CEQA Drainage Study
For
PDS2016-TPM-21243
Via Roswitha TPM

Prepared By:

LEPPERT ENGINEERING CORPORATION
5190 GOVERNOR DRIVE, SUITE 205
SAN DIEGO, CA 92122

May 2017

RSF 14.01-59.04

Declaration of Responsible Charge

I hereby declare that I am the engineer of work for this project. That I have exercised responsible charge over the design of the project as defined in section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the County of San Diego is confined to review only and does not relieve me, as engineer of work, of my responsibilities for project design.

_____

John D. Leppert
RCE 26283 Exp. 03-31-18

Table of Contents

Appendices

Introduction

The purpose of this drainage study is to analyze the existing drainage condition associated with the proposed subdivision of 18181 Via Roswitha.

Purpose of Project

This proposed development will consist of subdividing an existing parcel containing two individual residential buildings, into two proposed parcels; one for each residence. The site is located on the North side of El Camino Del Norte at the terminus of Via Roswitha. Via Roswitha is a 40' private road easement dedicated per PM No. 10014. 8181 Via Roswitha, is located in the un-incorporated community of Rancho Santa Fe, in the Northern portion of San Diego County. The project site is approximately 5 miles East of Interstate 5 via Encinitas Blvd. (See Appendix A for a vicinity and location map).

Description of Watershed

The Powell Residence, located at 18181 Via Roswitha, is part of the Carlsbad Hydrologic Unit. More specifically, it is part of the San Elijo Hydraulic Sub-Area (904.61) which is part of the Escondido Creek Hydrologic Area (904.60) and which is part of the larger Carlsbad Watershed (904.00).

The Carlsbad Hydrologic Unit encompasses approximately 210 square miles in area extending from Lake Wohlford in the East to the Pacific Ocean to the West. The cities of Vista and Oceanside comprise its Northern boundary while the Cities of Solana Beach & Escondido, and the community of Rancho Santa Fe make up its Southern extremities. Another important aspect of this watershed is that it contains four major costal lagoons: Buena Vista, Agua Hedionda, Batiquitos, and the San Elijo.

The Escondido Creek Hydrologic Sub Area is approximately 84.6 square miles in area, extends inland approximately 24 miles, has an elevation range of 2,420 feet, and discharges into the San Elijo Lagoon. Four main reservoirs are also located within this watershed: Lake Wohlford, Dixon Lake, San Dieguito Reservoir, and Olivenhain Reservoir. Escondido Creek HSA also run through various municipalities: the cities of Escondido, Solana Beach, Encinitas, San Marcos, and the unincorporated areas of Norther San Diego County. Because this project site is located on the top of a small hill, existing drainage patterns flow in different directions as it makes its way off-site. Escondido Creek located to the North and an unidentified stream to the South are the first points of runoff collection from the project site. Both waterways drain into the San Elijo Lagoon.
The San Elijo Lagoon is a sensitive habitat and ecosystem for numerous types of waterfowl, fish, shellfish, and native plant & animal species. It is listed on the CWA 303(d) list of impaired water bodies for bacteria, eutrophication, and sedimentation/siltation.

Method of Calculation

The total runoff from the site is calculated using the guidelines set forth in the June 2003 San Diego County Hydrology Manual. The specific calculation used is the Rational Method. This is the standard practice for watersheds under 0.5 square miles. Excerpts from the San Diego County Hydrology Manual are located in Appendix E.

Autodesk Storm and Sanitary Analysis was used for the storm analysis. Autodesk Storm and Sanitary Analysis is a link-node based model that performs hydrology, hydraulic, and water quality analysis of storm water and wastewater drainage systems, including sewage treatment plants and water quality control devices. A link represents a hydraulic element (i.e., a pipe, channel, pump, standpipe, culvert, or weir) that transports flow and constituents. A node can represent the junction of two or more links, a storm drain catch basin inlet, the location of a flow or pollutant input into the system, or a storage element (such as a detention pond, retention pond, settling pond, or lake).

Hydrologic Criteria

The following criteria were used in computing runoff from the existing and proposed project.

- Design storm: 100-year.
- Hydrology method: Rational method (Q=CIA) per section 3, pages 1-4 San Diego County Hydrology Manual
- Time of Concentration (Tc) for Existing Condition: The time of concentration was found based on Table 3-2 of the San Diego County Hydrology Manual.
- Time of Concentration (Tc) for Proposed Condition: The proposed development does not propose any new impervious or construction so there is no proposed condition to analyze.
- Effective Slope: The effective slope for natural watersheds was computed per section 3, page 17 of the San Diego County Hydrology Manual.
- Intensity of Rainfall I: The rainfall intensity was calculated using the Rainfall Intensity-Duration-Frequency Curves (100- year) section 3, pages 7 & 8 of the San Diego County Hydrology Manual.
- Runoff Coefficients (Rational Method):
    - $C = 0.9 * Imp\% + C * (1-Imp\%)$
    - $I = (7.44*P_6)/(D^{0.645})$ where D= Tc

    Soil Group D: According to section 4, page 16 of the San Diego County Hydrology Manual, soils in group D have a very slow infiltration rate when thoroughly wetted, and are shallow over nearly impervious material. The rate of water transmission is also very slow. The soil map used can be found in Appendix G.
- Runoff coefficient C: The following runoff coefficients were used as shown on section 3, pages 4-6 of the San Diego County Hydrology Manual.

EXISTING - Residential (Low Density Residential): 0.41

Existing Condition

The existing 9.35 acre site is comprised of 7 drainage basins divided amongst a multiple building complex at the top of a small hill. The complex is a single-family residence which includes a 13,000 sf. house, 3,300 sf. detached garage, 1,650 sf. pool house, 1,800 sf. barn, and a 2,100 sf. servants residence. Several basins drain different directions away from the property. However the areas identified for Parcel 2 primarily drain to the South and enter

Via Roswitha's drainage facilities. All of the existing drainage sheet flows to adjacent properties eventually being collected by stormdrain facilities.

A table summarizing the drainage basins is found in Appendix D.

