Appendix J Preliminary Drainage Report

Appendix

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Preliminary Drainage Report

for

PATHWAYS TO COLLEGE K-8 CHARTER SCHOOL

APN # 0414-212-08-0 AND 0414-212-09-0

January 31, 2022 - updated 5-10-22

Prepared by:

KOLIBRIEN®

Civil / Structural / Surveying
27919 Jefferson Ave., Suite 201
Temecula, CA 92590
Office: (888) 827-7140
Fax: (888) 827-9724

John H. Johnson, P.E., P.L.S.

Provided for:

Pathways to College K-8 Charter School
Contact: Craig Merrill
9144 Third Avenue
Hesperia, CA 92345
PHONE: (760) 949-8002

Project #

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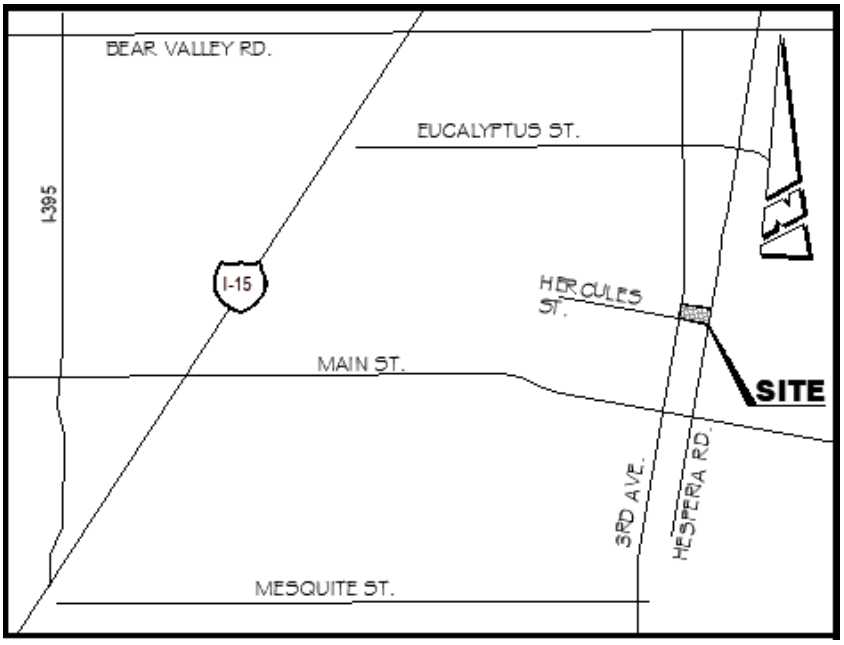
Project Location:



Project Information:

SITE ADDRESS:

3RD AVE, HESPERIA, CA 92345
SOUTH OF MOJAVE ST., EAST OF 3RD AVE., NORTH OF HERCULES ST.,
AND WEST OF HESPERIA AVE., HESPERIA, CA 92345

ASSESSOR'S PARCEL NO.:

0414-212-08-0 AND 0414-212-09-0

FLOOD ZONE DESIGNATION:

THIS PROPERTY IS IN FLOODWAY AREA ZONE X, AS IS SHOWN ON FLOOD INSURANCE RATE MAPS FOR THE COUNTY OF SAN BERNARDINO, CALIFORNIA, SHOWN ON COMMUNITY PANEL NUMBER 0607 1CG495H.

ON-SITE DISTURBED AREA:

11.79 ACRES

PROJECT TEAM

APPLICANT/ OWNER:	PATHWAYS TO COLLEGE K-8 CHARTER SCHOOL CONTACT: CRAIG MERRILL 9144 THIRD AVENUE HESPERIA, CA. 92345 T: 760-949-8002 craig.merrill@pathwaysk8.com	CIVIL ENGINEER:	KOLIBRIEN CONTACT: JOHN JOHNSON 27919 JEFFERSON AVENUE TEMECULA CA. 92590T: 951-252-1034 john@kolibrien.biz
ARCHITECT:	KIRK MOELLER ARCHITECTS, INC. CONTACT: ANDREW CHAMPION 2888 LOKER AVENUE EAST, STE. 220 CARLSBAD, CA. 92010 T: 760-814-8128 andy@kmarchitectsinc.com	LANDSCAPE ARCHITECT:	ENVIRONS CONTACT: MARTIN SCHMIDT 1909 STATE STREET SAN DIEGO, CA. 92101 T: 619-232-7007 marty@environs.us

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APPENDICES

1 INTRODUCTION

1.1. SITE DESCRIPTION

1.1.1. LOCATION

The site is located south of Mojave St., east of 3rd Ave., west of Hesperia Rd, and north of Hercules St., in the City of Hesperia.

1.1.2. EXISTING CONDITION

The existing school site is approximately 9.99 acres of vacant land and the adjacent area is 1.79 acres of vacant land. The total site is 11.78 acres. There are some existing improvements along 3rd Avenue and Hesperia Street. The groundwater table is greater than 80" deep and the soil is type C, which has an estimated infiltration rated to Moderately high (0.20 to 0.57 in/hr) capacity of the most limiting layer to transmit water (Ksat).

1.1.3. PROPOSED CONDITION

The proposed project is an elementary charter school with several buildings, hardscape, standard parking including a loading zone for students and landscaped areas. Outdoor activities would include typical school activities such as sports and playground area. 3rd Avenue and Mojave Street are proposed to be improved within the existing R/W.

1.2. PURPOSE OF REPORT

The purpose of this report is for preliminary analysis and design the hydrological and hydraulic conditions of the subject parcel during modeled flood events and to provide recommendations to mitigate increased runoff and water quality treatment in accordance with the City of Hesperia and San Bernardino County Flood Control, and California standards and guidelines.

1.3. FLOOD INFORMATION

The project is located in the Mojave River Area. FEMA area flood map 06071C6495H delineates the site as zone X which states the site is located just outside the area of 0.2% annual chance of flood; and not within any areas of 1% annual chance of flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and not within areas protected by levees from 1% annual chance flood.

2. EXISTING DRAINAGE

2.1. OFFSITE

A review of surrounding topography shows the offsite adjacent lot southerly of the project is tributary, but flow from the area will be conveyed around the proposed site by a swale and discharged following the existing drainage pattern toward the corner of Mojave St and Hesperia Rd.

2.2. ONSITE

The site is relatively flat with gentle slopes draining northerly and easterly to the northeasterly corner of the project site along Hesperia Road. NOAA Atlas 14, Volume 6, Version 2 was utilized in determining 10 year and 100 year average area rainfall data for use in this analysis. The NRCS / USDA WSS Soils report indicated soil type C with an estimated infiltration rated to Moderately high (0.20 to 0.57 in/hr) capacity of the most limiting layer to transmit water (Ksat). The Runoff Curve Number per figure C-3 in the Hydrology Manual, a CN number of 79 was selected for an AMC II. The existing site has no impervious surface area.

3. PROPOSED DRAINAGE

3.1. OFFSITE

The project proposes to improve the 3rd Avenue and Mojave Street. Existing flows in 3rd Avenue and Hesperia Road shall not be impacted. The addition of impervious area within the right-of-way of said roadways shall be mitigated by onsite stormwater retention and infiltration such that any additional flows generated within the project gross area shall be stored and infiltrated onsite as there is excess capacity.

3.2. ONSITE

The project preliminary grading proposed is designed to prevent offsite run-on and to prevent onsite run-off. Onsite flows shall drain via paved surfaces and curb gutters to proposed swales that drain to a large stormwater retention basin. The swales will be size for the Q100 gravity flows. The drainage shall convey onsite flows to the proposed infiltration basin in the northeasterly corner of the site. The shallow infiltration basin sized to retain the difference in generated stormwater volume from the 10 and 100 year storms as well as for hydromodification mitigation. Additionally, the City of Hesperia has a requirement for new developments such that the project shall retain 13.5 cubic feet per each 100 square feet of project impervious surface area. The proposed condition is approximately 46% impervious (5.37 acres onsite), which equates to 31,568 cubic feet of storage required. Additionally, peak flow will be mitigated through infiltration and detention time.

