math>V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%</math></i></li> <li>An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: <input type="checkbox"/>  <i>Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed</i></li> </ul>

### 4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-10 Hydromodification Control BMPs (DA 1)	
<b>1</b> Volume reduction needed for HCOC performance criteria (ft <sup>3</sup> ): N/A, the project does not have the potential to cause or contribute to an HCOC in a downstream channel <i>(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1</i>	<b>2</b> On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft <sup>3</sup> ): <i>Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction</i>
<b>3</b> Remaining volume for HCOC volume capture (ft <sup>3</sup> ): <i>Item 1 – Item 2</i>	<b>4</b> Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft <sup>3</sup> ): <i>Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)</i>
<b>5</b> If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification <input type="checkbox"/> <i>Attach in-stream control BMP selection and evaluation to this WQMP</i>	
<b>6</b> Is Form 4.2-2 Item 11 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i> <ul style="list-style-type: none"> <li>Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP <input type="checkbox"/>  <i>BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)</i> </li> <li>Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities <input type="checkbox"/></li> <li>Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/></li> </ul>	
<b>7</b> Form 4.2-2 Item 12 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i> <ul style="list-style-type: none"> <li>Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs <input type="checkbox"/>  <i>BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)</i> </li> <li>Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/></li> </ul>	



## 4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

## Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

<b>Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)</b>			
<b>BMP</b>	<b>Responsible Party(s)</b>	<b>Inspection/ Maintenance Activities Required</b>	<b>Minimum Frequency of Activities</b>
N1. Education of Property Owners, Tenants and Occupants on Stormwater BMPs	Locust XC, LLC (Owner)	The owner shall be familiar with the contents of this WQMP and shall provide BMP information materials to the occupants/tenants on management practices for commercial developments that contribute to the protection of stormwater quality. (See Appendix K in Section 6.4 for the applicable BMP Educational Materials.) Among other things, these materials will describe the use of chemicals (including household type) that should be limited to the property, with no discharge of wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials are available from the San Bernardino Stormwater Program and can be downloaded at: <a href="http://www.sbcountystormwater.org/gov_out.html">http://www.sbcountystormwater.org/gov_out.html</a> .	Frequency: Continuous
N2. Activity Restrictions	Locust XC, LLC (Owner)	The owner will implement use /activity restrictions for the project for the purpose of surface water quality protection through the use of lease terms. For example, automobile washing, maintenance, and repairs will not be allowed at the project site, and all staff shall be trained in prohibited discharges.	Frequency: Continuous
N3. Landscape Management BMPs	Locust XC, LLC (Owner)	The owner will identify on-going landscape maintenance requirements consistent with applicable local stormwater quality ordinances that will include fertilizer and/or pesticide application restrictions and mowing and trimmings containment and disposal.	Frequency: Continuous
N4. BMP Maintenance	Locust XC, LLC (Owner)	The owner will be responsible for implementation of each non- structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities per this Form.	Frequency: Continuous

<b>Form 5-1 BMP Inspection and Maintenance</b> <b>(use additional forms as necessary)</b>			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N5. Title 22 CCR Compliance	Locust XC, LLC (Owner)	No hazardous materials are anticipated to be present at the proposed project, but if future tenants handle hazardous materials, the owner shall require Title 22 CCR compliance.	Frequency: Continuous
N6. Local Water Quality Ordinances	Locust XC, LLC (Owner)	The owner will comply with any applicable local water quality ordinances.	Frequency: Continuous
N7. Spill Contingency Plan	Locust XC, LLC (Owner)	The owner will prepare a Spill Contingency Plan based on specified types of building or suite occupancies. The Plan will mandate stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.	Frequency: Upon Occupancy
N9. Hazardous Materials Disclosure Compliance	Locust XC, LLC (Owner)	No hazardous materials are currently anticipated to be used or produced at the proposed project, but if future tenants handle hazardous materials on the site, the owner shall require hazardous materials disclosure compliance.	Frequency: Continuous
N10. Uniform Fire Code Implementation	Locust XC, LLC (Owner)	The owner shall require all tenants to abide by the Uniform Fire Code.	Frequency: Continuous
N11. Litter / Debris Control Program	Locust XC, LLC (Owner)	The owner will implement trash management and litter control procedures throughout the site aimed at reducing pollution of drainage water. The owner may contract with its landscape maintenance firm to provide this service during regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting/reporting trash disposal violations by tenants or businesses.	Frequency: Weekly
N12. Employee Training	Locust XC, LLC (Owner)	The owner will prepare an education program manual (see N1) for future employees of businesses at the project, and will train the employees on such matters as the proper storage and use of pesticides, implementation of hazardous spill contingency plans, and prohibitions on non-stormwater discharges.	Frequency: Upon hire, and annually thereafter
N13. House-keeping of Loading Docks	Locust XC, LLC (Owner)	Keep all fluids indoors. Clean up spills immediately and keep spills from entering storm drain system. No direct discharges into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleaned up immediately and disposed of properly.	Frequency: Continuous

<b>Form 5-1 BMP Inspection and Maintenance</b> <b>(use additional forms as necessary)</b>			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N14. Catch Basin Inspection Program	Locust XC, LLC (Owner)	On-site catch basins shall be inspected, cleaned and maintained on an annual basis, in the early fall prior to the start of the rainy season, and before and after all major storms. Catch basins shall be monitored for evidence of illegal dumping on an as-needed frequency.	Frequency: Annually, and before and after all major storms
N15. Vacuum Sweeping of Private Streets and Parking Lots	Locust XC, LLC (Owner)	The owner will ensure that the project's parking lots will be swept on a monthly basis, or more often if necessary, using a vacuum assisted sweeper.	Frequency: Monthly, or more often if necessary
N17. Comply With All Other Applicable NPDES Permits	Locust XC, LLC (Owner)	The owner shall comply with the statewide General Construction Permit during the entire period of construction by filing an NOI and SWPPP with the State Water Board and complying with all BMP implementation and reporting requirements. Following building occupation, the owner shall require all tenants needing coverage under the State's General Industrial Activities Permit to acquire coverage.	Frequency: Continuous
S1. Storm Drain System Stenciling and Signage	Locust XC, LLC (Owner)	Stencil or label storm drain inlets and catch basins with prohibitive language (such as: "No Dumping – Flows to Creek"). Maintain legibility of stencils and signs.	Frequency: Annually
S3. Design and Construct Trash and Waste Storage Areas to Reduce Pollution Introduction	Locust XC, LLC (Owner)	Trash storage areas will be paved with an impervious surface, designed to not allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements around the area, screened or walled to prevent off-site transport of trash, and provide solid roof or awning.	Frequency: Continuous
S4. Use Efficient Irrigation Systems & Landscape Design	Locust XC, LLC (Owner)	Irrigation systems shall include reducers or shut off valves triggered by a pressure drop. Timers will be used to avoid over watering and watering cycles shall be adjusted seasonally. Plants with similar watering requirements will be grouped, and native or drought tolerant species will be used where appropriate.	Frequency: Continuous

<b>Form 5-1 BMP Inspection and Maintenance</b> <b>(use additional forms as necessary)</b>			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
S5. Finish Grade of Land-scaped Areas at a Minimum of 1-2 Inches Below Top of Curb, Sidewalk or Pavement	Locust XC, LLC (Owner)	Landscaped areas will be finish-graded at a minimum of 1-2 inches below top of curb or sidewalk for increased retention of stormwater/irrigation water.	Frequency: Continuous
S7. Covered Dock Areas	Locust XC, LLC (Owner)	The project does not propose below grade loading docks, and the runoff from the "dock high" loading area will not directly connect to the municipal storm drain system. The loading dock area will drain runoff to catch basins with filter inserts for pre-treatment prior to the flows being retained on site and infiltrated.	Frequency: Continuous
LID BMP #1— Onsite Infiltration (Underground Chamber)	Locust XC, LLC (Owner)	Quarterly inspections of the underground infiltration BMP shall be conducted utilizing the designed manholes/inspection ports. The BMP shall be cleaned when inspection reveals that accumulated sediment or trash is clogging the system. Accumulated sediment and trash can be evacuated through the manholes.	Frequency: Quarterly And Immediately After Major Storm Events
LID BMP #2— Treatment Control Measure (Proprietary Catch Basin Insert Filters— Pretreatment for Onsite Infiltration) (Kristar FloGard +Plus Catch Basin Insert Filters or Approved Equivalent)	Locust XC, LLC (Owner)	Twice a year, prior to and after the rainy season, and after major storm events, the catch basin insert filters shall be visually inspected for damage, have all sediment and debris removed, and the filter medium pouches shall be replaced if necessary. The owner may conduct this maintenance itself, or may enter into a service contract for the maintenance of the insert filters as detailed in the Kristar FloGard +Plus Specifications /Maintenance Requirements brochure, a copy of which is attached hereto as Appendix I in Section 6.4.	Frequency: Every Six Months (Approximately April 1st and October 1st) and Immediately After Major Storm Events

## Section 6 WQMP Attachments

### 6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

**Appendix A: Vicinity Map**

**Appendix B: Receiving Waters Map**

**Appendix C: San Bernardino County Project Site WAP Report**

**Appendix D: WQMP Site Plan**

### 6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

**Appendix E: Link to Electronic Version of Final WQMP, Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement, Precise Grading Plans**

## 6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

**Appendix F: Operation and Maintenance (O & M) Plan**

**Appendix G: Record of BMP Implementation, Maintenance and Inspection**

**Appendix H: Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement**

## 6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

**Appendix I: Kristar FloGard +PLUS Catch Basin Insert Filter Specification (Pretreatment for Infiltration)**

**Appendix J: BMP Fact Sheet— INF-7: Underground Infiltration Fact Sheet (from Orange County TGD for Project WQMPs)**

**Appendix K: BMP Educational Materials**

- Industrial and Commercial Facilities Brochure (San Bernardino County Website)
- Commercial Landscape Maintenance Fact Sheet (San Bernardino County Website)
- Stormwater Management Practices for Commercial Landscape Maintenance Brochure (San Bernardino County Website)
- Commercial Trash Enclosures Brochure (San Bernardino County Website)
- Construction & Development Fact Sheet (San Bernardino County Website)
- Regulatory Information Fact Sheet (San Bernardino County Website)
- SC-11 Spill Prevention, Control & Cleanup
- SC-30 Outdoor Loading / Unloading
- SC-34 Waste Handling & Disposal
- SC-35 Safer Alternative Products
- SC-41 Building & Grounds Maintenance
- SC-42 Building Repair and Construction
- SC-43 Parking / Storage Area Maintenance
- SC-44 Drainage System Maintenance
- SD-10 Site Design & Landscape Planning
- SD-13 Storm Drain Signage

**Appendix L: NOAA Point Precipitation Frequency Estimate for 2 Year, 1 Hour Storm**

**Appendix M: TGR Geotechnical, Inc.'s Limited Geotechnical Investigation Report, 2889 Locust Avenue, Rialto, California, dated March 10, 2020**

**Appendix N: Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet (from Orange County TGD for Project WQMPs)**

**Appendix O: Hydrology and Hydraulics Report for 2889 N. Locust Avenue, Rialto, California, dated December 21, 2021**



## 6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

### **APPENDICES INCLUDED IN SECTION 6.1 (Site Plan and Drainage Plan):**

**Appendix A: Vicinity Map**

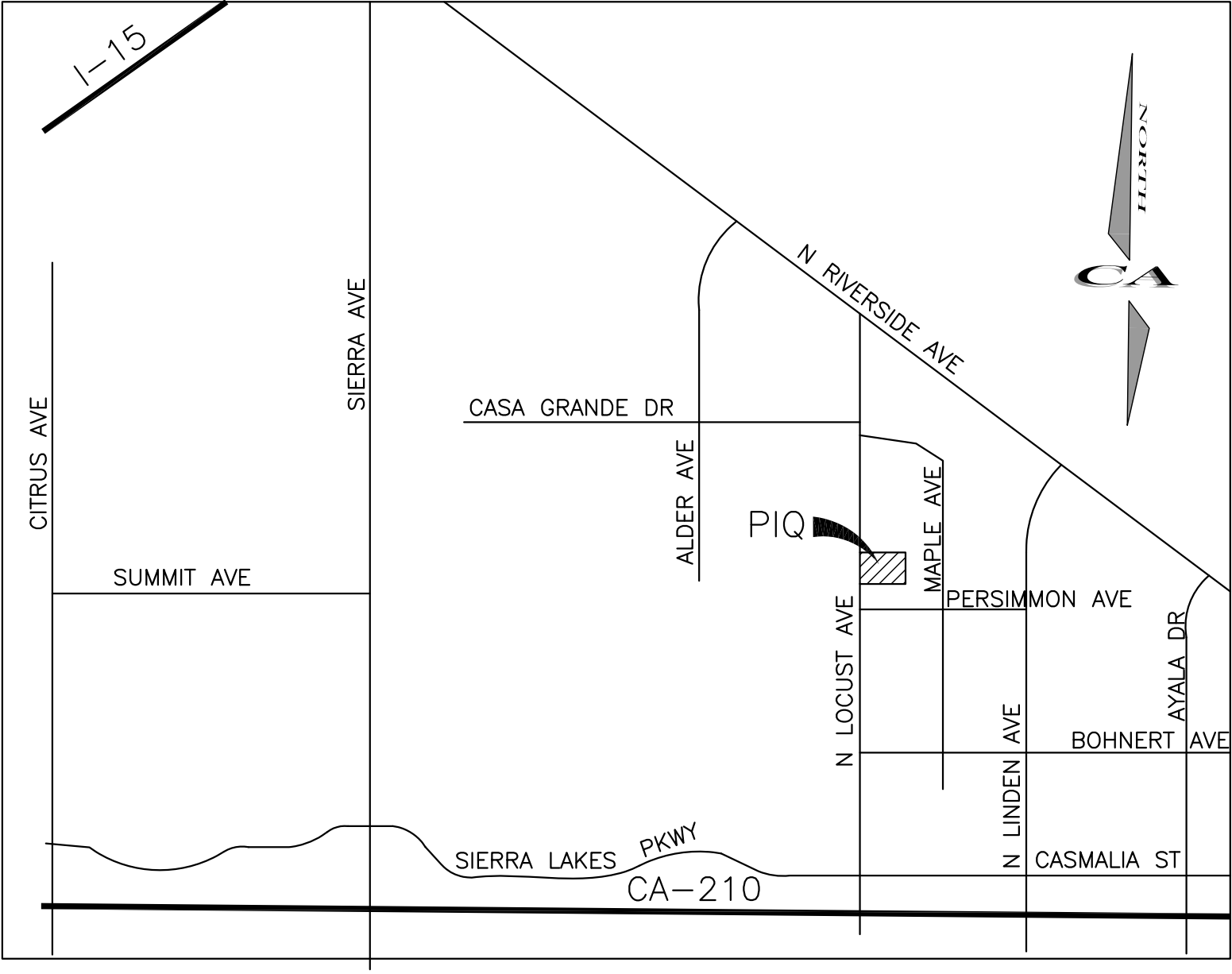
**Appendix B: Receiving Waters Map**

**Appendix C: San Bernardino County Project Site WAP Report**

**Appendix D: WQMP Site Plan**

# **APPENDIX A**

## **Vicinity Map**



VICINITY MAP

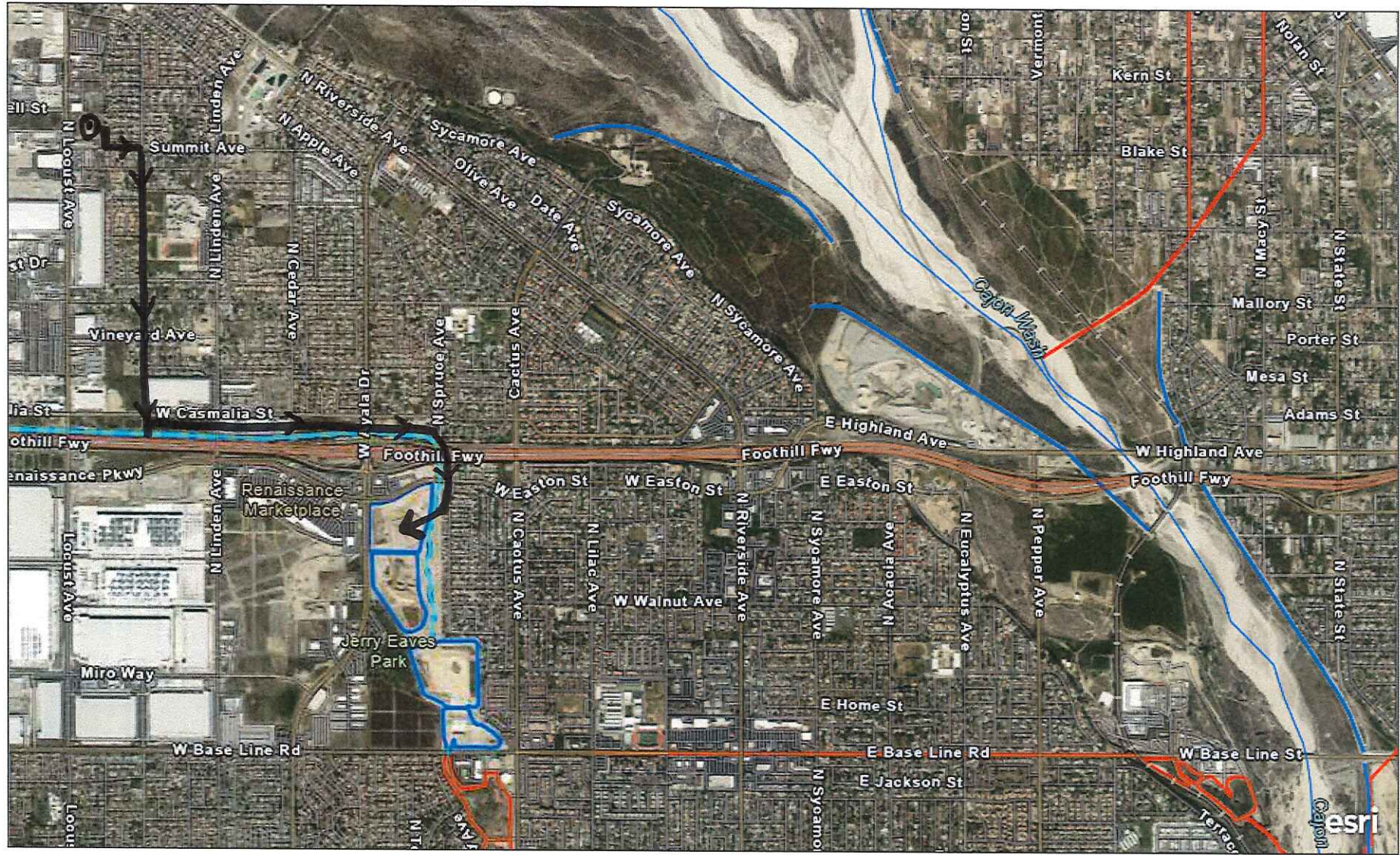
NOT TO SCALE

## **APPENDIX B**

### **Receiving Waters Map**



## Flood Control Facilities



This map represents the San Bernardino Flood Control district Redbook facility inventory

0.6mi

San Bernardino County, Maxar | Created by Brent Rolf | Esri Community Maps Contributors, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA

⊙ Project site : 2889 N. Locust Ave., Rialto, CA 92377

→ Drainage flow from project site to Cactus Basin #5

RECEIVING WATERS MAP



## **APPENDIX C**

### **San Bernardino County Project Site WAP Report**

**WQMP Project Report**

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Tuesday, December 28, 2021

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

<b>Project Site Parcel Number(s):</b>	023919311
<b>Project Site Acreage:</b>	4.802
<b>HCOC Exempt Area:</b>	Yes. Verify that the project is completely within the HCOC exemption area.
<b>Closest Receiving Waters:</b>	<b>System Number - 205</b>
<small>(Applicant to verify based on local drainage facilities and topography.)</small>	<b>Facility Name - Riverside Groin #5, COE</b>
	<b>Owner - SBCFCD</b>
<b>Closest channel segment's susceptibility to Hydromodification:</b>	EHM
<b>Highest downstream hydromodification susceptibility:</b>	High
<b>Is this drainage segment subject to TMDLs?</b>	No
<b>Are there downstream drainage segments subject to TMDLs?</b>	No
<b>Is this drainage segment a 303d listed stream?</b>	No
<b>Are there 303d listed streams downstream?</b>	Yes
<b>Are there unlined downstream waterbodies?</b>	No
<b>Project Site Onsite Soil Group(s):</b>	A
<b>Environmentally Sensitive Areas within 200':</b>	None
<b>Groundwater Depth (FT):</b>	-380
<b>Parcels with potential septic tanks within 1000':</b>	No
<b>Known Groundwater Contamination Plumes within 1000':</b>	Yes
<b>Studies and Reports Related to Project Site:</b>	<a href="#">Cactus Basin</a> <a href="#">CSDP 3-3 Rialto Channel Drainage Area Volume I</a> <a href="#">CSDP 3-3 Rialto Channel Drainage Area Volume II</a> <a href="#">CSDP 3-3 Rialto Channel Drainage Area Volume III</a> <a href="#">Revised CSDP 3-3 Rialto Channel Drainage Area</a> <a href="#">CSDP 3-3 Rialto Channel Drainage Area Volume I</a> <a href="#">CSDP 3-3 Rialto Channel Drainage Area Volume IV</a> <a href="#">CSDP 3-3 Rialto Channel Drainage Area Volume V</a> <a href="#">CSDP 3 CALC SHEET FOR HYDRO</a> <a href="#">CSDP 3-3 Rialto Channel Drain Area Draft</a> <a href="#">Preliminary Report on Proposed North SBFCP</a> <a href="#">Rialto Channel SD Plan</a> <a href="#">Rialto MPD Vol1</a> <a href="#">Rialto MPD Vol II</a> <a href="#">RS-Rialto Map Book-FINAL Layout2</a> <a href="#">San Sevaine - Boyle Map 0001</a> <a href="#">San Sevaine - Boyle Map 0002</a> <a href="#">San Sevaine - Boyle Map 0003</a> <a href="#">SBVMWD High Groundwater / Pressure Zone Area</a>

## **APPENDIX D**

### **WQMP Site Plan**



PRELIMINARY  
WQMP SITE PLAN  
2889 N. LOCUST AVE.  
RIALTO, CA

PROJECT DATA:

TOTAL SITE AREA OF PROPOSED  
DEVELOPMENT: 4.71 AC (205,044 SF)

BUILDING AREA: 96,748 SF  
WALKWAYS / CONC. GUTTER / DOCK AREAS: 38,491 SF  
DRIVEWAYS / DRIVE AISLES / PARKING AREAS: 49,135 SF

20,670 SF LANDSCAPING PROVIDED  
(10.1% PERVIOUS AREA)

CURRENT USE: VACANT  
PROPOSED USE: INDUSTRIAL

WATERSHED:  
SANTA ANA RIVER

WQMP DCV CALCULATION

AREA 1

AREA = 4.71 AC (205,044 SF)  
RUNOFF COEFFICIENT (90% IMPERVIOUS)  
 $C = 0.858 * (.90)^3 - 0.78 * (.90)^2 + 0.774 * (.90) + .04 = 0.730$   
2YR 1 HR STORM = 0.730 IN  
 $P6 = 1.4807 * 0.730 = 1.0809$  IN  
 $DCV = 205,044 \text{ SF} * 0.730 * 1.0809 \text{ IN} / 12 \text{ IN/FT} * 1.963 = 26,466 \text{ CF}$

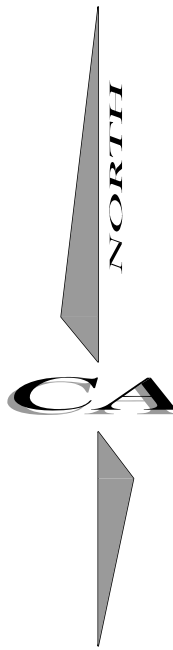
BMP VOLUME CALCULATION

BMP VOLUME  
PIPE CROSS SECTIONAL AREA =  $(50.26) * 10 \text{ CF/LF} = 502.60 \text{ CF/LF}$   
ROCK CROSS SECTIONAL AREA =  $248.70 \text{ CF/LF ROCK AREA} * 0.35 = 87.05 \text{ CF/LF}$   
TOTAL CROSS SECTIONAL AREA =  $589.65 \text{ CF/LF} * 125 \text{ LF} = 73,706 \text{ CF}$   
EFFECTIVE DEPTH =  $73,706 \text{ CF} / 12,500 \text{ SF BOTTOM} = 5.90'$

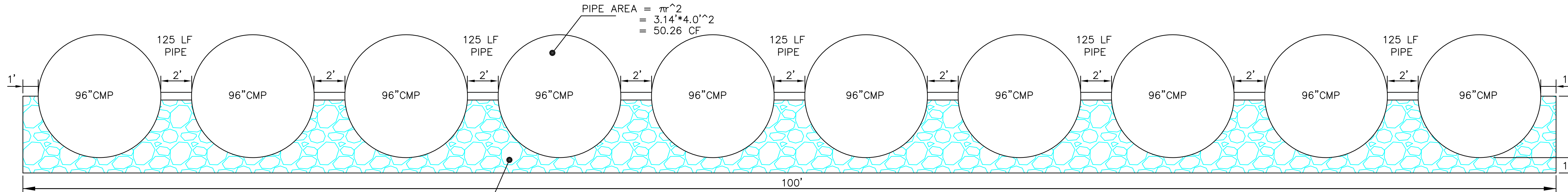
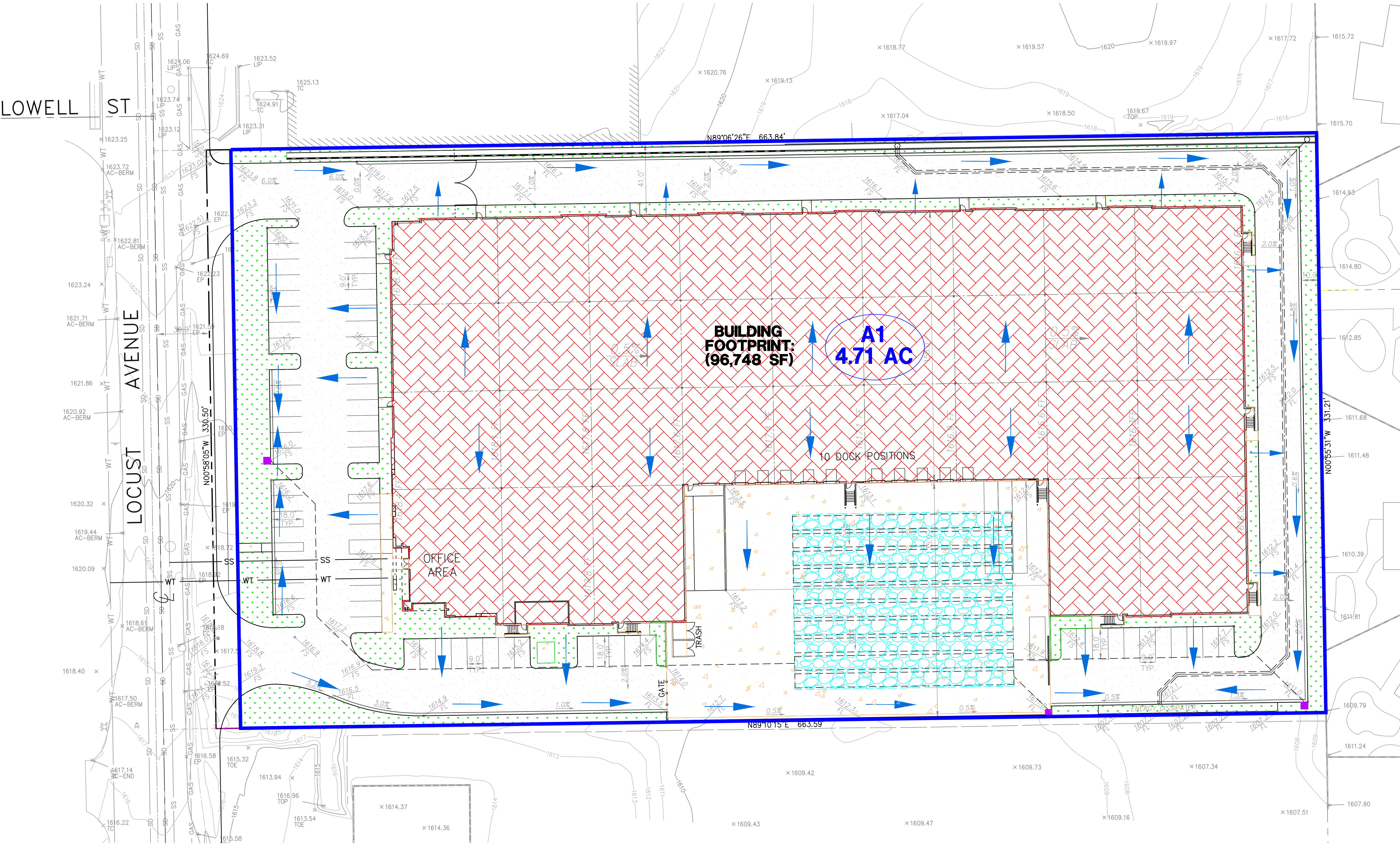
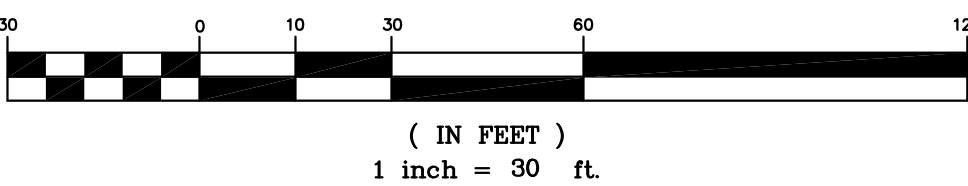
$V_{ret} = (P_{design} / 12 * S_{ainf} * T_{fill}) + (S_{ares} * D_{res} * N_{agg})$   
 $P_{design} = 15.5'' \text{ MEASURED} / 3.06 \text{ S.F.} = 5.07''/\text{HR}$   
 $S_{ainf} = 12,500 \text{ SF}$   
 $S_{ares} = 12,500 \text{ SF}$   
 $T_{fill} = 3 \text{ HRS}$   
 $D_{res} = \text{EFFECTIVE DEPTH} = 5.90'$   
 $N_{agg} = 1.0 \text{ (EFFECTIVE DEPTH ACCOUNTED FOR ROCK)}$   
 $V_{ret} = (5.07 / 12 * 12,500 * 3) + (12,500 * 5.90 * 1)$   
 $V_{ret} = 89,594 \text{ CF}$   
BMP VOLUME (89,594 CF) > DCV VOLUME (26,466 CF)

BMP LEGEND

- AREA 1**
- DRAINAGE AREAS
  - FLOW DIRECTION
  - UNDERGROUND INFILTRATION PIPE PER DETAIL HEREON
  - LANDSCAPE AREA EFFICIENT IRRIGATION  
LANDSCAPE AREA RUNOFF-MINIMIZING DESIGN
  - PROPOSED BUILDING
  - ASPHALT CONCRETE DRIVE AISLES
  - CONCRETE HARDSCAPE/ENHANCED PAVING
  - CATCH BASIN WITH INSERT FILTER & STORM DRAIN STENCIL SIGNAGE
  - TRASH ENCLOSURE



GRAPHIC SCALE



ROCK AREA =  $(\text{FACILITY AREA} - \text{PIPE AREA}) * 0.35$   
 $= (100 * 5) - (0.5 * 50.26 * 10) = 248.70 \text{ CF/LF}$   
 $248.70 \text{ CF/LF} * 125 \text{ LF} = 31,089 \text{ CF} * 0.35 = 10,881 \text{ CF}$

INFILTRATION BMP  
CROSS SECTION

1"=4"



FRED CORNWELL R.C.E. 45591 DATE

PREPARED BY:  
**CA ENGINEERING, INC.**  
Planning • Engineering • Surveying  
13821 NEWPORT AVE., STE 110  
TUSTIN, CA 92780  
949-724-9480 949-724-9484 FAX

DATE	BY	REVISION	DATE
Dec 28 2021			
JOB NO.			
251-55			
Sht. C-2			



## 6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

### APPENDICES INCLUDED IN SECTION 6.2 (Electronic Data Submittal):

**Appendix E:    Link to Electronic Version of Final WQMP, Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement, Precise Grading Plans**

## **APPENDIX E**

**Link to Electronic Version of Final  
WQMP, Water Quality Management  
Plan and Stormwater BMP Transfer,  
Access and Maintenance Agreement,  
Precise Grading Plans  
(To Be Provided in Final Approved  
WQMP)**

## 6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

**APPENDICES INCLUDED IN SECTION 6.3 (Post Construction):**

**Appendix F: Operation and Maintenance (O & M) Plan**

**Appendix G: Record of BMP Implementation, Maintenance and Inspection**

**Appendix H: Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement**

## **APPENDIX F**

# **Operation and Maintenance (O & M) Plan**

# **OPERATION AND MAINTENANCE (O&M) PLAN**

**Water Quality Management Plan  
for**

**Locust Avenue Industrial Project**

**2889 N. Locust Avenue  
Rialto, CA 92377**

Appendix F, Operation and Maintenance Plan

Note: OWNER = Locust XC, LLC

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
Y	<p><b>N1. Education of Property Owners, Tenants and Occupants on Stormwater BMPs</b></p> <p>The owner shall be familiar with the contents of this WQMP and shall provide BMP information materials to the occupants/tenants on management practices for commercial developments that contribute to the protection of stormwater quality. (See Appendix K in Section 6.4 of the WQMP for the applicable BMP Educational Materials.) Among other things, these materials will describe the use of chemicals (including household type) that should be limited to the property, with no discharge of wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials are also available from the San Bernardino Stormwater Program and can be downloaded at:  <a href="http://www.sbcountystormwater.org/gov_out.html">http://www.sbcountystormwater.org/gov_out.html</a>.</p>	Frequency: Continuous	<p>Locust XC, LLC            3010 Old Ranch Parkway, Ste. 470            Seal Beach, CA 90740            (562) 795-0270            gretchenk@xebecrealty.com</p>
Y	<p><b>N2. Activity Restrictions</b></p> <p>The owner will implement use /activity restrictions for the project for the purpose of surface water quality protection through the use of lease terms. For example, automobile washing, maintenance, and repairs will not be allowed at the project site, and all staff shall be trained in prohibited discharges.</p>	Frequency: Continuous	<p>Locust XC, LLC            3010 Old Ranch Parkway, Ste. 470            Seal Beach, CA 90740            (562) 795-0270            gretchenk@xebecrealty.com</p>

Appendix F, Operation and Maintenance Plan  
Page 2 of 12

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<b>N3. Landscape Management BMPs</b> The owner will identify on-going landscape maintenance requirements consistent with applicable local stormwater quality ordinances that will include fertilizer and/or pesticide application restrictions and mowing and trimmings containment and disposal.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N4. BMP Maintenance</b> The owner will be responsible for implementation of each non- structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities per the maintenance narratives in this document.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N5. Title 22 CCR Compliance</b> No hazardous materials are anticipated to be present at the proposed project, but if future tenants handle hazardous materials, the owner shall require Title 22 CCR compliance.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N6. Local Water Quality Ordinances</b> The owner will comply with any applicable local water quality ordinances.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N7. Spill Contingency Plan</b> The owner will prepare a Spill Contingency Plan based on specified types of building or suite occupancies. The Plan will mandate stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.	Frequency: Upon occupancy	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com



Appendix F, Operation and Maintenance Plan  
Page 3 of 12

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
N	<b>N8. Underground Storage Tank Compliance</b>		
Y	<b>N9. Hazardous Materials Disclosure Compliance</b> No hazardous materials are currently anticipated to be used or produced at the proposed project, but if future tenants handle hazardous materials on the site, the owner shall require hazardous materials disclosure compliance.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N10. Uniform Fire Code Implementation</b> The owner shall require all tenants to abide by the Uniform Fire Code.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N11. Litter/Debris Control Program</b> The owner will implement trash management and litter control procedures throughout the site aimed at reducing pollution of drainage water. The owner may contract with its landscape maintenance firm to provide this service during regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting/reporting trash disposal violations by tenants or businesses.	Frequency: Weekly	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N12. Employee Training</b> The owner will prepare an education program manual (see N1) for future employees of businesses at the project, and will train the employees on such matters as the proper storage and use of pesticides, implementation of hazardous spill contingency plans, and prohibitions on non-stormwater discharges.	Frequency: Upon hire, and annually thereafter	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<b>N13. Housekeeping of Loading Docks</b> Keep all fluids indoors. Clean up spills immediately and keep spills from entering storm drain system. No direct discharges into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleaned up immediately and disposed of properly.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N14. Catch Basin Inspection Program</b> On-site catch basins shall be inspected, cleaned and maintained on an annual basis, in the early fall prior to the start of the rainy season, and before and after all major storms. Catch basins shall be monitored for evidence of illegal dumping on an as-needed frequency.	Frequency: Annually, and before and after all major storms	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
Y	<b>N15. Vacuum Sweeping of Private Streets and Parking Lots</b> The owner will ensure that the project's parking lots will be swept on a monthly basis, or more often if necessary, using a vacuum assisted sweeper.	Frequency: Monthly, or more often if necessary	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
N	<b>N16. Other Non-structural Measures for Public Agency Projects</b>		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p><b>N17. Comply With All Other Applicable NPDES Permits</b></p> <p>The owner shall comply with the statewide General Construction Permit during the entire period of construction by filing an NOI and SWPPP with the State Water Board and complying with all BMP implementation and reporting requirements. Following building occupation, the owner shall require all tenants needing coverage under the State's General Industrial Activities Permit to acquire coverage.</p>	Frequency: Continuous	<p>Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
<b>Structural Source Control BMPs</b>			
Y	<p><b>S1. Provide Storm Drain System Stenciling and Signage</b></p> <p>Storm drain stencils are highly visible source control messages, typically placed directly adjacent to storm drain inlets. The stencils contain a brief statement that prohibits the dumping of improper materials into the MS4. Graphical icons, either illustrating anti-dumping symbols or images of receiving water fauna, are effective supplements to the anti-dumping message. Stencils and signs alert the public to the destination of pollutants discharged into stormwater. The following requirements will be included in the project design and shown on the project plans:</p> <ul style="list-style-type: none"> <li>- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language (such as: "No Dumping – Flows to Creek") and/or graphical icons to discourage illegal dumping.</li> <li>- Maintain legibility of stencils and signs.</li> </ul>	Frequency: Annually	<p>Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com</p>
N	<p><b>S2. Design and Construct Outdoor Material Storage Areas to Reduce Pollution Introduction</b></p>		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p><b>S3. Design and Construct Trash and Waste Storage Areas to Reduce Pollution Introduction</b></p> <p>Trash storage areas will be designed to reduce pollutant introduction. All trash container areas will meet the following requirements:</p> <ul style="list-style-type: none"> <li>- Paved with an impervious surface, designed to not allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements around the area, screened or walled to prevent off-site transport of trash; and</li> <li>- Provide solid roof or awning to prevent exposure to direct precipitation.</li> <li>- No trash area drains will be connected to the MS4.</li> </ul>	Frequency: Continuous	<p>Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p><b>S4. Use Efficient Irrigation Systems &amp; Landscape Design, Water Conservation, Smart Controllers, and Source Control</b></p> <p>The following methods to reduce excessive irrigation runoff and pollutant introduction will be incorporated for all landscaped areas where applicable: (1) employing rain shutoff devices to prevent irrigation after precipitation; (2) designing irrigation systems to each landscape area's specific water requirements; (3) using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines; (4) the timing and application methods of irrigation water shall be designed to minimize the runoff of excess irrigation water into the municipal storm drain system; (5) employing other comparable, equally effective, methods to reduce irrigation water runoff; grouping plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration; (6) choosing plants with low irrigation requirements (for example, native or drought tolerant species); (7) using mulches (such as wood chips or shredded wood products) in planter areas without ground cover to minimize sediment in runoff; (8) installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and using native plant material where possible and/or as recommended by the landscape architect; (9) leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible; and (10) choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth.</p>	Frequency: Continuous	<p>Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<b>S5. Finish Grade of Landscaped Areas at a Minimum of 1-2 Inches Below Top of Curb, Sidewalk or Pavement</b> All landscape pockets, fingers, setback areas, parkway strips, street medians, etc., will be finish-graded at a minimum of 1-2 inches below top of curb or sidewalk for increased retention/infiltration of stormwater and irrigation water.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
N	<b>S6. Protect Slopes and Channels and Provide Energy Dissipation</b>		
Y	<b>S7. Covered Dock Areas</b> The project does not propose below grade loading docks, and the runoff from the "dock high" loading area will not directly connect to the municipal storm drain system. The loading dock area will drain runoff to catch basins with filter inserts for pre-treatment prior to the flows being retained on site and infiltrated.	Frequency: Continuous	Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com
N	<b>S8. Covered Maintenance Bays With Spill Containment Plans</b>		
N	<b>S9. Vehicle Wash Areas With Spill Containment Plans</b>		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
N	S10. Covered Outdoor Processing Areas		
N	S11. Equipment Wash Areas With Spill Containment Plans		
N	S12. Fueling Areas		
N	S13. Hillside Landscaping		
N	S14. Wash Water Control for Food Preparation Areas		
N	S15. Community Car Wash Racks		



BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Low Impact Development BMPs			
Y	<p><b>LID BMP #1— Onsite Infiltration (Underground Chamber)</b></p> <p>Quarterly inspections of the underground infiltration BMPs shall be conducted utilizing the designed manholes/inspection ports. The BMPs shall be cleaned when inspection reveals that accumulated sediment or trash is clogging the system. Accumulated sediment and trash can be evacuated through the manholes.</p>	Frequency: Quarterly And Immediately After Major Storm Events	<p>Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com</p>
Y	<p><b>LID BMP #2— Treatment Control Measures Proprietary Catch Basin Insert Filters (Pretreatment for Onsite Infiltration)</b></p> <p><b>(Kristar FloGard +Plus Catch Basin Insert Filters or Approved Equivalent)</b></p> <p>Twice a year, prior to and after the rainy season, and after major storm events, the catch basin insert filters shall be visually inspected for damage, have all sediment and debris removed, and the filter medium pouches shall be replaced if necessary. The owner may conduct this maintenance itself, or may enter into a service contract for the maintenance of the insert filters as detailed in the Kristar FloGard +Plus Specifications /Maintenance Requirements brochure, a copy of which is attached hereto.</p>	Frequency: Every Six Months (Approximately April 1st and October 1st) and Immediately After Major Storm Events	<p>Locust XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchenk@xebecrealty.com</p>

### **Required Permits**

No permits are required for the implementation, operation, and maintenance of the BMPs described in this plan.

### **Recordkeeping**

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

# Innovative stormwater management products



## FloGard®+PLUS<sup>®</sup> Catch Basin Insert Filter

### FloGard®+PLUS Catch Basin Insert Filter

#### GENERAL FILTER CONFIGURATION

FloGard®+PLUS catch basin insert filter shall provide solids filtration through a filter screen or filter liner, and hydrocarbon capture shall be effected using a non-leaching absorbent material contained in a pouch or similar removable restraint. Hydrocarbon absorbent shall not be placed at an exposed location at the entry to the filter that would allow blinding by debris and sediment without provision for self-cleaning in operation.

Filter shall conform to the dimensions of the inlet in which it is applied, allow removal and replacement of all internal components, and allow complete inspection and cleaning in the field.

#### FLOW CAPACITY

Filter shall provide two internal high-flow bypass locations that in total exceed the inlet peak flow capacity. Filter shall provide filtered flow capacity in excess of the required "first flush" treatment flow. Unit shall not impede flow into or through the catch basin when properly sized and installed.

#### MATERIALS

Filter support frame shall be constructed of type 304 stainless steel. Filter screen, when used in place of filter liner, shall be type 304 or 316 stainless steel, with an apparent opening size of not less than 4 U.S. mesh. Filter liner, when used in place of filter screen, shall be woven polypropylene geotextile fabric liner with an apparent opening size (AOS) of not less than 40 U.S. mesh as determined by ASTM D 4751. Filter liner shall include a support basket of polypropylene geogrid with stainless steel cable reinforcement.

Filter frame shall be rated at a minimum 25-year service life. All other materials, with the exception of the hydrocarbon absorbent, shall have a rated service life in excess of 2 years.

#### FloGard®+PLUS TEST RESULTS SUMMARY

Testing Agency	% TSS Removal	% Oil and Grease Removal	% PAH Removal
UCLA	80	70 to 80	
U of Auckland Tonking & Taylor Ltd. (for city of Auckland)	78 to 95		
U of Hawaii (for city of Honolulu)	80		20 to 40

#### FEATURES

- Easy to install, inspect and maintain
- Can be retrofitted to existing drain catch basins – or used in new projects
- Economical and efficient
- Catches pollutants where they are easiest to catch (at the inlet)
- No standing water – minimizes vector, bacteria and odor problems
- Can be incorporated as part of a "Treatment Train"

#### BENEFITS

- Lower installation, inspection and maintenance costs
- Versatile installation applications
- Higher return on investment
- Allows for installation on small and confined sites
- Minimizes vector, bacteria and odor problems
- Allows user to target specific pollutants

# Innovative stormwater management products

## FloGard® +PLUS Catch Basin Insert Filter



### INSTALLATION AND MAINTENANCE

Filter shall be installed and maintained in accordance with manufacturer's general instructions and recommendations.

### PERFORMANCE

Filter shall provide 80% removal of total suspended solids (TSS) from treated flow with a particle size distribution consistent with typical urban street deposited sediments. Filter shall capture at least 70% of oil and grease and 40% of total phosphorus (TP) associated with organic debris from treated flow. Unit shall provide for isolation of trapped pollutants, including debris, sediments, and floatable trash and hydrocarbons, from bypass flow such that re-suspension and loss of pollutants is minimized during peak flow events.

### FloGard®+PLUS COMPETITIVE FEATURE COMPARISON

Evaluation of FloGard+PLUS Units (Based on flow-comparable units) (Scale 1-10, 10 being best)	FloGard+PLUS	Other Insert Filter Types**
<b>Flow Rate</b>	10	7
<b>Removal Efficiency*</b>	80%	45%
<b>Capacity – Sludge and Oil</b>	7	7
<b>Service Life</b>	10	3
<b>Installation – Ease of Handling / Installation</b>	8	6
<b>Ease of Inspections &amp; Maintenance</b>	7	7
<b>Value</b>	10	2

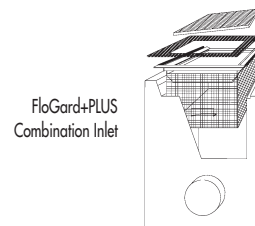
\*approximate, based on field sediment removal testing in urban street application \*\*average

Long-Term Cost Comparison (Scale 1-10, 10 being lowest cost, higher number being best)	FloGard+PLUS	Other Insert Filter Types
Unit cost — initial (\$/cfs treated)	10	4
Installation cost (\$/cfs treated)	9	6
Adsorbent replacement (annual avg \$/cfs treated)	10	2
Unit materials replacement (annual avg \$/cfs treated)	10	10
Maintenance cost (annual avg \$/cfs treated)	9	6
<b>Total first yr (\$/cfs treated)</b>	10	5
<b>Total Annual Avg (\$/cfs treated, avg over 20 yrs)*</b>	10	5

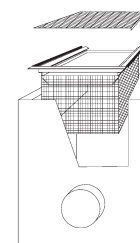
\*assumes 3% annual inflation



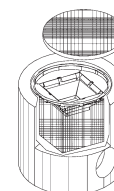
Captured debris from  
FloGard+PLUS,  
Dana Point, CA



FloGard+PLUS  
Combination Inlet



FloGard+PLUS  
Flat Grate



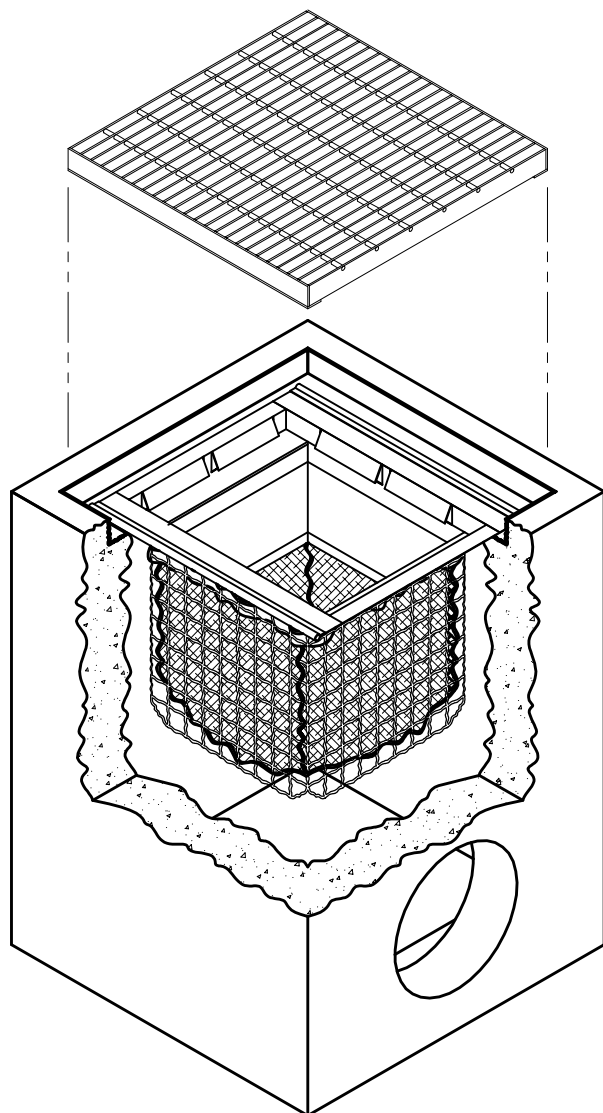
FloGard+PLUS  
Round Gated Inlet

KriStar Enterprises, Inc.  
P.O. Box 6419  
Santa Rosa, CA 95406-1419

PH: 800-579-8819  
FAX: 707-524-8186  
[www.kristar.com](http://www.kristar.com)

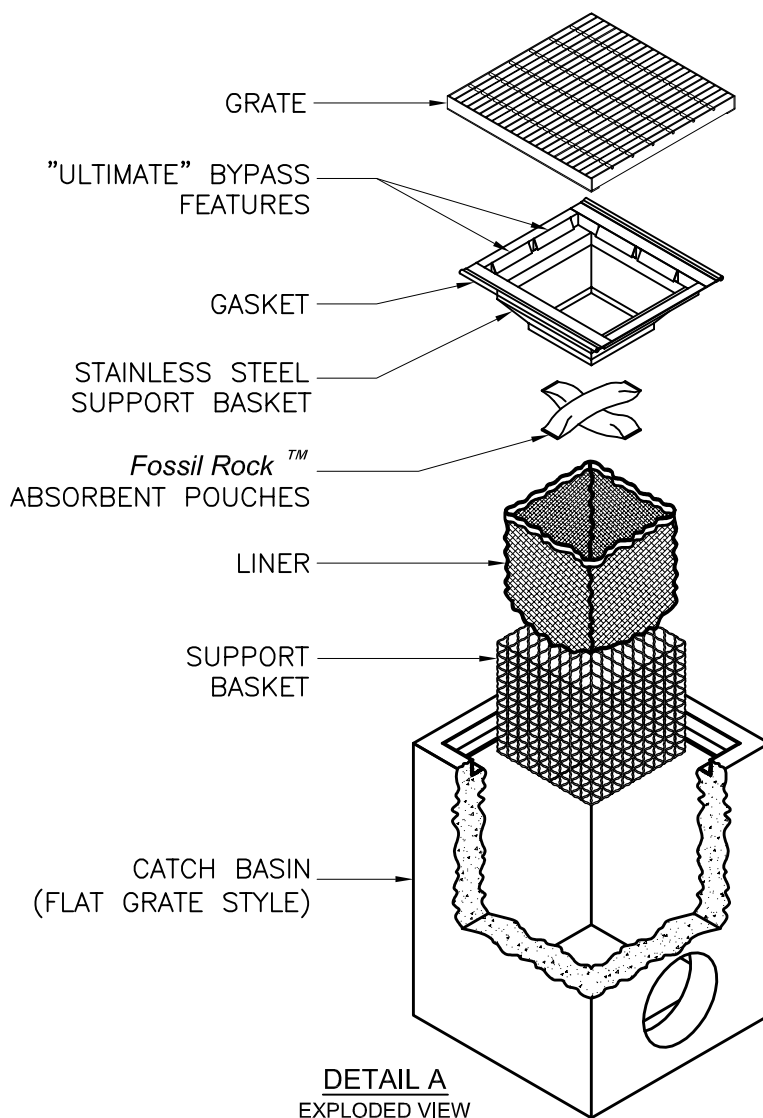
© 2004 KriStar Enterprises, Inc.  
FGP-T 11.19.18.04.2M

FloGard® is a registered trademarks of  
KriStar Enterprises, Inc.



**FLOGARD+PLUS® FILTER**  
-INSTALLED INTO CATCH BASIN-

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



**NOTES:**

1. FloGard®+Plus (frame mount) high capacity catch basin inserts are available in most sizes and styles (see specifier chart, sheet 2 of 2). Refer to the FloGard®+Plus (wall mount) insert for devices to fit non-standard, or combination style catch basins.
2. Filter insert shall have both an "initial" filtering bypass and "ultimate" high flow bypass feature.
3. Filter support frame shall be constructed from stainless steel Type 304.
4. Allow a minimum of 2.0 feet, of clearance between the bottom of the grate and top of outlet pipe(s), or refer to the FloGard® insert for "shallow" installations.
5. Filter medium shall be *Fossil Rock™*, installed and maintained in accordance with manufacturer specifications.
6. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.
7. Filtered flow rate includes a safety factor of two.

TITLE

**FloGard® +PLUS**  
CATCH BASIN FILTER INSERT  
(Frame Mount)  
FLAT GRATED INLET



**KriStar Enterprises, Inc.**

P.O. Box 6419, Santa Rosa, CA 95406  
Ph: 800.579.8819, Fax: 707.524.8186, [www.kristar.com](http://www.kristar.com)

DRAWING NO.