Procedure for Calculating Time of Concentration and Rainfall Intensity

The time of concentration for the sub-basing was determined using the Figure 3-3 from the 2003 County Hydrology Manual. Specific values were obtained using the formula included on the nomograph:

$$T = \frac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{S}}$$

The resulting Tc for the various sub-basins within the site are shown below.

Basin	Area, ac.	C value	Length	Height	Slope	T_c	$Q_{sub-basin}$
Sub-1	1.1	0.44	270	55	20.37%	18.15	1.61
Sub-2	0.9	0.41	135	55	40.74%	18.15	1.19
Sub-3	0.4	0.41	245	35	14.29%	11.55	0.65
Sub-4	1.9	0.44	370	65	17.57%	21.45	2.41
Sub-5	2.9	0.49	500	50	10.00%	16.50	4.82
Sub-6	1.2	0.46	335	35	10.45%	11.55	2.44
Sub-7	1.0	0.41	290	40	13.79%	13.20	1.58

Comparison between Existing and Proposed Conditions

The existing and proposed conditions are the same, as the proposed project only includes a mapping action.

Adequacy of Existing Drainage Facilities

The size of the drainage facility located at the intersection of Via Roswitha and El Camino del Norte was sized based on the existing development of the Powell property. With the proposed subdivision there is no increased runoff , since there is no additional imperviousness associated. The existing facilities as designed are adequate for the proposed project.

Control of Pollutants

Site design and Source control BMPs associated with the existing site condition have been identified based upon the 2016 San Diego County BMP Design Manual. A Storm Water Management Plan (SWQMP) for Minor Projects has been prepared, and included with the project submittal. The existing residence implements several site design and source control measures within the existing design, and these measures will be maintained in that the proposed project seeks only to subdivide the property.

Conclusion

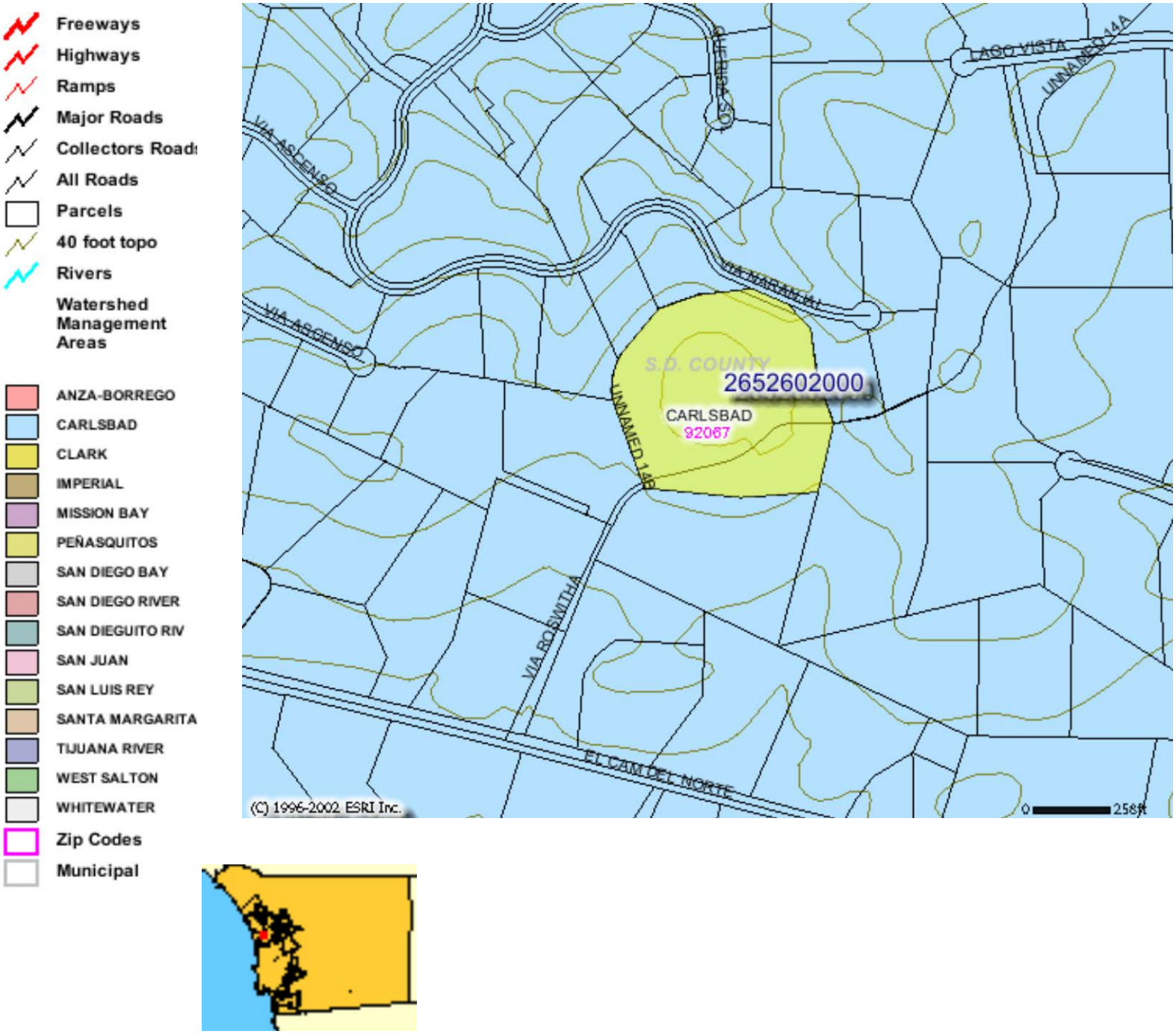
The existing drainage pathways are to be maintained in both the pre and post development condition and therefore no additional runoff impact is associated with this project. There is no mitigation required for the proposed project, since the existing runoff will not be increased by the associated approval of this mapping action. The site proximity to the existing floodplain was determined based upon FIRM map .06073C1065G and the site is not within or adjacent to the floodplain so the proposed subdivision will not be impacted by the floodplain. The existing site is situated at the top of a natural hill; there is no anticipated risk to the property if a levee or dam were to fail at any point upstream of the project site. A summary of the existing runoff totals can be found below, and since the proposed condition is the same as existing there will be no change to the runoff rates identified.

