Spreadsheet #4 Depth-Velocity-Flow Tables for V-ditches with 2:1 side slopes

concrete	n	0.013		
slope	1			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	2.66	0.3		
0.5	4.22	2.1	3.067333	0.315278
0.75	5.53	6.2	4.466024	0.546951
1	6.7	13.4		
1.25	7.78	24.3		
1.5	8.78	39.5		
1.75	9.73	59.6		
2	10.64	85.1		
2.25	11.51	116.5		
2.5	12.35	154.3		
2.75	13.16	199		
3	13.94	251		

concrete	n	0.013		
slope	1.5			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	3.26	0.4		
0.5	5.17	2.6		
0.75	6.78	7.6	6.27446	0.6715
1	8.21	16.4		
1.25	9.53	29.8		
1.5	10.76	48.4		
1.75	11.92	73		
2	13.03	104.2		
2.25	14.1	142.7		
2.5	15.12	189		
2.75	16.11	243.7		
3	17.08	307.4		

concrete	n	0.013		
slope	2			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	3.76	0.5		
0.5	5.97	3	4.75892	0.363
0.75	7.82	8.8		
1	9.48	19		
1.25	11	34.4		
1.5	12.42	55.9		
1.75	13.77	84.3		
2	15.05	120.4		
2.25	16.28	164.8		
2.5	17.46	218.3		
2.75	18.61	281.4		
3	19.72	354.9		

Spreadsheet #4 Depth-Velocity-Flow Tables for V-ditches with 2:1 side slopes

concrete	n	0.013		
slope	4			
depth (ft)	velocity (ft/	flow (cfs)		
0	0	0		
0.25	5.32	0.7	1.976	0.092857
0.5	8.44	4.2		
0.75	11.07	12.4		
1	13.41	26.8		
1.25	15.56	48.6		
1.5	17.57	79		
1.75	19.47	119.2		
2	211.28	170.2		
2.25	23.02	233.1		
2.5	24.69	208.7		
2.75	26.31	398		
3	27.88	501.9		

concrete	n	0.013		
slope	6			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	6.52	0.8		
0.5	10.34	5.2	7.7615	0.33125
0.75	13.55	15.2		
1	16.42	32.8		
1.25	19.05	59.5		
1.5	21.51	96.8		
1.75	23.84	146		
2	26.06	208.5		
2.25	28.19	285.4		
2.5	30.24	378		
2.75	32.23	487.4		
3	34.15	614.7		

concrete	n	0.013		
slope	7.5			
depth (ft)	velocity (ft/	flow (cfs)		
0	0	0		
0.25	7.28	0.9	5.015111	0.172222
0.5	11.56	5.8		
0.75	15.15	17		
1	18.36	36.7		
1.25	21.3	66.6		
1.5	24.05	108.2		
1.75	26.66	163.3		
2	29.14	233.1		
2.25	31.52	319.1		
2.5	33.81	422.7		
2.75	36.03	545		
3	38.18	687.3		

Spreadsheet #4 Depth-Velocity-Flow Tables for V-ditches with 2:1 side slopes

concrete	n	0.013		
slope	10			
depth (ft)	velocity (ft/	flow (cfs)		
0	0	0		
0.25	8.41	1.1	7.721909	0.229545
0.5	13.35	6.7		
0.75	17.5	19.7		
1	21.2	42.4		
1.25	24.6	76.9		
1.5	27.77	125		
1.75	30.78	188.5		
2	33.65	269.2		
2.25	36.39	368.5		
2.5	39.04	488		
2.75	41.6	639.3		
3	44.09	793.6		

concrete	n	0.013		
slope	12			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	9.21	1.2		
0.5	14.63	7.3	10.12518	0.292213
0.75	19.17	21.6		
1	23.22	46.4		
1.25	26.94	84.2		
1.5	30.43	136.9		
1.75	33.72	206.5		
2	36.86	294.9		
2.25	39.87	403.7		
2.5	42.77	534.6		
2.75	45.58	689.3		
3	48.3	869.4		

concrete	n	0.013		
slope	20			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	11.9	1.5		
0.5	18.88	9.4	12.54499	0.273101
0.75	24.74	27.8		
1	29.98	60		
1.25	34.78	108.7		
1.5	39.28	176.8		
1.75	43.53	266.6		
2	47.58	380.7		
2.25	51.47	521.1		
2.5	55.22	690.2		
2.75	58.84	889.9		
3	62.35	1122.3		

Spreadsheet #4 Depth-Velocity-Flow Tables for V-ditches with 2:1 side slopes

earth (coarse sand)	n	0.026		
slope	1			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	1.33	0.2		
0.5	2.11	1.1		
0.75	2.77	3.1	2.1562	0.5175
1	3.35	6.7		
1.25	3.89	12.2	3.416764	1.030909
1.5	4.39	19.8	4.147895	1.378947
1.75	4.87	29.8		
2	5.32	42.6		
2.25	5.75	58.3		
2.5	6.17	77.2		
2.75	6.58	99.5		
3	6.97	125.5		

earth (coarse sand)	n	0.026		
slope	3			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	2.3	0.3		
0.5	3.66	1.8		
0.75	4.79	5.4	4.5075	0.6875
1	5.8	11.6		
1.25	6.74	21		
1.5	7.61	34.2		
1.75	8.43	51.6		
2	9.21	73.7		
2.25	9.97	100.9		
2.5	10.69	133.7		
2.75	11.39	172.3		
3	12.07	217.3		

earth (coarse sand)	n	0.026		
slope	6			
depth (ft)	velocity (ft/	flow (cfs)		
0.25	3.26	0.4		
0.5	5.17	2.6		
0.75	6.78	7.6		
1	8.21	16.4	8.0085	0.964773
1.25	9.53	29.8		
1.5	10.76	48.4		
1.75	11.92	73		
2	13.03	104.2		
2.25	14.1	142.7		
2.5	15.12	189		
2.75	16.11	243.7		
3	17.08	307.4		

Spreadsheet #4 Depth-Velocity-Flow Tables for V-ditches with 2:1 side slopes

rock (riprap)		n	0.03		
slope		6			
depth (ft)		velocity (ft/	flow (cfs)		
	0.25	2.82	0.4		
	0.5	4.48	2.2		
	0.75	5.87	6.6		
	1	7.11	14.2	6.173474	0.811184
	1.25	8.26	25.8		
	1.5	9.32	42		
	1.75	10.33	63.3		
	2	11.29	90.3		
	2.25	12.22	123.7		
	2.5	13.11	163.8		
	2.75	13.96	211.2		
	3	14.8	266.4		