FGP-0001

REV

A

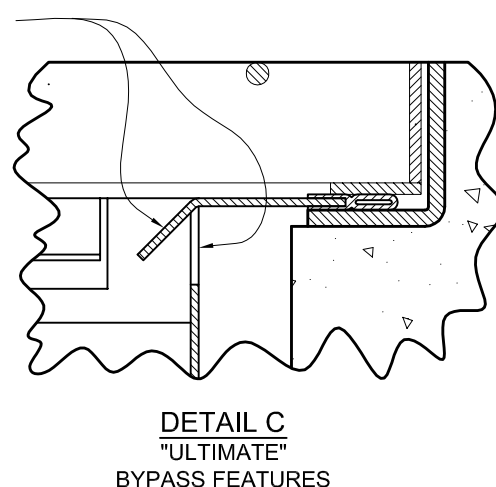
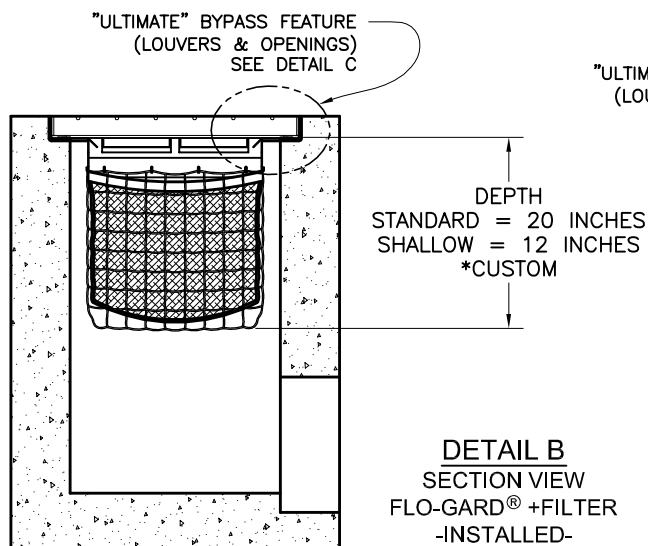
ECO

0001

DATE

JPR 09/01/06

SHEET 1 OF 2



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

SPECIFIER CHART								
MODEL NO.  STANDARD DEPTH	STANDARD & SHALLOW DEPTH (Data in these columns is the same for both STANDARD & SHALLOW versions)			STANDARD DEPTH -20 Inches-		MODEL NO.  SHALLOW DEPTH	SHALLOW DEPTH -12 Inches-	
	INLET ID Inside Dimension (inch x inch)	GRATE OD Outside Dimension (inch x inch)	TOTAL BYPASS CAPACITY (cu. ft.)	SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)		SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)
FGP-12F	12 X 12	12 X 14	2.8	0.3	0.4	FGP-12F8	.15	.25
FGP-1530F	15 X 30	15 X 35	6.9	2.3	1.6	FGP-1530F8	1.3	.9
FGP-16F	16 X 16	16 X 19	4.7	0.8	0.7	FGP-16F8	.45	.4
FGP-1624F	16 X 24	16 X 26	5.0	1.5	1.2	FGP-1624F8	.85	.7
FGP-18F	18 X 18	18 X 20	4.7	0.8	0.7	FGP-18F8	.45	.4
FGP-1820F	16 X 19	18 X 21	5.9	2.1	1.4	FGP-1820F8	1.2	.8
FGP-1824F	16 X 22	18 X 24	5.0	1.5	1.2	FGP-1824F8	.85	.7
FGP-1836F	18 X 36	18 X 40	6.9	2.3	1.6	FGP-1836F8	1.3	.9
FGP-2024F	18 X 22	20 X 24	5.9	1.2	1.0	FGP-2024F8	.7	.55
FGP-21F	22 X 22	22 X 24	6.1	2.2	1.5	FGP-21F8	1.25	.85
FGP-2142F	21 X 40	24 X 40	9.1	4.3	2.4	FGP-2142F8	2.45	1.35
FGP-2148F	19 X 46	22 X 48	9.8	4.7	2.6	FGP-2148F8	2.7	1.5
FGP-24F	24 X 24	24 X 27	6.1	2.2	1.5	FGP-24F8	1.25	.85
FGP-2430F	24 X 30	26 X 30	7.0	2.8	1.8	FGP-2430F8	1.6	1.05
FGP-2436F	24 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8	1.95	1.15
FGP-2448F	24 X 48	26 X 48	9.3	4.4	2.4	FGP-2448F8	2.5	1.35
FGP-28F	28 X 28	32 X 32	6.3	2.2	1.5	FGP-28F8	1.25	.85
FGP-2440F	24 X 36	28 X 40	8.3	4.2	2.3	FGP-2440F8	2.4	1.3
FGP-30F	30 X 30	30 X 34	8.1	3.6	2.0	FGP-30F8	2.05	1.15
FGP-36F	36 X 36	36 X 40	9.1	4.6	2.4	FGP-36F8	2.65	1.35
FGP-3648F	36 X 48	40 X 48	11.5	6.8	3.2	FGP-3648F8	3.9	1.85
FGP-48F	48 X 48	48 X 54	13.2	9.5	3.9	FGP-48F8	5.45	2.25
FGP-SD24F	24 X 24	28 X 28	6.1	2.2	1.5	FGP-SD24F8	1.25	.85
FGP-1836FGO	18 X 36	20 X 40	6.9	2.3	1.6	FGP-1836F8GO	1.3	.9
FGP-2436FGO	20 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8GO	1.95	1.15
FGP-48FGO	18 X 48	20 X 54	6.3	2.2	1.5	FGP-48F8GO	1.25	.85

TITLE

**FloGard® +PLUS**  
CATCH BASIN FILTER INSERT  
(Frame Mount)  
FLAT GRATED INLET



**KriStar Enterprises, Inc.**

P.O. Box 6419, Santa Rosa, CA 95406  
Ph: 800.579.8819, Fax: 707.524.8186, [www.kristar.com](http://www.kristar.com)

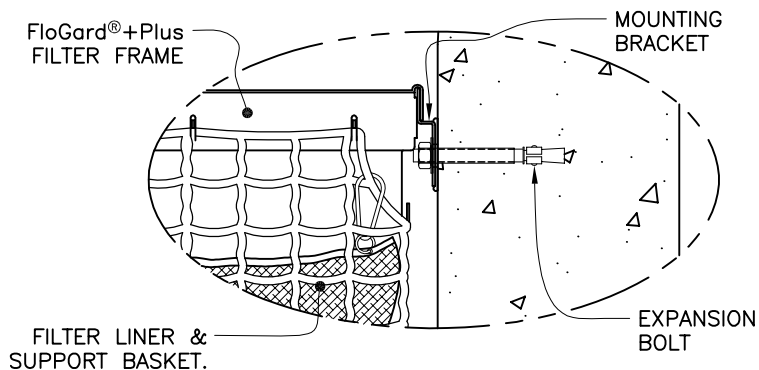
DRAWING NO. FGP-0001	REV A	ECO 0001	DATE JPR 09/01/06	SHEET 2 OF 2
-------------------------	----------	-------------	----------------------	--------------

## SPECIFIER CHART

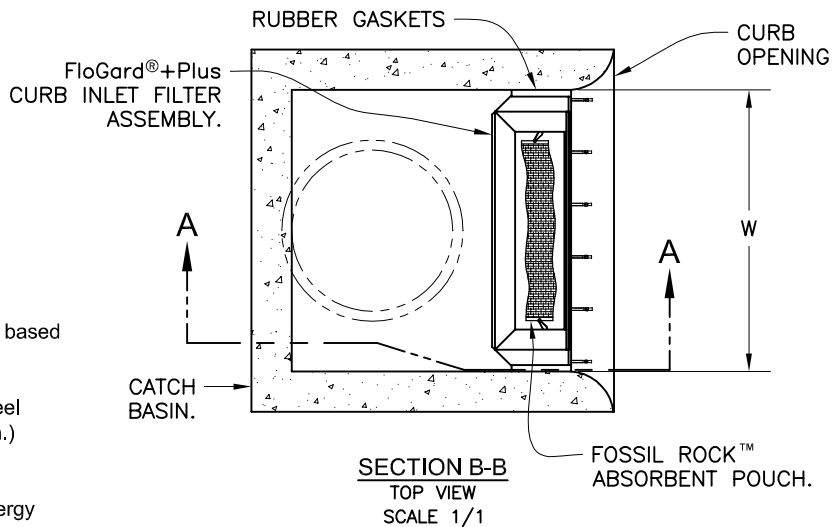
MODEL NO.	Curb Opening Width - W -	Storage Capacity - Cu. Ft. -	Filtered Flow Rate - GPM/CFS -	Bypass Flow Rate - GPM/CFS -
FGP-24CI	2.0' (24")	.95	338 / .75	2,513 / 5.6
FGP-30CI	2.5' (30")	1.20	450 / 1.00	3,008 / 6.7
FGP-36CI	3.0' (36")	1.50	563 / 1.25	3,547 / 7.9
FGP-42CI	3.5' (42")	1.80	675 / 1.50	3,951 / 8.8
FGP-48CI	4.0' (48")	2.10	768 / 1.76	4,445 / 9.9
FGP-5.0CI	5.0' (60")	2.40	900 / 2.00	5,208 / 11.6
FGP-6.0CI	6.0' (72")	3.05	1,126 / 2.51	6,196 / 13.8
FGP-7.0CI	7.0' (84")	3.65	1,350 / 3.01	7,139 / 15.9
FGP-8.0CI	8.0' (96")	4.25	1,576 / 3.51	8,082 / 18.0
FGP-10.0CI	10.0' (120")	4.85	1,800 / 4.01	9,833 / 21.9
FGP-12.0CI	12.0' (144")	6.10	2,252 / 5.02	11,764 / 26.2
FGP-14.0CI	14.0' (168")	7.30	2,700 / 6.02	13,515 / 30.1
FGP-16.0CI	16.0' (192")	8.55	3,152 / 7.02	15,446 / 34.4
FGP-18.0CI	18.0' (216")	9.45	3,490 / 7.78	17,152 / 38.2
FGP-21.0CI	21.0' (252")	10.95	4,050 / 9.02	19,891 / 44.3
FGP-28.0CI	28.0' (336")	14.60	5,400 / 12.03	26,311 / 58.6

## NOTES:

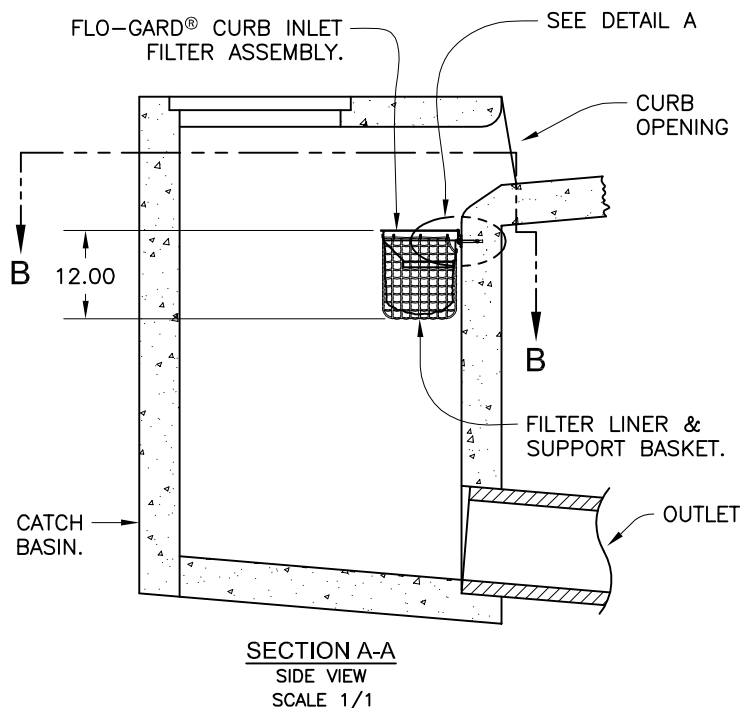
- FloGard®+PLUS filter inserts shall be installed across the entire width of curb opening. Storage capacity and clean flow rates are based on full width installation.
- Filter insert shall be attached to the catch basin with stainless steel expansion anchor bolts & washers (3/8" x 2-1/2" minimum length.) See detail A.
- FloGard®+PLUS filter inserts are designed with a debris trap/energy dissipator for the retention of floatables and collected sediments.
- Filter support frame shall be constructed from stainless steel Type 304.
- Filter liner shall be constructed from durable polypropylene, woven, monofilament, geotextile. Filter liner shall not allow the retention of water between storm events.
- Filter inserts are supplied with "clip-in" filter pouches utilizing FOSSIL ROCK™ filter medium for the collection and retention of petroleum hydrocarbons (oils & greases).
- FloGard®+PLUS filter inserts and FOSSIL ROCK™ filter medium pouches must be maintained in accordance with manufacturer recommendations.
- FloGard +PLUS filter inserts are available in standard lengths of 24", 30", 35", 42" & 48" and may be installed in various length combinations (end to end) to fit length of noted catch basin.
- Clean flow rates are "calculated" based on liner flow rate of 140 gallons per minute per square foot of material, a factor of .50 has been applied to allow for anticipated sediment & debris loading. An additional safety factor of between .25 & .50 may be applied to allow for site specific sediment loading.
- Storage capacity reflects maximum solids collection prior to impending "initial" filtering bypass. The "ultimate" high-flow bypass will not become impeded due to maximum solids loading.



DETAIL A  
MOUNTING BRACKET & EXPANSION BOLTS  
SEE NOTE 2  
SCALE 6/1



SECTION B-B  
TOP VIEW  
SCALE 1/1



SECTION A-A  
SIDE VIEW  
SCALE 1/1

TITLE

**FloGard® +PLUS**  
CATCH BASIN FILTER INSERT  
(Curb Inlet Style)



**KriStar Enterprises, Inc.**

360 Sutton Place, Santa Rosa, CA 95407  
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

DRAWING NO. FGP-0002	REV D	ECO 0059 JPR 12/30/08	DATE JPR 11/3/06	SHEET 1 OF 1
-------------------------	----------	--------------------------	---------------------	--------------





## **GENERAL SPECIFICATIONS FOR MAINTENANCE OF *FLO-GARD+PLUS*® CATCH BASIN INSERT FILTERS**

### **SCOPE:**

Federal, State and Local Clean Water Act regulations and those of insurance carriers require that stormwater filtration systems be maintained and serviced on a recurring basis. The intent of the regulations is to ensure that the systems, on a continuing basis, efficiently remove pollutants from stormwater runoff thereby preventing pollution of the nation's water resources. These specifications apply to the FloGard+Plus® Catch Basin Insert Filter.

### **RECOMMENDED FREQUENCY OF SERVICE:**

Drainage Protection Systems (DPS) recommends that installed Flo-Gard+Plus® Catch Basin Insert Filters be serviced on a recurring basis. Ultimately, the frequency depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, cans, paper, etc.); however, it is recommended that each installation be serviced a minimum of three times per year, with a change of filter medium once per year. DPS technicians are available to do an on-site evaluation, upon request.

### **RECOMMENDED TIMING OF SERVICE:**

DPS guidelines for the timing of service are as follows:

1. For areas with a definite rainy season: Prior to, during and following the rainy season.
2. For areas subject to year-round rainfall: On a recurring basis (at least three times per year).
3. For areas with winter snow and summer rain: Prior to and just after the snow season and during the summer rain season.
4. For installed devices not subject to the elements (washracks, parking garages, etc.): On a recurring basis (no less than three times per years).

### **SERVICE PROCEDURES:**

1. The catch basin grate shall be removed and set to one side. The catch basin shall be visually inspected for defects and possible illegal dumping. If illegal dumping has occurred, the proper authorities and property owner representative shall be notified as soon as practicable.
2. Using an industrial vacuum, the collected materials shall be removed from the liner. (Note: DPS uses a truck-mounted vacuum for servicing Flo-Gard+Plus® catch basin inserts.)
3. When all of the collected materials have been removed, the filter medium pouches shall be removed by unsnapping the tether from the D-ring and set to one side. The filter liner, gaskets, stainless steel frame and mounting brackets, etc. shall be inspected for continued serviceability. Minor damage or defects found shall be corrected on-the-spot and a notation made on the Maintenance Record. More extensive deficiencies that affect the efficiency of the filter (torn liner, etc.), if approved by the customer representative, will be corrected and an invoice submitted to the representative along with the Maintenance Record.
4. The filter medium pouches shall be inspected for defects and continued serviceability and replaced as necessary and the pouch tethers re-attached to the liner's D-ring. See below.
5. The grate shall be replaced.



## **REPLACEMENT AND DISPOSAL OF EXPOSED FILTER MEDIUM AND COLLECTED DEBRIS**

The frequency of filter medium pouch exchange will be in accordance with the existing DPS-Customer Maintenance Contract. DPS recommends that the medium be changed at least once per year. During the appropriate service, or if so determined by the service technician during a non-scheduled service, the filter medium pouches will be replaced with new pouches. Once the exposed pouches and debris have been removed, DPS has possession and must dispose of it in accordance with local, state and federal agency requirements.

**DPS also has the capability of servicing all manner of catch basin inserts and catch basins without inserts, underground oil/water separators, stormwater interceptors and other such devices. All DPS personnel are highly qualified technicians and are confined space trained and certified. Call us at (888) 950-8826 for further information and assistance.**

## **APPENDIX G**

### **Record of BMP Implementation, Maintenance and Inspection**

## RECORD OF BMP IMPLEMENTATION, MAINTENANCE AND INSPECTION

**Today's Date:**

**Name of Person Performing Activity  
(Printed):**

**Signature:**

[illegible]

## **APPENDIX H**

### **Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement**

AND WHEN RECORDED MAIL TO

City Clerk  
City of Rialto  
150 S. Palm Ave  
Rialto, CA 92376

SPACE ABOVE THIS LINE FOR RECORDER'S USE

**WATER QUALITY MANAGEMENT PLAN AND STORMWATER BMP  
TRANSFER, ACCESS AND MAINTENANCE AGREEMENT**

**CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF  
CALIFORNIA**

This Agreement is made and entered into this \_\_\_\_ day of \_\_\_\_\_, 20\_\_, by and between the CITY OF RIALTO, a municipal corporation, hereinafter referred to as CITY, and **Locust XC, LLC**, hereinafter referred to as OWNER.

WHEREAS, the Owner is the legal property owner of the real property situated in the State of California, County of San Bernardino, located at **2889 N. Locust Avenue** in the City of Rialto, more commonly referred to as San Bernardino County Tax Assessor Parcel No. **0239-193-11-0-000** described in Exhibit A and depicted in Exhibit B attached hereto and incorporated herein by this reference; and

WHEREAS, at the time of initial approval of the development project known as the **Locust Avenue Industrial Project** within the Property described herein, the City required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoff; and

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the City, hereinafter referred to as "WQMP," to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff; and

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City; and

WHEREAS, said BMPs, with installation and/or implementation on private property and draining only private property, are part of a private facility with all maintenance or replacement therefore, the sole responsibility of the Owner in accordance with the terms of this Agreement;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. The Owner hereby provides the City or the City's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by City's Director of Public Works with no advance notice, for the purpose of inspection, sampling, testing of the BMPs, and in case of emergency, to undertake all necessary repairs or other preventative measures at the owner's expense as provided in paragraph 3 below. The City shall make every effort at all times to minimize or avoid interference with the Owner's use of the Property.

2. The Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by the Owner and the Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event the Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City, the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or the Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the Civil Code from the date of the notice of expense until paid in full.

4. The City may require the Owner to post security in form and for a time period satisfactory to the City to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under this Agreement, the City may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of this Agreement. As an additional remedy, the Director may withdraw any previous stormwater-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as the Owner repays to the City its reasonable costs incurred in accordance with paragraph 3 above.

5. This Agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

6. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

7. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien against the Property.

8. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. The Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. The Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. The Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

9. Time is of the essence in the performance of this Agreement.

10. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

IF TO CITY:

\_\_\_\_\_  
Director of Public Works  
150 S. Palm Avenue  
Rialto, CA 92376

IF TO OWNER:

Gretchen Kendrick  
Authorized Signatory  
3010 Old Ranch Parkway, Suite 470  
Seal Beach, CA 90740

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

APPROVED AS TO FORM;

APPROVED AS TO CONTENT:

By: (Signature Not Required)  
City Attorney

By: \_\_\_\_\_  
Director of Public Works  
City of Rialto

City of Rialto

Owner: Locust XC, LLC  
(Company)

By: \_\_\_\_\_  
City Manager

By: \_\_\_\_\_  
(Signature and Date)

Name: Gretchen Kendrick  
(Please Print or Type Name)

ATTEST:

\_\_\_\_\_  
City Clerk

Title: Authorized Signatory  
(Please Print or Type Title)

**NOTE: OWNER'S SIGNATURE MUST BE NOTARIZED FOR RECORDATION**

**EXHIBIT A**  
**LEGAL DESCRIPTION**

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF RIALTO, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE WEST  $\frac{1}{2}$  OF THE NORTH  $\frac{1}{2}$  OF THE SOUTH  $\frac{1}{2}$  OF THE SOUTHWEST  $\frac{1}{4}$  OF THE SOUTHEAST  $\frac{1}{4}$ , FRACTIONAL SECTION 21, TOWNSHIP 1 NORTH, RANGE 5 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO GOVERNMENT SURVEY.

EXCEPTING THEREFROM THE WEST 30 FEET AS DEEDED TO THE COUNTY OF SAN BERNARDINO BY DEED RECORDED IN BOOK 3640, PAGE 509 OF OFFICIAL RECORDS.

APN: 0239-193-11-0-000



**EXHIBIT B**  
**BMP SITE PLAN**



PRELIMINARY  
WQMP SITE PLAN  
2889 N. LOCUST AVE.  
RIALTO, CA

PROJECT DATA:

TOTAL SITE AREA OF PROPOSED DEVELOPMENT: 4.71 AC (205,044 SF)

BUILDING AREA: 96,748 SF  
WALKWAYS / CONC. GUTTER / DOCK AREAS: 38,491 SF  
DRIVEWAYS / DRIVE AISLES / PARKING AREAS: 49,135 SF

20,670 SF LANDSCAPING PROVIDED (10.1% PERVIOUS AREA)

CURRENT USE: VACANT  
PROPOSED USE: INDUSTRIAL

WATERSHED:  
SANTA ANA RIVER

WQMP DCV CALCULATION

AREA 1  
AREA = 4.71 AC (205,044 SF)  
RUNOFF COEFFICIENT (90% IMPERVIOUS)  
 $C = 0.858 * (.90)^3 - 0.78 * (.90)^2 + 0.774 * (.90) + .04 = 0.730$   
2YR 1 HR STORM = 0.730 IN  
 $P6 = 1.4807 * 0.730 = 1.0809$  IN  
 $DCV = 205,044 \text{ SF} * 0.730 * 1.0809 \text{ IN} / 12 \text{ IN/FT} * 1.963 = 26,466 \text{ CF}$

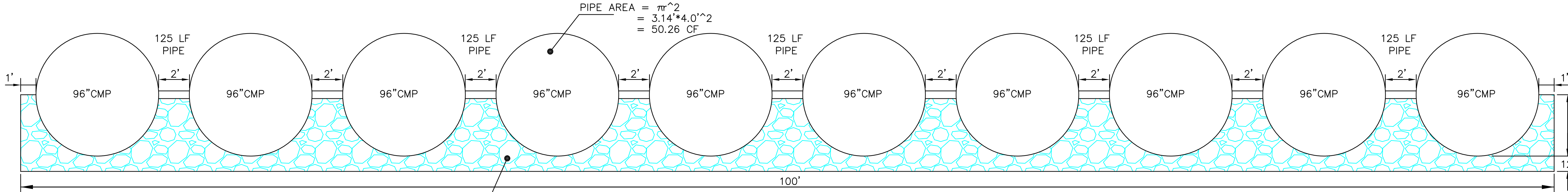
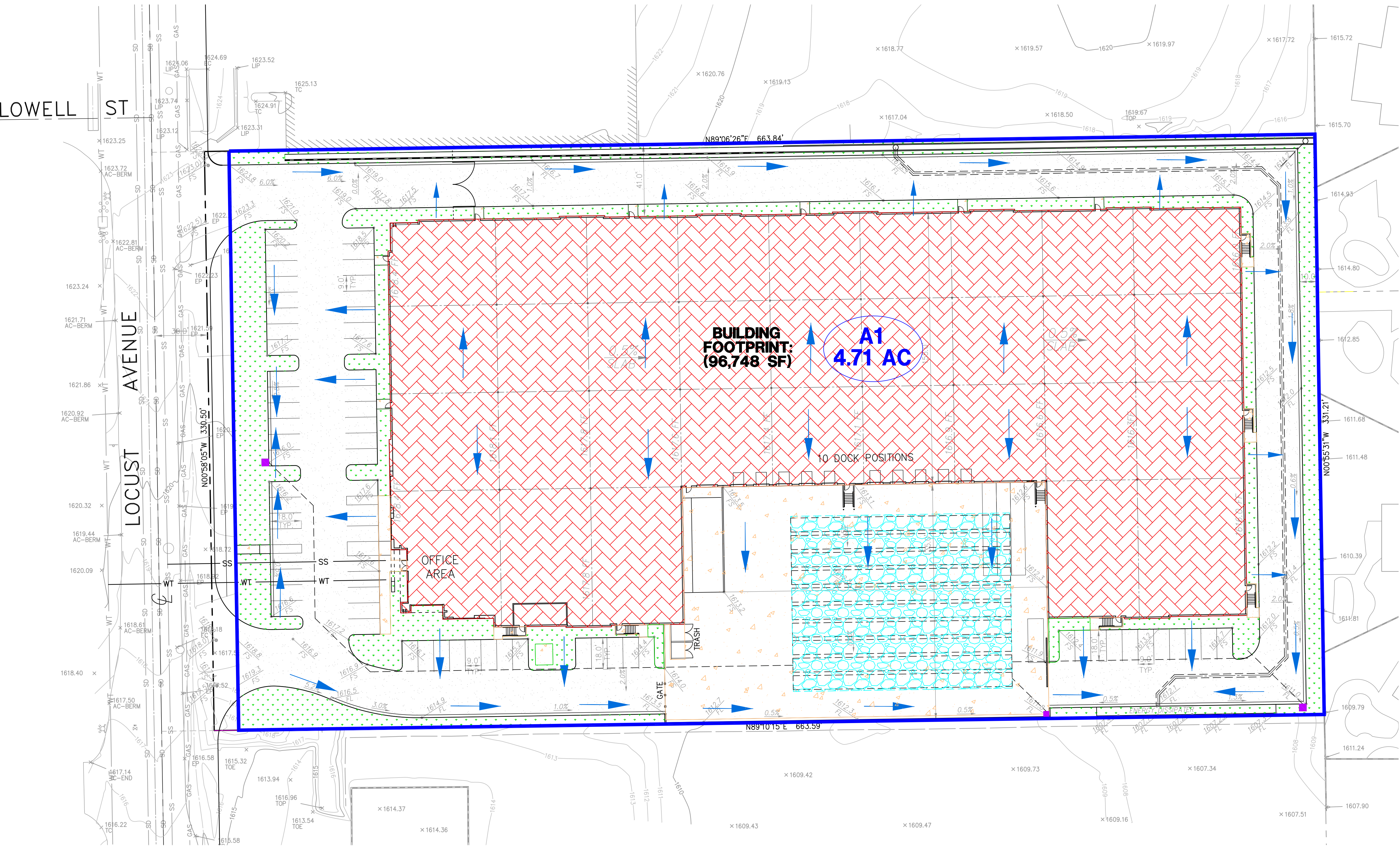
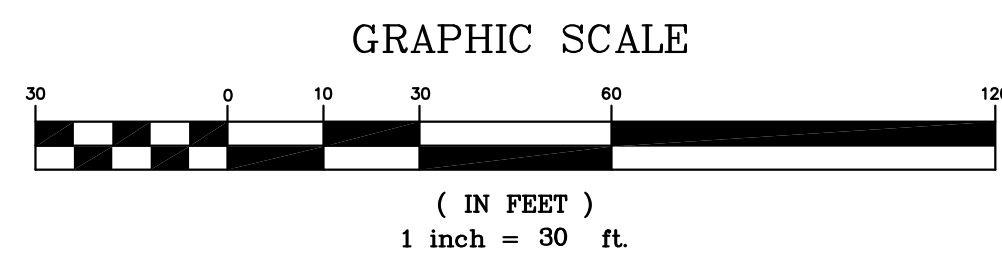
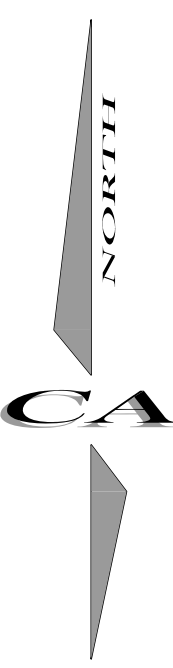
BMP VOLUME CALCULATION

BMP VOLUME  
PIPE CROSS SECTIONAL AREA =  $(50.26) * 10 \text{ CF/LF} = 502.60 \text{ CF/LF}$   
ROCK CROSS SECTIONAL AREA =  $248.70 \text{ CF/LF ROCK AREA} * 0.35 = 87.05 \text{ CF/LF}$   
TOTAL CROSS SECTIONAL AREA =  $589.65 \text{ CF/LF} * 125 \text{ LF} = 73,706 \text{ CF}$   
EFFECTIVE DEPTH =  $73,706 \text{ CF} / 12,500 \text{ SF BOTTOM} = 5.90'$

$V_{ret} = (P_{design} / 12 * S_{ainf} * T_{fill}) + (S_{ares} * D_{res} * N_{agg})$   
 $P_{design} = 15.5" \text{ MEASURED} / 3.06 \text{ S.F.} = 5.07" / \text{HR}$   
 $S_{ainf} = 12,500 \text{ SF}$   
 $S_{ares} = 12,500 \text{ SF}$   
 $T_{fill} = 3 \text{ HRS}$   
 $D_{res} = \text{EFFECTIVE DEPTH} = 5.90'$   
 $N_{agg} = 1.0 \text{ (EFFECTIVE DEPTH ACCOUNTED FOR ROCK)}$   
 $V_{ret} = (5.07 / 12 * 12,500 * 3) + (12,500 * 5.90 * 1)$   
 $V_{ret} = 89,594 \text{ CF}$   
BMP VOLUME (89,594 CF) > DCV VOLUME (26,466 CF)

BMP LEGEND

- AREA 1**
- DRAINAGE AREAS
  - FLOW DIRECTION
  - UNDERGROUND INFILTRATION PIPE PER DETAIL HEREON
  - LANDSCAPE AREA EFFICIENT IRRIGATION  
LANDSCAPE AREA RUNOFF-MINIMIZING DESIGN
  - PROPOSED BUILDING
  - ASPHALT CONCRETE DRIVE AISLES
  - CONCRETE HARDSCAPE/ENHANCED PAVING
  - CATCH BASIN WITH INSERT FILTER & STORM DRAIN STENCIL SIGNAGE
  - TRASH ENCLOSURE



ROCK AREA =  $(\text{FACILITY AREA} - \text{PIPE AREA}) * 0.35$   
 $= (100 * 5) - (0.5 * 50.26 * 10) = 248.70 \text{ CF/LF}$   
 $248.70 \text{ CF/LF} * 125 \text{ LF} = 31,089 \text{ CF} * 0.35 = 10,881 \text{ CF}$

INFILTRATION BMP  
CROSS SECTION  
1" = 4'

	PREPARED BY:		DATE	BY	REVISION	DATE
	<b>CA ENGINEERING, INC.</b>					Dec 28 2021
	Planning • Engineering • Surveying					JOB NO.
	13821 NEWPORT AVE., STE 110					251-55
	TUSTIN, CA 92780					Sht. C-2
FRED CORNWELL R.C.E. 45591		DATE				
949-724-9480 949-724-9484 FAX						



## 6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

### APPENDICES INCLUDED IN SECTION 6.4 (Other Supporting Documentation):

**Appendix I:** Kristar FloGard +PLUS Catch Basin Insert Filter Specification (Pretreatment for Infiltration)

**Appendix J:** BMP Fact Sheet— INF-7: Underground Infiltration Fact Sheet (from Orange County TGD for Project WQMPs)

**Appendix K:** BMP Educational Materials

- Industrial and Commercial Facilities Brochure (San Bernardino County Website)
- Commercial Landscape Maintenance Fact Sheet (San Bernardino County Website)
- Stormwater Management Practices for Commercial Landscape Maintenance Brochure (San Bernardino County Website)
- Commercial Trash Enclosures Brochure (San Bernardino County Website)
- Construction & Development Fact Sheet (San Bernardino County Website)
- Regulatory Information Fact Sheet (San Bernardino County Website)
- SC-11 Spill Prevention, Control & Cleanup
- SC-30 Outdoor Loading / Unloading
- SC-34 Waste Handling & Disposal
- SC-35 Safer Alternative Products
- SC-41 Building & Grounds Maintenance
- SC-42 Building Repair and Construction
- SC-43 Parking / Storage Area Maintenance
- SC-44 Drainage System Maintenance
- SD-10 Site Design & Landscape Planning
- SD-13 Storm Drain Signage

**Appendix L:** NOAA Point Precipitation Frequency Estimate for 2 Year, 1 Hour Storm

**Appendix M:** TGR Geotechnical, Inc.'s Limited Geotechnical Investigation Report, 2889 Locust Avenue, Rialto, California, dated March 10, 2020

**Appendix N:** Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet (from Orange County TGD for Project WQMPs)

**Appendix O:** Hydrology and Hydraulics Report for 2889 N. Locust Avenue, Rialto, California, dated December 21, 2021

# **APPENDIX I**

## **Kristar FloGard +PLUS Catch Basin Insert Filter Specification (Pretreatment for Infiltration)**

# Innovative stormwater management products



## *FloGard*® **+PLUS** Catch Basin Insert Filter

### FloGard®+PLUS Catch Basin Insert Filter

#### GENERAL FILTER CONFIGURATION

FloGard®+PLUS catch basin insert filter shall provide solids filtration through a filter screen or filter liner, and hydrocarbon capture shall be effected using a non-leaching absorbent material contained in a pouch or similar removable restraint. Hydrocarbon absorbent shall not be placed at an exposed location at the entry to the filter that would allow blinding by debris and sediment without provision for self-cleaning in operation.

Filter shall conform to the dimensions of the inlet in which it is applied, allow removal and replacement of all internal components, and allow complete inspection and cleaning in the field.

#### FLOW CAPACITY

Filter shall provide two internal high-flow bypass locations that in total exceed the inlet peak flow capacity. Filter shall provide filtered flow capacity in excess of the required "first flush" treatment flow. Unit shall not impede flow into or through the catch basin when properly sized and installed.

#### MATERIALS

Filter support frame shall be constructed of type 304 stainless steel. Filter screen, when used in place of filter liner, shall be type 304 or 316 stainless steel, with an apparent opening size of not less than 4 U.S. mesh. Filter liner, when used in place of filter screen, shall be woven polypropylene geotextile fabric liner with an apparent opening size (AOS) of not less than 40 U.S. mesh as determined by ASTM D 4751. Filter liner shall include a support basket of polypropylene geogrid with stainless steel cable reinforcement.

Filter frame shall be rated at a minimum 25-year service life. All other materials, with the exception of the hydrocarbon absorbent, shall have a rated service life in excess of 2 years.

#### FloGard®+PLUS TEST RESULTS SUMMARY

Testing Agency	% TSS Removal	% Oil and Grease Removal	% PAH Removal
UCLA	80	70 to 80	
U of Auckland Tonking & Taylor Ltd. (for city of Auckland)	78 to 95		
U of Hawaii (for city of Honolulu)	80		20 to 40

#### FEATURES

- Easy to install, inspect and maintain
- Can be retrofitted to existing drain catch basins – or used in new projects
- Economical and efficient
- Catches pollutants where they are easiest to catch (at the inlet)
- No standing water – minimizes vector, bacteria and odor problems
- Can be incorporated as part of a "Treatment Train"

#### BENEFITS

- Lower installation, inspection and maintenance costs
- Versatile installation applications
- Higher return on investment
- Allows for installation on small and confined sites
- Minimizes vector, bacteria and odor problems
- Allows user to target specific pollutants

# Innovative stormwater management products

## FloGard® +PLUS Catch Basin Insert Filter



### INSTALLATION AND MAINTENANCE

Filter shall be installed and maintained in accordance with manufacturer's general instructions and recommendations.

### PERFORMANCE

Filter shall provide 80% removal of total suspended solids (TSS) from treated flow with a particle size distribution consistent with typical urban street deposited sediments. Filter shall capture at least 70% of oil and grease and 40% of total phosphorus (TP) associated with organic debris from treated flow. Unit shall provide for isolation of trapped pollutants, including debris, sediments, and floatable trash and hydrocarbons, from bypass flow such that re-suspension and loss of pollutants is minimized during peak flow events.

### FloGard®+PLUS COMPETITIVE FEATURE COMPARISON

Evaluation of FloGard+PLUS Units (Based on flow-comparable units) (Scale 1-10, 10 being best)	FloGard+PLUS	Other Insert Filter Types**
<b>Flow Rate</b>	10	7
<b>Removal Efficiency*</b>	80%	45%
<b>Capacity – Sludge and Oil</b>	7	7
<b>Service Life</b>	10	3
<b>Installation – Ease of Handling / Installation</b>	8	6
<b>Ease of Inspections &amp; Maintenance</b>	7	7
<b>Value</b>	10	2

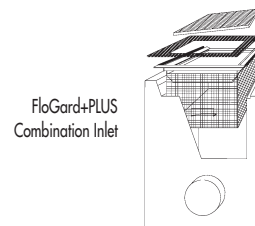
\*approximate, based on field sediment removal testing in urban street application \*\*average

Long-Term Cost Comparison (Scale 1-10, 10 being lowest cost, higher number being best)	FloGard+PLUS	Other Insert Filter Types
Unit cost — initial (\$/cfs treated)	10	4
Installation cost (\$/cfs treated)	9	6
Adsorbent replacement (annual avg \$/cfs treated)	10	2
Unit materials replacement (annual avg \$/cfs treated)	10	10
Maintenance cost (annual avg \$/cfs treated)	9	6
<b>Total first yr (\$/cfs treated)</b>	10	5
<b>Total Annual Avg (\$/cfs treated, avg over 20 yrs)*</b>	10	5

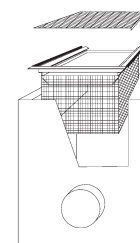
\*assumes 3% annual inflation



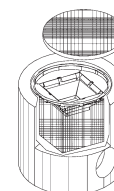
Captured debris from  
FloGard+PLUS,  
Dana Point, CA



FloGard+PLUS  
Combination Inlet



FloGard+PLUS  
Flat Grate



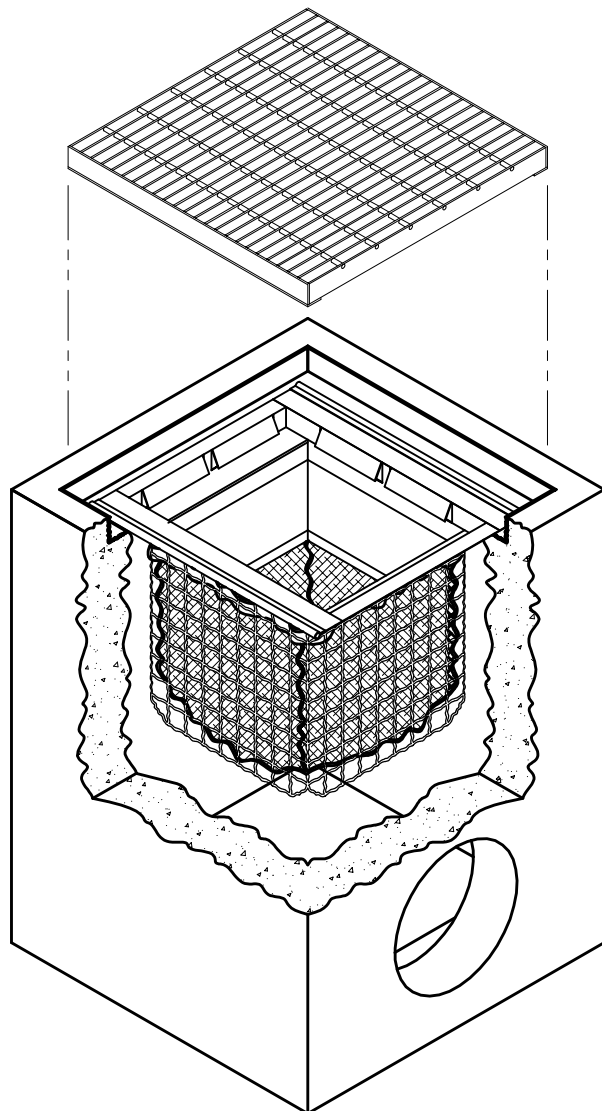
FloGard+PLUS  
Round Gated Inlet

KriStar Enterprises, Inc.  
P.O. Box 6419  
Santa Rosa, CA 95406-1419

PH: 800-579-8819  
FAX: 707-524-8186  
**www.kristar.com**

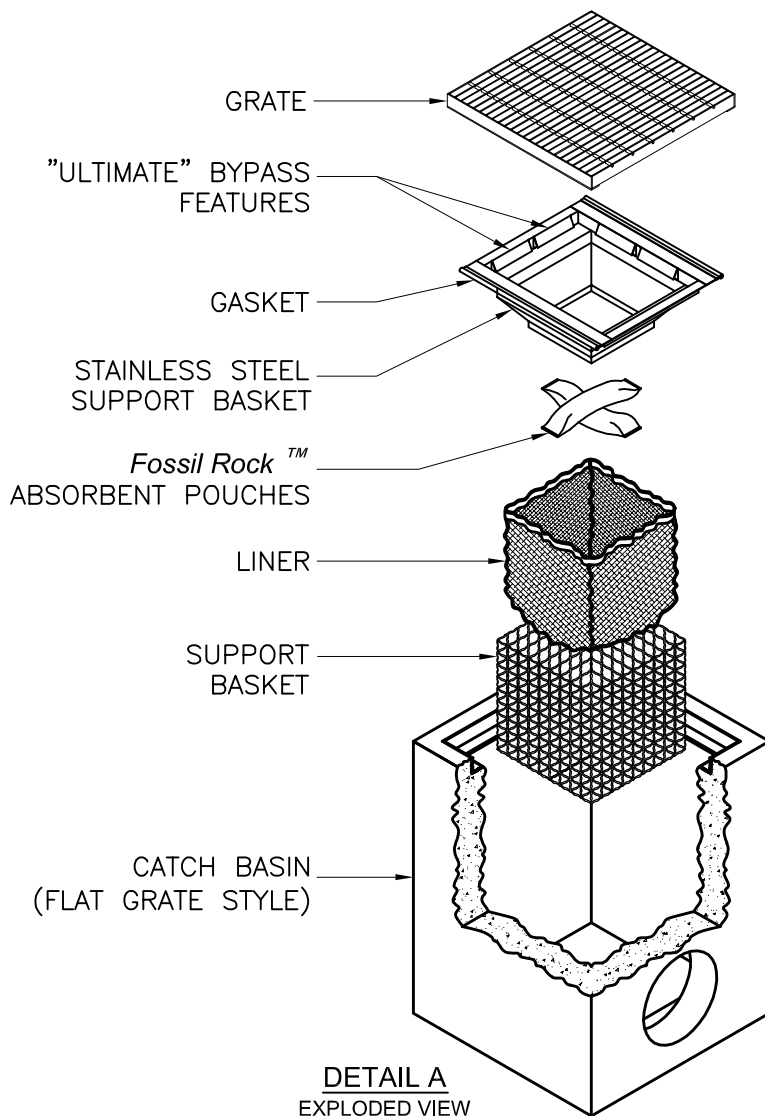
© 2004 KriStar Enterprises, Inc.  
FGP-T 11.19.18.04.2M

FloGard® is a registered trademarks of  
KriStar Enterprises, Inc.



**FLOGARD+PLUS® FILTER**  
-INSTALLED INTO CATCH BASIN-

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



**NOTES:**

1. FloGard®+Plus (frame mount) high capacity catch basin inserts are available in most sizes and styles (see specifier chart, sheet 2 of 2). Refer to the FloGard®+Plus (wall mount) insert for devices to fit non-standard, or combination style catch basins.
2. Filter insert shall have both an "initial" filtering bypass and "ultimate" high flow bypass feature.
3. Filter support frame shall be constructed from stainless steel Type 304.
4. Allow a minimum of 2.0 feet, of clearance between the bottom of the grate and top of outlet pipe(s), or refer to the FloGard® insert for "shallow" installations.
5. Filter medium shall be *Fossil Rock™*, installed and maintained in accordance with manufacturer specifications.
6. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.
7. Filtered flow rate includes a safety factor of two.

TITLE

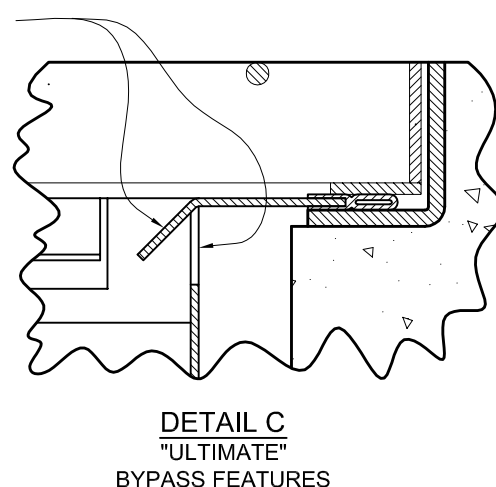
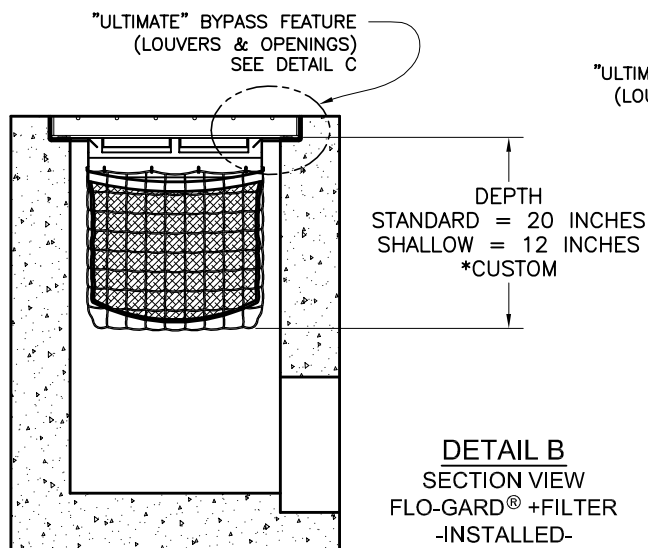
**FloGard® +PLUS**  
CATCH BASIN FILTER INSERT  
(Frame Mount)  
FLAT GRATED INLET



**KriStar Enterprises, Inc.**

P.O. Box 6419, Santa Rosa, CA 95406  
Ph: 800.579.8819, Fax: 707.524.8186, [www.kristar.com](http://www.kristar.com)

DRAWING NO. FGP-0001	REV A	ECO 0001	DATE JPR 09/01/06	SHEET 1 OF 2
-------------------------	----------	-------------	----------------------	--------------



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

SPECIFIER CHART								
MODEL NO.  STANDARD DEPTH	STANDARD & SHALLOW DEPTH (Data in these columns is the same for both STANDARD & SHALLOW versions)			STANDARD DEPTH -20 Inches-		MODEL NO.  SHALLOW DEPTH	SHALLOW DEPTH -12 Inches-	
	INLET ID Inside Dimension (inch x inch)	GRATE OD Outside Dimension (inch x inch)	TOTAL BYPASS CAPACITY (cu. ft.)	SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)		SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)
FGP-12F	12 X 12	12 X 14	2.8	0.3	0.4	FGP-12F8	.15	.25
FGP-1530F	15 X 30	15 X 35	6.9	2.3	1.6	FGP-1530F8	1.3	.9
FGP-16F	16 X 16	16 X 19	4.7	0.8	0.7	FGP-16F8	.45	.4
FGP-1624F	16 X 24	16 X 26	5.0	1.5	1.2	FGP-1624F8	.85	.7
FGP-18F	18 X 18	18 X 20	4.7	0.8	0.7	FGP-18F8	.45	.4
FGP-1820F	16 X 19	18 X 21	5.9	2.1	1.4	FGP-1820F8	1.2	.8
FGP-1824F	16 X 22	18 X 24	5.0	1.5	1.2	FGP-1824F8	.85	.7
FGP-1836F	18 X 36	18 X 40	6.9	2.3	1.6	FGP-1836F8	1.3	.9
FGP-2024F	18 X 22	20 X 24	5.9	1.2	1.0	FGP-2024F8	.7	.55
FGP-21F	22 X 22	22 X 24	6.1	2.2	1.5	FGP-21F8	1.25	.85
FGP-2142F	21 X 40	24 X 40	9.1	4.3	2.4	FGP-2142F8	2.45	1.35
FGP-2148F	19 X 46	22 X 48	9.8	4.7	2.6	FGP-2148F8	2.7	1.5
FGP-24F	24 X 24	24 X 27	6.1	2.2	1.5	FGP-24F8	1.25	.85
FGP-2430F	24 X 30	26 X 30	7.0	2.8	1.8	FGP-2430F8	1.6	1.05
FGP-2436F	24 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8	1.95	1.15
FGP-2448F	24 X 48	26 X 48	9.3	4.4	2.4	FGP-2448F8	2.5	1.35
FGP-28F	28 X 28	32 X 32	6.3	2.2	1.5	FGP-28F8	1.25	.85
FGP-2440F	24 X 36	28 X 40	8.3	4.2	2.3	FGP-2440F8	2.4	1.3
FGP-30F	30 X 30	30 X 34	8.1	3.6	2.0	FGP-30F8	2.05	1.15
FGP-36F	36 X 36	36 X 40	9.1	4.6	2.4	FGP-36F8	2.65	1.35
FGP-3648F	36 X 48	40 X 48	11.5	6.8	3.2	FGP-3648F8	3.9	1.85
FGP-48F	48 X 48	48 X 54	13.2	9.5	3.9	FGP-48F8	5.45	2.25
FGP-SD24F	24 X 24	28 X 28	6.1	2.2	1.5	FGP-SD24F8	1.25	.85
FGP-1836FGO	18 X 36	20 X 40	6.9	2.3	1.6	FGP-1836F8GO	1.3	.9
FGP-2436FGO	20 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8GO	1.95	1.15
FGP-48FGO	18 X 48	20 X 54	6.3	2.2	1.5	FGP-48F8GO	1.25	.85

TITLE

**FloGard® +PLUS**  
CATCH BASIN FILTER INSERT  
(Frame Mount)  
FLAT GRATED INLET



**KriStar Enterprises, Inc.**

P.O. Box 6419, Santa Rosa, CA 95406  
Ph: 800.579.8819, Fax: 707.524.8186, [www.kristar.com](http://www.kristar.com)

DRAWING NO. FGP-0001	REV A	ECO 0001	DATE JPR 09/01/06	SHEET 2 OF 2
-------------------------	----------	-------------	----------------------	--------------

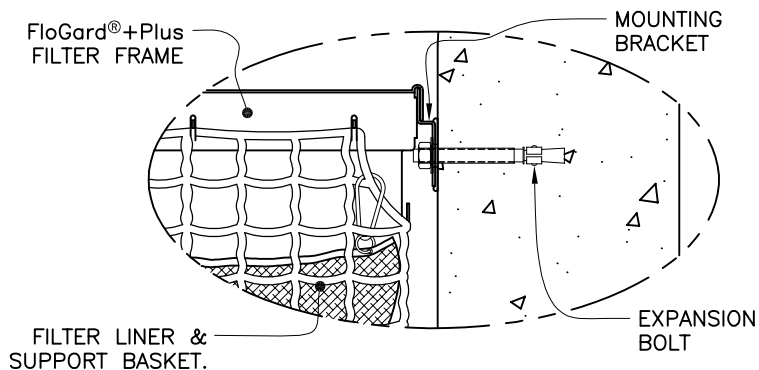


## SPECIFIER CHART

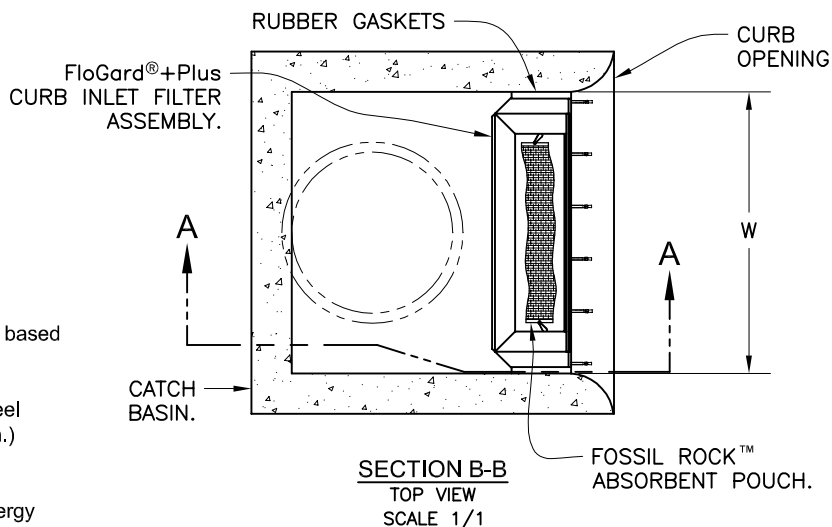
MODEL NO.	Curb Opening Width - W -	Storage Capacity - Cu. Ft. -	Filtered Flow Rate - GPM/CFS -	Bypass Flow Rate - GPM/CFS -
FGP-24CI	2.0' (24")	.95	338 / .75	2,513 / 5.6
FGP-30CI	2.5' (30")	1.20	450 / 1.00	3,008 / 6.7
FGP-36CI	3.0' (36")	1.50	563 / 1.25	3,547 / 7.9
FGP-42CI	3.5' (42")	1.80	675 / 1.50	3,951 / 8.8
FGP-48CI	4.0' (48")	2.10	768 / 1.76	4,445 / 9.9
FGP-5.0CI	5.0' (60")	2.40	900 / 2.00	5,208 / 11.6
FGP-6.0CI	6.0' (72")	3.05	1,126 / 2.51	6,196 / 13.8
FGP-7.0CI	7.0' (84")	3.65	1,350 / 3.01	7,139 / 15.9
FGP-8.0CI	8.0' (96")	4.25	1,576 / 3.51	8,082 / 18.0
FGP-10.0CI	10.0' (120")	4.85	1,800 / 4.01	9,833 / 21.9
FGP-12.0CI	12.0' (144")	6.10	2,252 / 5.02	11,764 / 26.2
FGP-14.0CI	14.0' (168")	7.30	2,700 / 6.02	13,515 / 30.1
FGP-16.0CI	16.0' (192")	8.55	3,152 / 7.02	15,446 / 34.4
FGP-18.0CI	18.0' (216")	9.45	3,490 / 7.78	17,152 / 38.2
FGP-21.0CI	21.0' (252")	10.95	4,050 / 9.02	19,891 / 44.3
FGP-28.0CI	28.0' (336")	14.60	5,400 / 12.03	26,311 / 58.6

## NOTES:

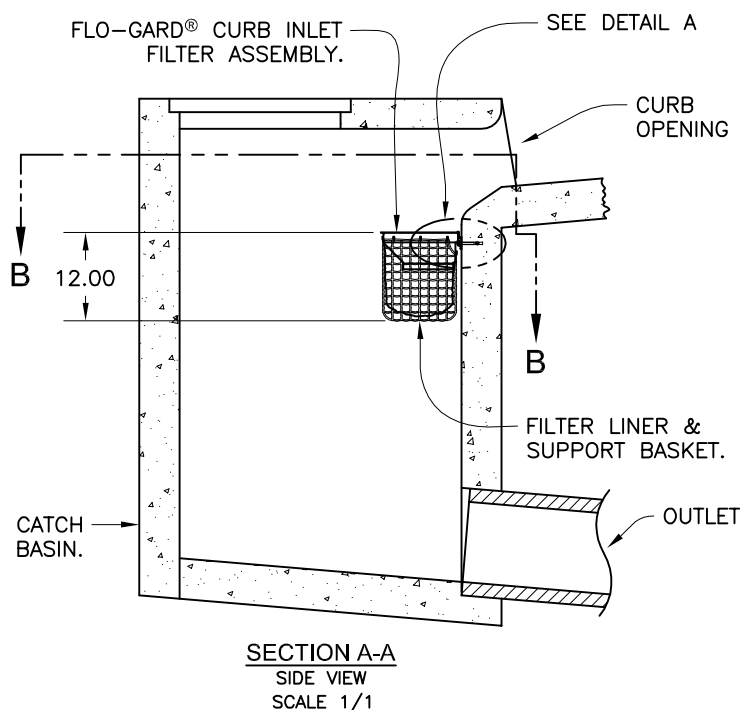
- FloGard®+PLUS filter inserts shall be installed across the entire width of curb opening. Storage capacity and clean flow rates are based on full width installation.
- Filter insert shall be attached to the catch basin with stainless steel expansion anchor bolts & washers (3/8" x 2-1/2" minimum length.) See detail A.
- FloGard®+PLUS filter inserts are designed with a debris trap/energy dissipator for the retention of floatables and collected sediments.
- Filter support frame shall be constructed from stainless steel Type 304.
- Filter liner shall be constructed from durable polypropylene, woven, monofilament, geotextile. Filter liner shall not allow the retention of water between storm events.
- Filter inserts are supplied with "clip-in" filter pouches utilizing FOSSIL ROCK™ filter medium for the collection and retention of petroleum hydrocarbons (oils & greases).
- FloGard®+PLUS filter inserts and FOSSIL ROCK™ filter medium pouches must be maintained in accordance with manufacturer recommendations.
- FloGard +PLUS filter inserts are available in standard lengths of 24", 30", 35", 42" & 48" and may be installed in various length combinations (end to end) to fit length of noted catch basin.
- Clean flow rates are "calculated" based on liner flow rate of 140 gallons per minute per square foot of material, a factor of .50 has been applied to allow for anticipated sediment & debris loading. An additional safety factor of between .25 & .50 may be applied to allow for site specific sediment loading.
- Storage capacity reflects maximum solids collection prior to impending "initial" filtering bypass. The "ultimate" high-flow bypass will not become impeded due to maximum solids loading.