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	390.00	391.00	0.00	0.00	0.00	2.37	390.12	0.00	0.88	0 00:00	0.00	0.00
2	Jun-02	Junction	386.00	387.00	0.00	0.00	0.00	3.85	386.12	0.00	0.88	0 00:00	0.00	0.00
3	Out-01	Outfall	370.00					1.55	370.00					
4	Out-02	Outfall	380.00					1.18	380.00					
5	Out-03	Outfall	373.00					0.70	373.00					
6	Out-04	Outfall	365.00					2.41	365.00					
7	Out-05	Outfall	373.00					7.99	373.12					

Appendix A

Location Map



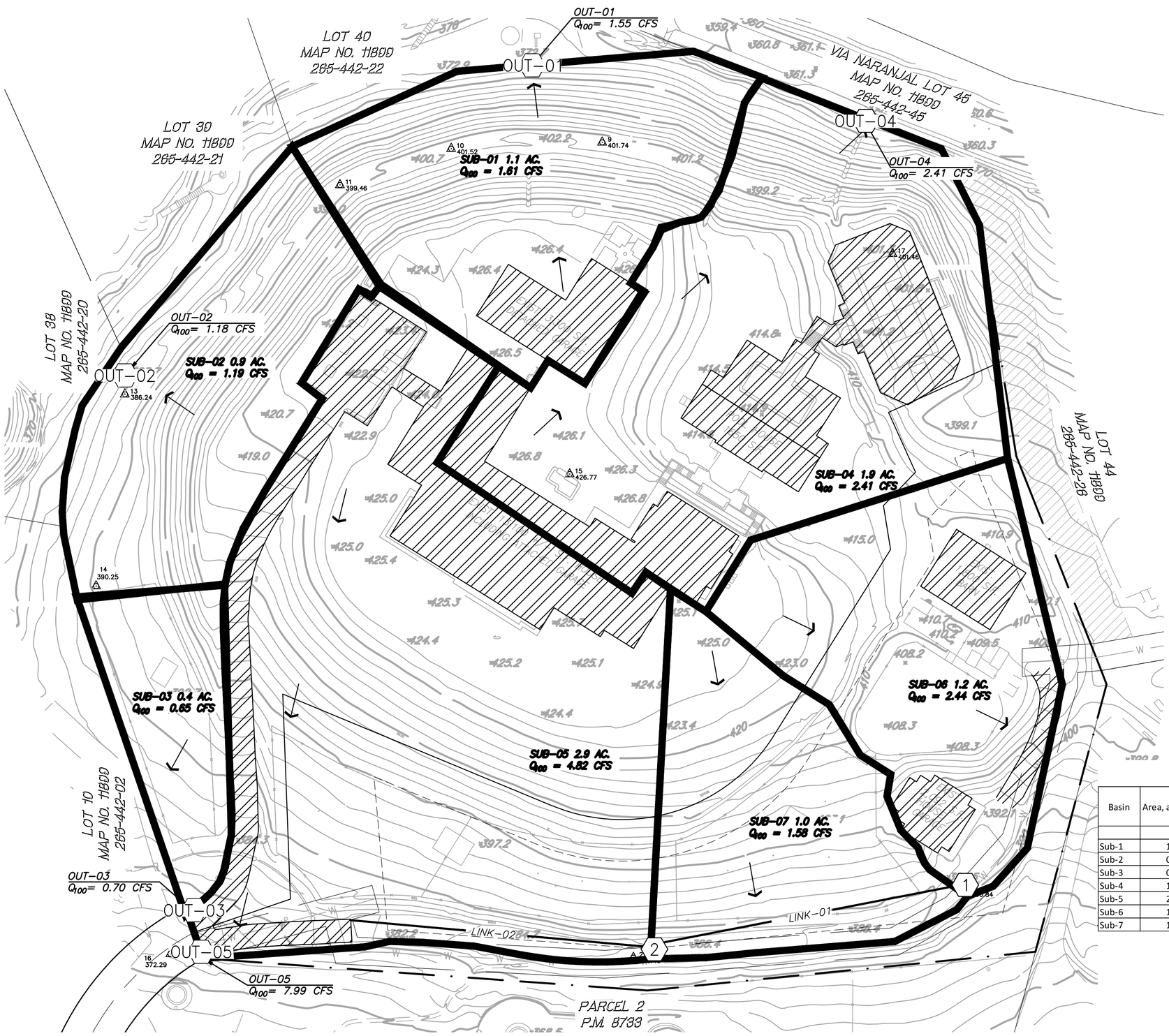
Appendix B

Site Drainage Map of

Existing Condition

EXISTING DRAINAGE EXHIBIT: TPM 21243

SHEET 1 OF 1 SHEETS



GRADING SHEET LEGEND:

- BOUNDARY
- PROPOSED LOT LINE
- EXISTING PRIVATE DRIVEWAYS
- EXISTING FENCE LINE
- EXISTING IMPERVIOUS AREA
- OVERLAND FLOW
- SSA LINK
- NODE

DRAINAGE NOTE:

RESIDENCE LOCATED ON TOP OF A SMALL HILL. EXISTING DRAIINAGE CONDITIONS WILL REMAIN INTACT. STORM WATER RUNOFF WILL SHEET FLOW ONTO ADJACENT PROPERTIES.

