DRAINAGE STUDY
FOR
San Miguel Fire Station #18

Project #121-138.1

Prepared For:

COUNTY OF SAN DIEGO
5510 Overland Ave
San Diego, CA 92123
(858) 694-2960

Prepared By:

Nasland Engineering
4740 Ruffner Street
San Diego, CA 92111

June 6, 2024

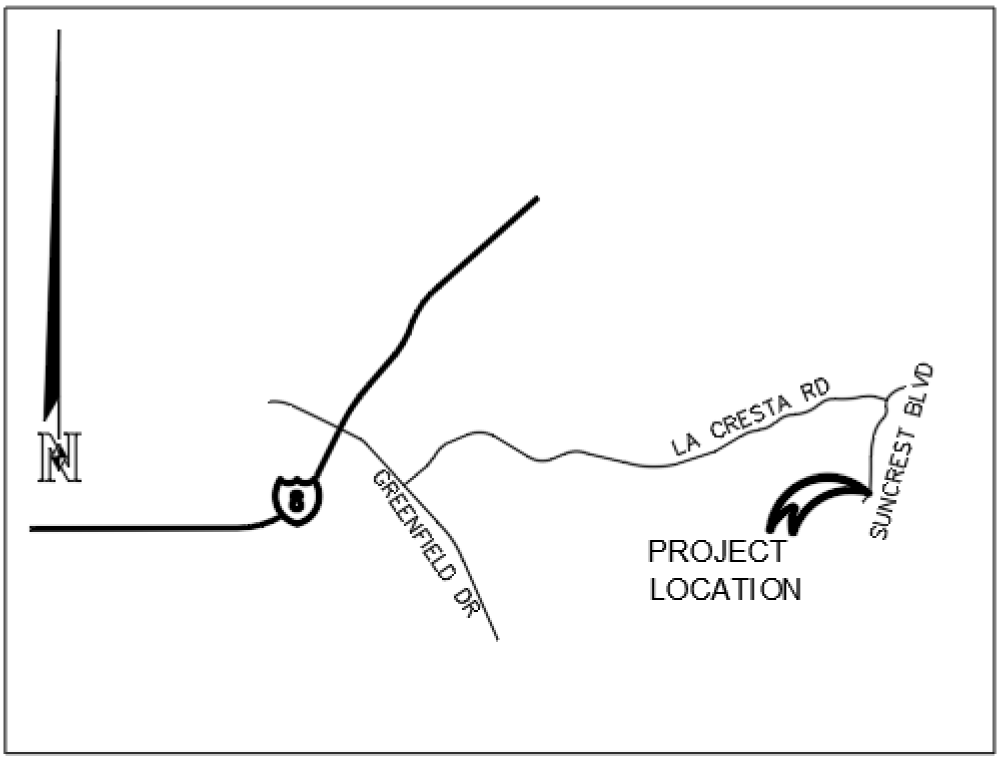
TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this drainage study is to evaluate the existing hydrologic conditions and evaluate the effects of the proposed redevelopment of San Miguel Fire Station #18 on the existing hydrologic regime. This drainage study has been prepared to comply with the methods and standards set forth by the County of San Diego's Hydrology Manual (June 2003) and the County of San Diego Hydraulic Design Manual (September 2014).

1.1 PROJECT LOCATION

San Miguel Fire Station is located at 1811 Suncrest Blvd in El Cajon. The Fire Station is bound by North Lane going east to west and Suncrest Blvd going south to north.



VICINITY MAP

NO SCALE

THOMAS BROTHER COORDINATES: PAGE 1253, J3

1.2 PROJECT DESCRIPTION

San Miguel Fire Station us a is a 0.512-acre existing fire station that sits on the corner of Suncrest Blvd and North Ln. The Fire Station consists of impervious pavement, three buildings with various appurtenances, various utilities and a concrete wall that extends through part of the site. The entire fire station is to be improved. The improvements will require the removal of all impervious pavement, the demolition of the three buildings, the concrete wall, and removal of various appurtenances and utilities within the site. The improvements also include removing three existing catch basins and the associated storm drain piping. There will be a proprietary linear modular wetland system and proprietary CMP detention piping to address pollutant control and hydromodification.

EXISTING CONDITIONS

The existing drainage within San Miguel Fire Station #18 mostly drains to three catch basins that conveys the drainage to the street. The southern half of the site drains over an asphalt parking lot/driveway and vegetated grass area to a catch basin located in the southwest corner of the site and into piping that conveys drainage offsite. The northern half of the site drains over an asphalt driveway to a catch basin on the west side of the site in front of the building where the fire trucks are stored and then drains into piping that conveys drainage offsite. The eastern front of the site and uphill storm runoff drain into a catch basin located in the southeast corner of the property and then into piping that conveys the drainage offsite. The asphalt parking lot in the northeast corner and the concrete driveway on the northwest corner of the site drains to the asphalt street along with storm runoff from the street further uphill. The street drainage conveys east to west directly north of the site.