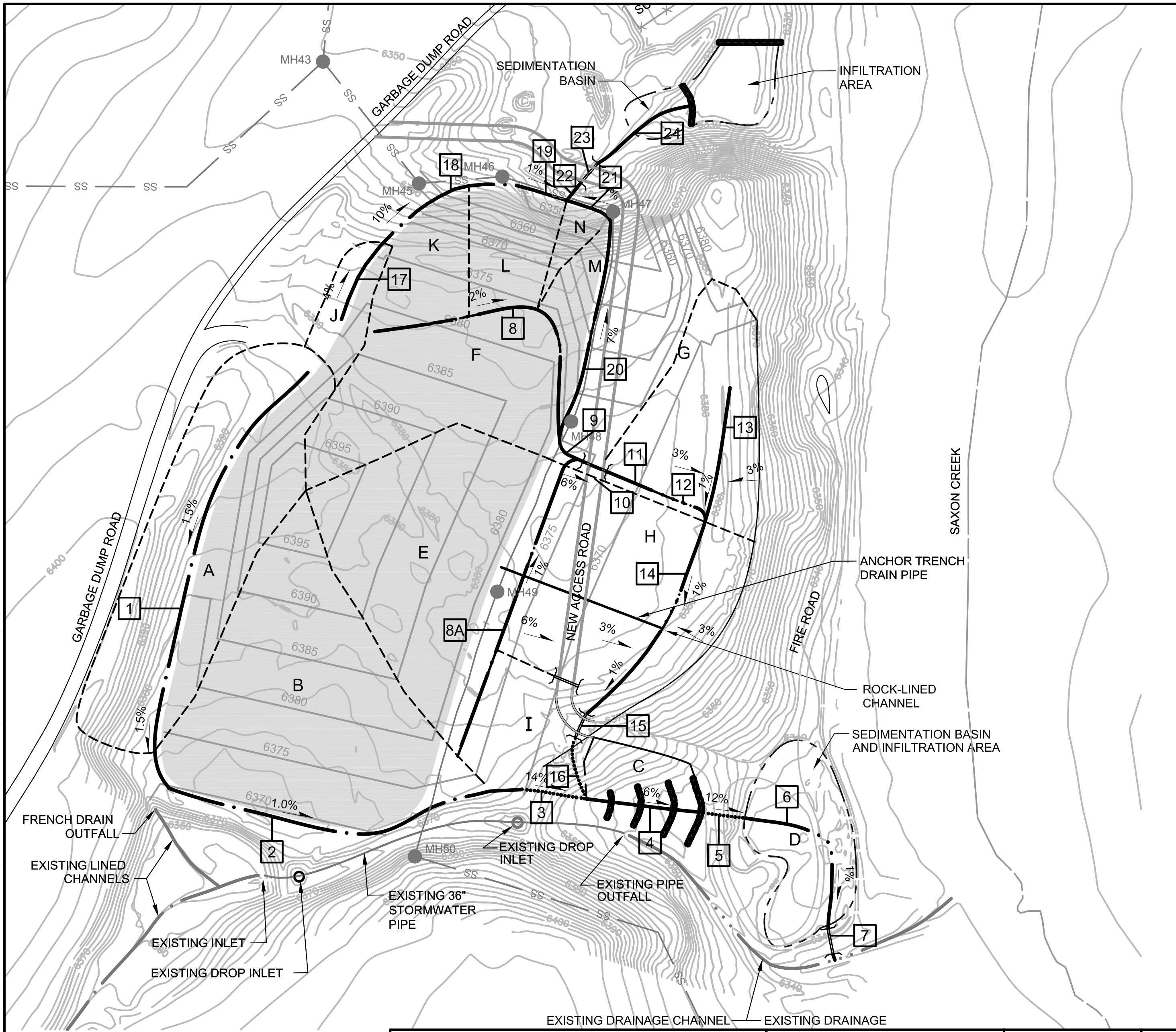
rock (riprap)		n	0.03		
slope		12			
depth (ft)		velocity (ft/	flow (cfs)		
	0.25	3.99	0.5		
	0.5	6.34	3.2		
	0.75	8.31	9.3	7.253951	0.615984
	1	10.06	20.1	9.259537	0.885648
	1.25	11.68	36.5		
	1.5	13.18	29.3		
	1.75	14.61	89.5		
	2	15.97	127.8		
	2.25	17.28	174.9		
	2.5	18.53	231.7		
	2.75	19.75	298.7		
	3	20.93	376.7		

Attachment A
Meyers Landfill Cap
Explanations of Column Headings for Surface Runoff Drainage Control System Design

COLUMN HEADING	EXPLANATION
Section Number	Identification number of the ditch to be analyzed. Refer to Figure1 for ditch layout.
Contributing Upstream Ditches	Identification number of the immediate upstream ditch, if any, that contributes flow to the ditch being analyzed. Refer to Figure 1 for ditch layout.
New drainage Areas	
ID No.	Identification number (or letter) of the drainage area that is contributing overland runoff flow to the ditch section being analyzed.
Area (sq ft), (acres)	Measured area in square feet and acres of the drainage basin that contributes overland flow to the ditch section being analyzed. The basin area is one of the factors used in determining overland runoff flow quantity using the rational method.
Effective Slope Factor	Adjustment factor to correct runoff quantity from steeper slopes. See Attachment A, Figure 13.
Contribution from New Drainage Area	The product of the drainage basin area, A (in acres), the effective slope factor, K, and the runoff coefficient, C.
Rainfall Intensity (in/hr)	Rainfall intensity in inches per hour used to determine overland flow quantity based on the rational method.
Flow from New Drainage Areas (cfs)	Total overland flow quantity, determined from the rational method in which overland flow, Q, in cubic feet per second, is equal to the product of rainfall intensity, i, in inches per hour and the drainage area contribution factor, KCA (see explanation for "contribution from new drainage area" above).

Attachment A
Meyers Landfill Cap
Explanations of Column Headings for Surface Runoff Drainage Control System Design

COLUMN HEADING	:	EXPLANATION
Flow from Upstream Areas (cfs)	:	Total flow from all contributing upstream drainage areas which is transfered through the connecting upstream channel section.
Total Flow in Ditch (cfs)	:	Equal to the sum of the flow from new drainage areas and the flow transfered from upstream areas.
Channel Type	:	Channel type selected to facilitate total flow quantity. Ditch types as follows: Rock lined "V"-ditch with 2 horizontal to 1 vertical (2:1) side slopes. Earth lined "V"-ditch with 2 horizontal to 1 vertical (2:1) side slopes. Concrete lined "V"-ditch with 2 horizontal to 1 vertical (2:1) side slopes.
Channel Length (ft)	:	Measured length, in feet, of the analyzed ditch section. See Figure 1.
Channel Slope (%)	:	Measured average slope of the analyzed ditch along its flow line.
Depth of Flow (ft)	:	Depth of channel flow. Depth was extracted from charts that relates depth of flow and flow velocity vs flow quantity for ditches of a given set of dimensions and roughness factor. The chart was produced from a program written by G. Buckle of IT Corporation. The program uses Manning's flow equation for open channels to relate depth of flow and velocity to flow quantity after the channel dimensions, channel slope, and roughness factor are input.
Velocity (ft/sec)	:	Average velocity of water in ditch in feet per second, determined from Manning's equation.