EXISTING CONDITIONS

Basin	Area, ac.		Rainfall amounts		C value	Rainfall intensity	Flow	Structures	Imperv Area (SF)	Imperv Area (AC)	Developed %
			6 hr	24 hr							
Sub-1	1.1	100-year	2.8	5.0	0.44	3.2	1.61	Detached garage	3,300	0.08	6.7%
Sub-2	0.9				0.41	3.2	1.19				0.0%
Sub-3	0.4				0.41	4.3	0.65				0.0%
Sub-4	1.9				0.44	2.9	2.41	Pool House/Tennis	5,500	0.13	6.7%
Sub-5	2.9				0.49	3.4	4.82	House/Dwy	21,000	0.48	16.8%
Sub-6	1.2				0.46	4.3	2.44	Guest House/Barn	5,350	0.12	9.9%
Sub-7	1.0				0.41	3.9	1.58				0.0%

Basin	Area, ac.	C value	Length	Height	Slope	T_c	$Q_{sub\text{-}basin}$
Sub-1	1.1	0.44	270	55	20.37%	18.15	1.61
Sub-2	0.9	0.41	135	55	40.74%	18.15	1.19
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Leppert Engineering
5190 Governor Drive, Suite 205, San Diego, Ca. 92122-2848
Phone: (619) 597-2001 Fax: (619) 597-2009

Appendix C

Site FEMA 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 (BFEs) 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 table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) Zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

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

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

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). this information was photogrammetrically compiled at a scale of 1:24,000 from aerial photography dated 2009.

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

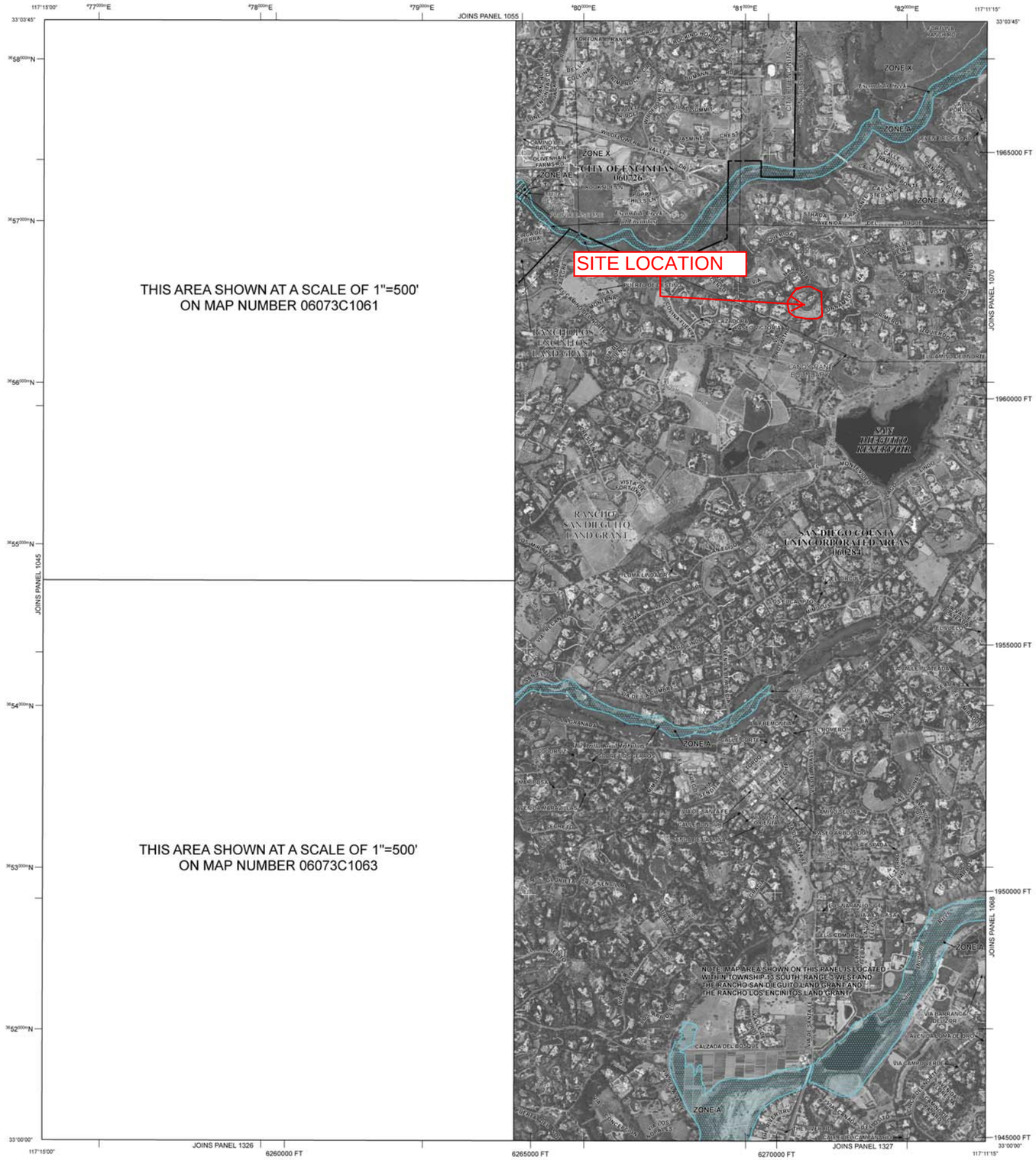
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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

Contact the **FEMA Map Service Center** at 1-877-FEMA MAP (1-877-336-2627) 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/business/nfip/.

The **"profile base lines"** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the "profile base line", in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.



LEGEND

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

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

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
* Referenced to the North American Vertical Datum of 1988
A — A — Cross section line
23 — 23 — Transect line
97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4675000mE — 1000-meter Universal Transverse Mercator grid ticks, zone 11
6000000 FT — 5000-foot grid values: California State Plane coordinate system, Zone VI (FIPSZONE = 406), Lambert projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
June 19, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
May 16, 2012 – to update corporate limits, to add roads and road names, to incorporate previously issued Letters of Map Revision, and to update map elevations to North American Vertical Datum of 1988.