DETAIL A  
MOUNTING BRACKET & EXPANSION BOLTS  
SEE NOTE 2  
SCALE 6/1



SECTION B-B  
TOP VIEW  
SCALE 1/1



SECTION A-A  
SIDE VIEW  
SCALE 1/1

TITLE

**FloGard® +PLUS**  
CATCH BASIN FILTER INSERT  
(Curb Inlet Style)



**KriStar Enterprises, Inc.**

360 Sutton Place, Santa Rosa, CA 95407  
Ph: 800.579.8819, Fax: 707.524.8186, www.kristar.com

DRAWING NO. FGP-0002	REV D	ECO 0059 JPR 12/30/08	DATE JPR 11/3/06	SHEET 1 OF 1
-------------------------	----------	--------------------------	---------------------	--------------



## **GENERAL SPECIFICATIONS FOR MAINTENANCE OF *FLO-GARD+PLUS*® CATCH BASIN INSERT FILTERS**

### **SCOPE:**

Federal, State and Local Clean Water Act regulations and those of insurance carriers require that stormwater filtration systems be maintained and serviced on a recurring basis. The intent of the regulations is to ensure that the systems, on a continuing basis, efficiently remove pollutants from stormwater runoff thereby preventing pollution of the nation's water resources. These specifications apply to the FloGard+Plus® Catch Basin Insert Filter.

### **RECOMMENDED FREQUENCY OF SERVICE:**

Drainage Protection Systems (DPS) recommends that installed Flo-Gard+Plus® Catch Basin Insert Filters be serviced on a recurring basis. Ultimately, the frequency depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, cans, paper, etc.); however, it is recommended that each installation be serviced a minimum of three times per year, with a change of filter medium once per year. DPS technicians are available to do an on-site evaluation, upon request.

### **RECOMMENDED TIMING OF SERVICE:**

DPS guidelines for the timing of service are as follows:

1. For areas with a definite rainy season: Prior to, during and following the rainy season.
2. For areas subject to year-round rainfall: On a recurring basis (at least three times per year).
3. For areas with winter snow and summer rain: Prior to and just after the snow season and during the summer rain season.
4. For installed devices not subject to the elements (washracks, parking garages, etc.): On a recurring basis (no less than three times per years).

### **SERVICE PROCEDURES:**

1. The catch basin grate shall be removed and set to one side. The catch basin shall be visually inspected for defects and possible illegal dumping. If illegal dumping has occurred, the proper authorities and property owner representative shall be notified as soon as practicable.
2. Using an industrial vacuum, the collected materials shall be removed from the liner. (Note: DPS uses a truck-mounted vacuum for servicing Flo-Gard+Plus® catch basin inserts.)
3. When all of the collected materials have been removed, the filter medium pouches shall be removed by unsnapping the tether from the D-ring and set to one side. The filter liner, gaskets, stainless steel frame and mounting brackets, etc. shall be inspected for continued serviceability. Minor damage or defects found shall be corrected on-the-spot and a notation made on the Maintenance Record. More extensive deficiencies that affect the efficiency of the filter (torn liner, etc.), if approved by the customer representative, will be corrected and an invoice submitted to the representative along with the Maintenance Record.
4. The filter medium pouches shall be inspected for defects and continued serviceability and replaced as necessary and the pouch tethers re-attached to the liner's D-ring. See below.
5. The grate shall be replaced.

## **REPLACEMENT AND DISPOSAL OF EXPOSED FILTER MEDIUM AND COLLECTED DEBRIS**

The frequency of filter medium pouch exchange will be in accordance with the existing DPS-Customer Maintenance Contract. DPS recommends that the medium be changed at least once per year. During the appropriate service, or if so determined by the service technician during a non-scheduled service, the filter medium pouches will be replaced with new pouches. Once the exposed pouches and debris have been removed, DPS has possession and must dispose of it in accordance with local, state and federal agency requirements.

**DPS also has the capability of servicing all manner of catch basin inserts and catch basins without inserts, underground oil/water separators, stormwater interceptors and other such devices. All DPS personnel are highly qualified technicians and are confined space trained and certified. Call us at (888) 950-8826 for further information and assistance.**

## **APPENDIX J**

### **BMP Fact Sheet—**

#### **INF-7: Underground Infiltration Fact Sheet (from Orange County TGD for Project WQMPs)**

### INF-7: Underground Infiltration

Underground infiltration is a vault or chamber with an open bottom that used to store runoff and percolate into the subsurface. A number of vendors offer proprietary infiltration products that allow for similar or enhanced rates of infiltration and subsurface storage while offering durable prefabricated structures. There are many varieties of proprietary infiltration BMPs that can be used for roads and parking lots, parks and open spaces, single and multi-family residential, or mixed-use and commercial uses.

#### Feasibility Screening Considerations

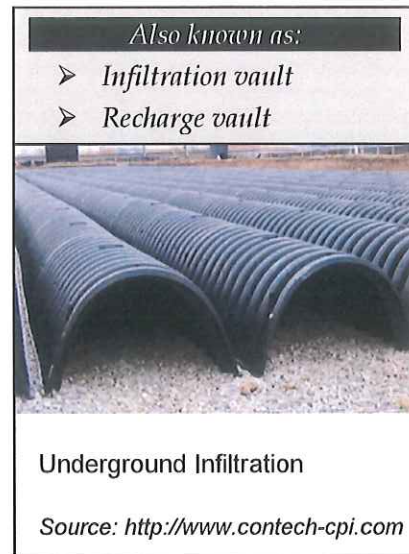
- Infiltration bails shall pass infeasible screening criteria to be considered for use.
- Underground infiltration galleries pose a potential risk of groundwater contamination; pretreatment should be used.

#### Opportunity Criteria

- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Appropriate for sites with limited surface space.
- Can be placed beneath roads, parking lots, parks, and athletic fields.
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is  $\leq 5$  feet from the bottom of the facility to native material and infiltration into fill is approved by a geotechnical professional.
- Tributary area land uses include mixed-use and commercial, single-family and multi-family, roads and parking lots, and parks and open spaces. High pollutant land uses should not be tributary to infiltration BMPs.

#### OC-Specific Design Criteria and Considerations

- ☐ Placement of BMPs should observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations, utilities, roadways, etc.)
- ☐ Minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- ☐ Minimum pretreatment should be provided upstream of the infiltration facility, and water bypassing pretreatment should not be directed to the facility.
- ☐ Underground infiltration should not be used for drainage areas with high sediment production potential unless preceded by full treatment control with a BMP effective for sediment removal.
- ☐ Design infiltration rate should be determined as described in [Appendix VII](#).
- ☐ Inspection ports or similar design features shall be provided to verify continued system performance and identify need for major maintenance.





- ☐ For infiltration facilities beneath roads and parking areas, structural requirements should meet H-20 load requirements.

### ***Computing Underground Infiltration Device Size***

---

Underground infiltration devices vary by design and by proprietary designs. The sizing method selected for use must be based on the BMP type it most strongly resembles.

- For underground infiltration devices with open pore volume (e.g., vaults, crates, pipe sections, etc), sizing will be most similar to infiltration basins.
- For underground infiltration devices with pore space (e.g., aggregate reservoirs), sizing will be most similar to permeable pavement.

### ***Additional References for Design Guidance***

---

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 5:  
[http://www.laschools.org/employee/design/fs-studies-and-reports/download/white\\_paper\\_report\\_material/Storm\\_Water\\_Technical\\_Manual\\_2009-opt-red.pdf?version\\_id=76975850](http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850)

# **APPENDIX K**

## **BMP Educational Materials**

- **Industrial and Commercial Facilities Brochure (San Bernardino County Website)**
- **Commercial Landscape Maintenance Fact Sheet (San Bernardino County Website)**
- **Stormwater Management Practices for Commercial Landscape Maintenance Brochure (San Bernardino County Website)**
- **Commercial Trash Enclosures Brochure (San Bernardino County Website)**
- **Construction & Development Fact Sheet (San Bernardino County Website)**
- **Regulatory Information Fact Sheet (San Bernardino County Website)**
- **SC-11 Spill Prevention, Control & Cleanup**
- **SC-30 Outdoor Loading / Unloading**
- **SC-34 Waste Handling & Disposal**
- **SC-35 Safer Alternative Products**
- **SC-41 Building & Grounds Maintenance**
- **SC-42 Building Repair and Construction**
- **SC-43 Parking / Storage Area Maintenance**
- **SC-44 Drainage System Maintenance**
- **SD-10 Site Design & Landscape Planning**
- **SD-13 Storm Drain Signage**

# **POLLUTION PREVENTION**

## **Important Phone Numbers**

**San Bernardino County Flood Control**  
(909) 387-8112

**County of San Bernardino**  
(909) 387-8109

**City of Big Bear Lake**  
(909) 866-5831

**City of Chino** (909) 591-9850

**City of Chino Hills** (909) 364-2722

**City of Colton** (909) 370-6128

**City of Fontana** (909) 350-6772

**City of Grand Terrace**  
(909) 824-6671 x 226

**City of Highland** (909) 864-8732 x 230

**City of Loma Linda** (909) 799-4405

**City of Montclair** (909) 625-9470

**City of Ontario** (909) 395-2025

**City of Rancho Cucamonga**  
(909) 477-2740 x 4063

**City of Redlands** (909) 798-7655

**City of Rialto** (909) 421-4921

**City of San Bernardino** (909) 384-5154

**City of Upland** (909) 931-4370

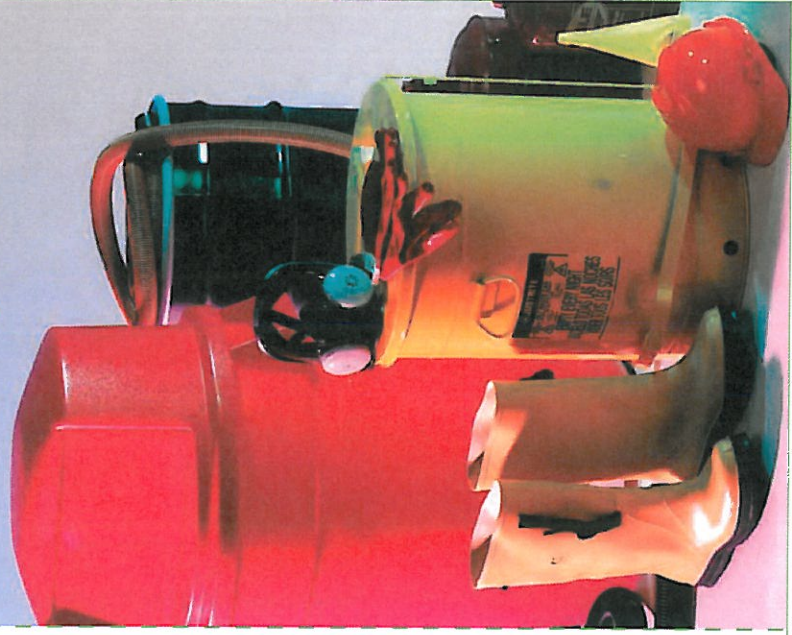
**City of Yucaipa** (909) 797-2489 x 243

**San Bernardino County  
Stormwater Program**  
825 East Third Street • Room 201  
San Bernardino, CA 94215-0835



# **STORM WATER Pollution Prevention**

**INDUSTRIAL AND COMMERCIAL FACILITIES**





# Pollution Prevention

To reduce the amount of pollutants reaching our storm drain system, which leads to the Santa Ana River and Pacific Ocean, the San Bernardino County Stormwater Program has developed Best Management Practices (BMPs) for Industrial and Commercial Facilities. City and County ordinances require that businesses comply with these BMPs, where applicable, to protect local water quality. Local cities and the County are required to verify implementation of these BMPs by performing regular facility inspections.



## Prohibited Discharges

- Discontinue all non-stormwater discharges to the storm drain system. It is prohibited to discharge any chemicals, wastes or wastewater into the gutter, street or storm drain.

## Outdoor Storage

- Install covers and secondary containment areas for all hazardous materials and wastes stored outdoors in accordance with County and/or City standards.
- Keep all temporary waste containers covered, except when in direct use.
- Sweep outdoor areas instead of using a hose or pressure washer.

## Outdoor Processes

- Move all process operations including vehicle and equipment maintenance inside of the building or into a covered and contained area.
- Wash equipment and vehicles in a contained and covered wash bay which is closed-loop or connected to a clarifier sized to city standards, then discharged to a sanitary sewer or take them to a commercial car wash.

## Spills and Clean Ups

- Clean up spills immediately when they occur, using dry clean up methods such as absorbent materials and followed by proper disposal of materials.
- Always have a spill kit available near chemical loading dock doors, vehicle maintenance and fueling areas.
- Follow your Business Emergency Plan, as filed with the County Fire Department at (909) 386-8401.

# Industrial and Commercial Facilities

- Report all prohibited discharges and non-implementation of BMPs to your local Stormwater Coordinator either at (800) CLEANUP or as listed at [www.sbcounty.gov/stormwater](http://www.sbcounty.gov/stormwater).
- Report hazardous materials spills to (800) 33 TOXIC and your local Fire Department Hazmat Team at 911.

## Training

Train employees in spill response procedures and prohibited discharges to the storm drain system, as prescribed in your local Stormwater Ordinance and in applicable Best Management Practices available at [www.cabmphandbooks.com](http://www.cabmphandbooks.com) and [www.sbcounty.gov/stormwater](http://www.sbcounty.gov/stormwater).

## Permitting

Stormwater discharges associated with specific categories of commercial and industrial facilities are regulated by the State Water Resources Control Board (SWRCB) through an Industrial Storm Water General Permit. A copy of the General Permit and application forms are available at: [www.waterboards.ca.gov/stormwtr/industrial.html](http://www.waterboards.ca.gov/stormwtr/industrial.html)

To report illegal dumping or for more information on stormwater pollution prevention, call:

**1 (800) CLEANUP**

or visit our websites at:

[www.sbcounty.gov/stormwater](http://www.sbcounty.gov/stormwater)

[www.1800cleanup.org](http://www.1800cleanup.org)





# Prevención de Contaminación

AL SISTEMA DE DRENAJE

Números de Teléfono Importantes

San Bernardino County Flood Control  
(909) 387-8112

County of San Bernardino  
(909) 387-8109

City of Big Bear Lake  
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

City of Grand Terrace  
(909) 824-6671 x 226

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

City of Rancho Cucamonga  
(909) 477-2740 x 4063

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

City of San Bernardino (909) 384-5154

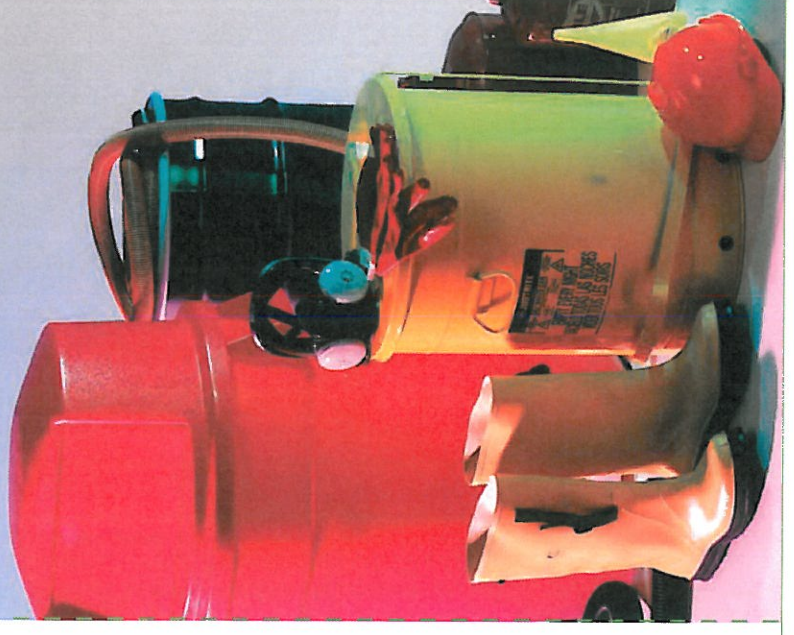
City of Upland (909) 931-4370

City of Yucaipa (909) 797-2489 x 243

# Prevención de Contaminación

AL SISTEMA DE DRENAJE

INSTALACIONES INDUSTRIALES Y COMERCIALES



San Bernardino County  
Stormwater Program  
825 East Third Street • Room 201  
San Bernardino, CA 94215-0835





# Prevención de Contaminación AL SISTEMA DE DRENAJE

Para reducir la cantidad de contaminantes que alcanzan nuestro sistema de aguas pluviales, las cuales desembocan en el Río Santa Ana y el Océano Pacífico, el Programa del Condado de San Bernardino ha desarrollado las pautas de Mejores Prácticas de Manejo (BMPs), por sus siglas en inglés) para instalaciones industriales y comerciales. Los decretos de la ciudad y del condado establecen que todas las empresas deben de cumplir con estas BMPs, cuando corresponda, para proteger la calidad del agua local. Las ciudades locales y el condado tienen la obligación de verificar la implementación de estas BMPs al llevar a cabo inspecciones regulares en sus instalaciones.

## Desagües Prohibidos

- Descontinúe todo desagüe de aguas no pluviales al sistema de drenaje de aguas pluviales. Está prohibido descargar cualquier sustancia química, residuo o agua residual a los drenajes de la cuneta, de la calle o de aguas pluviales.

## Almacenamiento al Aire Libre

- Instale cubiertas y áreas de retención secundarias para todos los materiales peligrosos y residuos almacenados al aire libre, estas instalaciones deberán de cumplir con los estándares establecidos por el condado y/o la ciudad.
- Mantenga todos los recipientes temporales de residuos cubiertos, con la excepción de cuando se estén utilizando directamente.
- Barra todas las áreas al aire libre en lugar de usar una manguera o un equipo de limpieza con agua a alta presión.

## Procesos al Aire Libre

- Reubique todos los procesos u operaciones, incluyendo el mantenimiento de vehículos y equipo, dentro de un edificio en una área cubierta e independiente.
- Lave el equipo y los vehículos en una fosa de lavado independiente que tenga un anillo cerrado o bien, esté conectada a un clarificador del tamaño de los estándares municipales, luego elimine los residuos en un drenaje sanitario o llévelos a un lavador de carros comercial.

## Derrames y Limpieza

- Limpie los derrames inmediatamente, utilice métodos de limpieza en seco como son el uso de materiales absorbentes y elimine estos materiales de la manera adecuada.
- Siempre tenga a la mano un estuche para derrames cerca de las puertas de los muelles de carga de sustancias químicas, en las áreas de mantenimiento de vehículos y en las áreas de combustible.
- Siga su Plan de Emergencia Comercial, como lo registró con el Departamento de Bomberos del



# Instalaciones Industriales y Comerciales

Condado marcando al (909) 386-8401.

- Reporte todos los desagües prohibidos y cualquier punto no implementado de las BMPs a su coordinador local de Aguas Pluviales llamando al (800) CLEANUP o como se indica en el enlace [www.sbcounty.gov/stormwater](http://www.sbcounty.gov/stormwater).
- Reporte cualquier derrame peligroso al (800) 33 TOXIC y al equipo Hazmat de su departamento local de bomberos marcando al 911.

## Capacitación

Capacite a los empleados sobre los procedimientos de respuesta ante un derrame y los desagües prohibidos al sistema de aguas pluviales, como lo indica el decreto local de aguas pluviales de Mejores Prácticas de Manejo (BMPs) disponibles en el sitio [www.cabmphandbooks.com](http://www.cabmphandbooks.com) y [www.sbcounty.gov/stormwater](http://www.sbcounty.gov/stormwater).

## Autoridad Competente

Los desagües de aguas pluviales relacionados con categorías específicas de instalaciones comerciales e industriales están regulados por la Junta Estatal de Control de Recursos Acuáticos (State Water Resources Control Board, SWRCB) a través de un permiso industrial general de aguas pluviales. Para obtener una copia de este permiso general y una solicitud, visite el sitio: [www.waterboards.ca.gov/stormwater/industrial.html](http://www.waterboards.ca.gov/stormwater/industrial.html)

Para reportar el desagüe de residuos ilegales o para obtener información adicional sobre la prevención de contaminación a las aguas pluviales, llame a:

**1 (800) CLEANUP**

o visite nuestro sitio:

[www.sbcounty.gov/stormwater](http://www.sbcounty.gov/stormwater)

[www.1800cleanup.org](http://www.1800cleanup.org)







### ■ Commercial landscape maintenance:

Yard waste, sediments and toxic lawn and garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Recycle Yard Waste:** Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Let your customers know about grass cycling --the natural recycling of grass by leaving clippings on the lawn when mowing instead of using a grass catcher. Grass clippings will quickly decompose, returning valuable nutrients to the soil. You can get more information at [www.ciwmb.ca.gov/Organics](http://www.ciwmb.ca.gov/Organics).
- **Use Fertilizers, Herbicides & Pesticides Safely:** Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural, non-toxic alternatives to traditional garden chemicals. If you must use chemical fertilizers, herbicides, or pesticides spot apply rather than blanketing entire areas, avoid applying near curbs and driveways and never apply before a rain.
- **Recycle Hazardous Waste:** Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility. For information on proper disposal, call (909) 386-8401.
- **Use Water Wisely:** Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads.
- **Planting:** Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.
- **Prevent Erosion:** Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways. Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff. Avoid excavation or grading during wet weather.
- **Store Materials Safely:** Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials should be covered with plastic sheeting to protect from rain, wind and runoff.



For more information about how you can prevent stormwater pollution:

[www.sbcountystormwater.org](http://www.sbcountystormwater.org)

PRESORTED  
STANDARD  
U.S. POSTAGE  
**PAID**  
SACRAMENTO, CA  
PERMIT# 000

**San Bernardino County Stormwater Program**  
825 East Third Street • Room 127  
San Bernardino, CA 94215-0835



# STORMWATER **Pollution Prevention**

## LANDSCAPE MAINTENANCE



# Pollution <sup>STORMWATER</sup> Prevention

## Stormwater Management Practices for Commercial Landscape Maintenance

### Recycle Yard Waste

Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Try grasscycling - the natural recycling of grass by leaving clippings on the lawn when mowing. Grass clippings will quickly decompose, returning valuable nutrients to the soil. Further information can be obtained at [www.ciwmb.ca.gov/Organics](http://www.ciwmb.ca.gov/Organics).

### Use Fertilizers, Herbicides and Pesticides Safely

Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use of natural, non-toxic alternatives to the traditional fertilizers, herbicides and pesticides is highly recommended. If you must use chemical fertilizers, herbicides, or pesticides:

- Spot apply pesticides and herbicides, rather than blanketing entire areas.
- Avoid applying near curbs and driveways, and never apply before a rain.
- Apply fertilizers as needed, when plants can best use it, and when the potential for it being carried away by runoff is low.

### Recycle Hazardous Waste

Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility, which accepts these types of materials. For information on proper disposal call, (909) 386-8401.

### Use Water Wisely

Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads. Plant native vegetation to reduce the need of water, fertilizers, herbicides, and pesticides.

### Prevent Erosion

Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways.

- Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff.
- Avoid excavation or grading during wet weather.

### Store Materials Safely

Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials must be covered with plastic sheeting to protect from rain, wind and runoff.

To report illegal dumping call  
**(877) WASTE18**  
or visit our website:  
**[sbcountystormwater.org](http://sbcountystormwater.org)**





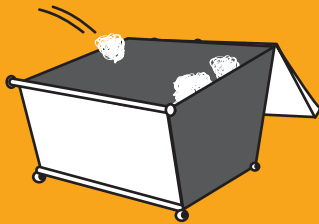
# COMMERCIAL TRASH ENCLOSURES

## FOLLOW THESE REQUIREMENTS TO KEEP OUR WATERWAYS CLEAN

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

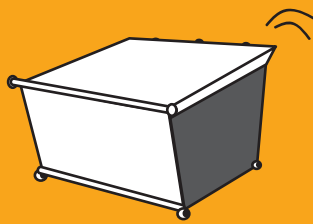
### PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

#### PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

#### CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

#### KEEP TOXICS OUT



- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

### SOME ADDITIONAL GUIDELINES, INCLUDE

#### ✓ SWEEP FREQUENTLY

Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

#### ✓ FIX LEAKS

Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

#### ✓ CONSTRUCT ROOF

Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

**THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!**



To report illegal dumping (877-WASTE18) or to find a household hazardous waste facility (800-OILY CAT): [sbcountystormwater.org](http://sbcountystormwater.org)  
To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program (909) 386-8401

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga • Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

# CONTENEDORES COMERCIALES PARA LA BASURA

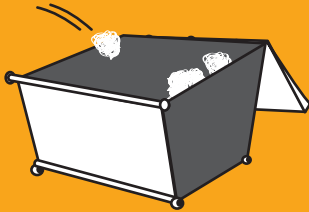
## SIGA ESTOS PASOS PARA MANTENER LIMPIAS NUESTRAS VÍAS FLUVIALES

Los contenedores de basura, tales como aquellos que se encuentran en las unidades comerciales y departamentos, generalmente contienen materiales que están destinados a los rellenos sanitarios o en algún establecimiento de reciclaje.

**Estos materiales NO deben ser vertidos en nuestros lagos y ríos locales.**

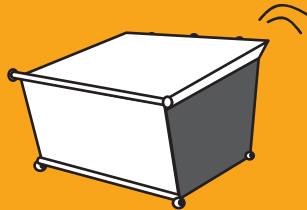
### SIGA ESTOS PASOS PARA PROTEGER LA CALIDAD DEL AGUA

#### COLOQUE LA BASURA ADENTRO



Coloque la basura adentro del contenedor (preferentemente en bolsas selladas)

#### CIERRE LA TAPA



Evite que la lluvia ingrese al contenedor para evitar un escape de escorrentía contaminada

#### MANTENGA LOS PRODUCTOS TÓXICOS AFUERA



- Pintura
- Lubricante, grasas y aceites usados
- Baterías, componentes electrónicos y luces fluorescentes

### ALGUNAS GUÍAS ADICIONALES, LAS CUALES INCLUYEN

#### ✓ BARRER CON FRECUENCIA

Barra con frecuencia las áreas de los recintos para la basura, en lugar de lavarlas con una manguera, para evitar que el agua contaminada se vierta en las calles y los desagües de lluvia.

#### ✓ REPARE LAS GOTERAS

Ocúpese inmediatamente de las goteras en los contenedores de basura. Use los métodos de limpieza en seco e infórmele a su recolector de basura para que reciba un reemplazo.

#### ✓ CONSTRUYA UN TECHO

Construya un techo de cubierta sólida sobre la estructura actual del recinto para la basura a fin de evitar que el agua de lluvia entre en contacto con los desechos y la basura. Consulte con su Ciudad/Condado para conocer los Códigos de Construcción.

En el Condado de San Bernardino, los desechos de alimentos y jardines, los productos químicos y otros restos que se vierten en los desagües de aguas pluviales y que terminan en nuestras vías fluviales sin tratamiento alguno provocan la contaminación de estas aguas. Usted puede ser parte de la solución si mantiene un recinto para la basura que no contamine el agua.

**¡MUCHAS GRACIAS POR AYUDAR A MANTENER EL CONDADO DE SB LIMPIO Y SIN CONTAMINACIÓN!**



Para informar acerca del vertedero ilegal, llame a **(877-WASTE18)**, o para encontrar un establecimiento donde arrojar los residuos peligrosos del hogar, llame a **(800-OILY CAT): sbcountystormwater.org**  
Para deshacerse de los residuos peligrosos llame al Condado de San Bernardino Departamento de Bomberos - programa CUPA **(909) 386-8401**

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga • Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

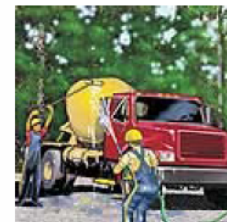


## SAN BERNARDINO COUNTY STORMWATER POLLUTION PREVENTION

### ■ Construction & development:

Soil, cement wash, asphalt, oil and other hazardous debris from construction sites often make their way into the San Bernardino County storm drain system, and flow untreated into local waterways. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Store Materials Safely:** Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.
- **Preventing Erosion:** Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydro mulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Use gravel approaches where truck traffic is frequent to reduce soil compaction and limit the tracking of sediment into the streets. For more information on erosion control, call (909) 799-7407.
- **Cleaning & Preventing Spills:** Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.
- **Maintaining Vehicles & Equipment:** Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, and brake and radiator fluids.
- **Ordering Materials & Recycling Waste:** Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Dispose of hazardous materials through a hazardous waste hauler or other means in accordance with the construction permit. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.
- **Concrete and mortar application:** Never dispose of cement washout into driveways, streets, gutters or drainage ditches. Wash concrete mixers and equipment only in specified washout areas, where the water flows into lined containment ponds. Cement wash water can be recycled by pumping it back into cement mixers for reuse.



For more information about how you can prevent stormwater pollution:

[www.sbcountystormwater.org](http://www.sbcountystormwater.org)



## SAN BERNARDINO COUNTY STORMWATER POLLUTION PREVENTION

### ■ Regulatory information

The Federal Water Pollution Control Act prohibits the discharge of any pollutant to navigable waters from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 passage of the Water Quality Act established NPDES permit requirements for discharges of storm water. The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

Industrial facilities and construction sites are regulated by the Regional Water Quality Control Board and State Water Resources Control Board, through general storm water permits. Most industrial, manufacturing or transportation businesses that store materials, products or equipment outdoors, or conduct vehicle washing or process operations outdoors are required to obtain coverage under the State Water Resources Control Board's General Industrial Activities Stormwater Permit. For more information about this permit, visit [www.swrcb.ca.gov/stormwtr/industrial.html](http://www.swrcb.ca.gov/stormwtr/industrial.html) or contact your local storm water coordinator.

If your business conducts construction activities, including clearing, grading, stockpiling or excavation that results in soil disturbances of at least one acre, you are subject to the State Water Resources Control Board's General Construction Activities Stormwater Permit. To find out more about this storm water permit for construction, visit: [www.swrcb.ca.gov/stormwtr/construction.html](http://www.swrcb.ca.gov/stormwtr/construction.html).

Cities and counties are regulated through permits issued by the Regional Boards. Since 1990, operators of large storm drain systems such as San Bernardino County's have been required to:

- Develop a storm water management program designed to prevent harmful pollutants from being dumped or washed by storm water runoff, into the storm water system, then discharged into local water bodies; and
- Obtain a National Pollutant Discharge Elimination System (NPDES) permit.

The NPDES permit programs in California are administered by the State Water Resources Control Board and by nine regional boards that issue NPDES permits and enforce regulations within their respective region.

San Bernardino County lies within the jurisdiction of the Santa Ana Region. This regional board issues a permit to the San Bernardino County Permittees, which includes the County of San Bernardino, San Bernardino County Flood Control District and incorporated cities of San Bernardino County. Since the program's inception, the County of San Bernardino has served as the principal permittee.





## **Documents & reports:**

The following documents describe the regulations and programs for water quality in San Bernardino County. You can review the latest Basin Plan, National Pollutant Discharge Elimination System (NPDES) Permit and Drainage Area Management Plan (DAMP).

- **Basin Plans:** The document for each region of the State Water Quality Board's jurisdiction, including Santa Ana, is the Water Quality Control Plan, commonly referred to as the Basin Plan. It is the foundation for the regulatory programs of each regional board. The Basin Plan documents the beneficial uses of the region's ground and surface waters, existing water quality conditions, problems, and goals, and actions by the regional board and others that are necessary to achieve and maintain water quality standards.

### ► [Water Control Plan for the Santa Ana River Basin](#)

- **Municipal National Pollutant Discharge Elimination System (NPDES) Permits:** The permits of each region outline additional steps for a storm water management program and specify requirements to help protect the beneficial uses of the receiving waters. They require permittees to develop and implement Best Management Practices (BMPs) to control/reduce the discharge of pollutants to waters of the United States to the maximum extent practicable (MEP).

### ► [Santa Ana Regional Water Quality Control Board Municipal NPDES Permit Order No. R8-2002-0012](#)

- **Report of Waste Discharge:** The Report of Waste Discharge (ROWD) describes the San Bernardino Stormwater Program, implemented by the County and cities to comply with their jointly held stormwater permit. It is the principle policy and guidance document for the NPDES Stormwater Program.

### ► [Report of Waste Discharge 2000](#)

- **San Bernardino County Storm Water Program Annual Status Report:** The Annual Status Report is a requirement of the NPDES permit for submittal to the Regional Boards and United States Environmental Protection Agency. The report presents an analysis and assessment of permit compliance activities.

### ► [Annual report](#) - will be posted soon

For more information about how you can prevent stormwater pollution:

**[www.sbcountystormwater.org](http://www.sbcountystormwater.org)**

# 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.

## 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:

## Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	<input checked="" type="checkbox"/>
Bacteria	
Oil and Grease	<input checked="" type="checkbox"/>
Organics	<input checked="" type="checkbox"/>





# SC-11 Spill Prevention, Control & Cleanup

---

- 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.*

# Spill Prevention, Control & Cleanup SC-11

---

- 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)

# SC-11 Spill Prevention, Control & Cleanup

---

- 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.

# Spill Prevention, Control & Cleanup SC-11

---

## 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

# SC-11 Spill Prevention, Control & Cleanup

---

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.

# Spill Prevention, Control & Cleanup SC-11

---

- 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.



# SC-11 Spill Prevention, Control & Cleanup

---

- 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

# Spill Prevention, Control & Cleanup SC-11

---

- 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/>



## Objectives

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

## Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

## 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

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

## Targeted Constituents

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



***Suggested Protocols******Loading and Unloading – General Guidelines***

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

***Inspection***

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

***Training***

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

## ***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

## ***Other Considerations (Limitations and Regulations)***

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

## **Requirements**

### ***Costs***

Costs should be low except when covering a large loading/unloading area.

### ***Maintenance***

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

## **Supplemental Information**

### ***Further Detail of the BMP***

#### ***Special Circumstances for Indoor Loading/Unloading of Materials***

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.
- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

**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/>





## Objectives

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

## Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

## Approach

### Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

## Targeted Constituents

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



***Suggested Protocols******General***

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

***Controlling Litter***

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

***Waste Collection***

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

## *Good Housekeeping*

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

## *Chemical/Hazardous Wastes*

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

## *Run-on/Runoff Prevention*

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene or hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

## *Inspection*

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

***Training***

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

***Spill Response and Prevention***

- Keep your 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.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

***Other Considerations (Limitations and Regulations)***

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

**Requirements*****Costs***

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

***Maintenance***

- None except for maintaining equipment for material tracking program.

**Supplemental Information*****Further Detail of the BMP******Land Treatment System***

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

### ***Examples***

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

### **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>

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

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>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>

## Description

Promote the use of less harmful products and products that contain little or no TMDL pollutants. Alternatives exist for most product classes including chemical fertilizers, pesticides, cleaning solutions, janitorial chemicals, automotive and paint products, and consumables (batteries, fluorescent lamps).

## Approach

Pattern a new program after the many established programs around the state and country. Integrate this best management practice as much as possible with existing programs at your facility.

Develop a comprehensive program based on:

- The "Precautionary Principle," which is an alternative to the "Risk Assessment" model that says it's acceptable to use a potentially harmful product until physical evidence of its harmful effects are established and deemed too costly from an environmental or public health perspective. For instance, a risk assessment approach might say it's acceptable to use a pesticide until there is direct proof of an environmental impact. The Precautionary Principle approach is used to evaluate whether a given product is safe, whether it is really necessary, and whether alternative products would perform just as well.
- Environmentally Preferable Purchasing Program to minimize the purchase of products containing hazardous ingredients used in the facility's custodial services, fleet maintenance, and facility maintenance in favor of using alternate products that pose less risk to employees and to the environment.
- Integrated Pest Management (IPM) or Less-Toxic Pesticide Program, which uses a pest management approach that minimizes the use of toxic chemicals and gets rid of pests by methods that pose a lower risk to employees, the public, and the environment.
- Energy Efficiency Program including no-cost and low-cost energy conservation and efficiency actions that can reduce both energy consumption and electricity bills, along with long-term energy efficiency investments.

Consider the following mechanisms for developing and implementing a comprehensive program:

- Policies

## Objectives

- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

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





- Procedures
  - Standard operating procedures (SOPs)
  - Purchasing guidelines and procedures
  - Bid packages (services and supplies)
- Materials
  - Preferred or approved product and supplier lists
  - Product and supplier evaluation criteria
  - Training sessions and manuals
  - Fact sheets for employees

Implement this BMP in conjunction with the Vehicle and Equipment Management fact sheets (SC20 – SC22) and SC41, Building and Grounds Maintenance.

***Training***

- Employees who handle potentially harmful materials in the use of safer alternatives.
- Purchasing departments should be encouraged to procure less hazardous materials and products that contain little or no harmful substances or TMDL pollutants.

***Regulations***

This BMP has no regulatory requirements. Existing regulations already encourage facilities to reduce the use of hazardous materials through incentives such as reduced:

- Specialized equipment storage and handling requirements,
- Storm water runoff sampling requirements,
- Training and licensing requirements, and
- Record keeping and reporting requirements.

***Equipment***

- There are no major equipment requirements to this BMP.

***Limitations***

- Alternative products may not be available, suitable, or effective in every case.

***Requirements******Cost Considerations***

- The primary cost is for staff time to: 1) develop new policies and procedures and 2) educate purchasing departments and employees who handle potentially harmful materials about the availability, procurement, and use of safer alternatives.

- Some alternative products may be slightly more expensive than conventional products.

## Supplemental Information

Employees and contractors / service providers can both be educated about safer alternatives by using information developed by a number of organizations including the references and resources listed below.

The following discussion provides some general information on safer alternatives. More specific information on particular hazardous materials and the available alternatives may be found in the references and resources listed below.

- Automotive products – Less toxic alternatives are not available for many automotive products, especially engine fluids. But there are alternatives to grease lubricants, car polishes, degreasers, and windshield washer solution. Rerefined motor oil is also available.
- Vehicle/Trailer lubrication – Fifth wheel bearings on trucks require routine lubrication. Adhesive lubricants are available to replace typical chassis grease.
- Cleaners – Vegetables-based or citrus-based soaps are available to replace petroleum-based soaps/detergents.
- Paint products – Water-based paints, wood preservatives, stains, and finishes are available.
- Pesticides – Specific alternative products or methods exist to control most insects, fungi, and weeds.
- Chemical Fertilizers – Compost and soil amendments are natural alternatives.
- Consumables – Manufacturers have either reduced or are in the process of reducing the amount of heavy metals in consumables such as batteries and fluorescent lamps. All fluorescent lamps contain mercury, however low-mercury containing lamps are now available from most hardware and lighting stores. Fluorescent lamps are also more energy efficient than the average incandescent lamp.
- Janitorial chemicals – Even biodegradable soap can harm fish and wildlife before it biodegrades. Biodegradable does not mean non-toxic. Safer products and procedures are available for floor stripping and cleaning, as well as carpet, glass, metal, and restroom cleaning and disinfecting.

## Examples

There are a number of business and trade associations, and communities with effective programs. Some of the more prominent are listed below in the references and resources section.

## References and Resources

Note: Many of these references provide alternative products for materials that typically are used inside and disposed to the sanitary sewer as well as alternatives to products that usually end up in the storm drain.

***General Sustainable Practices and Pollution Prevention Including Pollutant-Specific Information***

California Department of Toxic Substances Control ([www.dtsc.ca.gov](http://www.dtsc.ca.gov))

California Integrated Waste Management Board ([www.ciwmb.ca.gov](http://www.ciwmb.ca.gov))

City of Santa Monica ([www.santa-monica.org/environment](http://www.santa-monica.org/environment))

City of Palo Alto ([www.city.palo-alto.ca.us/cleanbay](http://www.city.palo-alto.ca.us/cleanbay))

City and County of San Francisco, Department of the Environment  
([www.ci.sf.ca.us/sfenvironment](http://www.ci.sf.ca.us/sfenvironment))

Earth 911 ([www.earth911.org/master.asp](http://www.earth911.org/master.asp))

Environmental Finance Center Region IX ([www.greenstart.org/efc9](http://www.greenstart.org/efc9))

Flex Your Power ([www.flexyourpower.ca.gov](http://www.flexyourpower.ca.gov))

GreenBiz.com ([www.greenbiz.com](http://www.greenbiz.com))

Green Business Program ([www.abag.org/bayarea/enviro/gbus/gb.html](http://www.abag.org/bayarea/enviro/gbus/gb.html))

Pacific Industrial and Business Association ([www.piba.org](http://www.piba.org))

Sacramento Clean Water Business Partners ([www.sacstormwater.org](http://www.sacstormwater.org))

USEPA BMP fact sheet – Alternative products  
([http://cfpub.epa.gov/npdes/stormwater/menuofbmps/poll\\_2.cfm](http://cfpub.epa.gov/npdes/stormwater/menuofbmps/poll_2.cfm))

USEPA Region IX Pollution Prevention Program ([www.epa.gov/region09/p2](http://www.epa.gov/region09/p2))

Western Regional Pollution Prevention Network ([www.westp2net.org](http://www.westp2net.org))

***Metals (mercury, copper)***

National Electrical Manufacturers Association - Environment, Health and Safety  
([www.nema.org](http://www.nema.org))

Sustainable Conservation ([www.suscon.org](http://www.suscon.org))

Auto Recycling Project

Brake Pad Partnership

***Pesticides and Chemical Fertilizers***

Bio-Integral Resource Center ([www.birc.org](http://www.birc.org))

California Department of Pesticide Regulation ([www.cdpr.ca.gov](http://www.cdpr.ca.gov))

University of California Statewide IPM Program ([www.ipm.ucdavis.edu/default.html](http://www.ipm.ucdavis.edu/default.html))

## *Dioxins*

Bay Area Dioxins Project (<http://dioxin.abag.ca.gov/>)

# Building & Grounds Maintenance SC-41



## Objectives

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

## Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

## 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

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

## Targeted Constituents

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



# **SC-41      Building & Grounds Maintenance**

---

- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

## ***Suggested Protocols***

### *Pressure Washing of Buildings, Rooftops, and Other Large Objects*

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

### *Landscaping Activities*

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

### *Building Repair, Remodeling, and Construction*

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.



# Building & Grounds Maintenance SC-41

---

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

## *Mowing, Trimming, and Planting*

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

## *Fertilizer and Pesticide Management*

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

## **SC-41      Building & Grounds Maintenance**

---

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

### ***Inspection***

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

### ***Training***

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

### ***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

### ***Other Considerations***

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

## **Requirements**

### ***Costs***

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

### ***Maintenance***

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

## Supplemental Information

### *Further Detail of the BMP*

#### *Fire Sprinkler Line Flushing*

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line 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>

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>

# Building Repair and Construction SC-42



## Description

Modifications are common particularly at large industrial sites. The activity may vary from minor and normal building repair to major remodeling, or the construction of new facilities. These activities can generate pollutants including solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos installation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

## Approach

### Pollution Prevention

- Recycle residual paints, solvents, lumber, and other materials to the maximum extent practical.
- Buy recycled products to the maximum extent practical.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contract to ensure certain proper housekeeping and disposal practices are implemented.

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Recycle

## Targeted Constituents

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



# SC-42 Building Repair and Construction

---

- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

## ***Suggested Protocols***

### *Repair & Remodeling*

- Follow BMPs identified in Construction BMP Handbook.
- Maintain good housekeeping practices while work is underway.
- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Cover materials of particular concern that must be left outside, particularly during the rainy season.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store materials properly that are normally used in repair and remodeling such as paints and solvents.
- Sweep out the gutter or wash the gutter and trap the particles at the outlet of the downspout if when repairing roofs, small particles have accumulated in the gutter. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vacuor truck, and clean the catch basin sump where you placed the plug.
- Properly store and dispose waste materials generated from construction activities. See Construction BMP Handbook.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed.

### *Painting*

- Enclose painting operations consistent with local air quality regulations and OSHA.
- Local air pollution regulations may, in many areas of the state, specify painting procedures which if properly carried out are usually sufficient to protect water quality.
- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.
- Mix paint indoors before using so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100% effective.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.

# **Building Repair and Construction SC-42**

---

- Do not transfer or load paint near storm drain inlets.
- Plug nearby storm drain inlets prior to starting painting and remove plugs when job is complete when there is significant risk of a spill reaching storm drains.
- Cover nearby storm drain inlets prior to starting work if sand blasting is used to remove paint.
- Use a ground cloth to collect the chips if painting requires scraping or sand blasting of the existing surface. Dispose the residue properly.
- Cover or enclose painting operations properly to avoid drift.
- Clean the application equipment in a sink that is connected to the sanitary sewer if using water based paints.
- Capture all cleanup-water and dispose of properly.
- Dispose of paints containing lead or tributyl tin and considered a hazardous waste properly.
- Store leftover paints if they are to be kept for the next job properly, or dispose properly.
- Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.

## ***Training***

Proper education of off-site contractors is often overlooked. The conscientious efforts of well trained employees can be lost by unknowing off-site contractors, so make sure they are well informed about what they are expected to do.

## ***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.
- Clean up spills immediately.
- Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.

## ***Limitations***

- This BMP is for minor construction only. The State's General Construction Activity Stormwater Permit has more requirements for larger projects. The companion "Construction Best Management Practice Handbook" contains specific guidance and best management practices for larger-scale projects.
- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Be certain that actions to help stormwater quality are consistent with Cal- and Fed-OSHA and air quality regulations.



# **SC-42     Building Repair and Construction**

---

## **Requirements**

### ***Costs***

These BMPs are generally low to modest in cost.

### ***Maintenance***

N/A

## **Supplemental Information**

### ***Further Detail of the BMP***

#### ***Soil/Erosion Control***

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the Construction Best Management Practice Handbook. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated or Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If because of the remodeling a new drainage system is to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective “in-line” treatment devices. See Treatment Control Fact Sheet TC-20 Wet Pond/Basin in Section 5 of the New Development and Redevelopment Handbook regarding design criteria. Include in the catch basin a “turn-down” elbow or similar device to trap floatables.

## **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



## 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.

## Objectives

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

## Targeted Constituents

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



# **SC-43 Parking/Storage Area Maintenance**

---

## ***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.

# **Parking/Storage Area Maintenance SC-43**

- 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/>





## 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.

## 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).

## Targeted Constituents

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





- 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 Stream 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 vacuor 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](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.





# **SD-10 Site Design & Landscape Planning**

---

## ***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

# Site Design & Landscape Planning SD-10

---

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.

# **SD-10 Site Design & Landscape Planning**

---

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.





## 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



– 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.