LEGEND:

1	DRAINAGE PATH SECTION
A	DRAINAGE AREA
—SS—●—SS—	EXISTING MANHOLE AND SEWER LINE
——·· ——	EARTH-LINED DRAINAGE CHANNEL
——·——	CONCRETE-LINED DRAINAGE CHANNEL
)═(	CULVERT
··············	ROCK-LINED CHANNEL
⌒	CHECK DAM
6375	PROPOSED TOPOGRAPHIC CONTOUR LINE
—— ——	LIMITS OF BORROW AREA
—×—×—	FENCELINE
—·—	CENTERLINE OF CREEK

SOURCE:
TOPOGRAPHIC INFORMATION PROVIDED BY FOREST SERVICE; SURVEY CONDUCTED IN 2006.

ERRG
Engineering/Remediation Resources Group, Inc.
115 Sansome Street, Suite 200
San Francisco, CA 94104
(415) 395-9974

CLIENT:	FOREST SERVICE
LOCATION:	MEYERS LANDFILL EL DORADO COUNTY, CA
DESIGNED BY:	VZC 12-2-08
CHECKED BY:	EB 12-2-08
P.E/P.G.:	PDL 12-2-08

SURFACE WATER CONTROL TRIBUTARY AREA

ERRG PROJECT NO.	REV. NO.	SHEET	OF	FIG NO.
28-072	0	1	1	C-1

P:\2008_Projects\28-072 Meyers LF Cap Design\N_Maps & Drawings\100% Design\Surface Water Control Tributary Area boundary. Differences were found to be mostly under 15 percent. However, it is suggested that when computing estimates along or within a few miles of a regional boundary, computations be made using equations applicable to each region and that the average of such computations be adopted.

Estimates of 1-hr precipitation-frequency values for return periods between 2 and 100 yrs. The 1-hr values for the 2- and 100-yr return periods can be plotted on the nomogram of figure 6 to obtain values for return periods greater than 2 yrs or less than 100 yrs. Draw a straight line connecting the 2- and 100-yr values and read the desired return-period value from the nomogram.

Estimates for 2- and 3-hr (120- and 180-min) precipitation-frequency values. To obtain estimates of precipitation-frequency values for 2 or 3 hrs, plot the 1- and 6-hr values from the Atlas on the appropriate nomogram of figure 15. Draw a straight line connecting the 1- and 6-hr values, and read the 2- and 3-hr values from the nomogram. This nomogram is independent of return period. It was developed using data from the same regions used to develop the 1-hr equations.

The mathematical solution from the data used to develop figure 15 gives the following equations for estimating the 2- and 3-hr values:

For Regions 1, 3, 4, and 5, figure 18 and/or 19	2-hr = 0.240 (6-hr) + 0.760 (1-hr)	(5)
	3-hr = 0.468 (6-hr) + 0.532 (1-hr)	(6)
For Region 2, figure 18	2-hr = 0.250 (6-hr) + 0.750 (1-hr)	(7)
	3-hr = 0.467 (6-hr) + 0.533 (1-hr)	(8)
For Region 6, figure 18 and/or 19	2-hr = 0.299 (6-hr) + 0.701 (1-hr)	(9)
	3-hr = 0.526 (6-hr) + 0.474 (1-hr)	(10)
For Region 7, figure 19	2-hr = 0.341 (6-hr) + 0.659 (1-hr)	(11)
	3-hr = 0.569 (6-hr) + 0.431 (1-hr)	(12)

Estimates for 12-hr (720-min) precipitation-frequency values. To obtain estimates for the 12-hr duration, plot values from the 6- and 24-hr maps on figure 16. Read the 12-hr estimates at the intersection of the line connecting these points with the 12-hr duration line of the nomogram.

Estimates for less than 1 hr. To obtain estimates for durations of less than 1 hr, apply the values in table 12 to the 1-hr value for the return period of interest.

Table 11. *Equations for estimating 1-hr values in California with statistical parameters for each equation*

Region of applicability*	Equation	Corr. coeff.	No. of stations	Mean of computed stn. values (inches)	Standard error of estimate (inches)
Northern Coast Ranges and western slopes of Siskiyou and Salmon Mountains (1)	$Y_2 = 0.160 + 0.520[(X_1)(X_1/X_2)]$	0.86	70	0.54	0.054
	$Y_{100} = 0.177 + 0.965[(Y_2)(X_3/X_1)]$	.74	66	1.10	.171
	$Y_{100} = 0.177 + 0.154(X_3/X_1) + 0.502[(X_3)(X_1/X_2)]$				
Mountainous regions east of crest of Cascade Range, west of Continental Divide, and north of southern boundary of Snake River Basin (2)	$Y_2 = 0.019 + 0.711[(X_1)(X_1/X_2)] + 0.001Z$	.82	98	0.40	.031
	$Y_{100} = 0.338 + 0.670[(X_3)(X_3/X_4)] + 0.001Z$	.80	79	1.04	.141
Coast Ranges of California, including spillover zones, from Klamath River Basin in north to Mexican border (3)	$Y_2 = 0.111 + 0.545[(X_1)(X_1/X_2)]$	.91	71	0.64	.073
	$Y_{100} = 0.221 + 0.885[(Y_2)(X_3/X_1)]$	.81	71	1.44	.294
	$Y_{100} = 0.221 + 0.098(X_3/X_1) + 0.482[(X_3)(X_1/X_2)]$				
Sacramento and San Joaquin River Valleys and coastal lowlands below 1,000 ft (4)	$Y_2 = 0.107 + 0.315(X_1)$	.90	65	0.59	.054
	$Y_{100} = -0.391 + 1.224[(Y_2)(X_3/X_1)] + 0.043(X_5)$	.87	63	1.30	.207
	$Y_{100} = -0.391 + 0.131(X_3/X_1) + 0.386(X_3) + 0.043(X_5)$				
Sierra Nevada, including its spillover zone (5)	$Y_2 = 0.126 + 0.561[(X_1)(X_1/X_2)]$	.90	67	0.58	.067
	$Y_{100} = -0.030 + 0.816[(Y_2)(X_3/X_1)] + 0.063(X_5)$	.78	67	1.36	.249
	$Y_{100} = -0.030 + 0.103(X_3/X_1) + 0.458[(X_3)(X_1/X_2)] + 0.063(X_5)$				
Southeastern desert region of California (6)	$Y_2 = 0.005 + 0.852[(X_1)(X_1/X_2)]$	.89	65	0.41	.047
	$Y_{100} = 0.322 + 0.789[(X_3)(X_3/X_4)]$	.87	65	1.25	.196
Lower Colorado River Basin within California (7)	$Y_2 = -0.011 + 0.942[(X_1)(X_1/X_2)]$	.95	86	0.72	.085
	$Y_{100} = 0.494 + 0.755[(X_3)(X_3/X_4)]$	.90	85	1.96	.290

* Numbers in parentheses refer to geographic regions shown in figure 18 and/or 19. See text for more complete description.

