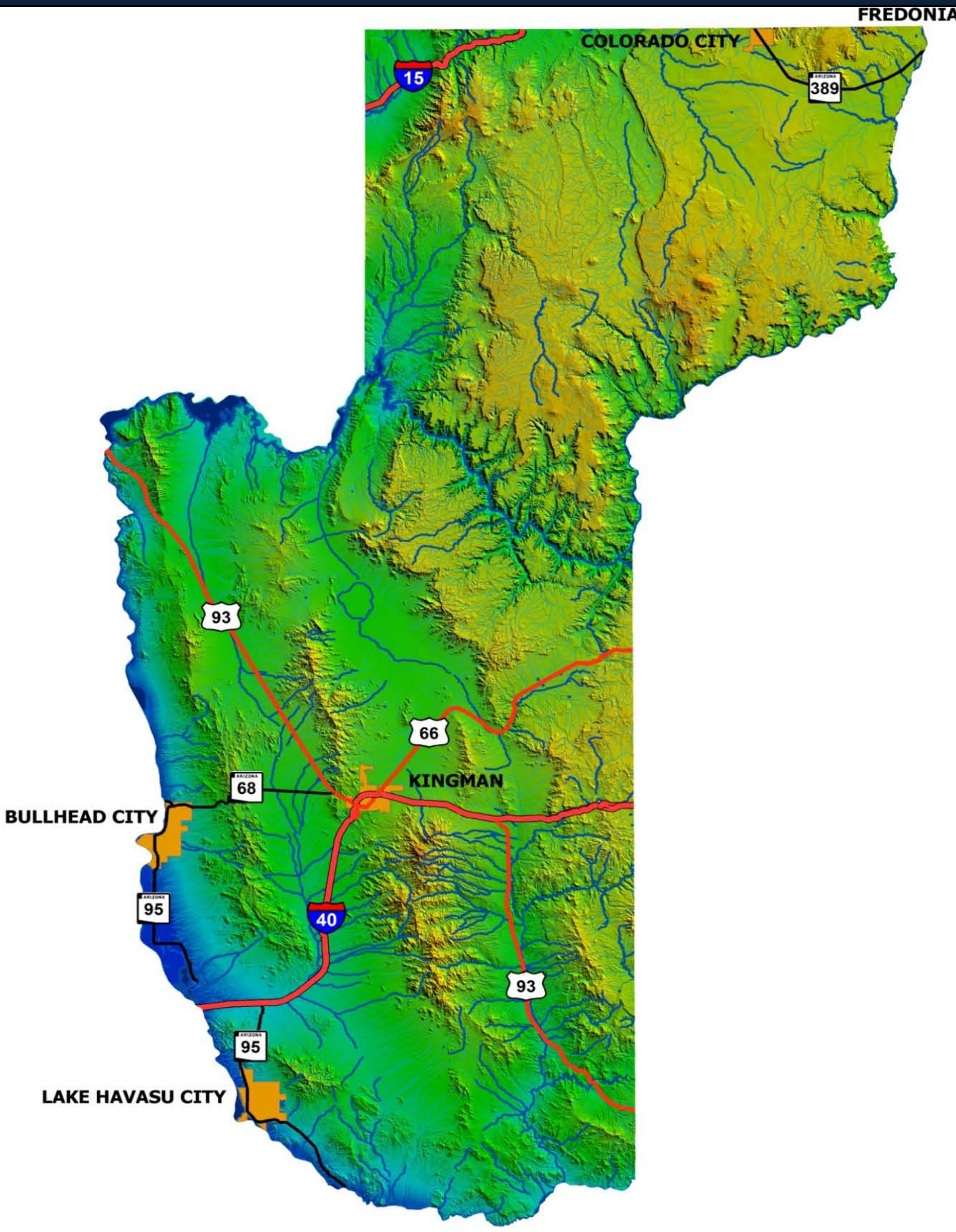
DRAINAGE DESIGN MANUAL FOR MOHAVE COUNTY

APPENDICES



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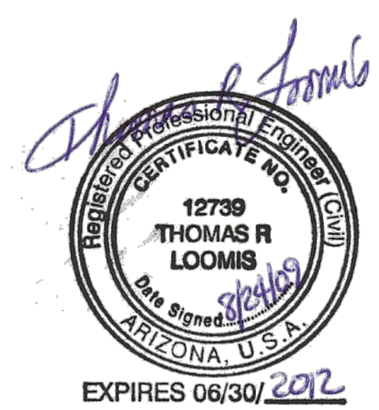


A. HYDROLOGY EXAMPLES

A.1 RAINFALL EXAMPLES

A.1.1 D-D-F AND I-D-F DATA FOR USE WITH THE RATIONAL METHOD

The Depth-Duration-Frequency (D-D-F) and Intensity-Duration-Frequency (I-D-F) data for use with the Rational Method can be generated in three ways.

Manually using Figure B.1 through Figure B.60.
Using the manual method within the DDMSW computer program.
Using ESRI ArcMap Shape files within the DDMSW computer program.
The use of each method will be demonstrated for the following problem:
Problem: A D-D-F and an I-D-F are needed for a small project in Kingman, AZ. The site is located in the west half of Section 9, T21N, R16W, G and SRM, and overlaps into Section 8.

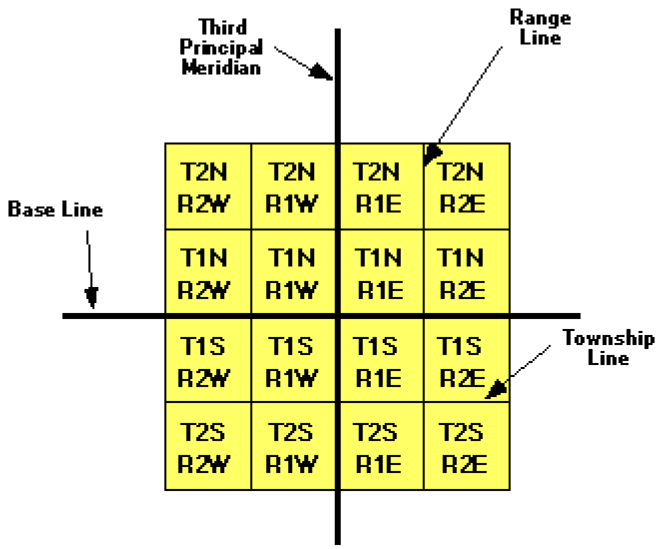
A.1.1.1 Example Using the Manual Method

Solution: The first step is to assemble copies of Figure B.1 through Figure B.60. Then the site must be located on each figure. Sites are located on the figures by use of world coordinates or by use of the Federal Township and Range System. A world coordinate graticule grid (latitude and longitude) with a 30-second resolution is shown on each figure. Also shown are the grid of township and range lines from the Federal Township and Range System. As a refresher, a basic graphical representation of the Federal Township and Range System is shown on Figure A.1. Using this information, a site can be located within the level of positional accuracy of the NOAA Atlas 14 point rainfall data depicted on the figure.

The T21N and R16W grid cell can be easily located on each figure. Then the location of Section 9 can be estimated visually by understanding where Section 9 is located using the standard system shown on Figure A.1. The example site location is identified on the Figure B.2 2-year 10-minute isopluvial map as shown on Figure A.2. Interpolating the isopluvial lines at the site location, the 2-year 10-minute point precipitation is estimated at 0.39 inches. This value is then entered in the appropriate cell in Table A.1. This same process was duplicated for the fifty nine (59) other isopluvial maps and the estimated point precipitation values tabulated in Table A.1.

Figure A.1 Federal Township and Range System

The largest grouping is the township which is named in reference to a Principal Meridian (P.M.) and a Baseline. T2N, R1E refers to Township 2 North (of the Baseline), Range 1 East (of the Principal Meridian). Surveys in Arizona are governed by the Gila and Salt River Base Line and Meridian. The Initial Point is at the intersection of these two lines. The Base Line runs east and west though this point and the Meridian runs north and south through the point. Land descriptions and property boundaries are governed by and identified by this point.



Within each township are 36 sections, each one mile square. Each section contains approximately 640 acres. The sections are numbered from 1 to 36 in the following order.

35	36	31	32	33	34	35	36	31	32
2	1	6	5	4	3	2	1	6	5
11	12	7	8	9	10	11	12	7	8
14	13	18	17	16	15	14	13	18	17
23	24	19	20	21	22	23	24	19	20
26	25	30	29	28	27	26	25	30	29
35	36	31	32	33	34	35	36	31	32
2	1	6	5	4	3	2	1	6	5