## **APPENDIX L**

### **NOAA Point Precipitation Frequency Estimate for 2 Year, 1 Hour Storm**





**NOAA Atlas 14, Volume 6, Version 2**  
**Location name: Rialto, California, USA\***  
**Latitude: 34.1518°, Longitude: -117.4097°**  
**Elevation: 1619.97 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



### POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF\\_tabular](#) | [PF\\_graphical](#) | [Maps\\_&\\_aerials](#)

### PF tabular

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
<b>Duration</b>	<b>Average recurrence interval (years)</b>									
	<b>1</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>1000</b>
<b>5-min</b>	<b>0.138</b> (0.115-0.168)	<b>0.183</b> (0.152-0.223)	<b>0.242</b> (0.200-0.295)	<b>0.289</b> (0.238-0.355)	<b>0.353</b> (0.281-0.450)	<b>0.403</b> (0.313-0.523)	<b>0.453</b> (0.343-0.603)	<b>0.504</b> (0.371-0.692)	<b>0.574</b> (0.405-0.822)	<b>0.629</b> (0.428-0.933)
<b>10-min</b>	<b>0.198</b> (0.165-0.240)	<b>0.262</b> (0.218-0.319)	<b>0.346</b> (0.287-0.422)	<b>0.414</b> (0.341-0.510)	<b>0.506</b> (0.402-0.644)	<b>0.577</b> (0.448-0.750)	<b>0.649</b> (0.492-0.865)	<b>0.723</b> (0.532-0.992)	<b>0.823</b> (0.581-1.18)	<b>0.901</b> (0.614-1.34)
<b>15-min</b>	<b>0.239</b> (0.199-0.290)	<b>0.317</b> (0.264-0.386)	<b>0.419</b> (0.347-0.511)	<b>0.501</b> (0.412-0.616)	<b>0.612</b> (0.486-0.779)	<b>0.698</b> (0.542-0.907)	<b>0.785</b> (0.595-1.05)	<b>0.874</b> (0.644-1.20)	<b>0.996</b> (0.702-1.43)	<b>1.09</b> (0.742-1.62)
<b>30-min</b>	<b>0.361</b> (0.300-0.438)	<b>0.479</b> (0.398-0.582)	<b>0.632</b> (0.524-0.771)	<b>0.757</b> (0.622-0.930)	<b>0.925</b> (0.734-1.18)	<b>1.05</b> (0.819-1.37)	<b>1.19</b> (0.898-1.58)	<b>1.32</b> (0.972-1.81)	<b>1.50</b> (1.06-2.15)	<b>1.65</b> (1.12-2.44)
<b>60-min</b>	<b>0.550</b> (0.458-0.668)	<b>0.730</b> (0.606-0.887)	<b>0.963</b> (0.798-1.17)	<b>1.15</b> (0.947-1.42)	<b>1.41</b> (1.12-1.79)	<b>1.61</b> (1.25-2.09)	<b>1.80</b> (1.37-2.40)	<b>2.01</b> (1.48-2.76)	<b>2.29</b> (1.62-3.28)	<b>2.51</b> (1.71-3.72)
<b>2-hr</b>	<b>0.832</b> (0.692-1.01)	<b>1.09</b> (0.905-1.32)	<b>1.42</b> (1.18-1.73)	<b>1.69</b> (1.39-2.08)	<b>2.05</b> (1.63-2.61)	<b>2.32</b> (1.81-3.02)	<b>2.60</b> (1.97-3.47)	<b>2.88</b> (2.12-3.96)	<b>3.27</b> (2.30-4.68)	<b>3.56</b> (2.42-5.28)
<b>3-hr</b>	<b>1.06</b> (0.885-1.29)	<b>1.39</b> (1.15-1.68)	<b>1.80</b> (1.49-2.19)	<b>2.13</b> (1.75-2.62)	<b>2.58</b> (2.05-3.28)	<b>2.92</b> (2.27-3.79)	<b>3.26</b> (2.47-4.34)	<b>3.61</b> (2.65-4.95)	<b>4.07</b> (2.87-5.83)	<b>4.43</b> (3.02-6.57)
<b>6-hr</b>	<b>1.58</b> (1.31-1.91)	<b>2.05</b> (1.70-2.49)	<b>2.65</b> (2.19-3.23)	<b>3.13</b> (2.57-3.85)	<b>3.77</b> (2.99-4.79)	<b>4.25</b> (3.30-5.52)	<b>4.73</b> (3.58-6.31)	<b>5.22</b> (3.84-7.16)	<b>5.87</b> (4.14-8.40)	<b>6.36</b> (4.33-9.44)
<b>12-hr</b>	<b>2.16</b> (1.79-2.62)	<b>2.81</b> (2.34-3.42)	<b>3.64</b> (3.02-4.44)	<b>4.30</b> (3.54-5.29)	<b>5.17</b> (4.11-6.58)	<b>5.82</b> (4.52-7.57)	<b>6.46</b> (4.90-8.62)	<b>7.11</b> (5.24-9.76)	<b>7.96</b> (5.62-11.4)	<b>8.61</b> (5.86-12.8)
<b>24-hr</b>	<b>2.94</b> (2.60-3.38)	<b>3.87</b> (3.42-4.47)	<b>5.05</b> (4.46-5.85)	<b>5.99</b> (5.24-6.98)	<b>7.21</b> (6.11-8.69)	<b>8.13</b> (6.74-9.99)	<b>9.02</b> (7.31-11.4)	<b>9.93</b> (7.82-12.9)	<b>11.1</b> (8.40-15.0)	<b>12.0</b> (8.77-16.7)
<b>2-day</b>	<b>3.60</b> (3.19-4.15)	<b>4.85</b> (4.29-5.59)	<b>6.45</b> (5.69-7.46)	<b>7.74</b> (6.77-9.02)	<b>9.47</b> (8.02-11.4)	<b>10.8</b> (8.94-13.3)	<b>12.1</b> (9.80-15.2)	<b>13.4</b> (10.6-17.4)	<b>15.3</b> (11.5-20.6)	<b>16.6</b> (12.2-23.2)
<b>3-day</b>	<b>3.86</b> (3.42-4.45)	<b>5.28</b> (4.67-6.09)	<b>7.16</b> (6.32-8.28)	<b>8.71</b> (7.62-10.2)	<b>10.8</b> (9.18-13.1)	<b>12.5</b> (10.4-15.4)	<b>14.2</b> (11.5-17.9)	<b>16.0</b> (12.6-20.7)	<b>18.4</b> (13.9-24.8)	<b>20.4</b> (14.9-28.4)
<b>4-day</b>	<b>4.12</b> (3.65-4.75)	<b>5.70</b> (5.04-6.58)	<b>7.82</b> (6.89-9.04)	<b>9.58</b> (8.38-11.2)	<b>12.0</b> (10.2-14.5)	<b>14.0</b> (11.6-17.2)	<b>16.0</b> (12.9-20.1)	<b>18.1</b> (14.3-23.4)	<b>21.1</b> (15.9-28.4)	<b>23.4</b> (17.1-32.7)
<b>7-day</b>	<b>4.72</b> (4.18-5.43)	<b>6.60</b> (5.83-7.61)	<b>9.13</b> (8.05-10.6)	<b>11.2</b> (9.84-13.1)	<b>14.2</b> (12.0-17.1)	<b>16.6</b> (13.7-20.4)	<b>19.0</b> (15.4-23.9)	<b>21.6</b> (17.0-28.0)	<b>25.2</b> (19.1-34.0)	<b>28.2</b> (20.6-39.3)
<b>10-day</b>	<b>5.09</b> (4.51-5.86)	<b>7.16</b> (6.34-8.27)	<b>9.97</b> (8.80-11.5)	<b>12.3</b> (10.8-14.4)	<b>15.6</b> (13.2-18.8)	<b>18.3</b> (15.2-22.5)	<b>21.0</b> (17.0-26.5)	<b>24.0</b> (18.9-31.0)	<b>28.1</b> (21.2-37.9)	<b>31.4</b> (22.9-43.8)
<b>20-day</b>	<b>6.09</b> (5.39-7.01)	<b>8.65</b> (7.65-9.98)	<b>12.2</b> (10.7-14.1)	<b>15.2</b> (13.3-17.7)	<b>19.4</b> (16.4-23.4)	<b>22.8</b> (18.9-28.0)	<b>26.4</b> (21.4-33.3)	<b>30.3</b> (23.8-39.2)	<b>35.7</b> (27.0-48.2)	<b>40.2</b> (29.4-56.1)
<b>30-day</b>	<b>7.10</b> (6.29-8.19)	<b>10.1</b> (8.94-11.7)	<b>14.3</b> (12.6-16.5)	<b>17.8</b> (15.6-20.8)	<b>22.9</b> (19.4-27.6)	<b>27.0</b> (22.4-33.3)	<b>31.4</b> (25.5-39.6)	<b>36.2</b> (28.5-46.8)	<b>42.9</b> (32.5-57.9)	<b>48.5</b> (35.4-67.6)
<b>45-day</b>	<b>8.49</b> (7.52-9.79)	<b>12.0</b> (10.6-13.9)	<b>16.9</b> (14.9-19.6)	<b>21.2</b> (18.5-24.7)	<b>27.3</b> (23.1-32.9)	<b>32.3</b> (26.8-39.7)	<b>37.7</b> (30.5-47.4)	<b>43.5</b> (34.3-56.3)	<b>51.8</b> (39.2-69.9)	<b>58.7</b> (43.0-82.0)
<b>60-day</b>	<b>9.88</b> (8.74-11.4)	<b>13.9</b> (12.3-16.0)	<b>19.4</b> (17.1-22.5)	<b>24.3</b> (21.2-28.3)	<b>31.3</b> (26.5-37.7)	<b>37.0</b> (30.7-45.6)	<b>43.2</b> (35.0-54.5)	<b>50.0</b> (39.4-64.7)	<b>59.8</b> (45.2-80.6)	<b>67.9</b> (49.6-94.7)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

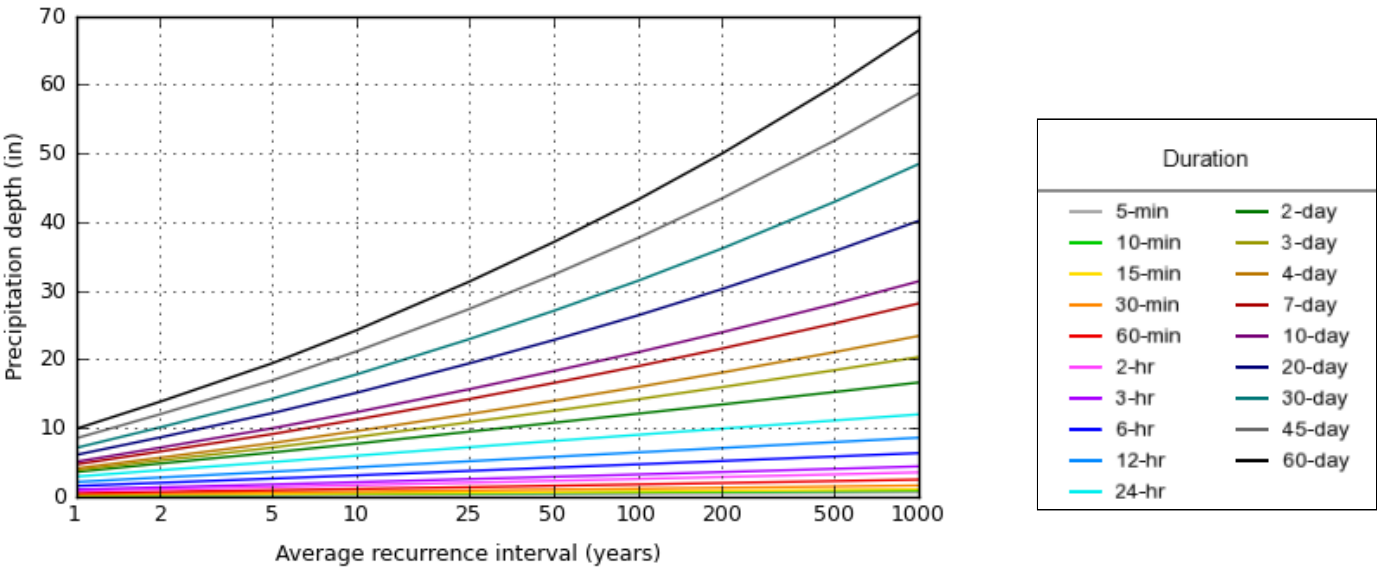
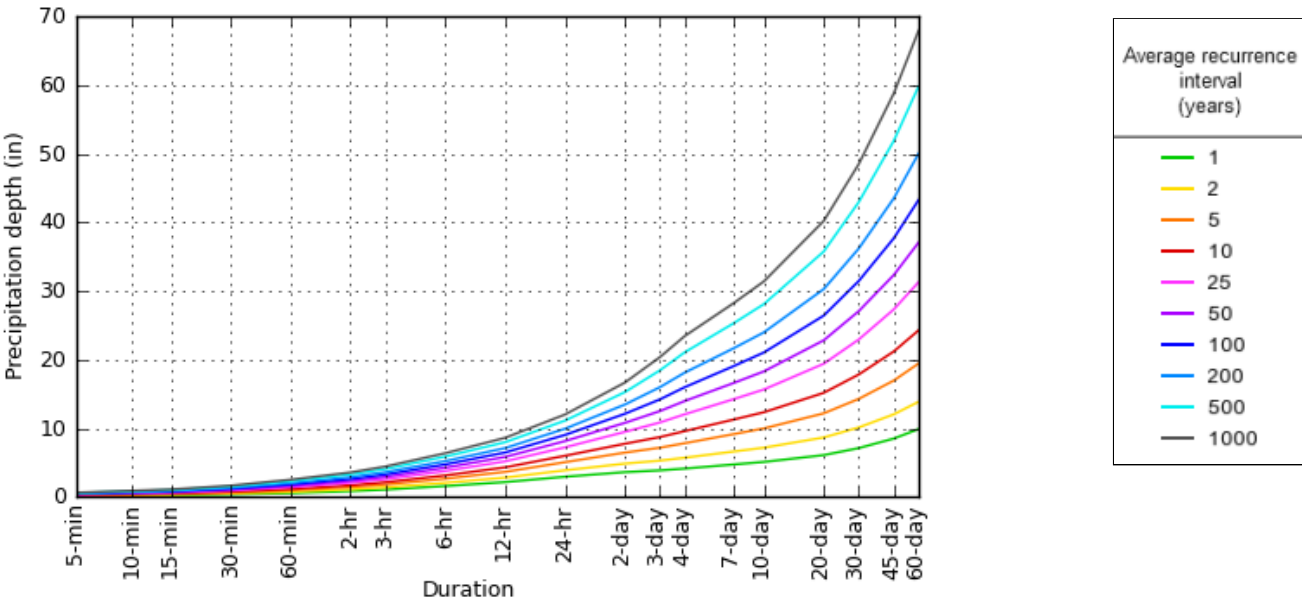
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical

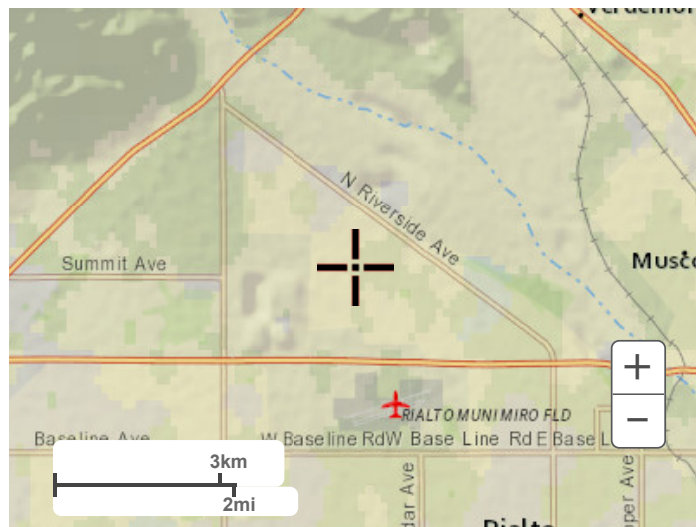
PDS-based depth-duration-frequency (DDF) curves  
Latitude: 34.1518°, Longitude: -117.4097°



[Back to Top](#)

Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

[Back to Top](#)

---

[US Department of Commerce](#)  
[National Oceanic and Atmospheric Administration](#)  
[National Weather Service](#)  
[National Water Center](#)  
1325 East West Highway  
Silver Spring, MD 20910  
Questions?: [HDSC.Questions@noaa.gov](mailto:HDSC.Questions@noaa.gov)

[Disclaimer](#)

## **APPENDIX M**

**TGR Geotechnical, Inc.'s Limited  
Geotechnical Investigation Report,  
2889 Locust Avenue, Rialto,  
California, dated March 10, 2020**



Geotechnical  
Environmental  
Hydrogeology  
Material Testing  
Construction Inspection

March 10, 2020

Project No. 20-6999

Xebec Realty  
3010 Old Ranch Parkway, Suite 470  
Seal Beach, CA 92660

Attention: Jake Spring, Vice President of Acquisitions

Subject: Limited Geotechnical Investigation Report, 2889 Locust Avenue, Rialto, California

Mr. Spring,

In accordance with your request and authorization, TGR Geotechnical, Inc. (TGR) has performed a preliminary geotechnical investigation for the proposed development at the subject site in the City of Rialto, California. The subject site is currently a 4.8-acre vacant dirt, gravel and cobble covered parcel of land. The site also has stockpiled soils and debris up to approximately 10 feet in height in the northwest, center, and western portions of the site. It is our understanding that the proposed development will consist of a 98,188-sq. ft. industrial building with associated truck docks, drive aisles and vehicle parking. This report presents the findings of our geotechnical investigation, including site seismicity, seismic settlement, liquefaction potential and provides geotechnical design recommendations for the proposed improvements. The work was performed in general accordance with our proposal dated January 16, 2020.

Based on our investigation the proposed development is feasible from a geotechnical viewpoint provided the recommendations presented in this report are implemented during design and construction.

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

Respectfully submitted,

**TGR GEOTECHNICAL, INC.**



Sanjay Govil, PhD, PE, GE 2382  
Principal Geotechnical Engineer



Edward L. Burrows, M.S, PG, CEG 1750  
Principal Engineering Geologist

Distribution: (4) Addressee



**ATTACHMENTS**

Plate 1 – Boring Location Map

Figure 1 – Site Location Map

Figure 2 – Regional Geology Map

Figure 3 – Regional Fault Map

Figure 4 – Seismic Hazard Zone Map

Table 1 – Percolation Test Worksheet

Appendix A – References

Appendix B – Log of Borings

Appendix C – Laboratory Testing Procedures and Results

Appendix D – Site Seismic Design and De-Aggregated Parameters

Appendix E – Standard Grading Specifications

## **EXECUTIVE SUMMARY**

Presented below are significant elements of our findings from a geotechnical viewpoint. These findings are based on our field exploration, laboratory testing, and geologic and engineering analysis.

### **Geotechnical/Geologic Concerns**

- There are no known faults passing through or adjacent to the subject site. The subject site is not located within an Alquist-Priolo Earthquake Fault Zone. The nearest faults to the subject site are the Lytle Creek Fault mapped approximately 1.1 miles to the northeast of the site, the San Jacinto Fault mapped 1.6 miles south of the site, the Cucamonga Fault mapped approximately 3.0 miles northwest of the site, the Rialto-Colton Fault mapped 3.9 miles southeast of the subject site and the Etiwanda Avenue Fault mapped 6.0 miles west of the subject site.
- Onsite soils are granular in nature, correlating to a “very low” expansion potential.
- It is anticipated that significant quantities of oversized material will be encountered during grading. Oversized material greater than 24 inches shall be disposed of or crushed and mixed with soil to be used as fill.
- Onsite soil stockpile material consists of debris and soils. The stockpile soils without organics are suitable for use as engineered fill provided the soils are cleaned of the debris.
- Excavations in site soils may be cut vertical to a maximum depth of 4 feet. All excavations exceeding 4 feet shall be shored or laid back 1:1 (horizontal to vertical) or flatter.
- At the time of our drilling, groundwater was not encountered to a depth of 17 feet below ground surface. Per USGS groundwater well data, the depth to historic high groundwater is approximately 244 feet below existing ground surface. Groundwater is not expected to impact the proposed development.
- The subject site is not located within an area having a potential for liquefaction. The total seismic settlement is estimated to be approximately 0.5 inches with a differential settlement of 0.25 inches over 30 feet.
- All depressions resulting from demolition activities shall be properly backfilled with engineered fill (minimum 90 percent) under the direction of the geotechnical consultant.
- Percolation test results utilizing the Porchet method indicate an infiltration rate of 15.56 to 30.07 inches per hour within the upper 5 feet within the native soils. A design infiltration rate of 15.5 inches per hour is recommended. These results do not include an applied factor of safety.

### **Foundations**

- The proposed buildings may be supported on conventional shallow pad or continuous footing foundation systems.
- An allowable bearing capacity of 2,500 psf may be utilized for foundation design for footings supported on minimum ninety (90) percent relative compacted engineered fill.

- The minimum recommended footing width is eighteen (18) inches for continuous footing and twenty-four (24) inches for pad footing.
- All shallow foundations should extend a minimum of twenty-four (24) inches below the lowest adjacent grade.
- All shallow foundations shall be supported on three (3) feet or half the width of the footing (whichever is greater) of engineered fill with minimum ninety (90) percent relative compaction at near optimum moisture content.
- Laboratory test results indicate that concrete in contact with onsite soils should be designed for exposure class S0 (minimum 2,500 psi concrete).

#### Slab-on-Grade

- Slab-on-grade should be a minimum of 5-inches thick.
- Slab-on-grade shall be reinforced with a minimum of No. 4 reinforcing bar on 18-inch centers in two horizontally perpendicular directions.
- The subgrade material should be compacted to a minimum of 90 percent of the maximum laboratory dry density (ASTM 1557) to a minimum depth of three (3) feet.
- Areas requiring moisture sensitive flooring shall be underlain by a minimum 15-mil visqueen (Stego Wrap or equivalent).

#### Pavement Design

- The pavement section was developed based on a tested "R-Value" for compacted site subgrade soils of 72.

ASPHALT PAVEMENT SECTION					PCC PAVEMENT SECTION		
Pavement Utilization	Traffic Index	Asphalt (Inch)	Aggregate Base (Inch)	Total (Inch)	*PCC	Aggregate Base (Inch)	Total (Inch)
Parking Stalls	4.5	3.0	4.0	7.0	--	--	--
Auto Driveways	5.0	3.0	4.0	7.0	--	--	--
Truck Aisles/ Driveways	6.0	4.0	6.0	10.0	*7	-	7
Loading Dock	7.0	4.0	6.0	10.0	*7	-	7

\*Minimum concrete compressive strength of 3,500 psi.

## **INTRODUCTION**

### **Site Descriptions and Proposed Project Development**

The subject site is located at 2889 Locust Avenue Avenue (Figure 1) in the City of Rialto, California. The subject site is currently a 4.8-acre vacant dirt, gravel and cobble covered parcel of land. The site also has stockpiled soils and debris up to approximately 10 feet in height in the northwest, center, and western portions of the site. We understand that the proposed development will consist of a 98,188-sq. ft. industrial building with associated truck docks, drive aisles and vehicle parking.

### **Scope of Work**

The scope of work for this geotechnical investigation included the following:

- Site reconnaissance to assess current site conditions and mark borings.
- Sampling and logging six (6) hollow stem auger borings utilizing a hollow stem drill rig to depths ranging from 6 to 17 feet at the subject site to evaluate subsurface soil conditions. The borings were backfilled with cuttings and any excess soil was disposed onsite.
- Percolation testing of the near surface soils (upper 5 feet) at two (2) locations.
- Laboratory testing of selected samples to include in-situ moisture density, maximum density and optimum moisture content, shear, consolidation, corrosion, passing No. 200 sieve and R-value.
- Engineering analysis including site seismicity, foundation design, and settlement potential.
- Preparation of this report summarizing subsurface soil conditions, site seismicity, seismic settlement, hydro-collapse potential and provide pertinent geotechnical/geologic information that may influence the proposed development.

### **Field Investigation**

Field exploration was performed on February 19, 2020 by an engineer from our firm who logged the borings and obtained representative samples, which were subsequently transported to the laboratory for further review and testing. The approximate locations of the borings are indicated on the enclosed Boring Location Map (Plate 1).

The subsurface conditions were explored by drilling, sampling, and logging six (6) borings with a truck mounted hollow stem auger drill rig. Borings B-1 through B-6 were advanced to an approximate depth of six (6) to seventeen (17) feet below existing grade, encountering refusal in each boring. Two (2) borings, P-1 and P-2, were advanced to an approximate depth of five (5) feet for percolation testing. Subsequent to drilling, all borings were backfilled with cuttings and the surface compacted. The log of borings presenting soil conditions and descriptions are presented in Appendix B.

The drill rig was equipped with a sampling apparatus to allow for recovery of driven modified California Ring Sampler (CRS), 3-inch outside diameter, and 2.42-inch inside diameter and SPT samples.

The samples were driven using an automatic 140-pound hammer falling freely from a height of 30 inches. The blow counts for CRS were converted to equivalent SPT blow counts. Soil descriptions were entered on the logs in general accordance with the Unified Soil Classification System (USCS). Driven samples and bulk samples of the earth materials encountered at selected intervals were recovered from the borings. The locations and depths of the soil samples recovered are indicated on the boring logs in Appendix B.

#### Percolation Testing

Percolation testing was performed at the subject site. Presented below are the infiltration rates per the Porchet Method from the percolation tests performed within the upper 5 feet. These do not include any factor of safety.

- P-1 at 0-5 feet                      15.56 inches per hour
- P-8 at 0-5 feet                      30.07 inches per hour

Based on the results of the percolation testing, an infiltration rate of 15.5 inches per hour is recommended for the design of storm water infiltration at the subject site. The infiltration test rates were determined utilizing the County of San Bernardino guidelines.

#### Laboratory Testing

Laboratory tests were performed on representative samples to verify the field classification of the recovered samples and to evaluate the geotechnical properties of the subsurface soils. The following tests were performed:

- In-situ moisture content (ASTM D2216) and dry density (ASTM D7263);
- Maximum Dry Density and Optimum Moisture Content (ASTM D1557);
- Consolidation (ASTM D2435);
- Direct Shear Strength (ASTM D3080);
- R-Value (CAL 301);
- Passing No. 200 sieve (ASTM 1140); and
- Corrosion series:
  1. Soluble Sulfate (CAL.417A);
  2. Soluble Chlorides (CAL.422);
  3. Minimum Resistivity (CAL.643); and
  4. pH.

Laboratory tests for geotechnical characteristics were performed in general accordance with the ASTM procedures. The results of the in-situ moisture content and density tests are shown on the borings logs. The results of the laboratory tests are presented in Appendix C.

## **GEOTECHNICAL FINDINGS**

### **Geology**

#### **Regional Geologic Setting**

The project site is located in the southeast portion of the Devore 7.5-minute Quadrangle, San Bernardino, California. Per the Geologic Map of the Devore 7.5-minute Quadrangle, California (Dibblee, 2003), the subject site is underlain by Quaternary alluvial gravel and sand of valley areas, comprised of boulder gravel near mountains, grading outward into finer gravel and sand. Figure 2 presents the Regional Geology Map.

#### **Earth Units**

Based on our subsurface investigation, the subject area is underlain by approximately 5 to 10 feet of light brown silty sand and gravel in a dry to slightly moist condition. The silty sand and gravel is underlain by brown to yellow brown gravelly sand a moist condition to 17 feet below existing grade, the maximum depth explored. Detailed descriptions of the earth units encountered in our borings are presented in the log of the borings. (Appendix B)

Onsite soil stockpile material consists of organics and soils with varying amounts of debris. The stockpile soils without organics are suitable for use as engineered fill provided the soils are cleaned of the debris and oversized particles.

#### **Groundwater**

Subsurface water was not encountered to a depth of approximately 17 feet below existing grade during the subsurface exploration. USGS groundwater data from wells nearest to the subject site indicate a historic high of approximately 244 feet below existing grade. Seasonal and long-term fluctuations in the groundwater may occur as a result of variations in subsurface conditions, rainfall, run-off conditions and other factors. Therefore, variations from our observations may occur. Static groundwater is not anticipated to impact the proposed development.

#### **Seismic Review**

##### **Faulting and Seismicity**

The subject site, like the rest of Southern California, is located within a seismically active region as a result of being located near the active margin between the North American and Pacific tectonic plates. The principal source of seismic activity is movement along the northwest-trending regional faults such as the San Andreas, San Jacinto and Elsinore fault zones. These fault systems produce approximately 5 to 35 millimeters per year of slip between the plates.

By definition of the State Mining and Geology Board, an active fault is one which has had surface displacement within the Holocene Epoch (roughly the last 11,000 years). The State Mining and Geology Board has defined a potentially active fault as any fault which has been active during the Quaternary Period (approximately the last 1,600,000 years). These definitions are used in delineating Earthquake Fault Zones as mandated by the Alquist-Priolo Geologic



Hazard Zones Act of 1972 and as subsequently revised in 1994 (Hart, 1997) as the Alquist-Priolo Geologic Hazard Zoning Act and Earthquake Fault Zones.

The intent of the act is to require fault investigations on sites located within Special Studies Zones to preclude new construction of certain inhabited structures across the trace of active faults.

The subject site is not included within any Earthquake Fault Zones as created by the Alquist-Priolo Earthquake Fault Zoning Act (Hart, 1997). Our review of geologic literature pertaining to the site area indicates that there are no known active or potentially active faults located within or immediately adjacent to the subject property.

The nearest fault to the subject site is the Lytle Creek Fault mapped approximately 1.1 miles to the northeast of the site. Other faults nearby include San Jacinto Fault mapped 1.6 miles south of the site, the Cucamonga Fault mapped approximately 3.0 miles northwest of the site, the Rialto-Colton Fault mapped 3.9 miles southeast of the subject site and the Etiwanda Avenue Fault mapped 6.0 miles west of the subject site. The regional fault map, Figure 4, shows the location of the subject site in respect to the regional faults.

### Secondary Seismic Hazards

#### Surface Fault Rupture and Ground Shaking

Since no known faults are located within the site, surface fault rupture is not anticipated. However, due to the close proximity of known active and potentially active faults, severe ground shaking should be expected during the life of the proposed structures.

#### Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when these ground conditions exist: 1) Shallow groundwater; 2) Low density, fine, clean sandy soils; and 3) High-intensity ground motion. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below foundations.

A review of the Seismic Hazard Zone Map, Ontario Quadrangle indicates that the subject site is not located in an area identified as having a potential for soil liquefaction. Moreover, due to the absence of shallow groundwater, it is our opinion that the potential for liquefaction as a result of ground shaking at the subject site is very low.

#### Landslide

Landslide involves downhill motion of earth materials during or subsequent to earth shaking. Historically, landslides triggered by earthquakes have been a significant cause of damage. Areas that are most susceptible to earthquake induced landslides are areas with steep slopes in poorly cemented or highly fractured bedrock, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits.

This property is not located within a mapped zone of earthquake induced landslide and is located in a relatively flat area. Based on the above, the potential for earthquake induced landslide is considered very low.

#### Lateral Spreading

Seismically induced lateral spreading involves primarily movement of earth materials due to earth shaking. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. The topography in the vicinity of the subject site is relatively flat. Therefore, the potential for lateral spreading at the subject site is considered very low.

## **DISCUSSIONS AND CONCLUSIONS**

### **General**

Based on our field exploration, laboratory testing and engineering analysis, it is our opinion that the proposed structure and proposed grading will be safe against hazard from landslide, settlement, or slippage and the proposed construction will have no adverse effect on the geologic stability of the adjacent properties provided our recommendations presented in this report are followed.

### **Conclusions**

Based on our findings and analyses, the subject site is likely to be subjected to moderate to severe ground shaking due to the proximity of known active and potentially active faults. This may reasonably be expected during the life of the structure and should be designed accordingly.

The primary conditions affecting the proposed project site development are as follows:

- The site is underlain by alluvium generally composed of gravels, cobbles and boulders in a silty sand matrix. **As such, oversized materials are anticipated to be encountered during grading operations.**
- Potential for hydro collapse.

The engineering evaluation performed concerning site preparation and the recommendations presented are based on information provided to us and obtained by us during our office and fieldwork. This report is prepared for the development of a 98,188-sq. ft. industrial building with associated truck docks, drive aisles and vehicle parking at the subject property. In the event that any significant changes are made to the proposed development, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the recommendations of this report are verified or modified in writing by TGR.

## **RECOMMENDATIONS**

### **Seismic Design Parameters**

When reviewing the 2019 California Building Code the following data should be incorporated into the design.

<b>Parameter</b>	<b>Value</b>
Latitude (degree)	34.1518
Longitude (degree)	-117.4087
Site Class	D
Site Coefficient, $F_a$	1.0
Site Coefficient, $F_v$	2.5
Mapped Spectral Acceleration at 0.2-sec Period, $S_s$	2.239 g
Mapped Spectral Acceleration at 1.0-sec Period, $S_1$	0.811 g
Spectral Acceleration at 0.2-sec Period Adjusted for Site Class, $S_{MS}$	2.239 g
Spectral Acceleration at 1.0-sec Period Adjusted for Site Class, $S_{M1}$	N/A
Design Spectral Acceleration at 0.2-sec Period, $S_{DS}$	1.492 g
Design Spectral Acceleration at 1.0-sec Period, $S_{D1}$	N/A

### **Site Specific Response Spectra**

The USGS Unified Hazard tool, the USGS RTGM Calculator and the USGS App for Deterministic Spectra Acceleration were utilized to develop site specific ground motion spectra. The analysis was performed utilizing the following attenuation relationships that are part of NGA as required by 2019 CBC code requirements.

- Campbell & Bozorgnia (2014)
- Boore, Stewart, Seyhan & Atkinson (2014)
- Chiou & Youngs (2014)
- Abrahamson, Silva & Kamal (2014)

The results of the Site Specific Response Spectra are incorporated in Table 1 and on Figure 1 in Appendix D. The results include deterministic spectra at 5% damping, maximum rotated component at 0.84 fractile and the probabilistic spectra, maximum rotated component at 5% damping for a return period of 2475 year and subsequently multiplied by risk coefficient to obtain the MCER probabilistic spectral acceleration. The  $V_{s30}$  utilized was 260 m/s.

The above generated spectral accelerations were compared against the minimum code requirements in ASCE7-16 (Chapters 11 and 21) resulting in the final design response spectra which is presented in Table 1 and on Figure 1 in Appendix D.

Based on Table 1 and Figure 1, the recommended Site Specific  $S_{DS}$  and  $S_{D1}$  are as follows:

$$S_{DS} = 1.620$$
$$S_{D1} = 2.059$$

The structural consultant should review the above parameters and the 2019 California Building Code to evaluate the seismic design.

Conformance to the criteria presented in the above table for seismic design does not constitute any type of guarantee or assurance that significant structural damage or ground failure will not occur during a large earthquake event. The intent of the code is “life safety” and not to completely prevent damage of the structure, since such design may be economically prohibitive.

#### Foundation Design Recommendations

The proposed buildings may be supported on continuous and/or spread footings. Bearing capacity recommendations for shallow foundations are presented below. These recommendations assume that the footings will be supported on a minimum of three (3) feet or half the width of the footing (whichever is greater) of engineered fill.

For foundations supported on three (3) feet or half the width of the footing (whichever is greater) of engineered fill with minimum ninety (90) percent relative compaction at near optimum moisture content, an allowable bearing pressure of 2500 pounds per square foot may be used in design.

All shallow foundations should extend a minimum of twenty-four (24) inches below the lowest adjacent grade. The minimum recommended footing width is eighteen (18) inches for continuous footing and twenty-four (24) inches for pad footing. A minimum reinforcement of two (2) No. 4 steel bar top and two (2) No. 4 steel bar bottom is required for continuous footings from a geotechnical viewpoint. Foundation design details such as concrete strength, reinforcements, etc should be established by the Structural Engineer.

A one-third (1/3) increase on the aforementioned bearing pressure may be used in design for short-term wind or seismic loads.

The total and differential static settlement is anticipated to be 1 inch and 0.5 inches over 60 feet or less. The total and differential seismic settlement is estimated to be 0.5 inches and 0.25 inches over 30 feet, respectively.

Resistance to lateral loads including wind and seismic forces may be provided by frictional resistance between the bottom of concrete and the underlying fill soils and by passive pressure against the sides of the foundations. A coefficient of friction of 0.40 may be used between concrete foundation and underlying soil. The recommended passive pressure of the engineered fill may be taken as an equivalent fluid pressure of 250 pounds per cubic foot (2,500 psf max).

Footings located near property lines where the lateral removal cannot be achieved shall be designed for a reduced bearing capacity of 1,500 pounds per square foot and the passive resistance shall be ignored.

#### Retaining Wall Recommendations

The following soil parameters may be used for the design of the retaining wall with level backfill and a maximum height of six (6) feet:

Conditions	Parameters
Friction Angle	32°
Active (Level)	40 psf/ft
Passive	250 (maximum 2,500 psf)
Friction Coefficient	0.40

- The passive pressure in the upper 6 inches of soil not confined by slabs or pavement should be neglected.
- All footings should meet the setback requirements presented in 2019 CBC.
- The retaining wall should be provided with a drainage system (Miradrain or equivalent) to prevent buildup of hydrostatic pressure behind the walls. We do not recommend omitting the drains behind walls.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure, should be considered in the design of the retaining wall. Loads applied within a 1:1 projection from the surcharging structure on the stem of the wall shall be considered as lateral surcharge. For lateral surcharge conditions, we recommend utilizing a horizontal load equal to 50 percent of the vertical load, as a minimum. This horizontal load should be applied below the 1:1 projection plane. To minimize the surcharge load from an adjacent footing, deepened footings may be considered.

#### Slab-On-Grade

Slab-on-grade should be a minimum of 5-inches thick and reinforced with a minimum of No. 4 reinforcing bar on 18-inch centers in two horizontally perpendicular directions. Reinforcing should be properly supported to ensure placement near the vertical midpoint of the slab. "Hooking" of the reinforcement is not considered an acceptable method of positioning the steel. The slab should not be structurally connected to the buildings. The subgrade material should be compacted to a minimum of 90 percent of the maximum laboratory dry density to a minimum depth of three (3) feet. Prior to placement of concrete, the subgrade soils should be moistened to near optimum moisture content and verified by our field representative.

The actual thickness and reinforcement of the slab shall be designed by the structural engineer and should include the anticipated loading condition (fork lift etc.) and the anticipated use of the building. For moisture sensitive flooring, the floor slab should be underlain by minimum 15-mil impermeable polyethylene membrane (Stego Wrap, Moistop Plus, or any equivalent meeting



the requirements of ASTM E1745, Class A rating) as a capillary break. Sand may be placed above and below the impermeable polyethylene membrane at the discretion of the project structural engineer/concrete contractor for proper curing and finish of the concrete slab-on-grade and protection of the membrane and is considered outside the scope of geotechnical engineering.

### Flatwork

Flatwork should be a minimum of 4-inches thick should be reinforced with a minimum of No. 3 reinforcing bar on 24-inch centers in two horizontally perpendicular directions. Reinforcing should be properly supported to ensure placement near the vertical midpoint of the slab. "Hooking" of the reinforcement is not considered an acceptable method of positioning the steel. The subgrade material should be compacted to a minimum of 90 percent of the maximum laboratory dry density (ASTM 1557) to a minimum depth of two (2) feet. Prior to placement of concrete, the subgrade soils should be moistened to near percent of optimum moisture content and verified by our field representative. The actual thickness and reinforcement of the slab shall be designed by the structural engineer and should include the anticipated loading condition.

### Modulus of Subgrade Reaction

The modulus of subgrade reaction may be taken as 175 pci ( $K_1$ ) for one (1) square foot footing/slab founded on site soils. This value should be reduced for change in size per the following formula:

$$K = K_1 \left( \frac{B+1}{2B} \right)^2$$

Where B = Width of Mat;

K = Coefficient of Subgrade Reaction of Footings Measuring B(ft) x B(ft).

### Cement Type and Corrosion

Based on laboratory testing concrete used should be designed in accordance with the provisions of ACI 318-14, Chapter 19 for Exposure Class S0 with a minimum unconfined compressive strength of 2,500 psi.

Corrosion tests indicate a mild corrosion potential for ferrous metals exposed to site soils.

TGR does not practice corrosion engineering. If needed, a qualified specialist should review the site conditions and evaluate the corrosion potential of the site soil to the proposed improvements and to provide the appropriate corrosion mitigations for the project.

### Expansive Soil

Onsite soils are granular in nature, correlating to a "very low" expansion potential.

### Shrinkage/Subsidence

Removal and recompaction of the near surface soils is estimated to result in shrinkage ranging from 5 to 10 percent. Minor ground subsidence is expected to occur in the soils below the zone of

removal, due to settlement and machinery working. The subsidence is estimated to be between one and two tenths of a foot.

## Site Development Recommendations

### General

During earthwork construction, all site preparation and the general procedures of the contractor should be observed, and the fill selectively tested by a representative of TGR. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and if warranted, modified and/or additional recommendations will be offered. During demolition of the existing building and associated site work, voids created from removal of buried elements (footings, pipelines, septic pits, etc.) shall be backfilled with engineered fill (min 90% relative compaction per ASTM D1557) under the observation of TGR.

### Grading

All grading should conform to the guidelines presented in the California Building Code (2019 edition), except where specifically superseded in the text of this report. Prior to grading, TGR's representative should be present at the pre-construction meeting to provide grading guidelines, if needed, and review any earthwork. Oversize particles may be encountered during grading. All particles greater than 4-inches shall be removed and disposed offsite.

It is recommended that at a minimum the upper 5 feet of site soils below existing grade be removed and replaced as engineered fill within the building footprint. The footings shall be supported on a minimum of three (3) feet or half the width of the footing (whichever is greater) of engineered fill. A minimum two (2) feet of engineered fill is recommended under flatwork and pavement. Site soils could be reused as engineered fill provided, they are free of oversized particles and the recommendations presented in this report are implemented. Exposed bottoms should be scarified a minimum of 6-inches, moisture conditioned to near optimum moisture and compacted to a minimum ninety (90) percent relative compaction. Subsequently, site fill soils should be re-compacted to a minimum of ninety (90) percent relative compaction at near optimum moisture content. The lateral extent of removals beyond the building/structure/footing limits should be equal to at least 5 feet.

The depth of over-excavation should be reviewed by the Geotechnical Consultant during the actual construction. Any subsurface obstruction buried structural elements, and unsuitable material encountered during grading, should be immediately brought to the attention of the Geotechnical Consultant for proper exposure, removal and processing, as recommended.

### Fill Placement

Prior to any fill placement TGR should observe the exposed surface soils. The site soils may be re-used as engineered fill provided, they are free of organic content and particle size greater than 4-inches. All particles greater than 4-inches shall be removed and disposed offsite. Fill shall be moisture conditioned to near optimum moisture and compacted to a minimum relative compaction of ninety (90) percent in accordance with ASTM D1557. Any import soils shall be non-expansive and approved by TGR Geotechnical Inc.

Based on our investigation, it is anticipated that significant quantities of oversized material (particles greater than 12 inches requiring special handling for disposal may be encountered during construction. Oversized material between 12 and 24 inches may be placed in areas of deep fill at depths below anticipated excavations (i.e. footings, utility trenches, etc.). Oversized material greater than 24 inches should be disposed of, either as landscape material or by removal from the site. Alternatively, oversized material may be crushed and mixed with soil to be used as fill. When placing fill with significant quantities of rock, it is essential that complete flooding occurs during grading to wash finer particles of soil into the voids between the rock.

### Compaction

Prior to fill placement, the exposed surface should be scarified to a minimum depth of six (6) inches, fill placed in six (6) inch loose lifts moisture conditioned to near optimum moisture and compacted to a minimum relative compaction of ninety (90) percent in accordance with ASTM D 1557.

### Trenching

All excavations should conform to CAL-OSHA and local safety codes.

### Temporary Excavation and Shoring

Temporary construction excavations may be anticipated during the proposed development. Soils may be cut vertically without shoring to a depth of approximately four (4) feet below adjacent surrounding grade. For deeper cuts, the slopes should be properly shored or sloped back to at least 1H:1.5V (Horizontal: Vertical) or flatter. The exposed slope face should be kept moist (but not saturated) during construction to reduce local sloughing. No surcharge loads should be permitted within a horizontal distance equal to the height of cut from the toe of excavation unless the cut is properly shored. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any nearby adjacent existing site facilities should be properly shored to maintain foundation support at the adjacent structures. Temporary excavation adjacent to existing footings may require A-B-C slot cuts.

### Drainage

Positive site drainage should be maintained at all times. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. Pad drainage should be directed towards the street/parking or other approved area.

### Utility Trench Backfill

All utility trench backfills in structural areas and beneath hardscape features should be brought to near optimum moisture content and compacted to a minimum relative compaction of ninety (90) percent of the laboratory standard. Flooding/jetting is not recommended.

Sand backfill, (unless trench excavation material), should not be allowed in parallel exterior trenches adjacent to and within an area extending below a 1:1 plane projected from the outside bottom edge of the footing. All trench excavations should minimally conform to CAL-OSHA and local safety codes. Soils generated from utility trench excavations may be used provided it is moisture conditioned and compacted to ninety (90) percent minimum relative compaction.

Due to the presence of rock it is suggested that areas of proposed underground utilities be over excavated to a minimum of 12 inches below the bottom of and on either side of the proposed utilities to prevent over breaking or loosening of the rock during trench excavation by the underground utility contractor.

#### Preliminary Pavement Design

The Caltrans method of design was utilized to develop the following asphalt pavement section. The section was developed based on a tested "R-Value" for compacted site subgrade soils of 72.

Traffic indices of 4.5, 5, 6, and 7 were assumed for use in the evaluation of automobile parking stalls and driveways, and medium and heavy truck driveways, respectively. The traffic indices are subject to approval by controlling authorities and shall be approved by the project civil engineer.

ASPHALT PAVEMENT SECTION					PCC PAVEMENT SECTION		
Pavement Utilization	Traffic Index	Asphalt (Inch)	Aggregate Base (Inch)	Total (Inch)	*PCC	Aggregate Base (Inch)	Total (Inch)
Parking Stalls	4.5	3.0	4.0	7.0	--	--	--
Auto Driveways	5.0	3.0	4.0	7.0	--	--	--
Truck Aisles/ Driveways	6.0	4.0	6.0	10.0	*7	-	7
Loading Dock	7.0	4.0	6.0	10.0	*7	-	7

\*Minimum concrete compressive strength of 3,500 psi.

Aggregate base material for Asphalt Pavement should consist of CMB complying with the specifications in Section 200.2.4 of the current "Standard Specifications for Public Works Construction" and should be compacted to at least ninety-five (95) percent of the maximum dry density (ASTM D1557). The surface of the base should exhibit a firm and unyielding condition just prior to the placement of asphalt concrete paving. The asphalt concrete shall be compacted to a minimum of ninety-five (95) percent relative compaction.

The pavement subgrade should be constructed in accordance with the recommendations presented in the grading section of this report.

The R-value and the associated pavement section should be confirmed at the completion of site grading.

An increase in the PCC pavement slab thickness, placement of steel reinforcement (or other alternatives such as Fibermesh) and joint spacing due to loading conditions including shrinkage

and thermal effects may be necessary and should be incorporated by the structural engineer as necessary to prevent adverse impact on pavement performance and maintenance.

### Geotechnical Review of Plans

All grading and foundation plans should be reviewed and accepted by the geotechnical consultant prior to construction. If significant time elapses since preparation of this report, the geotechnical consultant should verify the current site conditions, and provide any additional recommendations (if necessary) prior to construction.

### Geotechnical Observation/Testing During Construction

The geotechnical consultant should perform observation and/or testing at the following stages:

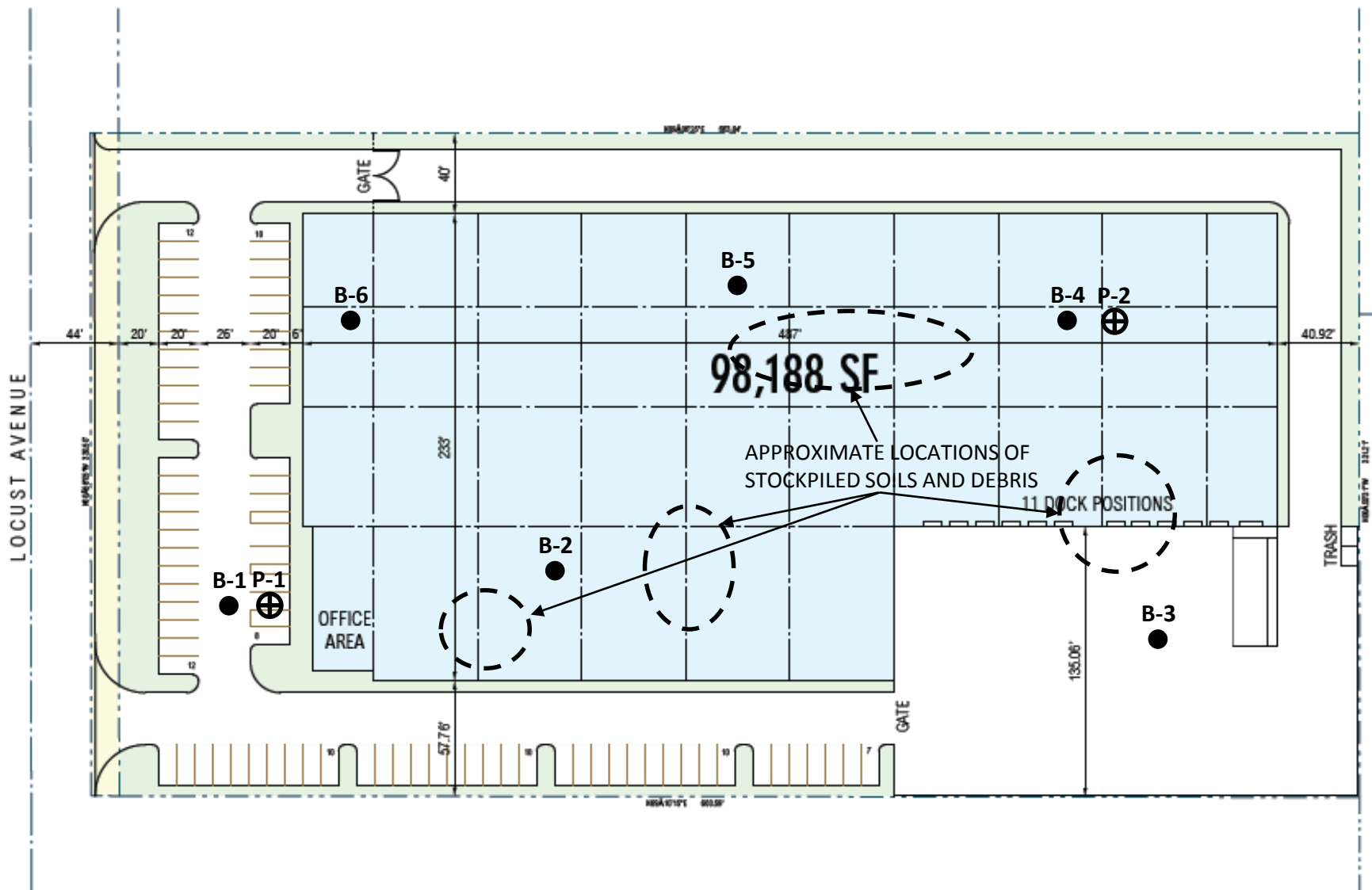
- During any grading and fill placement;
- During utility trench excavation and backfill;
- After foundation excavation and prior to placing concrete;
- During placement of aggregate base and asphalt concrete or Portland cement concrete;
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

### Limitations

This report was prepared for a specific client and a specific project, based on the client's needs, directions and requirements at the time.

This report was necessarily based upon data obtained from a limited number of observances, site visits, soil and/or other samples, tests, analyses, histories of occurrences, spaced subsurface exploration and limited information on historical events and observations. Such information is necessarily incomplete. Variations can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time.

This report is not authorized for use by and is not to be relied upon by any party except the client with whom TGR contracted for the work. Use or reliance on this report by any other party is that party's sole risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify TGR from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of TGR.



B-6

● APPROXIMATE LOCATION OF EXPLORATORY BORING

P-2

⊕ APPROXIMATE LOCATION OF EXPLORATORY BORING



Geotechnical  
Environmental  
Hydrogeology  
Material Testing  
Construction Inspection

# BORING LOCATION MAP 2889 LOCUST AVENUE RIALTO, CALIFORNIA

PROJECT NO. 20-6999

PLATE 1





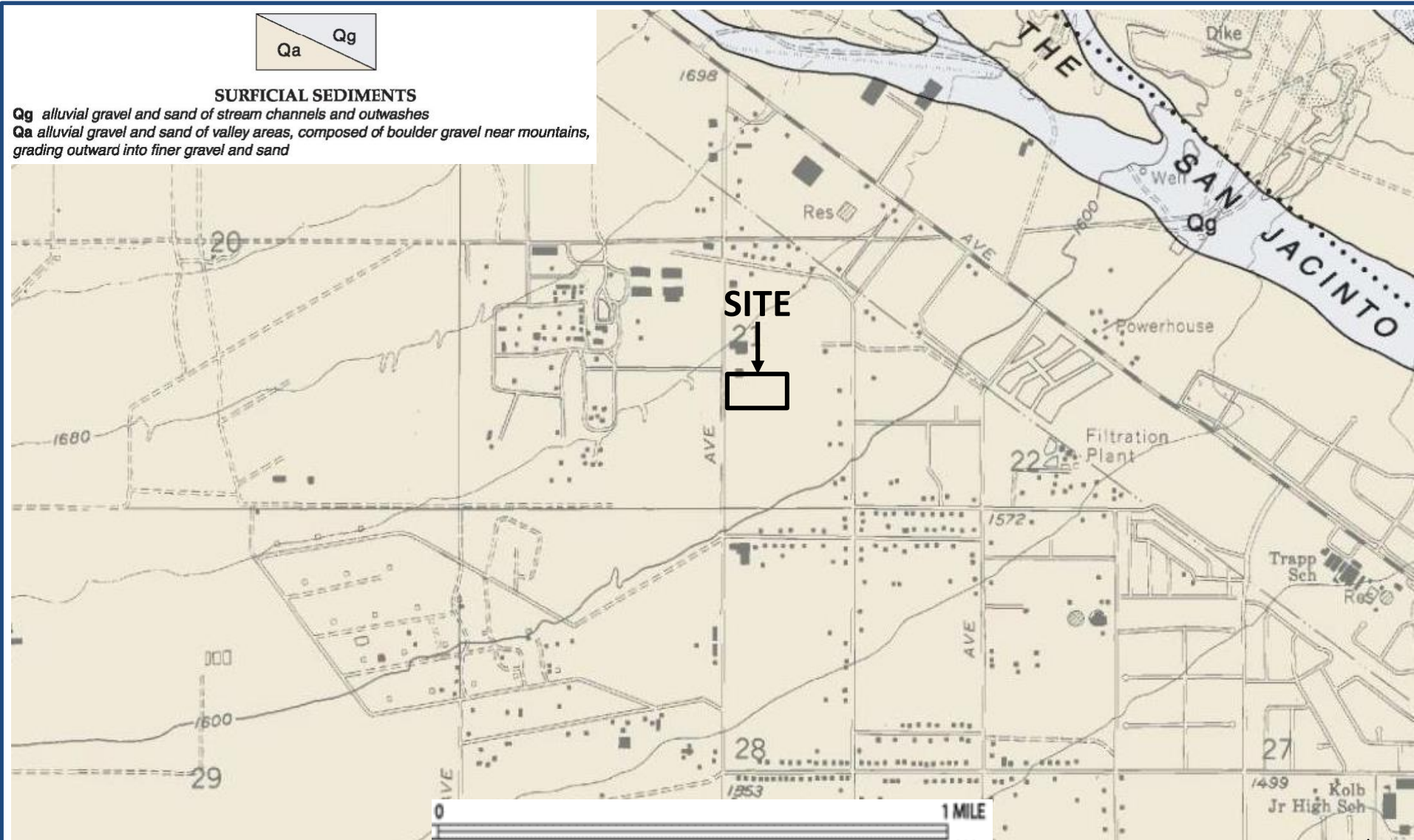
Geotechnical  
Environmental  
Hydrogeology  
Material Testing  
Construction Inspection

# SITE LOCATION MAP 2889 LOCUST AVENUE RIALTO, CALIFORNIA

PROJECT NO. 20-6999

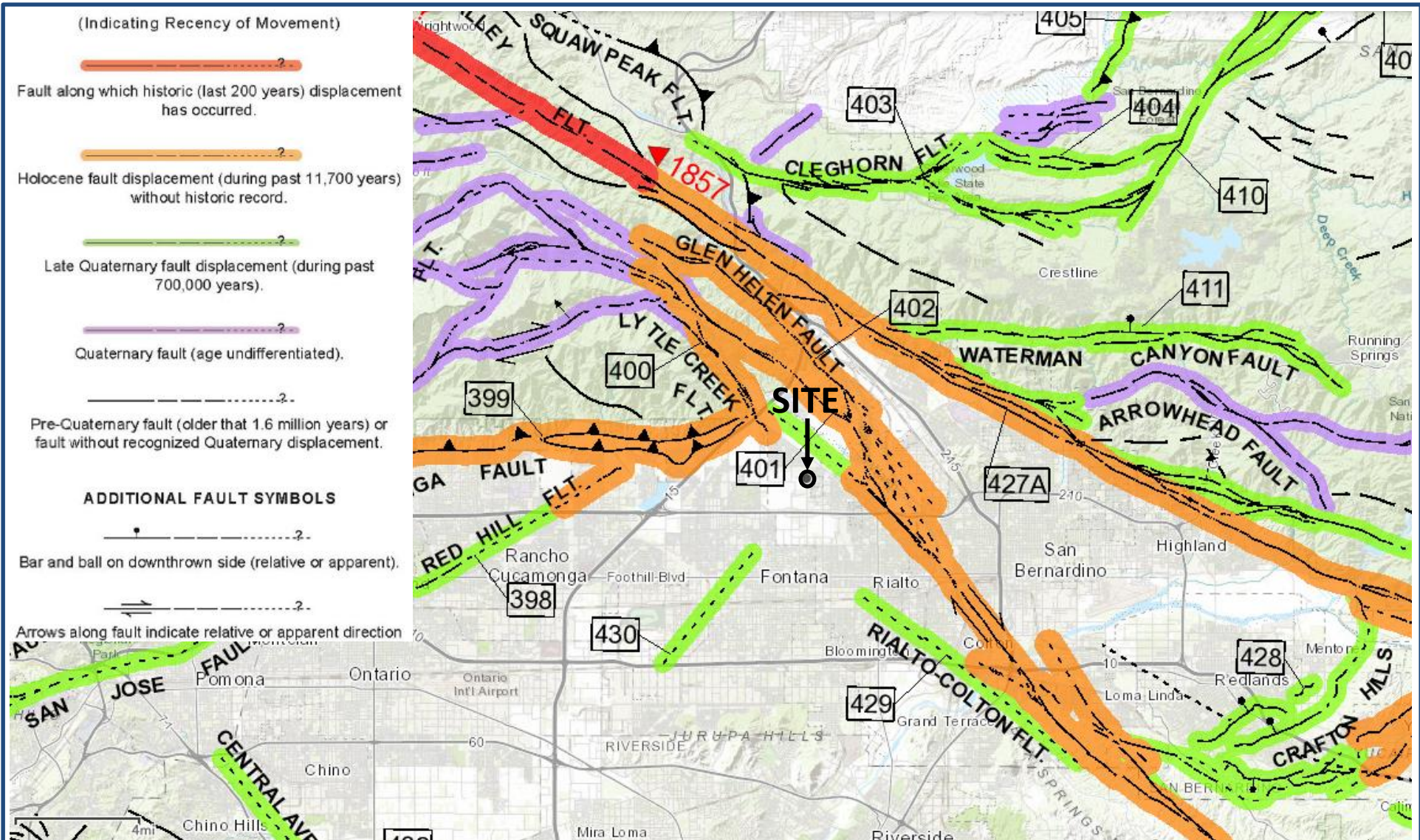
FIGURE 1



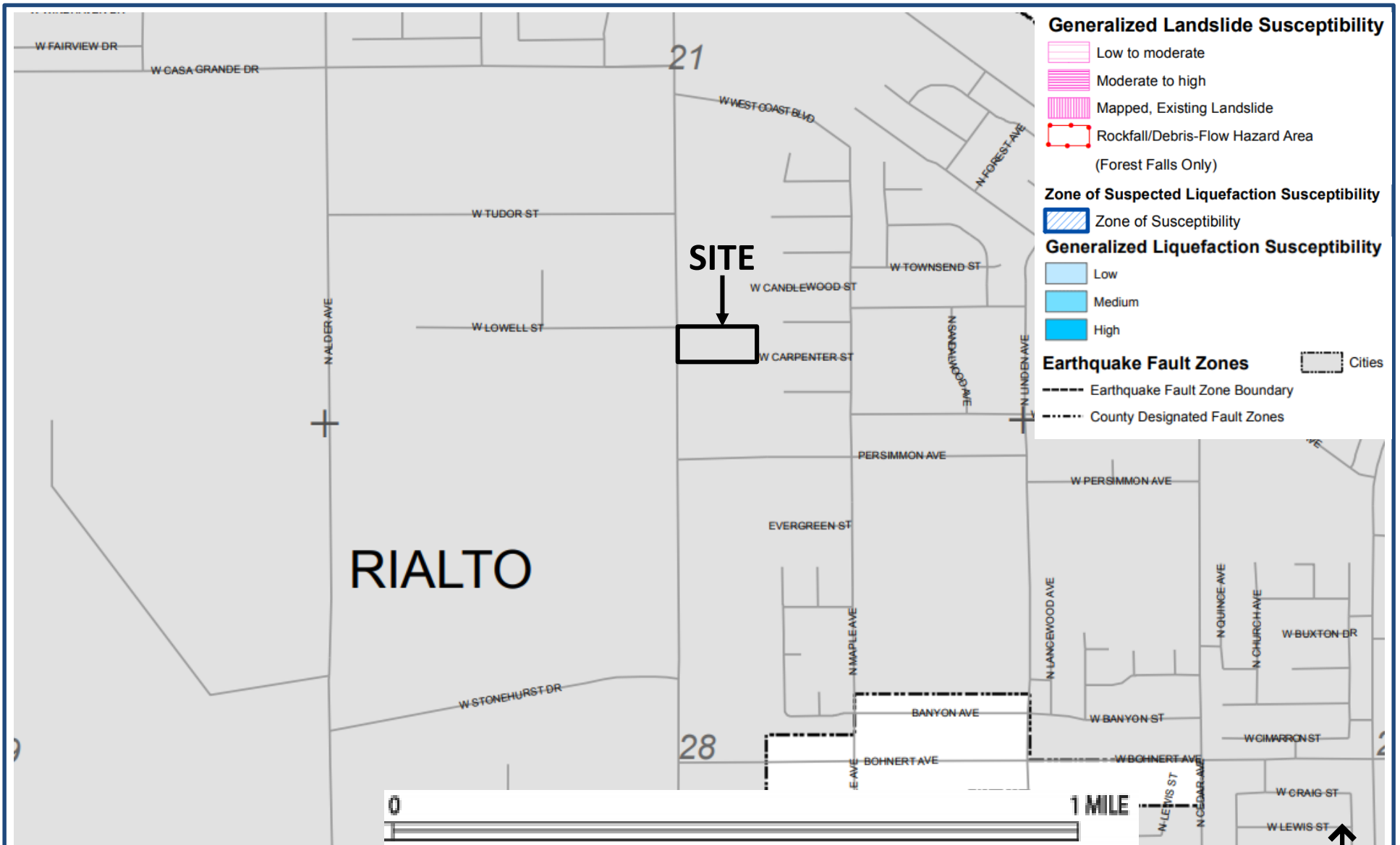


Dibblee, T.W., and Minch, J.A., 2003, Geologic map of the Devore quadrangle, San Bernardino County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-105, scale 1:24,000..