List of variables

Y_2 = 2-yr 1-hr estimated value
Y_{100} = 100-yr 1-hr estimated value
X_1 = 2-yr 6-hr value from precipitation-frequency maps
X_2 = 2-yr 24-hr value from precipitation-frequency maps
X_3 = 100-yr 6-hr value from precipitation-frequency maps
X_4 = 100-yr 24-hr value from precipitation-frequency maps
X_5 = latitude (in decimals) minus 32°
Z = elevation in hundreds of feet

Illustration of Use of Precipitation-Frequency Maps, Diagrams, and Equations

To illustrate the use of these maps, values were read from figures 32 to 43 for the point at 34°00′ N. and 117°00′ W. These values are shown in boldface type in table 13. The values read from the maps should be plotted on the return-period diagram of figure 6 because (1) not all points are as easy to locate on a series of maps as are latitude-longitude intersections, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. This has been done for the 24-hr values in table 13 (fig. 17a) and a line of best fit has been drawn subjectively. On this nomogram, the 5- and 10-yr values appear to be somewhat off the line. The value read from the maps is corrected (as shown by the strikeout in table 13); such corrected values are adopted in preference to the original readings.

The 2- and 100-yr 1-hr values for the point were computed from the equations applicable to Region 3, figures 18 and 19 (table 11). The 2-yr 1-hr is estimated at 0.60 in. (2-yr 6- and 24-hr values from table 13); the estimated 100-yr 1-hr value is 1.38 in. (100- and 2-yr 6-hr from table 13 and 2-yr 1-hr as computed above). By plotting these 1-hr values on figure 6 and connecting them with a straight line, one can obtain estimates for return periods of 5, 10, 25, and 50 yrs.

The 2- and 3-hr values can be estimated by using the proper nomogram of figure 15 or equations (3) and (4). The 1- and 6-hr values for the desired return period are obtained as above. Plot these points on the nomogram of figure 15 and connect them with a straight line. Read the estimates for 2 or 3 hrs at the intersections of the connecting line and the 2- and 3-hr vertical lines. In the example shown in figure 17b, the intersections are close to the values of 0.84 and 1.07, which would result from application of equations (3) and (4).

