PRELIMINARY

DRAINAGE REPORT

for

PEN-0031 / LST21-0009

Old 215 Industrial Business Park

SITE LOCATED

SE CORNER OF OLD 215 FRONTAGE ROAD AND BAY AVENUE
CITY OF MORENO VALLEY
COUNTY OF RIVERSIDE
STATE OF CALIFORNIA

APN: 263-230-002, 263-220-004,-008,-009,-017,-018,-023,-027,-028,-029

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May 20, 2021

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Attachments

JURISDICTION AND SCOPE OF DRAINAGE REPORT

Stormwater impacts associated with the Old 215 Industrial Business Park project are within the jurisdiction of the City of Moreno Valley. The City requires that hydrologic analyses be performed according to methodologies prescribed by the Riverside County Flood Control and Water Conservation District (RCFC).

The scope of this preliminary report relates to potential storm water impacts associated with development of the project site and quantifies a preliminary estimate of onsite detention volume required by calculating pre- and post-developed runoff volumes for 1-, 3-, 6- & 24-hour durations of the 2-, 5-, 10- and 100-year storm events using USDA NRCS (SCS) TR-55 (1986) methodology.

PROJECT DESCRIPTION, ANALYSIS AND CONCLUSION

The six buildings of Old 215 Industrial Business Park are located at the southeast corner of Old 215 Frontage Road and Bay Avenue in the City of Moreno Valley. The project site is 11.460 acres. The very small areas south of Buildings D, E, and F, and east of Buildings C and F discharge as historically away from the immediate site (0.288 acres) and ultimately to the same area discharge drain into which the site area also discharges. The primary site entrance is off Old 215 Frontage Road and a fire access entrance is provided off Bay Avenue. Please reference Preliminary Post-Developed Drainage Map, attached.

The post-developed site will detain an incremental increase in volume between the existing and post-developed site runoff to lower the peak discharge (flow rate) from the post-developed site to approximately match (typically less than 105% of) the existing site peak discharge. The needed detention volume is estimated in this preliminary report using TR-55 to preliminarily design siting requirements for detention facilities, while peak flow mitigation will be calculated later, in the final report, using RCFC Unit Hydrograph and other numerical methods to route the reservoir volume through a controlled hydraulics outlet structure. At this preliminary stage, only an estimated detention volume is provided.

All site surface soils are Hydrologic Soil Group C soils per the attached NRCS Soils Report. Precipitation data for TR-55 was taken from NOAA Atlas 14, attached.

TR-55 Runoff Curve (RC) numbers (which closely match RCFC Runoff Index numbers) were selected for each type of existing and post-developed surface, with weighted RC numbers calculated (where conditions warrant weighting). RC numbers were adjusted conservatively (to add to the incremental increase) where such adjustments are warranted (see Detention Estimation spreadsheet attached). Results indicate the largest estimated detention volume occurs with the 100-year 24-hour storm event, or an incremental increase in runoff volume between existing and post-developed of approximately 5,526 cubic feet (cf). An underground detention storage area of 5,650 cf is shown on the Preliminary Post-Developed Drainage Map using water-tight 36-inch diameter storm pipe.

Existing runoff from two offsite areas, shown on the Preliminary Post-Developed Drainage Map, is bypassed (one via an 8-inch and the other via a 12-inch storm drain pipe) though the project site and discharged to their respective historic courses. The 8-inch bypass line discharges its flow westerly into the existing 24-inch storm drain in the east right of way of Old 215 Frontage Road, while the 12-inch bypass line discharges its flow through a surface grate/bubbler at the south end of the site. All these flows end up at the same existing area inlet box near the southwest corner of the site.

All onsite flows in existing and post-developed conditions enter the existing 36-inch pipe passing under Old 215 Frontage Road near the southwest corner of the site. Discharge from the onsite water quality treatment system will reach this pipe downstream of the controlled outlet structure.

A post-developed hydrology map is attached to show the site, planned detention system configuration, integration with water quality treatment system, and preliminary results from RCFC Rational Method hydrology. The preliminary estimated post-developed peak 100-year 1-hour flow rate from the project site is 24.5 cfs (10-year 1-hour peak is 15.5 cfs). In the final report, the existing and post-developed conditions of the site will be analyzed using RCFC Unit Hydrographs. Although RCFC states their Unit Hydrograph methods should only be used for areas larger than 300-500 acres, it is possible to calibrate by UH parameters for smaller areas (though this area is much smaller) to approximate peak flow rates gotten from the RCFC Rational Method. This approach is often accepted in this region to allow completion of the required numerical time study and associated reservoir routing analyses.

Offsite flow from the project street frontage will be conveyed into the same existing outlet as onsite flows via the same existing path, though with improved curb and gutter, and with lower flows being first treated with a proprietary water quality treatment (curb inlet) device prior to discharge into the historic course.

To conclude this preliminary report, no adverse impacts to existing storm drain facilities or property are anticipated with development of this project site.

ATTACHMENTS

TR-55 DETENTION ESTIMATION AND SUPPORTING TR-55 DOCUMENTATION
NOAA PRECIPITATION DATA
NRCS SOILS REPORT
RCFC RATIONAL METHOD HYDROLOGY POST-DEVELOPED
RCFC PRECIPITATION MAPS
PRELIMINARY HYDROLOGY MAP POST-DEVELOPED CONDITION

SB&O INC. PLANNING ENGINEERING SURVEYING

Detention Estimation

Job No: 75002
By: BCK
Date: 5/20/2021

Old 215 Industrial

NRCS TR-55 (attached) usedto estimate detention volume.

Precipitation per NOAA.

Hydrologic Soil Group (HSG) per NRCS.

Runoff volume = runoff depth, q, in inches (per Eq. 2-3 of TR-55, p. 2-1), times the Site Area.