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

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

MAP SCALE 1" = 1000'

500 0 500 1,000 1,500 2,000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1065G

FIRM

FLOOD INSURANCE RATE MAP
SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 1065 OF 2375
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ENCINITAS, CITY OF	060726	1065	G
SAN DIEGO COUNTY	060284	1065	G

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
06073C1065G

MAP REVISED
MAY 16, 2012

Federal Emergency Management Agency

Appendix D

Basin Summary Table

EXISTING CONDITIONS

Basin	Area, ac.		Rainfall amounts		C value	Rainfall intensity	Flow	Structures	Imperv Area (SF)	Imperv Area (AC)	Developed %
			6 hr	24 hr							
Sub-1	1.1	100-year	2.8	5.0	0.44	3.2	1.61	Detached garage	3,300	0.08	6.7%
Sub-2	0.9				0.41	3.2	1.19				0.0%
Sub-3	0.4				0.41	4.3	0.65				0.0%
Sub-4	1.9				0.44	2.9	2.41	Pool House/Tennis	5,500	0.13	6.7%
Sub-5	2.9				0.49	3.4	4.82	House/Dwy	21,000	0.48	16.8%
Sub-6	1.2				0.46	4.3	2.44	Guest House/Barn	5,350	0.12	9.9%
Sub-7	1.0				0.41	3.9	1.58				0.0%

Basin	Area, ac.	C value	Length	Height	Slope	T_c	$Q_{sub\text{-}basin}$
Sub-1	1.1	0.44	270	55	20.37%	18.15	1.61
Sub-2	0.9	0.41	135	55	40.74%	18.15	1.19
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Sub-6	1.2	0.46	335	35	10.45%	11.55	2.44
Sub-7	1.0	0.41	290	40	13.79%	13.20	1.58

Appendix E

Excerpts from the San Diego County Hydrology Manual, 2003

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
~~Low Density Residential (LDR)~~	~~Residential, 2.0 DU/A or less~~	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

4.1.2.1 Hydrologic Soil Group

Soil properties influence the relationship between rainfall and runoff since soils have differing rates of infiltration. Based on infiltration rates, the NRCS has divided soils into four hydrologic soil groups.

Group A

Soils have high infiltration rate when thoroughly wetted; chiefly deep, well-drained to excessively drained sand, gravel, or both. Rate of water transmission is high; thus runoff potential is low.

Group B

Soils have moderate infiltration rate when thoroughly wetted; chiefly soils that are moderately deep to deep, moderately well drained to well drained, and moderately coarse textured. Rate of water transmission is moderate.

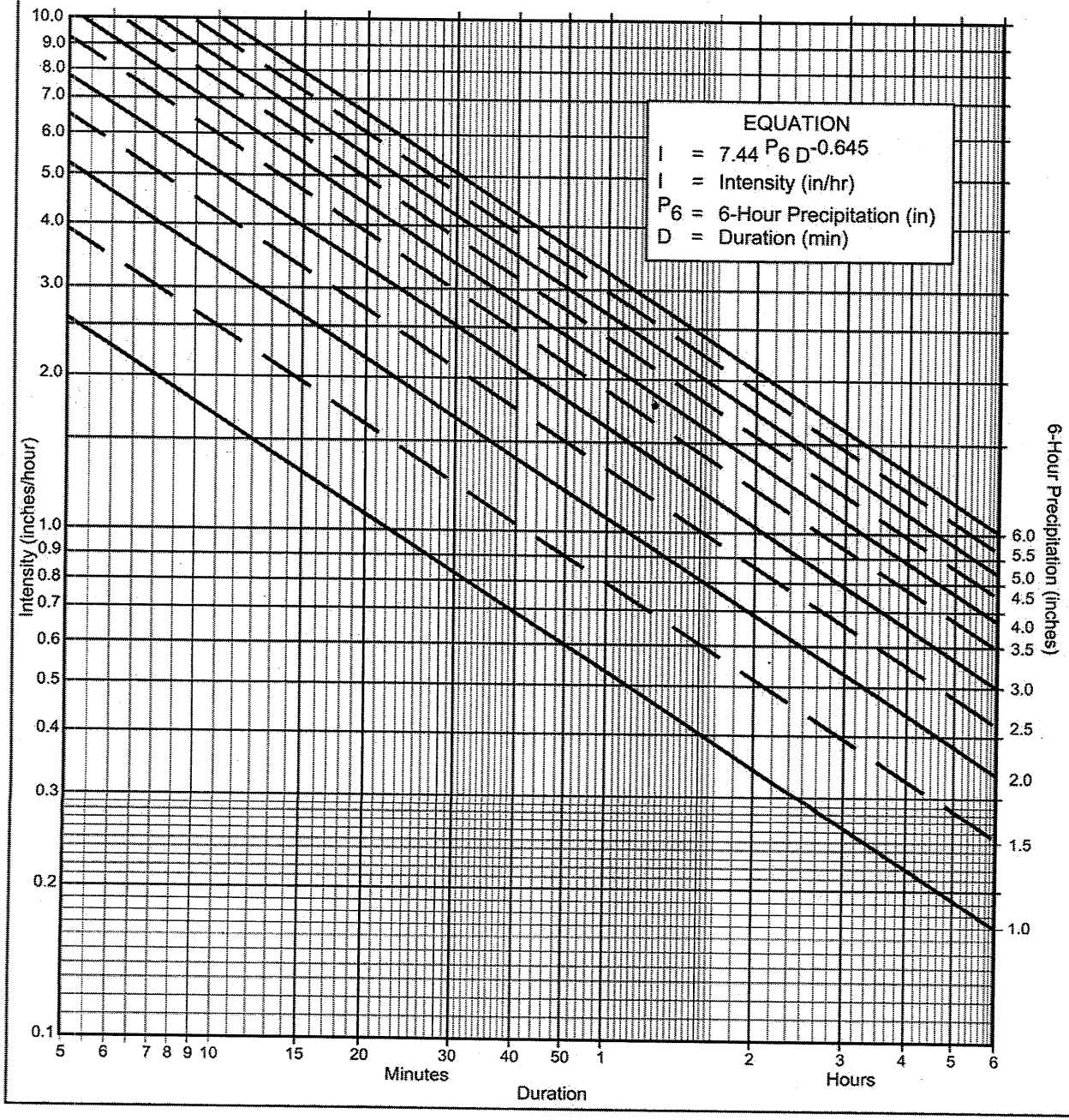
Group C

Soils have slow infiltration rate when thoroughly wetted; chiefly soils that have a layer impeding downward movement of water, or moderately fine to fine textured soils that have a slow infiltration rate. Rate of water transmission is slow.

Group D

Soils have very slow infiltration rate when thoroughly wetted; chiefly clays that have a high shrink-swell potential, soils that have a high permanent water table, soils that have a claypan or clay layer at or near the surface, or soils that are shallow over nearly impervious material. Rate of water transmission is very slow.