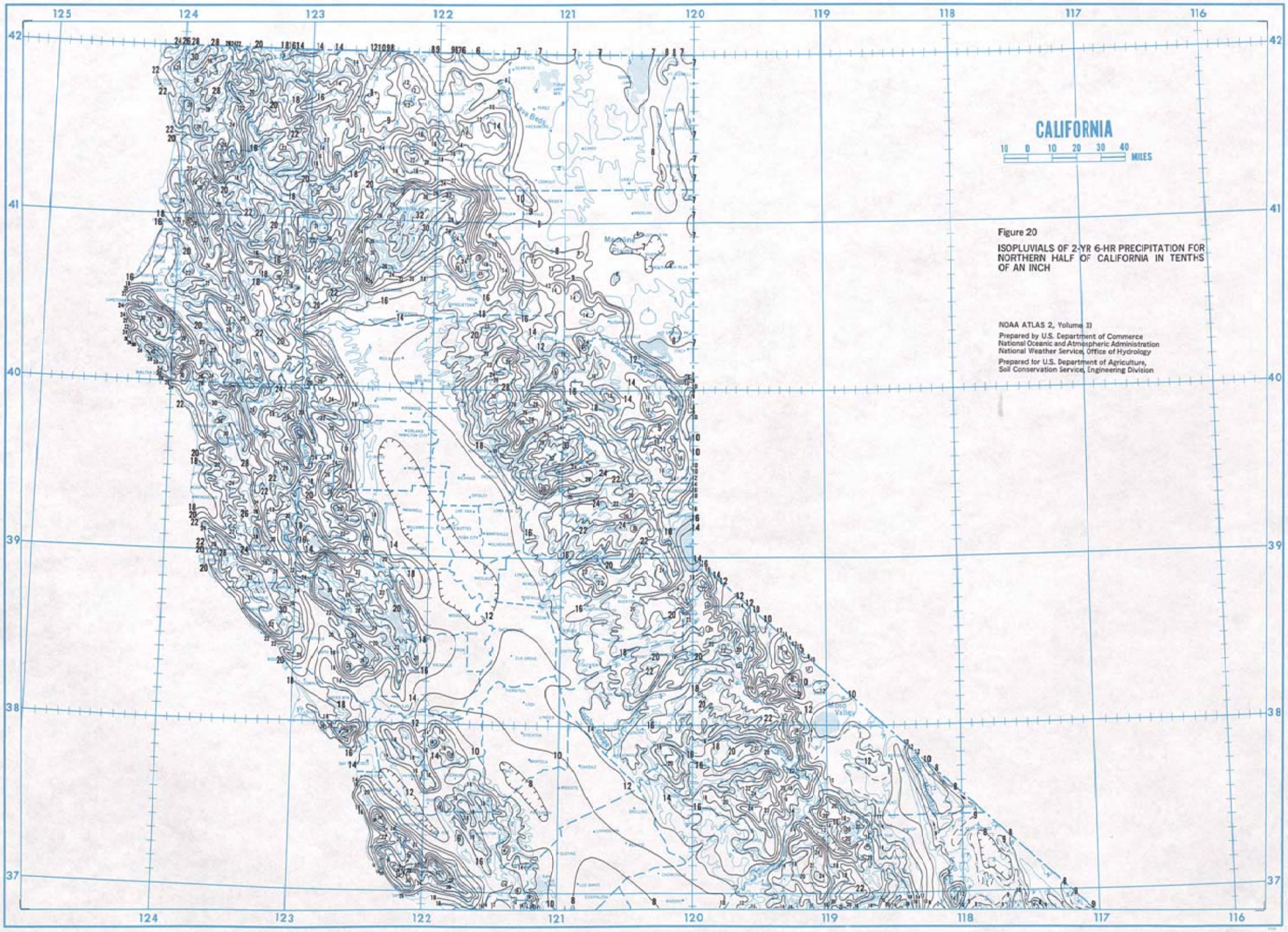


Figure 20

ISOPLUVIALS OF 2-YR 6-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

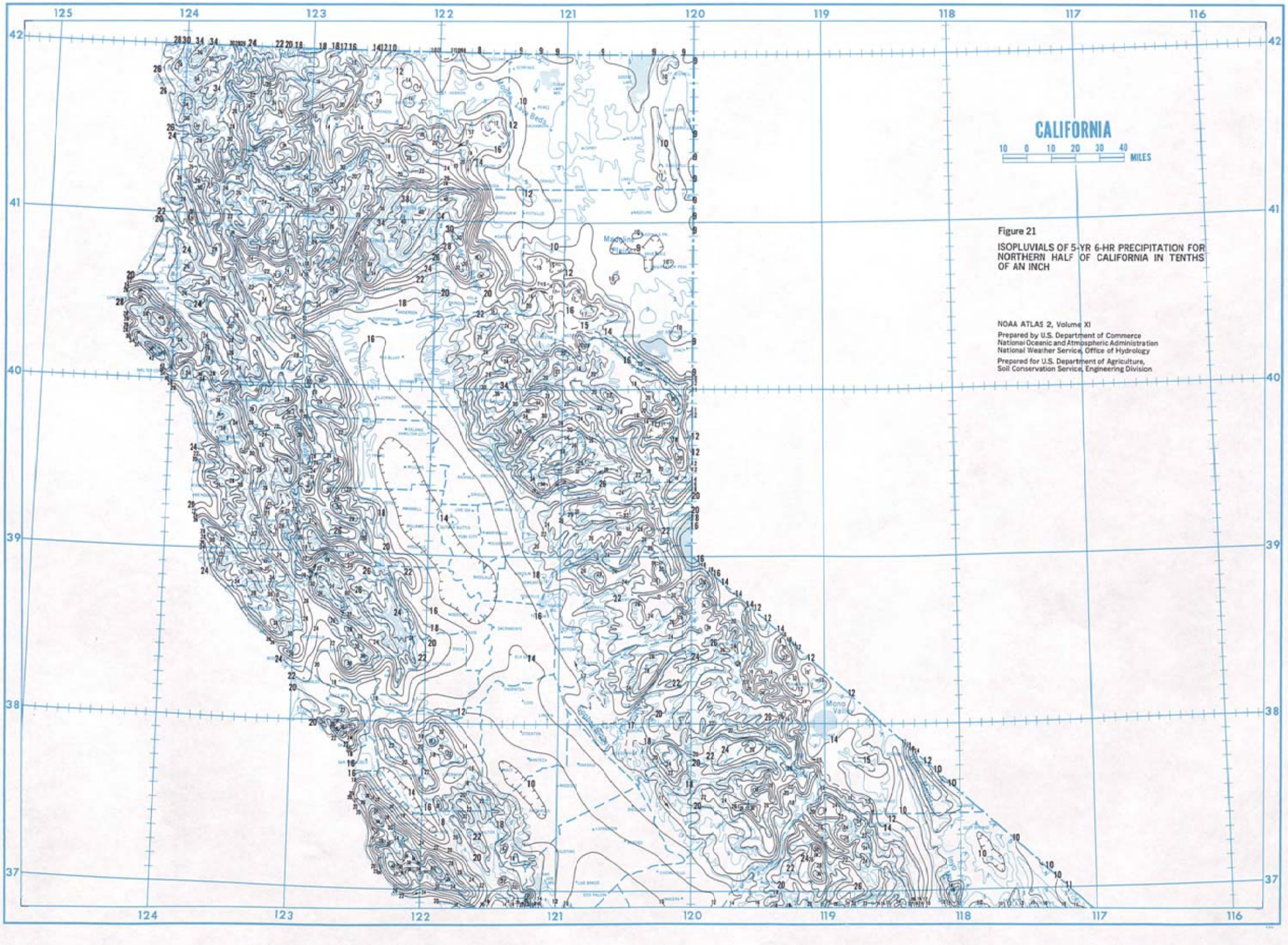


Figure 21

ISOPLUVIALS OF 5-YR 6-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

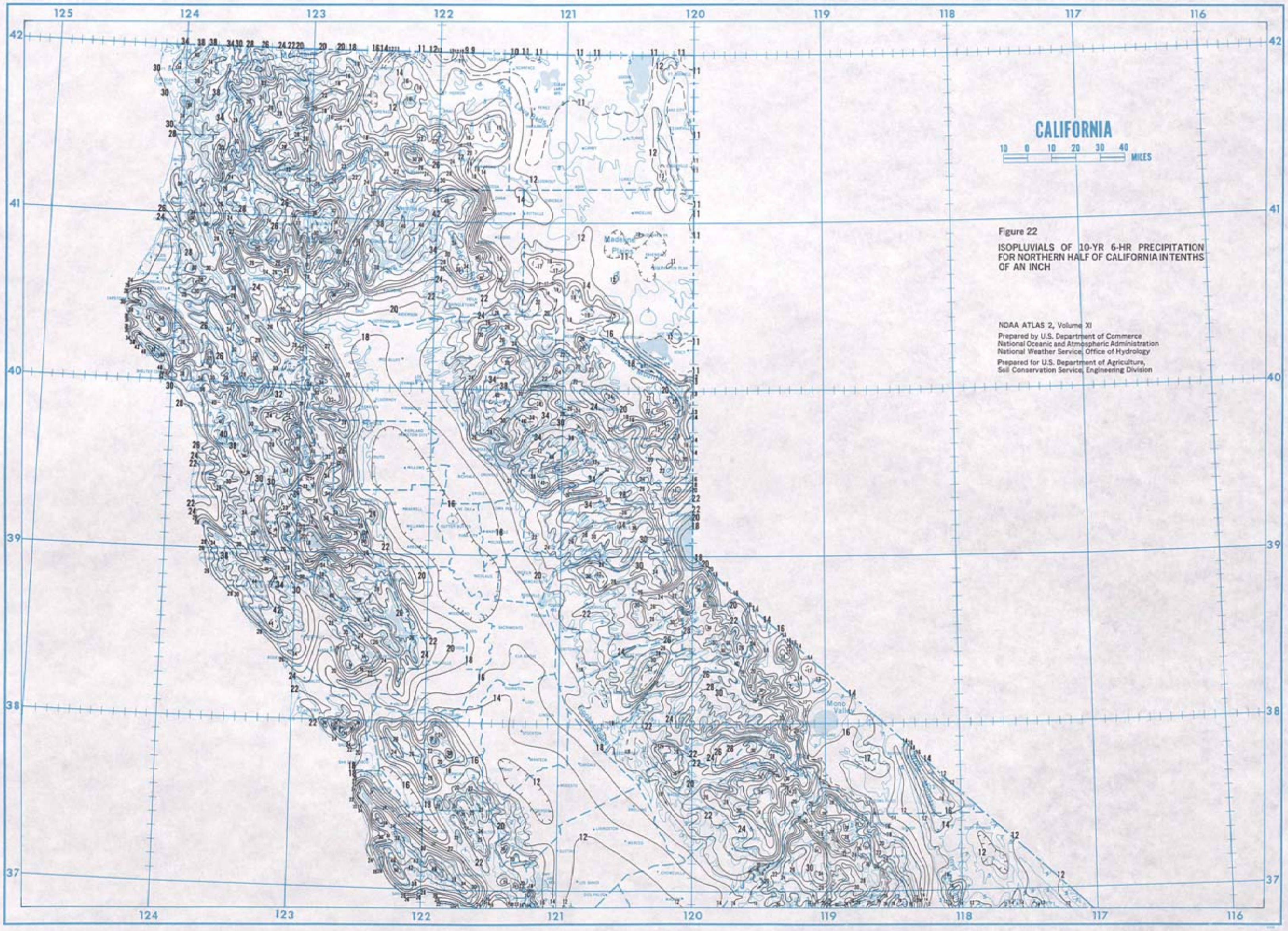


Figure 22

ISOPLUVIALS OF 10-YR 6-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