Soil Group:	C			
Area:	499,186	sf	Prop CN:	91.0
Area:	11.4597	ac	Exist CN:	89.7

Storm Event	Precip Depth (in)	Prop Runoff Vol. (cf)	Exist Runoff Vol. (cf)	Estimated Detention Volume (Prop – Exist) (cf)
2-yr 1-hr	0.447	2,086	1,439	647
2-yr 3-hr	0.771	8,749	7,215	1,534
2-yr 6-hr	1.060	16,705	14,496	2,209
2-yr 24-hr	1.840	42,636	39,105	3,531
5-yr 1-hr	0.597	4,775	3,704	1,072
5-yr 3-hr	0.999	14,916	12,840	2,076
5-yr 6-hr	1.360	26,119	23,326	2,794
5-yr 24-hr	2.420	63,970	59,778	4,192
10-yr 1-hr	0.724	7,602	6,189	1,413
10-yr 3-hr	1.190	20,670	18,194	2,476
10-yr 6-hr	1.610	34,550	31,345	3,204
10-yr 24-hr	2.890	81,904	77,302	4,602
100-yr 1-hr	1.200	20,983	18,488	2,496
100-yr 3-hr	1.850	42,993	39,449	3,545
100-yr 6-hr	2.480	66,234	61,984	4,250
100-yr 24-hr	4.520	146,318	140,792	5,526

Chapter 2 Estimating Runoff

SCS runoff curve number method

The SCS Runoff Curve Number (CN) method is described in detail in NEH-4 (SCS 1985). The SCS runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[eq. 2-1]}$$

where

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

Initial abstraction (I_a) is all losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. I_a is highly variable but generally is correlated with soil and cover parameters. Through studies of many small agricultural watersheds, I_a was found to be approximated by the following empirical equation:

$$I_a = 0.2S \qquad \text{[eq. 2-2]}$$

By removing I_a as an independent parameter, this approximation allows use of a combination of S and P to produce a unique runoff amount. Substituting equation 2-2 into equation 2-1 gives:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[eq. 2-3]}$$

S is related to the soil and cover conditions of the watershed through the CN. CN has a range of 0 to 100, and S is related to CN by:

$$S = \frac{1000}{CN} - 10 \qquad \text{[eq. 2-4]}$$

Figure 2-1 and table 2-1 solve equations 2-3 and 2-4 for a range of CN's and rainfall.

Factors considered in determining runoff curve numbers

The major factors that determine CN are the hydrologic soil group (HSG), cover type, treatment, hydrologic condition, and antecedent runoff condition (ARC). Another factor considered is whether impervious areas outlet directly to the drainage system (connected) or whether the flow spreads over pervious areas before entering the drainage system (unconnected). Figure 2-2 is provided to aid in selecting the appropriate figure or table for determining curve numbers.

CN's in table 2-2 (*a* to *d*) represent average antecedent runoff condition for urban, cultivated agricultural, other agricultural, and arid and semiarid rangeland uses. Table 2-2 assumes impervious areas are directly connected. The following sections explain how to determine CN's and how to modify them for urban conditions.

Hydrologic soil groups

Infiltration rates of soils vary widely and are affected by subsurface permeability as well as surface intake rates. Soils are classified into four HSG's (A, B, C, and D) according to their minimum infiltration rate, which is obtained for bare soil after prolonged wetting. Appendix A defines the four groups and provides a list of most of the soils in the United States and their group classification. The soils in the area of interest may be identified from a soil survey report, which can be obtained from local SCS offices or soil and water conservation district offices.

Most urban areas are only partially covered by impervious surfaces: the soil remains an important factor in runoff estimates. Urbanization has a greater effect on runoff in watersheds with soils having high infiltration rates (sands and gravels) than in watersheds predominantly of silts and clays, which generally have low infiltration rates.

Any disturbance of a soil profile can significantly change its infiltration characteristics. With urbanization, native soil profiles may be mixed or removed or fill material from other areas may be introduced. Therefore, a method based on soil texture is given in appendix A for determining the HSG classification for disturbed soils.

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

1 Average runoff condition, and $I_a=0.2S$
2 Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.
3 Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

NOAA Atlas 14, Volume 6, Version 2
Location name: Moreno Valley, California, USA*
Latitude: 33.9192°, Longitude: -117.2819°
Elevation: m/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