1.4 PROPOSED CONDITIONS

The proposed drainage pattern changes consist of removing the three catch basins within the property and rerouting all storm runoff that lands or drains into site to the south east corner property via channelized flow with curb & gutter and a concrete swale. The drainage will then enter a proprietary linear modular wetland system to be cleaned of pollutants before conveying through piping into proprietary CMP detention piping. The storm runoff will slowly release through an orifice for hydromodification control into piping. The storm runoff will then outlet through a headwall to the north of the site into the street to be conveyed as surface flow.

The drainage from the east side of the property where the sceptic system will be placed and drainage along the north side of the property along the asphalt street conveys via surface flow to the asphalt street.

All drainage eventually drains down the asphalt street and into a curb inlet approximately 200’ west of the site.

2.0 METHODOLOGY

2.1 HYDROLOGY

Hydrologic analysis was conducted to determine the 2-year, 10-year and 100-year design storm peak runoff rate to each proposed storm drain pipe. All hydrologic analysis was prepared using the rational method in accordance with the San Diego County Hydrology Manual.

2.1.1 Rational Method

The rational method formula estimates the peak rate or runoff at any location within a watershed. The rational method assumes that the peak runoff rate is generated from a constant rainfall intensity over the drainage area for a duration of time. The duration of time is equal to the time of concentration which is defined as the time required for a rain drop to fall at the most upstream point in the tributary drainage basin to the point in question. The rational method equation is as follows:

$$Q = CIA$$

Where

Q = Peak Discharge Rate (cfs)

C = Runoff Coefficient

I = Rainfall Intensity (in/hr)

A = Tributary Area (acres)

2.1.2 Runoff Coefficient

The runoff coefficient is the percentage of excess rainfall that will flow overland at the point of interest. The runoff coefficient is based on the surface type and the soil type. The runoff coefficient can be represented by the equation below:

$$C = 0.9\ (\%imp) + Cp\ (\%\ pervious)$$

Where:

C = Runoff Coefficient

% imp = Percent of impervious surface with 90% runoff

% per = Percent of pervious surfaces (%per = 1 - %imp)

Cp = Pervious Runoff Coefficient based on soil type

2.1.3 Rainfall Intensity

The rainfall intensity (I) is the constant rate of rainfall over the tributary area for a duration of time that is equal to the time of concentration for a selected design storm frequency. To estimate the rainfall intensity an Intensity-Duration design chart (Figure 3-1 of the Hydrology Manual) was used. The Intensity-Duration design chart is modeled after the following equation:

$$I = 7.44\ P_6\ D^{-.645}$$

Where

I = Rainfall intensity specific to Design storm (in/hr)

P_6 = Adjusted 6-hour storm rainfall amount (in)

D = Storm Duration which equals the Time of Concentration, Tc

The 6-hour rainfall amount is determined for the storm event in question from isopluvial maps located in Appendix B of the Hydrology Manual. The 2-year, 10-year, and 100-year design storm was analyzed for the road way drainage. The 6-hour storm rainfall amount is as follows:

85th Percentile Storm Event	P_6 = 0.50 in
2 Year Storm Event	P_6 = 1.30 in
10 Year Storm Event	P_6 =1.90 in
100 Year Storm Event	P_6 = 2.75 in

2.1.4 Time of Concentration

The time of concentrations (Tc) is the time required for the runoff to flow from the most remote part of the drainage area to the point of interest. The time of concentration is calculated as the sum of the initial time of concentration (T_i) and the travel time (T_t).

$T_c = T_i + T_t$

Initial Time of Concentration

The initial time of concentration is based on sheet flow conditions at the upstream portion of the drainage basin. Sheet flow conditions are analyzed using the Overland Time of Flow developed by the Federal Aviation Agency (FAA). This method is based on the following equation:

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

Where:

Ti = Initial time of concentration (min)

C = Weighted runoff coefficient

D = Distance or length of sheet flow (ft)

S = Slope of sheet flow (%)

Remaining Time of Concentration

The remaining time of concentration is developed through the Kirpich formula when the total length of the initial subarea is greater than the maximum length allowable (Table 3-2 of the Hydrology Manual) by following equation:

$$T_t = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

Where:

Tc = Time of Concentration (hours)

L = Watercourse Distance (miles)

ΔE = Change in elevation along effective slope line (feet)

3.0 SUMMARY

Below is a summary of the hydrologic analysis for the offsite hydrology for the Q100 year rainfall event at the unmitigated condition. The unmitigated condition does not account for stormwater detention via stormwater storage devices such as bioretention basins or urban pond. All Calculations can be seen in **Appendix A and B** at the back of this report.