Figure A.2 I-D-F example site location for 2-year 10-minute precipitation

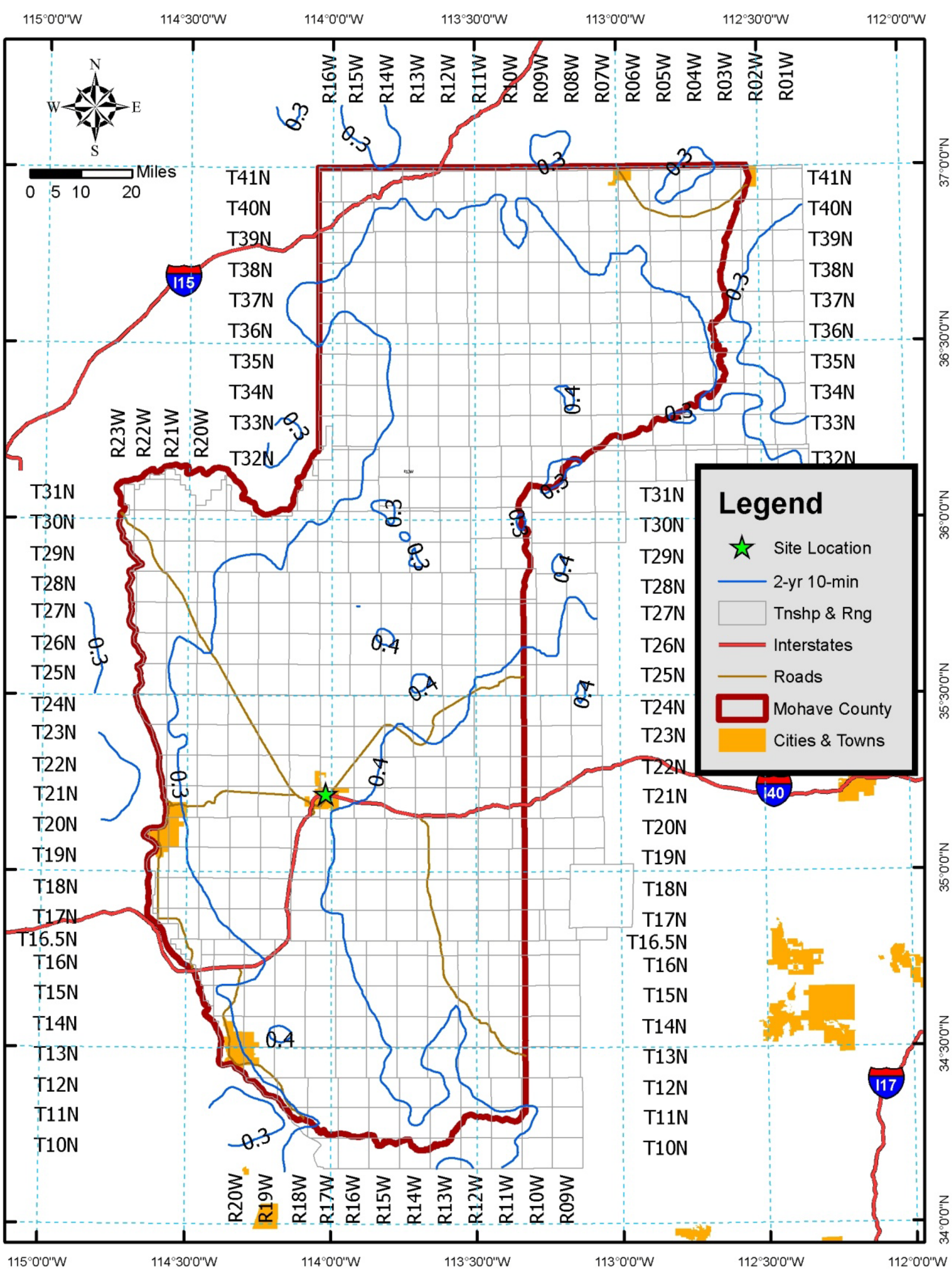


Table A.1 Rainfall Depth-Duration-Frequency for Kingman, AZ (manual)

(estimated using Figure B.1 through Figure B.60)

Duration	Rainfall Depth, in inches					
	Storm Frequency, in years					
	2	5	10	25	50	100
5-min	0.23	0.37	0.44	0.56	0.60	0.69
10-min	0.39	0.56	0.66	0.79	0.90	1.05
15-min	0.48	0.68	0.80	0.99	1.18	1.29
30-min	0.64	0.90	1.09	1.38	1.58	1.70
1-hour	0.79	1.10	1.37	1.68	1.96	2.18
2-hour	0.88	1.26	1.50	1.90	2.20	2.49
3-hour	0.95	1.29	1.59	2.00	2.41	2.80
6-hour	1.09	1.49	1.86	2.36	2.76	3.30
12-hour	1.29	1.77	2.17	2.76	3.10	3.50
24-hour	1.58	2.17	2.75	3.40	3.90	4.40

The next step is to use the point precipitation data from Table A.1 to compute the rainfall intensity for each storm duration and frequency combination. This is done as follows:

$$I_{F,D} = \frac{P_{F,D}}{D} \qquad \text{A.1}$$

where:

$I_{F,D}$ = rainfall intensity in inches per hour for frequency F and duration D.
$P_{F,D}$ = point precipitation in inches for frequency F and duration D.
D = storm duration D in hours.

Applying Equation A.1 for the 5-minute 2-year storm:

$$I_{2-\text{yr},5-\text{min}} = \frac{0.23}{\frac{5}{60}}$$

= 2.76 inches/hour.

Insert the computed value in Table A.2 in the 2-year 5-minute cell. Apply Equation A.1 to all values from Table A.1 and place the results in Table A.2.

Table A.2 Rainfall Intensity-Duration-Frequency for Kingman, AZ (manual)

(computed using the data in Table A.1)

	Rainfall Intensity, in inches/hour					
	Storm Frequency, in years					
Duration	**2**	**5**	**10**	**25**	**50**	**100**
5-min	2.76	4.44	5.28	6.72	7.20	8.28
10-min	2.34	3.36	3.96	4.74	5.40	6.30
15-min	1.92	2.72	3.20	3.96	4.72	5.16
30-min	1.28	1.80	2.18	2.76	3.16	3.40
1-hour	0.79	1.10	1.37	1.68	1.96	2.18
2-hour	0.44	0.63	0.75	0.95	1.10	1.25
3-hour	0.32	0.43	0.53	0.67	0.80	0.93
6-hour	0.18	0.25	0.31	0.39	0.46	0.55
12-hour	0.11	0.15	0.18	0.23	0.26	0.29
24-hour	0.07	0.09	0.11	0.14	0.16	0.18

A.1.1.2 Example using the DDMSW Manual Method

NOTE: *To apply this method, the Mohave County-specific version of the DDMSW computer program must be installed on your computer as well as Adobe Acrobat Reader. Both are free programs. DSMSW can be downloaded from the Mohave County web site at* http://www.co.mohave.az.us/FloodControlDrainageDesignManual *and Adobe Acrobat Reader can be downloaded at* http://www.adobe.com.

Solution: The NOAA Atlas 14 point precipitation data is supplied by NOAA in a GIS grid format with a cell size of about 2,500 feet square. This method is applied by determining the average point precipitation value of the cell or cells that cover the subject watershed. In DDMSW, the user selects the cell or cells that cover the project site. DDMSW then “looks up” the point precipitation values for each storm frequency and duration for each cell or cells specified and compute an average value for every storm frequency-duration combination. To select the project cells, the general project site location is identified by the user from an index map contained within DDMSW in Adobe PDF format. The index map is on page 1 of the PDF (77 pages). The user locates the map covering the project watershed (Figure A.3) and then moves to the page where the more detailed map is located (Figure A.4).

Figure A.3 DDMSW NOAA Atlas 14 index map

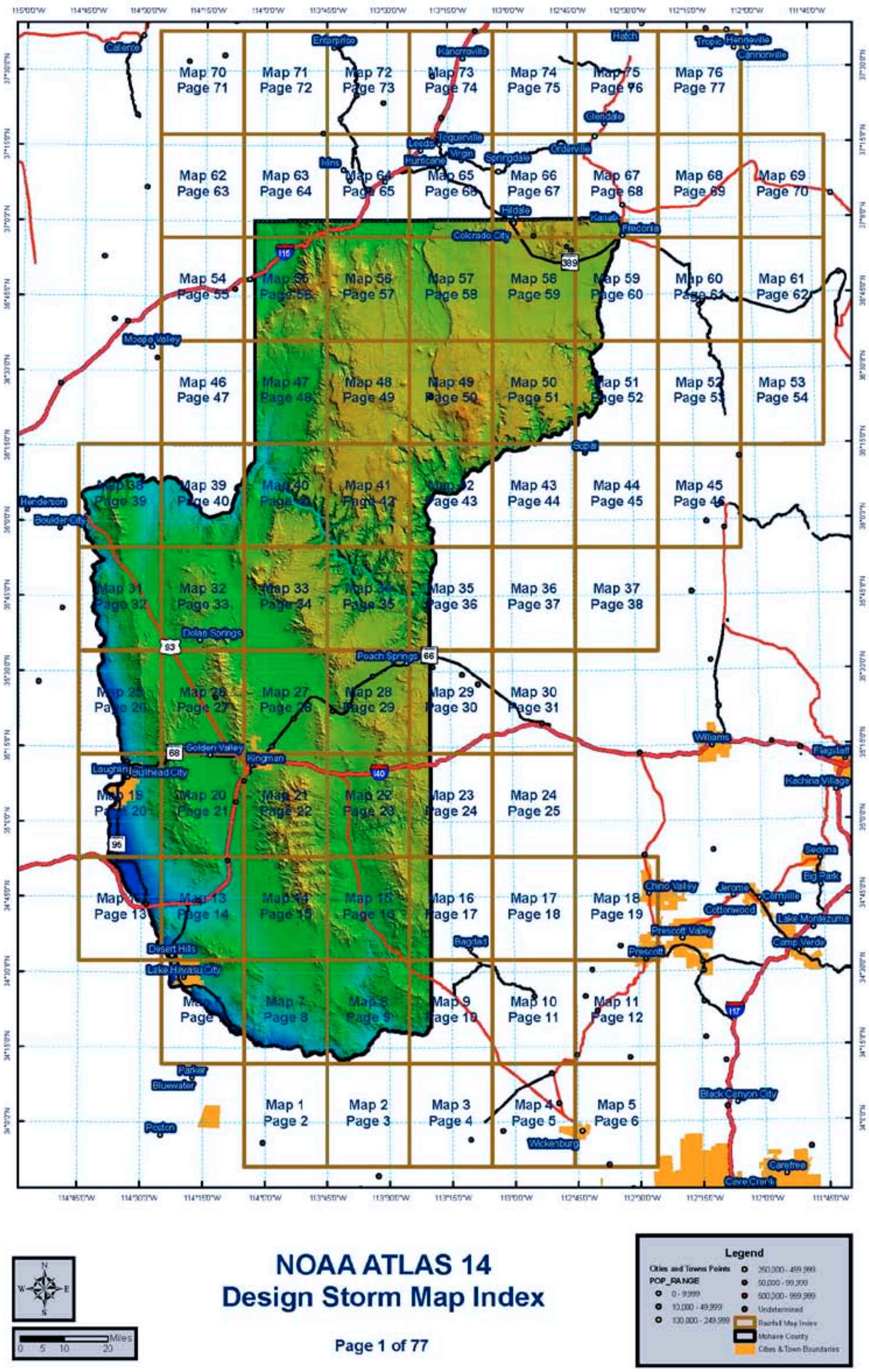
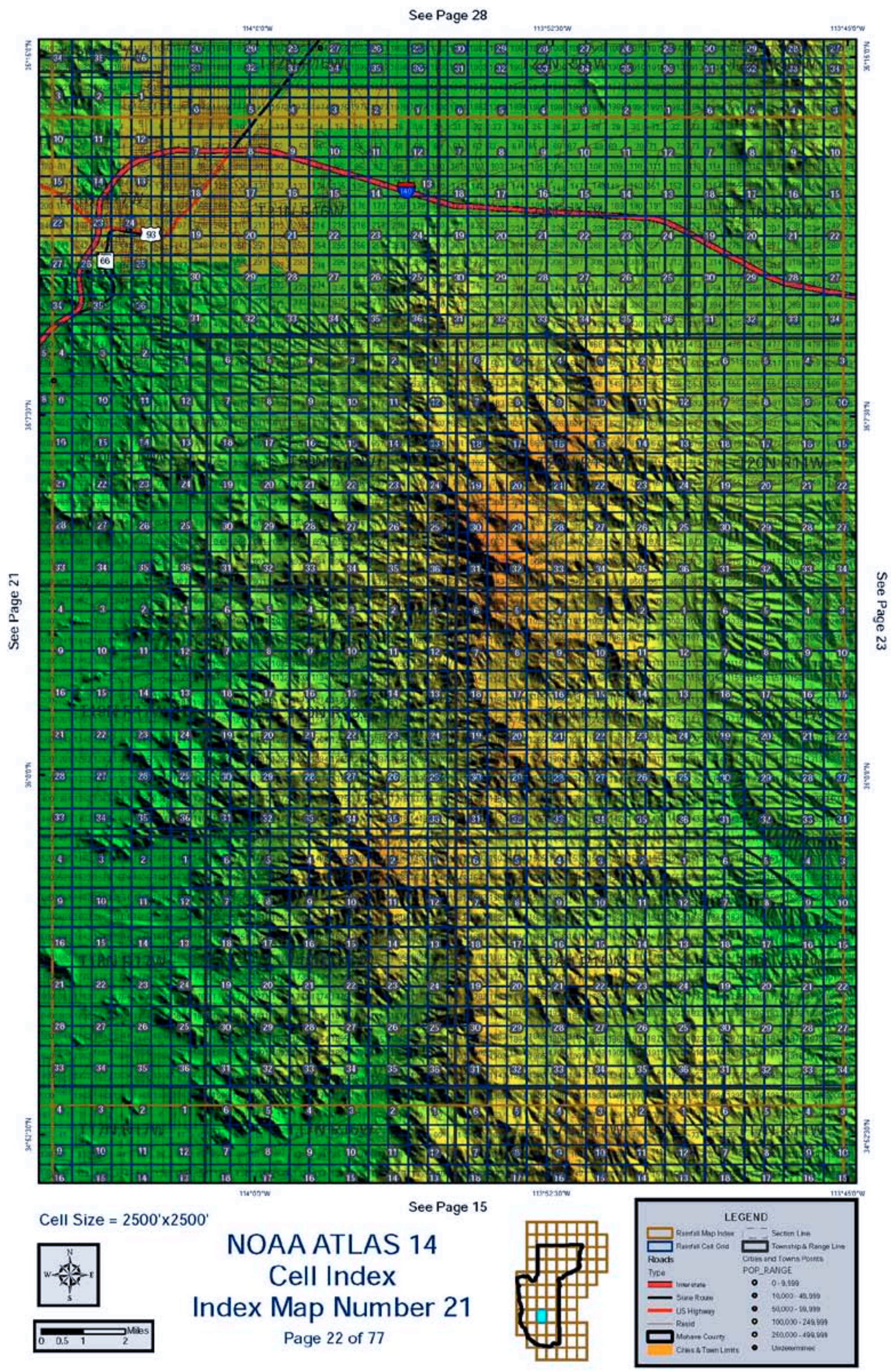