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.089 (0.074-0.107)	0.118 (0.098-0.143)	0.157 (0.131-0.191)	0.191 (0.157-0.234)	0.238 (0.190-0.302)	0.276 (0.215-0.358)	0.316 (0.240-0.421)	0.359 (0.265-0.492)	0.421 (0.297-0.601)	0.471 (0.321-0.697)
10-min	0.127 (0.106-0.154)	0.169 (0.141-0.204)	0.225 (0.187-0.274)	0.273 (0.225-0.335)	0.341 (0.272-0.433)	0.396 (0.308-0.513)	0.453 (0.344-0.603)	0.515 (0.380-0.705)	0.603 (0.426-0.862)	0.675 (0.460-1.00)
15-min	0.154 (0.129-0.186)	0.204 (0.170-0.247)	0.273 (0.227-0.331)	0.330 (0.272-0.405)	0.413 (0.329-0.523)	0.479 (0.373-0.621)	0.548 (0.416-0.729)	0.623 (0.460-0.853)	0.729 (0.515-1.04)	0.816 (0.556-1.21)
30-min	0.237 (0.198-0.286)	0.314 (0.262-0.380)	0.419 (0.348-0.509)	0.508 (0.419-0.622)	0.634 (0.505-0.805)	0.736 (0.573-0.954)	0.843 (0.640-1.12)	0.958 (0.707-1.31)	1.12 (0.792-1.60)	1.25 (0.855-1.86)
60-min	0.337 (0.282-0.408)	0.447 (0.373-0.542)	0.597 (0.497-0.726)	0.724 (0.597-0.888)	0.905 (0.720-1.15)	1.05 (0.817-1.36)	1.20 (0.913-1.60)	1.37 (1.01-1.87)	1.60 (1.13-2.29)	1.79 (1.22-2.65)
2-hr	0.490 (0.409-0.593)	0.636 (0.530-0.770)	0.830 (0.690-1.01)	0.992 (0.817-1.22)	1.22 (0.968-1.54)	1.39 (1.08-1.80)	1.57 (1.20-2.09)	1.77 (1.30-2.42)	2.03 (1.43-2.90)	2.24 (1.53-3.32)
3-hr	0.598 (0.500-0.724)	0.771 (0.643-0.933)	0.999 (0.831-1.21)	1.19 (0.979-1.45)	1.45 (1.15-1.83)	1.65 (1.28-2.14)	1.85 (1.41-2.47)	2.07 (1.53-2.83)	2.37 (1.67-3.38)	2.60 (1.77-3.85)
6-hr	0.824 (0.688-0.997)	1.06 (0.882-1.28)	1.36 (1.13-1.66)	1.61 (1.33-1.98)	1.95 (1.56-2.48)	2.22 (1.73-2.87)	2.48 (1.89-3.30)	2.76 (2.03-3.78)	3.13 (2.21-4.48)	3.42 (2.33-5.07)
12-hr	1.07 (0.894-1.30)	1.39 (1.16-1.68)	1.80 (1.49-2.18)	2.13 (1.76-2.61)	2.59 (2.06-3.28)	2.94 (2.29-3.81)	3.29 (2.50-4.38)	3.65 (2.70-5.00)	4.15 (2.93-5.93)	4.53 (3.09-6.71)
24-hr	1.40 (1.24-1.62)	1.84 (1.63-2.13)	2.42 (2.13-2.80)	2.89 (2.53-3.37)	3.53 (2.99-4.25)	4.02 (3.34-4.95)	4.52 (3.66-5.69)	5.04 (3.97-6.52)	5.73 (4.34-7.73)	6.28 (4.60-8.75)
2-day	1.67 (1.48-1.93)	2.23 (1.97-2.58)	2.97 (2.62-3.44)	3.58 (3.13-4.18)	4.41 (3.73-5.31)	5.05 (4.19-6.21)	5.70 (4.62-7.18)	6.37 (5.03-8.25)	7.29 (5.52-9.83)	8.01 (5.86-11.2)
3-day	1.79 (1.58-2.06)	2.42 (2.14-2.79)	3.25 (2.87-3.77)	3.94 (3.45-4.60)	4.88 (4.14-5.89)	5.61 (4.66-6.91)	6.36 (5.15-8.01)	7.14 (5.63-9.24)	8.20 (6.21-11.1)	9.03 (6.61-12.6)
4-day	1.93 (1.71-2.23)	2.64 (2.33-3.04)	3.57 (3.15-4.14)	4.35 (3.80-5.07)	5.41 (4.58-6.52)	6.24 (5.17-7.67)	7.08 (5.74-8.92)	7.97 (6.28-10.3)	9.18 (6.95-12.4)	10.1 (7.42-14.1)
7-day	2.18 (1.93-2.51)	3.02 (2.67-3.49)	4.14 (3.65-4.80)	5.07 (4.43-5.92)	6.36 (5.38-7.66)	7.36 (6.11-9.05)	8.39 (6.80-10.6)	9.47 (7.47-12.3)	11.0 (8.29-14.8)	12.1 (8.88-16.9)
10-day	2.32 (2.05-2.68)	3.24 (2.87-3.75)	4.48 (3.95-5.19)	5.51 (4.82-6.43)	6.94 (5.88-8.36)	8.06 (6.69-9.91)	9.22 (7.47-11.6)	10.4 (8.22-13.5)	12.1 (9.17-16.3)	13.4 (9.83-18.7)
20-day	2.76 (2.44-3.18)	3.90 (3.45-4.50)	5.45 (4.81-6.31)	6.76 (5.91-7.89)	8.59 (7.27-10.4)	10.0 (8.34-12.4)	11.6 (9.37-14.6)	13.2 (10.4-17.1)	15.4 (11.7-20.8)	17.2 (12.6-24.0)
30-day	3.26 (2.88-3.76)	4.60 (4.07-5.31)	6.45 (5.68-7.46)	8.01 (7.00-9.35)	10.2 (8.66-12.3)	12.0 (9.96-14.8)	13.9 (11.2-17.5)	15.9 (12.5-20.5)	18.7 (14.1-25.2)	20.9 (15.3-29.2)
45-day	3.86 (3.42-4.45)	5.40 (4.78-6.24)	7.54 (6.65-8.73)	9.37 (8.19-10.9)	12.0 (10.2-14.5)	14.1 (11.7-17.4)	16.4 (13.3-20.6)	18.8 (14.8-24.3)	22.3 (16.8-30.0)	25.1 (18.3-34.9)
60-day	4.48 (3.96-5.16)	6.18 (5.47-7.14)	8.57 (7.55-9.92)	10.6 (9.29-12.4)	13.6 (11.5-16.4)	16.0 (13.3-19.7)	18.6 (15.1-23.4)	21.4 (16.9-27.7)	25.4 (19.3-34.3)	28.8 (21.0-40.1)

[1] 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.

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PF graphical

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

Western Riverside Area, California

Old 215 Industrial Park

February 3, 2021

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.

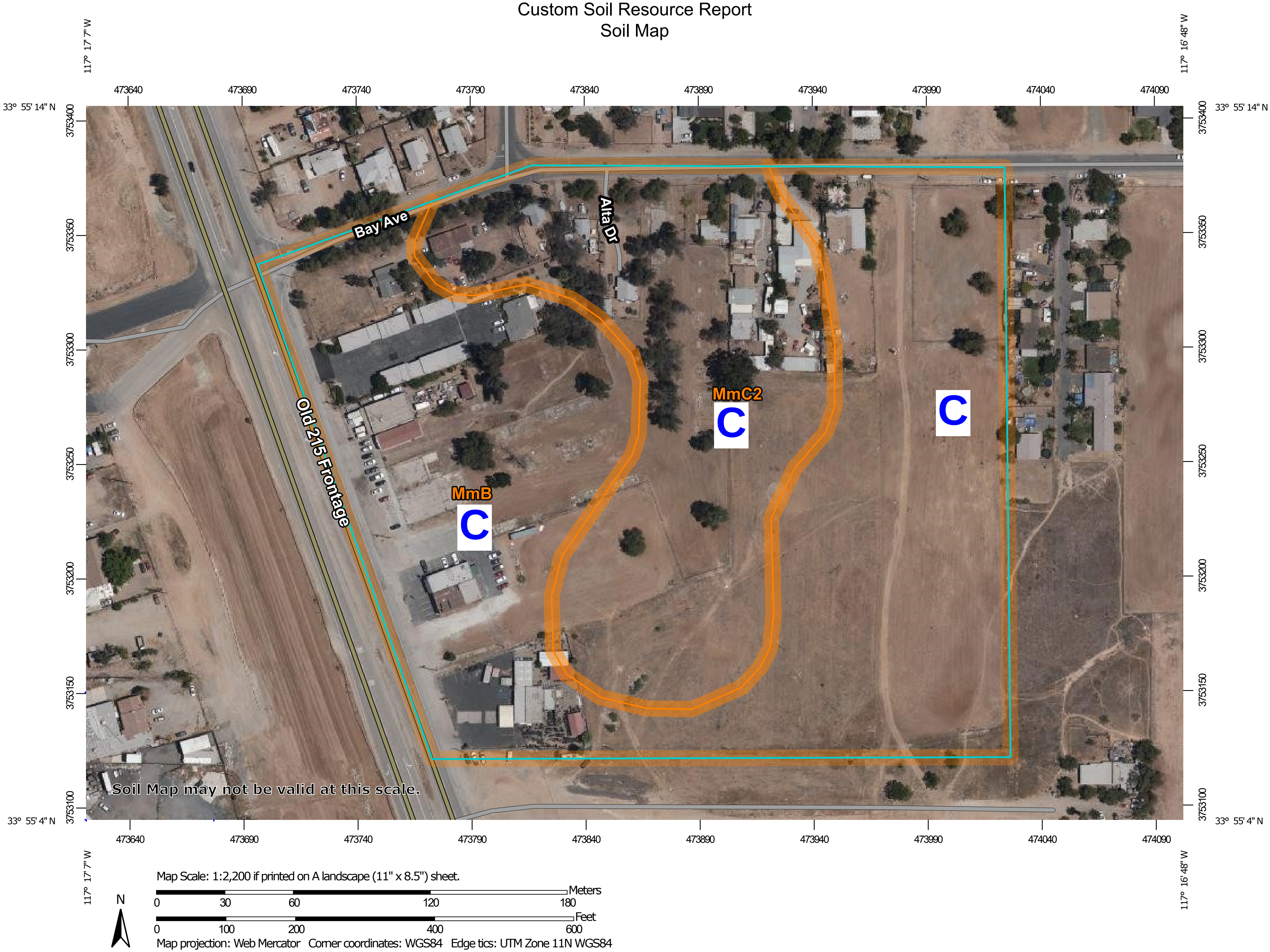
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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.