Existing (100 YEAR):

EXISTING BASIN SUMMARY

100 YEAR - 6 HOUR Storm

Basin	C Value	Tc (mins)	Intensity (in/hr)	Area (acres)	Runoff (Q, cfs)
E1	0.80	5.55	6.77	0.18	0.95
E2	0.85	5.00	7.25	0.21	1.31
E3	0.44	7.56	5.55	0.63	1.53
E4	0.78	5.00	7.25	0.20	1.11
				TOTAL RUNOFF =	**4.90**

Proposed (100 YEAR):

PROPOSED BASIN SUMMARY

100 YEAR - 6 HOUR Storm

Basin	C Value	Tc (mins)	Intensity (in/hr)	Area (acres)	Runoff Q (cfs)
P1	0.60	7.27	5.69	1.01	3.45
P2	0.58	6.30	6.24	0.21	0.76
				TOTAL RUNOFF =	**4.21**

Total Q=Decrease of 0.69CFS from the existing 100-year storm (Q=4.90)

Point of Connection Comparison

POINT OF CONNECTION COMPARISON

POC	Existing Runoff Q (cfs)	Proposed Runoff Q (cfs)	Runoff Difference Q (cfs)
A	1.11	4.21	3.10
B	3.79	0.00	-3.79

4.0 CONCLUSION

The redevelopment of San Miguel Fire Station #18 will decrease the total runoff generated from the site at an unmitigated condition by 0.69 CFS (14%). The proposed improvements shall improve the current condition by decreasing the release of the flow onto the asphalt street from the detention piping located onsite. With the above recommended improvements in place, we do not anticipate any adverse effects to the areas surrounding San Miguel Fire Station #18.

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

James J Linn Date
R.C.E. 84231
Exp. 9-30-25

REFERENCES

County of San Diego County Hydrology Manual prepared by the County of San Diego Department of Public Works, Flood Control Section, June 2003

San Diego County Hydraulic Design Manual prepared by the County of San Diego Department of Public Works, Flood Control Section, September 2014

Low Impact Development Handbook, Stormwater Management Strategies, prepared by the County of San Diego Department of Public Works, July 2014

Best Management Practices for Erosion and Sediment Control & Storm Water Retention/Detention by San Diego County Association of Resource Conservation Districts, San Diego County Edition

2018 San Diego Regional Standard Drawings, prepared by the County of San Diego Department of Public Works, October 2018, www.regional-stds.com

APPENDIX A: EXISTING HYDROLOGY

- Existing Hydrologic Map
- Existing Runoff Coefficient Tables
- Existing Time of Concentration Tables
- Existing Hydraulic Calculations

BASIN DATA: EXISTING SITE

Runoff Coefficient

Sub Area	Area (acres)	% Impervious	% Pervious	Description	C Value
E1	0.18	82.5%	17.5%	Building/Landscape/Asphalt Pavement	**0.80**
E2	0.21	91.7%	8.3%	Building/Landscape/Asphalt Pavement	**0.85**
E3	0.63	22.6%	77.4%	Asphalt Road/Uphill Properties	**0.44**
E4	0.20	80.3%	19.7%	Asphalt Road/Natural Vegetation	**0.78**
Total	1.22				

Hydrologic Soil Type C

EXISTING BASIN SUMMARY

100 YEAR - 6 HOUR Storm

Basin	C Value	Tc (mins)	Intensity (in/hr)	Area (acres)	Runoff (Q, cfs)
E1	0.80	5.55	6.77	0.18	0.95
E2	0.85	5.00	7.25	0.21	1.31
E3	0.44	7.56	5.55	0.63	1.53
E4	0.78	5.00	7.25	0.20	1.11
				TOTAL RUNOFF =	**4.90**

EXISTING HYDROLOGY EXHIBIT

SCALE: 1"=20"

LEGEND

PROPOSED BASIN BOUNDARY
RUNOFF FLOW LINE

20 0 20 40 60 80
SCALE 1" = 20'

REGISTERED PROFESSIONAL ENGINEER
JAMES JARRETT LINN
No. 84231
EXP. 9-30-25
CIVIL
STATE OF CALIFORNIA

Nasland Civil Engineering
Surveying
Land Planning

121–138.1
T (858) 292-7770
4740 Ruffner Street
San Diego, CA 92111
nasland.com

COUNTY APPROVED CHANGES

NO.	DESCRIPTION:	APPROVED BY:	DATE:

BENCH MARK

DESCRIPTION: C/L MON ON RIOS CANYON ROAD
C/L MON BRASS DISC SET IN CONC. BELOW SURFACE.
LOCATION: C/L OF RIOS CANYON RD AND MOUNTAIN VIEW RD
RECORD FROM: RECORD OF SURVEY 11252
ELEVATION: 1377.47' DATUM: M.S.L.

PRIVATE CONTRACT

SHEET 1 | COUNTY OF SAN DIEGO DEPARTMENT OF PUBLIC WORKS | 22 SHEETS

EXISTING HYDROLOGY EXHIBIT:

SAN MIGUEL FIRE STATION #18

CALIFORNIA COORDINATE INDEX 230–1809

APPROVED
DIRECTOR OF PUBLIC WORKS
BY:

ENGINEER OF WORK
JARRETT J. LINN R.C.E. 84231

GRADING PERMIT NO:

NE JOB # 121–138.1

BASIN DATA: EXISTING SITE

Runoff Coefficient

Sub Area	Area (acres)	% Impervious	% Pervious	Description	C Value
E1	0.18	82.5%	17.5%	Building/Landscape/Asphalt Pavement	**0.80**
E2	0.21	91.7%	8.3%	Building/Landscape/Asphalt Pavement	**0.85**
E3	0.63	22.6%	77.4%	Asphalt Road/Uphill Properties	**0.44**
E4	0.20	80.3%	19.7%	Asphalt Road/Natural Vegetation	**0.78**
Total	1.22				