Figure A.4 DDMSW NOAA Atlas 14 detailed location map



Using Figure A.3, it can be seen that the project site, in T21N, R16W, is located on Map 21. Moving to Map 21, as shown on Figure A.4, the Sections 8 and 9 must be located. The sections are labeled in white with a brown background. The NOAA Atlas 14 cells are labeled blue. Grid cells 51, 52, 91 and 92 approximate the location of the watershed in the west half of Section 9 and overlapping into Section 8.

In DDMSW, establish a new project then perform the following steps:

1. Open menu item *Hydrology|Rainfall*.
2. Set the *Data Source* to Manual.
3. Click on the *Maps* button to load the PDF of the NOAA Atlas 14 Index Maps.
4. Locate the project site on the overview index page and see that detailed Map Number 21 is needed.
5. Move to PDF page 22 to find Map Number 21.
6. Verify that Map Number 21 depicts Township 21N, Range 16W. Estimate the location of Section 9 on the map and write down the numbers of the grid cells covering the project watershed (51, 52, 91 and 92).
7. Close the PDF file and return to DDMSW.
8. Use the *Multiple Map Selection Menu*. The table on the left side of the wind with the headings *Map*, *From*, and *To*, should be empty.
9. Click on *Add*.
10. Click on the *Magnifying Glass* icon to the right of *Map Index* and select Map 21.
11. Enter 51 in the *From* field and 52 in the *To* field. Click Save.
12. Click on *Add*.
13. Enter 91 in the *From* field and 92 in the *To* field. Click Save.
14. Click on *Update*. The *Average Rainfall Data for Project* table should be updated and match the values listed in Table A.3.

Table A.3 Rainfall Depth-Duration-Frequency for Kingman, AZ (DDMSW mm)

(estimated using the DDMSW Manual Method)

Duration	Rainfall Depth, in inches					
	Storm Frequency, in years					
	2	5	10	25	50	100
5-min	0.254	0.356	0.429	0.526	0.598	0.673
10-min	0.387	0.543	0.653	0.801	0.910	1.024
15-min	0.479	0.672	0.809	0.992	1.128	1.269
30-min	0.645	0.905	1.090	1.336	1.519	1.709
1-hour	0.798	1.121	1.349	1.653	1.880	2.115
2-hour	0.875	1.234	1.512	1.893	2.205	2.534
3-hour	0.936	1.302	1.599	2.022	2.376	2.759
6-hour	1.102	1.509	1.833	2.303	2.687	3.108
12-hour	1.284	1.753	2.133	2.652	3.081	3.529
24-hour	1.597	2.190	2.650	3.300	3.820	4.370

A.1.1.3 Example using the DDMSW GIS Method

Solution: Create an ESRI shape file containing a polygon of the total study watershed area. The fields required for the various ESRI shape files used within DDMSW are listed in Table A.4. Note that the rainfall shape file for the overall watershed boundary polygon only requires one field, the Major Basin ID. For this example, a polygon of the Kingman corporate boundary is used to obtain an average D-D-F for the entire city (Figure A.5). DDMSW overlays the polygon on the NOAA Atlas 14 rain cell grid, which is GIS version of the grids shown in the PDF file used for the DDMSW manual method (see Figure A.4). The grid cells that touch and are contained within the polygon are selected and an average point precipitation depth computed for each frequency-duration combination. To implement the GIS approach using DDMSW, the following steps should be followed. For this example, the results are shown in Table A.5.

1. Open menu item *Hydrology|Rainfall*.
2. Set the *Data Source* to GIS.
3. Click on the *Select a* file button and point DDMSW to the desired polygon of the entire watershed under consideration.
4. Click on *Update*.

Table A.4 DDMSW required fields for GIS shape files

Map	Field Name	Type and Length	Description
Rainfall	BASINID	Character 2	Major Basin ID
Sub Basin	AREAID	Character 6	Unique ID
	BASINID	Character 2	Major Basin ID
	AREASF	Numeric 12.0	Area in square feet
Land Use	LUCODE	Character 15	Land use code
Soils	SOIL_LID	Numeric 15.0	Soils code
L_{ca}	AREAID	Character 6	Unique ID (same as sub basin)
	BASINID	Character 2	Major Basin ID
	LENGTH	Numeric 12.0	Length in feet
	USGE	Numeric 9.2	Upstream ground elevation
	DSGE	Numeric 9.2	Downstream ground elevation
T_c	AREAID	Character 6	Unique ID (same as sub basin)
	BASINID	Character 2	Major Basin ID
	LENGTH	Numeric 12.0	Length in feet
	USGE	Numeric 9.2	Upstream ground elevation
	DSGE	Numeric 9.2	Downstream ground elevation

Figure A.5 DDMSW NOAA Atlas 14 Kingman-area polygon

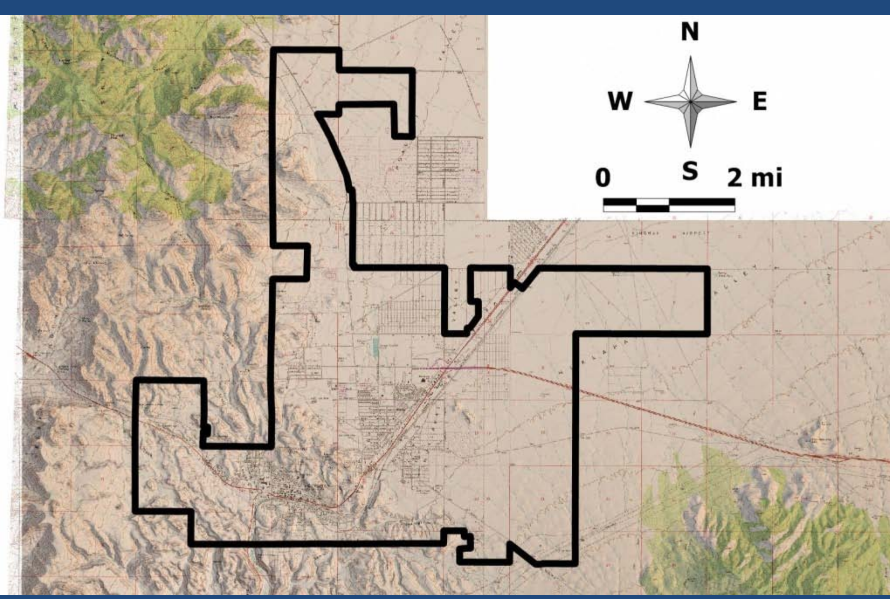


Table A.5 Rainfall Depth-Duration-Frequency for Kingman, AZ (DDMSW GIS)

(estimated using the DDMSW GIS Method)

Duration	Rainfall Depth, in inches					
	Storm Frequency, in years					
	2	5	10	25	50	100
5-min	0.252	0.355	0.428	0.526	0.600	0.676
10-min	0.384	0.541	0.652	0.801	0.913	1.029
15-min	0.477	0.670	0.808	0.993	1.131	1.275
30-min	0.642	0.903	1.088	1.337	1.523	1.717
1-hour	0.794	1.117	1.347	1.655	1.885	2.125
2-hour	0.873	1.233	1.512	1.896	2.213	2.546
3-hour	0.935	1.302	1.600	2.024	2.381	2.767
6-hour	1.100	1.509	1.835	2.306	2.692	3.116
12-hour	1.284	1.755	2.136	2.658	3.089	3.540
24-hour	1.586	2.175	2.634	3.283	3.801	4.353

An important consideration when applying the DDMSW GIS method is to be sure the following projection and coordinate system is used when preparing all shape files for use with the Mohave County-specific version of DDMSW:

State Plane Coordinate System, NAD 83, Arizona West, U.S. Survey feet.

The Mohave County DDMSW NOAA Atlas 14 GIS rainfall data is in the above projection. To obtain meaningful results, all shape files must be in the Mohave County standard projection and coordinate system.

An ESRI ArcView license is NOT required to apply the DDMSW GIS method. Shape files can, of course, be created using ArcView (http://www.ersi.com). Other options include AutoCAD and Microstation (with the optional GIS capable add-on packages), Map Info (http://www.pbinsight.com/products/location-intelligence/applications/mapping-analytical/mapinfo-professional/), and Manifold Project (http://www.manifold.net).