Soil Map


117° 17' 7" W
117° 16' 48" W
33° 55' 14" N
33° 55' 4" N
473640
473690
473740
473790
473840
473890
473940
473990
474040
474090
3753400
3753350
3753300
3753250
3753200
3753150
3753100
Bay Ave
Alta Dr
Old 215 Frontage
MmC2
C
C
MmB
C
Soil Map may not be valid at this scale.
Map Scale: 1:2,200 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 30 60 120 180
Feet
0 100 200 400 600
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

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 1:15,800.

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: Western Riverside Area, California
Survey Area Data: Version 13, May 27, 2020

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

Date(s) aerial images were photographed: May 25, 2019—Jun 25, 2019

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
MmB	Monserate sandy loam, 0 to 5 percent slopes	12.3	67.0%
MmC2	Monserate sandy loam, 5 to 8 percent slopes, eroded	6.1	33.0%
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.

Western Riverside Area, California

MmB—Monserate sandy loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: hcx4
Elevation: 700 to 2,500 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 220 to 280 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Monserate and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monserate

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 10 inches: sandy loam
H2 - 10 to 28 inches: sandy clay loam
H3 - 28 to 45 inches: indurated
H4 - 45 to 57 inches: cemented
H5 - 57 to 70 inches: loamy coarse sand, coarse sandy loam
H5 - 57 to 70 inches:

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 39 inches to duripan
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R019XD029CA
Hydric soil rating: No

Minor Components

Greenfield

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

Hanford

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

Tujunga

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

MmC2—Monserate sandy loam, 5 to 8 percent slopes, eroded

Map Unit Setting

National map unit symbol: hcx5
Elevation: 700 to 2,500 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 220 to 280 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Monserate and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monserate

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 10 inches: sandy loam
H2 - 10 to 28 inches: sandy clay loam
H3 - 28 to 45 inches: indurated
H4 - 45 to 57 inches: cemented
H5 - 57 to 70 inches: loamy coarse sand, coarse sandy loam
H5 - 57 to 70 inches:

Properties and qualities

Slope: 5 to 8 percent
Depth to restrictive feature: 20 to 39 inches to duripan
Drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R019XD029CA
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 3 percent
Hydric soil rating: No

Ramona

Percent of map unit: 3 percent
Hydric soil rating: No

Hanford

Percent of map unit: 3 percent
Hydric soil rating: No

Greenfield

Percent of map unit: 3 percent
Hydric soil rating: No

Tujunga

Percent of map unit: 3 percent
Hydric soil rating: No

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Riverside County Rational Hydrology Program

```
CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study       Date: 05/24/21  File:75002rmP100.out
------------------------------------------------------------------------
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75002
Old 215 Industrial Park
Rational Method Hydrology
100-Year 1-Hour Peak Flow

```
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********
 English (in-lb) Units used in input data file
------------------------------------------------------------------------
Program License Serial Number 6241
------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.160(In.)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.160(In/Hr)
Slope of intensity duration curve = 0.4900

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   221.000(Ft.)
Top (of initial area) elevation =  1546.500(Ft.)
Bottom (of initial area) elevation =  1544.400(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.00950  s(percent)=      0.95
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.596 min.
Rainfall intensity =      3.422(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.887
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
```



```
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      0.783(CFS)
Total initial stream area =        0.258(Ac.)
Pervious area fraction = 0.100
```

DA 10

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       3.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1544.400(Ft.)
Downstream point elevation =  1535.000(Ft.)
Channel length thru subarea  =  1006.000(Ft.)
Channel base width  =   20.000(Ft.)
Slope or 'Z' of left channel bank =  31.000
Slope or 'Z' of right channel bank =   0.167
Estimated mean flow rate at midpoint of channel =      9.634(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      9.634(CFS)
Depth of flow =   0.162(Ft.), Average velocity =   2.641(Ft/s)
Channel flow top width =   25.048(Ft.)
Flow Velocity =    2.64(Ft/s)
Travel time  =    6.35 min.
Time of concentration =   12.95 min.

Sub-Channel No. 1 Critical depth =      0.184(Ft.)
  '     '       '     Critical flow top width =     25.722(Ft.)
  '     '       '     Critical flow velocity=    2.295(Ft/s)
  '     '       '     Critical flow area =      4.197(Sq.Ft)

 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      2.459(In/Hr) for a   100.0 year storm
Subarea runoff =     17.619(CFS) for      8.119(Ac.)
Total runoff =     18.401(CFS)     Total area =       8.377(Ac.)
Depth of flow =   0.236(Ft.), Average velocity =   3.301(Ft/s)
```

DA 20

```
Sub-Channel No. 1 Critical depth =      0.277(Ft.)
  '     '       '     Critical flow top width =     28.644(Ft.)
  '     '       '     Critical flow velocity=    2.728(Ft/s)
  '     '       '     Critical flow area =      6.746(Sq.Ft)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      30.000 to Point/Station      69.000
**** SUBAREA FLOW ADDITION ****
```

```
COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    12.95 min.
Rainfall intensity =      2.459(In/Hr) for a   100.0 year storm
Subarea runoff =      4.375(CFS) for      2.016(Ac.)
Total runoff =     22.776(CFS)     Total area =      10.393(Ac.)
```