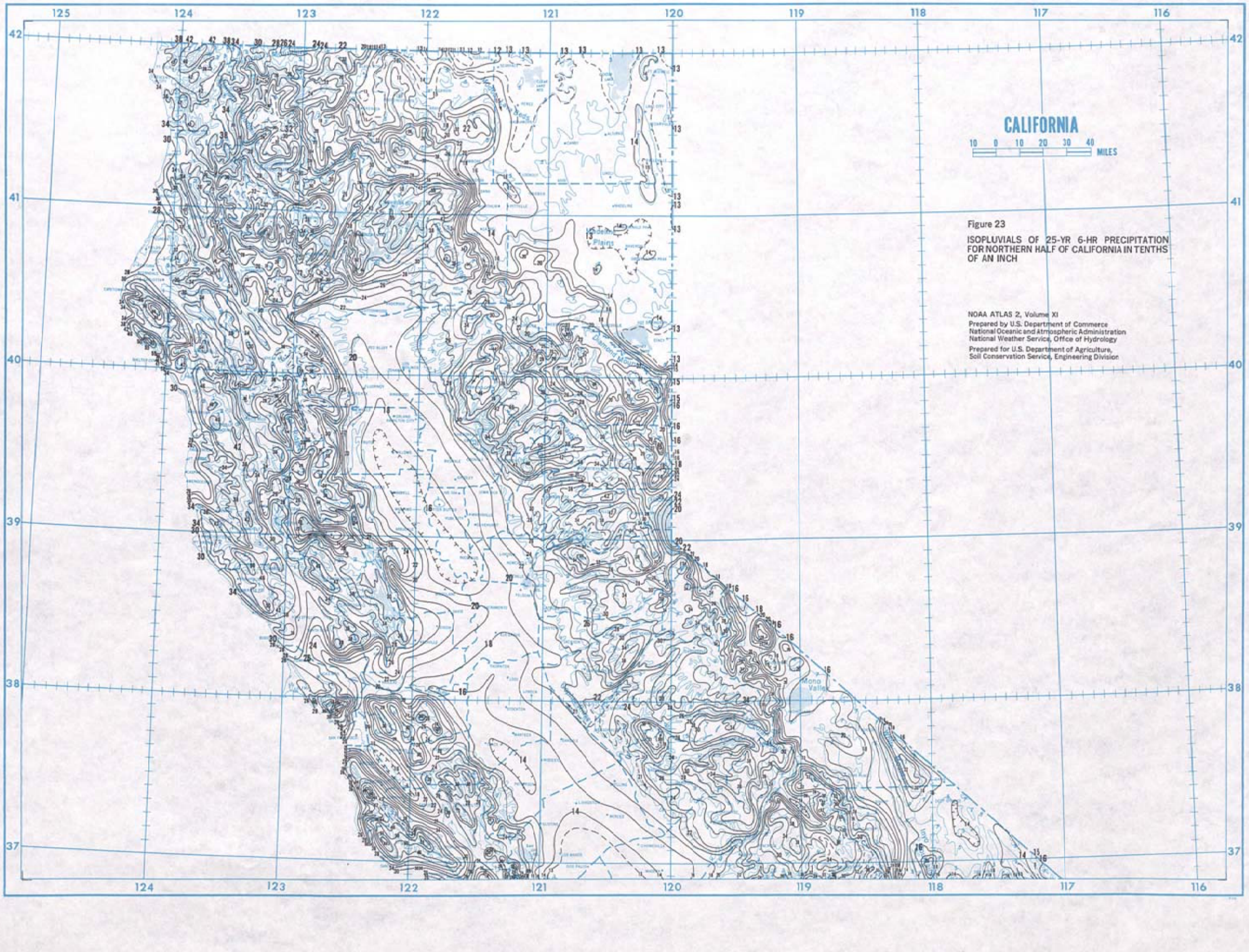


Figure 23

ISOPLUVIALS OF 25-YR 6-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

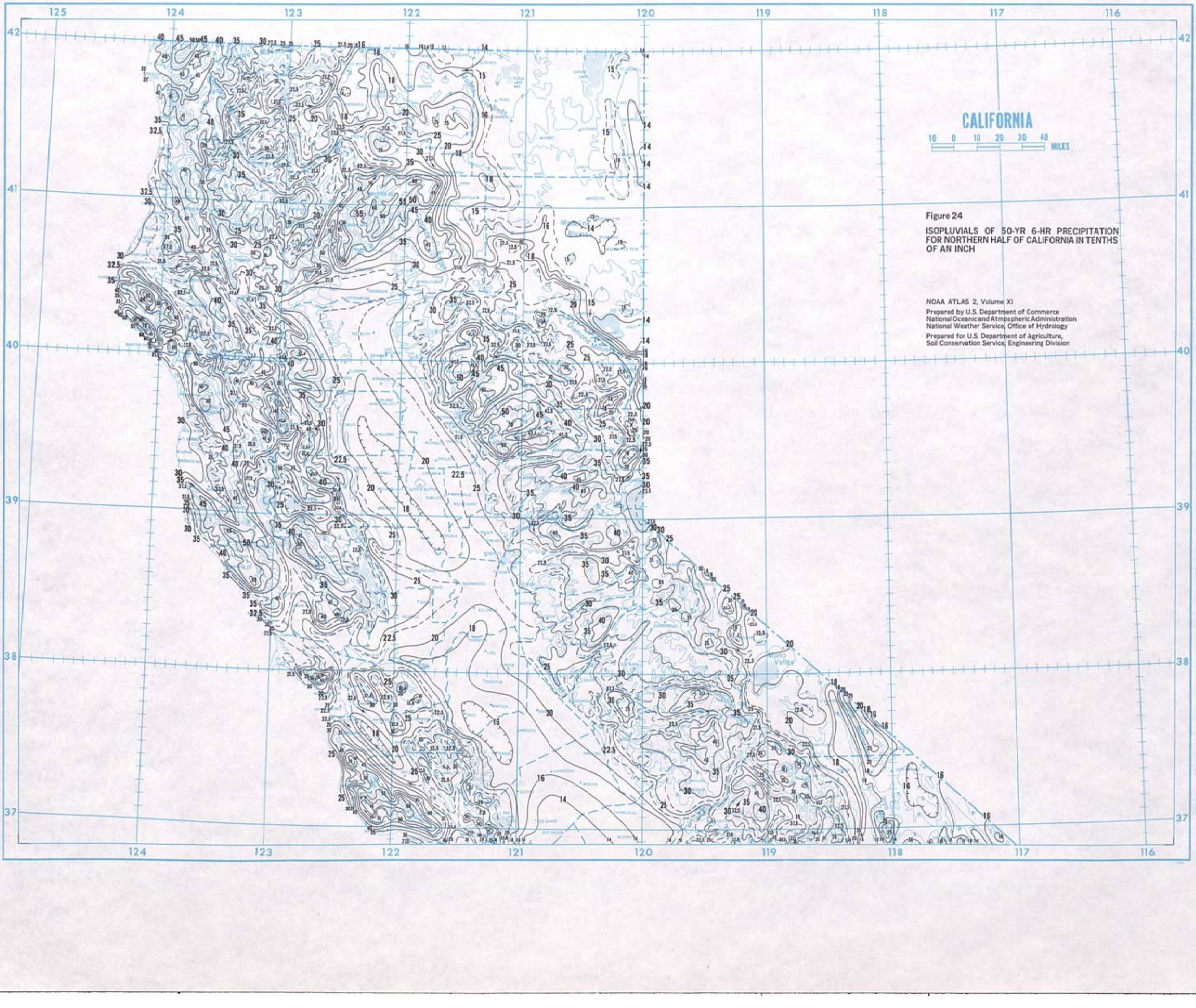


Figure 24

ISOPLUVIALS OF 50-YR 6-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

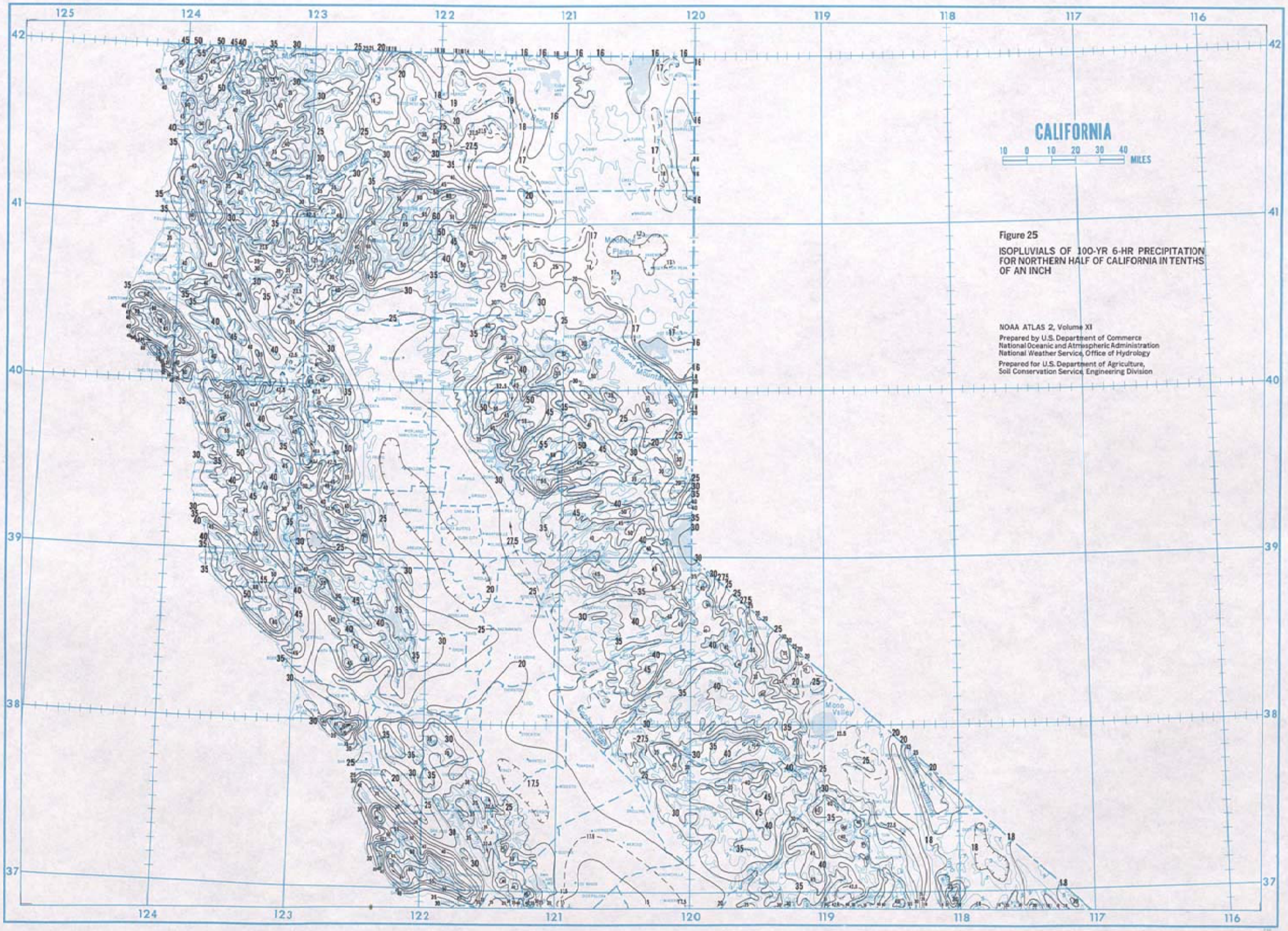


Figure 25