4. HYDROLOGY AND HYDRAULIC SUMMARY

Rational Hydrology methodology was utilized to model the 10 and 100 year peak flows and flood volumes for this project. The San Bernardino County Hydrology Manual were used to develop the hydrological parameters for the 10 and 100 year storm events. Rational method runoff hydrographs were analyzed per Appendix I of the Hydrology Manual to determine flood volumes for each storm in the existing and proposed site conditions. The difference in volume and peak flows shall be mitigated via onsite infiltration as noted in the proposed drainage summary.

4.1. Existing Conditions

EXISTING RATIONAL HYDROLOGY - 10 YEAR

Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.0158	824.95		17.50	
A1	C, Grass	11.79	1.45	1.00	0.4	11.142						17.50

EXISTING RATIONAL HYDROLOGY - 100 YEAR

Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.0158	824.95		17.50	
A1	C, Grass	11.79	2.45	1.00	0.4	21.753						17.50

4.2. Proposed Conditions

PROPOSED RATIONAL HYDROLOGY - 10 YEAR												
Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.013	884.00		13.00	
A-1	C, Land, roof, pave	7.88	1.70	0.59	0.58	9.63						13.00
							9.63					
A-2	C, Land	3.91	1.45	1.00	0.58	3.06		0.010	699.00	2.80	3.93	16.93
							12.69					
PROPOSED RATIONAL HYDROLOGY - 100 YEAR												
Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.013	884.00		13.00	
A-1	C, Land, roof, pave	7.88	2.80	0.59	0.58	17.43						13.00
							17.43					
A-2	C, Land	3.91	2.50	1.00	0.58	6.76		0.010	699.00	3.24	3.40	16.40
							24.19					

See Rational Method Unit Hydrograph Analysis in Appendix A for comparison of existing and Proposed unit hydrographs.

4.3. Conclusions

All onsite storm drain conveyance systems shall be sized to conservatively accommodate all 100-year rational peak flowrates.

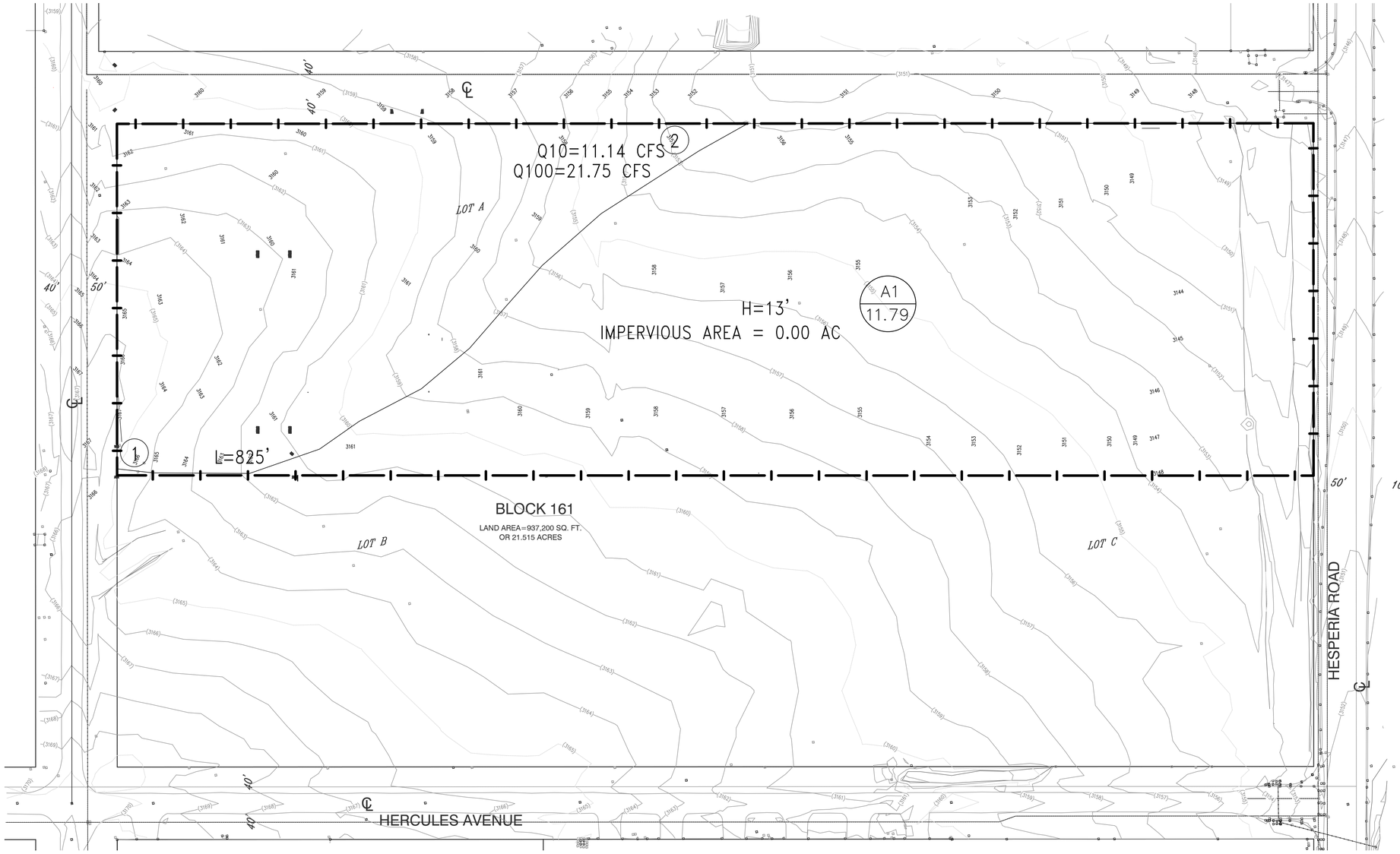
Infiltration is proposed as the highest and best use for water quality treatment and to mitigate for hydromodification. Infiltration is also proposed to mitigate stormwater volume and peak flowrates as well as meet the City's requirement to store 13.5 cubic feet for every additional 100 square feet of impervious surface area constructed.

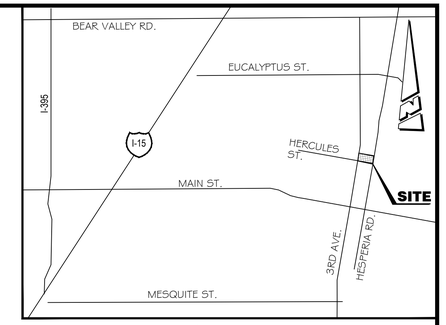
The difference in volume and peak flows shall be mitigated through the onsite shallow infiltration and drywell system as noted in the proposed drainage summary. The volume required for the site by the city is 31,568 cubic feet and the proposed basin provides 60,875 cubic feet.

APPENDIX

Figure 1

EXISTING RATIONAL HYDROLOGY MAP
for PATHWAYS TO COLLEGE K-8 CHARTER SCHOOL





VICINITY MAP
NOT TO SCALE

SITE ADDRESS:

3RD AVE, HESPERIA, CA 92345
SOUTH OF MOJAVE ST., EAST OF 3RD AVE., NORTH OF HERCULES ST.,
AND WEST OF HESPERIA AVE., HESPERIA, CA 92345

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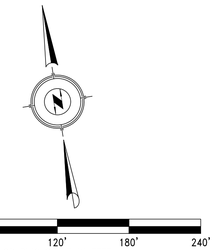
ON-SITE DISTURBED AREA:

11.79 ACRES



HYDROLOGY SUMMARY

LEGEND

- PROP. BLDG PERIMETER
- BOUNDARY LINE
- RIGHT OF WAY
- CENTERLINE
- FLOW LINE
- FENCE LINE
- DRAINAGE MANAGEMENT AREA
- EX. CONTOUR (XXX)
- PROP. CONTOUR [XXX]
- EX. PALM TREE
- EX. TREE
- EX. FIRE HYDRANT
- EX. BUILDING
- P.C.C. CONCRETE SURFACE
- BIORETENTION AREA
- REMOVE A.C. PAVEMENT
- RIPRAP
- TURF BLOCK POROUS PAVEMENT
- PROPOSED SLOPE EMBANKMENT (TOP / TOE)
- LANDSCAPING
- A.C. PAVEMENT
- PAINT HANDICAP/CROSSWALK
- PAINT DIRECTION ARROW
- PAINT PARKING STALL
- INDICATES SUBAREA DESIGNATION (X1) / INDICATES AREA IN ACRES (XX.X)
- INDICATES DIRECTION OF STORMWATER RUNNOFF