Modified From: Jennings, C. W., 2010, Fault Activity Map of California and Adjacent Areas, California Division of Mines and Geology, Geologic Data Map Series, No. 6, Scale 1:750,000.



Modified From: San Bernardino Land Use Plan, 2010, General Plan, Geologic Hazard Overlay, Map No. FH21-C, plotted March 9, 2010.

Test Hole	Total Depth (in)	Initial Depth (in)	Final Depth (in)	$\Delta$ Water Level (in)	Initial Time (min)	Final Time (min)	$\Delta$ Time (min)	Initial Height of Water (in)	Final Height of Water (in)	Average Height of Water (in)	Infiltration Rate (in/hr)
P-1	60	5	12	7	0.0	1.0	1.0	55	48	51.50	15.70
	60	4.5	11.5	7	0.0	1.0	1.0	55.5	48.5	52.00	15.56
	60	4.5	11.75	7.25	0.0	1.0	1.0	55.5	48.25	51.88	16.15
	60	5	12.5	7.5	0.0	1.0	1.0	55	47.5	51.25	16.90
	60	4.75	12	7.25	0.0	1.0	1.0	55.25	48	51.63	16.22
	60	4	11.5	7.5	0.0	1.0	1.0	56	48.5	52.25	16.59
P-2	60	3.75	22	18.25	0.0	1.0	1.0	56.25	38	47.13	44.58
	60	3.5	21.25	17.75	0.0	1.0	1.0	56.5	38.75	47.63	42.92
	60	6	20.25	14.25	0.0	1.0	1.0	54	39.75	46.88	34.99
	60	2.5	15.75	13.25	0.0	1.0	1.0	57.5	44.25	50.88	30.07
	60	2.5	16.5	14	0.0	1.0	1.0	57.5	43.5	50.50	32.00
	60	3	17.5	14.5	0.0	1.0	1.0	57	42.5	49.75	33.62
	60	3	17.5	14.5	0.0	1.0	1.0	57	42.5	49.75	33.62
	60	3	17	14	0.0	1.0	1.0	57	43	50.00	32.31

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

$\Delta H$  = Change in height  
 $\Delta t$  = Time interval  
 r = Radius

$I_t$  = Infiltration Rate  
 $H_{ave}$  = Average Head Height over the time interval

## **APPENDIX A REFERENCES**



## APPENDIX A

### References

- California, State of, Department of Conservation, Division of Mines and Geology, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, CDMG Special Publication 117A.
- \_\_\_\_\_, 1998, Maps of Known Active Fault Near – Source Zones in California and Adjacent Portions of Nevada.
- \_\_\_\_\_, 1998, Seismic Hazard Zone Report for the Ontario 7.5-Minute Quadrangle, Los Angeles County, California, Report 040.
- \_\_\_\_\_, 1999, State of California Seismic Hazard Zones Map, Ontario Quadrangle, Official Map Released November 17, 2000,, Scale 1:24,000.
- Dibblee, T.W., and Minch, J.A., 2003, Geologic map of the Devore quadrangle, San Bernardino County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-105, scale 1:24,000.
- Hart, E. W., 1997, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning with Index to Special Study Zones Maps: Department of Conservation, Division of Mines and Geology, Special Publication 42
- International Code Council (ICC), California Building Code, 2019 Edition
- Jennings, C. W., 2010, Fault Activity Map of California and Adjacent Areas, California Division of Mines and Geology, Geologic Data Map Series, No. 6, Scale 1:750,000
- San Bernardino Land Use Plan, 2010, General Plan, Geologic Hazard Overlay, Map No. FH21-C, plotted March 9, 2010.

**APPENDIX B  
LOG OF BORINGS**

**THE FOLLOWING DESCRIBES THE TERMS AND SYMBOLS USED ON THE LOG  
OF BORINGS TO SUMMARIZE THE RESULTS OBTAINED IN THE FIELD  
INVESTIGATION AND SUBSEQUENT LABORATORY TESTING**

**DENSITY AND CONSISTENCY**

The consistency of fine grained soils and the density of coarse grained soils are described on the basis of the Standard Penetration Test as follows:

<b>COARSE GRAINED SOILS</b>	<b>ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (Tsf)</b>	<b>FINE GRAINED SOILS</b>
-----------------------------	--	---------------------------

Very Loose	< 4	< 0.25	Very Soft	< 2
Loose	4 – 10	0.35 – 0.50	Soft	2 – 4
Medium	10 – 30	0.50 – 1.0	Firm (Medium)	4 – 8
Dense	30 – 50	1.0 – 2.0	Stiff	8 – 15
Very Dense	> 50	2.0 – 4.0	Very Stiff	15 – 30
		> 4.0	Hard	> 30

**PARTICLE SIZE DEFINITION (As per ASTM D2487 and D422)**

Boulder	⇒ Larger than 12 inches	Coarse Sands	⇒ No. 10 to No. 4 sieve
Cobbles	⇒ 3 to 12 inches	Medium Sands	⇒ No. 40 to No. 10 sieve
Coarse Gravel	⇒ 3/4 to 3 inches	Fine Sands	⇒ No. 200 to 40 sieve
Fine Gravel	⇒ No. 4 to 3/4 inches	Silt	⇒ 5µm to No. 200 sieve
		Clay	⇒ Smaller than 5µm

**SOIL CLASSIFICATION**

Soils and bedrock are classified and described based on their engineering properties and characteristics using ASTM D2487 and D2488.

Percentage description of minor components:

Trace	1 – 10%	Some	20 – 35%
Little	10 – 20%	And or y	25 – 50%

Stratified soils description:

Parting	0 to 1/16 inch thick	Layer	½ to 12 inches thick
Seam	1/16 to ½ inch thick	Stratum	> 12 inches thick

# SOIL CLASSIFICATION CHART

## UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
Clean Gravels (Less than 5% fines)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	GC	Clayey gravels, gravel-sand-clay mixtures
	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

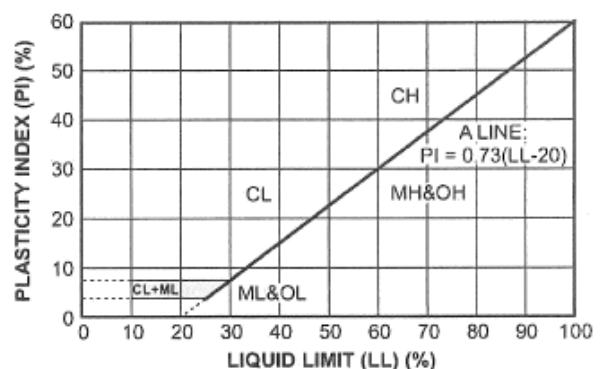
## LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP  
 More than 12 percent ..... GM, GC, SM, SC  
 5 to 12 percent ..... Borderline cases requiring dual symbols

## PLASTICITY CHART



## PARTICLE SIZE LIMITS

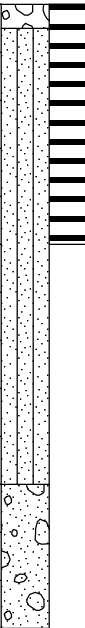
COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	
	3"	¾"	NO. 4	NO. 10	NO. 40	NO. 200

# LOG OF EXPLORATORY BORING B-1

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS			
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS	<div><div><div><div></div></div><div>Shelby Tube</div></div><div><div><div></div></div><div>Modified California</div></div><div><div><div></div></div><div>Standard Split Spoon</div></div><div><div><div></div></div><div>No recovery</div></div><div><div><div></div></div><div>Water Table ATD</div></div></div>	Moisture Content (%)	Dry Density, (pcf)	Other Tests
										
							Surface is dirt, gravel, cobbles and boulders. Silty Sand and Gravel- light brown, moist, dense, fine grained sand, abundant fine to coarse grained gravel and cobbles.			
5				25	SM		...Same as above, medium dense.	6	111	Max, Corrosion, Shear
10				>50	SPG		Gravelly Sand- yellow brown, slightly moist, very dense, fine to coarse grained sand, fine to coarse grained gravel.	2	129	Consol
15							Total Depth: 13 feet due to refusal in rocks. No groundwater encountered during drilling. Caving observed at 3 feet. Boring backfilled with soil cuttings upon completion.			
20										
25										

LOG OF BORING 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 2**







TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-2

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS				
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS					
							Moisture Content (%)	Dry Density, (pcf)	Other Tests		
<div><div><div><div><div></div><div>Shelby Tube</div></div><div><div></div><div>Modified California</div></div></div><div><div><div></div><div>Standard Split Spoon</div></div><div><div></div><div>Water Table ATD</div></div></div><div><div><div></div><div>No recovery</div></div></div></div></div>											
SUMMARY OF SUBSURFACE CONDITIONS											
5			48		SPG	Surface is dirt, gravel, cobbles and boulders. Silty Sand and Gravel- light brown, dry, dense, fine grained sand, abundant fine to coarse grained gravel and cobbles.			2	129	
10			>50		SPG	...Same as above, very dense.			5	130	
15			>50		SPG	...Same as above, slightly moist, very dense.			3	133	
20						Total Depth: 17 feet due to refusal in rocks. No groundwater encountered during drilling. Caving observed at 5 feet. Boring backfilled with soil cuttings upon completion.					
25											

LOG OF BORING 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 3**



TGR GEOTECHNICAL, INC.






# LOG OF EXPLORATORY BORING B-3

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS			
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS	<div><div><div><div></div></div><div>Shelby Tube</div></div><div><div><div></div></div><div>Modified California</div></div></div> <div><div><div></div></div><div>Standard Split Spoon</div></div> <div><div><div></div></div><div>No recovery</div></div> <div><div><div></div></div><div>Water Table ATD</div></div>	Moisture Content (%)	Dry Density, (pcf)	Other Tests
							SUMMARY OF SUBSURFACE CONDITIONS			
							Surface is dirt, gravel, cobbles and boulders. Silty Sand and Gravel- light brown, slightly moist, dense, fine grained sand, fine to coarse grained gravel.			
5			49			SPG	Gravelly Sand- brown, moist, dense, fine to coarse grained sand, fine to coarse grained gravel.	3	133	
10							Total Depth: 8 feet due to refusal in rocks. No groundwater encountered during drilling. Caving observed at 3 feet. Boring backfilled with soil cuttings upon completion.			
15										
20										
25										

LOG OF BORING 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 4**



TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-4

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS			
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS	<div><div><div><div></div></div><div>Shelby Tube</div></div><div><div><div></div></div><div>Standard Split Spoon</div></div><div><div><div></div></div><div>No recovery</div></div><div><div><div></div></div><div>Modified California</div></div><div><div><div></div></div><div>Water Table ATD</div></div></div>	Moisture Content (%)	Dry Density, (pcf)	Other Tests
	<div><div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div></div>									

R-Value

LOG OF BORING 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 5**





TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-5

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS		
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS	<div><div><div></div></div> Shelby Tube</div>	<div><div><div></div></div> Standard Split Spoon</div>	<div><div><div></div></div> No recovery</div>
SUMMARY OF SUBSURFACE CONDITIONS							Moisture Content (%)	Dry Density, (pcf)	Other Tests
5			>50	SPG	Surface is dirt, gravel, cobbles and boulders. Silty Sand and Gravel- brown, slightly moist, dense, fine grained sand, fine to coarse grained gravel, cobbles.	2	128	Consol	
					Gravelly Sand- brown, moist, very dense, fine to coarse grained sand, fine to coarse grained gravel, cobbles.				
					Total Depth: 8 feet due to refusal in rocks. No groundwater encountered during drilling. Caving observed at 5 feet. Boring backfilled with soil cuttings upon completion.				
10									
15									
20									
25									

LOG OF BORING 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 6**



TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-6

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS		
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS			
							Moisture Content (%)	Dry Density, (pcf)	Other Tests
<div><div><div><div><div></div><div>Shelby Tube</div></div><div><div></div><div>Standard Split Spoon</div></div><div><div></div><div>No recovery</div></div></div><div><div><div></div><div>Modified California</div></div><div><div></div><div>Water Table ATD</div></div></div></div></div>							SUMMARY OF SUBSURFACE CONDITIONS		

LOG OF BORING: 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 7**



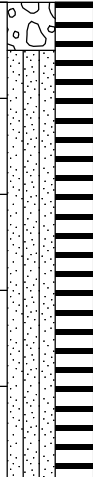
TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING P-1

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS					
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS	<div><div><div></div><div>Shelby Tube</div></div><div><div></div><div>Modified California</div></div></div>	<div><div></div><div>Standard Split Spoon</div></div>	<div><div></div><div>No recovery</div></div>	Moisture Content (%)	Dry Density, (pcf)	Other Tests
SUMMARY OF SUBSURFACE CONDITIONS												
5						SM	Surface is dirt, gravel, cobbles and boulders.					
							Silty Sand and Gravel- light brown, slightly moist to dry, dense, fine grained sand, abundant fine to coarse grained gravel and cobbles.					
							Total Depth: 5 feet. No groundwater encountered during drilling. No caving observed. Boring utilized for percolation testing Boring backfilled with soil cuttings upon completion.					
10												

LOG OF BORING 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 8**








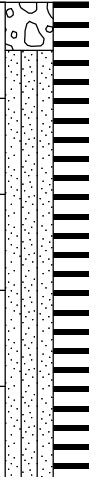
TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING P-2

Sheet 1 of 1

Project Number: **20-6999**  
 Project Name: **2889 Locust Avenue, Rialto**  
 Date Drilled: **2/19/20 - 2/19/20**  
 Ground Elev:

Logged By: **RA**  
 Project Engineer: **SG**  
 Drill Type: **Hollow Stem**  
 Drive Wt & Drop: **140lbs / 30in**

Depth (ft)	Graphic Log	FIELD RESULTS					LAB RESULTS				
		Bulk Sample	Drive Sample	SPT blows/ft (or equivalent N)	Pocket Pen (tsf)	USCS	 Shelby Tube	 Standard Split Spoon	 No recovery		
							 Modified California	 Water Table ATD			
SUMMARY OF SUBSURFACE CONDITIONS							Moisture Content (%)	Dry Density, (pcf)	Other Tests		
5					SM	Surface is dirt, gravel, cobbles and boulders.					-200=8.5%
						Silty Sand and Gravel- light brown, dry, very dense, fine grained sand, fine to coarse grained gravel, cobbles.					
						Total Depth: 5 feet. No groundwater encountered during drilling. No caving observed. Boring utilized for percolation testing Boring backfilled with soil cuttings upon completion.					
10											

LOG OF BORING 20-6999 XEBEC RIALTO.GPJ TGR GEOTECH.GDT 2/27/20

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 9**



TGR GEOTECHNICAL, INC.



## **APPENDIX C LABORATORY TEST RESULTS**

## APPENDIX C

### Laboratory Testing Procedures and Results

**Moisture and Density Determination Tests:** Moisture content and dry density determinations were performed on relatively undisturbed samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from "undisturbed" or disturbed samples.

**Maximum Density Tests:** The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM Test Method D1557. The results of these tests are presented in the table below:

Sample Location	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-1 @ 0-5 feet	Silty Sand and Gravel	135.5	6.0

**Direct Shear Tests:** Direct shear test was performed on selected remolded and/or undisturbed sample, which was soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1-hour prior to application of shearing force. The sample was tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.001 to 0.5 inches per minute (depending upon the soil type). The test results are presented in the test data and in the table below:

Sample Location	Sample Description	Friction Angle (degrees)	Apparent Cohesion (psf)
B-1 @ 0-5 feet	Silty Sand and Gravel (Remolded)	32	84

**Consolidation Tests (ASTM D2435):** Consolidation test were performed on selected, relatively undisturbed ring samples. Samples were placed in a consolidometer and loads were applied in geometric progression. The percent consolidation for each load cycle was recorded as the ratio of the amount of vertical compression to the original 1-inch height. The consolidation pressure curves are presented in the test data.

**Corrosivity Test:** Electrical conductivity, pH, and soluble chloride tests were conducted on representative samples and the results are presented in the test data and in the table below:

Sample Location	Sample Description	Soluble Chloride (CAL.422) ppm	Electrical Resistivity (CAL.643) (ohm-cm)	PH (CAL.747)	Potential Degree of Attack on Steel
B-1 @ 0-5 feet	Silty Sand and Gravel	59	17,200	6.7	Mild

**Soluble Sulfates:** The soluble sulfate content of selected sample was determined by standard geochemical methods. The test result is presented in the table below:

<b>Sample Location</b>	<b>Sample Description</b>	<b>Water Soluble Sulfate in Soil, (% by Weight)</b>	<b>Sulfate Content (ppm)</b>	<b>Exposure Class*</b>
B-1 @ 0-5 feet	Silty Sand and Gravel	0.0152	152	S0

\* Based on the current version of ACI 318-14 Building Code, Table No. 19.3.1.1; Exposure Categories and Classes.

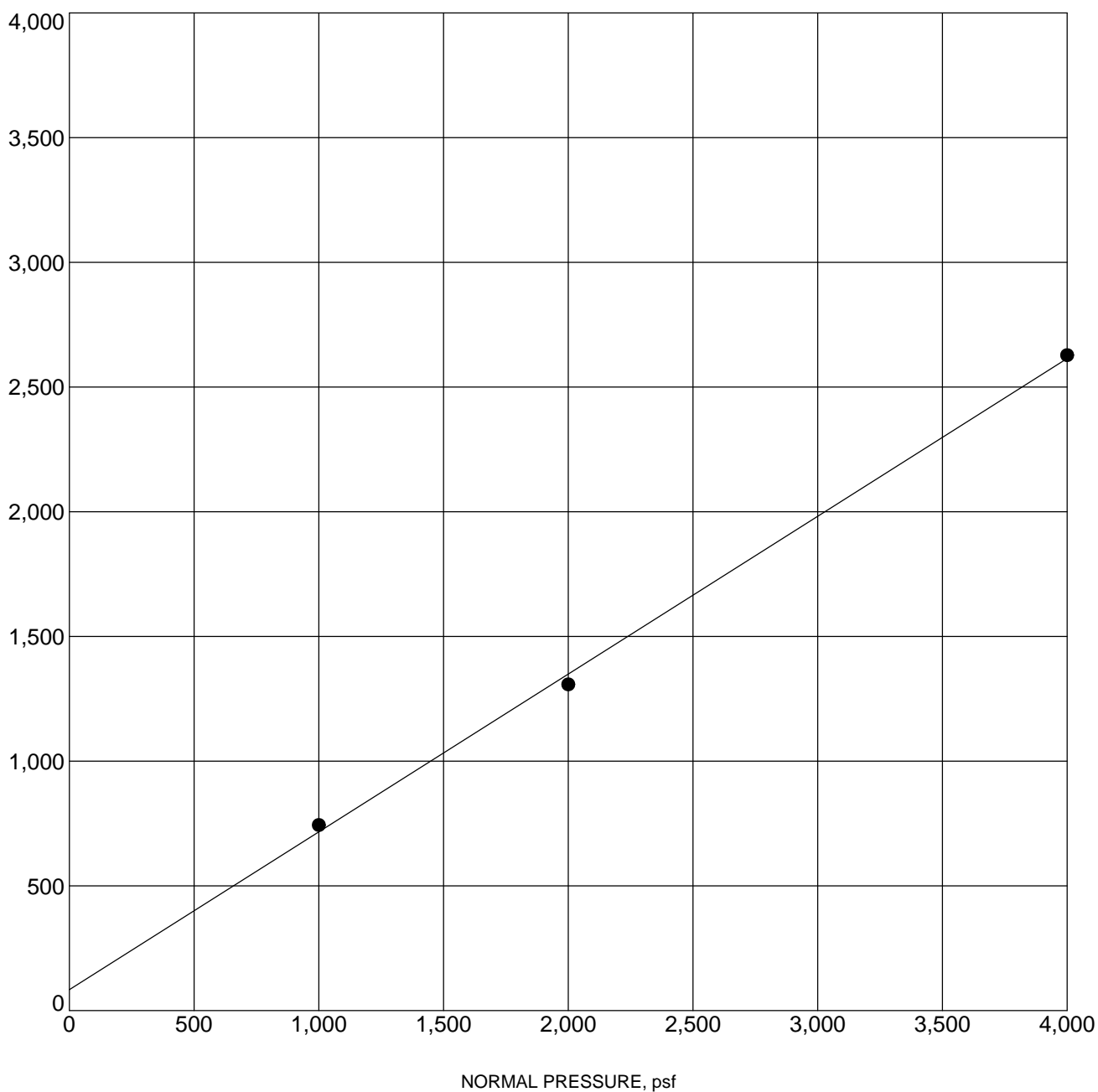
**Wash Sieve Test:** Typical materials were washed over No. 200 sieve (ASTM Test Method D1140). The test results are presented below:

<b>Sample Location</b>	<b>% Passing No. 200 Sieve</b>
P-1 @ 0-5 feet	19.0%
P-2 @ 0-5 feet	8.5%

**R-Value:** The resistance "R"-Value was determined by the California Materials Method No. 301 for subgrade soils. One sample was prepared and exudation pressure and "R"-Value determined. The graphically determined "R"-Value at exudation pressure of 300 psi is presented in the test data and summarized in the table below:

<b>Sample Location</b>	<b>Sample Description</b>	<b>R-Value</b>
B-4 @ 0-5 feet	Silty Sand and Gravel	72

SHEAR STRENGTH, psf



NORMAL PRESSURE, psf

Specimen Identification		Classification	$\gamma_d$	MC%	c	$\phi$
● B-1	0-5	Silty Sand and Gravel - Remolded - 90% RC	122	6	84	32



TGR GEOTECHNICAL, INC.

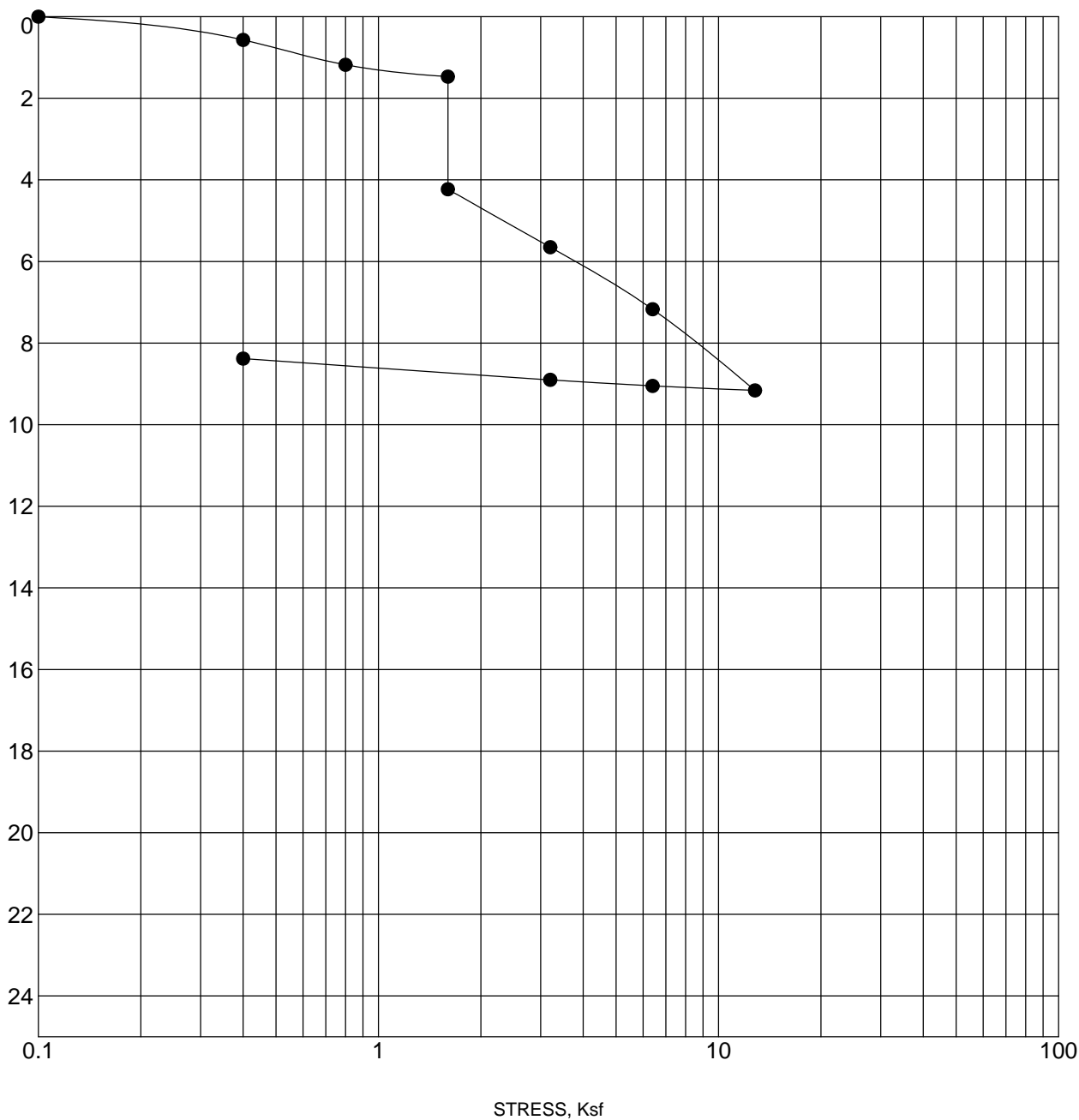
3037 S. Harbor Blvd  
 Santa Ana, CA 92704  
 Telephone: 714-641-7189  
 Fax: 714-641-7190

### DIRECT SHEAR TEST

Project Number: 20-6999

Project Name: 2889 Locust Avenue, Rialto

STRAIN, %



Specimen Identification		Classification	$\gamma_d$	MC%
● B-1	5.0	Silty Sand and Gravel	111	6



TGR GEOTECHNICAL, INC.

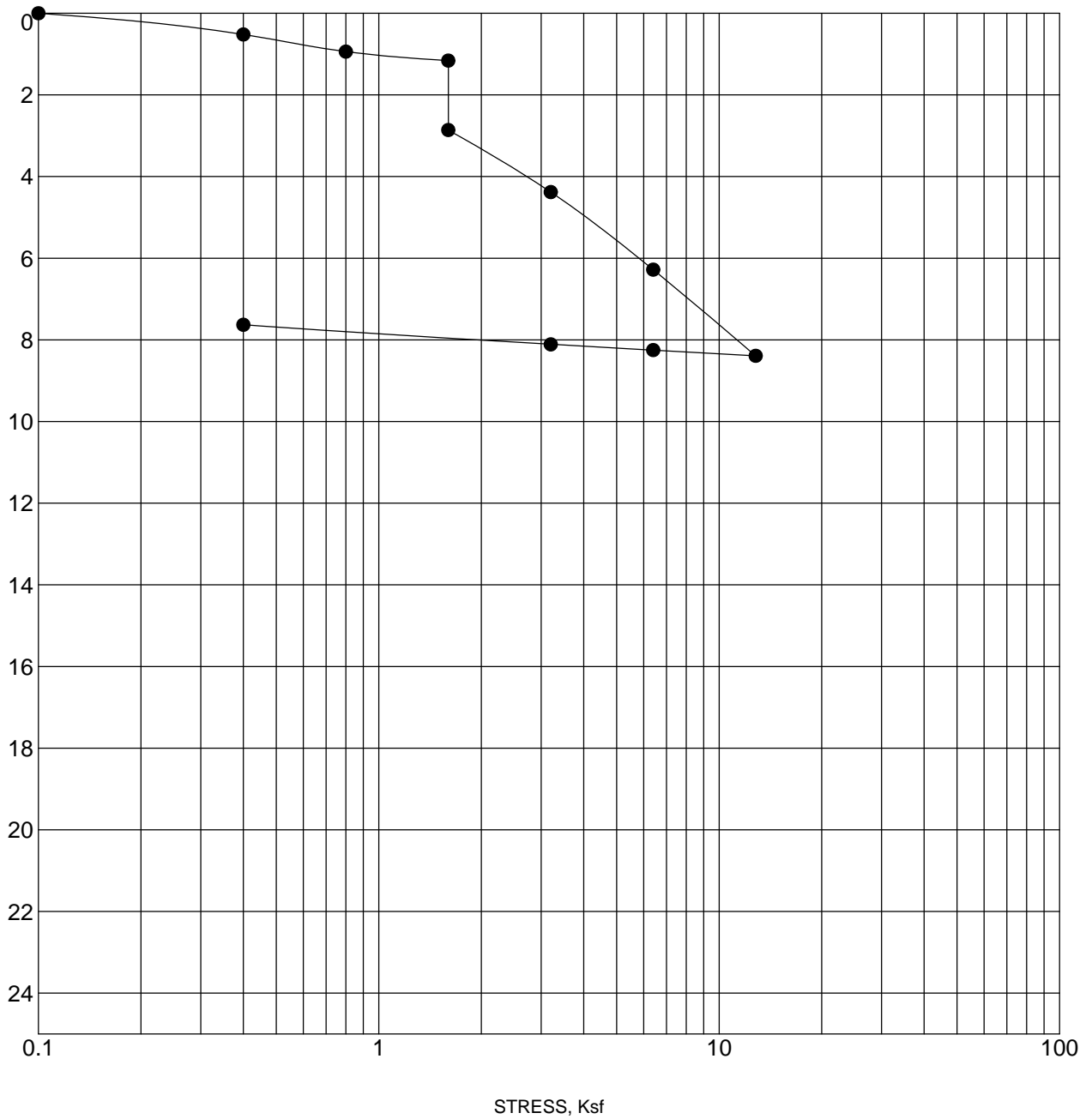
3037 S. Harbor Blvd  
 Santa Ana, CA 92704  
 Telephone: 714-641-7189  
 Fax: 714-641-7190

## CONSOLIDATION TEST

Project Number: 20-6999

Project Name: 2889 Locust Avenue, Rialto

STRAIN, %



Specimen Identification	Classification	$\gamma_d$	MC%
● B-5 5.0	Gravelly Sand	128	2



TGR GEOTECHNICAL, INC.

3037 S. Harbor Blvd  
 Santa Ana, CA 92704  
 Telephone: 714-641-7189  
 Fax: 714-641-7190

## CONSOLIDATION TEST

Project Number: 20-6999

Project Name: 2889 Locust Avenue, Rialto



# ANAHEIM TEST LAB, INC

196 Technology Dr., Unit D  
Irvine, CA 92618  
Phone (949)336-6544

TO:

TGR GEOTECHNICAL  
3037 S. HARBOR BLVD.  
SANTA ANA, CA 92704

DATE: 02/26/2020

P.O. NO: VERBAL

LAB NO: C-3609

SPECIFICATION: CTM-417/422/643

MATERIAL: Soil

Project No.: 20-6999  
Project: XEBEC- Rialto  
Sample ID: B-1 @ 0-5'

## **ANALYTICAL REPORT**

### **CORROSION SERIES**

SUMMARY OF DATA

pH	SOLUBLE SULFATES per CT. 417 ppm	SOLUBLE CHLORIDES per CT. 422 ppm	MIN. RESISTIVITY per CT. 643 ohm-cm
6.7	152	59	17,200

RESPECTFULLY SUBMITTED



WES BRIDGER LAB MANAGER

# ANAHEIM TEST LAB, INC

196 Technology Drive, Unit D  
Irvine, CA 92618  
Phone (949) 336-6544

TO:

TGR GEOTECHNICAL  
3037 S. HARBOR BLVD.  
SANTA ANA, CA. 92704

DATE: 02/26/2020

P.O. NO.: VERBAL

LAB NO.: C-3610

SPECIFICATION: CTM- 301

MATERIAL: Brown, Silty Sand  
w. Gravel

---

Project No.: 20-6999  
Project: XEBEC- Rialto  
Sample ID: B-4 @ 0'-5'

## ANALYTICAL REPORT

### "R" VALUE

BY EXUDATION

BY EXPANSION

72

N/A

RESPECTFULLY SUBMITTED



---

WES BRIDGER LAB MANAGER

# "R" VALUE CA 301

Client: TGR

ATL No.: C-3610

Date: 2/26/2020

Client Reference No.: 20-6999

Sample: B4 @ 0'-5'

Soil Type: Brown, Silty Sand w. Gravel

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	350	350	350	
Initial Moisture Content	%	1.4	1.4	1.4	
Moisture at Compaction	%	10.2	9.8	9.4	
Briquette Height	in.	2.47	2.52	2.53	
Dry Density	pcf	121.0	121.8	123.1	
EXUDATION PRESSURE	psi	146	269	464	
EXPANSION dial	(x .0001)	0	0	0	
Ph at 1000 pounds	psi	20	18	15	
Ph at 2000 pounds	psi	36	32	26	
Displacement	turns	4.3	4.1	3.88	
"R" Value		67	71	77	
CORRECTED "R" VALUE		67	71	77	

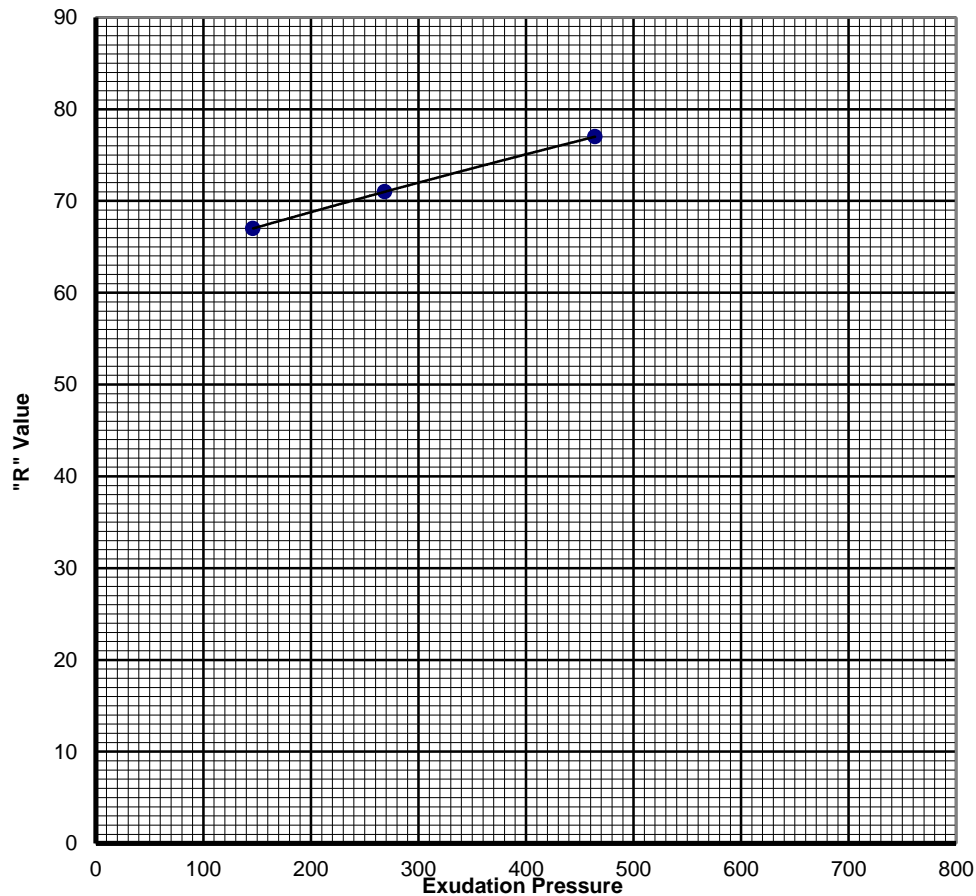
## Final "R" Value

BY EXUDATION:  
@ 300 psi

72

BY EXPANSION:  
TI = 5.0

N/A



**APPENDIX D**  
**SITE SEISMIC DESIGN AND DE-AGGREGATED PARAMETERS**

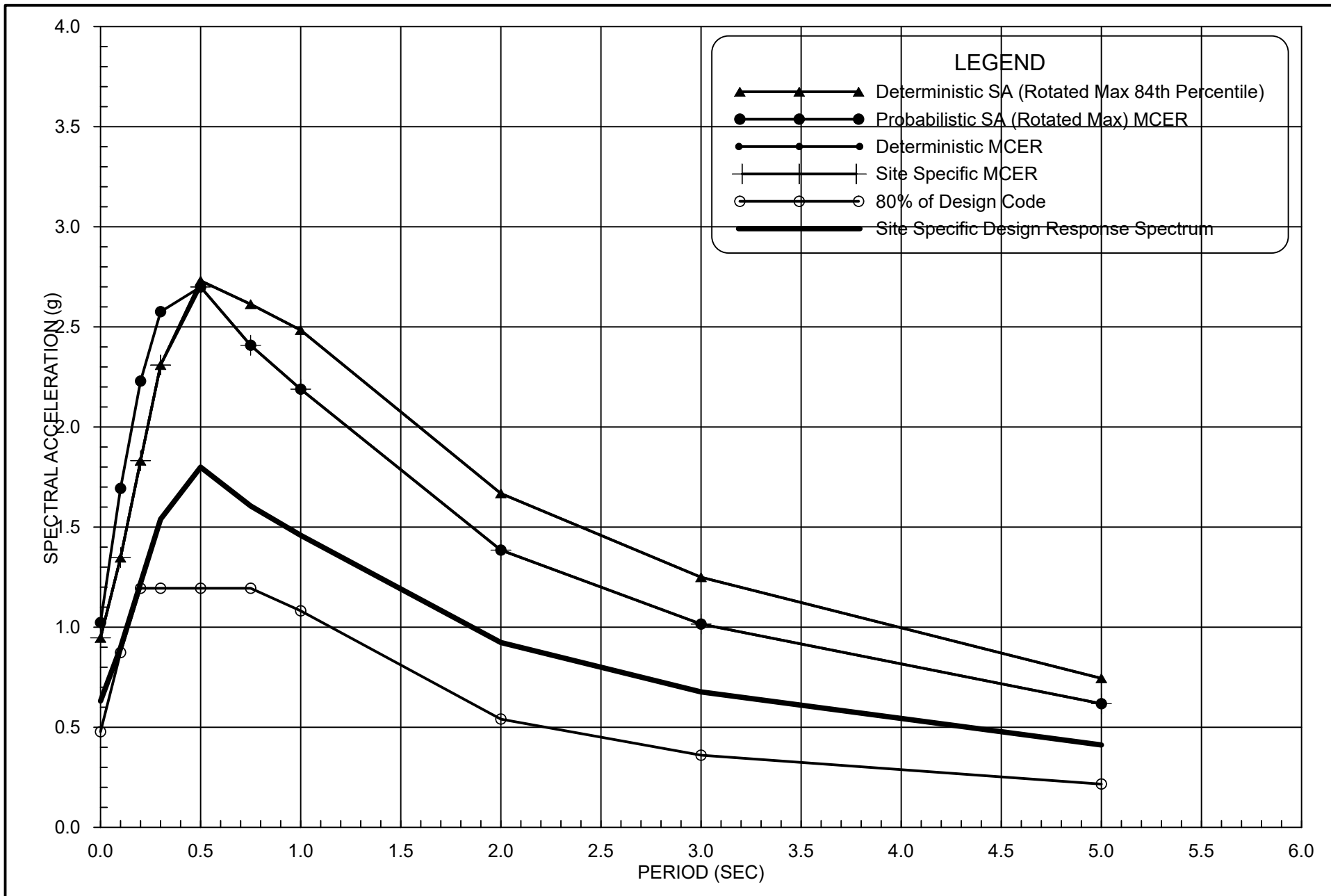
**TABLE 1**  
**SITE SPECIFIC GROUND MOTION ANALYSIS**

20-6999 Xebec Rialto

SA Period (sec)	Probabilistic Spectral Acceleration (g)	Risk Coefficients	Probabilistic Spectral Acceleration MCER (g)	Deterministic Spectral Acceleration (g)	Is Largest Deterministic Spectral Acceleration <1.5*Fa	Deterministic MCER	Site Specific MCER	2/3 of Spite Specific MCER	80% Code Design	Site Specific Design Response Spectrum
	Rotated Maximum		Rotated Maximum	Rotated Maximum 84th Percentile						
0	1.1132	0.919	1.0230	0.9465	No	0.9465	0.9465	0.6310	0.4777	0.6310
0.1	1.8425	0.919	1.6933	1.3468		1.3468	1.3468	0.8979	0.8733	0.8979
0.2	2.4255	0.919	2.2290	1.8311		1.8311	1.8311	1.2207	1.1941	1.2207
0.3	2.8058	0.918	2.5757	2.3088		2.3088	2.3088	1.5392	1.1941	1.5392
0.5	2.9469	0.916	2.6994	2.7305		2.7305	2.6994	1.7996	1.1941	1.7996
0.75	2.6359	0.914	2.4079	2.6131		2.6131	2.4079	1.6052	1.1941	1.6052
1	2.4024	0.911	2.1886	2.4838		2.4838	2.1886	1.4591	1.0813	1.4591
2	1.5201	0.911	1.3848	1.6680		1.6680	1.3848	0.9232	0.5407	0.9232
3	1.1144	0.911	1.0152	1.2494		1.2494	1.0152	0.6768	0.3604	0.6768
5	0.6780	0.911	0.6177	0.7445		0.7445	0.6177	0.4118	0.2163	0.4118

Code Sds	1.493	Crs =	0.919	Code Ss =	2.239
Code Sd1	1.352	Cr1 =	0.911	Code S1 =	0.811
To	0.18	Code Fa =	1	Sms =	2.239
Ts	0.91	Code Fv =	2.5	Sm1 =	2.0275
TL	12				
Input					

**Site Specific Sds = 1.620**  
**Site Specific Sd1 = 2.059**



Geotechnical  
Environmental  
Hydrogeology  
Material Testing  
Construction Inspection

TGR GEOTECHNICAL  
3037 S. HARBOR BLVD  
SANTA ANA, CA 92704  
www.tgrgeotech.com  
info@tgrgeotech.com  
p: 714.641.7189  
f: 714.641.7190

## SITE SPECIFIC DESIGN RESPONSE SPECTRA XEBEC - RIALTO

Project No.: 20-6999

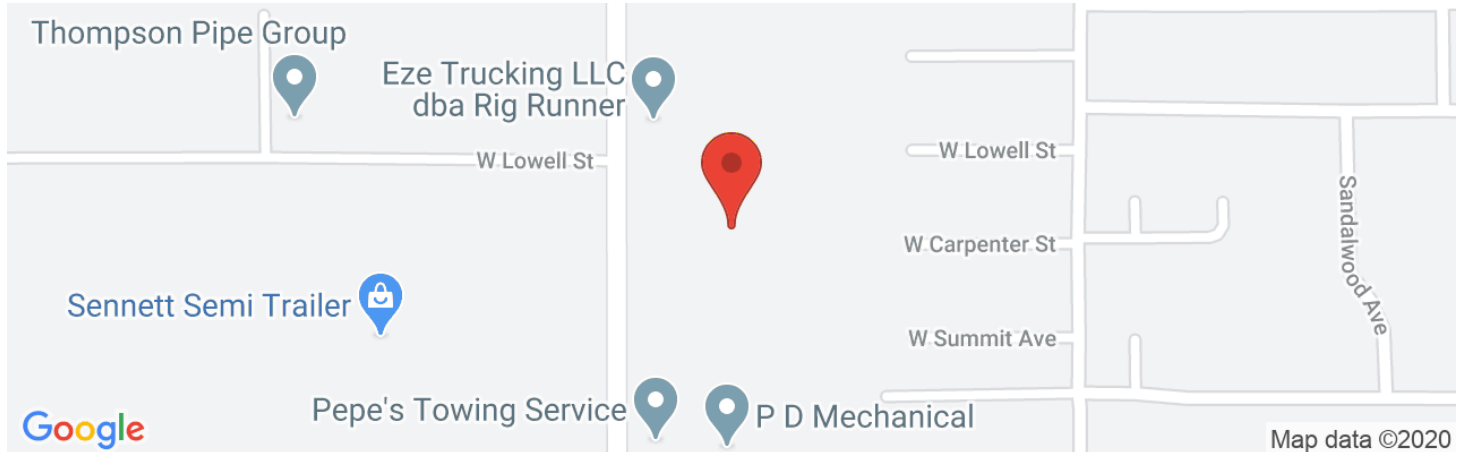
**FIGURE 1**





# 2889 Locust Avenue, Rialto

Latitude, Longitude: 34.1518, -117.4087



Date	2/21/2020, 3:29:18 PM
Design Code Reference Document	ASCE7-16
Risk Category	III
Site Class	D - Stiff Soil


Type	Value	Description
$S_S$	2.239	$MCE_R$ ground motion. (for 0.2 second period)
$S_1$	0.811	$MCE_R$ ground motion. (for 1.0s period)
$S_{MS}$	2.239	Site-modified spectral acceleration value
$S_{M1}$	null -See Section 11.4.8	Site-modified spectral acceleration value
$S_{DS}$	1.492	Numeric seismic design value at 0.2 second SA
$S_{D1}$	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
$F_a$	1	Site amplification factor at 0.2 second
$F_v$	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.919	$MCE_G$ peak ground acceleration
$F_{PGA}$	1.1	Site amplification factor at PGA
$PGA_M$	1.011	Site modified peak ground acceleration
$T_L$	12	Long-period transition period in seconds
$S_{sRT}$	2.552	Probabilistic risk-targeted ground motion. (0.2 second)
$S_{sUH}$	2.802	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
$S_{sD}$	2.239	Factored deterministic acceleration value. (0.2 second)
$S_{1RT}$	1.028	Probabilistic risk-targeted ground motion. (1.0 second)
$S_{1UH}$	1.157	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
$S_{1D}$	0.811	Factored deterministic acceleration value. (1.0 second)
$PGAd$	0.919	Factored deterministic acceleration value. (Peak Ground Acceleration)
$C_{RS}$	0.911	Mapped value of the risk coefficient at short periods
$C_{R1}$	0.888	Mapped value of the risk coefficient at a period of 1 s

## DISCLAIMER

While the information presented on this website is believed to be correct, SEAOC / OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this website.

# Unified Hazard Tool



Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the [U.S. Seismic Design Maps web tools](#) (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

^ Input

Edition

Dynamic: Conterminous U.S. 2014 (update) (v4.2.0)

Latitude

Decimal degrees

34.1518

Longitude

Decimal degrees, negative values for western longitudes

-117.4087

Site Class

259 m/s (Site class D)

Spectral Period

Peak Ground Acceleration

Time Horizon

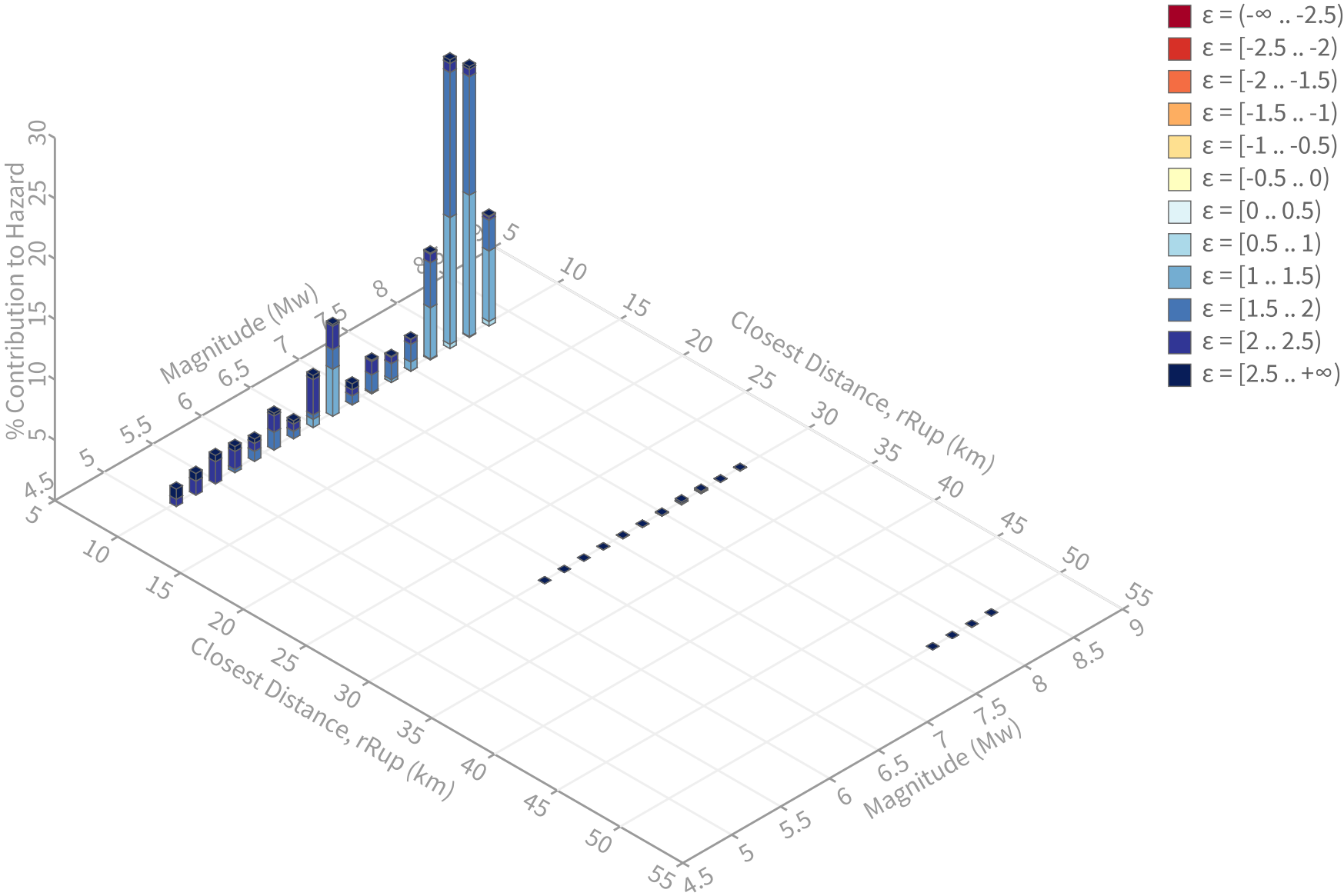
Return period in years

2475

^ Deaggregation

Component

Total



# Summary statistics for, Deaggregation: Total

## Deaggregation targets

**Return period:** 2475 yrs  
**Exceedance rate:** 0.0004040404 yr<sup>-1</sup>  
**PGA ground motion:** 1.0490641 g

## Totals

**Binned:** 100 %  
**Residual:** 0 %  
**Trace:** 0.02 %

## Mode (largest m-r bin)

**m:** 7.9  
**r:** 5.72 km  
**ε<sub>0</sub>:** 1.5 σ  
**Contribution:** 23.89 %

## Discretization

**r:** min = 0.0, max = 1000.0, Δ = 20.0 km  
**m:** min = 4.4, max = 9.4, Δ = 0.2  
**ε:** min = -3.0, max = 3.0, Δ = 0.5 σ

## Recovered targets

**Return period:** 3277.103 yrs  
**Exceedance rate:** 0.00030514756 yr<sup>-1</sup>

## Mean (over all sources)

**m:** 7.44  
**r:** 6.16 km  
**ε<sub>0</sub>:** 1.66 σ

## Mode (largest m-r-ε<sub>0</sub> bin)

**m:** 7.91  
**r:** 7.89 km  
**ε<sub>0</sub>:** 1.7 σ  
**Contribution:** 12.01 %

## Epsilon keys

**ε0:** [-∞ .. -2.5)  
**ε1:** [-2.5 .. -2.0)  
**ε2:** [-2.0 .. -1.5)  
**ε3:** [-1.5 .. -1.0)  
**ε4:** [-1.0 .. -0.5)  
**ε5:** [-0.5 .. 0.0)  
**ε6:** [0.0 .. 0.5)  
**ε7:** [0.5 .. 1.0)  
**ε8:** [1.0 .. 1.5)  
**ε9:** [1.5 .. 2.0)  
**ε10:** [2.0 .. 2.5)  
**ε11:** [2.5 .. +∞]

Deaggregation Contributors

Source Set	Source	Type	r	m	$\epsilon_0$	lon	lat	az	%
UC33brAvg_FM31		System							43.47
	San Andreas (San Bernardino N) [3]		8.61	7.69	1.81	117.360°W	34.218°N	31.69	15.60
	San Jacinto (San Bernardino) [1]		4.03	8.02	1.36	117.379°W	34.177°N	44.05	14.26
	San Jacinto (Lytle Creek connector) [1]		1.69	7.97	1.17	117.406°W	34.156°N	29.45	5.23
	Fontana (Seismicity) [0]		1.75	6.61	1.40	117.411°W	34.146°N	201.70	3.52
	Cucamonga [0]		5.69	7.36	1.60	117.445°W	34.192°N	323.39	1.92
UC33brAvg_FM32		System							42.71
	San Andreas (San Bernardino N) [3]		8.61	7.71	1.80	117.360°W	34.218°N	31.69	15.71
	San Jacinto (San Bernardino) [1]		4.03	8.01	1.36	117.379°W	34.177°N	44.05	14.18
	San Jacinto (Lytle Creek connector) [1]		1.69	7.97	1.17	117.406°W	34.156°N	29.45	5.24
	Fontana (Seismicity) [0]		1.75	6.61	1.40	117.411°W	34.146°N	201.70	2.88
	Cucamonga [0]		5.69	7.38	1.59	117.445°W	34.192°N	323.39	1.80
UC33brAvg_FM31 (opt)		Grid							6.91
	PointSourceFinite: -117.409, 34.201		7.46	5.65	2.18	117.409°W	34.201°N	0.00	2.72
	PointSourceFinite: -117.409, 34.201		7.46	5.65	2.18	117.409°W	34.201°N	0.00	2.72
UC33brAvg_FM32 (opt)		Grid							6.91
	PointSourceFinite: -117.409, 34.201		7.46	5.65	2.18	117.409°W	34.201°N	0.00	2.72
	PointSourceFinite: -117.409, 34.201		7.46	5.65	2.18	117.409°W	34.201°N	0.00	2.72



## **APPENDIX E STANDARD GRADING GUIDELINES**

## **STANDARD GRADING SPECIFICATIONS**

These specifications present the usual and minimum requirements for grading operations performed under the observation and testing of TGR Geotechnical, Inc.

No deviation from these specifications will be allowed, except where specifically superseded in the Preliminary Geotechnical Investigation report, or in other written communication signed by the Soils Engineer or Engineering Geologist.