DA 30

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       40.000 to Point/Station       69.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    12.95 min.
Rainfall intensity =      2.459(In/Hr) for a   100.0 year storm
Subarea runoff =      1.688(CFS) for      0.778(Ac.)
Total runoff =     24.465(CFS)     Total area =      11.171(Ac.)
```

DA 40

ONSITE FLOW TOTAL

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       50.000 to Point/Station       79.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    12.95 min.
Rainfall intensity =      2.459(In/Hr) for a   100.0 year storm
Subarea runoff =      1.161(CFS) for      0.535(Ac.)
Total runoff =     25.626(CFS)     Total area =      11.706(Ac.)
```

DA 50

STREET FLOW TOTAL

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       70.000 to Point/Station       98.000
**** SUBAREA FLOW ADDITION ****
```



```
COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    12.95 min.
Rainfall intensity =      2.459(In/Hr) for a   100.0 year storm
Subarea runoff =      0.851(CFS) for      0.392(Ac.)
Total runoff =     26.476(CFS)     Total area =      12.098(Ac.)
```

BP 70

8" BYPASS FLOW

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       80.000 to Point/Station       99.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    12.95 min.
Rainfall intensity =      2.459(In/Hr) for a   100.0 year storm
Subarea runoff =      0.805(CFS) for      0.371(Ac.)
Total runoff =     27.281(CFS)     Total area =      12.469(Ac.)
```

BP 80

PART 1 OF 2 INTO 12" BYPASS FLOW

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       90.000 to Point/Station       99.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.882
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Time of concentration =    12.95 min.
Rainfall intensity =      2.459(In/Hr) for a   100.0 year storm
Subarea runoff =      1.682(CFS) for      0.775(Ac.)
Total runoff =     28.963(CFS)     Total area =      13.244(Ac.)
End of computations, total study area =          13.24 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  69.0
```

BP 90

PART 2 OF 2 INTO 12" BYPASS FLOW

Riverside County Rational Hydrology Program

```
CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study        Date: 05/24/21  File:75002rmP10.out
------------------------------------------------------------------------
```

75002
Old 215 Industrial Park
Rational Method Hydrology
10-Year 1-Hour Peak Flow

```
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********
 English (in-lb) Units used in input data file
------------------------------------------------------------------------
Program License Serial Number 6241
------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

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

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.160(In.)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.772(In/Hr)
Slope of intensity duration curve = 0.4900

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   221.000(Ft.)
Top (of initial area) elevation =  1546.500(Ft.)
Bottom (of initial area) elevation =  1544.400(Ft.)
Difference in elevation =     2.100(Ft.)
Slope =    0.00950  s(percent)=      0.95
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.596 min.
Rainfall intensity =      2.276(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.881
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
```



```
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      0.517(CFS)
Total initial stream area =        0.258(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1544.400(Ft.)
Downstream point elevation =  1535.000(Ft.)
Channel length thru subarea  =  1006.000(Ft.)
Channel base width  =   20.000(Ft.)
Slope or 'Z' of left channel bank =  31.000
Slope or 'Z' of right channel bank =   0.167
Estimated mean flow rate at midpoint of channel =      6.131(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      6.131(CFS)
Depth of flow =   0.124(Ft.), Average velocity =   2.248(Ft/s)
Channel flow top width =   23.875(Ft.)
Flow Velocity =    2.25(Ft/s)
Travel time  =    7.46 min.
Time of concentration =   14.06 min.

Sub-Channel No. 1 Critical depth =      0.138(Ft.)
  '     '       '     Critical flow top width =     24.292(Ft.)
  '     '       '     Critical flow velocity=    2.011(Ft/s)
  '     '       '     Critical flow area =      3.049(Sq.Ft)

 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      1.571(In/Hr) for a    10.0 year storm
Subarea runoff =     11.163(CFS) for      8.119(Ac.)
Total runoff =     11.681(CFS)     Total area =       8.377(Ac.)
Depth of flow =   0.181(Ft.), Average velocity =   2.825(Ft/s)