ISOPLUVIALS OF 100-YR 6-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 26

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

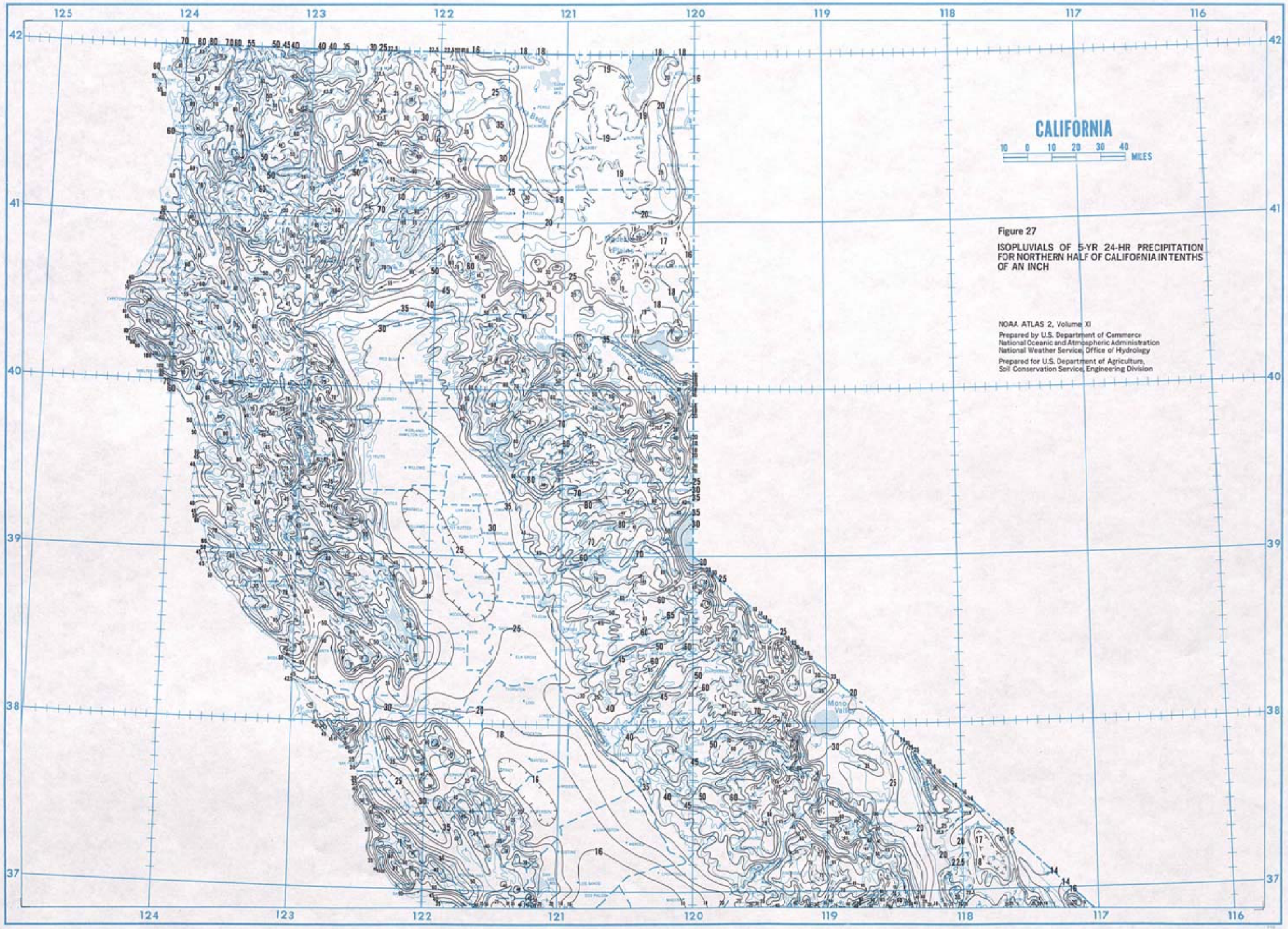


Figure 27

ISOPLUVIALS OF 5-YR 24-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 28

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

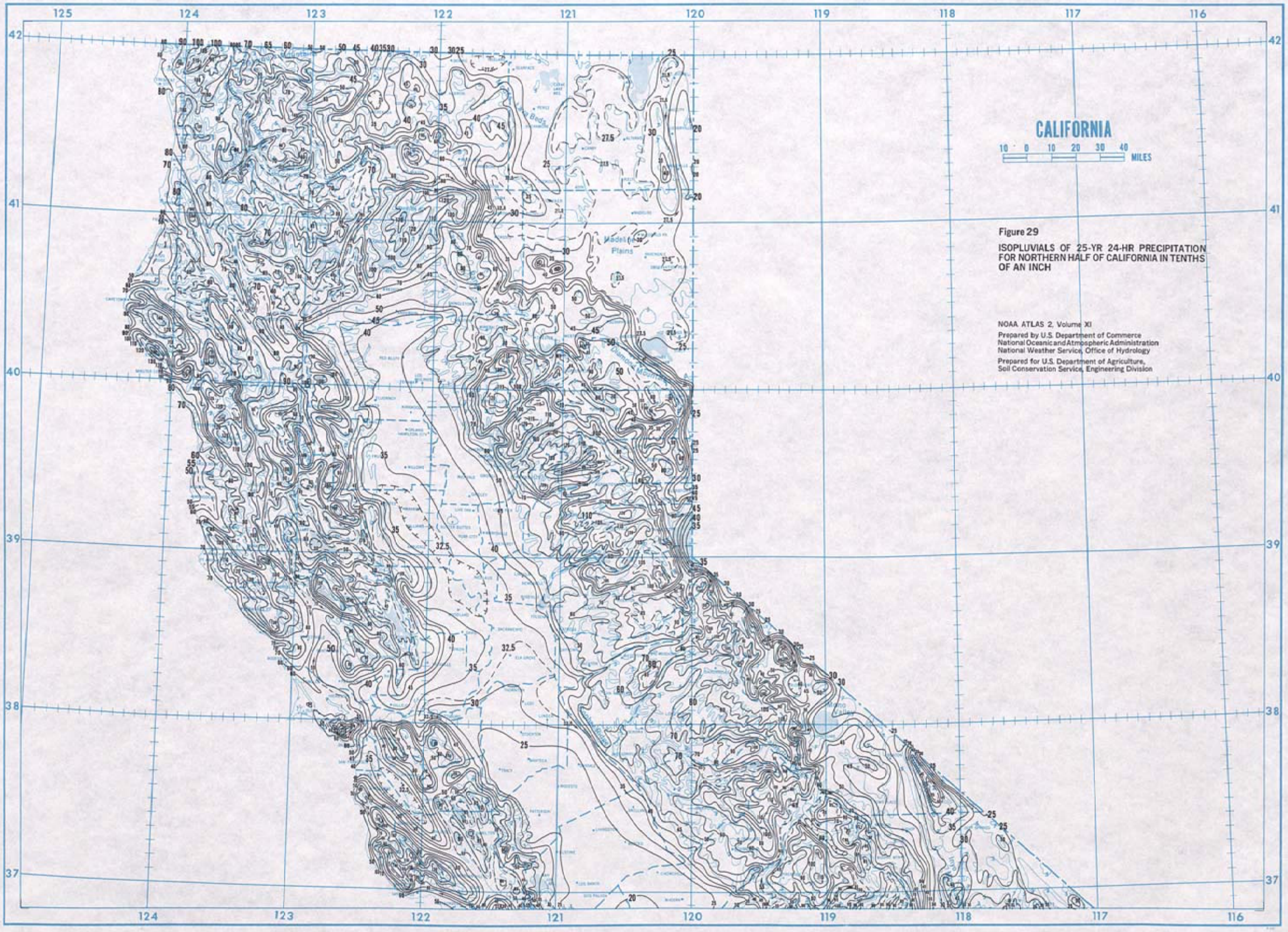


Figure 29

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 30

ISOPLUVIALS OF 50-YR 24-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 31

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION FOR NORTHERN HALF OF CALIFORNIA IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume XI

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division