A.1.1.4 Comparison of Methods

The first comparison is between the Manual Method and the DDMSW Manual Method. Closely examine the results in Table A.1 and Table A.3. The differences in point precipitation vary from hundredths of an inch to as much as 0.19 inches for the 100-year 6-hour storm. The differences are minimal and will not have a significant effect on hydrologic modeling results for small watersheds based on either method when applying the Rational Method.

The second comparison is between the DDMSW Manual Method and the DDMSW GIS method. Keep in mind that the DDMSW Manual Method example is for a site-specific location within Kingman in Section 9, T21N, R16W. The DDMSW GIS Method example is for the City of Kingman corporate area. Closely examine the results displayed in Table A.3 and Table A.5. The differences are minor, with variances measured in hundredths of an inch. This means that the NOAA Atlas 14 point precipitation data only has slight variations for all considered durations and frequencies across the entire Kingman metropolitan area. The data in Table A.5 can be used with confidence for rainfall-runoff modeling for watersheds within the Kingman corporate boundary.

A.1.2 RAINFALL DATA FOR USE WITH THE UNIT HYDROGRAPH METHOD

The data necessary for use with the unit hydrograph method is as follows:

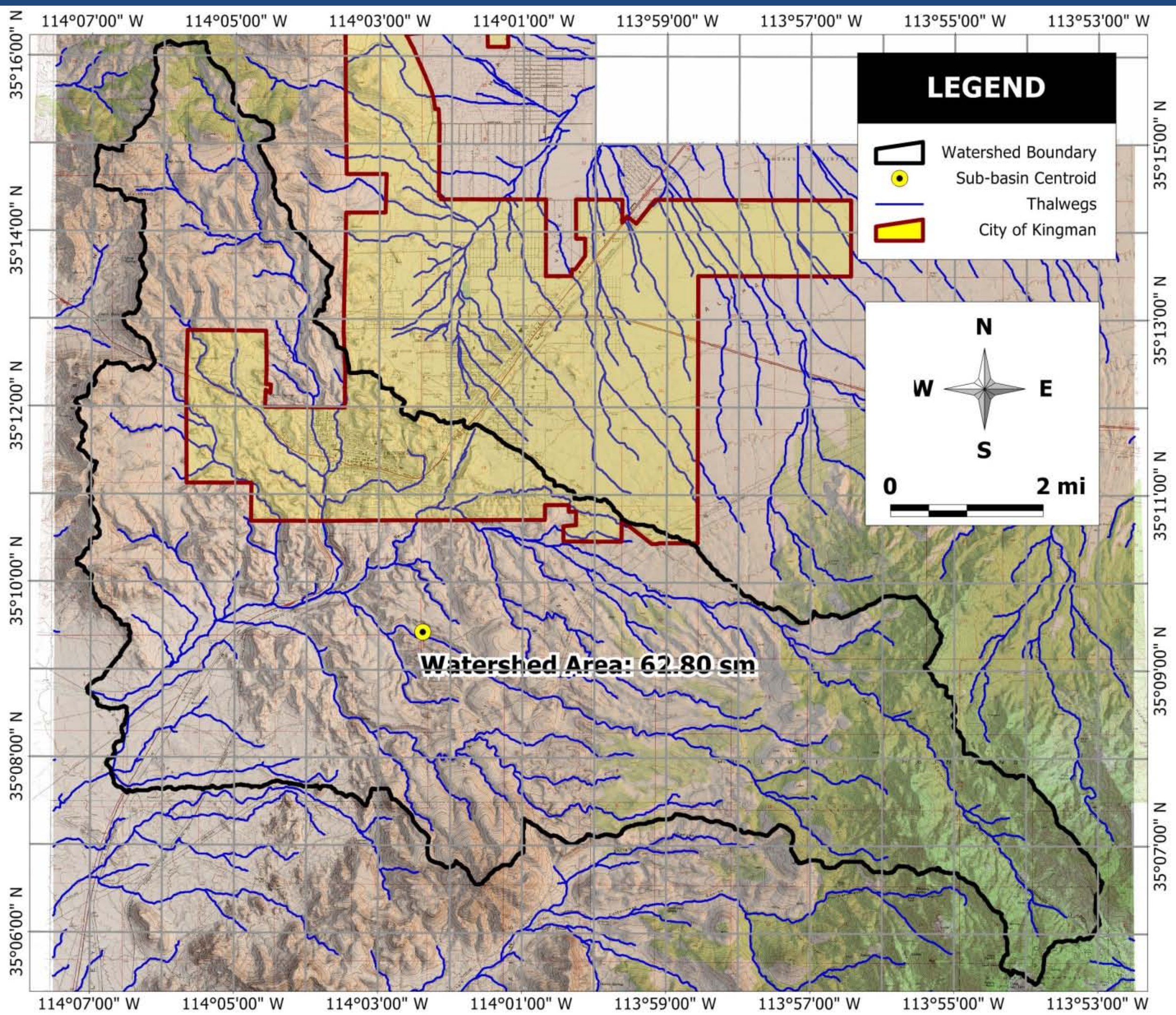
1. The following point precipitation values for the storm to be modeled (ie. 100-yr, 10-yr, etc.). Items g and h are only necessary for storms longer than 6-hours.

    a. 5-min, b. 15- min, c. 1-hr, d. 2- hr, e. 3- hr, f. 6- hr, g. 12- hr, h. 24- hr.

The depth area curve for the storm to be modeled.

Problem: Point precipitation data are needed for a HEC-1 model of a large watershed within, and south of, Kingman, AZ. The site is located as shown on Figure A.6. Prepare the HEC-1 precipitation records for a 100-year 24-hour storm.

Figure A.6 Unit Hydrograph Method watershed limits map



A.1.2.2 Example Using the Manual Method

Solution: Prepare a watershed location map as shown on Figure A.6. Next, assemble copies of Figure B.51, Figure B.53, and Figure B.55 through Figure B.60. There is a significant elevation difference from the top to the bottom of the watershed; 8,054 to 2814. Therefore, orographic effects could significantly affect precipitation. Due to the scale and lack of resolution of the isopluvial maps, it is not reasonable to attempt to determine multiple precipitation values for representative portions of the watershed. Therefore, accounting for orographic effects is not a viable option for this watershed when using this method. The centroid of the overall watershed is used to estimate the average point precipitation values. The same basic procedure applied in Appendix A.1.1.1 should be followed here. However, instead of using the Section, Township, and Range information, the world coordinates for the watershed centroid will be used to location the position on the NOAA Atlas 14 isopluvial maps from Appendix B. The coordinates of the watershed centroid are: 35°09'26" North by -114°02'23" West.

A world coordinate graticule grid (latitude and longitude) with a 30-second resolution is shown on each isopluvial figure. Using this information, the point precipitation values were interpolated from Figure B.51, Figure B.53, and Figure B.55 through Figure B.60 and are shown in Table A.6.

Table A.6 Unit Hydrograph Method point precipitation estimate (manual)

ID	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Watershed	0.70	1.31	2.20	2.65	2.83	3.40	3.70	4.50

Depth-area reduction factors for the 100-year 24-hour storm are determined using the data in Table 7.3. The results are shown in Table A.7.

Table A.7 Unit Hydrograph Method depth-area reduction (manual)

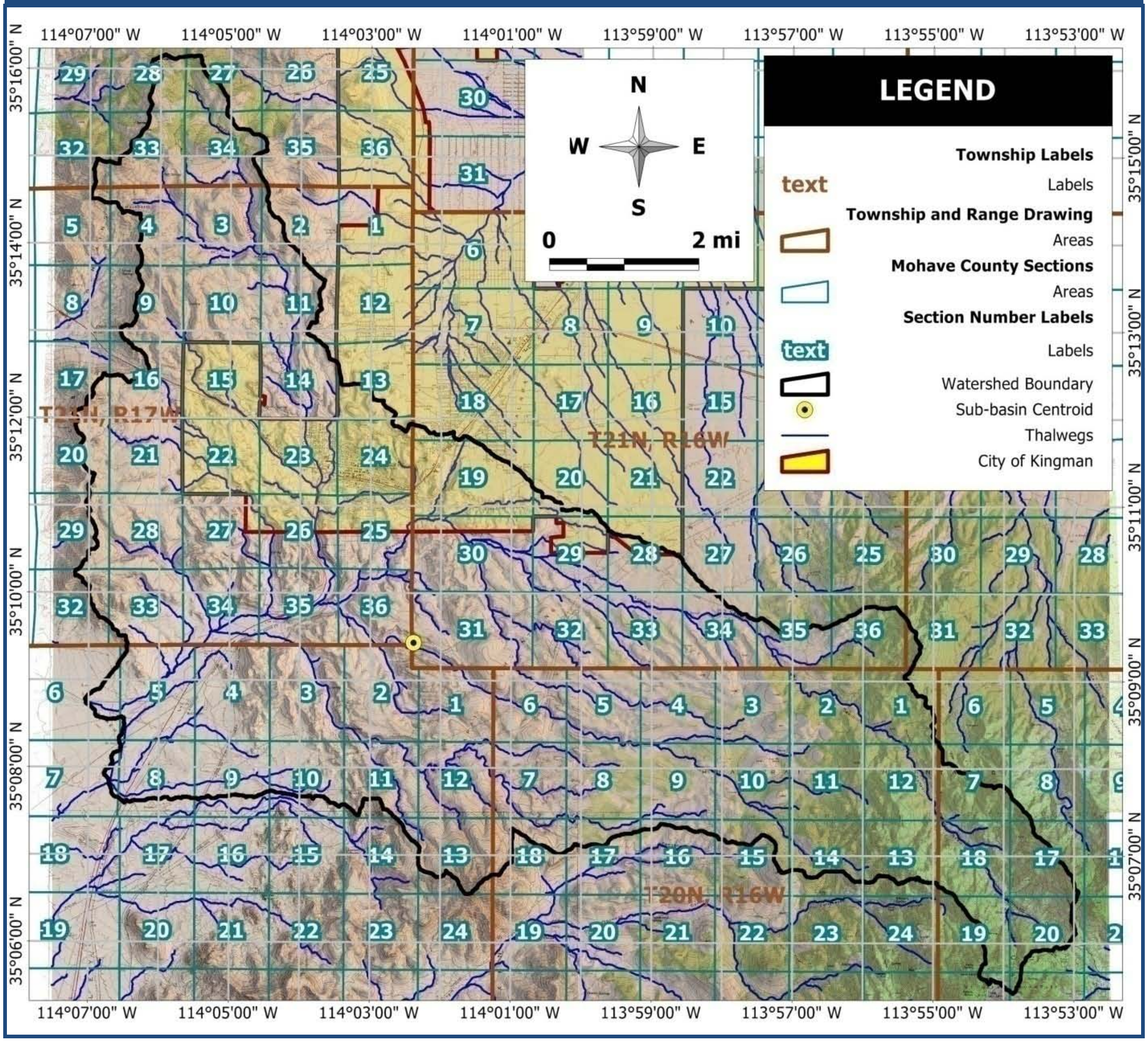
Watershed Area	Depth-Area Factor	Areally Reduced Precipitation
0	1.000	4.50
10	0.950	4.28
20	0.919	4.14
30	0.900	4.05
40	0.887	3.99
50	0.877	3.95
60	0.870	3.92
70	0.863	3.88