A list of soils throughout San Diego County and their hydrologic classification is located on the map in Appendix A. Soil Survey maps can be obtained from local NRCS offices for use in estimating soil type. The NRCS maps are also available at the County of San Diego DPWFCS. Consideration should be given to the effects of urbanization on the



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.8 in., P_{24} = 5.0, $\frac{P_6}{P_{24}}$ = 56 %(2)

(c) Adjusted $P_6^{(2)}$ = 2.8 in.

(d) t_x = _____ min.

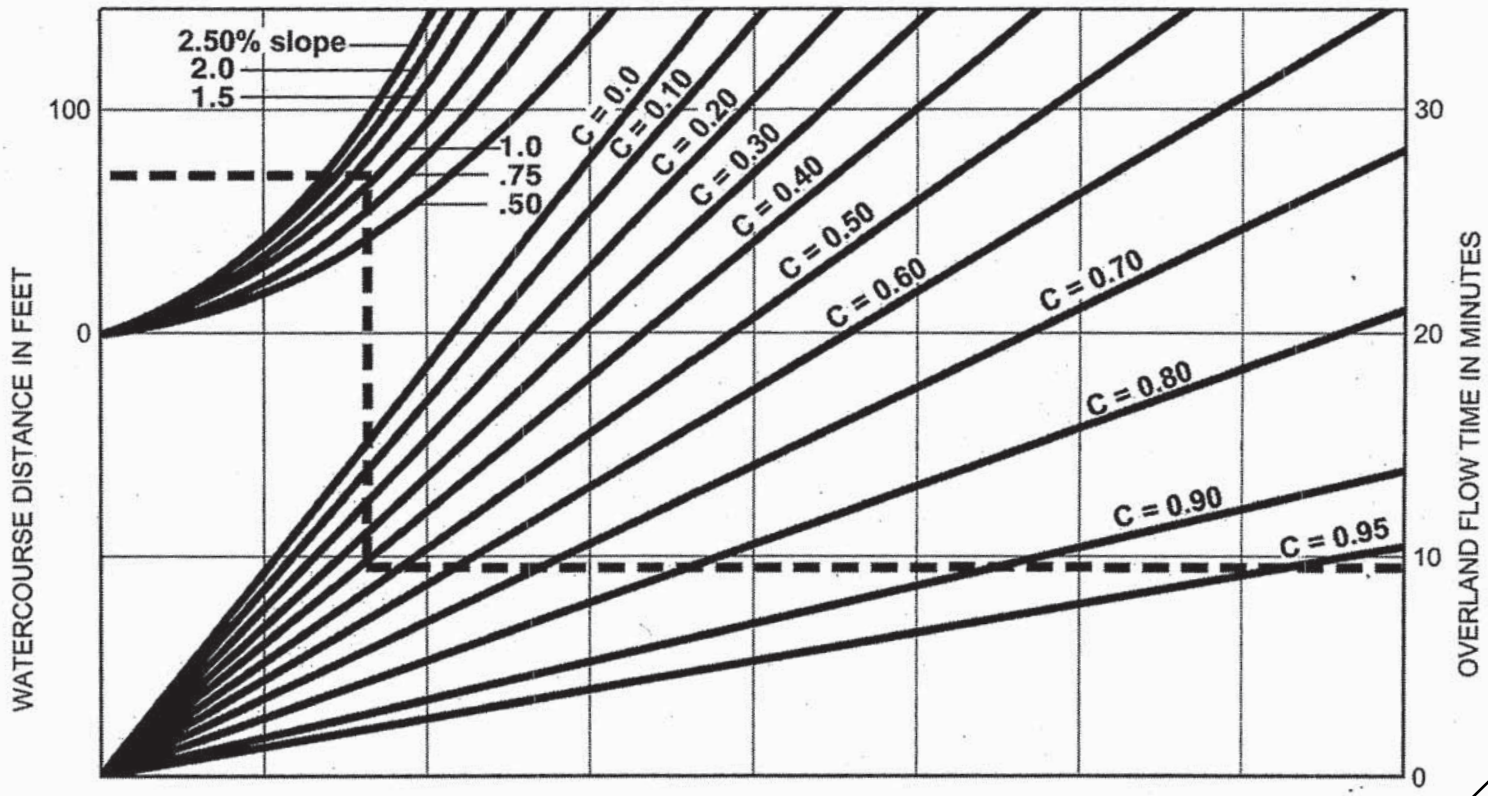
(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	(5.81)
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE
3-1



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

Tc computed using formula

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

SITE P6 = 2.8

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
SD
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
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N W E S

3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

SITE P24 = 5.0

Orange County

Riverside County

Imperial County

Mexico

Pacific Ocean

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
S.D. COUNTY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
CHULA VISTA
IMPERIAL BEACH
SD

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'

33°30' 33°15' 33°00' 32°45' 32°30'

DPW GIS
Department of Public Works Geographic Information Services

SanGIS
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N W E S

3 0 3 Miles

Appendix F

Watershed Reference Material

Carlsbad Watershed - Overview

Hydrologic Unit 904.10 - 904.63

Hydrologic Areas:	Loma Alta	904.1
	Buena Vista Creek	904.2
	Agua Hedionda	904.3
	Encinas	904.4
	San Marcos	904.5
	Escondido Creek	904.6
Major Water Bodies:	Loma Alta Creek, Buena Vista Creek, Buena Vista Lagoon, Agua Hedionda Creek, Agua Hedionda Lagoon, San Marcos Creek, Batiquitos Lagoon, Escondido Creek, San Elijo Lagoon, and Lake Wolhford	
CWA 303(d) List:	Agua Hedionda Creek: manganese, selenium, sulfates, TDS; Agua Hedionda Lagoon: indicator bacteria, sedimentation/siltation; Buena Creek: DDT, nitrate and nitrite, phosphate; Buena Vista Creek: sediment toxicity; Buena Vista Lagoon: indicator bacteria, nutrients, sedimentation/siltation; Cottonwood Creek (San Marcos Creek Watershed): DDT, phosphorous, sediment toxicity; Escondido Creek: DDT, manganese, phosphate, selenium, sulfates, TDS; Loma Alta Slough: eutrophic, indicator bacteria; Pacific Ocean Shoreline (Buena Vista Creek HA, Escondido Creek HA, Loma Alta HA, San Marcos HA): indicator bacteria; Reidy Canyon Creek: phosphorous; San Elijo Lagoon: eutrophic, indicator bacteria, sedimentation/siltation; San Marcos Creek: DDE, phosphorous, sediment toxicity; San Marcos Lake: ammonia as nitrogen, nutrients, phosphorous	
Major Impacts:	Surface water quality degradation, beach closures, sedimentation, habitat degradation and loss, invasive species, eutrophication	
Constituents of Concern:	Indicator bacteria, nutrients, and sediment	
Sources / Activities:	Urban runoff, agricultural runoff, sewage spills, livestock, and domestic animals	