Sub-Channel No. 1 Critical depth =      0.207(Ft.)
  '     '       '     Critical flow top width =     26.453(Ft.)
  '     '       '     Critical flow velocity=    2.429(Ft/s)
  '     '       '     Critical flow area =      4.809(Sq.Ft)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       30.000 to Point/Station       69.000
```

**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 14.06 min.
Rainfall intensity = 1.571(In/Hr) for a 10.0 year storm
Subarea runoff = 2.772(CFS) for 2.016(Ac.)
Total runoff = 14.453(CFS) Total area = 10.393(Ac.)

++
Process from Point/Station 40.000 to Point/Station 69.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 14.06 min.
Rainfall intensity = 1.571(In/Hr) for a 10.0 year storm
Subarea runoff = 1.070(CFS) for 0.778(Ac.)
Total runoff = 15.522(CFS) Total area = 11.171(Ac.)

++
Process from Point/Station 50.000 to Point/Station 79.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 14.06 min.
Rainfall intensity = 1.571(In/Hr) for a 10.0 year storm
Subarea runoff = 0.736(CFS) for 0.535(Ac.)
Total runoff = 16.258(CFS) Total area = 11.706(Ac.)

++
Process from Point/Station 70.000 to Point/Station 98.000
**** SUBAREA FLOW ADDITION ****

COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 14.06 min.
Rainfall intensity = 1.571(In/Hr) for a 10.0 year storm
Subarea runoff = 0.539(CFS) for 0.392(Ac.)
Total runoff = 16.797(CFS) Total area = 12.098(Ac.)

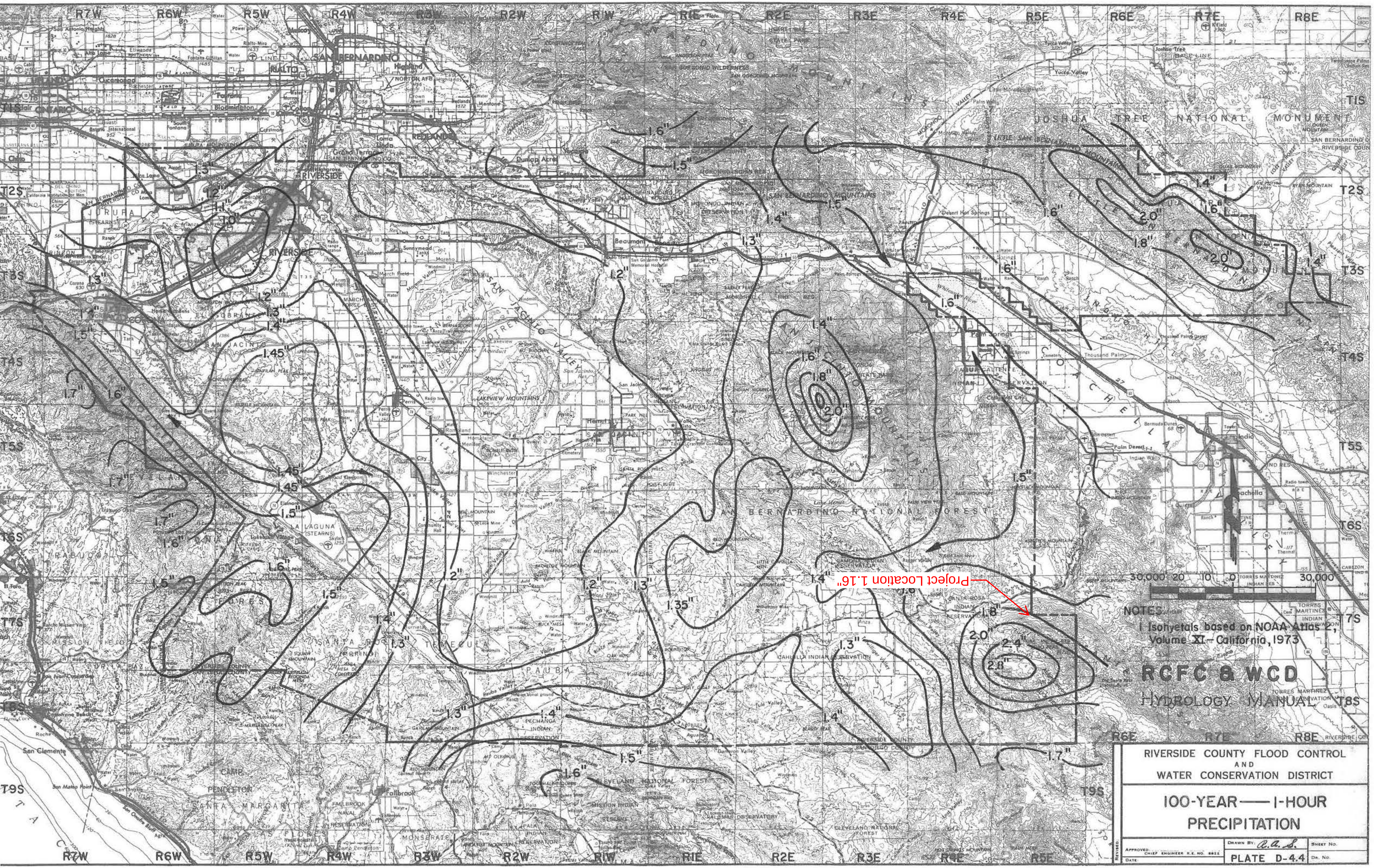
++
Process from Point/Station 80.000 to Point/Station 99.000
**** SUBAREA FLOW ADDITION ****

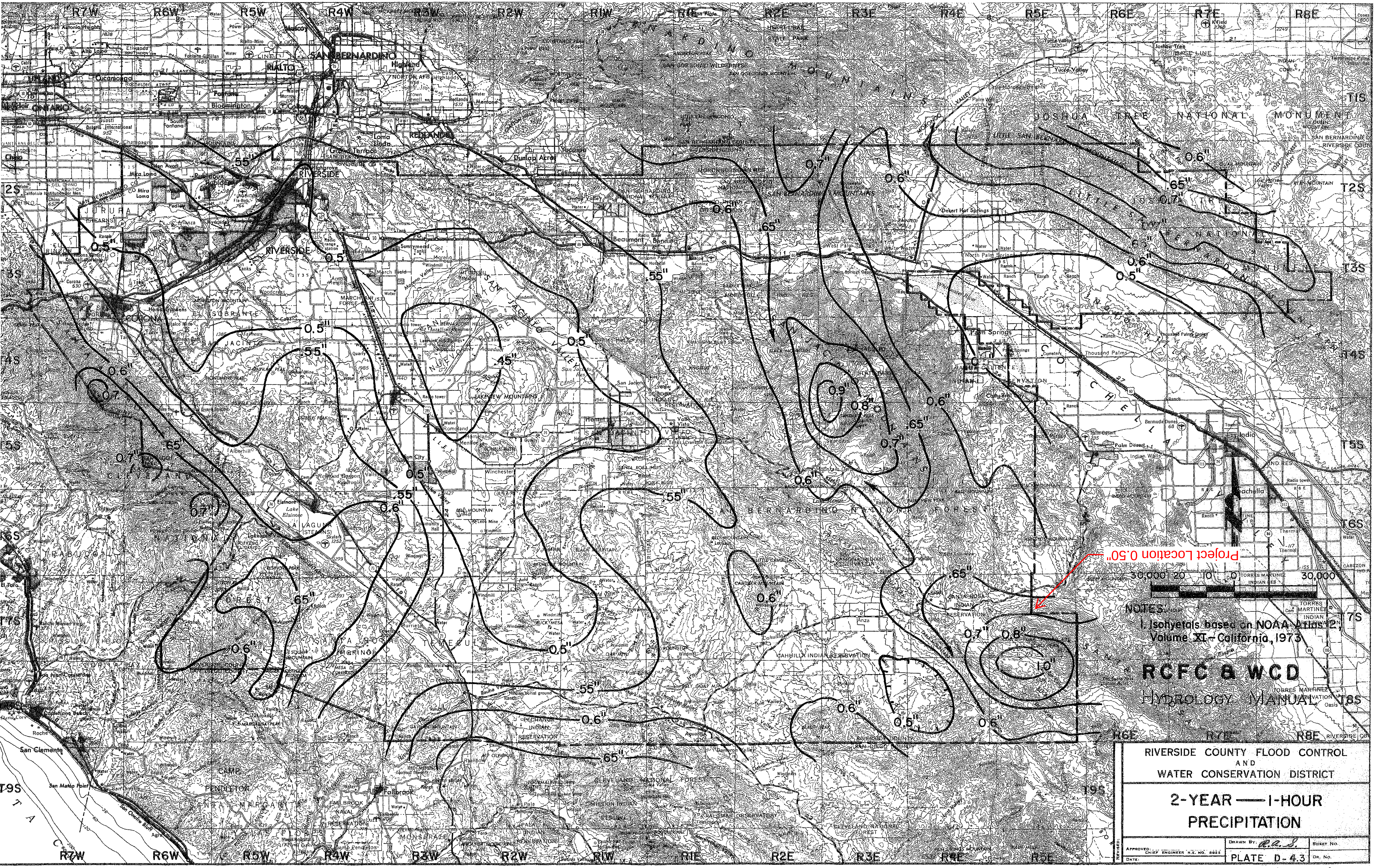