A.1.2.3 Example using the DDMSW Manual Method

NOTE: *To apply this method, the Mohave County-specific version of the DDMSW computer program must be installed on your computer as well as Adobe Acrobat Reader. Both are free programs. DSMSW can be downloaded from the Mohave County web site at* http://www.co.mohave.az.us/FloodControlDrainageDesignManual *and Adobe Acrobat Reader can be downloaded at* http://www.adobe.com*.*

Solution: Follow the same approach as outlined in Appendix A.1.1.2. The Section, Township and Range lines are shown on Figure A.7. Use this information with the PDF map file in DDMSW to locate the project cells. Inspection of the DDMSW PDF Index Map shows that the subject watershed lies on Maps 20, 21, 26, and 27 as shown on Figure A.8. Inspection of these four maps with the section, township and range data yields the following cell numbers listed by Map Number and shown graphically on Figure A.9 through Figure A.12:

Figure A.7 Unit Hydrograph Method watershed limits map



Map 20: 38-40, 78-80, 118-120, 157-160, 197-200, 237-240, 277-280, 317-320, 357-360, 397-400, 438-440, 477-480, 517-520, 558-560, and 598-600.

Map 21: 1-3, 41-43, 81-84, 121-125, 161-168, 201-209, 241-251, 281-293, 321-334, 361-380, 401-420, 441-460, 481-501, 521-541, 561-583, 606-624, 646-650, 656-665, 687-688, 701-705, 742-745, and 782-783.

Map 26: 1799-1800, 1839-1840, 1878-1880, 1917-1920, 1958-1960, and 1999-2000.

Map 27: 1801, 1841-1842, 1881-1882, 1921-1922, and 1961-1963.

In DDMSW, establish a new project then perform the following steps:

1. Open menu item *Hydrology|Rainfall*.
2. Set the *Data Source* to Manual.
3. Click on the *Maps* button to load the PDF of the NOAA Atlas 14 Index Maps.
4. Locate the project site on the overview index page and see that detailed Map Numbers 20, 21, 26, and 27 are needed.
5. Examine PDF pages 21, 22, 27, and 28 to find Map Numbers 20, 21, 26, and 27, respectively. Determine the cell numbers listed above for each map.
6. Close the PDF file and return to DDMSW.
7. Use the *Multiple Map Selection Menu*. The table on the left side of the wind with the headings *Map*, *From*, and *To*, should be empty.
8. Click on *Add*.
9. Click on the *Magnifying Glass* icon to the right of *Map Index* and select Map 20.
10. Enter 38 in the *From* field and 40 in the *To* field. Click Save.
11. Click on *Add*.
12. Enter 78 in the *From* field and 80 in the *To* field. Click Save.
13. Repeat Steps 11 and 12 for the remaining cells on Map 20.
14. Follow Steps 8 through 13 for cells on Maps 21, 26, and 27.
15. Click on *Update*. The *Average Rainfall Data for Project* table should be updated and match the values listed in Table A.15.