### **1.0 GENERAL**

- The Soils Engineer and Engineering Geologist are the Owner's or Builder's representatives on the project. For the purpose of these specifications, observation and testing by the Soils Engineer includes that observation and testing performed by any person or persons employed by, and responsible to, the licensed Geotechnical Engineer or Geologist signing the grading report.
- All clearing, site preparation or earthwork performed on the project shall be conducted by the Contractor under the observation of the Geotechnical Engineer.
- It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Geotechnical Engineer and to place, spread, mix, water and compact the fill in accordance with the specifications of the Geotechnical Engineer. The Contractor shall also remove all material considered unsatisfactory by the Geotechnical Engineer.
- It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of Compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement and time of year.
- A final report will be issued by the Geotechnical Engineer and Engineering Geologist attesting to the Contractor's conformance with these specifications.

**2.0 SITE PREPARATION**

- All vegetation and deleterious material such as rubbish shall be disposed of off-site. The removal must be concluded prior to placing fill.
- The Civil Engineer shall locate all houses, sheds, sewage disposal systems, large trees or structures on the site, or on the grading plan to the best of his knowledge prior to preparing the ground surface.
- Soil, alluvium or rock materials determined by the Geotechnical Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as part of a compacted fill must be approved by the Geotechnical Engineer.
- After the ground surface to receive fill has been cleared, it shall be scarified, disced or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks or other uneven features which may prevent uniform compaction.

The scarified ground surface shall then be brought to optimum moisture content, mixed as required, and compacted as specified. If the scarified zone is greater than twelve inches in depth, the excess shall be removed and placed in lifts restricted to six inches. Prior to placing fill, the ground surface to receive fill shall be inspected, tested and approved by the Geotechnical Engineer.

- Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines or others not located prior to grading are to be removed or treated in a manner prescribed by the Geotechnical Engineer.

**3.0 COMPACTED FILLS**

- Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Geotechnical Engineer. Roots, tree branches and other matter missed during clearing shall be removed from the fill as directed by the Geotechnical Engineer.
- Rock fragments less than six inches in diameter may be utilized in the fill, provided:

- They are not placed in concentrated pockets.
  - There is a sufficient percentage of fine-grained material to surround the rocks.
  - The distribution of the rocks is observed by the Geotechnical Engineer.
- Rocks greater than six inches in diameter shall be taken off-site, or placed in accordance with the recommendations of the Geotechnical Engineer in areas designated as suitable for rock disposal. Details for rock disposal such as location, moisture control, percentage of the rock placed, etc., will be referred to in the “Conclusions and Recommendations” section of the Geotechnical Report, if applicable.

If rocks greater than six inches in diameter were not anticipated in the Preliminary Geotechnical report, rock disposal recommendations may not have been made in the “Conclusions and Recommendations” section. In this case, the Contractor shall notify the Geotechnical Engineer if rocks greater than six inches in diameter are encountered. The Geotechnical Engineer will then prepare a rock disposal recommendation or request that such rocks be taken off-site.

- Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.
- Representative samples of materials to be utilized as compacted fill shall be analyzed in the laboratory by the Geotechnical Engineer to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Geotechnical Engineer as soon as possible.
- Material used in the compacting process shall be evenly spread, watered or dried, processed and compacted in thin lifts not to exceed six inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Engineer.

- If the moisture content or relative compaction varies from that required by the Geotechnical Engineer, the Contractor shall rework the fill until it is approved by the Geotechnical Engineer.
- Each layer shall be compacted to 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency; (in general, ASTM D1557 will be used.)

If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use or expansive soil conditions, the area to receive fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the grading report.

- All fill shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of five horizontal to one vertical, in accordance with the recommendations of the Geotechnical Engineer.
- The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the Preliminary report. (See details)
- Drainage terraces and subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, or with the recommendation of the Geotechnical Engineer and Engineer Geologist.
- The Contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes, buttresses and stabilization fills. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction.

The Contractor shall prepare a written detailed description of the method or methods he will employ to obtain the required slope compaction. Such documents shall be submitted to the Geotechnical Engineer for review and comments prior to the start of grading.

If a method other than overbuilding and cutting back to the compacted core is to be employed, slope tests will be made by the Geotechnical Engineer during construction of the slopes to determine if the required compaction is being achieved. Where failing tests occur or other field problems arise, the contractor will be notified by the Geotechnical Engineer.

If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor shall rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Geotechnical Engineer.

- All fill slopes should be planted or protected from erosion by methods specified in the preliminary report or by means approved by the governing authorities.
- Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials; and the transition shall be stripped of all soil prior to placing fill. (See detail)

#### **4.0 CUT SLOPES**

- The Engineering Geologist shall inspect all cut slopes excavated in rock, lithified or formation material at vertical intervals not exceeding ten feet.
- If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these



conditions shall be analyzed by the Engineering Geologist and Geotechnical Engineer; and recommendations shall be made to treat these problems.

- Cut slopes that face in the same direction as the prevailing drainage shall be protected from slope wash by a non-erosive interceptor swale placed at the top of the slope.
- Unless otherwise specified in the soils and geological report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.
- Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Geotechnical Engineer or Engineering Geologist.

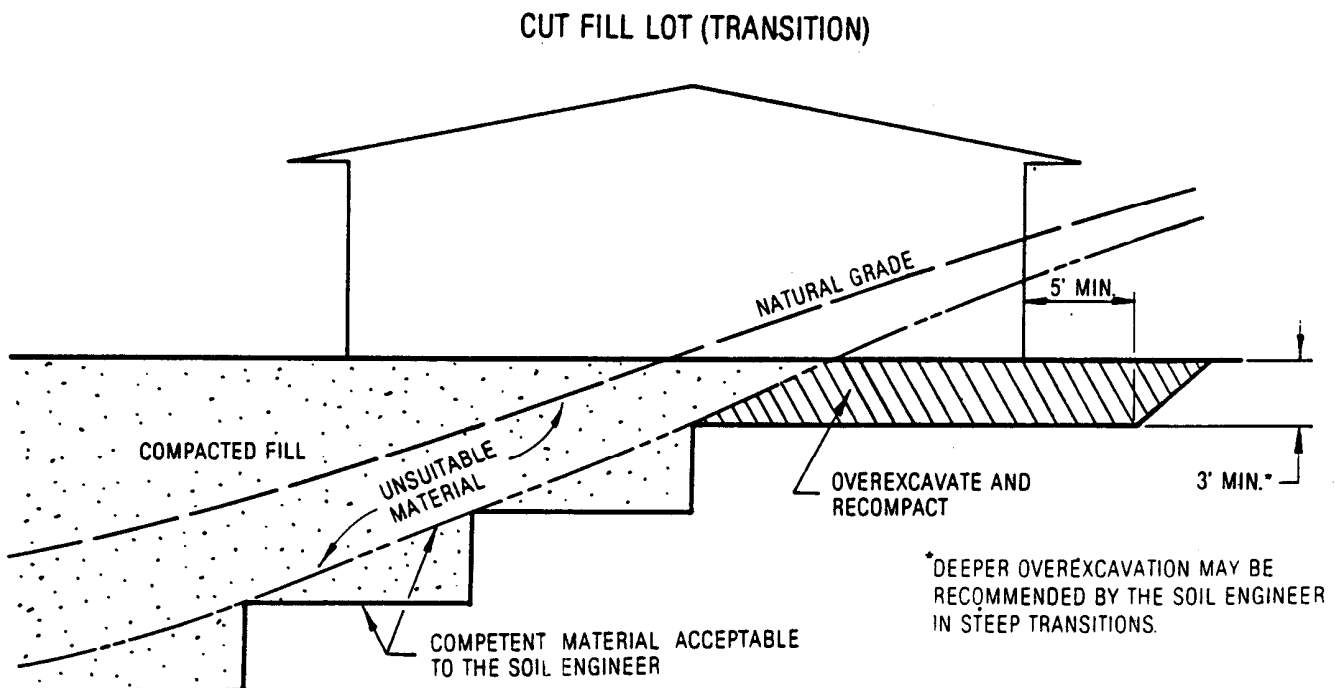
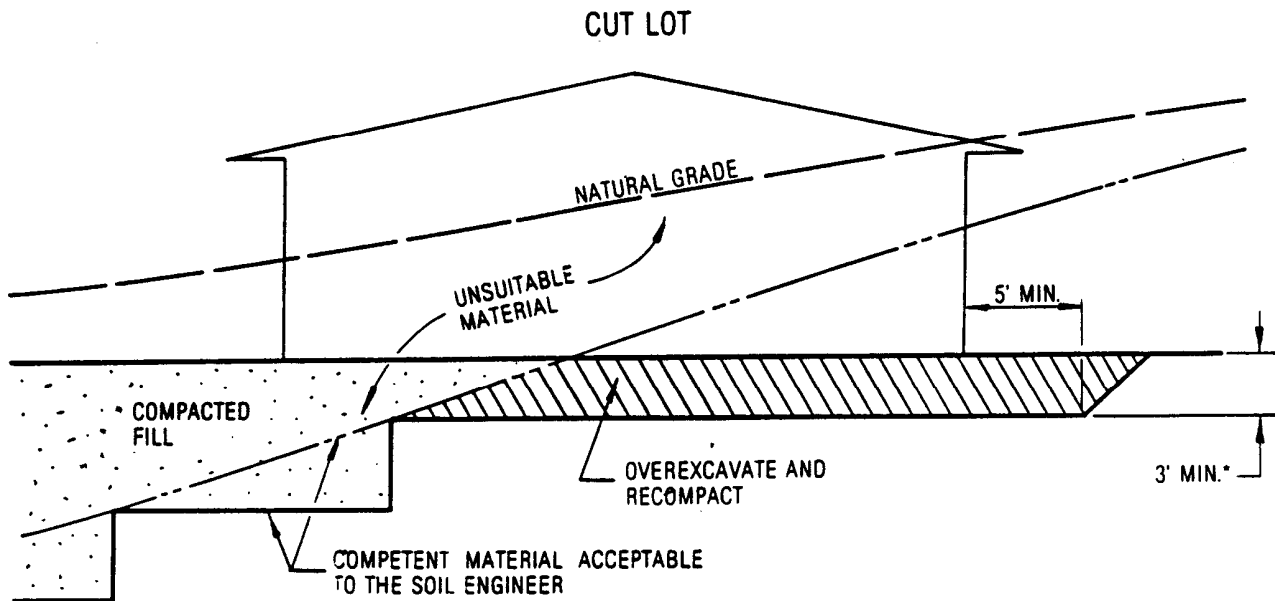
## **5.0 GRADING CONTROL**

- Inspection of the fill placement shall be provided by the Geotechnical Engineer during the progress of grading.
- In general, density tests should be made at intervals not exceeding two feet of fill height or every 500 cubic yards of fill placed. This criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction of being achieved.
- Density tests should be made on the surface material to receive fill as required by the Geotechnical Engineer.
- All cleanout, processed ground to receive fill, key excavations, subdrains and rock disposal must be inspected and approved by the Geotechnical Engineer (and often by the governing authorities) prior to placing any fill. It shall be the Contractor's responsibility to notify the Geotechnical Engineer and governing authorities when such areas are ready for inspection.

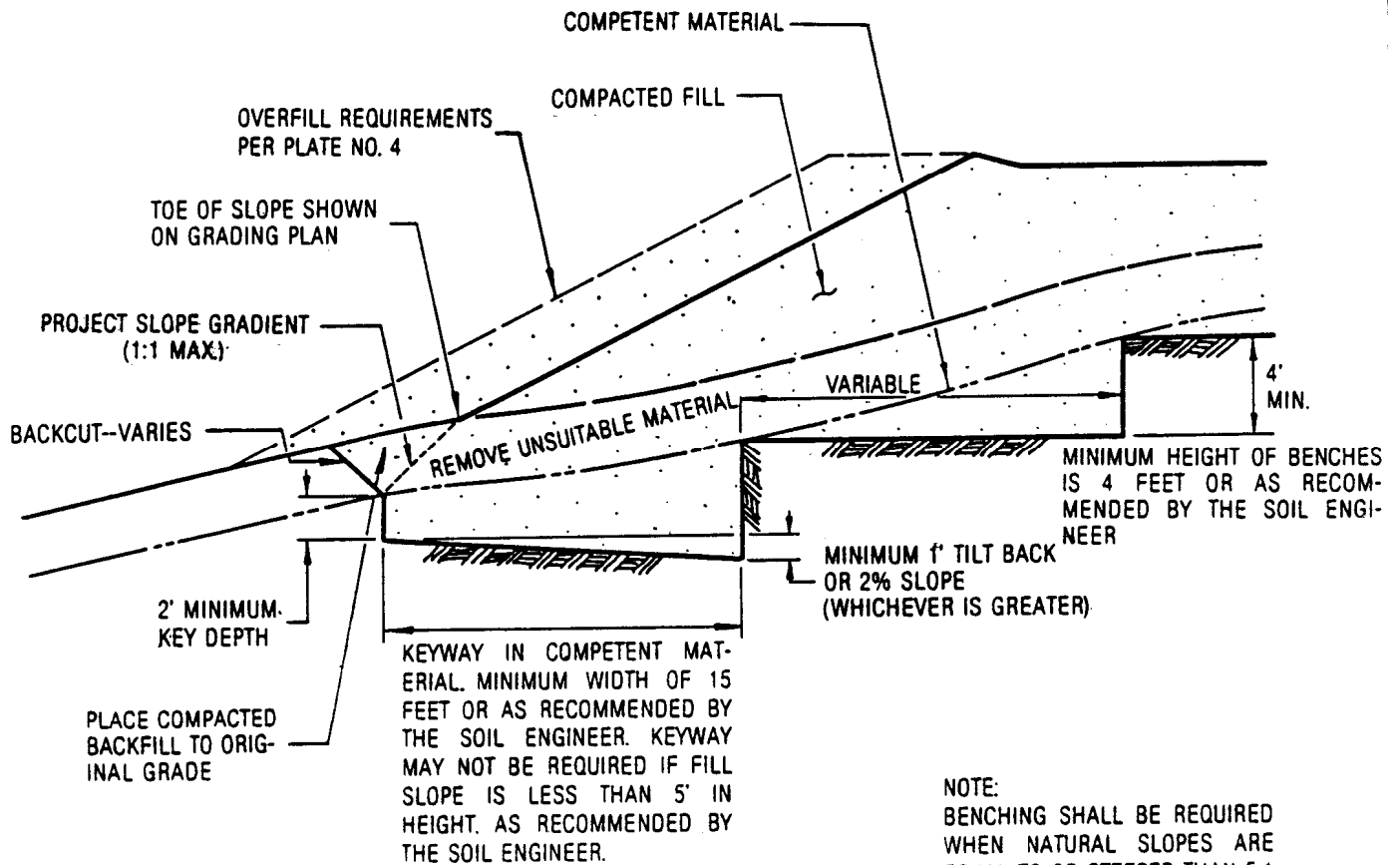
**6.0 CONSTRUCTION CONSIDERATIONS**

- Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.
- Upon completion of grading and termination of observations by the Geotechnical Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Geotechnical Engineer or Engineering Geologist.
- Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.

# TYPICAL OVEREXCAVATION OF DAYLIGHT LINE

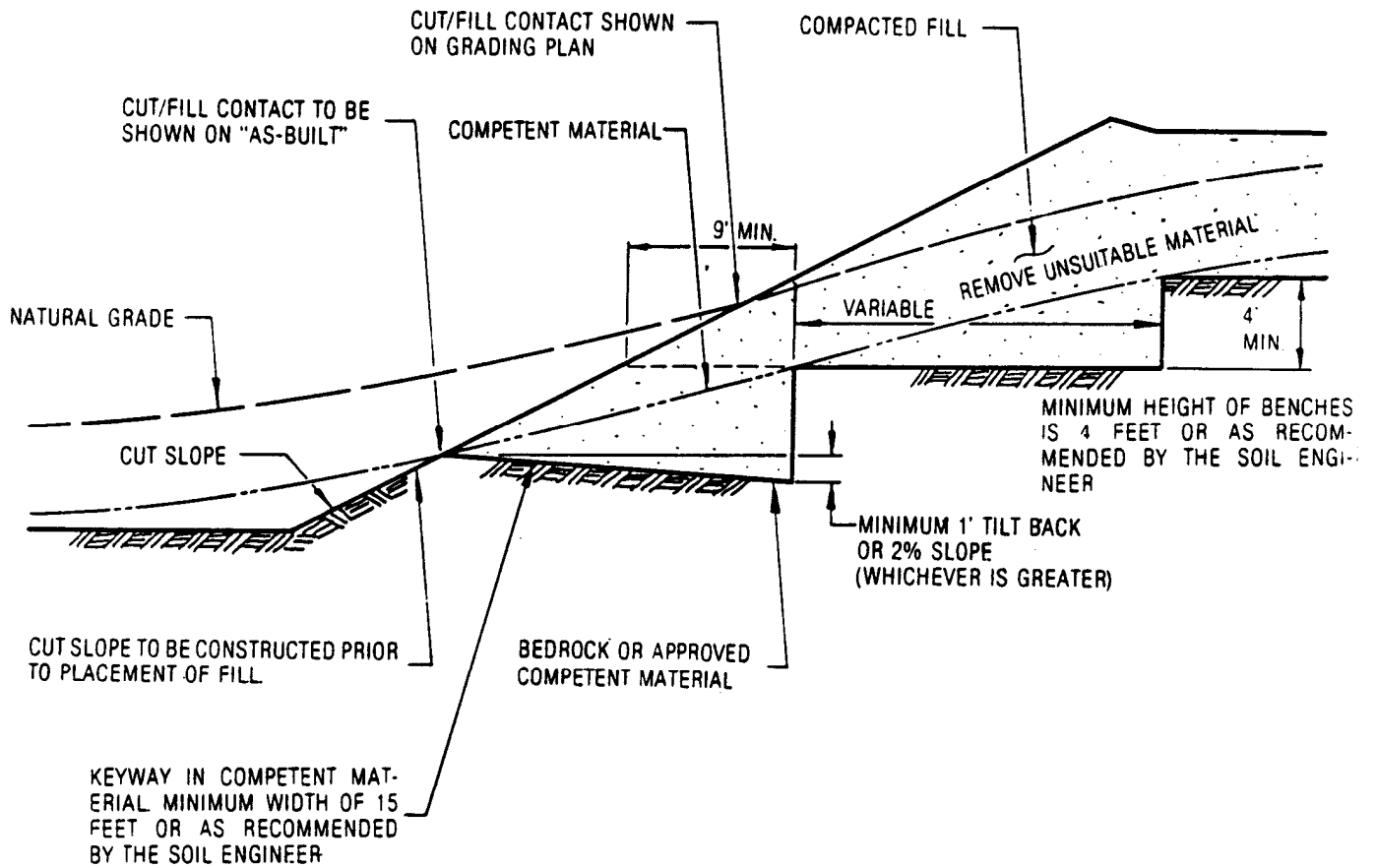


# TYPICAL FILL OVER NATURAL SLOPE

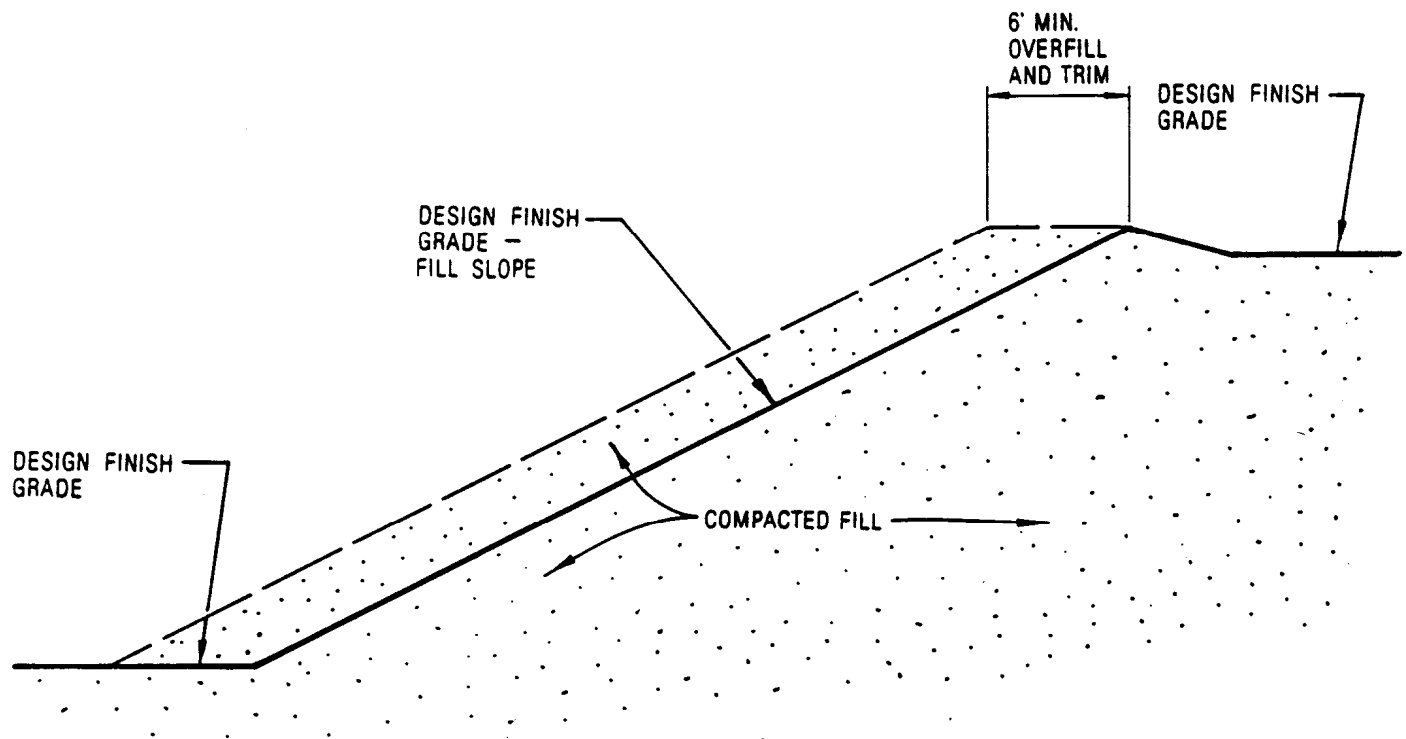


NOTE:  
BENCHING SHALL BE REQUIRED  
WHEN NATURAL SLOPES ARE  
EQUAL TO OR STEEPER THAN 5:1  
OR WHEN RECOMMENDED BY  
THE SOIL ENGINEER.

# TYPICAL FILL-OVER-CUT SLOPE



# TYPICAL FILL SLOPE CONSTRUCTION

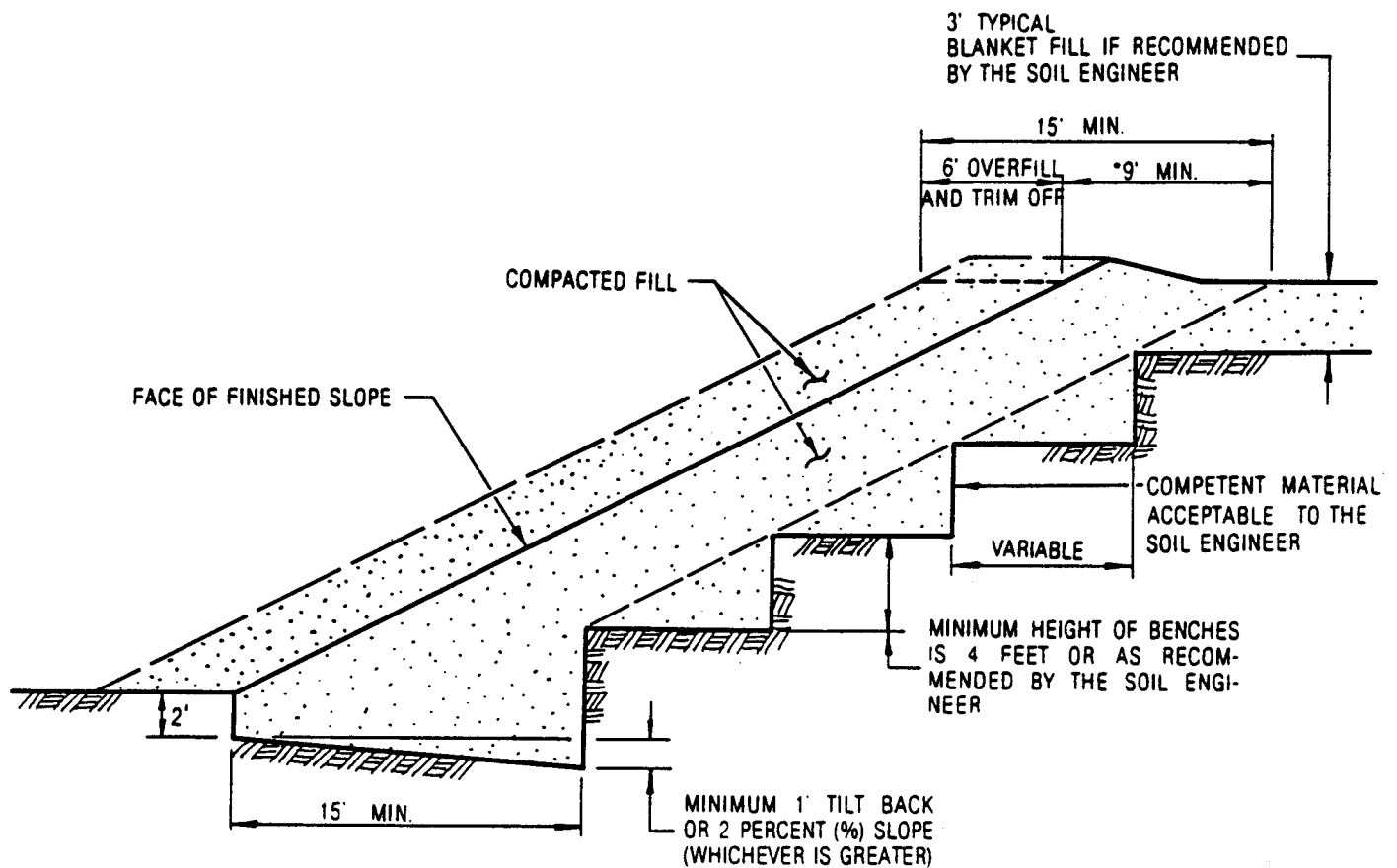


## NOTES:

1. ALL FILL SLOPES, INCLUDING BUTTRESS AND STABILIZATION FILLS, SHALL BE OVERFILLED A MINIMUM OF SIX FEET HORIZONTALLY WITH COMPACTED FILL AND TRIMMED TO THE DESIGN FINISH GRADE.  
EXCEPTIONS:  
A. FILL SLOPE OVER CUT SLOPE.  
B. FILL SLOPE ADJACENT TO EXISTING IMPROVEMENTS.
2. THE EXCEPTIONS ABOVE WHICH DO NOT HAVE THE 6 FOOT SLOPE OVERFILL AND TRIM SHALL BE COMPACTED AS STATED IN THE PROJECT SPECIFICATIONS.



# TYPICAL STABILIZATION FILL

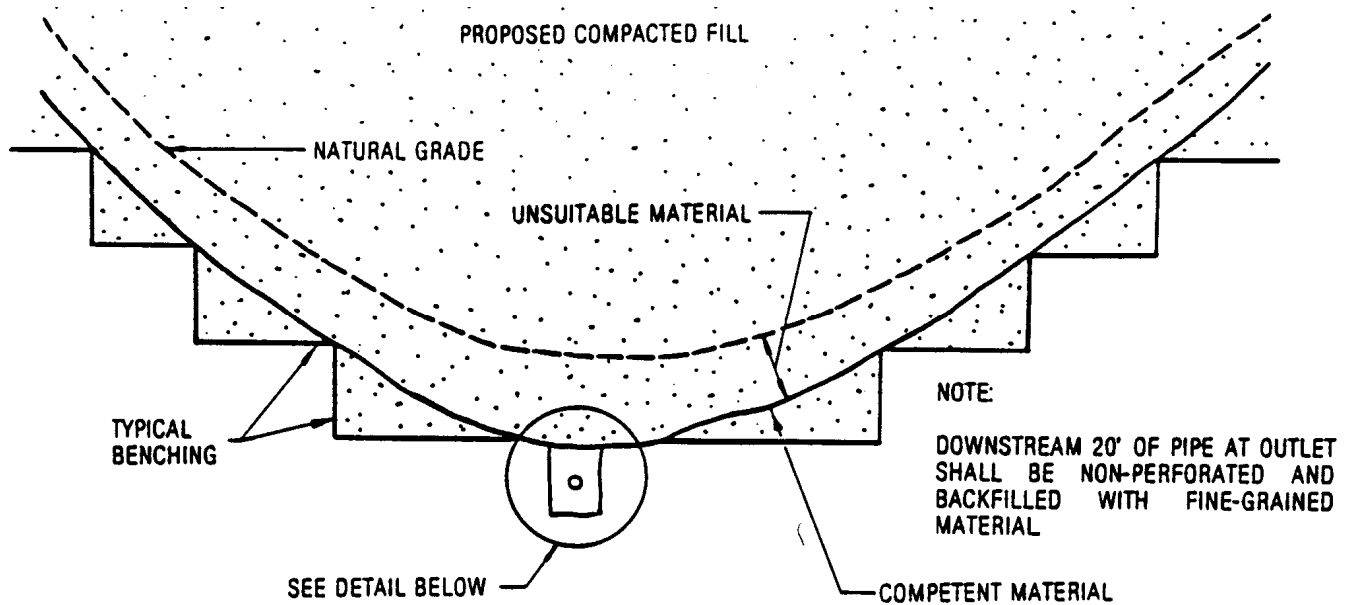


## NOTE:

SEE PLATE 6 FOR TYPICAL SUBDRAIN DETAILS FOR STABILIZATION FILLS. IF RECOMMENDED BY THE SOIL ENGINEER.

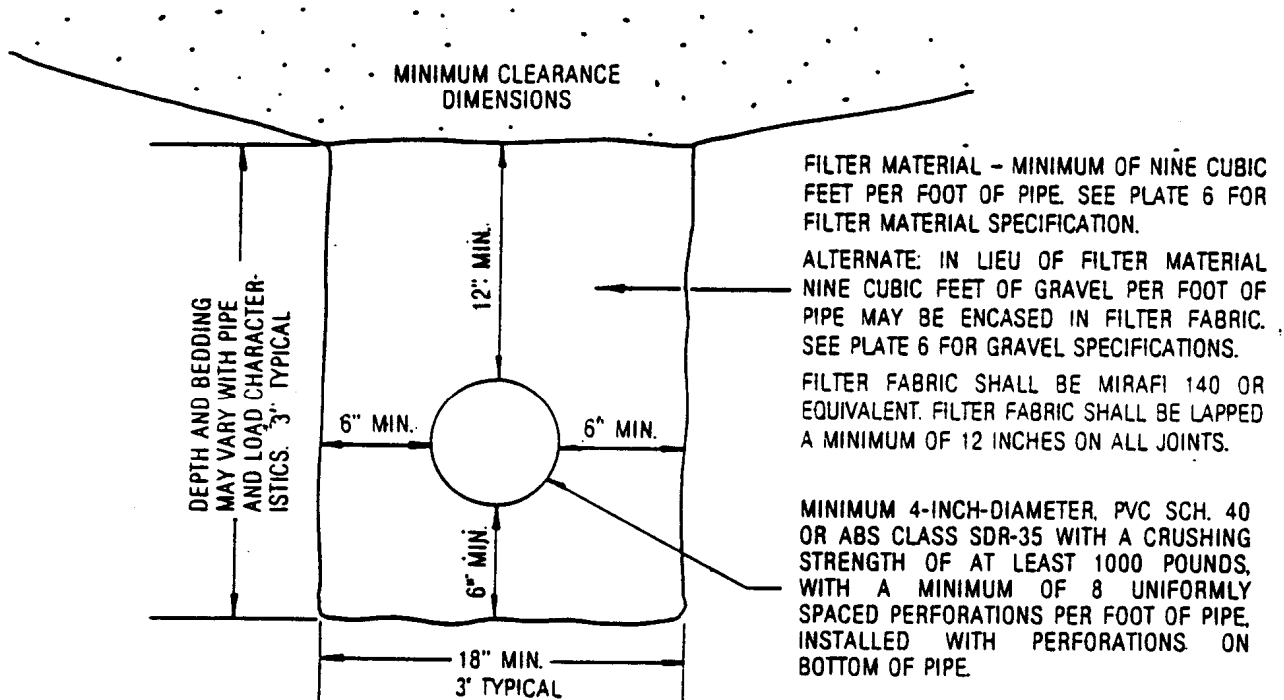
\*GREATER THAN 9' IF RECOMMENDED BY THE SOIL ENGINEER.  
15' WHERE NO 6' OVERFILL

# TYPICAL CANYON SUBDRAIN

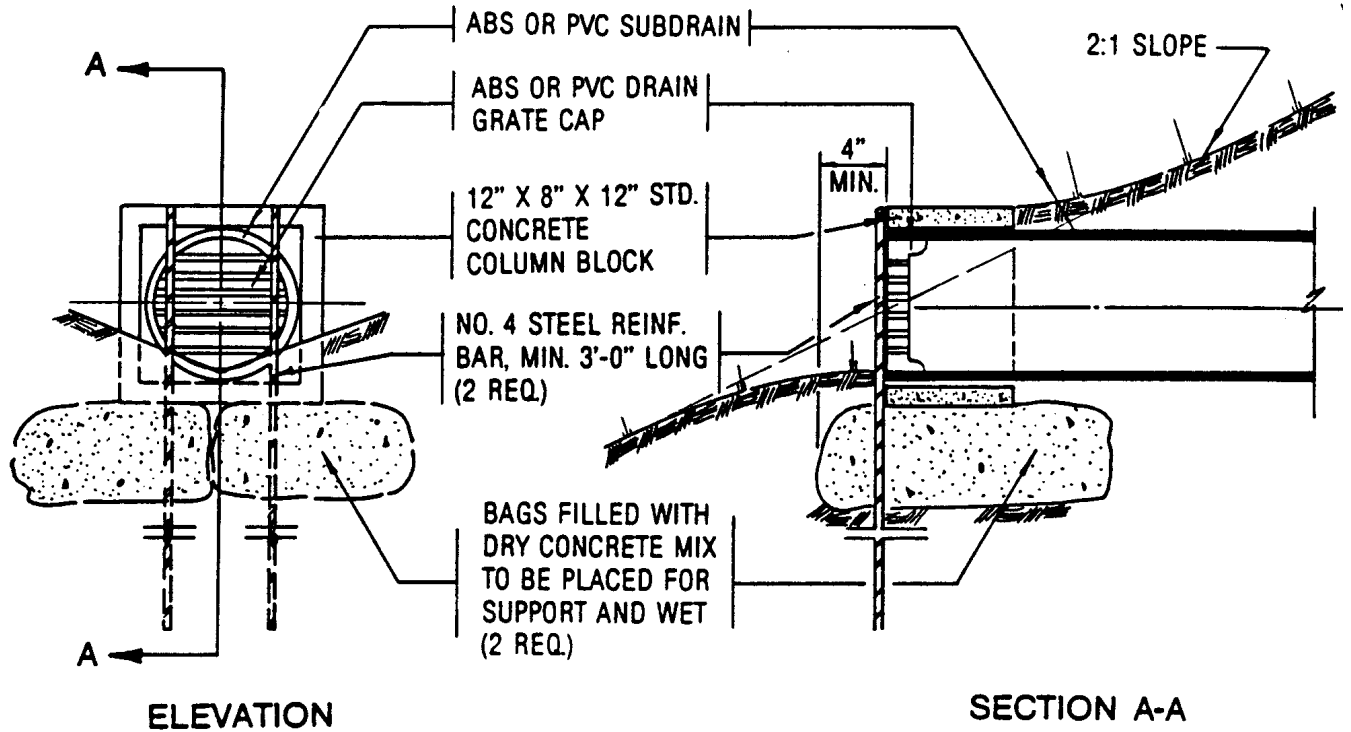


## NOTES:

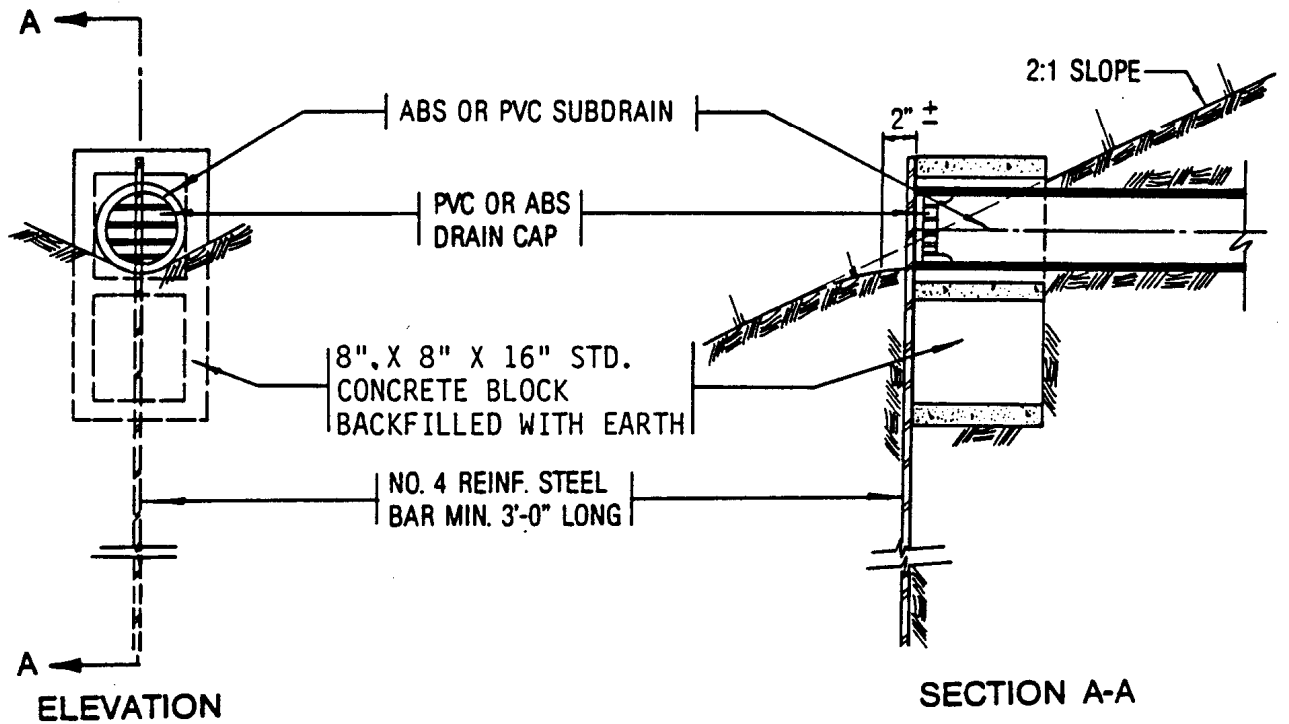
PIPE SHALL BE A MINIMUM OF 4 INCHES DIAMETER AND RUNS OF 500 FEET OR MORE USE 6-INCH DIAMETER PIPE, OR AS RECOMMENDED BY THE SOIL ENGINEER



# SUBDRAIN OUTLET MARKER

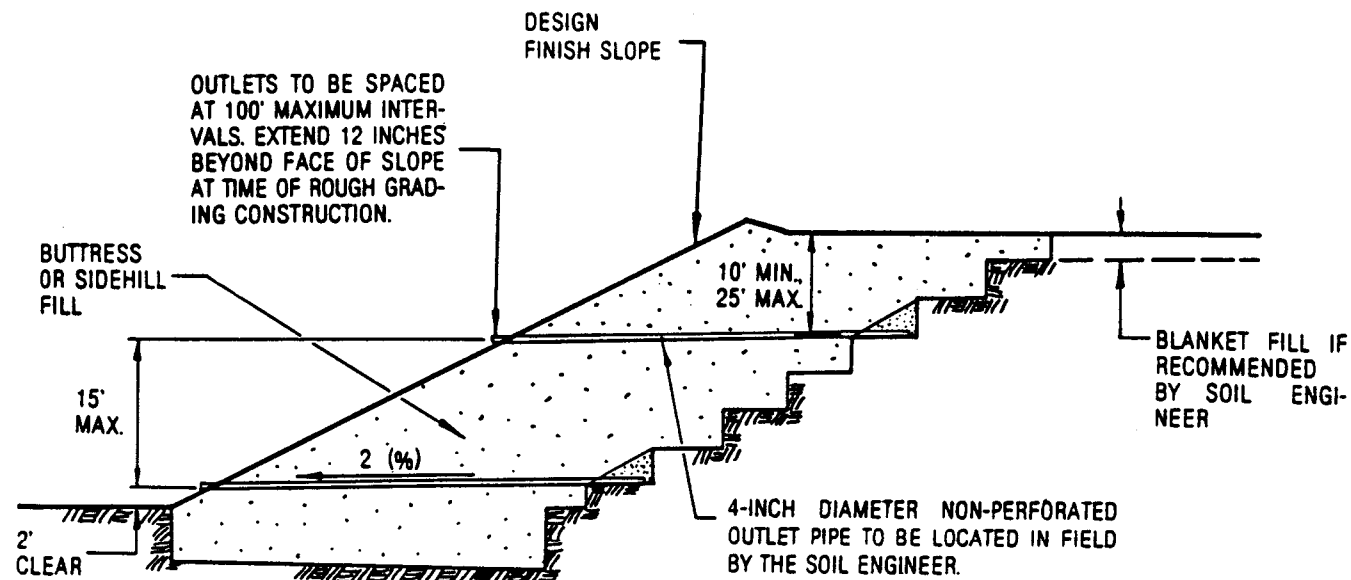


## SUBDRAIN OUTLET MARKER FOR 6" AND 8" PIPES



## SUBDRAIN OUTLET MARKER - 4" PIPE

# TYPICAL STABILIZATION AND BUTTRESS FILL SUBDRAIN



FILTER MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO MA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50

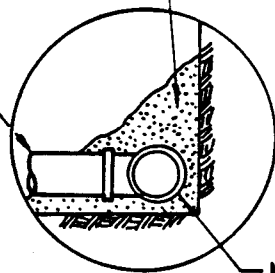
FILTER MATERIAL - MINIMUM OF FIVE CUBIC FEET PER FOOT OF PIPE. SEE ABOVE FOR FILTER MATERIAL SPECIFICATION.

ALTERNATIVE: IN LIEU OF FILTER MATERIAL, FIVE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE ABOVE FOR GRAVEL SPECIFICATION.

FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4-INCH DIAMETER PVC SCH 40 OR ABS CLASS SDR 35 WITH A CRUSHING STRENGTH OF AT LEAST 1,000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.

OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW

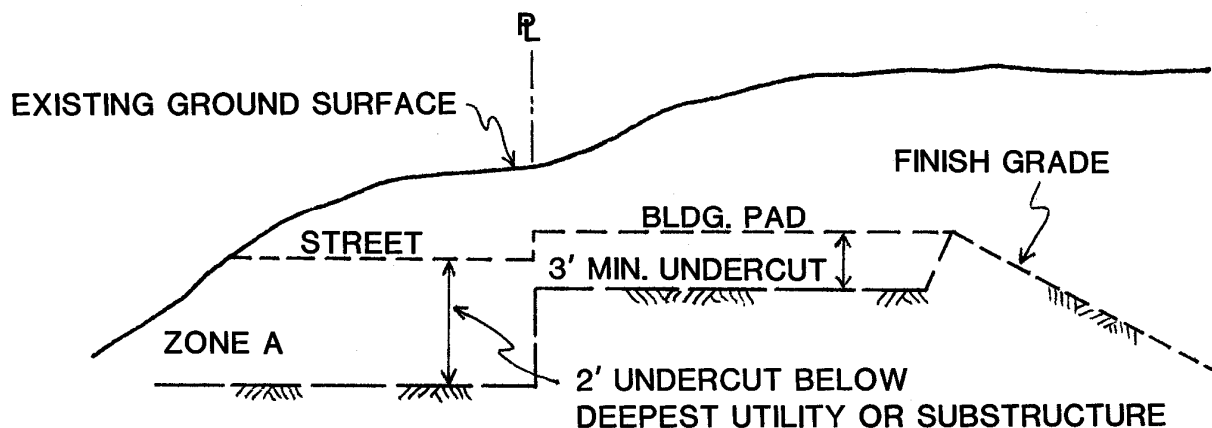


## NOTES:

1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

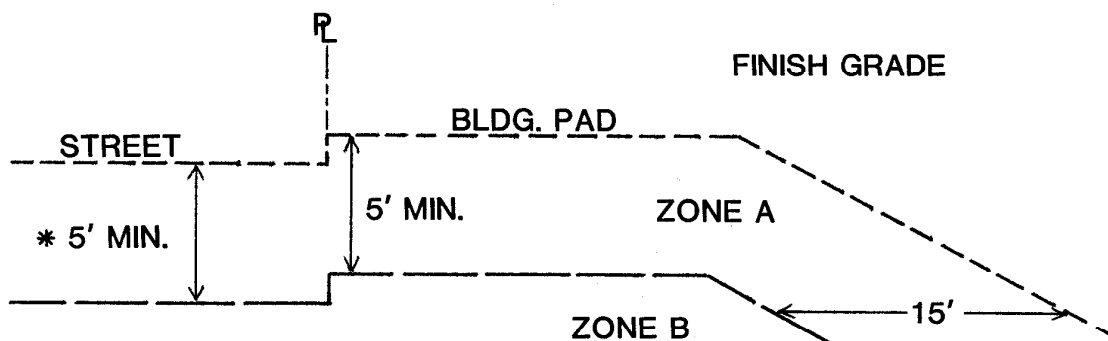
# TYPICAL CUT AND FILL GRADING DETAILS

## TYPICAL GRADING WITHIN PROPOSED DEEP BEDROCK CUT AREAS



NO SCALE

## TYPICAL GRADING WITHIN PROPOSED FILL AREAS



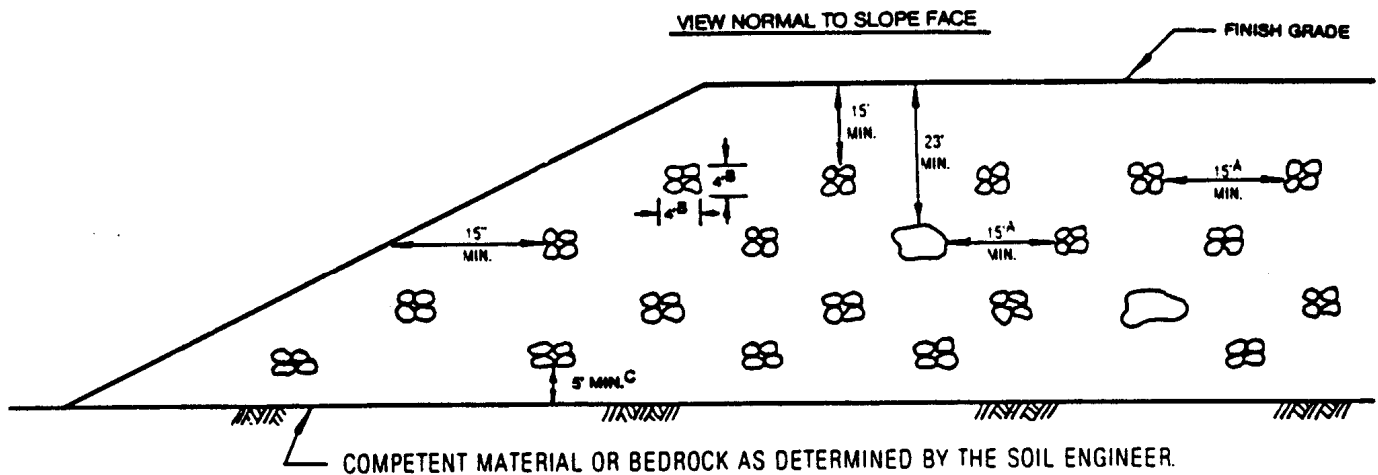
### LEGEND

ZONE A ..... "SOIL" FILL PLACED IN ACCORDANCE WITH THE RECOMMENDATIONS PRESENTED IN SECTION 11.2.3 OF THIS REPORT

ZONE B ..... "SOIL-ROCK" AND/OR "ROCK" FILL PLACED IN ACCORDANCE WITH THE RECOMMENDATIONS PRESENTED IN SECTION 11.2.3 OF THIS REPORT

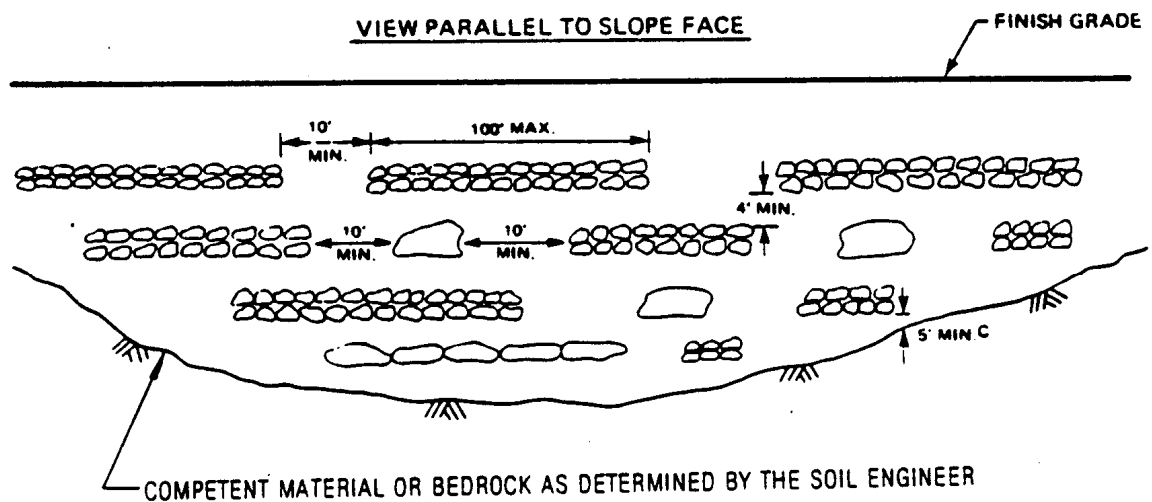
\* 5' OR 1' BELOW DEEPEST UTILITY, WHICHEVER IS GREATER

# TYPICAL OVERSIZE ROCK DISPOSAL – “SOIL-ROCK” FILL



## NOTE:

ORIENTATION OF WINDROWS MAY VARY BUT SHALL BE AS RECOMMENDED BY SOIL ENGINEER.



## NOTES:

- ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.
- HEIGHT AND WIDTH MAY VARY DEPENDING ON ROCK SIZE AND TYPE OF EQUIPMENT.
- IF APPROVED BY THE SOIL ENGINEER, WINDROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIALS OR BEDROCK PROVIDING ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.
- VOIDS IN WINDROW TO BE FILLED BY FLOODING GRANULAR SOIL INTO PLACE. GRANULAR SOIL SHALL MEAN ANY SOIL WHICH HAS A UNIFIED SOIL CLASSIFICATION SYSTEM (UBC 29-1) DESIGNATION OF SM, SP, SW, GM, GP, OR GW.
- AFTER FILL BETWEEN WINDROWS IS PLACED AND COMPACTED WITH THE LIFT OF FILL COVERING WINDROW, WINDROW SHALL BE PROOF-ROLLED WITH D-9 DOZER OR EQUIVALENT.
- OVERSIZED ROCK IS DEFINED AS LARGER THAN 12" IN SIZE.



## **APPENDIX N**

### **Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet (from Orange County TGD for Project WQMPs)**

### Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	3	0.75
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	2	0.50
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Tributary area size	0.25	2	0.50
		Level of pretreatment/ expected sediment loads	0.25	2	0.50
		Redundancy	0.25	2	0.50
		Compaction during construction	0.25	1	0.25
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{Total} = S_A \times S_B$				3.06	
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)				15.5	
Design Infiltration Rate, in/hr, $K_{DESIGN} = K_{Observed} / S_{Total}$				5.07	
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					

**Note:** The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

#### VII.4. Considerations for Infiltration Rate Factor of Safety

Given the known potential for infiltration BMPs to fail over time, an appropriate factor of safety applied to infiltration testing results must be mandatory. The infiltration rate will decline between maintenance cycles as the BMP surface becomes occluded and particulates accumulate in the infiltrative layer. Monitoring of actual facility performance has shown that the full-scale infiltration rate is far lower than the rate measured by small-scale testing. It is important that adequate conservatism is incorporated in the selection of design infiltration rates. The design infiltration rate discussed here is the infiltration rate of the underlying soil, below the elevation to which soil amendments would not be provided.

The factor of safety that should be applied to measured infiltration rates is a function of:

- Suitability of underlying soils for infiltration
- The infiltration system design.

These factors are discussed in the following sections.

The *measured infiltration rate* calculated for the purpose of infiltration infeasibility screening ([TGD Section 2.4.2.4](#)) shall be based on a factor of safety of 2.0 applied to the rates obtained from the infiltration test results. No adjustments from this value are permitted. The factor of safety used to compute the *design infiltration rate* shall not be less than 2.0, but may be higher at the discretion of the design engineer and acceptance of the plan reviewer, per the considerations described in the following sections.

It is recognized that there are competing objectives in the selection of a factor of safety. There is an initial economic incentive to select a lower factor of safety to yield smaller BMP designs. A low factor of safety also allows a broader range of systems to be considered “feasible” in marginal conditions. However, there are both economic and environmental incentives for the use of an appropriate factor of safety to prevent premature failure and substandard performance. The use of an artificially low factor of safety to demonstrate feasibility in the design process is shortsighted in that it does not consider the long term feasibility of the system.

The best way to balance these competing factors is through a commitment to thorough site investigation, use of effective pretreatment controls, good construction practices, the commitment to restore the infiltration rates of soils that are damaged by prior uses or construction practices, and the commitment to effective maintenance practices. However, these commitments do not mitigate the need to apply a factor of safety to account for uncertainty and long term deterioration that cannot be technically mitigated. Therefore, a factor of safety of no less than 2.0 shall be used to compute the design infiltration rate.

#### VII.4.1. Site Suitability Considerations

Suitability assessment related considerations include ([Table VII.3](#)):

- Soil assessment methods – the site assessment extent (e.g., number of borings, test pits, etc.) and the measurement method used to estimate the short-term infiltration rate.
- Predominant soil texture/percent fines – soil texture and the percent of fines can greatly influence the potential for clogging.
- Site soil variability – site with spatially heterogeneous soils (vertically or horizontally) as determined from site investigations are more difficult to estimate average properties for resulting in a higher level of uncertainty associated with initial estimates.
- Depth to seasonal high groundwater/impervious layer – groundwater mounding may become an issue during excessively wet conditions where shallow aquifers or shallow clay lenses are present.

**Table VII.3: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors**

Consideration	High Concern	Medium Concern	Low Concern
Assessment methods (see explanation below)	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates	Direct measurement of $\geq 20$ percent of infiltration area with localized infiltration measurement methods (e.g., infiltrometer)	Direct measurement of $\geq 50$ percent of infiltration area with localized infiltration measurement methods or Use of extensive test pit infiltration measurement methods
Texture Class	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site soil variability	Highly variable soils indicated from site assessment or limited soil borings collected during site assessment	Soil borings/test pits indicate moderately homogeneous soils	Multiple soil borings/test pits indicate relatively homogeneous soils
Depth to groundwater/ impervious layer	<5 ft below facility bottom	5-10 ft below facility bottom	>10 below facility bottom

Localized infiltration testing refers to methods such as the double ring infiltrometer test (ASTM D3385-88) which measure infiltration rates over an area less than 10 sq-ft, may include lateral

flow, and do not attempt to account for heterogeneity of soil. The amount of area each test represents should be estimated depending on the observed heterogeneity of the soil.