Hydrologic Soil Type C

Time of Concentration

Sheet Flow

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

Basin	C Value	L (ft)	Δ Height (ft)	Slope (%)	T_i (min)
E1	0.80	100.00	1.50	1.50	4.80
E2	0.85	100.00	2.50	2.50	3.31
E3	0.44	100.00	12.00	12.00	5.23
E4	0.78	100.00	8.00	8.00	2.86

Concentrated Flow

$$Tc = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

Basin	C Value	L (ft)	Δ Height (ft)	Slope (%)	T_t (min)
E1	0.80	52.46	1.00	1.91	0.76
E2	0.85	87.69	1.50	1.71	1.17
E3	0.44	394.05	22.65	5.75	2.34
E4	0.78	245.63	9.00	3.66	1.93

Total Time of Concentration

Basin	T_i (min)	T_t (min)	Tc (min)
E1	4.80	0.76	5.55
E2	3.31	1.17	5.00
E3	5.23	2.34	7.56
E4	2.86	1.93	5.00

Note: A minimum Tc = 5 minutes was used for all calculations

Use Figure A-1: Intensity Duration-Frequency Chart

6 HOUR Storm

			2 year	10 year	100 year
			P6 =1.3 in	P6 =1.9 in	P6 =2.75 in
Basin	**C Value**	**T_c (mins)**	**Intensity ($^{in}/_{hr}$)**	**Intensity (in/hr)**	**Intensity (in/hr)**
E1	0.80	5.55	3.20	4.68	6.77
E2	0.85	5.00	3.43	5.01	7.25
E3	0.44	7.56	2.62	3.83	5.55
E4	0.78	5.00	3.43	5.01	7.25

Note: See the charts and graphs used for the hydrologic calculations at the end of this study.

EXISTING BASIN SUMMARY

100 YEAR - 6 HOUR Storm

Basin	C Value	Tc (mins)	Intensity (in/hr)	Area (acres)	Runoff (Q, cfs)
E1	0.80	5.55	6.77	0.18	0.95
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E3	0.44	7.56	5.55	0.63	1.53
E4	0.78	5.00	7.25	0.20	1.11
				TOTAL RUNOFF =	**4.90**

BASIN DATA: PROPOSED SITE

Runoff Coefficient

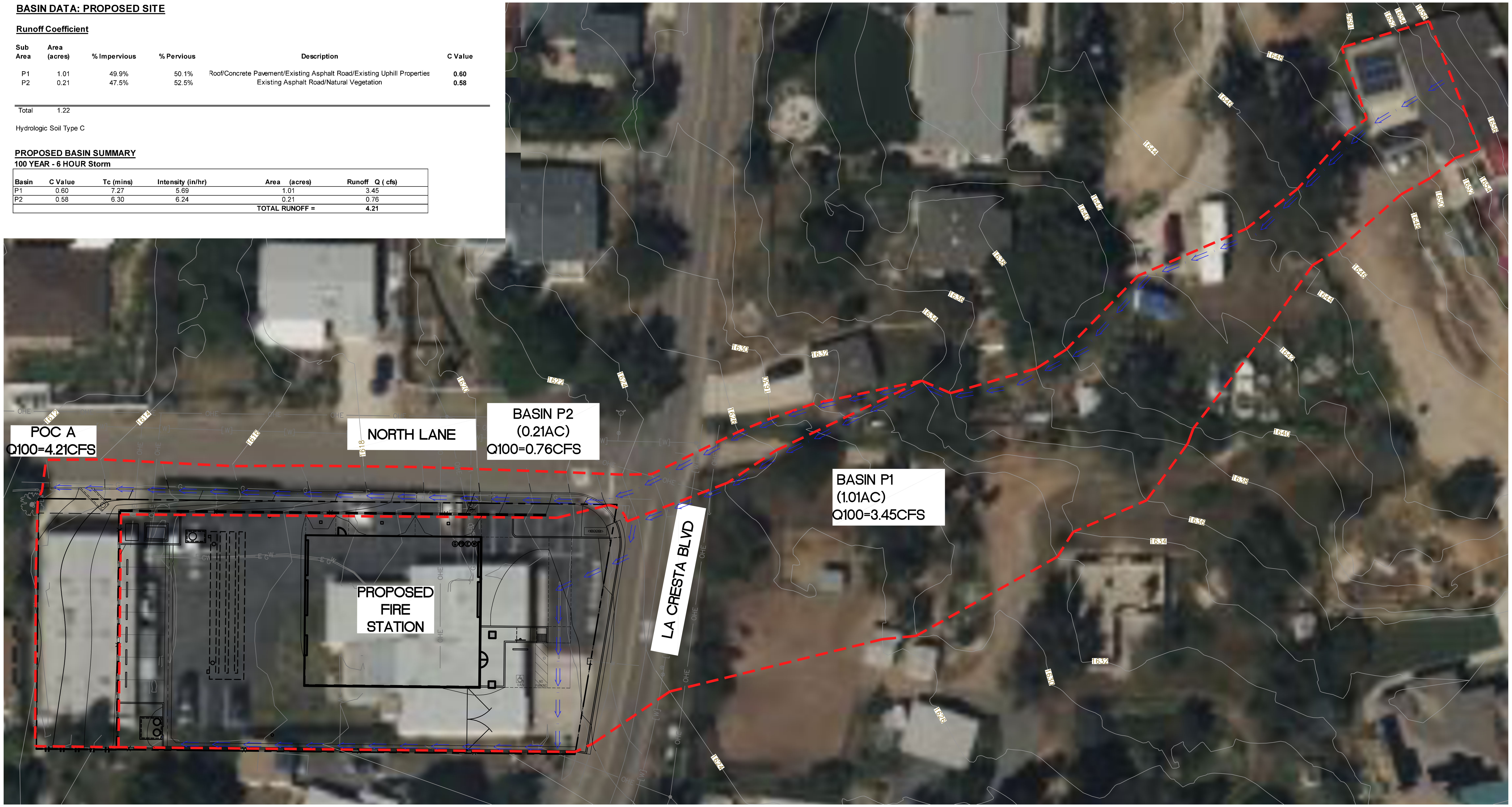
Sub Area	Area (acres)	% Impervious	% Pervious	Description	C Value
P1	1.01	49.9%	50.1%	Roof/Concrete Pavement/Existing Asphalt Road/Existing Uphill Properties	**0.60**
P2	0.21	47.5%	52.5%	Existing Asphalt Road/Natural Vegetation	**0.58**
Total	1.22				