Figure A.8 DDMSW NOAA Atlas 14 Index Map

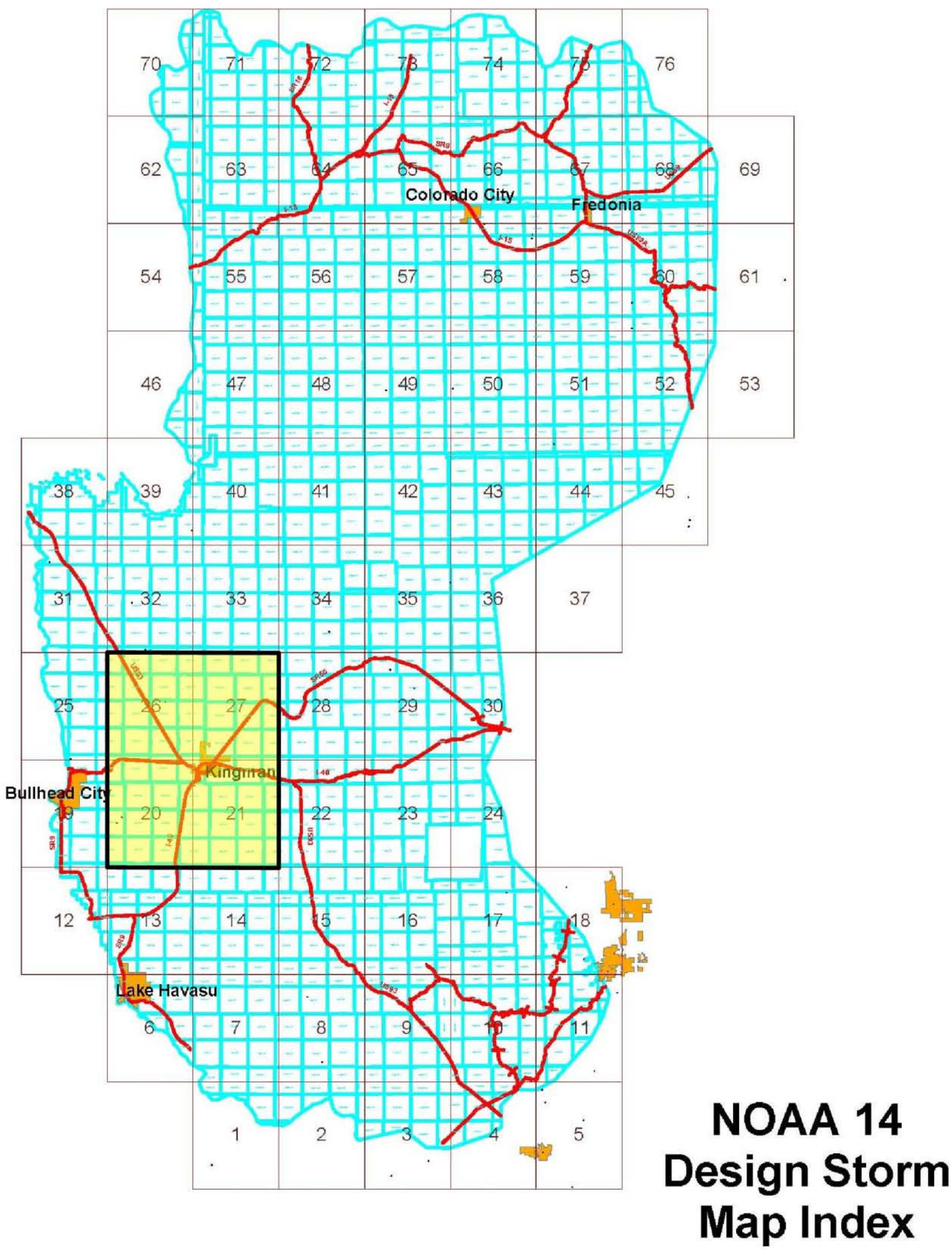


Figure A.9 DDMSW NOAA Atlas 14 Map 26

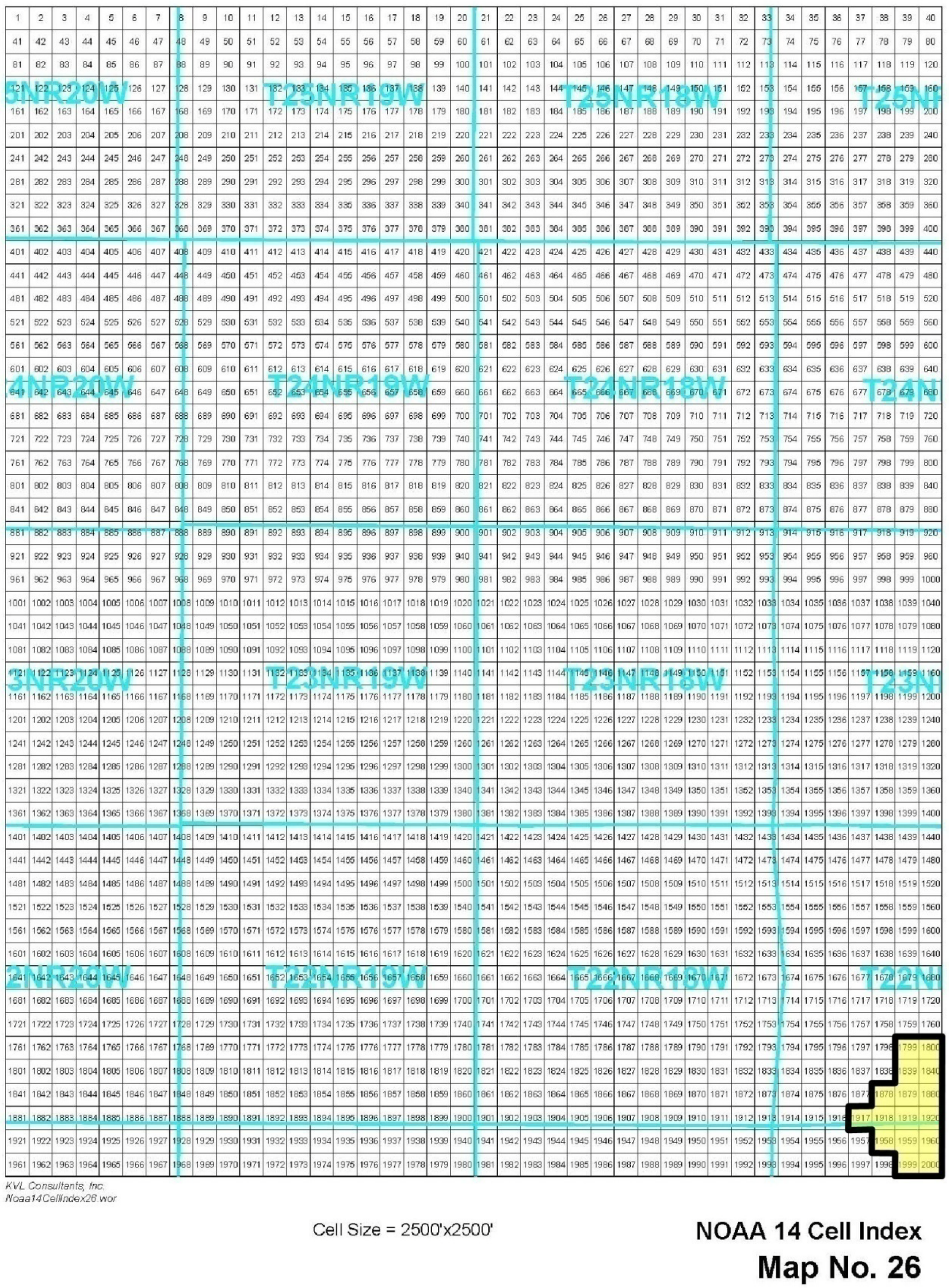
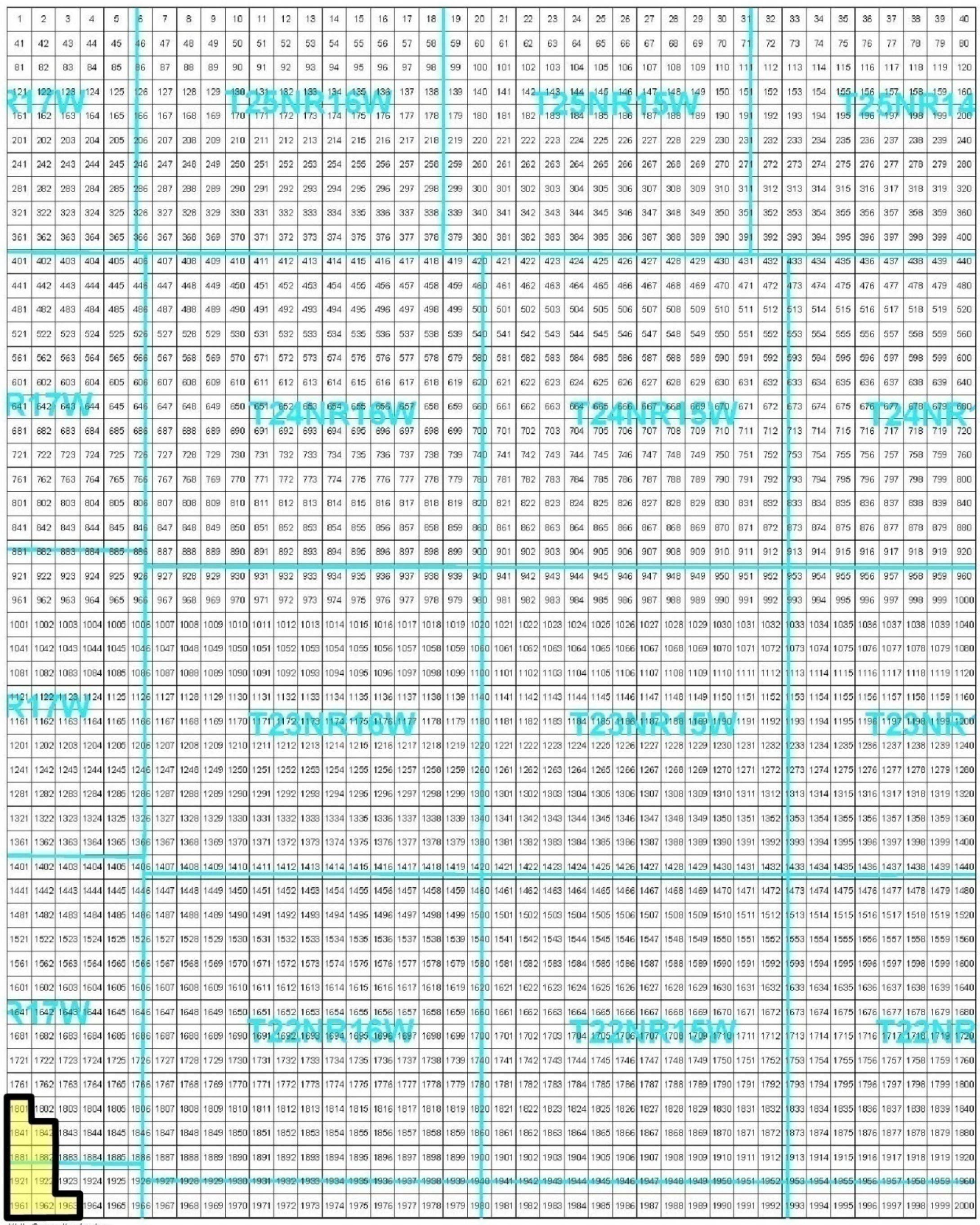


Figure A.10 DDMSW NOAA Atlas 14 Map 27



KVL Consultants, Inc.
Noaa14CellIndex27.wor

Cell Size = 2500'x2500'