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 14.06 min.
Rainfall intensity = 1.571(In/Hr) for a 10.0 year storm
Subarea runoff = 0.510(CFS) for 0.371(Ac.)
Total runoff = 17.307(CFS) Total area = 12.469(Ac.)

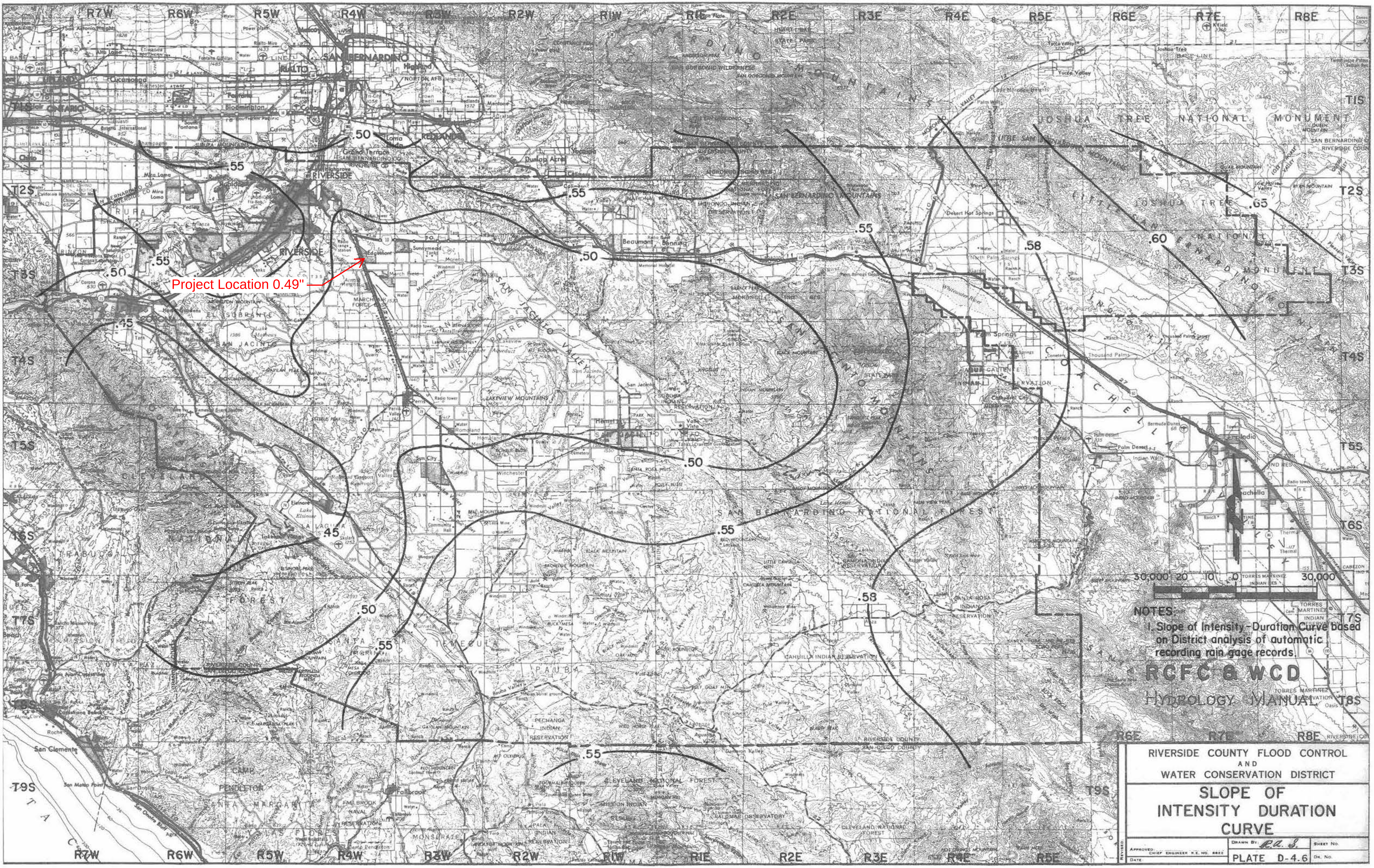
++
Process from Point/Station 90.000 to Point/Station 99.000
**** SUBAREA FLOW ADDITION ****

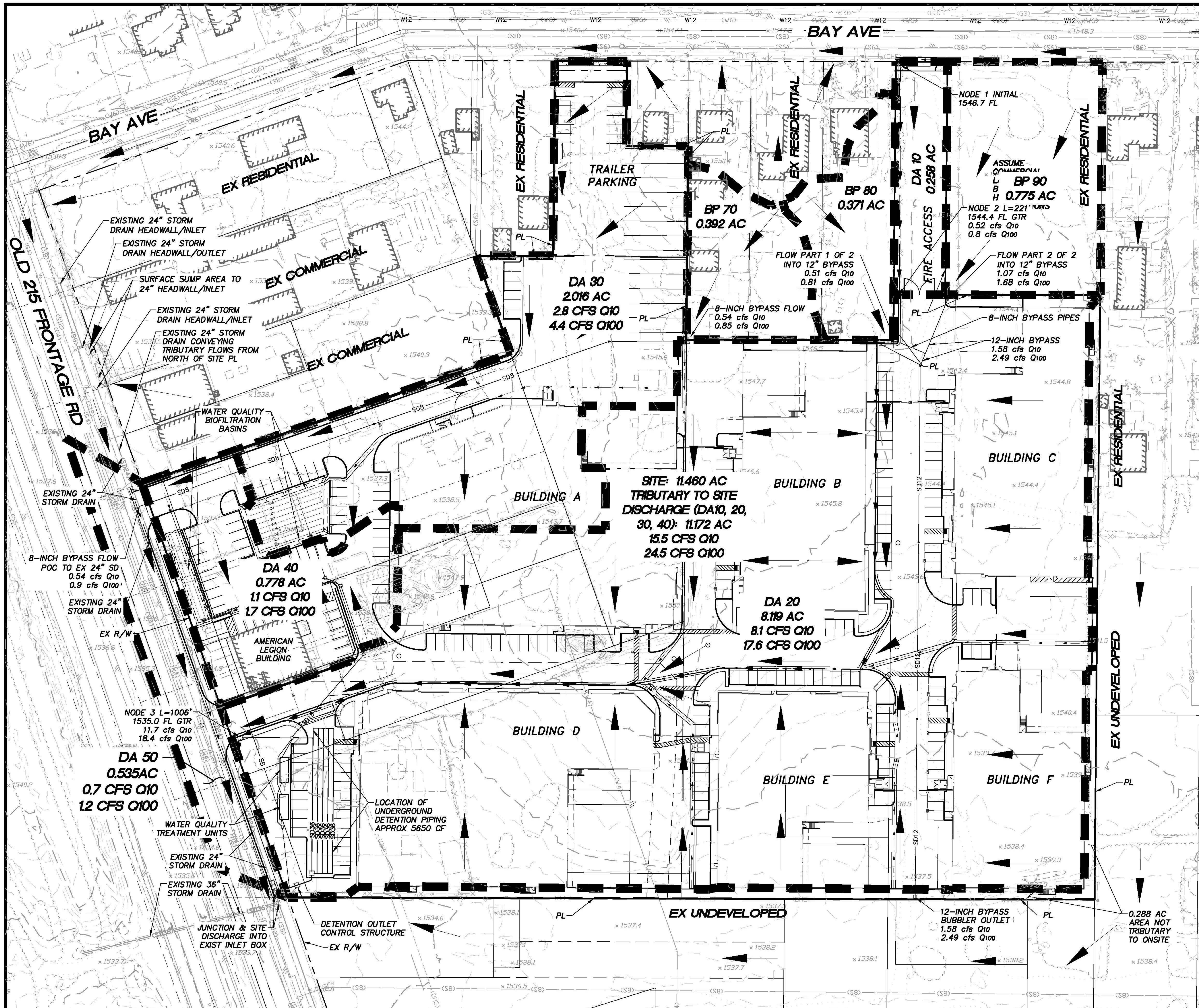
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2) = 69.00
Pervious area fraction = 0.100; Impervious fraction = 0.900
Time of concentration = 14.06 min.
Rainfall intensity = 1.571(In/Hr) for a 10.0 year storm
Subarea runoff = 1.066(CFS) for 0.775(Ac.)
Total runoff = 18.373(CFS) Total area = 13.244(Ac.)
End of computations, total study area = 13.24 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

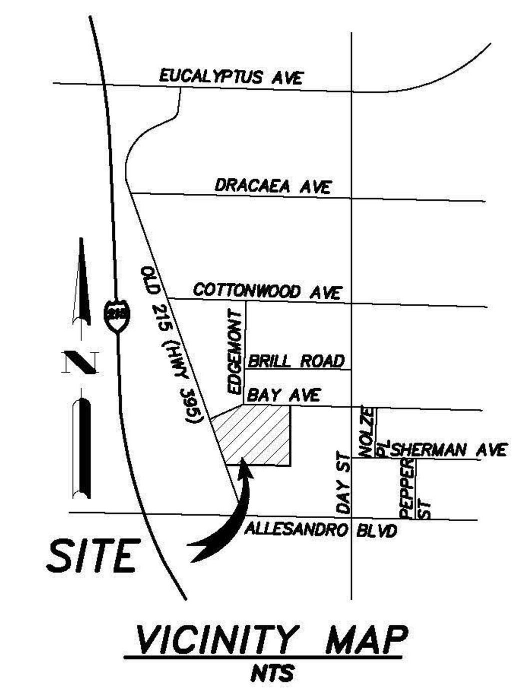
Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number = 69.0


RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
100-YEAR — 1-HOUR PRECIPITATION
PLATE D-4.4
RCFC & WCD HYDROLOGY MANUAL
NOTES
1 Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973
Project Location 1.16"
30,000 20 10 0 30,000
SAN BERNARDINO
RIVERSIDE
JOSHUA TREE NATIONAL MONUMENT
SAN BERNARDINO NATIONAL FOREST
CLEVELAND NATIONAL FOREST
SAN JACINTO VALLEY
LAKEVIEW MOUNTAINS
COACHELLA
Palm Springs
Hemet
Beaumont
San Clemente


RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
2-YEAR — 1-HOUR
PRECIPITATION
PLATE D-4.3
RCFC & WCD
HYDROLOGY MANUAL
NOTES:
1. Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973