REGISTERED PROFESSIONAL ENGINEER
JOHN H. JOHNSON
No. 83934
Exp. 9/30/23
CIVIL
STATE OF CALIFORNIA

JOHN H. JOHNSON R.C.E. 83934 DATE
MY REGISTRATION EXPIRES ON 09/30/2023

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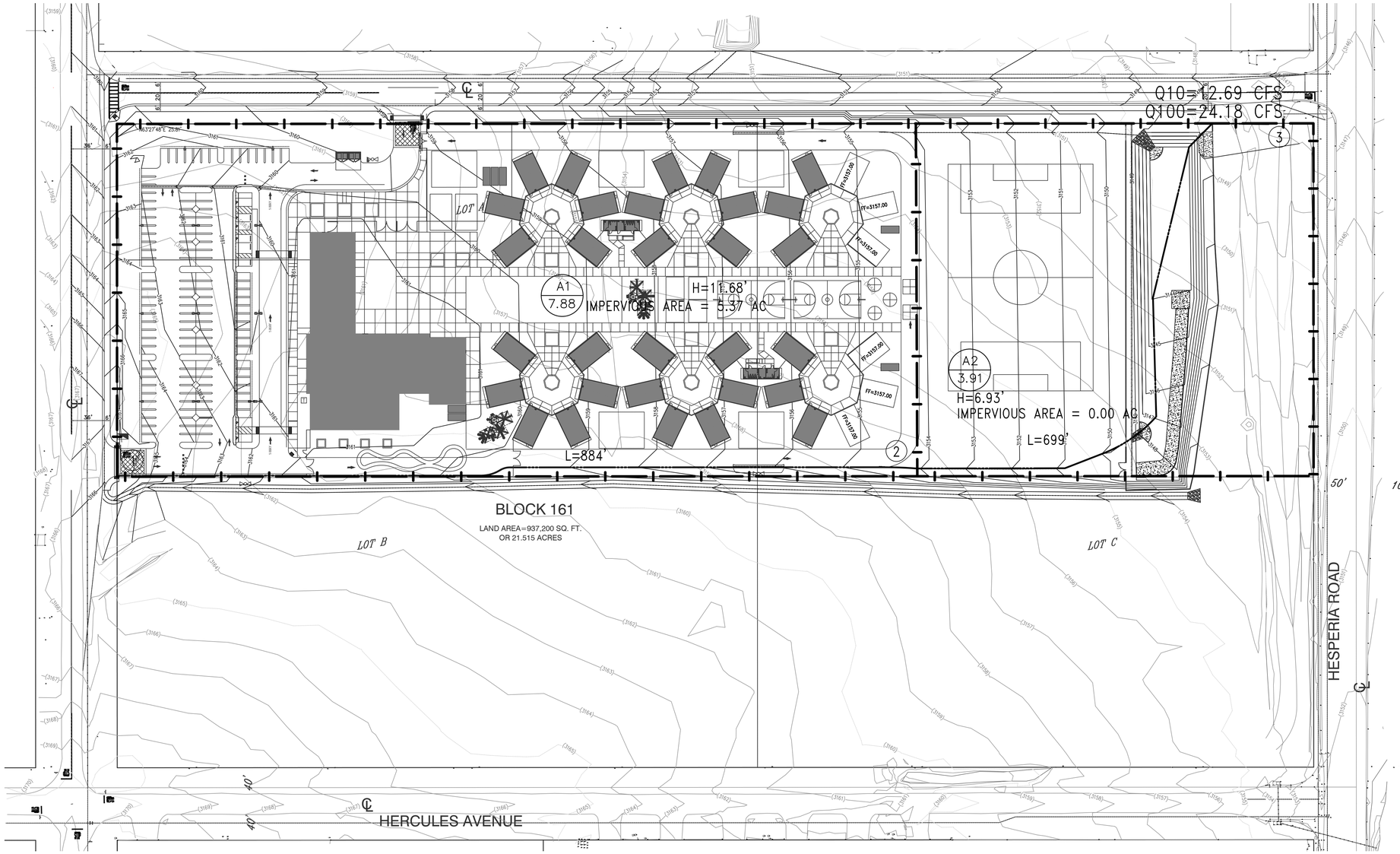
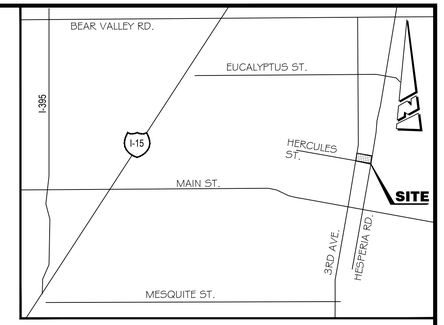
SHEET 1 OF 3

File:

Figure 2

PROPOSED RATIONAL HYDROLOGY MAP
for PATHWAYS TO COLLEGE K-8 CHARTER SCHOOL





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ON-SITE DISTURBED AREA:

11.79 ACRES

0' 30' 60' 120' 180' 240'
GRAPHIC SCALE IN FEET
1" = 60'

LEGEND

- PROP. BLDG PERIMETER
- BOUNDARY LINE
- RIGHT OF WAY
- CENTERLINE
- FLOW LINE
- FENCE LINE
- DRAINAGE MANAGEMENT AREA
- (XXX) EX. CONTOUR
- [XXX] PROP. CONTOUR
- EX. PALM TREE
- EX. TREE
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SHEET 2 OF 3

File:

Appendix A

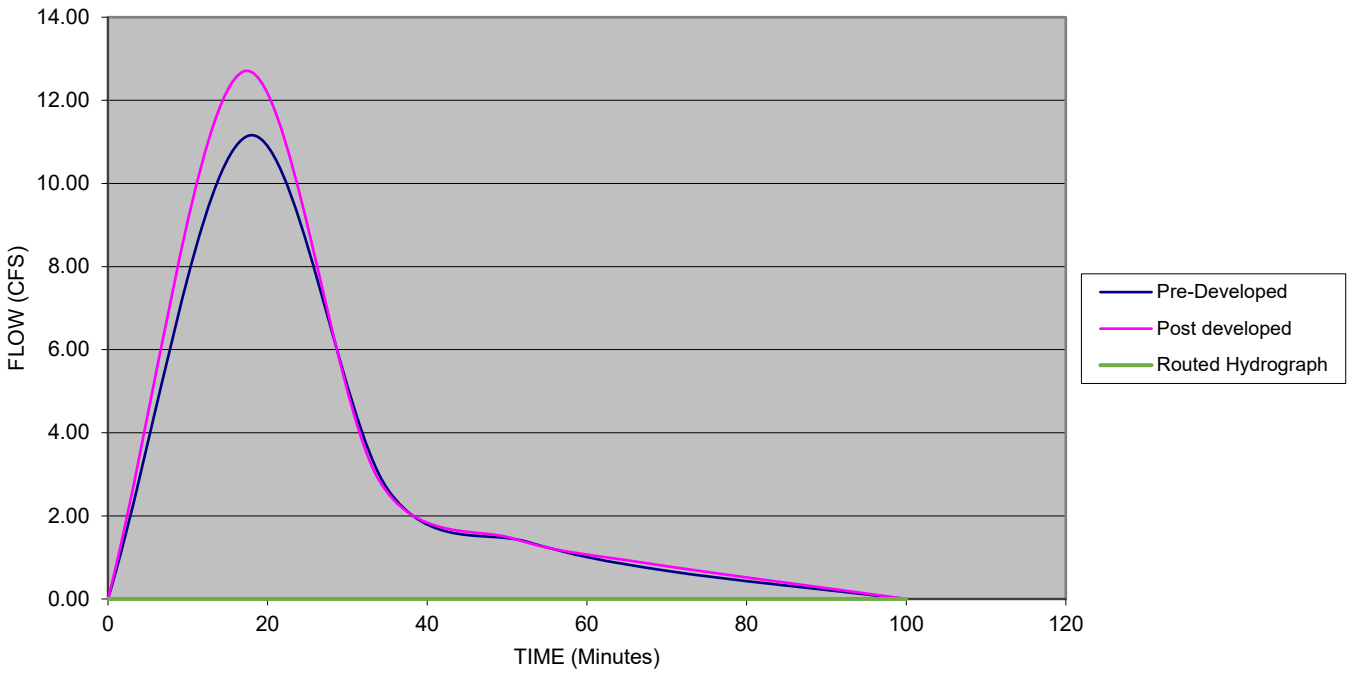
Small Area Runoff Hydrograph--10 year

Qpb= Pre-developed peak flowrate = 11.142 cfs Area = 11.79 ac
TCpb= Pre-developed time of conc. = 17.5 min.