The Carlsbad Hydrologic Unit (HU) is approximately 210 square miles in area extending from the headwaters above Lake Wolhford in the east to the Pacific Ocean in the west, and from Vista and Oceanside in the north to Solana Beach, Escondido, and the community of Rancho Santa Fe to the south. The cities of Carlsbad, San Marcos, and Encinitas are entirely within this HU. There are numerous important surface hydrologic features within the Carlsbad HU including four unique coastal lagoons, three major creeks, and two large water storage reservoirs. The HU contains four major, roughly parallel hydrologic areas (HAs). From north to south they are the Buena Vista (901.2), the Agua Hedionda (904.3), the Batiquitos (904.5), and the San Elijo (904.6) HAs. Two smaller HAs, the Loma Alta (904.1) and the Canyon de las Encinas (904.4) are also within the Carlsbad HU.

The largest jurisdictions in terms of land area in the Carlsbad HU are the unincorporated San Diego County areas (66 sq. miles), the cities of Carlsbad (39 sq. miles) and San Marcos (24 sq. miles), and an approximately 27 square mile portion of the City of Escondido. The cities of Carlsbad, San Marcos, and Encinitas are located entirely within the HU. Approximately 48% of the Carlsbad HU is urbanized. The dominant land uses are residential (29%), commercial/industrial (6%), freeways and roads (12%), agriculture (12%), and vacant/undeveloped (32%).

The Agua Hedionda, Buena Vista, and San Elijo lagoons are experiencing impairments to beneficial uses due to excessive coliform bacteria and sediment loading from upstream sources. These coastal lagoons represent critical regional resources that provide freshwater and estuarine habitats for numerous

plant and animal species. Other water bodies in the Carlsbad HU have been identified as impaired on the California 303(d) list for elevated coliform bacteria including several locations in the Pacific Ocean near creek and lagoon outlets.

The population of the Carlsbad HU is approximately 500,000 residents making it the third most densely populated in San Diego County behind the Pueblo San Diego and the Penasquitos HUs. A high percentage of the undeveloped land is in private ownership and the population of the Carlsbad HU is projected to increase to over 700,000 residents by 2015. Effective planning measures will be needed to prevent this rapid development from further degrading water quality in this region of San Diego County.

Beneficial water uses within the Carlsbad Watershed as designated in the State Water Resources Control Board's San Diego Region Basin Plan.

Beneficial Uses	Inland Surface Water	Coastal Waters	Reservoirs and Lakes	Ground Water
Municipal and Domestic Supply	X		X	X
Agricultural Supply	X		X	X
Industrial Service Supply	X	X	X	X
Navigation		X		
Contact Water Recreation	X	X	X	
Non-Contact Water Recreation	X	X	X	
Commercial and Sport Fishing		X		
Warm Freshwater Habitat	X	X	X	
Cold Freshwater Habitat	X		X	
Estuarine Habitat		X		
Wildlife Habitat	X	X	X	
Biological Habitats		X		
Rare, Threatened, or End.	X	X		
Marine Habitat		X		
Migration of Aquatic Organisms		X		
Aquaculture		X		
Shellfish Harvesting		X		
Spawning, Reprod. and/or Early Develop.		X		
Hydropower Generation	X		X	

Summary of beneficial use designations.

Appendix G

Soil Map

- Caltrans Tier 1 Monitoring Sites
- Calwater Watersheds
- Coastal Zone
- Counties
- Geologic Map (Legend)
- High Risk Receiving Watersheds
- Monthly Precipitation
- MS4 Areas
- Post Miles
- Rainfall Distribution
- RWQCB Boundaries
- USGS Topo Maps
- Watershed Boundary Dataset
- Zip Codes