Hydrologic Soil Type C

PROPOSED BASIN SUMMARY

100 YEAR - 6 HOUR Storm

Basin	C Value	Tc (mins)	Intensity (in/hr)	Area (acres)	Runoff Q (cfs)
P1	0.60	7.27	5.69	1.01	3.45
P2	0.58	6.30	6.24	0.21	0.76
				TOTAL RUNOFF =	4.21



PROPOSED HYDROLOGY EXHIBIT

SCALE: 1"=20'

LEGEND

PROPOSED BASIN BOUNDARY
RUNOFF FLOW LINE

20 0 20 40 60 80
SCALE 1" = 20'

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SAN MIGUEL FIRE STATION #18

CALIFORNIA COORDINATE INDEX 230–1809

APPROVED
DIRECTOR OF PUBLIC WORKS
BY:

ENGINEER OF WORK
JARRETT J. LINN R.C.E. 84231

GRADING PERMIT NO:

APPENDIX B: PROPOSED HYDROLOGY

- Proposed Hydrologic Map
- Proposed Runoff Coefficient Tables
- Proposed Time of Concentration Tables
- Proposed Hydraulic Calculations

BASIN DATA: PROPOSED SITE

Runoff Coefficient

Sub Area	Area (acres)	% Impervious	% Pervious	Description	C Value
P1	1.01	49.9%	50.1%	Roof/Concrete Pavement/Existing Asphalt Road/Existing Uphill Properties	**0.60**
P2	0.21	47.5%	52.5%	Existing Asphalt Road/Natural Vegetation	**0.58**
Total	1.22				

Hydrologic Soil Type C

Time of Concentration

Sheet Flow

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

Basin	C Value	L (ft)	Δ Height (ft)	Slope (%)	T_i (min)
P1	0.60	100.00	12.00	12.00	3.94
P2	0.58	100.00	9.00	9.00	4.46

Concentrated Flow

$$Tc = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

Basin	C Value	L (ft)	Δ Height (ft)	Slope (%)	T_t (min)
P1	0.60	548.00	24.18	4.41	3.34
P2	0.58	252.00	11.00	4.37	1.84

Total Time of Concentration

Basin	T_i (min)	T_t (min)	T_c (min)
P1	3.94	3.34	7.27
P2	4.46	1.84	6.30

Note: A minimum Tc = 5 minutes was used for all calculations

Use Figure A-1: Intensity Duration-Frequency Chart

6 HOUR Storm

			2 year	10 year	100 year
			P6 =1.3 in	P6 =1.9 in	P6 =2.75 in
Basin	**C Value**	**T_c (mins)**	**Intensity ($^{in}/_{hr}$)**	**Intensity (in/hr)**	**Intensity (in/hr)**
P1	0.60	7.27	2.69	3.93	5.69
P2	0.58	6.30	2.95	4.31	6.24

Note: See the charts and graphs used for the hydrologic calculations at the end of this study.