Qpa= Post-developed peak flowrate = 12.69 cfs
TCpa= Post-developed time of conc. = 16.93 min.
Vs= Volume of storage provided = 60875 ft^3 Required for Hydromodification

Pre-Developed Hydrograph					Post-developed Hydrograph				
Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time	Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time
0			0.00	0	0			0	0
Tc	1.45	0.40	11.14	17.5	Tc	1.45	0.320	12.69	16.93
2Tc	0.95	0.40	2.65	35	2Tc	0.97	0.320	2.89	33.86
3Tc	0.75	0.40	1.38	52.5	3Tc	0.77	0.320	1.45	50.79
4Tc	0.62	0.40	0.68	70	4Tc	0.65	0.320	0.85	67.72
END	0		0.00	100	END	0		0	100

Vs required =Σ(Qpa*Tc-QpbTc)*60 = 2071 ft^3



Routed Volume = ΣQpbTc*60 -Vs =

V at 0Tc =	0	ft^3	Vout at 0Tc=	0	ft^3	Qout =	0	cfs
V at Tc =	12891	ft^3	Vout at Tc=	0	ft^3	Qout =	0	cfs
V at 2Tc =	15825	ft^3	Vout at 2Tc=	0	ft^3	Qout =	0	cfs
V at 3Tc =	17302	ft^3	Vout at 3Tc=	0	ft^3	Qout =	0	cfs
V at 4Tc =	18170	ft^3	Vout at 4Tc=	0	ft^3	Qout =	0	cfs
V at End=	18170	ft^3	Vout at End=	0	ft^3	Qout =	0	cfs

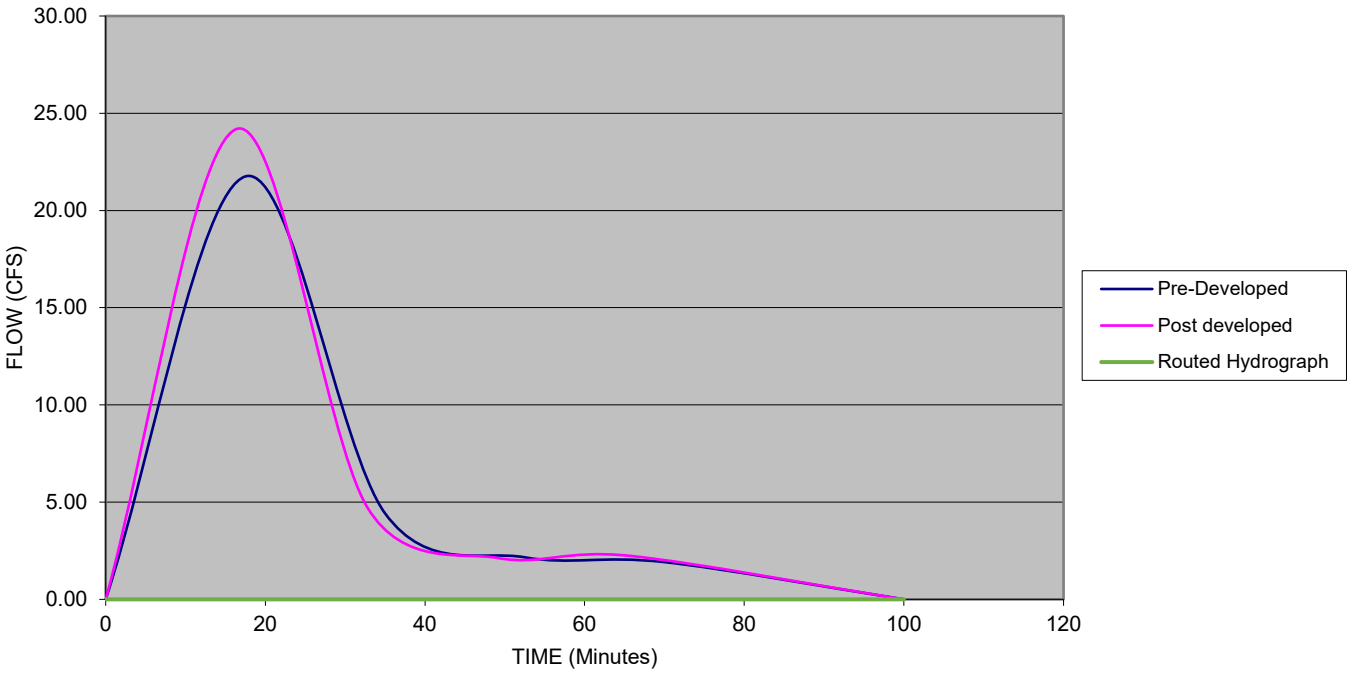
Small Area Runoff Hydrograph--100 year

Qpb= Pre-developed peak flowrate = 21.75 cfs Area = 11.79 ac
TCpb= Pre-developed time of conc. = 17.5 min.

Qpa= Post-developed peak flowrate = 24.19 cfs
TCpa= Post-developed time of conc. = 16.4 min.
Vs= Volume of storage provided = 60875 ft^3 Required for Hydromodification

Pre-Developed Hydrograph					Post-developed hydrograph				
Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time	Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time
0			0.00	0	0			0	0
Tc	2.45	0.400	21.75	17.5	Tc	2.5	0.320	24.19	16.4
2Tc	1.6	0.400	4.42	35	2Tc	1.65	0.320	4.72	32.8
3Tc	1.25	0.400	2.16	52.5	3Tc	1.28	0.320	2.12	49.2
4Tc	1.1	0.400	1.92	70	4Tc	1.15	0.320	2.24	65.6
END	0		0.00	100	END	0		0	100

Vs required =Σ(Qpa*Tc-QpbTc)*60 = 2971 ft^3



Routed Volume = ΣQpbTc*60 -Vs =

V at 0Tc =	0	ft^3	Vout at 0Tc=	0	ft^3	Qout =	0	cfs
V at Tc =	23803	ft^3	Vout at Tc=	0	ft^3	Qout =	0	cfs
V at 2Tc =	28444	ft^3	Vout at 2Tc=	0	ft^3	Qout =	0	cfs
V at 3Tc =	30532	ft^3	Vout at 3Tc=	0	ft^3	Qout =	0.00	cfs
V at 4Tc =	32736	ft^3	Vout at 4Tc=	0	ft^3	Qout =	0.00	cfs
V at End=	32736	ft^3	Vout at End=	0	ft^3	Qout =	0	cfs