Extensive infiltration testing refers to methods that include excavating a significant portion of the proposed infiltration area, filling the excavation with water, and monitoring drawdown. The excavation should be to the depth of the proposed infiltration surface and ideally be at least 50 to 100 square feet.

In all cases, testing should be conducted in the area of the proposed BMP where, based on review of available geotechnical data, soils appear least likely to support infiltration.

#### VII.4.2. Design Related Considerations

Design related considerations include ([Table VII.4](#)):

- Size of area tributary to facility – all things being equal, risk factors related to infiltration facilities increase with an increase in the tributary area served. Therefore facilities serving larger tributary areas should use more restrictive adjustment factors.
- Level of pretreatment/ expected influent sediment loads – credit should be given for good pretreatment by allowing less restrictive factors to account for the reduced probability of clogging from high sediment loading. Also, facilities designed to capture runoff from relatively clean surfaces such as rooftops are likely to see low sediment loads and therefore should be allowed to apply less restrictive safety factors.
- Redundancy – facilities that consist of multiple subsystems operating in parallel such that parts of the system remains functional when other parts fail and/or bypass should be rewarded for the built-in redundancy with less restrictive correction and safety factors. For example, if bypass flows would be at least partially treated in another BMP, the risk of discharging untreated runoff in the event of clogging the primary facility is reduced. A bioretention facility that overflows to a landscaped area is another example.
- Compaction during construction – proper construction oversight is needed during construction to ensure that the bottoms of infiltration facility are not overly compacted. Facilities that do not commit to proper construction practices and oversight should have to use more restrictive correction and safety factors.

**Table VII.4: Design Related Considerations for Infiltration Facility Safety Factors**

Consideration	High Concern	Medium Concern	Low Concern
Tributary area size	Greater than 10 acres.	Greater than 2 acres but less than 10 acres.	2 acres or less.
Level of pretreatment/ expected influent sediment loads	Pretreatment from gross solids removal devices only, such as hydrodynamic separators, racks and screens AND tributary area includes landscaped areas, steep slopes, high traffic areas, or any other areas expected to produce high sediment, trash, or debris loads.	Good pretreatment with BMPs that mitigate coarse sediments such as vegetated swales AND influent sediment loads from the tributary area are expected to be relatively low (e.g., low traffic, mild slopes, disconnected impervious areas, etc.).	Excellent pretreatment with BMPs that mitigate fine sediments such as bioretention or media filtration OR sedimentation or facility only treats runoff from relatively clean surfaces, such as rooftops.
Redundancy of treatment	No redundancy in BMP treatment train.	Medium redundancy, other BMPs available in treatment train to maintain at least 50% of function of facility in event of failure.	High redundancy, multiple components capable of operating independently and in parallel, maintaining at least 90% of facility functionality in event of failure.
Compaction during construction	Construction of facility on a compacted site or elevated probability of unintended/ indirect compaction.	Medium probability of unintended/ indirect compaction.	Heavy equipment actively prohibited from infiltration areas during construction and low probability of unintended/ indirect compaction.



#### VII.4.3. Determining Factor of Safety

A factor of safety shall be used. To assist in selecting the appropriate design infiltration rate, the measured short term infiltration rate should be adjusted using a weighted average of several safety factors using the worksheet shown in [Worksheet H](#) below. The design infiltration rate would be determined as follows:

1. For each consideration shown in [Table VII.3](#) and [Table VII.4](#) above, determine whether the consideration is a high, medium, or low concern.
2. For all high concerns, assign a factor value of 3, for medium concerns, assign a factor value of 2, and for low concerns assign a factor value of 1.
3. Multiply each of the factors by the corresponding weight to get a product.
4. Sum the products within each factor category to obtain a safety factor for each.
5. Multiply the two safety factors together to get the final combined safety factor. If the combined safety factor is less than 2, then 2 shall be used as the safety factor.
6. Divide the measured short term infiltration rate by the combined safety factor to obtain the adjusted design infiltration rate for use in sizing the infiltration facility.

The design infiltration rate shall be used to size BMPs and to evaluate their expected long term performance. This rate shall not be less than 2, but may be higher at the discretion of the design engineer.

## **APPENDIX O**

**Hydrology and Hydraulics Report for  
2889 N. Locust Avenue, Rialto,  
California, dated December 21, 2021**

## **PRELIMINARY HYDROLOGY REPORT**

**FOR**

**LOCUST AVE. DISTRIBUTUION CENTER**

**2889 N LOCUST AVENUE  
RIALTO, CA**

**CITY OF RIALTO**

**Date: December 21, 2021**

**PLANS PREPARED UNDER THE SUPERVISION OF:**

---

Fred Cornwell, P.E. - R.C.E 45591

Date

## Table of Contents

1.0	INTRODUCTION .....	1
2.0	EXISTING DRAINAGE CONDITIONS .....	1
3.0	PROPOSED DRAINAGE CONDITIONS .....	1
4.0	HYDROLOGICAL AND SOIL DATA .....	1
5.0	HYDROLOGY RESULTS .....	1
6.0	WATER QUALITY .....	2
7.0	FLOOD PLAIN DESIGNATION .....	2
8.0	METHODOLOGY .....	2
9.0	HYDRAULICS .....	2
10.0	RESULTS .....	2
11.0	CONCLUSION .....	3
12.0	VICINITY MAP .....	4
13.0	SOIL AND RAINFALL DATA TABLES .....	5
	APPENDICES .....	6
	APPENDIX A: EXISTING RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES. .....	7
	APPENDIX B: PROPOSED RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES.....	13
	APPENDIX C: PROPOSED HYDROGRAPH METHOD & BASIN ROUTING, 100 YEAR STORM FREQUENCY OUTPUT FILE.....	26
	APPENDIX D: STORAGE VOLUME & OUTFLOW CALCULATIONS AND Ybar CALCULATIONS .....	35
	EXHIBITS .....	36
	EXHIBIT A: EXISTING CONDITION HYDROLOGY MAP .....	37
	EXHIBIT B: PROPOSED CONDITION HYDROLOGY MAP .....	38
	EXHIBIT C: FIRM MAP .....	39
	EXHIBIT D: WQMP SITE PLAN.....	40

## **1.0 INTRODUCTION**

The purpose of this report is to present the hydrology analysis and drainage calculations for a proposed Locust Ave. industrial development located in the City of Rialto, California. The site proposes to construct an industrial building with an approximately 96,000 square feet footprint on approximately 4.7 net acres. This report will determine the existing and proposed storm water runoff rates from the Project site, provide analysis of the impacts to adjacent and downstream properties and facilities, and determine how to protect the building from 100-yr flood. This project is considered an "Industrial/Commercial Development".

## **2.0 EXISTING DRAINAGE CONDITIONS**

The subject site is currently vacant barren land with exposed rock outcroppings and fronts on Locust Ave. to the west. It is surrounded by industrial to the north and south and residential to the east. The site drains from the north to the south and somewhat to the east. The low point on our site is near the southeasterly corner being approximately 10' lower than the street elevation.

The site to the north drains onto the proposed project and our property drains onto the property to the south. The Master Plan of Drainage (MPD) shows that the properties to the east of Locust Ave. are tabulated to drain southerly and easterly to a system in Maple Ave. There is an existing 102" storm drain in Locust Ave. but our site is not tributary to that system.

## **3.0 PROPOSED DRAINAGE CONDITIONS**

Drainage for the proposed site will be conveyed via sheet flow and gutters to three catch basins, with filters, which connect to storage pipes located along the southern portion of the site. The storage pipes will collect the drainage and allow to infiltrate.

The project proposes to install a bypass storm drain that will collect the off-site flows coming from the north and outlet them at the low point along the southerly boundary. The outlet will have energy dissipating devices that will dissipate the flows as to mimic the historic flow pattern.

The on-site infiltration pipes will be sized to contain and infiltrate up to the 100 year storm event. This will assure that the proposed project will have no adverse effect on the neighboring property because it will eliminate all historic flows that were coming from the vacant site.

The storage pipe facility will be modeled as a flow through basin with the outlet flows being the infiltrated amount.

## **4.0 HYDROLOGICAL AND SOIL DATA**

References used in this report were the following:

- San Bernardino County Flood Control District, Hydrology Manual, dated August 1986.
- NOAA Atlas 14, Volume 6, Version 2, Point Precipitation Frequency Estimates.

Based on the hydrological soils group designation the site consists of soil group "A". The soil group designation is presented in the enclosed "Hydrologic Soils Group Map" at the end of this Section.

- Slope of Intensity Duration Curve = 0.6

The point precipitation frequency estimates for the project site are presented at the end of this Section.

## **5.0 HYDROLOGY RESULTS**

The results of the 2, 25 and 100-year storm events for both the existing and proposed conditions are shown on the hydrology maps in this report.

We have also prepared a unit hydrograph for the proposed 100 year storm event which will be utilized in the basin routing model.

## **6.0 WATER QUALITY**

The water quality as shown in the project's WQMP and described Section 3.0, will utilize the inlet filters and infiltration facility as the water quality BMP's. More information on the water quality is shown on the WQMP Site Plan (Exhibit D)

## **7.0 FLOOD PLAIN DESIGNATION**

The site falls within a Zone "X" designation under the FEMA Map 06071C7920H, dated August 28, 2008. Zone X (Shaded) represents areas determined to be outside the 0.2% annual chance floodplain.

## **8.0 METHODOLOGY**

The San Bernardino County Rational and Unit Hydrograph Methods described in the San Bernardino County Hydrology Manual were utilized to determine the storm flows. The San Bernardino County Unit Hydrograph Method was used to provide hydrological information for routing of the proposed basin. The Computer Software Programs used was Advanced Engineering Software (AES) Rational Tabling Version 15.0 for the Rational Method and the small area hydrograph module CH1 – v1.8 for the Hydrograph Routing to size the basins.

This report will analyze the 2, 25 & 100 year storms for the rational method and the 100 year storm for the basin routing.

## **9.0 HYDRAULICS**

### **ON-SITE:**

The storage facility consists of six 96" CMP pipes that are connected via 24" HDPE pipes at 20' o.c. This will allow the flows to fill all the pipes during storm events before being infiltrated.

The results are shown in Appendix D. These outflows will be modeled in the basin routing for the 100 year storm event.

The pipe flows and catch basin hydraulics will be analyzed using the rational method flows in the Final Hydrology report.

### **OFF-SITE:**

The Master Plan of Drainage (MPD) shows an existing 39" pipe, labeled "XC4-5X in Maple Ave. and a proposed 54" pipe, labeled as "C4-5". The flows exiting our site will go through the neighboring property to the south and onto Summit Ave., then go easterly to the drainage facilities in Maple Ave.

## **10.0 RESULTS**

### **RIALTO DISTRIBUTION CENTER - HYDROLOGY STUDY**

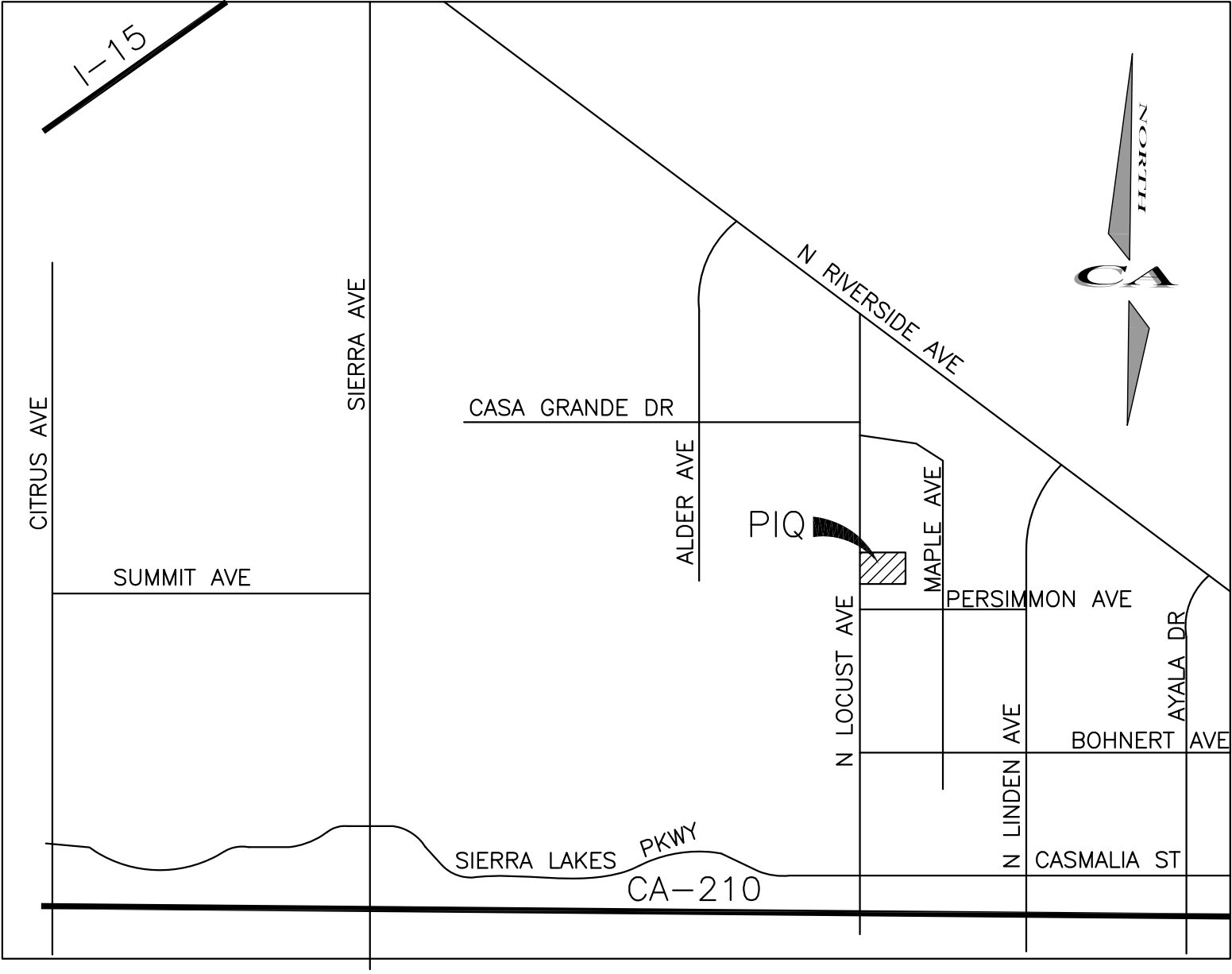
It is shown in Appendix "C" that the storm flows for the 100 year storm event are completely contained in the storage facility and infiltrated on-site. The maximum depth in the pipes is shown in the basin routing output to be 6.40'.

## **11.0 CONCLUSION**

The results show that the 100 year storm will be collected and infiltrated.



## **12.0 VICINITY MAP**

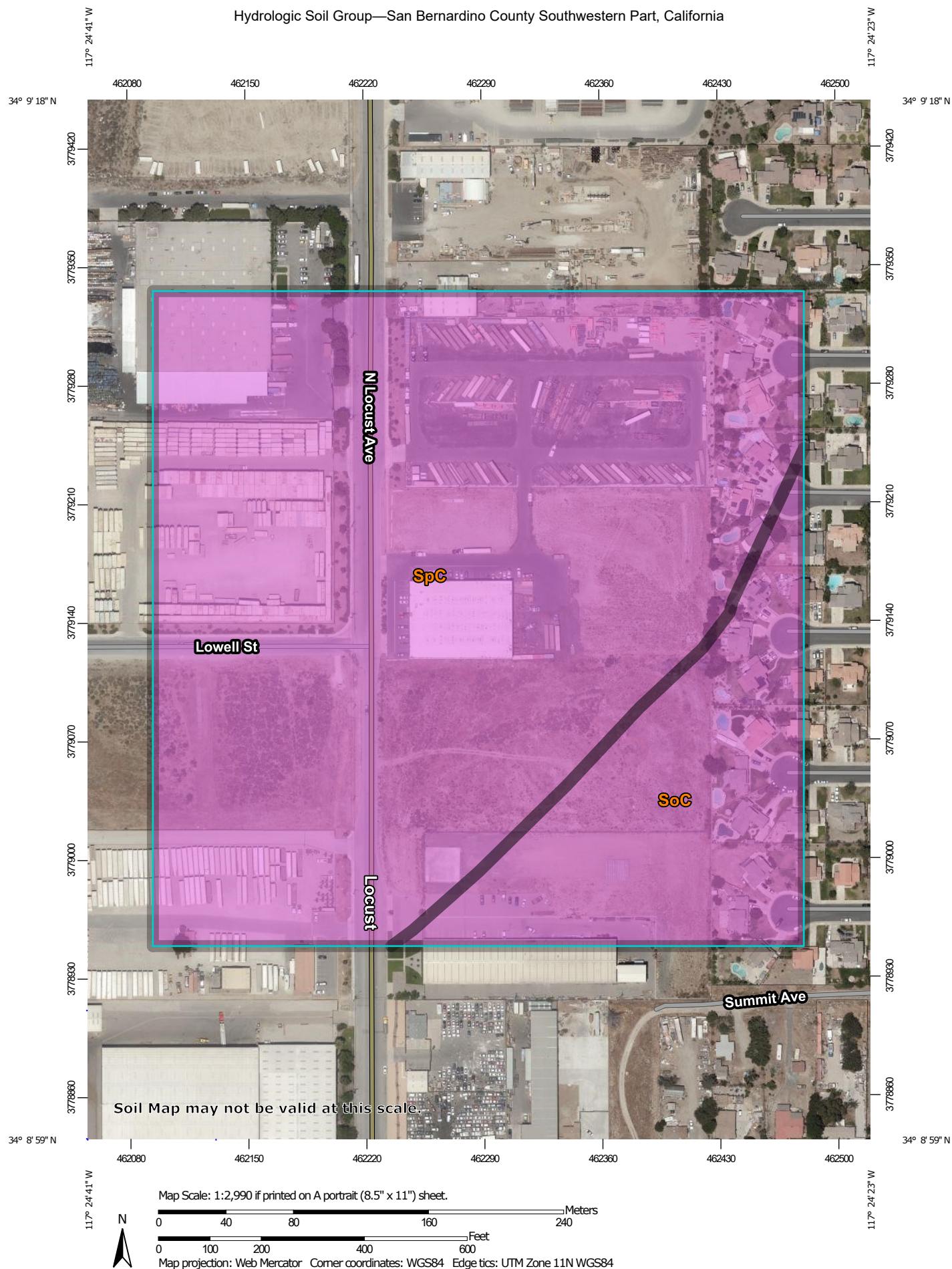


**VICINITY MAP**

**NOT TO SCALE**

## **13.0 SOIL AND RAINFALL DATA TABLES**

# Hydrologic Soil Group—San Bernardino County Southwestern Part, California




## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines


 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points






 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California  
 Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Apr 1, 2018—Jun 30, 2018

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	A	7.3	19.8%
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	A	29.7	80.2%
<b>Totals for Area of Interest</b>			<b>37.1</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher





**NOAA Atlas 14, Volume 6, Version 2**  
**Location name: Rialto, California, USA\***  
**Latitude: 34.1518°, Longitude: -117.4097°**  
**Elevation: 1619.97 ft\*\***

\* source: ESRI Maps

\*\* source: USGS



**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF\\_tabular](#) | [PF\\_graphical](#) | [Maps\\_&\\_aerials](#)

**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
<b>Duration</b>	<b>Average recurrence interval (years)</b>									
	<b>1</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>1000</b>
<b>5-min</b>	<b>0.138</b> (0.115-0.168)	<b>0.183</b> (0.152-0.223)	<b>0.242</b> (0.200-0.295)	<b>0.289</b> (0.238-0.355)	<b>0.353</b> (0.281-0.450)	<b>0.403</b> (0.313-0.523)	<b>0.453</b> (0.343-0.603)	<b>0.504</b> (0.371-0.692)	<b>0.574</b> (0.405-0.822)	<b>0.629</b> (0.428-0.933)
<b>10-min</b>	<b>0.198</b> (0.165-0.240)	<b>0.262</b> (0.218-0.319)	<b>0.346</b> (0.287-0.422)	<b>0.414</b> (0.341-0.510)	<b>0.506</b> (0.402-0.644)	<b>0.577</b> (0.448-0.750)	<b>0.649</b> (0.492-0.865)	<b>0.723</b> (0.532-0.992)	<b>0.823</b> (0.581-1.18)	<b>0.901</b> (0.614-1.34)
<b>15-min</b>	<b>0.239</b> (0.199-0.290)	<b>0.317</b> (0.264-0.386)	<b>0.419</b> (0.347-0.511)	<b>0.501</b> (0.412-0.616)	<b>0.612</b> (0.486-0.779)	<b>0.698</b> (0.542-0.907)	<b>0.785</b> (0.595-1.05)	<b>0.874</b> (0.644-1.20)	<b>0.996</b> (0.702-1.43)	<b>1.09</b> (0.742-1.62)
<b>30-min</b>	<b>0.361</b> (0.300-0.438)	<b>0.479</b> (0.398-0.582)	<b>0.632</b> (0.524-0.771)	<b>0.757</b> (0.622-0.930)	<b>0.925</b> (0.734-1.18)	<b>1.05</b> (0.819-1.37)	<b>1.19</b> (0.898-1.58)	<b>1.32</b> (0.972-1.81)	<b>1.50</b> (1.06-2.15)	<b>1.65</b> (1.12-2.44)
<b>60-min</b>	<b>0.550</b> (0.458-0.668)	<b>0.730</b> (0.606-0.887)	<b>0.963</b> (0.798-1.17)	<b>1.15</b> (0.947-1.42)	<b>1.41</b> (1.12-1.79)	<b>1.61</b> (1.25-2.09)	<b>1.80</b> (1.37-2.40)	<b>2.01</b> (1.48-2.76)	<b>2.29</b> (1.62-3.28)	<b>2.51</b> (1.71-3.72)
<b>2-hr</b>	<b>0.832</b> (0.692-1.01)	<b>1.09</b> (0.905-1.32)	<b>1.42</b> (1.18-1.73)	<b>1.69</b> (1.39-2.08)	<b>2.05</b> (1.63-2.61)	<b>2.32</b> (1.81-3.02)	<b>2.60</b> (1.97-3.47)	<b>2.88</b> (2.12-3.96)	<b>3.27</b> (2.30-4.68)	<b>3.56</b> (2.42-5.28)
<b>3-hr</b>	<b>1.06</b> (0.885-1.29)	<b>1.39</b> (1.15-1.68)	<b>1.80</b> (1.49-2.19)	<b>2.13</b> (1.75-2.62)	<b>2.58</b> (2.05-3.28)	<b>2.92</b> (2.27-3.79)	<b>3.26</b> (2.47-4.34)	<b>3.61</b> (2.65-4.95)	<b>4.07</b> (2.87-5.83)	<b>4.43</b> (3.02-6.57)
<b>6-hr</b>	<b>1.58</b> (1.31-1.91)	<b>2.05</b> (1.70-2.49)	<b>2.65</b> (2.19-3.23)	<b>3.13</b> (2.57-3.85)	<b>3.77</b> (2.99-4.79)	<b>4.25</b> (3.30-5.52)	<b>4.73</b> (3.58-6.31)	<b>5.22</b> (3.84-7.16)	<b>5.87</b> (4.14-8.40)	<b>6.36</b> (4.33-9.44)
<b>12-hr</b>	<b>2.16</b> (1.79-2.62)	<b>2.81</b> (2.34-3.42)	<b>3.64</b> (3.02-4.44)	<b>4.30</b> (3.54-5.29)	<b>5.17</b> (4.11-6.58)	<b>5.82</b> (4.52-7.57)	<b>6.46</b> (4.90-8.62)	<b>7.11</b> (5.24-9.76)	<b>7.96</b> (5.62-11.4)	<b>8.61</b> (5.86-12.8)
<b>24-hr</b>	<b>2.94</b> (2.60-3.38)	<b>3.87</b> (3.42-4.47)	<b>5.05</b> (4.46-5.85)	<b>5.99</b> (5.24-6.98)	<b>7.21</b> (6.11-8.69)	<b>8.13</b> (6.74-9.99)	<b>9.02</b> (7.31-11.4)	<b>9.93</b> (7.82-12.9)	<b>11.1</b> (8.40-15.0)	<b>12.0</b> (8.77-16.7)
<b>2-day</b>	<b>3.60</b> (3.19-4.15)	<b>4.85</b> (4.29-5.59)	<b>6.45</b> (5.69-7.46)	<b>7.74</b> (6.77-9.02)	<b>9.47</b> (8.02-11.4)	<b>10.8</b> (8.94-13.3)	<b>12.1</b> (9.80-15.2)	<b>13.4</b> (10.6-17.4)	<b>15.3</b> (11.5-20.6)	<b>16.6</b> (12.2-23.2)
<b>3-day</b>	<b>3.86</b> (3.42-4.45)	<b>5.28</b> (4.67-6.09)	<b>7.16</b> (6.32-8.28)	<b>8.71</b> (7.62-10.2)	<b>10.8</b> (9.18-13.1)	<b>12.5</b> (10.4-15.4)	<b>14.2</b> (11.5-17.9)	<b>16.0</b> (12.6-20.7)	<b>18.4</b> (13.9-24.8)	<b>20.4</b> (14.9-28.4)
<b>4-day</b>	<b>4.12</b> (3.65-4.75)	<b>5.70</b> (5.04-6.58)	<b>7.82</b> (6.89-9.04)	<b>9.58</b> (8.38-11.2)	<b>12.0</b> (10.2-14.5)	<b>14.0</b> (11.6-17.2)	<b>16.0</b> (12.9-20.1)	<b>18.1</b> (14.3-23.4)	<b>21.1</b> (15.9-28.4)	<b>23.4</b> (17.1-32.7)
<b>7-day</b>	<b>4.72</b> (4.18-5.43)	<b>6.60</b> (5.83-7.61)	<b>9.13</b> (8.05-10.6)	<b>11.2</b> (9.84-13.1)	<b>14.2</b> (12.0-17.1)	<b>16.6</b> (13.7-20.4)	<b>19.0</b> (15.4-23.9)	<b>21.6</b> (17.0-28.0)	<b>25.2</b> (19.1-34.0)	<b>28.2</b> (20.6-39.3)
<b>10-day</b>	<b>5.09</b> (4.51-5.86)	<b>7.16</b> (6.34-8.27)	<b>9.97</b> (8.80-11.5)	<b>12.3</b> (10.8-14.4)	<b>15.6</b> (13.2-18.8)	<b>18.3</b> (15.2-22.5)	<b>21.0</b> (17.0-26.5)	<b>24.0</b> (18.9-31.0)	<b>28.1</b> (21.2-37.9)	<b>31.4</b> (22.9-43.8)
<b>20-day</b>	<b>6.09</b> (5.39-7.01)	<b>8.65</b> (7.65-9.98)	<b>12.2</b> (10.7-14.1)	<b>15.2</b> (13.3-17.7)	<b>19.4</b> (16.4-23.4)	<b>22.8</b> (18.9-28.0)	<b>26.4</b> (21.4-33.3)	<b>30.3</b> (23.8-39.2)	<b>35.7</b> (27.0-48.2)	<b>40.2</b> (29.4-56.1)
<b>30-day</b>	<b>7.10</b> (6.29-8.19)	<b>10.1</b> (8.94-11.7)	<b>14.3</b> (12.6-16.5)	<b>17.8</b> (15.6-20.8)	<b>22.9</b> (19.4-27.6)	<b>27.0</b> (22.4-33.3)	<b>31.4</b> (25.5-39.6)	<b>36.2</b> (28.5-46.8)	<b>42.9</b> (32.5-57.9)	<b>48.5</b> (35.4-67.6)
<b>45-day</b>	<b>8.49</b> (7.52-9.79)	<b>12.0</b> (10.6-13.9)	<b>16.9</b> (14.9-19.6)	<b>21.2</b> (18.5-24.7)	<b>27.3</b> (23.1-32.9)	<b>32.3</b> (26.8-39.7)	<b>37.7</b> (30.5-47.4)	<b>43.5</b> (34.3-56.3)	<b>51.8</b> (39.2-69.9)	<b>58.7</b> (43.0-82.0)
<b>60-day</b>	<b>9.88</b> (8.74-11.4)	<b>13.9</b> (12.3-16.0)	<b>19.4</b> (17.1-22.5)	<b>24.3</b> (21.2-28.3)	<b>31.3</b> (26.5-37.7)	<b>37.0</b> (30.7-45.6)	<b>43.2</b> (35.0-54.5)	<b>50.0</b> (39.4-64.7)	<b>59.8</b> (45.2-80.6)	<b>67.9</b> (49.6-94.7)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

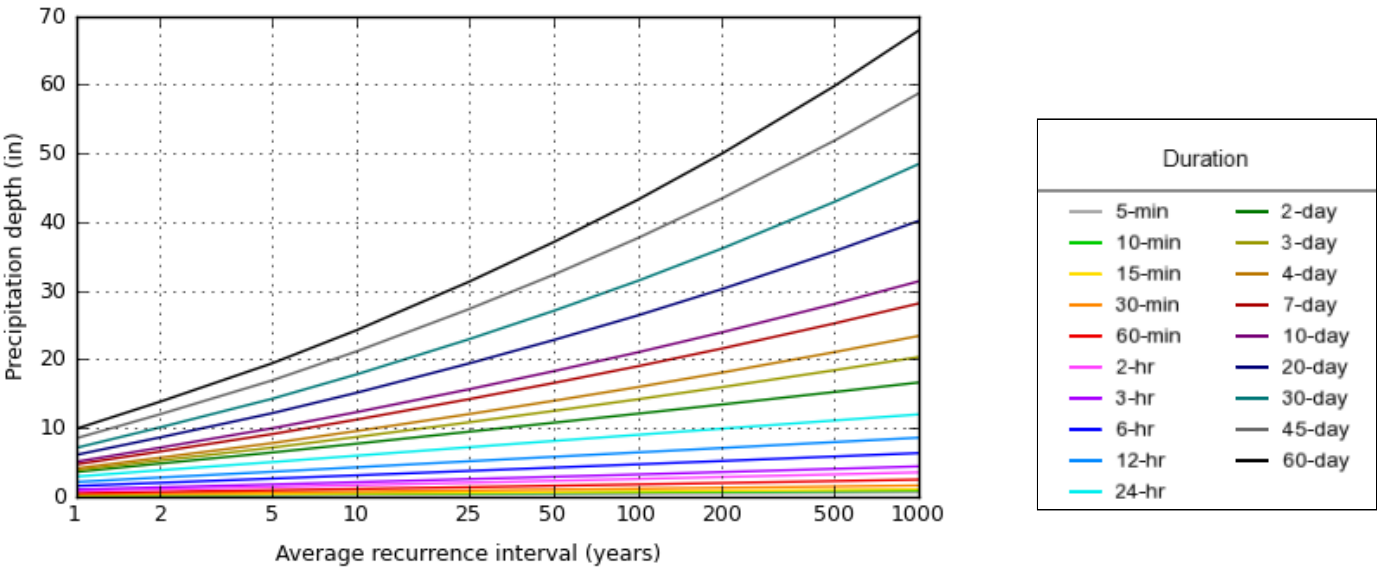
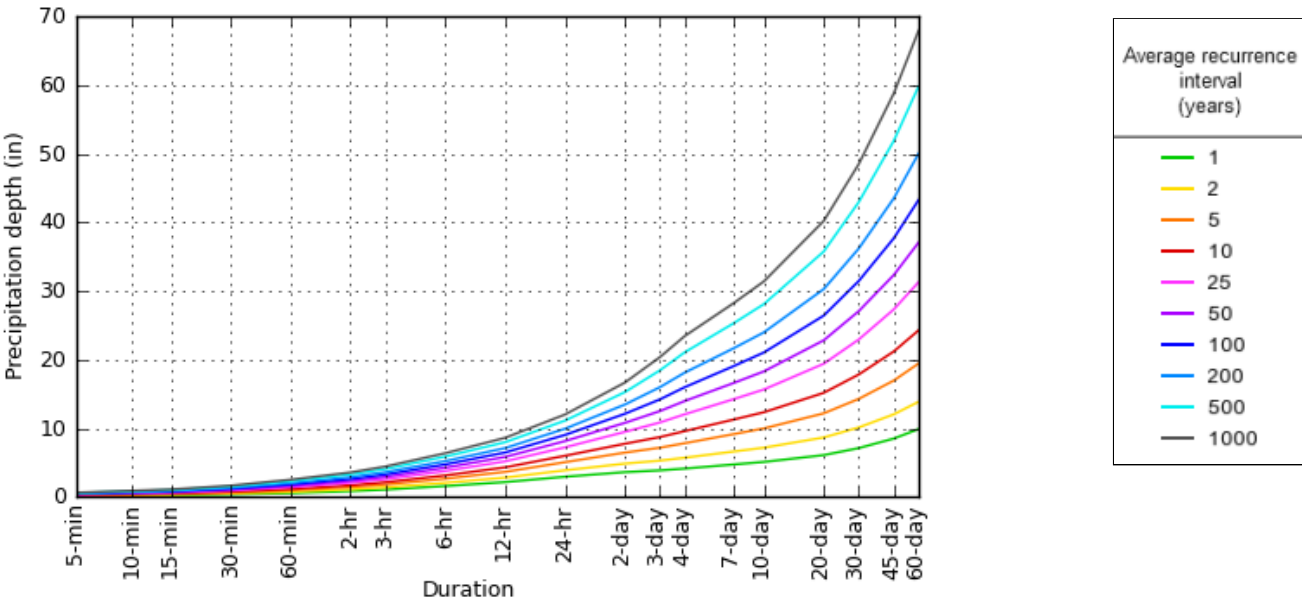
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical

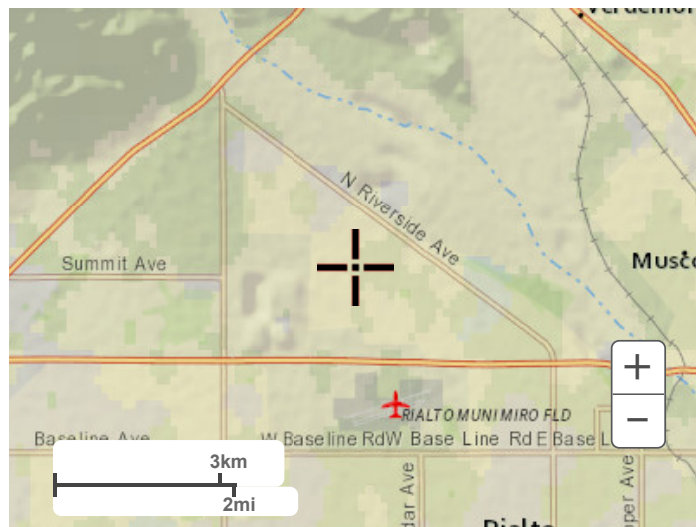
PDS-based depth-duration-frequency (DDF) curves  
Latitude: 34.1518°, Longitude: -117.4097°



[Back to Top](#)

Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

[Back to Top](#)

---

[US Department of Commerce](#)  
[National Oceanic and Atmospheric Administration](#)  
[National Weather Service](#)  
[National Water Center](#)  
1325 East West Highway  
Silver Spring, MD 20910  
Questions?: [HDSC.Questions@noaa.gov](mailto:HDSC.Questions@noaa.gov)

[Disclaimer](#)

## APPENDICES

## APPENDIX A: EXISTING RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES.

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

CA Engineering
13821 Newport Ave., Ste 110
Tustin, Ca. 92780

***** DESCRIPTION OF STUDY *****
* EXISTING CONDITION *
* 2 YR STORM *
* *
*****

FILE NAME: 251-55EX.DAT
TIME/DATE OF STUDY: 12:18 12/16/2021
=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

USER SPECIFIED STORM EVENT(YEAR) = 2.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800
COMPUTED RAINFALL INTENSITY DATA:
STORM EVENT = 2.00 1-HOUR INTENSITY(INCH/HOUR) = 0.6957
SLOPE OF INTENSITY DURATION CURVE = 0.6000

*ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
      HALF- CROWN TO STREET-CROSSFALL: CURB GUTTER-GEOMETRIES: MANNING
      WIDTH CROSSFALL IN- / OUT-/PARK- HEIGHT WIDTH LIP HIKE FACTOR
NO. (FT) (FT) SIDE / SIDE/ WAY (FT) (FT) (FT) (FT) (n)
=== =====
1 30.0 20.0 0.018/0.018/0.020 0.67 2.00 0.0313 0.167 0.0150

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

*****
FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

```

```

=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 485.00
ELEVATION DATA: UPSTREAM(FEET) = 1624.40 DOWNSTREAM(FEET) = 1608.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 16.658
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 1.501
SUBAREA Tc AND LOSS RATE DATA(AMC I):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF" A 2.64 0.95 1.000 35 16.66
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.95
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 1.31
TOTAL AREA(ACRES) = 2.64 PEAK FLOW RATE(CFS) = 1.31

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 359.00
ELEVATION DATA: UPSTREAM(FEET) = 1617.00 DOWNSTREAM(FEET) = 1607.50

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 15.357
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 1.576
SUBAREA Tc AND LOSS RATE DATA(AMC I):
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF" A 2.07 0.95 1.000 35 15.36
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.95
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 1.17
TOTAL AREA(ACRES) = 2.07 PEAK FLOW RATE(CFS) = 1.17

=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 2.1 TC(MIN.) = 15.36
EFFECTIVE AREA(ACRES) = 2.07 AREA-AVERAGED Fm(INCH/HR)= 0.95
AREA-AVERAGED Fp(INCH/HR) = 0.95 AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS) = 1.17
=====
=====
END OF RATIONAL METHOD ANALYSIS

```



```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* EXISTING CONDITION *
* 25 YR STORM *
* *
*****

```

FILE NAME: 251-55EX.DAT  
TIME/DATE OF STUDY: 12:17 12/16/2021

```

=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

USER SPECIFIED STORM EVENT(YEAR) = 25.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 25.00 1-HOUR INTENSITY(INCH/HOUR) = 1.3811  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF-WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL IN- / OUT- / SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER WIDTH (FT)	GEOMETRIES LIP (FT)	MANNING HIKE (FT)	FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```

*****
FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 485.00
ELEVATION DATA: UPSTREAM(FEET) = 1624.40 DOWNSTREAM(FEET) = 1608.80

```

```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 16.658
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 2.980
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A        2.64      0.76      1.000      55      16.66
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.76
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 5.27
TOTAL AREA(ACRES) = 2.64 PEAK FLOW RATE(CFS) = 5.27

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 359.00
ELEVATION DATA: UPSTREAM(FEET) = 1617.00 DOWNSTREAM(FEET) = 1607.50

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 15.357
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 3.128
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A        2.07      0.76      1.000      55      15.36
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.76
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 4.41
TOTAL AREA(ACRES) = 2.07 PEAK FLOW RATE(CFS) = 4.41
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 2.1 TC(MIN.) = 15.36
EFFECTIVE AREA(ACRES) = 2.07 AREA-AVERAGED Fm(INCH/HR)= 0.76
AREA-AVERAGED Fp(INCH/HR) = 0.76 AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS) = 4.41
=====
END OF RATIONAL METHOD ANALYSIS

```

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* EXISTING CONDITION *
* 100 YR STORM *
*
*****

```

FILE NAME: 251-55EX.DAT  
TIME/DATE OF STUDY: 12:17 12/16/2021

```

=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 100.00 1-HOUR INTENSITY(INCH/HOUR) = 1.8000  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/PARK- SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH LIP HIKE (FT) (FT) (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00 0.0313 0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```

*****
FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 485.00
ELEVATION DATA: UPSTREAM(FEET) = 1624.40 DOWNSTREAM(FEET) = 1608.80

```

```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 16.658
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.883
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A        2.64      0.44      1.000      75      16.66
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.44
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 8.19
TOTAL AREA(ACRES) = 2.64 PEAK FLOW RATE(CFS) = 8.19

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 359.00
ELEVATION DATA: UPSTREAM(FEET) = 1617.00 DOWNSTREAM(FEET) = 1607.50

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 15.357
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.077
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE              GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"    A        2.07      0.44      1.000      75      15.36
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.44
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
SUBAREA RUNOFF(CFS) = 6.79
TOTAL AREA(ACRES) = 2.07 PEAK FLOW RATE(CFS) = 6.79
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 2.1 TC(MIN.) = 15.36
EFFECTIVE AREA(ACRES) = 2.07 AREA-AVERAGED Fm(INCH/HR)= 0.44
AREA-AVERAGED Fp(INCH/HR) = 0.44 AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS) = 6.79
=====
END OF RATIONAL METHOD ANALYSIS

```

## APPENDIX B: PROPOSED RATIONAL METHOD, 2, 25 & 100 YEAR STORM FREQUENCY OUTPUT FILES.

```
*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420
```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```
***** DESCRIPTION OF STUDY *****
* PROPOSED CONDITION *
* 2 YR STORM *
* *
*****
```

FILE NAME: 251-55PR.DAT  
TIME/DATE OF STUDY: 14:51 12/16/2021

```
=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--
```

USER SPECIFIED STORM EVENT(YEAR) = 2.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 2.00 1-HOUR INTENSITY(INCH/HOUR) = 0.6957  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/PARK- SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```
*****
```

```

FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) =   927.00
ELEVATION DATA: UPSTREAM(FEET) =   1623.80  DOWNSTREAM(FEET) =   1611.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.007
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =   1.924
SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE            GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A       2.19    1.33    0.100    17    11.01
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =   1.33
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =   0.100
SUBAREA RUNOFF(CFS) =       3.53
TOTAL AREA(ACRES) =       2.19  PEAK FLOW RATE(CFS) =       3.53

*****
FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) =   1606.00  DOWNSTREAM(FEET) =   1604.50
FLOW LENGTH(FEET) =   190.00  MANNING'S N =   0.013
DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   4.62
ESTIMATED PIPE DIAMETER(INCH) =   15.00  NUMBER OF PIPES =    1
PIPE-FLOW(CFS) =       3.53
PIPE TRAVEL TIME(MIN.) =   0.69  Tc(MIN.) =   11.69
LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =   1117.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =   1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS =   3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
TIME OF CONCENTRATION(MIN.) =   11.69
RAINFALL INTENSITY(INCH/HR) =   1.86
AREA-AVERAGED Fm(INCH/HR) =   0.13
AREA-AVERAGED Fp(INCH/HR) =   1.33
AREA-AVERAGED Ap =   0.10
EFFECTIVE STREAM AREA(ACRES) =       2.19
TOTAL STREAM AREA(ACRES) =       2.19
PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.53

*****
FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) =   126.00
ELEVATION DATA: UPSTREAM(FEET) =   1618.50  DOWNSTREAM(FEET) =   1616.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   5.000
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =   3.090

```

```

SUBAREA Tc AND LOSS RATE DATA(AMC I ):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp        Ap      SCS  Tc
    LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A        0.67    1.33    0.100    17    5.00
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 1.33
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) =      1.78
TOTAL AREA(ACRES) =      0.67    PEAK FLOW RATE(CFS) =      1.78

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      3.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1611.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 414.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 9.0 INCH PIPE IS 6.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 4.91
ESTIMATED PIPE DIAMETER(INCH) = 9.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 1.78
PIPE TRAVEL TIME(MIN.) = 1.41 Tc(MIN.) = 6.41
LONGEST FLOWPATH FROM NODE      4.00 TO NODE      3.00 = 540.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.41
RAINFALL INTENSITY(INCH/HR) = 2.66
AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.67
TOTAL STREAM AREA(ACRES) = 0.67
PEAK FLOW RATE(CFS) AT CONFLUENCE = 1.78

*****
FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 474.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.80 DOWNSTREAM(FEET) = 1606.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.456
* 2 YEAR RAINFALL INTENSITY(INCH/HR) = 2.431
SUBAREA Tc AND LOSS RATE DATA(AMC I ):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp        Ap      SCS  Tc
    LAND USE            GROUP   (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A        1.85    1.33    0.100    17    7.46
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 1.33
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) =      3.83
TOTAL AREA(ACRES) =      1.85    PEAK FLOW RATE(CFS) =      3.83

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      3.00 IS CODE = 31

```



```

-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.80 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 41.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 12.0 INCH PIPE IS 5.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 9.87
ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 3.83
PIPE TRAVEL TIME(MIN.) = 0.07 Tc(MIN.) = 7.53
LONGEST FLOWPATH FROM NODE 6.00 TO NODE 3.00 = 515.00 FEET.

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 7.53
RAINFALL INTENSITY(INCH/HR) = 2.42
AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 1.85
TOTAL STREAM AREA(ACRES) = 1.85
PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.83

** CONFLUENCE DATA **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	3.53	11.69	1.856	1.33( 0.13)	0.10	2.2	1.00
2	1.78	6.41	2.663	1.33( 0.13)	0.10	0.7	4.00
3	3.83	7.53	2.418	1.33( 0.13)	0.10	1.9	6.00

```

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

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	8.23	6.41	2.663	1.33( 0.13)	0.10	3.4	4.00
2	8.45	7.53	2.418	1.33( 0.13)	0.10	3.9	6.00
3	7.63	11.69	1.856	1.33( 0.13)	0.10	4.7	1.00

```

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 8.45 Tc(MIN.) = 7.53
EFFECTIVE AREA(ACRES) = 3.93 AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33 AREA-AVERAGED Ap = 0.10
TOTAL AREA(ACRES) = 4.7
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 4.7 TC(MIN.) = 7.53
EFFECTIVE AREA(ACRES) = 3.93 AREA-AVERAGED Fm(INCH/HR) = 0.13
AREA-AVERAGED Fp(INCH/HR) = 1.33 AREA-AVERAGED Ap = 0.100
PEAK FLOW RATE(CFS) = 8.45

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
------------------	------------	--------------	------------------------	---------------------	----	---------------	-------------------

1	8.23	6.41	2.663	1.33( 0.13)	0.10	3.4	4.00
2	8.45	7.53	2.418	1.33( 0.13)	0.10	3.9	6.00
3	7.63	11.69	1.856	1.33( 0.13)	0.10	4.7	1.00

=====

=====

END OF RATIONAL METHOD ANALYSIS

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* PROPOSED CONDITION *
* 25 YR STORM *
* *
*****

```

FILE NAME: 251-55PR.DAT  
TIME/DATE OF STUDY: 14:51 12/16/2021

```

=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

USER SPECIFIED STORM EVENT(YEAR) = 25.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 25.00 1-HOUR INTENSITY(INCH/HOUR) = 1.3811  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF-WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL IN- / OUT- / SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER WIDTH (FT)	GEOMETRIES LIP (FT)	MANNING HIKE (FT)	FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

```

*****
FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 927.00
ELEVATION DATA: UPSTREAM(FEET) = 1623.80 DOWNSTREAM(FEET) = 1611.00

```

```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 11.007
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 3.820
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
COMMERCIAL            A      2.19      0.98      0.100      32  11.01
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 7.34
TOTAL AREA(ACRES) = 2.19 PEAK FLOW RATE(CFS) = 7.34

*****
FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 190.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 18.0 INCH PIPE IS 12.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.47
ESTIMATED PIPE DIAMETER(INCH) = 18.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 7.34
PIPE TRAVEL TIME(MIN.) = 0.58 Tc(MIN.) = 11.59
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 11.59
RAINFALL INTENSITY(INCH/HR) = 3.70
AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 2.19
TOTAL STREAM AREA(ACRES) = 2.19
PEAK FLOW RATE(CFS) AT CONFLUENCE = 7.34

*****
FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 126.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.50 DOWNSTREAM(FEET) = 1616.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 5.000
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 6.134
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
COMMERCIAL            A      0.67      0.98      0.100      32  5.00
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 3.64
TOTAL AREA(ACRES) = 0.67 PEAK FLOW RATE(CFS) = 3.64

```

```

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1611.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 414.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 12.0 INCH PIPE IS 8.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.91
ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 3.64
PIPE TRAVEL TIME(MIN.) = 1.17 Tc(MIN.) = 6.17
LONGEST FLOWPATH FROM NODE 4.00 TO NODE 3.00 = 540.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.17
RAINFALL INTENSITY(INCH/HR) = 5.41
AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.67
TOTAL STREAM AREA(ACRES) = 0.67
PEAK FLOW RATE(CFS) AT CONFLUENCE = 3.64

*****
FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 474.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.80 DOWNSTREAM(FEET) = 1606.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.456
* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 4.826
SUBAREA Tc AND LOSS RATE DATA(AMC II):
  DEVELOPMENT TYPE/      SCS SOIL      AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP    (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL            A        1.85    0.98    0.100    32    7.46
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.98
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 7.87
TOTAL AREA(ACRES) = 1.85 PEAK FLOW RATE(CFS) = 7.87

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.80 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 41.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 15.0 INCH PIPE IS 8.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 11.81

```

```

ESTIMATED PIPE DIAMETER(INCH) = 15.00    NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 7.87
PIPE TRAVEL TIME(MIN.) = 0.06    Tc(MIN.) = 7.51
LONGEST FLOWPATH FROM NODE 6.00 TO NODE 3.00 = 515.00 FEET.

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 7.51
RAINFALL INTENSITY(INCH/HR) = 4.80
AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 1.85
TOTAL STREAM AREA(ACRES) = 1.85
PEAK FLOW RATE(CFS) AT CONFLUENCE = 7.87

** CONFLUENCE DATA **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	7.34	11.59	3.705	0.98( 0.10)	0.10	2.2	1.00
2	3.64	6.17	5.409	0.98( 0.10)	0.10	0.7	4.00
3	7.87	7.51	4.804	0.98( 0.10)	0.10	1.9	6.00

```

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

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	16.68	6.17	5.409	0.98( 0.10)	0.10	3.4	4.00
2	17.31	7.51	4.804	0.98( 0.10)	0.10	3.9	6.00
3	15.84	11.59	3.705	0.98( 0.10)	0.10	4.7	1.00

```

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 17.31    Tc(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR) = 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98    AREA-AVERAGED Ap = 0.10
TOTAL AREA(ACRES) = 4.7
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 4.7    TC(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR)= 0.10
AREA-AVERAGED Fp(INCH/HR) = 0.98    AREA-AVERAGED Ap = 0.100
PEAK FLOW RATE(CFS) = 17.31

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	16.68	6.17	5.409	0.98( 0.10)	0.10	3.4	4.00
2	17.31	7.51	4.804	0.98( 0.10)	0.10	3.9	6.00
3	15.84	11.59	3.705	0.98( 0.10)	0.10	4.7	1.00

```

=====
END OF RATIONAL METHOD ANALYSIS

```

```

*****
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
(c) Copyright 1983-2008 Advanced Engineering Software (aes)
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

```

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

```

***** DESCRIPTION OF STUDY *****
* PROPOSED CONDITION *
* 100 YR STORM *
* *
*****

```

```

FILE NAME: 251-55PR.DAT
TIME/DATE OF STUDY: 14:52 12/16/2021
=====
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=====
--*TIME-OF-CONCENTRATION MODEL*--

```

```

USER SPECIFIED STORM EVENT(YEAR) = 100.00
SPECIFIED MINIMUM PIPE SIZE(INCH) = 8.00
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.150
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.800
COMPUTED RAINFALL INTENSITY DATA:
STORM EVENT = 100.00 1-HOUR INTENSITY(INCH/HOUR) = 1.8000
SLOPE OF INTENSITY DURATION CURVE = 0.6000

```

```

*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
      HALF- CROWN TO STREET-CROSSFALL: CURB GUTTER-GEOMETRIES: MANNING
      WIDTH CROSSFALL IN- / OUT-/PARK- HEIGHT WIDTH LIP HIKE FACTOR
NO. (FT) (FT) SIDE / SIDE/ WAY (FT) (FT) (FT) (FT) (n)
=== =====
1 30.0 20.0 0.018/0.018/0.020 0.67 2.00 0.0313 0.167 0.0150

```

```

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

```

```

*****
FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 927.00
ELEVATION DATA: UPSTREAM(FEET) = 1623.80 DOWNSTREAM(FEET) = 1611.00

```



```

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 11.007
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.979
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A      2.19      0.74      0.100      52      11.01
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.74
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 9.67
TOTAL AREA(ACRES) = 2.19 PEAK FLOW RATE(CFS) = 9.67

*****
FLOW PROCESS FROM NODE 2.00 TO NODE 3.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(Feet) = 1606.00 DOWNSTREAM(Feet) = 1604.50
FLOW LENGTH(Feet) = 190.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 21.0 INCH PIPE IS 13.5 INCHES
PIPE-FLOW VELOCITY(Feet/Sec.) = 5.91
ESTIMATED PIPE DIAMETER(INCH) = 21.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 9.67
PIPE TRAVEL TIME(MIN.) = 0.54 Tc(MIN.) = 11.54
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 11.54
RAINFALL INTENSITY(INCH/HR) = 4.84
AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 2.19
TOTAL STREAM AREA(ACRES) = 2.19
PEAK FLOW RATE(CFS) AT CONFLUENCE = 9.67

*****
FLOW PROCESS FROM NODE 4.00 TO NODE 5.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(Feet) = 126.00
ELEVATION DATA: UPSTREAM(Feet) = 1618.50 DOWNSTREAM(Feet) = 1616.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 5.000
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 7.994
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL  AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP  (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A      0.67      0.74      0.100      52      5.00
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.74
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 4.78
TOTAL AREA(ACRES) = 0.67 PEAK FLOW RATE(CFS) = 4.78

```

```

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1611.00 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 414.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 15.0 INCH PIPE IS 8.7 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 6.45
ESTIMATED PIPE DIAMETER(INCH) = 15.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 4.78
PIPE TRAVEL TIME(MIN.) = 1.07 Tc(MIN.) = 6.07
LONGEST FLOWPATH FROM NODE 4.00 TO NODE 3.00 = 540.00 FEET.

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE = 1
-----
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 6.07
RAINFALL INTENSITY(INCH/HR) = 7.12
AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 0.67
TOTAL STREAM AREA(ACRES) = 0.67
PEAK FLOW RATE(CFS) AT CONFLUENCE = 4.78

*****
FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE = 21
-----
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 474.00
ELEVATION DATA: UPSTREAM(FEET) = 1618.80 DOWNSTREAM(FEET) = 1606.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.456
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 6.290
SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL      AREA      Fp      Ap      SCS      Tc
    LAND USE          GROUP    (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)
COMMERCIAL              A        1.85    0.74    0.100    52    7.46
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.74
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100
SUBAREA RUNOFF(CFS) = 10.35
TOTAL AREA(ACRES) = 1.85 PEAK FLOW RATE(CFS) = 10.35

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      3.00 IS CODE = 31
-----
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1606.80 DOWNSTREAM(FEET) = 1604.50
FLOW LENGTH(FEET) = 41.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 15.0 INCH PIPE IS 9.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 12.55

```

```

ESTIMATED PIPE DIAMETER(INCH) = 15.00    NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 10.35
PIPE TRAVEL TIME(MIN.) = 0.05    Tc(MIN.) = 7.51
LONGEST FLOWPATH FROM NODE 6.00 TO NODE 3.00 = 515.00 FEET.

*****
FLOW PROCESS FROM NODE 3.00 TO NODE 3.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<
=====
TOTAL NUMBER OF STREAMS = 3
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 3 ARE:
TIME OF CONCENTRATION(MIN.) = 7.51
RAINFALL INTENSITY(INCH/HR) = 6.26
AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 1.85
TOTAL STREAM AREA(ACRES) = 1.85
PEAK FLOW RATE(CFS) AT CONFLUENCE = 10.35

** CONFLUENCE DATA **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	9.67	11.54	4.839	0.74( 0.07)	0.10	2.2	1.00
2	4.78	6.07	7.116	0.74( 0.07)	0.10	0.7	4.00
3	10.35	7.51	6.263	0.74( 0.07)	0.10	1.9	6.00

```

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

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	21.81	6.07	7.116	0.74( 0.07)	0.10	3.3	4.00
2	22.72	7.51	6.263	0.74( 0.07)	0.10	3.9	6.00
3	20.87	11.54	4.839	0.74( 0.07)	0.10	4.7	1.00

```

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 22.72    Tc(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74    AREA-AVERAGED Ap = 0.10
TOTAL AREA(ACRES) = 4.7
LONGEST FLOWPATH FROM NODE 1.00 TO NODE 3.00 = 1117.00 FEET.
=====
END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 4.7    TC(MIN.) = 7.51
EFFECTIVE AREA(ACRES) = 3.94    AREA-AVERAGED Fm(INCH/HR)= 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.74    AREA-AVERAGED Ap = 0.100
PEAK FLOW RATE(CFS) = 22.72

** PEAK FLOW RATE TABLE **

```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	21.81	6.07	7.116	0.74( 0.07)	0.10	3.3	4.00
2	22.72	7.51	6.263	0.74( 0.07)	0.10	3.9	6.00
3	20.87	11.54	4.839	0.74( 0.07)	0.10	4.7	1.00

```

=====
END OF RATIONAL METHOD ANALYSIS

```

## APPENDIX C: PROPOSED HYDROGRAPH METHOD & BASIN ROUTING, 100 YEAR STORM FREQUENCY OUTPUT FILE.

\*\*\*\*\*

### SMALL AREA UNIT HYDROGRAPH MODEL

=====

(C) Copyright 1989-2008 Advanced Engineering Software (aes)  
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

CA Engineering  
13821 Newport Ave., Ste 110  
Tustin, Ca. 92780

\*\*\*\*\*

-----  
Problem Descriptions:  
100 YEAR STORM BASIN ROUTING

-----

RATIONAL METHOD CALIBRATION COEFFICIENT = 1.10  
TOTAL CATCHMENT AREA(ACRES) = 4.70  
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.070  
LOW LOSS FRACTION = 0.080  
TIME OF CONCENTRATION(MIN.) = 7.51  
SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA  
USER SPECIFIED RAINFALL VALUES ARE USED  
RETURN FREQUENCY(YEARS) = 100  
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.45  
30-MINUTE POINT RAINFALL VALUE(INCHES) = 1.19  
1-HOUR POINT RAINFALL VALUE(INCHES) = 1.80  
3-HOUR POINT RAINFALL VALUE(INCHES) = 3.26  
6-HOUR POINT RAINFALL VALUE(INCHES) = 4.73  
24-HOUR POINT RAINFALL VALUE(INCHES) = 9.02

-----

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 3.58  
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = -0.05

\*\*\*\*\*

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	7.5	15.0	22.5	30.0
0.10	0.0036	0.83	.Q	.	.	.	.
0.23	0.0122	0.84	.Q	.	.	.	.
0.35	0.0209	0.84	.Q	.	.	.	.
0.48	0.0296	0.84	.Q	.	.	.	.
0.60	0.0383	0.85	.Q	.	.	.	.
0.73	0.0471	0.85	.Q	.	.	.	.
0.85	0.0559	0.85	.Q	.	.	.	.
0.98	0.0648	0.86	.Q	.	.	.	.
1.11	0.0736	0.86	.Q	.	.	.	.
1.23	0.0826	0.86	.Q	.	.	.	.