PROPOSED BASIN SUMMARY

100 YEAR - 6 HOUR Storm

Basin	C Value	Tc (mins)	Intensity (in/hr)	Area (acres)	Runoff Q (cfs)
P1	0.60	7.27	5.69	1.01	3.45
P2	0.58	6.30	6.24	0.21	0.76
				TOTAL RUNOFF =	**4.21**

APPENDIX C: REFERENCE DOCUMENTS

- Hydrologic Soil Groups (Web Soils)
- County of San Diego Intensity Duration Design Chart
- County of San Diego Intensity Duration Design Chart
    - County of San Diego 2 yr Storm 6-hour Isopoluvial Map
    - County of San Diego 10 yr Storm 6-hour Isopoluvial Map
    - County of San Diego 100 yr Storm 6-hour Isopoluvial Map
- San Miguel Fire Station #18 Civil Improvement Plan Set (Sheets pertaining to Storm Drain)
- County of San Diego Runoff Coefficient Table 3-1

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
San Diego County Area, California

SAN MIGUEL FIRE STATION #18 WEB SOILS SURVEY

January 22, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

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 Diego County Area, California
Survey Area Data: Version 19, Aug 30, 2023

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

Date(s) aerial images were photographed: Mar 24, 2022—Apr 29, 2022

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CmrG	Cieneba-Rock outcrop complex, 30 to 75 percent slopes, very stony	7.1	38.9%
FvD	Fallbrook-Vista sandy loams, 9 to 15 percent slopes	11.2	61.1%
Totals for Area of Interest		**18.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Diego County Area, California

CmrG—Cieneba-Rock outcrop complex, 30 to 75 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2zwsb
Elevation: 3,670 to 4,440 feet
Mean annual precipitation: 25 to 29 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 185 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Cieneba and similar soils: 50 percent
Rock outcrop: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cieneba

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Residuum weathered from quartz-diorite

Typical profile

A - 0 to 10 inches: coarse sandy loam
Cr - 10 to 20 inches: bedrock

Properties and qualities

Slope: 30 to 75 percent
Surface area covered with cobbles, stones or boulders: 0.1 percent
Depth to restrictive feature: 9 to 16 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately low (0.01 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): 7e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R019XD924CA - LOAMY WEST
Hydric soil rating: No

Description of Rock Outcrop

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8e
Hydric soil rating: No

Minor Components

Vista

Percent of map unit: 5 percent
Landform: Mountain slopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Las posas

Percent of map unit: 5 percent
Landform: Mountains
Landform position (three-dimensional): Mountainflank
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R019XD924CA - LOAMY WEST
Hydric soil rating: No

FvD—Fallbrook-Vista sandy loams, 9 to 15 percent slopes

Map Unit Setting

National map unit symbol: hbc1
Elevation: 200 to 3,900 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 59 to 64 degrees F
Frost-free period: 210 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Fallbrook and similar soils: 50 percent
Vista and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fallbrook

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope

Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granodiorite

Typical profile

H1 - 0 to 8 inches: sandy loam
H2 - 8 to 12 inches: loam
H3 - 12 to 28 inches: sandy clay loam
H4 - 28 to 41 inches: loam
H5 - 41 to 44 inches: weathered bedrock

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F019XG913CA - Loamy Hills <30"ppt
Hydric soil rating: No

Description of Vista

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Grus derived from granodiorite and/or grus derived from quartz-diorite

Typical profile

H1 - 0 to 19 inches: sandy loam
H2 - 19 to 35 inches: coarse sandy loam
H3 - 35 to 39 inches: weathered bedrock

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: F019XG913CA - Loamy Hills <30"ppt
Hydric soil rating: No