NOAA Atlas 14, Volume 6, Version 2
Location name: Hesperia, California, USA*
Latitude: 34.4348°, Longitude: -117.3018°
Elevation: 3164.97 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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	0.086 (0.071-0.106)	0.121 (0.100-0.147)	0.167 (0.137-0.205)	0.206 (0.168-0.254)	0.260 (0.205-0.332)	0.303 (0.235-0.396)	0.348 (0.263-0.466)	0.396 (0.291-0.545)	0.463 (0.326-0.664)	0.516 (0.351-0.766)
10-min	0.124 (0.102-0.151)	0.173 (0.143-0.211)	0.239 (0.197-0.293)	0.295 (0.241-0.364)	0.373 (0.294-0.476)	0.435 (0.336-0.567)	0.499 (0.377-0.668)	0.568 (0.417-0.781)	0.664 (0.468-0.952)	0.740 (0.504-1.10)
15-min	0.150 (0.124-0.183)	0.209 (0.173-0.256)	0.289 (0.238-0.355)	0.356 (0.291-0.440)	0.451 (0.356-0.576)	0.526 (0.407-0.686)	0.604 (0.456-0.808)	0.687 (0.504-0.945)	0.803 (0.565-1.15)	0.895 (0.609-1.33)
30-min	0.216 (0.178-0.264)	0.301 (0.249-0.368)	0.417 (0.343-0.511)	0.513 (0.419-0.634)	0.649 (0.513-0.830)	0.757 (0.586-0.988)	0.870 (0.657-1.16)	0.989 (0.726-1.36)	1.16 (0.814-1.66)	1.29 (0.877-1.91)
60-min	0.286 (0.237-0.350)	0.400 (0.330-0.489)	0.553 (0.455-0.678)	0.681 (0.556-0.842)	0.861 (0.681-1.10)	1.00 (0.777-1.31)	1.16 (0.872-1.54)	1.31 (0.964-1.81)	1.53 (1.08-2.20)	1.71 (1.16-2.54)
2-hr	0.408 (0.337-0.498)	0.547 (0.452-0.669)	0.737 (0.607-0.903)	0.897 (0.733-1.11)	1.12 (0.888-1.44)	1.31 (1.01-1.71)	1.50 (1.13-2.00)	1.70 (1.25-2.34)	1.98 (1.40-2.84)	2.21 (1.50-3.28)
3-hr	0.504 (0.417-0.616)	0.668 (0.552-0.817)	0.891 (0.734-1.09)	1.08 (0.883-1.34)	1.35 (1.07-1.73)	1.57 (1.21-2.04)	1.79 (1.35-2.40)	2.04 (1.49-2.80)	2.37 (1.67-3.41)	2.65 (1.80-3.93)
6-hr	0.699 (0.578-0.853)	0.917 (0.757-1.12)	1.22 (1.00-1.49)	1.47 (1.20-1.82)	1.83 (1.45-2.34)	2.12 (1.64-2.77)	2.43 (1.84-3.25)	2.76 (2.03-3.79)	3.22 (2.27-4.62)	3.60 (2.45-5.34)
12-hr	0.900 (0.744-1.10)	1.21 (0.996-1.48)	1.62 (1.34-1.99)	1.98 (1.61-2.44)	2.47 (1.96-3.16)	2.87 (2.22-3.75)	3.29 (2.49-4.40)	3.74 (2.75-5.14)	4.37 (3.08-6.26)	4.88 (3.32-7.24)
24-hr	1.21 (1.07-1.39)	1.66 (1.47-1.92)	2.28 (2.01-2.64)	2.80 (2.45-3.26)	3.53 (2.99-4.25)	4.11 (3.41-5.05)	4.72 (3.82-5.95)	5.37 (4.23-6.95)	6.28 (4.75-8.48)	7.02 (5.13-9.80)
2-day	1.38 (1.22-1.59)	1.92 (1.70-2.21)	2.65 (2.34-3.07)	3.28 (2.87-3.82)	4.16 (3.52-5.00)	4.86 (4.04-5.98)	5.61 (4.54-7.06)	6.40 (5.04-8.29)	7.53 (5.69-10.2)	8.44 (6.17-11.8)
3-day	1.48 (1.31-1.71)	2.07 (1.83-2.39)	2.88 (2.54-3.33)	3.57 (3.12-4.16)	4.54 (3.85-5.47)	5.32 (4.42-6.54)	6.15 (4.98-7.75)	7.04 (5.55-9.12)	8.31 (6.29-11.2)	9.35 (6.83-13.1)
4-day	1.59 (1.41-1.83)	2.22 (1.97-2.56)	3.10 (2.73-3.58)	3.84 (3.36-4.47)	4.89 (4.14-5.88)	5.73 (4.76-7.05)	6.63 (5.37-8.35)	7.60 (5.99-9.84)	8.98 (6.79-12.1)	10.1 (7.38-14.1)
7-day	1.75 (1.55-2.01)	2.44 (2.16-2.81)	3.39 (2.99-3.92)	4.19 (3.67-4.89)	5.34 (4.52-6.43)	6.26 (5.19-7.69)	7.23 (5.86-9.10)	8.27 (6.52-10.7)	9.75 (7.37-13.2)	11.0 (8.00-15.3)
10-day	1.86 (1.65-2.15)	2.59 (2.30-2.99)	3.60 (3.18-4.16)	4.45 (3.90-5.19)	5.66 (4.80-6.82)	6.64 (5.51-8.16)	7.66 (6.21-9.65)	8.76 (6.91-11.4)	10.3 (7.81-13.9)	11.6 (8.47-16.2)
20-day	2.21 (1.96-2.54)	3.08 (2.73-3.55)	4.29 (3.79-4.96)	5.32 (4.66-6.19)	6.78 (5.75-8.17)	7.97 (6.61-9.79)	9.21 (7.46-11.6)	10.6 (8.31-13.7)	12.4 (9.41-16.8)	14.0 (10.2-19.5)
30-day	2.56 (2.27-2.95)	3.57 (3.16-4.11)	4.97 (4.39-5.74)	6.17 (5.40-7.19)	7.89 (6.69-9.50)	9.28 (7.70-11.4)	10.8 (8.71-13.5)	12.3 (9.71-16.0)	14.6 (11.0-19.7)	16.4 (12.0-22.9)
45-day	3.02 (2.68-3.48)	4.19 (3.71-4.83)	5.83 (5.15-6.74)	7.24 (6.34-8.44)	9.28 (7.87-11.2)	10.9 (9.09-13.5)	12.7 (10.3-16.0)	14.6 (11.5-18.9)	17.3 (13.1-23.4)	19.5 (14.2-27.2)
60-day	3.40 (3.01-3.91)	4.67 (4.13-5.38)	6.46 (5.70-7.46)	8.01 (7.01-9.33)	10.3 (8.69-12.4)	12.1 (10.0-14.9)	14.1 (11.4-17.7)	16.2 (12.8-21.0)	19.3 (14.6-26.0)	21.8 (15.9-30.4)

[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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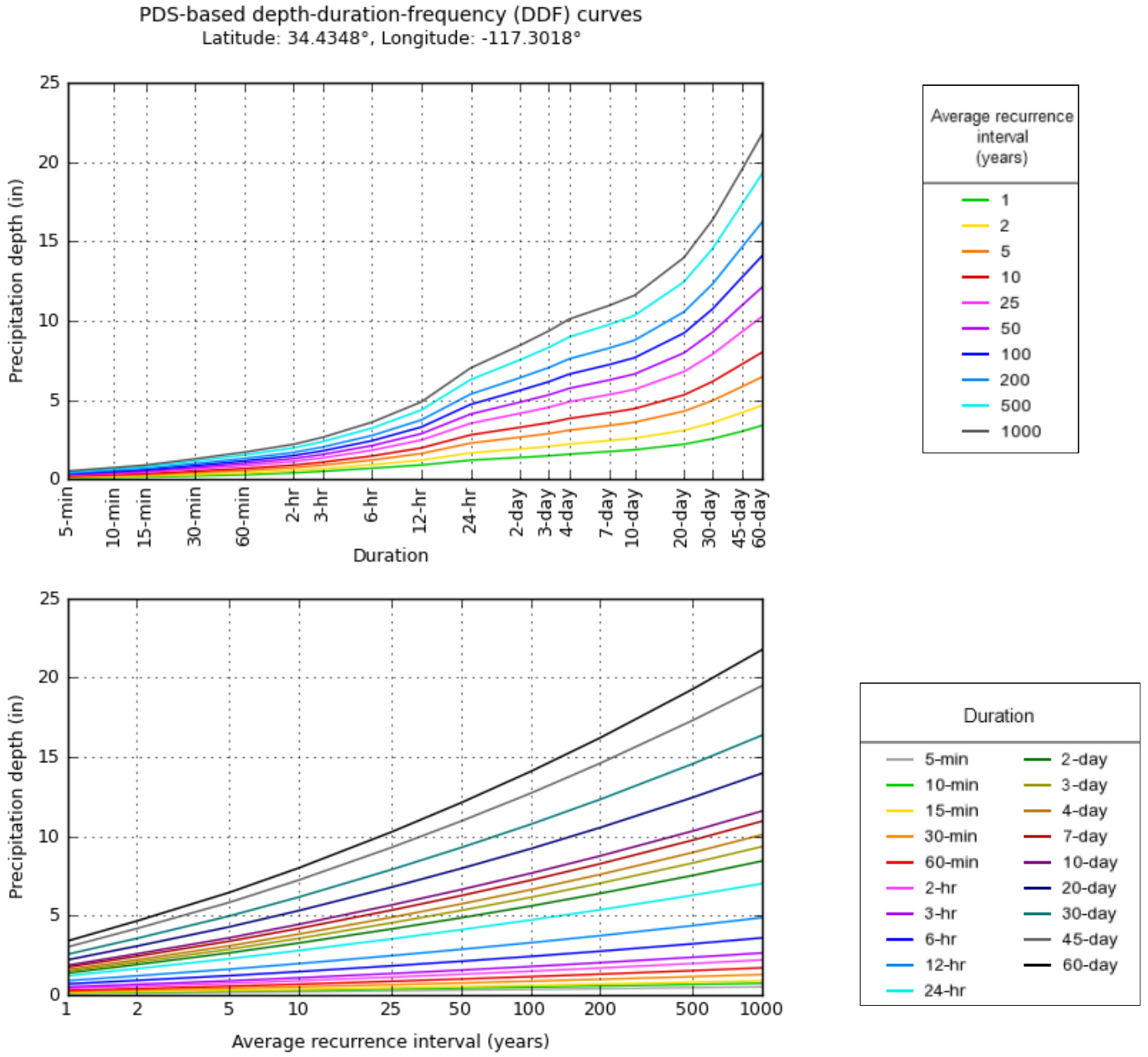
PF graphical