Project Location 0.50"
30,000 20 10 0 30,000
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
T1S
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
SAN BERNARDINO
RIVERSIDE
CORONA
RIALTO
ONTARIO
REDLANDS
Beaumont
Banning
Hemet
Elsinore
Fallbrook
San Clemente
JOSHUA TREE NATIONAL MONUMENT
SAN BERNARDINO NATIONAL FOREST
CLEVELAND NATIONAL FOREST
CAMP PENDLETON
CAHUILLA INDIAN RESERVATION


Project Location 0.49"
.45
.50
.55
.58
.60
.65
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
T1S
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
SAN BERNARDINO
RIVERSIDE
ONTARIO
JOSHUA TREE NATIONAL MONUMENT
SAN JACINTO VALLEY
SAN JACINTO MOUNTAINS
SAN BERNARDINO NATIONAL FOREST
CLEVELAND NATIONAL FOREST
COACHELLA
LAKEVIEW MOUNTAINS
PAUBA
San Clemente
30,000 20 10 0 30,000
NOTES:
1. Slope of Intensity-Duration Curve based on District analysis of automatic recording rain gage records.
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
SLOPE OF INTENSITY DURATION CURVE
PLATE D-4.6





OWNER

PHELAN DEVELOPMENT COMPANY
450 NEWPORT CENTER DRIVE, SUITE 405
NEWPORT BEACH, CA 92660
TANIA CHAVEZ
(949) 531-6559

APN

263-230-002,
263-220-004,-008,-009,-017,-018,-023,-027,-028,-029

LEGEND

DRAINAGE AREA LIMITS
PROPOSED STORM DRAIN
DIRECTION OF SURFACE DRAINAGE

GRAPHIC SCALE
50' 0 50' 100' 150'

SCALE: 1" = 50'

SB&O INC.
PLANNING ENGINEERING SURVEYING
41689 Enterprise Circle North, Suite 126
Temecula, Ca. 92590
951-695-8900
951-695-8901 Fax

PRELIMINARY POST-DEVELOPED DRAINAGE MAP OLD 215 INDUSTRIAL

SHEET 1 OF 1

PRELIMINARY 5/20/2021 | 75000.25