Minor Components

Cieneba

Percent of map unit: 5 percent
Hydric soil rating: No

Las posas

Percent of map unit: 5 percent
Hydric soil rating: No

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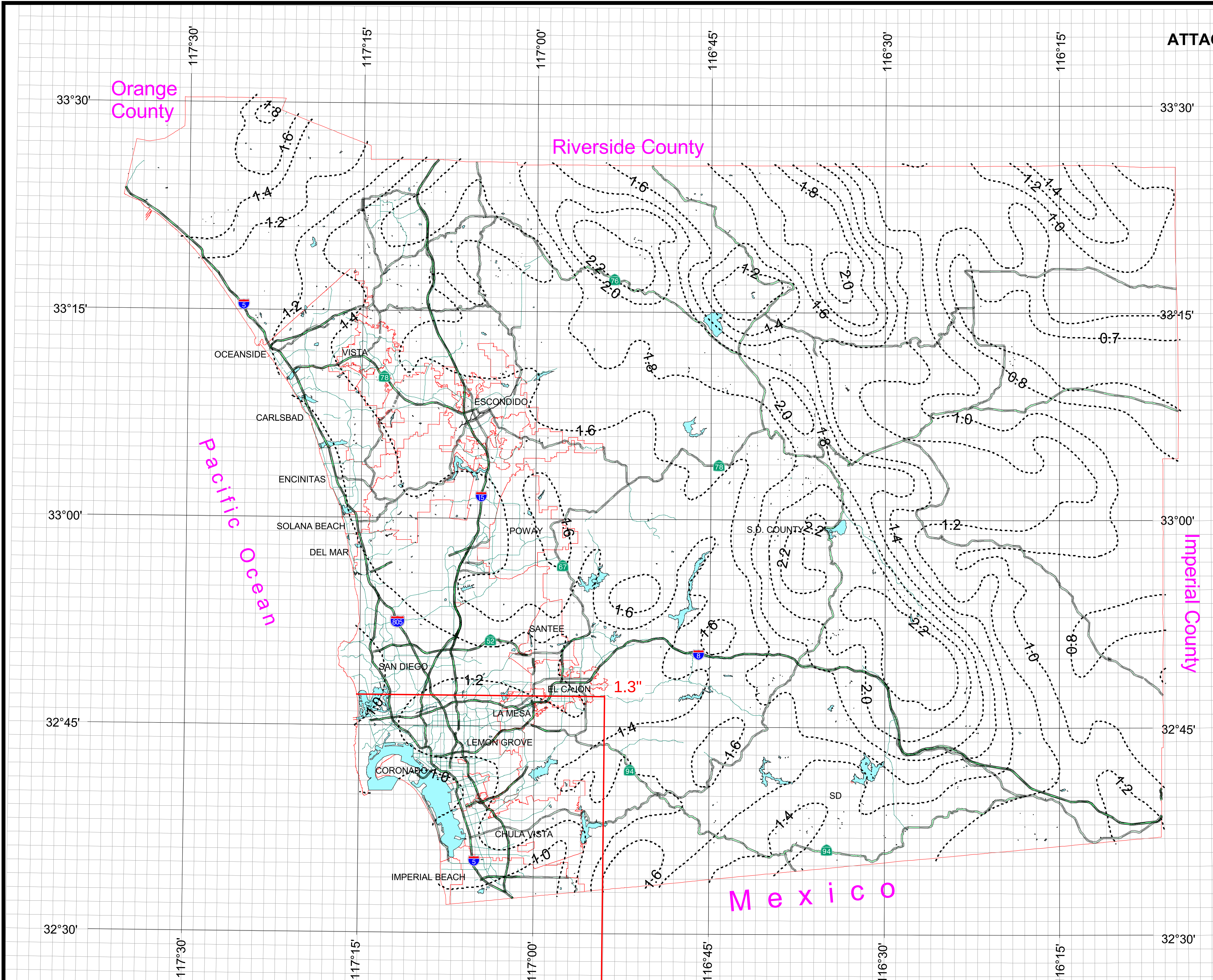
County of San Diego Hydrology Manual

Rainfall Isopluvials

2 Year Rainfall Event - 6 Hours



Isopluvial (inches)

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3 0 3 Miles

Department of Public Works
Geographic Information Services

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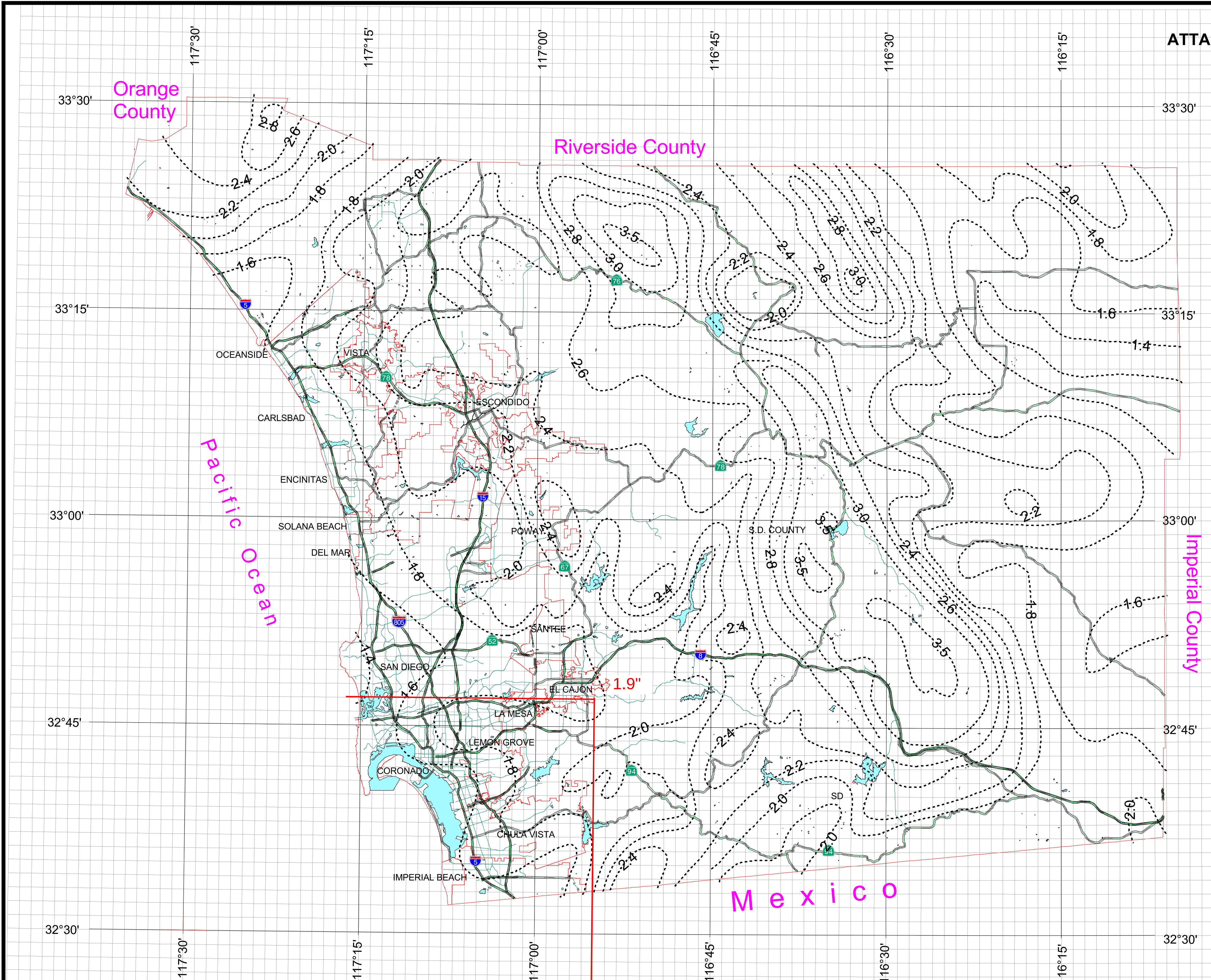
County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 6 Hours