NOAA Atlas 14, Volume 6, Version 2

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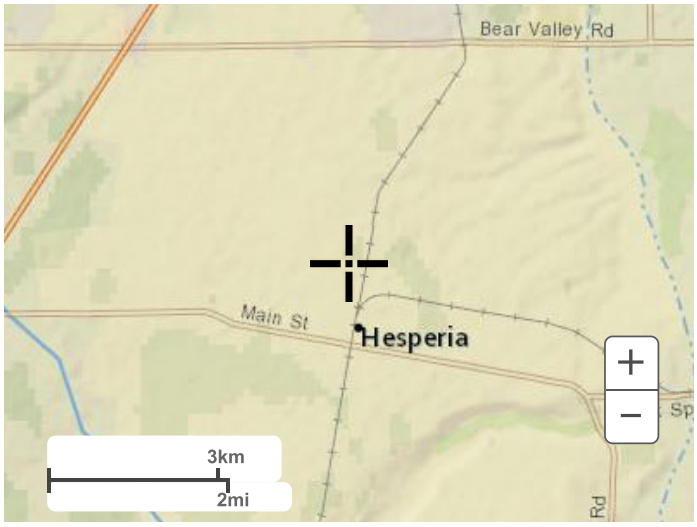
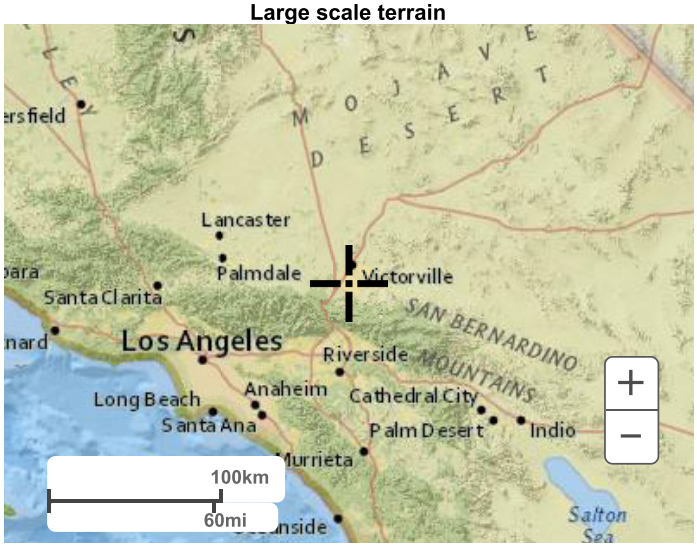
Maps & aerials

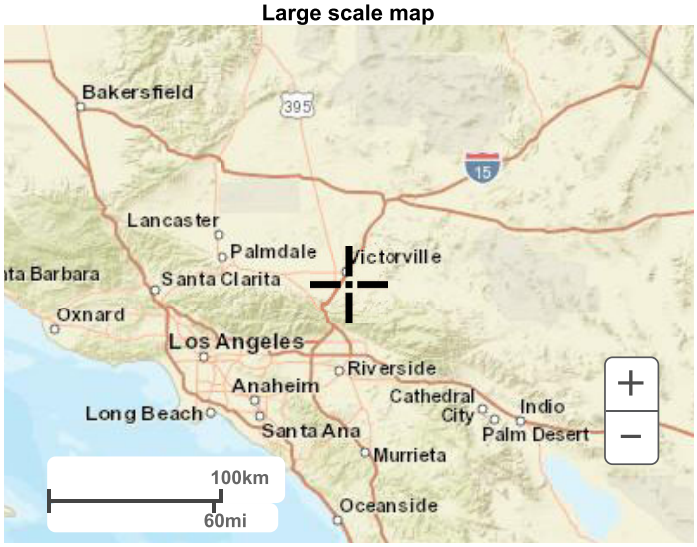
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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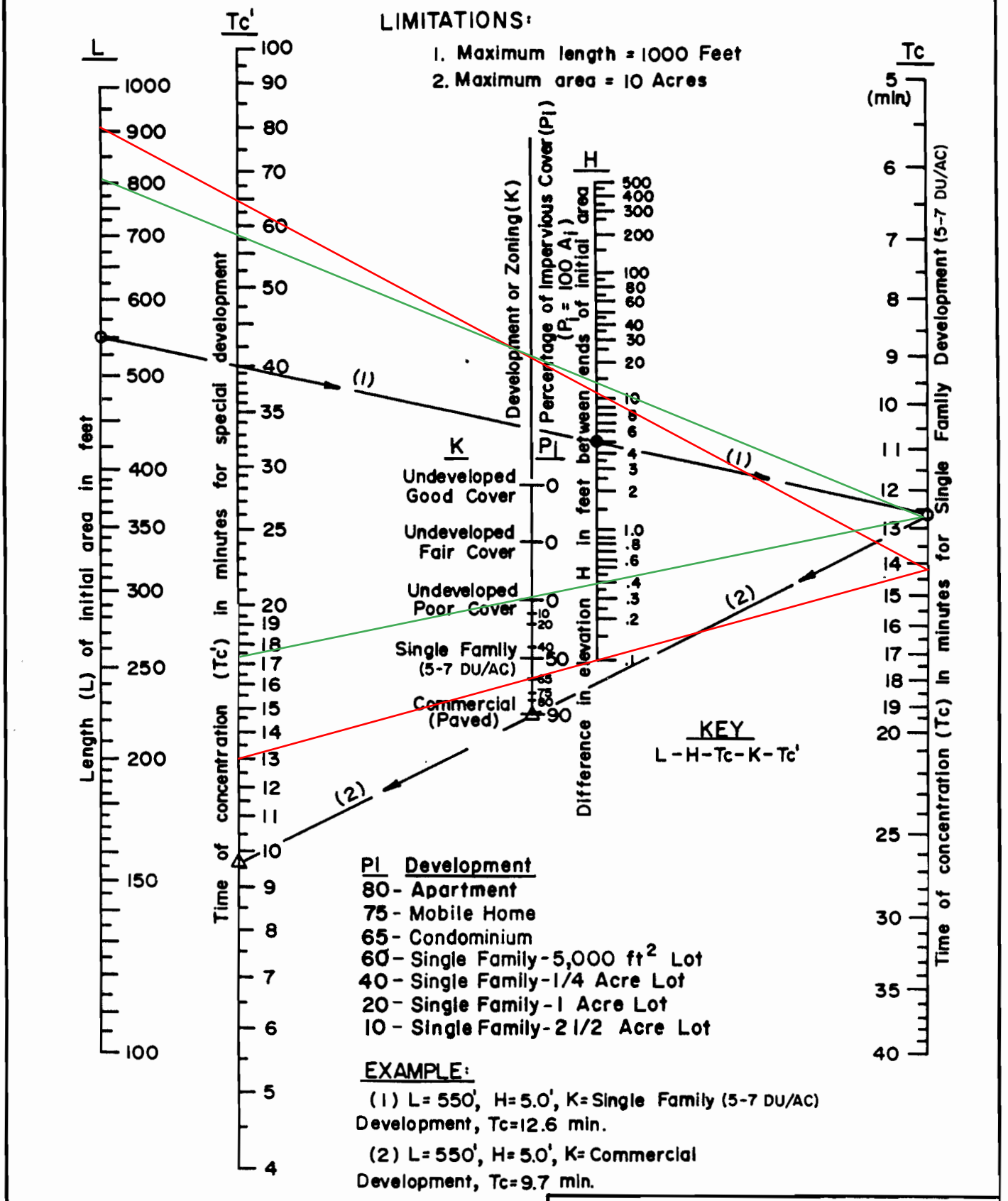


SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

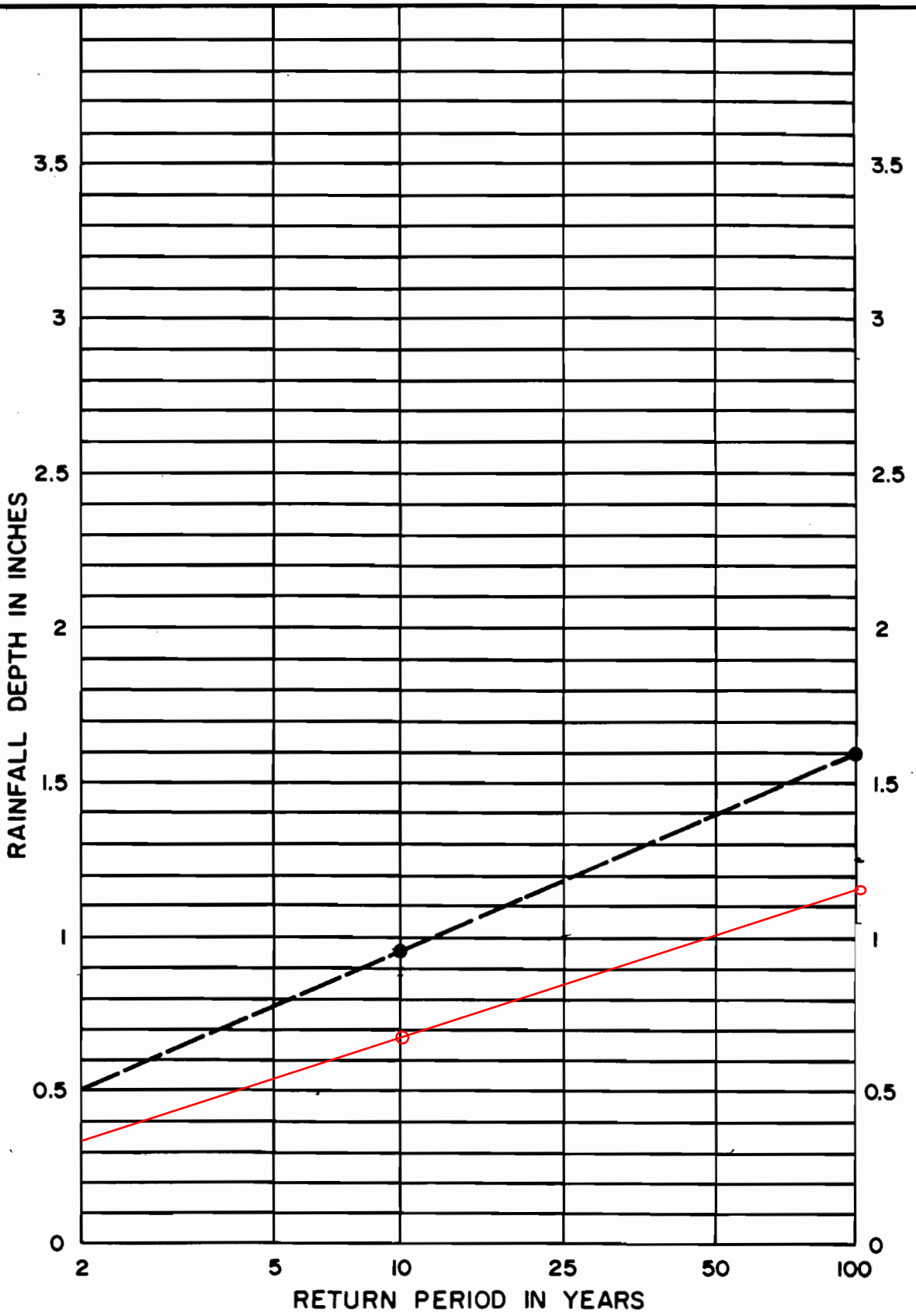
Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)



NOTE:

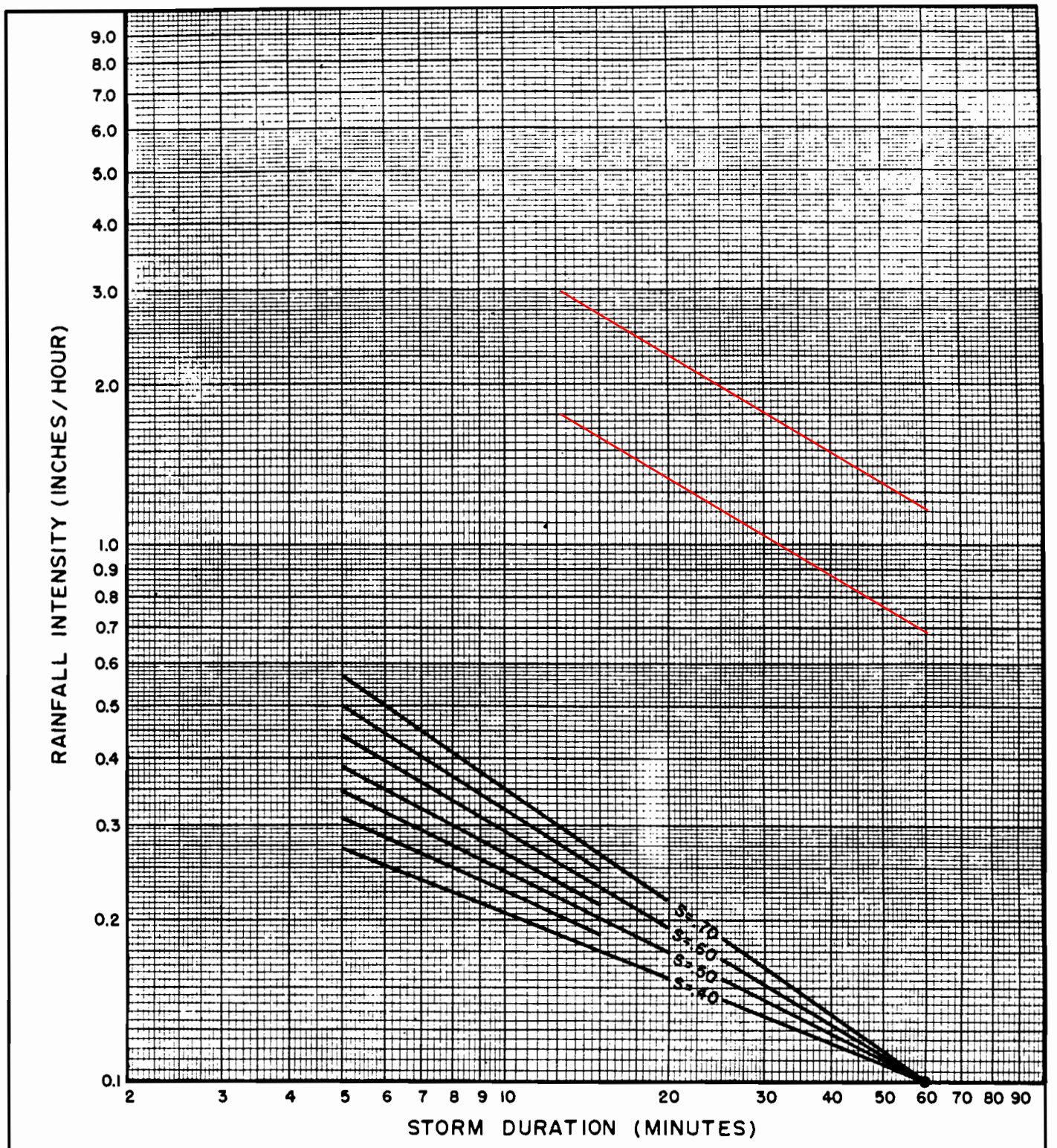
1. FOR INTERMEDIATE RETURN PERIODS PLOT 10-YEAR AND 100-YEAR ONE HOUR VALUES FROM MAPS, THEN CONNECT POINTS AND READ VALUE FOR DESIRED RETURN PERIOD. FOR EXAMPLE GIVEN 10-YEAR ONE HOUR = 0.95" AND 100-YEAR ONE HOUR = 1.60", 25-YEAR ONE HOUR = 1.18".