NOAA 14 Cell Index

Map No. 27

Figure A.11 DDMSW NOAA Atlas 14 Map 20

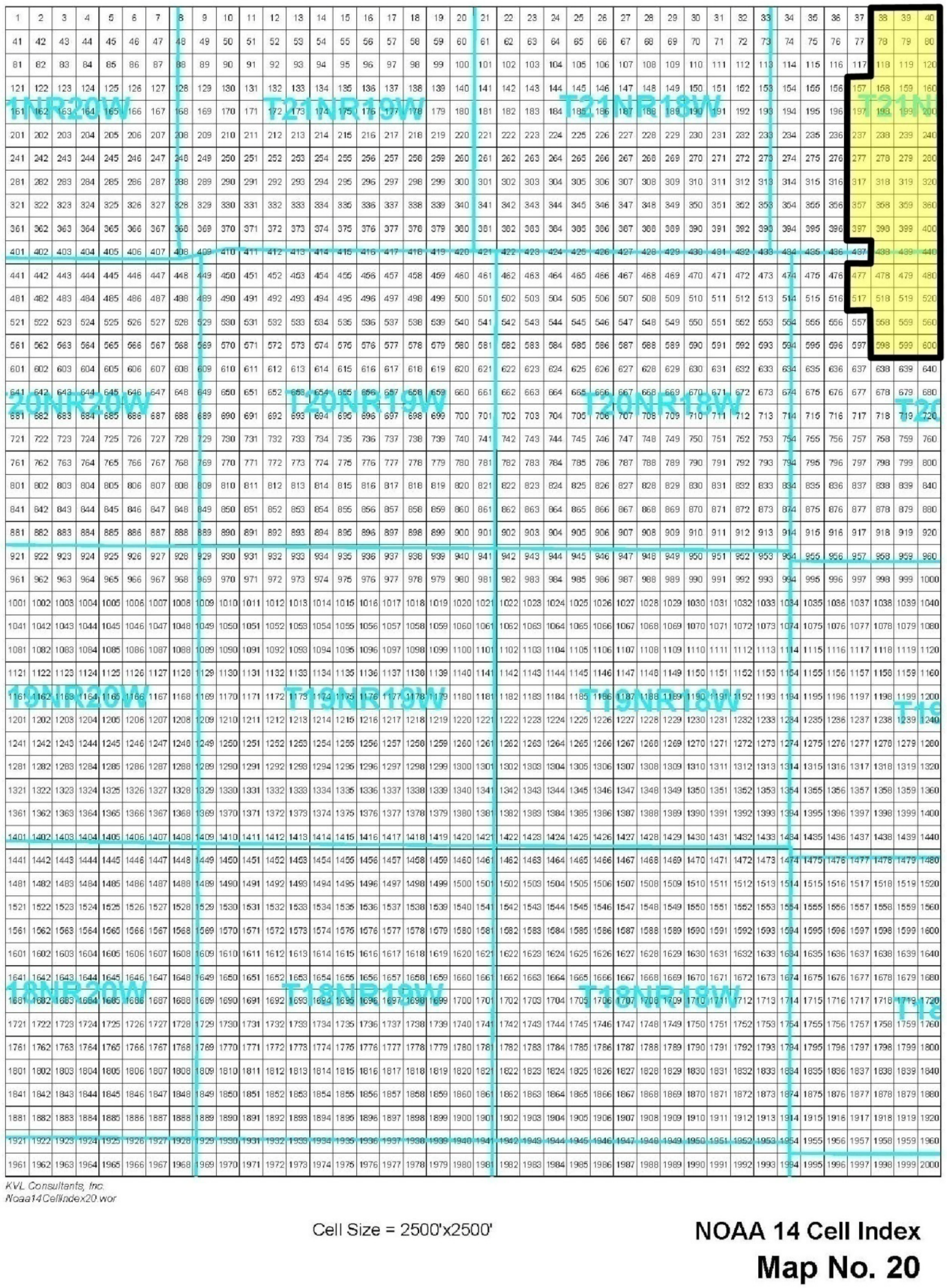


Figure A.12 DDMSW NOAA Atlas 14 Map 21

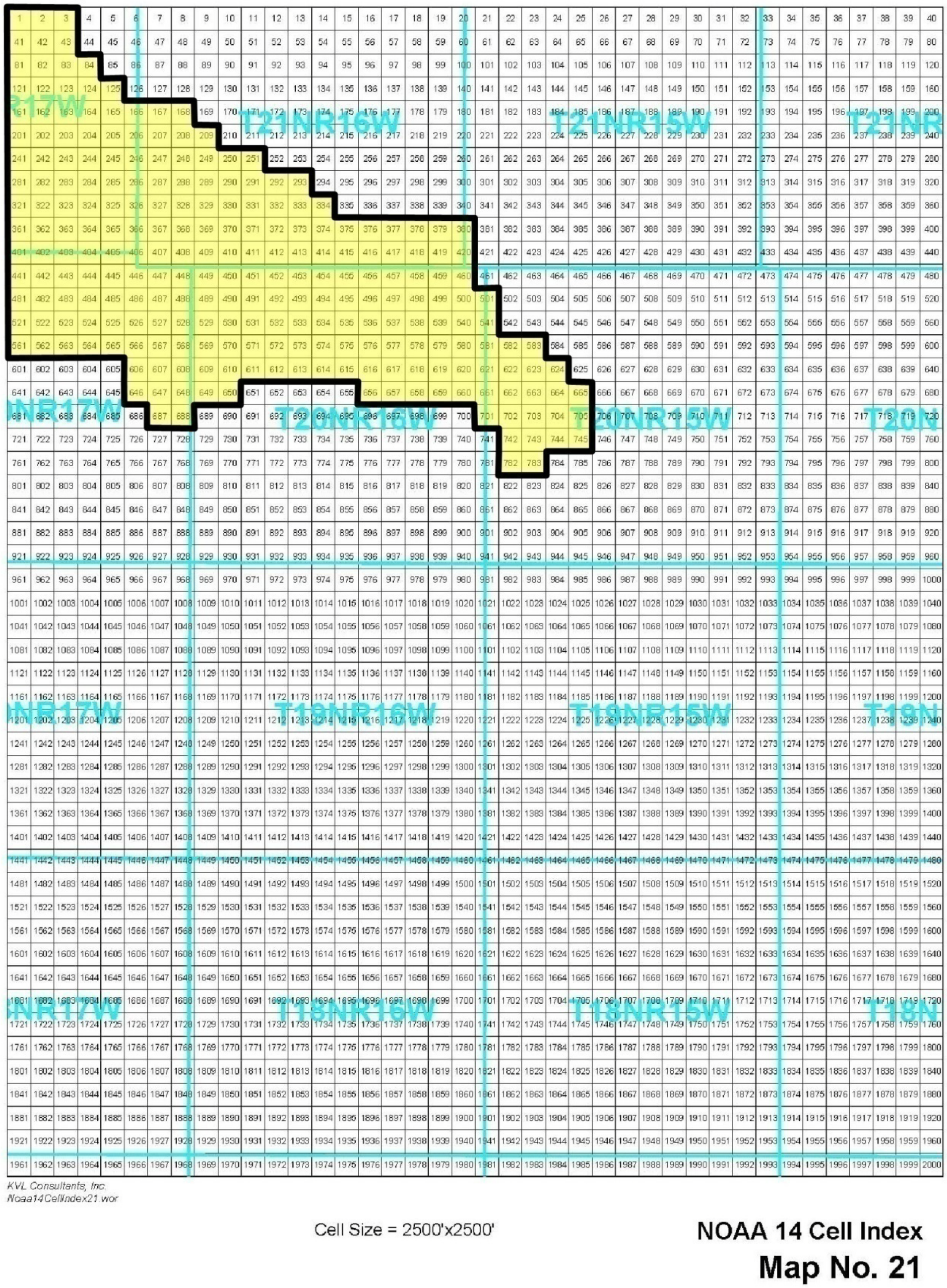


Table A.8 Rainfall D-D-F for Unit Hydrograph Example (DDMSW mm)

(estimated using the DDMSW Manual Method)

Duration	Rainfall Depth, in inches					
	Storm Frequency, in years					
	2	5	10	25	50	100
5-min	0.258	0.365	0.441	0.544	0.623	0.705
10-min	0.393	0.555	0.671	0.828	0.948	1.073
15-min	0.488	0.688	0.832	1.027	1.175	1.330
30-min	0.657	0.927	1.120	1.383	1.582	1.791
1-hour	0.813	1.147	1.387	1.711	1.958	2.217
2-hour	0.898	1.271	1.562	1.966	2.300	2.655
3-hour	0.962	1.342	1.652	2.094	2.466	2.873
6-hour	1.132	1.554	1.892	2.382	2.784	3.225
12-hour	1.325	1.813	2.207	2.751	3.200	3.672
24-hour	1.623	2.228	2.701	3.371	3.908	4.479

The data in Table A.8 can then be used to prepare the needed input data for the HEC-1 PH and JD records as shown in Table A.9 and Table A.10.

Table A.9 Unit Hydrograph Method point precipitation estimate(DDMSW mm)

(results using the DDMSW Manual Method)

ID	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Watershed	0.705	1.330	2.217	2.655	2.873	3.225	3.672	4.479

Depth-area reduction factors for the 100-year 24-hour storm are determined using the data in Table 7.3. The results are shown in Table A.10.

Table A.10 Unit Hydrograph Method depth-area reduction (DDMSW manual)

Watershed Area	Depth-Area Factor	Areally Reduced Precipitation
0	1.000	4.479
10	0.950	4.255
20	0.919	4.116
30	0.900	4.031
40	0.887	3.973
50	0.877	3.928
60	0.870	3.897
70	0.863	3.865

A.1.2.4 Example using the DDMSW GIS Method

Solution: Create an ESRI shape file containing a polygon of the total study watershed area. The fields required for the various ESRI shape files used within DDMSW are listed in Table A.4. Note that the rainfall shape file for the overall watershed boundary polygon only requires one field, the Major Basin ID. For this example, a polygon of the entire watershed is used to obtain a watershed-specific D-D-F for the study area (Figure A.6). DDMSW overlays the polygon on the NOAA Atlas 14 rain cell grid, which is a GIS version of the grids shown in the PDF file used for the DDMSW manual method (see Figure A.8 through Figure A.12). The grid cells that touch and are contained within the polygon are selected and an average point precipitation depth computed for each frequency-duration combination. To implement the GIS approach using DDMSW, the following steps should be followed. For this example, the results are shown in Table A.11.

1. Open menu item *Hydrology|Rainfall*.
2. Set the *Data Source* to GIS.
3. Click on the *Select* button and point DDMSW to the desired polygon of the entire watershed under consideration.

Click on *Update*.

Be sure to verify that the correct projection and coordinate system is assigned to the GIS shape file used for the watershed limits, as described in Appendix A.1.1.3.

Table A.11 Rainfall D-D-F for unit hydrograph example (DDMSW GIS)

(estimated using the DDMSW GIS Method)

Duration	Rainfall Depth, in inches Storm Frequency, in years					
	2	5	10	25	50	100
5-min	0.259	0.365	0.441	0.545	0.623	0.706
10-min	0.394	0.555	0.672	0.829	0.949	1.074
15-min	0.488	0.688	0.833	1.028	1.176	1.332
30-min	0.657	0.927	1.121	1.384	1.584	1.794
1-hour	0.813	1.147	1.388	1.713	1.961	2.220
2-hour	0.899	1.273	1.564	1.968	2.304	2.659
3-hour	0.963	1.343	1.654	2.097	2.469	2.877
6-hour	1.133	1.556	1.894	2.385	2.788	3.229
12-hour	1.327	1.815	2.210	2.755	3.204	3.677
24-hour	1.624	2.231	2.704	3.375	3.913	4.484

The data in Table A.11 can then be used to prepare the needed input data for the HEC-1 PH and JD records as shown in Table A.12 and Table A.13.

Table A.12 Unit Hydrograph Method point precipitation estimate(DDMSW GIS)

(results using the DDMSW GIS Method)

ID	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Watershed	0.706	1.332	2.220	2.659	2.877	3.229	3.677	4.484

Depth-area reduction factors for the 100-year 24-hour storm are determined using the data in Table 7.3. The results are shown in Table A.13.

Table A.13 Unit Hydrograph Method depth-area reduction (DDMSW GIS)

Watershed Area	Depth-Area Factor	Areally Reduced Precipitation
0	1.000	4.484
10	0.950	4.260
20	0.919	4.121
30	0.900	4.036
40	0.887	3.977
50	0.877	3.932
60	0.870	3.901
70	0.863	3.870

A.1.2.5 Comparison of Methods

The results from the three methods for use with the HEC-1 PH and JD records are compared in Table A.14.

Table A.14 Unit Hydrograph Method point precipitation estimate(DDMSW GIS)

(results using the DDMSW GIS Method)

Method	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
Manual	0.70	1.31	2.20	2.65	2.83	3.40	3.70	4.50
DDMSW Manual	0.705	1.330	2.217	2.655	2.873	3.225	3.672	4.479
DDMSW GIS	0.706	1.332	2.220	2.659	2.877	3.229	3.677	4.484

The most accurate results are expected from the DDMSW FIS Method, so the other two methods are compared with it. Note that the Manual Method has the highest error, especially for the 100-year 24-hour point precipitation. The DDMSW Manual Method and the DDMSW GIS Method are close enough that there is no practical difference. The Manual Method is most acceptable for small watersheds where the difference in point precipitation values are small across the watershed. The DDMSW methods should be used for larger watersheds.

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A.2 RATIONAL METHOD EXAMPLE

A.2.1 PROBLEM STATEMENT

A 212.3 acre mixed-use residential and commercial development is planned in Kingman, AZ for the tract of land shown on Figure A.13. One of the watersheds (71.38 acres) that is contained entirely within the site has been delineated into three (3) sub-basins using available topographic mapping and the proposed street drainage patterns. A storm drain is to be constructed to convey runoff from the residential areas through the commercial tract.

Determine the 10-year, post-development peak discharge at concentration points CP 1 (storm drain inlet) and CP 2 (storm drain outlet). Use both the combined watershed and triangular hydrograph method approaches as defined in Section 7.3.3.2. Compare the results.

A.2.2 GIVEN PARAMETERS

Rainfall depth-duration-frequency statistics were prepared as described in Appendix A.1 and the results listed in Table A.15 and Table A.16.

Time of concentration and land use area data are listed in Table A.17.

The resistance coefficient for all three sub-basins is 0.025 per Table 7.4.

The maximum permissible velocity in the storm drain is 6 fps, and the storm drain length is 918 feet, as shown on Figure A.13.

The land use zoning classifications proposed are:

R-1, 2 acre minimum = LDR Land Use Code
R-1, 0.5 acre minimum = LDR Land Use Code
R-MH, 7,000 sf lots = MDR Land Use Code
C-1, Neighborhood Commercial = C1 Land Use Code

Table A.15 Rainfall Depth-Duration-Frequency for Kingman, AZ (DDMSW GIS)

(estimated using the DDMSW GIS Method)

	Rainfall Depth, in inches					
	Storm Frequency, in years					
Duration	2	5	10	25	50	100
5-min	0.252	0.355	0.428	0.526	0.600	0.676
10-min	0.384	0.541	0.652	0.801	0.913	1.029
15-min	0.477	0.670	0.808	0.993	1.131	1.275
30-min	0.642	0.903	1.088	1.337	1.523	1.717
1-hour	0.794	1.117	1.347	1.655	1.885	2.125
2-hour	0.873	1.233	1.512	1.896	2.213	2.546
3-hour	0.935	1.302	1.600	2.024	2.381	2.767
6-hour	1.100	1.509	1.835	2.306	2.692	3.116
12-hour	1.284	1.755	2.136	2.658	3.089	3.540
24-hour	1.586	2.175	2.634	3.283	3.801	4.353

Table A.16 Rainfall Intensity-Duration-Frequency for Kingman, AZ (DDMSW GIS)

(computed using the data in Table A.15)

	Rainfall Intensity, in inches/hour					
	Storm Frequency, in years					
Duration	2	5	10	25	50	100
5-min	3.024	4.260	5.136	6.312	7.200	8.112
10-min	2.304	3.246	3.912	4.806	5.478	6.174
15-min	1.908	2.680	3.232	3.972	4.524	5.100
30-min	1.284	1.806	2.176	2.674	3.046	3.434
1-hour	0.794	1.117	1.347	1.655	1.885	2.125
2-hour	0.437	0.617	0.756	0.948	1.107	1.273
3-hour	0.312	0.434	0.533	0.675	0.794	0.922
6-hour	0.183	0.252	0.306	0.384	0.449	0.519
12-hour	0.107	0.146	0.178	0.222	0.257	0.295
24-hour	0.066	0.091	0.110	0.137	0.158	0.181