Isopluvial (inches)



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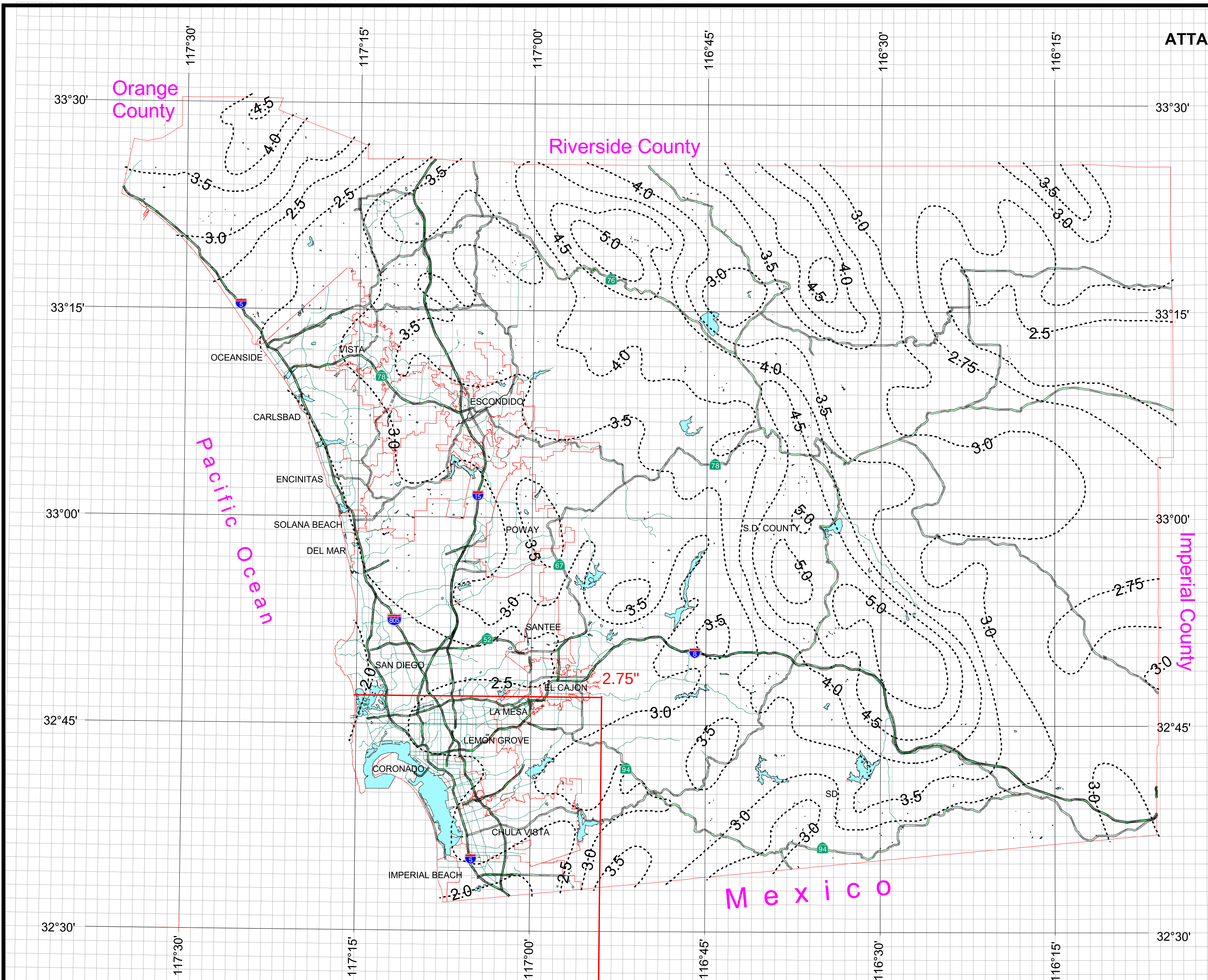
County of San Diego Hydrology Manual

Rainfall Isopluviais



100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

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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