1.36	0.0916	0.87	.Q	.	.	.	.
1.48	0.1006	0.87	.Q	.	.	.	.
1.61	0.1096	0.88	.Q	.	.	.	.
1.73	0.1187	0.88	.Q	.	.	.	.
1.86	0.1279	0.89	.Q	.	.	.	.
1.98	0.1370	0.89	.Q	.	.	.	.
2.11	0.1463	0.89	.Q	.	.	.	.
2.23	0.1555	0.90	.Q	.	.	.	.
2.36	0.1649	0.90	.Q	.	.	.	.
2.48	0.1742	0.91	.Q	.	.	.	.
2.61	0.1836	0.91	.Q	.	.	.	.
2.73	0.1931	0.92	.Q	.	.	.	.
2.86	0.2026	0.92	.Q	.	.	.	.
2.98	0.2121	0.92	.Q	.	.	.	.
3.11	0.2217	0.93	.Q	.	.	.	.
3.23	0.2314	0.93	.Q	.	.	.	.
3.36	0.2411	0.94	.Q	.	.	.	.
3.48	0.2508	0.94	.Q	.	.	.	.
3.61	0.2606	0.95	.Q	.	.	.	.
3.73	0.2705	0.95	.Q	.	.	.	.
3.86	0.2804	0.96	.Q	.	.	.	.
3.98	0.2903	0.96	.Q	.	.	.	.
4.11	0.3004	0.97	.Q	.	.	.	.
4.23	0.3104	0.98	.Q	.	.	.	.
4.36	0.3206	0.98	.Q	.	.	.	.
4.48	0.3307	0.99	.Q	.	.	.	.
4.61	0.3410	0.99	.Q	.	.	.	.
4.73	0.3513	1.00	.Q	.	.	.	.
4.86	0.3617	1.01	.Q	.	.	.	.
4.99	0.3721	1.01	.Q	.	.	.	.
5.11	0.3826	1.02	.Q	.	.	.	.
5.24	0.3931	1.02	.Q	.	.	.	.
5.36	0.4038	1.03	.Q	.	.	.	.
5.49	0.4144	1.04	.Q	.	.	.	.
5.61	0.4252	1.04	.Q	.	.	.	.
5.74	0.4360	1.05	.Q	.	.	.	.
5.86	0.4469	1.06	.Q	.	.	.	.
5.99	0.4579	1.06	.Q	.	.	.	.
6.11	0.4689	1.07	.Q	.	.	.	.
6.24	0.4800	1.08	.Q	.	.	.	.
6.36	0.4912	1.09	.Q	.	.	.	.
6.49	0.5025	1.09	.Q	.	.	.	.
6.61	0.5138	1.10	.Q	.	.	.	.
6.74	0.5252	1.11	.Q	.	.	.	.
6.86	0.5367	1.12	.Q	.	.	.	.
6.99	0.5483	1.12	.Q	.	.	.	.
7.11	0.5600	1.13	.Q	.	.	.	.
7.24	0.5718	1.14	.Q	.	.	.	.
7.36	0.5836	1.15	.Q	.	.	.	.
7.49	0.5955	1.16	.Q	.	.	.	.
7.61	0.6076	1.17	.Q	.	.	.	.
7.74	0.6197	1.18	.Q	.	.	.	.
7.86	0.6319	1.19	.Q	.	.	.	.
7.99	0.6443	1.19	.Q	.	.	.	.
8.11	0.6567	1.21	.Q	.	.	.	.
8.24	0.6692	1.21	.Q	.	.	.	.
8.36	0.6819	1.23	.Q	.	.	.	.
8.49	0.6946	1.24	.Q	.	.	.	.
8.62	0.7075	1.25	.Q	.	.	.	.
8.74	0.7204	1.26	.Q	.	.	.	.
8.87	0.7335	1.27	.Q	.	.	.	.
8.99	0.7468	1.28	.Q	.	.	.	.
9.12	0.7601	1.30	.Q	.	.	.	.

9.24	0.7736	1.31	.Q	.	.	.	.
9.37	0.7872	1.32	.Q	.	.	.	.
9.49	0.8009	1.33	.Q	.	.	.	.
9.62	0.8148	1.35	.Q	.	.	.	.
9.74	0.8288	1.36	.Q	.	.	.	.
9.87	0.8430	1.38	.Q	.	.	.	.
9.99	0.8573	1.39	.Q	.	.	.	.
10.12	0.8718	1.41	.Q	.	.	.	.
10.24	0.8864	1.42	.Q	.	.	.	.
10.37	0.9012	1.44	.Q	.	.	.	.
10.49	0.9162	1.45	.Q	.	.	.	.
10.62	0.9314	1.48	.Q	.	.	.	.
10.74	0.9467	1.49	.Q	.	.	.	.
10.87	0.9623	1.52	. Q	.	.	.	.
10.99	0.9780	1.53	. Q	.	.	.	.
11.12	0.9940	1.56	. Q	.	.	.	.
11.24	1.0101	1.57	. Q	.	.	.	.
11.37	1.0265	1.60	. Q	.	.	.	.
11.49	1.0431	1.61	. Q	.	.	.	.
11.62	1.0600	1.65	. Q	.	.	.	.
11.74	1.0771	1.66	. Q	.	.	.	.
11.87	1.0945	1.70	. Q	.	.	.	.
11.99	1.1122	1.72	. Q	.	.	.	.
12.12	1.1314	2.00	. Q	.	.	.	.
12.24	1.1524	2.04	. Q	.	.	.	.
12.37	1.1737	2.08	. Q	.	.	.	.
12.50	1.1954	2.11	. Q	.	.	.	.
12.62	1.2174	2.15	. Q	.	.	.	.
12.75	1.2398	2.18	. Q	.	.	.	.
12.87	1.2626	2.23	. Q	.	.	.	.
13.00	1.2858	2.26	. Q	.	.	.	.
13.12	1.3094	2.31	. Q	.	.	.	.
13.25	1.3335	2.34	. Q	.	.	.	.
13.37	1.3581	2.41	. Q	.	.	.	.
13.50	1.3832	2.45	. Q	.	.	.	.
13.62	1.4089	2.52	. Q	.	.	.	.
13.75	1.4352	2.56	. Q	.	.	.	.
13.87	1.4621	2.65	. Q	.	.	.	.
14.00	1.4898	2.70	. Q	.	.	.	.
14.12	1.5183	2.82	. Q	.	.	.	.
14.25	1.5478	2.88	. Q	.	.	.	.
14.37	1.5782	3.00	. Q	.	.	.	.
14.50	1.6096	3.07	. Q	.	.	.	.
14.62	1.6422	3.23	. Q	.	.	.	.
14.75	1.6761	3.32	. Q	.	.	.	.
14.87	1.7114	3.52	. Q	.	.	.	.
15.00	1.7484	3.64	. Q	.	.	.	.
15.12	1.7875	3.92	. Q	.	.	.	.
15.25	1.8289	4.08	. Q	.	.	.	.
15.37	1.8734	4.53	. Q	.	.	.	.
15.50	1.9245	5.33	. Q	.	.	.	.
15.62	1.9836	6.10	. Q	.	.	.	.
15.75	2.0496	6.65	. Q	.	.	.	.
15.87	2.1248	7.91	. Q	.	.	.	.
16.00	2.2185	10.19	. Q	.	.	.	.
16.13	2.3898	22.94	. Q	.	.	.	.
16.25	2.5431	6.71	. Q	.	.	.	.
16.38	2.6072	5.68	. Q	.	.	.	.
16.50	2.6587	4.29	. Q	.	.	.	.
16.63	2.7004	3.77	. Q	.	.	.	.
16.75	2.7376	3.41	. Q	.	.	.	.
16.88	2.7715	3.15	. Q	.	.	.	.
17.00	2.8030	2.94	. Q	.	.	.	.

17.13	2.8324	2.75	. Q	.	.	.	.
17.25	2.8600	2.60	. Q	.	.	.	.
17.38	2.8864	2.48	. Q	.	.	.	.
17.50	2.9115	2.38	. Q	.	.	.	.
17.63	2.9356	2.28	. Q	.	.	.	.
17.75	2.9588	2.20	. Q	.	.	.	.
17.88	2.9812	2.13	. Q	.	.	.	.
18.00	3.0029	2.06	. Q	.	.	.	.
18.13	3.0225	1.74	. Q	.	.	.	.
18.25	3.0402	1.68	. Q	.	.	.	.
18.38	3.0573	1.63	. Q	.	.	.	.
18.50	3.0739	1.58	. Q	.	.	.	.
18.63	3.0901	1.54	. Q	.	.	.	.
18.75	3.1059	1.50	. Q	.	.	.	.
18.88	3.1212	1.47	.Q	.	.	.	.
19.00	3.1362	1.43	.Q	.	.	.	.
19.13	3.1508	1.40	.Q	.	.	.	.
19.25	3.1652	1.37	.Q	.	.	.	.
19.38	3.1792	1.34	.Q	.	.	.	.
19.50	3.1929	1.31	.Q	.	.	.	.
19.63	3.2064	1.29	.Q	.	.	.	.
19.76	3.2196	1.27	.Q	.	.	.	.
19.88	3.2326	1.24	.Q	.	.	.	.
20.01	3.2453	1.22	.Q	.	.	.	.
20.13	3.2579	1.20	.Q	.	.	.	.
20.26	3.2702	1.18	.Q	.	.	.	.
20.38	3.2823	1.16	.Q	.	.	.	.
20.51	3.2943	1.15	.Q	.	.	.	.
20.63	3.3060	1.13	.Q	.	.	.	.
20.76	3.3176	1.11	.Q	.	.	.	.
20.88	3.3290	1.10	.Q	.	.	.	.
21.01	3.3403	1.08	.Q	.	.	.	.
21.13	3.3514	1.07	.Q	.	.	.	.
21.26	3.3624	1.05	.Q	.	.	.	.
21.38	3.3732	1.04	.Q	.	.	.	.
21.51	3.3839	1.03	.Q	.	.	.	.
21.63	3.3944	1.01	.Q	.	.	.	.
21.76	3.4049	1.00	.Q	.	.	.	.
21.88	3.4152	0.99	.Q	.	.	.	.
22.01	3.4254	0.98	.Q	.	.	.	.
22.13	3.4354	0.97	.Q	.	.	.	.
22.26	3.4454	0.96	.Q	.	.	.	.
22.38	3.4553	0.95	.Q	.	.	.	.
22.51	3.4650	0.94	.Q	.	.	.	.
22.63	3.4747	0.93	.Q	.	.	.	.
22.76	3.4842	0.92	.Q	.	.	.	.
22.88	3.4937	0.91	.Q	.	.	.	.
23.01	3.5030	0.90	.Q	.	.	.	.
23.13	3.5123	0.89	.Q	.	.	.	.
23.26	3.5215	0.88	.Q	.	.	.	.
23.38	3.5306	0.88	.Q	.	.	.	.
23.51	3.5396	0.87	.Q	.	.	.	.
23.64	3.5485	0.86	.Q	.	.	.	.
23.76	3.5574	0.85	.Q	.	.	.	.
23.89	3.5661	0.84	.Q	.	.	.	.
24.01	3.5748	0.84	.Q	.	.	.	.
24.14	3.5792	0.00	Q	.	.	.	.

-----

Problem Descriptions:



=====

FLOW-THROUGH DETENTION BASIN MODEL

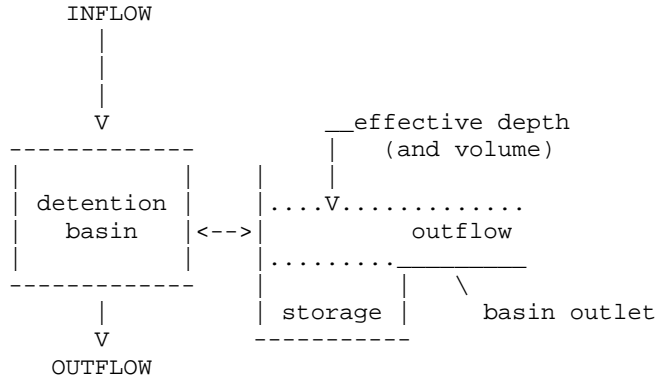
SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:

CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 7.510

DEAD STORAGE(AF) = 0.00

SPECIFIED DEAD STORAGE(AF) FILLED = 0.00

ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00



DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:

TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 10

*BASIN-DEPTH	STORAGE	OUTFLOW	**BASIN-DEPTH	STORAGE	OUTFLOW	*
(FEET)	(ACRE-FEET)	(CFS)	(FEET)	(ACRE-FEET)	(CFS)	*
* 0.000	0.000	0.000	** 1.000	0.100	1.470	*
* 2.000	0.269	1.470	** 3.000	0.485	1.470	*
* 4.000	0.723	1.470	** 5.000	0.971	1.470	*
* 6.000	1.198	1.470	** 7.000	1.411	1.470	*
* 8.000	1.588	1.470	** 9.000	1.692	1.470	*

BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:

INTERVAL	DEPTH	{S-O*DT/2}	{S+O*DT/2}
NUMBER	(FEET)	(ACRE-FEET)	(ACRE-FEET)
1	0.00	0.00000	0.00000
2	1.00	0.09244	0.10765
3	2.00	0.26097	0.27617
4	3.00	0.47704	0.49224
5	4.00	0.71543	0.73063
6	5.00	0.96359	0.97879
7	6.00	1.19086	1.20606
8	7.00	1.40291	1.41811
9	8.00	1.58083	1.59603
10	9.00	1.68487	1.70007

WHERE S=STORAGE(AF);O=OUTFLOW(AF/MIN.);DT=UNIT INTERVAL(MIN.)

DETENTION BASIN ROUTING RESULTS:

NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

TIME	DEAD-STORAGE	INFLOW	EFFECTIVE	OUTFLOW	EFFECTIVE
(HRS)	FILLED(AF)	(CFS)	DEPTH(FT)	(CFS)	VOLUME(AF)
0.104	0.000	0.83	0.08	0.06	0.008

0.229	0.000	0.84	0.15	0.17	0.015
0.354	0.000	0.84	0.21	0.26	0.021
0.479	0.000	0.84	0.26	0.34	0.026
0.604	0.000	0.85	0.30	0.42	0.030
0.730	0.000	0.85	0.34	0.48	0.034
0.855	0.000	0.85	0.38	0.53	0.038
0.980	0.000	0.86	0.41	0.58	0.041
1.105	0.000	0.86	0.43	0.62	0.043
1.230	0.000	0.86	0.45	0.65	0.045
1.355	0.000	0.87	0.47	0.68	0.047
1.481	0.000	0.87	0.49	0.71	0.049
1.606	0.000	0.88	0.51	0.73	0.051
1.731	0.000	0.88	0.52	0.75	0.052
1.856	0.000	0.89	0.53	0.77	0.053
1.981	0.000	0.89	0.54	0.79	0.054
2.106	0.000	0.89	0.55	0.80	0.055
2.232	0.000	0.90	0.56	0.82	0.056
2.357	0.000	0.90	0.57	0.83	0.057
2.482	0.000	0.91	0.57	0.84	0.057
2.607	0.000	0.91	0.58	0.85	0.058
2.732	0.000	0.92	0.59	0.86	0.059
2.857	0.000	0.92	0.59	0.87	0.059
2.983	0.000	0.92	0.60	0.87	0.060
3.108	0.000	0.93	0.60	0.88	0.060
3.233	0.000	0.93	0.61	0.89	0.061
3.358	0.000	0.94	0.61	0.90	0.061
3.483	0.000	0.94	0.62	0.90	0.062
3.608	0.000	0.95	0.62	0.91	0.062
3.734	0.000	0.95	0.62	0.91	0.062
3.859	0.000	0.96	0.63	0.92	0.063
3.984	0.000	0.96	0.63	0.93	0.063
4.109	0.000	0.97	0.64	0.93	0.064
4.234	0.000	0.98	0.64	0.94	0.064
4.359	0.000	0.98	0.64	0.94	0.064
4.485	0.000	0.99	0.65	0.95	0.065
4.610	0.000	0.99	0.65	0.96	0.065
4.735	0.000	1.00	0.66	0.96	0.066
4.860	0.000	1.01	0.66	0.97	0.066
4.985	0.000	1.01	0.66	0.97	0.066
5.110	0.000	1.02	0.67	0.98	0.067
5.236	0.000	1.02	0.67	0.98	0.067
5.361	0.000	1.03	0.68	0.99	0.068
5.486	0.000	1.04	0.68	1.00	0.068
5.611	0.000	1.04	0.68	1.00	0.068
5.736	0.000	1.05	0.69	1.01	0.069
5.861	0.000	1.06	0.69	1.02	0.069
5.987	0.000	1.06	0.70	1.02	0.070
6.112	0.000	1.07	0.70	1.03	0.070
6.237	0.000	1.08	0.71	1.03	0.071
6.362	0.000	1.09	0.71	1.04	0.071
6.487	0.000	1.09	0.72	1.05	0.072
6.612	0.000	1.10	0.72	1.05	0.072
6.738	0.000	1.11	0.72	1.06	0.072
6.863	0.000	1.12	0.73	1.07	0.073
6.988	0.000	1.12	0.73	1.08	0.073
7.113	0.000	1.13	0.74	1.08	0.074
7.238	0.000	1.14	0.74	1.09	0.075
7.364	0.000	1.15	0.75	1.10	0.075
7.489	0.000	1.16	0.76	1.11	0.076
7.614	0.000	1.17	0.76	1.11	0.076
7.739	0.000	1.18	0.77	1.12	0.077
7.864	0.000	1.19	0.77	1.13	0.077
7.989	0.000	1.19	0.78	1.14	0.078

8.115	0.000	1.21	0.78	1.15	0.078
8.240	0.000	1.21	0.79	1.16	0.079
8.365	0.000	1.23	0.80	1.17	0.080
8.490	0.000	1.24	0.80	1.18	0.080
8.615	0.000	1.25	0.81	1.19	0.081
8.740	0.000	1.26	0.82	1.20	0.082
8.865	0.000	1.27	0.82	1.21	0.082
8.991	0.000	1.28	0.83	1.22	0.083
9.116	0.000	1.30	0.84	1.23	0.084
9.241	0.000	1.31	0.84	1.24	0.085
9.366	0.000	1.32	0.85	1.25	0.085
9.491	0.000	1.33	0.86	1.26	0.086
9.616	0.000	1.35	0.87	1.27	0.087
9.742	0.000	1.36	0.88	1.28	0.088
9.867	0.000	1.38	0.89	1.29	0.089
9.992	0.000	1.39	0.89	1.31	0.089
10.117	0.000	1.41	0.90	1.32	0.090
10.242	0.000	1.42	0.91	1.33	0.091
10.367	0.000	1.44	0.92	1.35	0.092
10.493	0.000	1.45	0.93	1.36	0.093
10.618	0.000	1.48	0.94	1.38	0.094
10.743	0.000	1.49	0.95	1.39	0.095
10.868	0.000	1.52	0.96	1.41	0.096
10.993	0.000	1.53	0.97	1.42	0.097
11.118	0.000	1.56	0.99	1.44	0.099
11.244	0.000	1.57	1.00	1.46	0.100
11.369	0.000	1.60	1.01	1.47	0.101
11.494	0.000	1.61	1.02	1.47	0.103
11.619	0.000	1.65	1.03	1.47	0.104
11.744	0.000	1.66	1.04	1.47	0.106
11.870	0.000	1.70	1.05	1.47	0.109
11.995	0.000	1.72	1.07	1.47	0.111
12.120	0.000	2.00	1.10	1.47	0.117
12.245	0.000	2.04	1.14	1.47	0.123
12.370	0.000	2.08	1.17	1.47	0.129
12.495	0.000	2.11	1.21	1.47	0.136
12.620	0.000	2.15	1.25	1.47	0.143
12.746	0.000	2.18	1.30	1.47	0.150
12.871	0.000	2.23	1.34	1.47	0.158
12.996	0.000	2.26	1.39	1.47	0.166
13.121	0.000	2.31	1.44	1.47	0.175
13.246	0.000	2.34	1.50	1.47	0.184
13.372	0.000	2.41	1.56	1.47	0.194
13.497	0.000	2.45	1.62	1.47	0.204
13.622	0.000	2.52	1.68	1.47	0.215
13.747	0.000	2.56	1.75	1.47	0.226
13.872	0.000	2.65	1.82	1.47	0.238
13.997	0.000	2.70	1.89	1.47	0.251
14.122	0.000	2.82	1.98	1.47	0.265
14.248	0.000	2.88	2.05	1.47	0.279
14.373	0.000	3.00	2.12	1.47	0.295
14.498	0.000	3.07	2.20	1.47	0.312
14.623	0.000	3.23	2.28	1.47	0.330
14.748	0.000	3.32	2.37	1.47	0.349
14.873	0.000	3.52	2.47	1.47	0.370
14.999	0.000	3.64	2.57	1.47	0.393
15.124	0.000	3.92	2.69	1.47	0.418
15.249	0.000	4.08	2.82	1.47	0.445
15.374	0.000	4.53	2.96	1.47	0.477
15.499	0.000	5.33	3.13	1.47	0.517
15.624	0.000	6.10	3.34	1.47	0.565
15.750	0.000	6.65	3.56	1.47	0.618
15.875	0.000	7.91	3.84	1.47	0.685

16.000	0.000	10.19	4.21	1.47	0.775
16.125	0.000	22.94	5.11	1.47	0.997
16.250	0.000	6.71	5.35	1.47	1.051
16.375	0.000	5.68	5.54	1.47	1.095
16.501	0.000	4.29	5.67	1.47	1.124
16.626	0.000	3.77	5.78	1.47	1.148
16.751	0.000	3.41	5.86	1.47	1.168
16.876	0.000	3.15	5.94	1.47	1.185
17.001	0.000	2.94	6.01	1.47	1.200
17.126	0.000	2.75	6.07	1.47	1.213
17.252	0.000	2.60	6.13	1.47	1.225
17.377	0.000	2.48	6.18	1.47	1.236
17.502	0.000	2.38	6.22	1.47	1.245
17.627	0.000	2.28	6.26	1.47	1.253
17.752	0.000	2.20	6.30	1.47	1.261
17.878	0.000	2.13	6.33	1.47	1.268
18.003	0.000	2.06	6.36	1.47	1.274
18.128	0.000	1.74	6.37	1.47	1.277
18.253	0.000	1.68	6.38	1.47	1.279
18.378	0.000	1.63	6.39	1.47	1.281
18.503	0.000	1.58	6.39	1.47	1.282
18.628	0.000	1.54	6.40	1.47	1.282
18.754	0.000	1.50	<u>6.40</u>	1.47	1.283
18.879	0.000	1.47	6.40	1.47	1.283
19.004	0.000	1.43	6.40	1.47	1.282
19.129	0.000	1.40	6.39	1.47	1.282
19.254	0.000	1.37	6.39	1.47	1.281
19.379	0.000	1.34	6.38	1.47	1.279
19.505	0.000	1.31	6.37	1.47	1.278
19.630	0.000	1.29	6.36	1.47	1.276
19.755	0.000	1.27	6.35	1.47	1.274
19.880	0.000	1.24	6.34	1.47	1.271
20.005	0.000	1.22	6.33	1.47	1.269
20.130	0.000	1.20	6.32	1.47	1.266
20.256	0.000	1.18	6.30	1.47	1.263
20.381	0.000	1.16	6.29	1.47	1.260
20.506	0.000	1.15	6.27	1.47	1.256
20.631	0.000	1.13	6.26	1.47	1.253
20.756	0.000	1.11	6.24	1.47	1.249
20.882	0.000	1.10	6.22	1.47	1.245
21.007	0.000	1.08	6.20	1.47	1.241
21.132	0.000	1.07	6.18	1.47	1.237
21.257	0.000	1.05	6.16	1.47	1.233
21.382	0.000	1.04	6.14	1.47	1.228
21.507	0.000	1.03	6.12	1.47	1.224
21.632	0.000	1.01	6.10	1.47	1.219
21.758	0.000	1.00	6.07	1.47	1.214
21.883	0.000	0.99	6.05	1.47	1.209
22.008	0.000	0.98	6.03	1.47	1.204
22.133	0.000	0.97	6.00	1.47	1.199
22.258	0.000	0.96	5.98	1.47	1.194
22.384	0.000	0.95	5.96	1.47	1.188
22.509	0.000	0.94	5.93	1.47	1.183
22.634	0.000	0.93	5.91	1.47	1.177
22.759	0.000	0.92	5.88	1.47	1.172
22.884	0.000	0.91	5.86	1.47	1.166
23.009	0.000	0.90	5.83	1.47	1.160
23.135	0.000	0.89	5.80	1.47	1.154
23.260	0.000	0.88	5.78	1.47	1.148
23.385	0.000	0.88	5.75	1.47	1.142
23.510	0.000	0.87	5.72	1.47	1.135
23.635	0.000	0.86	5.69	1.47	1.129
23.760	0.000	0.85	5.67	1.47	1.123

23.885	0.000	0.84	5.64	1.47	1.116
24.011	0.000	0.84	5.61	1.47	1.110
24.136	0.000	0.00	5.54	1.47	1.095
-----					

**APPENDIX D: STORAGE VOLUME & OUTFLOW CALCULATIONS AND  $\bar{Y}$ bar  
CALCULATIONS**

## **STORAGE PIPE CALCULATIONS**

LOCUST AVE.

VOLUME = 1250 LF - 96" DIA. PIPE INF. FACILITY

### **OUTFLOW:**

#### **INFILTRATION**

INFILTRATION RATE - 5.07 "/HR (WQMP Worksheet H)

FACILITY AREA - 12,500 SF

TOTAL INF. =  $5.07"/HR * (1/3600 \text{ SEC}/HR * 1/12 \text{ FT}/IN) * 12,500 = 1.47 \text{ CFS}$

OUTLET		STORAGE		
HEAD (h)	OUTLET FLOW			
	CFS	CF	AF	TOTAL
1	1.47	4375	0.10044	0.10044
2	1.47	7324	0.16814	0.26857
3	1.47	9412	0.21607	0.48464
4	1.47	10384	0.23838	0.72303
5	1.47	10810	0.24816	0.97119
6	1.47	9900	0.22727	1.19846
7	1.47	9237	0.21205	1.41051
8	1.47	7750	0.17792	1.58843
9	1.47	4532	0.10404	1.69247



## YBAR CALCULATIONS

DEVELOPED AREA A						
2 YEAR STORM						
P24 = 3.87 in.						
SUBAREA	ACRES	CN	S	Ia	Yj	Yj*Aj
A1	2.19	94	0.64	0.13	0.83	1.81
A2	0.67	94	0.64	0.13	0.83	0.55
A3	1.85	94	0.64	0.13	0.83	1.53
<b>TOTAL</b>	<b>4.71</b>					

$$Y = (\sum Y_j * A_j) / A \quad Y = 0.83$$

$$Y_{bar} = 1 - Y \quad Y_{bar} = 0.17$$

DEVELOPED AREA A						
25 YEAR STORM						
P24 = 7.21 in.						
SUBAREA	ACRES	CN	S	Ia	Yj	Yj*Aj
A1	2.19	94	0.64	0.13	0.90	1.97
A2	0.67	94	0.64	0.13	0.90	0.60
A3	1.85	94	0.64	0.13	0.90	1.67
<b>TOTAL</b>	<b>4.71</b>					

$$Y = (\sum Y_j * A_j) / A \quad Y = 0.90$$

$$Y_{bar} = 1 - Y \quad Y_{bar} = 0.10$$

DEVELOPED AREA A						
100 YEAR STORM						
P24 = 9.02 in.						
SUBAREA	ACRES	CN	S	Ia	Yj	Yj*Aj
A1	2.19	94	0.64	0.13	0.92	2.01
A2	0.67	94	0.64	0.13	0.92	0.62
A3	1.85	94	0.64	0.13	0.92	1.70
<b>TOTAL</b>	<b>4.71</b>					

$$Y = (\sum Y_j * A_j) / A \quad Y = 0.92$$

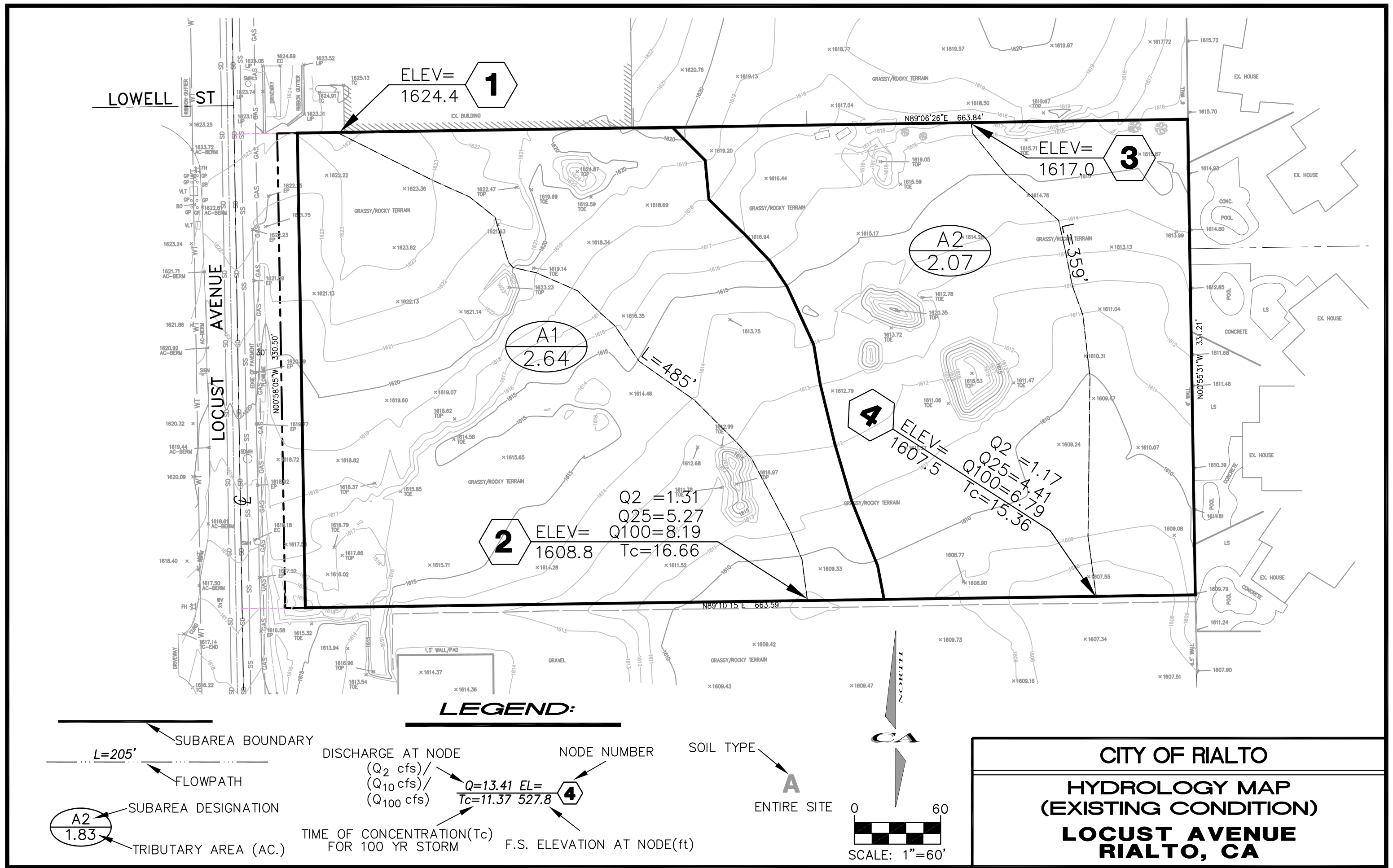
$$Y_{bar} = 1 - Y \quad Y_{bar} = 0.08$$

### DEFINITIONS:

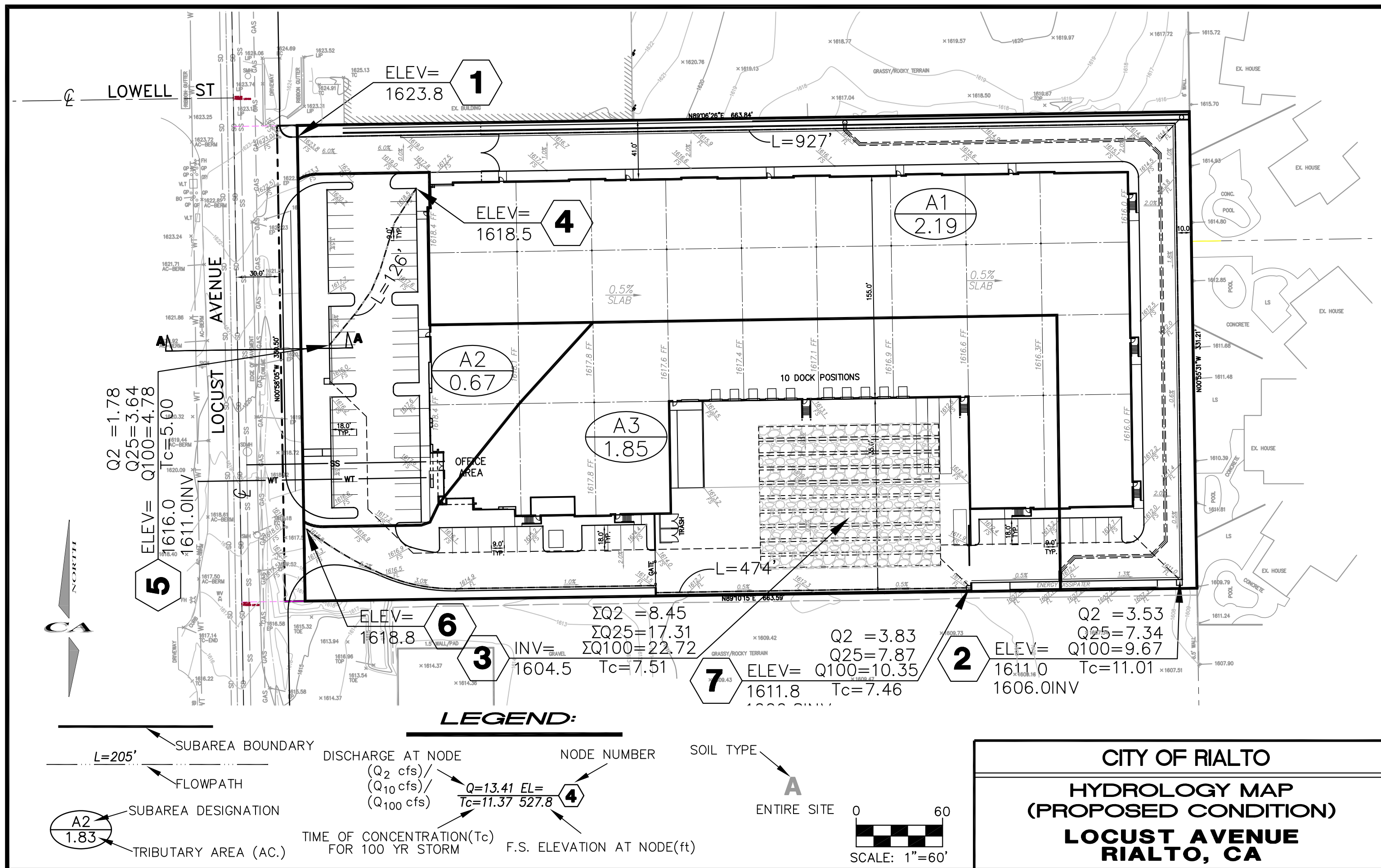
CN - CURVE NUMBER OF HYDRAULIC SOIL COVER
S - ESTIMATE OF TOTAL SOIL CAPACITY
Ia - INITIAL ABSTRACTION
Yj - 24-HR STORM RUNOFF YIELD FRACTION
Ybar - CATCHMENT LOW LOSS FRACTION

## EXHIBITS

## **EXHIBIT A: EXISTING CONDITION HYDROLOGY MAP**



## **EXHIBIT B: PROPOSED CONDITION HYDROLOGY MAP**



## EXHIBIT C: FIRM MAP



NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

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

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

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

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

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

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

NGS Information Services  
NOAA, NINGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3242

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

**Base map** information shown on this FIRM was derived from digital orthophotography collected by the U.S. Department of Agriculture Farm Service Agency. This imagery was flown in 2005 and was produced with a 1-meter ground sample distance.

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

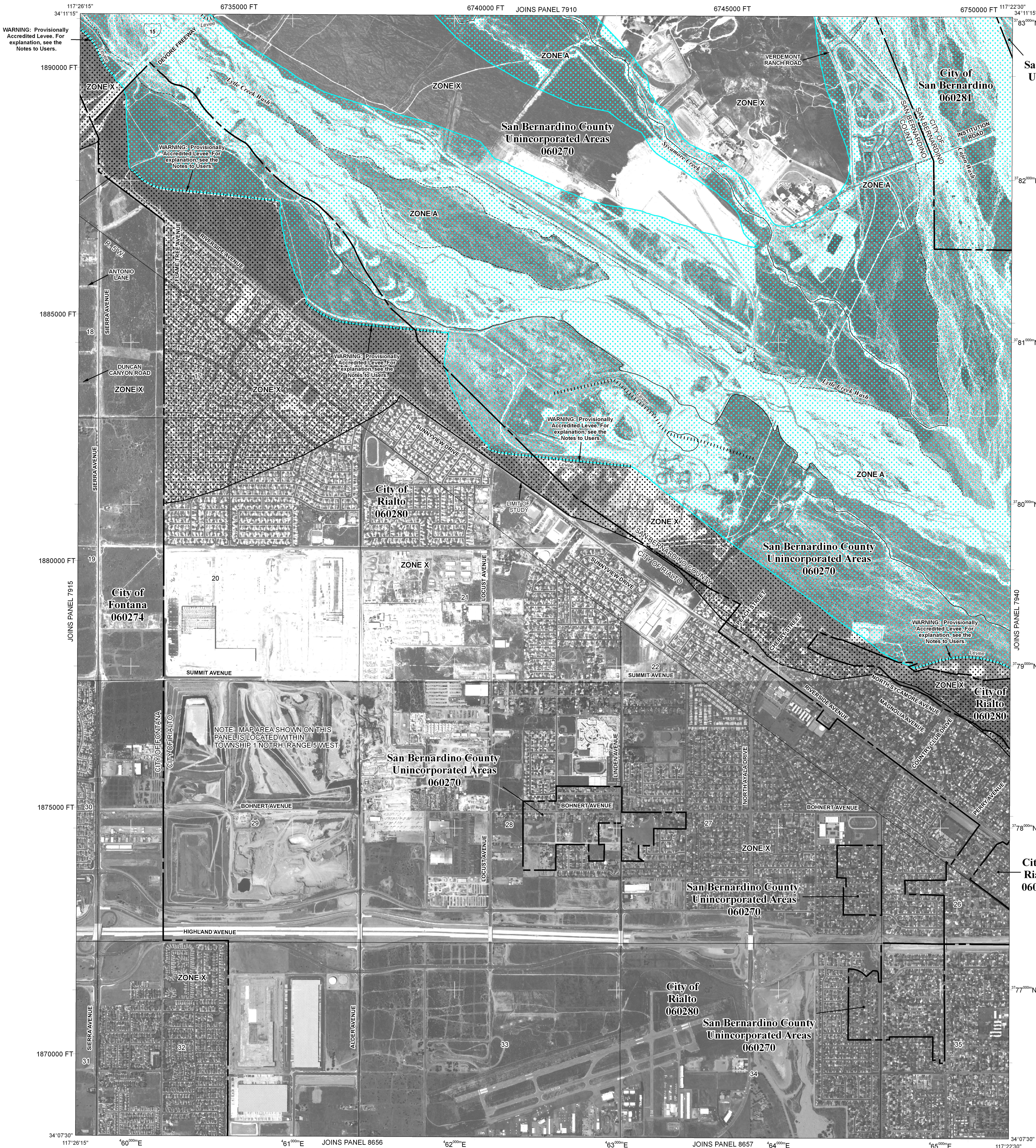
**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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

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

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

**WARNING:** This map contains levees, dikes, or other structures that have been provisionally accredited and mapped as providing protection from the 1-percent-annual-chance flood. To maintain accreditation, the levee owner or community is required to submit documentation necessary to comply with 44 CFR Section 65.10 by August 8, 2009. Because of the risk of overtopping or failure of the structure, communities should take proper precautions to protect lives and minimize damages in these areas, such as issuing an evacuation plan and encouraging property owners to purchase flood insurance.



LEGEND

**SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

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

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

**FLOODWAY AREAS IN ZONE AE**

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

**OTHER FLOOD AREAS**

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

**OTHER AREAS**

- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

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

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

\* Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 11N
- 5000-foot grid ticks; California State Plane coordinate system, zone V (FIPSZONE 0405), Lambert Conformal Conic projection
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile

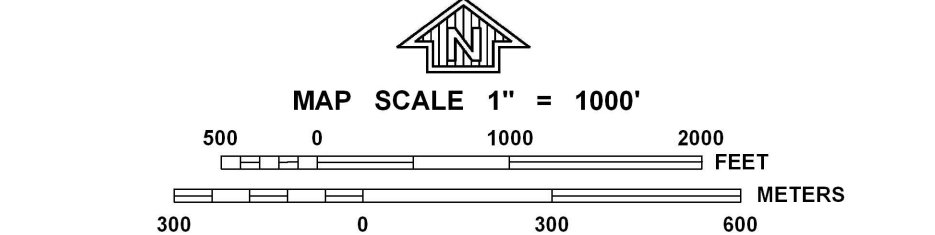
**MAP REPOSITORY**  
Refer to listing of Map Repositories on Map Index

**EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**  
March 15, 1996

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**  
August 28, 2008 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-538-6620.



**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 7920H**

**FIRM**

**FLOOD INSURANCE RATE MAP**

**SAN BERNARDINO COUNTY, CALIFORNIA AND INCORPORATED AREAS**

**PANEL 7920 OF 9400**

(SEE MAP INDEX FOR FIRM LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
FONTANA, CITY OF	060274	7920	H
RIALTO, CITY OF	060280	7920	H
SAN BERNARDINO COUNTY	060270	7920	H
SAN BERNARDINO, CITY OF	060281	7920	H

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

**MAP NUMBER**  
06071C7920H

**MAP REVISED**  
AUGUST 28, 2008

**Federal Emergency Management Agency**



## **EXHIBIT D: WQMP SITE PLAN**



PRELIMINARY  
WQMP SITE PLAN  
2889 N. LOCUST AVE.  
RIALTO, CA

PROJECT DATA:

TOTAL SITE AREA OF PROPOSED  
DEVELOPMENT: 4.71 AC (205,044 SF)

BUILDING AREA: 96,748 SF  
WALKWAYS / CONC. GUTTER / DOCK AREAS: 38,491 SF  
DRIVEWAYS / DRIVE AISLES / PARKING AREAS: 49,135 SF

20,670 SF LANDSCAPING PROVIDED  
(10.1% PERVIOUS AREA)

CURRENT USE: VACANT  
PROPOSED USE: INDUSTRIAL

WATERSHED:  
SANTA ANA RIVER

WQMP DCV CALCULATION

AREA 1

AREA = 4.71 AC (205,044 SF)  
RUNOFF COEFFICIENT (90% IMPERVIOUS)  
 $C = 0.858 * (.90)^3 - 0.78 * (.90)^2 + 0.774 * (.90) + .04 = 0.730$   
2YR 1 HR STORM = 0.730 IN  
 $P6 = 1.4807 * 0.730 = 1.0809$  IN  
 $DCV = 205,044 \text{ SF} * 0.730 * 1.0809 \text{ IN} / 12 \text{ IN/FT} * 1.963 = 26,466 \text{ CF}$

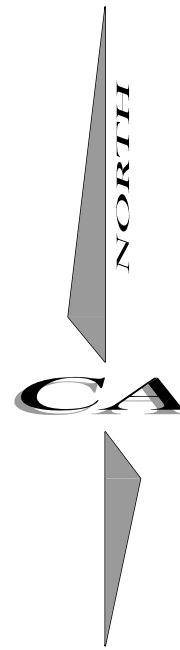
BMP VOLUME CALCULATION

BMP VOLUME  
PIPE CROSS SECTIONAL AREA =  $(50.26) * 10 \text{ CF/LF} = 502.60 \text{ CF/LF}$   
ROCK CROSS SECTIONAL AREA =  $248.70 \text{ CF/LF ROCK AREA} * 0.35 = 87.05 \text{ CF/LF}$   
TOTAL CROSS SECTIONAL AREA =  $589.65 \text{ CF/LF} * 125 \text{ LF} = 73,706 \text{ CF}$   
EFFECTIVE DEPTH =  $73,706 \text{ CF} / 12,500 \text{ SF BOTTOM} = 5.90'$

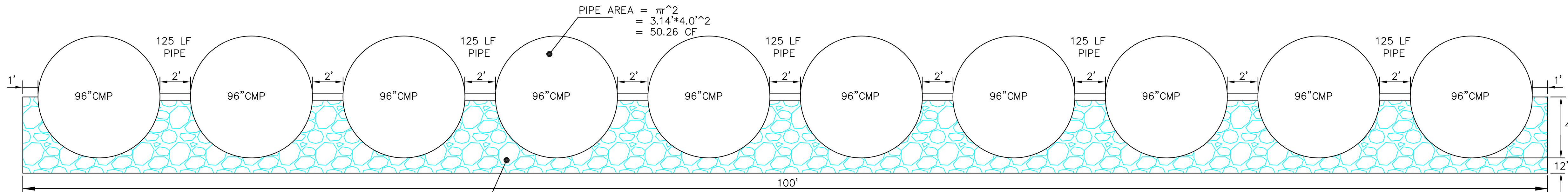
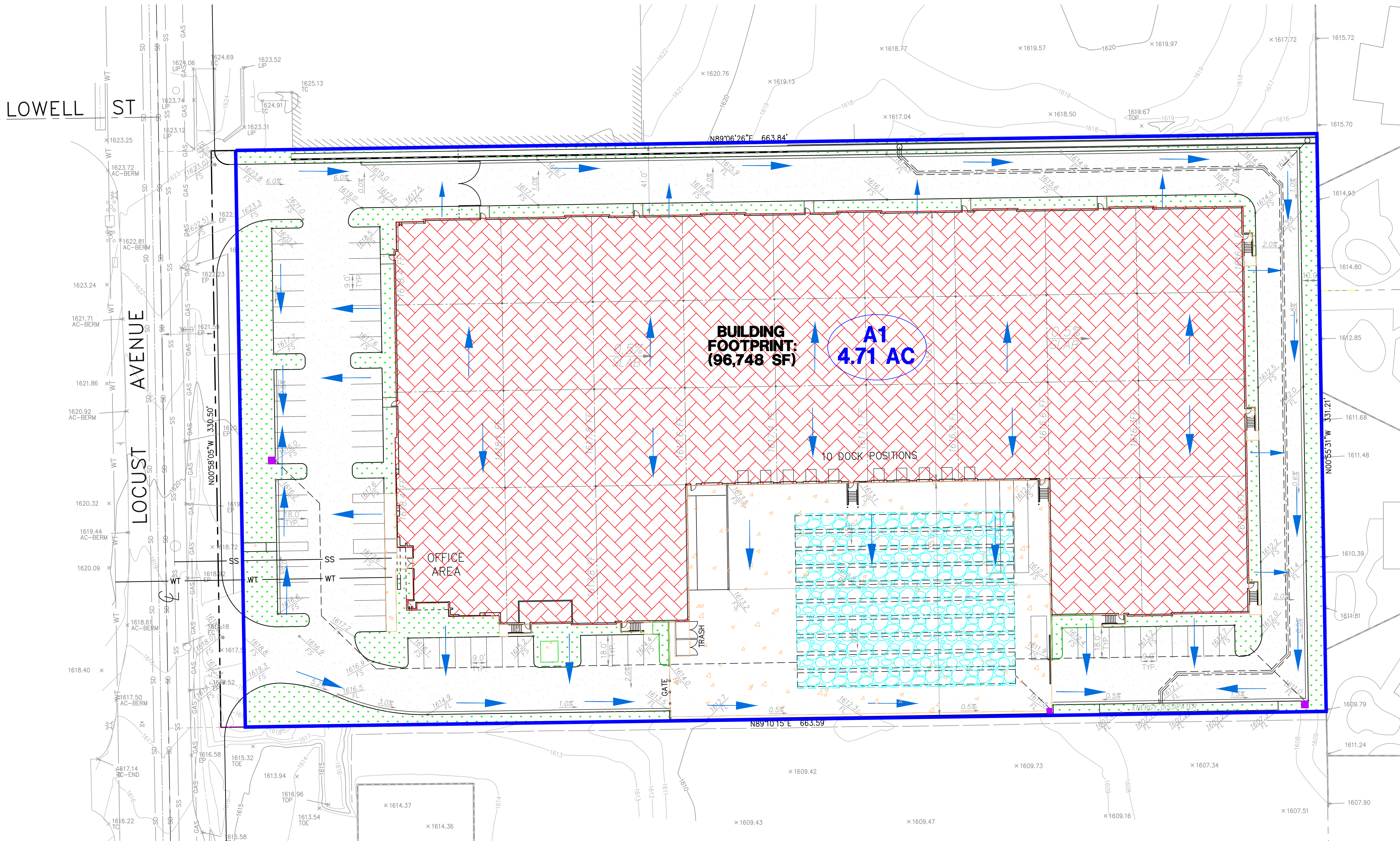
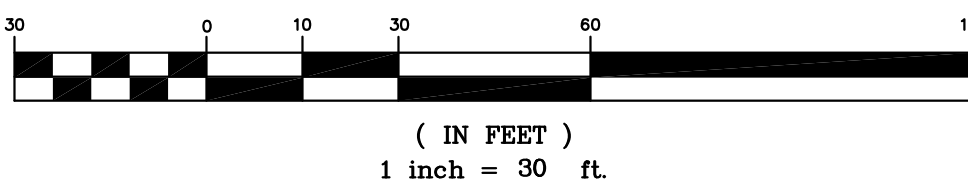
$V_{ret} = (P_{design} / 12 * S_{ainf} * T_{fill}) + (S_{ares} * D_{res} * N_{agg})$   
 $P_{design} = 15.5'' \text{ MEASURED} / 3.06 \text{ S.F.} = 5.07''/\text{HR}$   
 $S_{ainf} = 12,500 \text{ SF}$   
 $S_{ares} = 12,500 \text{ SF}$   
 $T_{fill} = 3 \text{ HRS}$   
 $D_{res} = \text{EFFECTIVE DEPTH} = 5.90'$   
 $N_{agg} = 1.0 \text{ (EFFECTIVE DEPTH ACCOUNTED FOR ROCK)}$   
 $V_{ret} = (5.07 / 12 * 12,500 * 3) + (12,500 * 5.90 * 1)$   
 $V_{ret} = 89,594 \text{ CF}$   
BMP VOLUME (89,594 CF) > DCV VOLUME (26,466 CF)

BMP LEGEND

- AREA 1**
- DRAINAGE AREAS
  - FLOW DIRECTION
  - UNDERGROUND INFILTRATION PIPE PER DETAIL HEREON
  - LANDSCAPE AREA EFFICIENT IRRIGATION  
LANDSCAPE AREA RUNOFF-MINIMIZING DESIGN
  - PROPOSED BUILDING
  - ASPHALT CONCRETE DRIVE AISLES
  - CONCRETE HARDSCAPE/ENHANCED PAVING
  - CATCH BASIN WITH INSERT FILTER & STORM DRAIN STENCIL SIGNAGE
  - TRASH ENCLOSURE



GRAPHIC SCALE



ROCK AREA =  $(\text{FACILITY AREA} - \text{PIPE AREA}) * 0.35$   
 $= (100 * 5) - (0.5 * 50.26 * 10) = 248.70 \text{ CF/LF}$   
 $248.70 \text{ CF/LF} * 125 \text{ LF} = 31,089 \text{ CF} * 0.35 = 10,881 \text{ CF}$

INFILTRATION BMP  
CROSS SECTION

1"=4'



FRED CORNWELL R.C.E. 45591 DATE

PREPARED BY:  
**CA ENGINEERING, INC.**  
Planning • Engineering • Surveying  
13821 NEWPORT AVE., STE 110  
TUSTIN, CA 92780  
949-724-9480 949-724-9484 FAX

DATE	BY	REVISION	DATE
Dec 28 2021			
JOB NO.			
251-55			
Sht. C-2			