REFERENCE: NOAA ATLAS 2, VOLUME XI - CAL., 1973

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

RAINFALL DEPTH VERSUS RETURN PERIOD FOR PARTIAL DURATION SERIES

FIGURE D-2



DESIGN STORM FREQUENCY = 10/100 YEARS

ONE HOUR POINT RAINFALL = .68/1.2 INCHES

LOG-LOG SLOPE = .56/.7

PROJECT LOCATION = 3rd Ave., Hesperia

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

INTENSITY - DURATION CURVES CALCULATION SHEET

FIGURE D-3

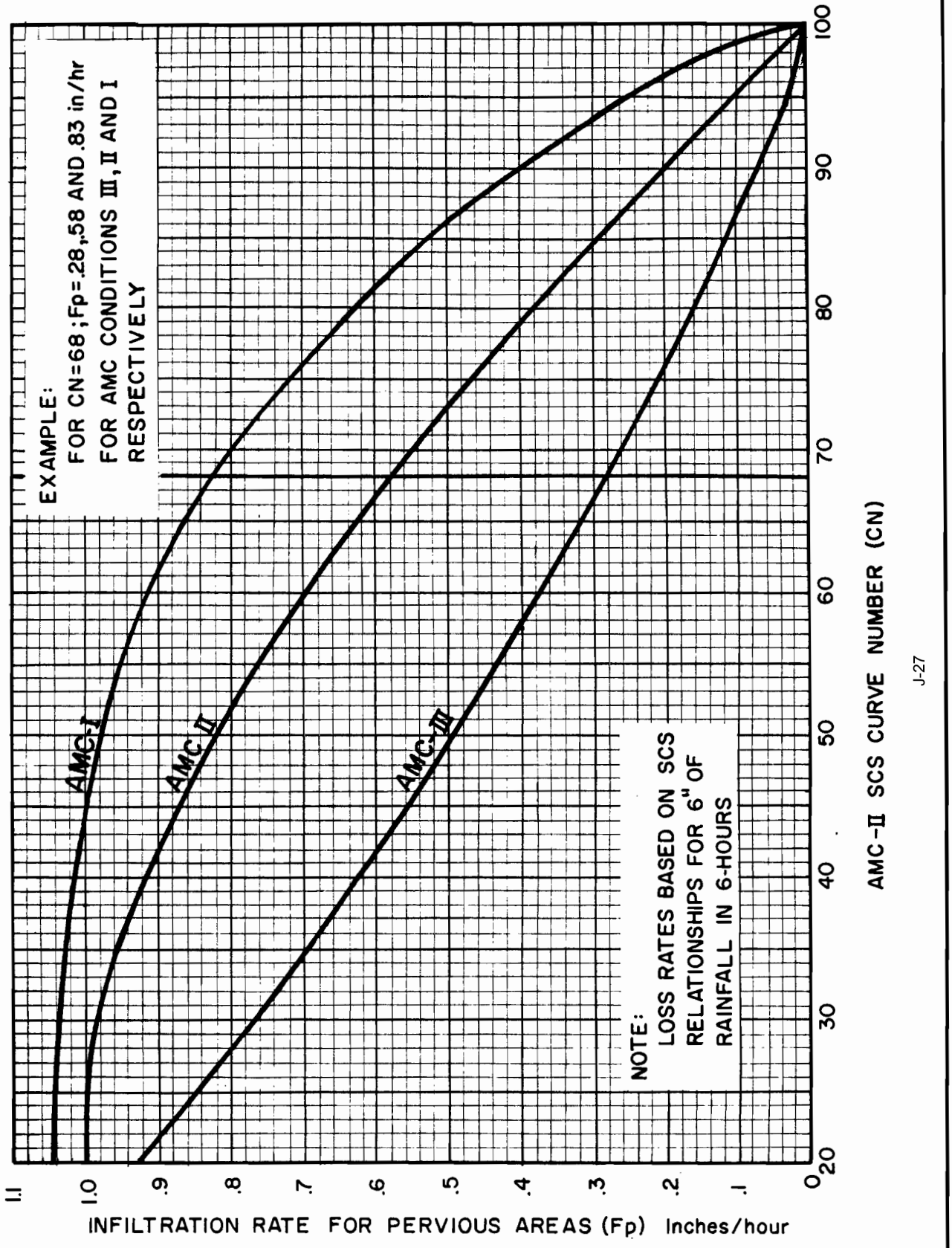
TABLE C.1. CURVE NUMBER RELATIONSHIPS

CN for AMC Condition II	Corresponding CN for AMC Condition I	III
100	100	100
95	87	99
90	78	98
85	70	97
80	63	94
75	57	91
70	51	87
65	45	83
60	40	79
55	35	75
50	31	70
45	27	65
40	23	60
35	19	55
30	15	50
25	12	45
20	9	39
15	7	33
10	4	26
5	2	17
0	0	0

C.6. ESTIMATION OF LOSS RATES

In estimating loss rates for design hydrology, a watershed curve number (CN) is determined for each soil-cover complex within the watershed using Figure C-3. The working range of CN values is between 0 and 98, where a low CN indicates low runoff potential (high infiltration), and a high CN indicates high runoff potential (low infiltration). Selection of a CN takes into account the major factors affecting loss rates on pervious surfaces including the hydrologic soil group, cover type and quality, and antecedent moisture condition (AMC).

Also included in the CN selection are the effects of "initial abstraction" (Ia) which represents the combined effects of other effective rainfall losses including depression storage, vegetation interception, evaporation, and transpiration, among other factors.



J-27

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6

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 Bernardino County, California, Mojave River Area

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 Scale: 1:2,600 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

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 1:24,000.

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

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

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

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

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

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

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Mar 27, 2021—May 24, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

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
105	BRYMAN LOAMY FINE SAND, 0 TO 2 PERCENT SLOPES	19.3	78.0%
106	BRYMAN LOAMY FINE SAND, 2 TO 5 PERCENT SLOPES	5.3	21.4%
112	CAJON SAND, 0 TO 2 PERCENT SLOPES	0.2	0.6%
Totals for Area of Interest		**24.8**	**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 Bernardino County, California, Mojave River Area

105—BRYMAN LOAMY FINE SAND, 0 TO 2 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkr9
Elevation: 2,800 to 3,200 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 63 degrees F
Frost-free period: 180 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Bryman and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bryman

Setting

Landform: Fan remnants
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 9 inches: loamy fine sand
H2 - 9 to 12 inches: sandy loam
H3 - 12 to 32 inches: sandy clay loam
H4 - 32 to 46 inches: sandy loam
H5 - 46 to 99 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
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
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Minor Components

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

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

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

Bryman, gravelly surface
Percent of map unit: 5 percent
Hydric soil rating: No

106—BRYMAN LOAMY FINE SAND, 2 TO 5 PERCENT SLOPES

Map Unit Setting
National map unit symbol: hkrb
Elevation: 3,000 to 3,400 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 63 degrees F
Frost-free period: 180 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Bryman and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bryman

Setting
Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile
H1 - 0 to 9 inches: loamy fine sand
H2 - 9 to 43 inches: sandy clay loam
H3 - 43 to 60 inches: sandy loam

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
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
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Minor Components

Cajon, loamy surface

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

Helendale

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

Mohave variant

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

Bryman, gravelly surface

Percent of map unit: 5 percent

112—CAJON SAND, 0 TO 2 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hkrj
Elevation: 1,800 to 3,200 feet
Mean annual precipitation: 3 to 6 inches
Mean annual air temperature: 59 to 66 degrees F
Frost-free period: 180 to 290 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Cajon

Setting

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

Typical profile

H1 - 0 to 7 inches: sand
H2 - 7 to 25 inches: sand
H3 - 25 to 45 inches: gravelly sand
H4 - 45 to 60 inches: stratified sand to loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: R030XF012CA - Sandy
Hydric soil rating: No

Minor Components

Manet

Percent of map unit: 5 percent
Landform: Playas
Hydric soil rating: Yes

Kimberlina

Percent of map unit: 5 percent

Helendale

Percent of map unit: 5 percent

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