Risk Level Determination

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

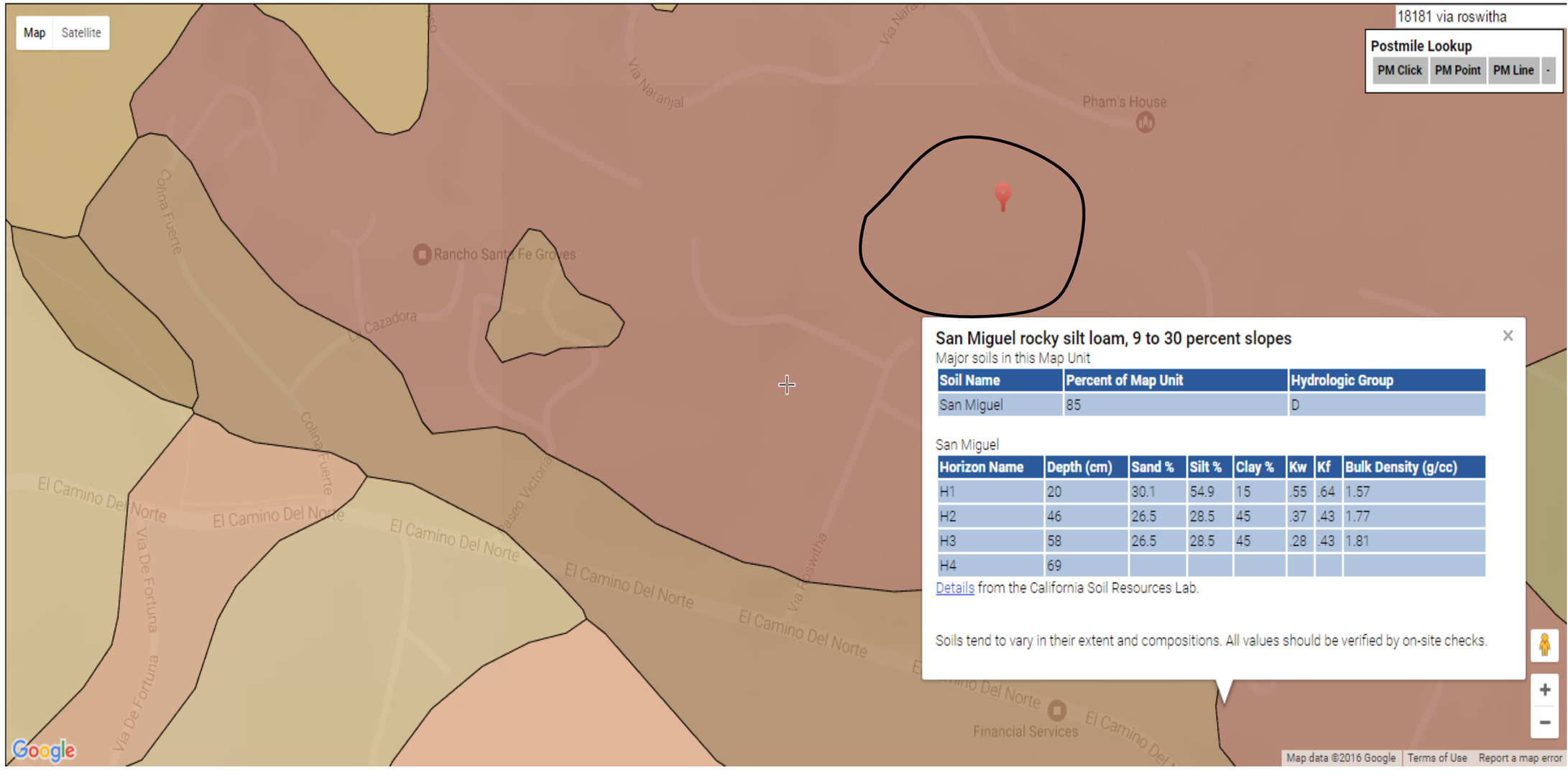
Compliance Storm Events

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

Information

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

Help



San Miguel rocky silt loam, 9 to 30 percent slopes

Major soils in this Map Unit

Soil Name	Percent of Map Unit	Hydrologic Group
San Miguel	85	D

San Miguel

Horizon Name	Depth (cm)	Sand %	Silt %	Clay %	Kw	Kf	Bulk Density (g/cc)
H1	20	30.1	54.9	15	.55	.64	1.57
H2	46	26.5	28.5	45	.37	.43	1.77
H3	58	26.5	28.5	45	.28	.43	1.81
H4	69						

Details from the California Soil Resources Lab.

Soils tend to vary in their extent and compositions. All values should be verified by on-site checks.

Appendix H

SSA Analysis

Project Description

File Name	Ex. SSA.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	May 19, 2017	00:00:00
End Analysis On	May 20, 2017	00:00:00
Start Reporting On	May 19, 2017	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins	7
Nodes	7
Junctions	2
Outfalls	5
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	2
Channels	2
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	1.10	0.4400	0.97	0.43	0.47	1.55	0 00:18:09
2	Sub-02	0.90	0.4100	0.97	0.40	0.36	1.18	0 00:18:09
3	Sub-03	0.40	0.4100	0.82	0.34	0.14	0.71	0 00:11:33
4	Sub-04	1.90	0.4400	1.03	0.45	0.86	2.41	0 00:21:27
5	Sub-05	2.90	0.4900	0.94	0.46	1.33	4.85	0 00:16:30
6	Sub-06	1.20	0.4600	0.82	0.38	0.45	2.37	0 00:11:33
7	Sub-07	1.00	0.4100	0.87	0.36	0.36	1.62	0 00:13:12

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	390.00	391.00	0.00	0.00	0.00	2.37	390.12	0.00	0.88	0 00:00	0.00	0.00
2	Jun-02	Junction	386.00	387.00	0.00	0.00	0.00	3.85	386.12	0.00	0.88	0 00:00	0.00	0.00
3	Out-01	Outfall	370.00					1.55	370.00					
4	Out-02	Outfall	380.00					1.18	380.00					
5	Out-03	Outfall	373.00					0.70	373.00					
6	Out-04	Outfall	365.00					2.41	365.00					
7	Out-05	Outfall	373.00					7.99	373.12					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Channel	Jun-01	Jun-02	230.00	390.00	386.00	1.7400	6.000	0.0320	2.30	30.18	0.08	1.38	0.12	0.23	0.00	
2	Link-02	Channel	Jun-02	Out-05	320.00	386.00	373.00	4.0600	6.000	0.0320	3.64	46.13	0.08	2.13	0.12	0.24	0.00	

Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	Jun-01	390.00	391.00	1.00	0.00	-390.00	0.00	-391.00	0.00	0.00
2	Jun-02	386.00	387.00	1.00	0.00	-386.00	0.00	-387.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	2.37	2.37	390.12	0.12	0.00	0.88	390.00	0.00	0 00:12	0 00:00	0.00	0.00
2	Jun-02	3.85	1.62	386.12	0.12	0.00	0.88	386.00	0.00	0 00:13	0 00:00	0.00	0.00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	Link-01	230.00	390.00	0.00	386.00	0.00	4.00	1.7400	Trapezoidal	0.500	24.500	0.0320	0.5000	0.5000	0.0000	0.00	No
2	Link-02	320.00	386.00	0.00	373.00	0.00	13.00	4.0600	Trapezoidal	0.500	24.500	0.0320	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	2.30	0 00:12	30.18	0.08	1.38	2.78	0.12	0.23	0.00		
2	Link-02	3.64	0 00:14	46.13	0.08	2.13	2.50	0.12	0.24	0.00		