Figure A.13 Rational Method watershed and land use map

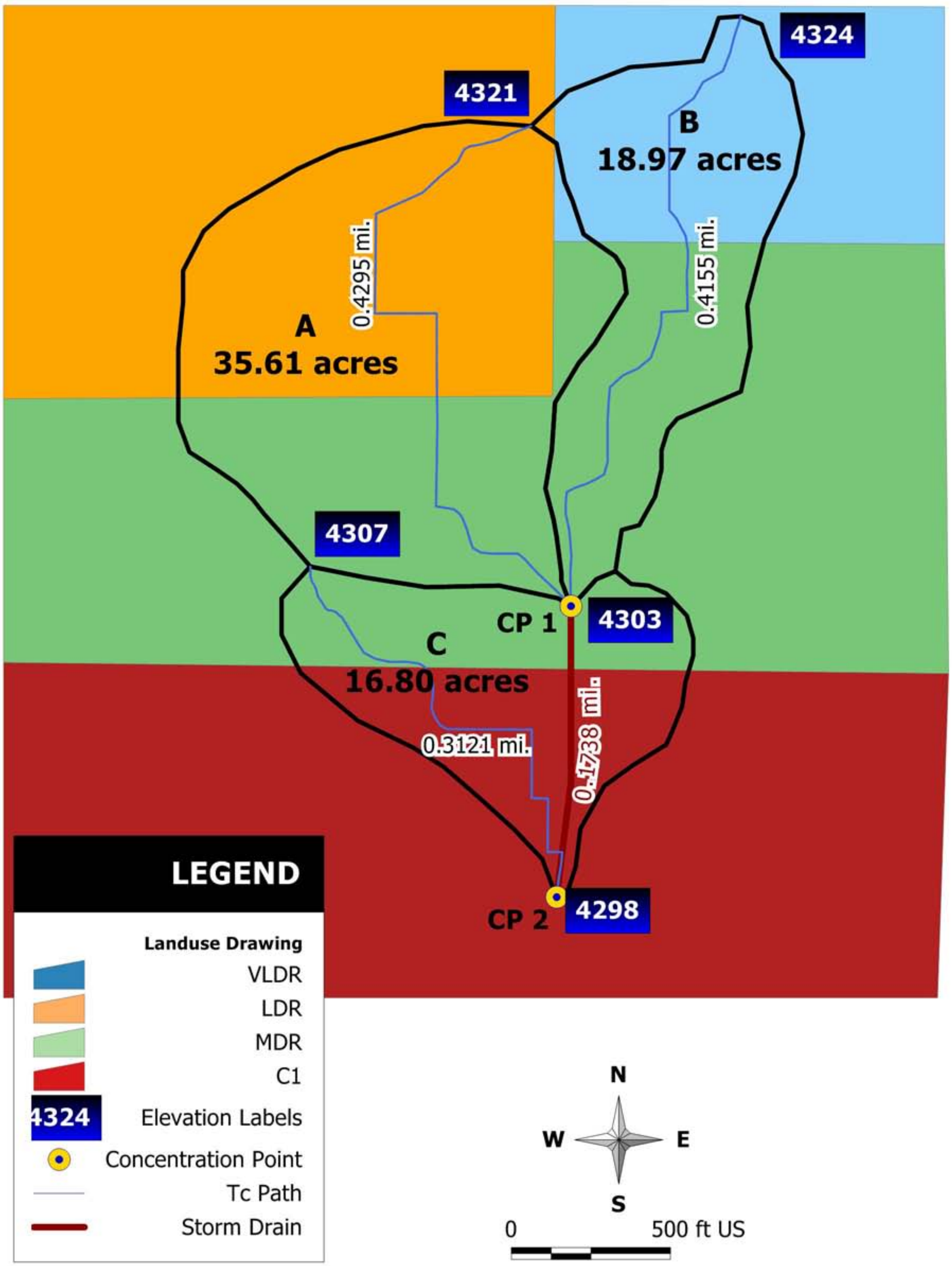


Table A.17 T_c and land use data

Sub-basin ID	T_c Computation Data			Land Use Area, acres				Total Drainage Area, acres
	Length, miles	Slope, ft./mi.	K_b	VLDR (114)	LDR (140)	MDR (160)	C1 (220)	
A	0.4295	41.9	0.025	0.36	20.25	15.00	0.00	35.61
B	0.4155	50.5	0.025	9.44	0.11	9.42	0.00	18.97
C	0.3121	28.8	0.025	0.00	0.00	7.61	9.19	16.80
			TOTALS:	**9.80**	**20.36**	**32.03**	**9.19**	**71.38**

A.2.3 SOLUTION USING MANUAL METHODS

1. Area: The areas for each sub-basin, and each land use within each sub-basin, were determined using available topographic mapping and are provided in Table A.17.

C: The C values for each land use were selected from Table 7.19 and are shown in Table A.18.

Table A.18 Rational Method example, land use C coefficients

DDMSW ID	Zoning Classification	Hydrologic Classification	Land Use Code	C	K_b
114	R-1, 2 acre	Very Low Density Residential	VLDR	0.42	0.04
140	R-1, 0.5 acre	Low Density Residential	LDR	0.48	0.04
160	R-MH, 7,000 sf	Medium Density Residential	MDR	0.60	0.025
220	C-1, Neighborhood Commercial	Commercial	C1	0.83	0.025

Compute the arithmetically area-weighted C value for sub-basins A, B, and C; A+B; and A+B+C, using the areas from Table A.17 and the C values from Table A.18:

NOTE: Composite C values are normally rounded to the nearest hundredth.

Sub-basin A:

$$C_w = \frac{(0.42)(0.36)+(0.48)(20.25)+(0.60)(15.00)}{35.61} = 0.53$$

Sub-basin B:

$$C_w = \frac{(0.42)(9.44)+(0.48)(0.11)+(0.60)(9.42)}{18.97} = 0.51$$

Sub-basin C:

$$C_w = \frac{(0.60)(7.61)+(0.83)(9.19)}{16.80} = 0.73$$

Sub-basins A + B:

$$C_w = \frac{(0.53)(35.61)+(0.51)(18.97)}{54.58} = 0.52$$

Sub-basins A + B + C:

$$C_w = \frac{(0.53)(35.61)+(0.51)(18.97)+(0.73)(16.80)}{71.38} = 0.57$$

The computed runoff coefficients (C) are:

Sub-basin A: 0.53

Sub-basin B: 0.51

Sub-basin C: 0.73

Sub-basin A + B: 0.52

Sub-basin A + B + C: 0.57

T_c Parameters:

L: The T_c flow paths were defined on the topographic mapping and measured. The lengths are tabulated in Table A.17.

S: The T_c paths were inspected and found to have a reasonably constant slope. The slopes were calculated in feet/mile using the lengths and elevations shown on Figure A.13 and tabulated in Table A.17.

K_b: Compute the arithmetically area-weighted K_b value for sub-basins A, B, and C; A+B; and A+B+C, using the areas from Table A.17 and the K_b values from Table A.18:

Sub-basin A:

$$K_{b_w} = \frac{(0.04)(0.36)+(0.04)(20.25)+(0..025)(15.00)}{35.61} = 0.034$$

Sub-basin B:

$$K_{b_w} = \frac{(0.04)(9.44)+(0.04)(0.11)+(0..025)(9.42)}{18.97} = 0.033$$

Sub-basin C:

$$K_{b_w} = 0.025$$

Sub-basins A + B:

$$K_{b_w} = \frac{(0.034)(35.61)+(0.033)(18.97)}{54.58} = 0.034$$

Sub-basins A + B + C:

$$K_{b_w} = \frac{(0.034)(35.76)+(0033)(18.97)+(0.025)(16.80)}{71.38} = 0.032$$

NOTE: K_b estimates are normally rounded to the nearest hundredth.

The computed K_b estimates are:

Sub-basin A: 0.03

Sub-basin B: 0.03

Sub-basin C: 0.03

Sub-basin A + B: 0.03

Sub-basin A + B + C: 0.03

Compile the rainfall data (already complete, see Table A.15 and Table A.16).

T_c: Compute T_c for sub-basins A, B, C, A + B, and A + B + C:

Sub-basin A:

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

$$T_c = 11.4(0.4295)^{0.5}(0.03)^{0.52}(41.9)^{-0.31}i^{-0.38}$$

$$T_c = 0.379i^{-0.38}$$

Estimate an initial T_c. Assume 5 fps velocity.

T_c = L/V = 2,268/5*60 = 8 min

From Table A.16:

$$i = \big((8-5)/(10-5)\big) * (3.91 - 5.14) + 5.14 = 4.4\ inches/hour$$

NOTE: Estimates of *i* are normally rounded to the nearest tenth of an inch per hour.

$$T_c = 0.379(4.4)^{-0.38} = 0.216\ hours = 13.0\ minutes$$

Recompute i for T_c = 13.8 minutes

$$i = \big((13.0-10)/(15-10)\big) * (3.23 - 3.91) + 3.91 = 3.5\ inches/hour$$

$$T_c = 0.379(3.5)^{-0.38} = 0.235\ hours = 14.1\ minutes$$

Recompute i for T_c = 14.1 minutes

$$i = \big((14.1-10)/(15-10)\big) * (3.23 - 3.91) + 3.91 = 3.4\ inches/hour$$

$$T_c = 0.379(3.4)^{-0.38} = 0.238\ hours = 14.3\ minutes$$

Difference is less than 2%. Use T_c = 14 min, i = 3.4 inches/hour

Sub-basin B:

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

$$T_c = 11.4(0.4155)^{0.5}(0.03)^{0.52}(50.5)^{-0.31}i^{-0.38}$$

$$T_c = 0.352i^{-0.38}$$

Estimate an initial T_c. Assume 4 fps velocity.

T_c = L/V = 2193/4*60 = 9 min

From Table A.16:

$$i = \big((9-5)/(10-5)\big) * (3.91 - 5.14) + 5.14 = 4.2\ inches/hour$$

$$T_c = 0.352(4.2)^{-0.38} = 0.204\ hours = 12.2\ minutes$$

Recompute i for T_c = 12.2 minutes

$$i = \big((12.2-10)/(15-10)\big) * (3.23 - 3.91) + 3.91 = 3.6\ inches/hour$$

$$T_c = 0.352(3.6)^{-0.38} = 0.216\ hours = 13.0\ minutes$$

Recompute i for T_c = 13.0 minutes

$$i = \big((13.0-10)/(15-10)\big) * (3.23 - 3.91) + 3.91 = 3.5\ inches/hour$$

$$T_c = 0.352(3.5)^{-0.38} = 0.219\ hours = 13.1\ minutes$$

Difference is less than 2%. Use T_c = 13 min, i = 3.5 inches/hour

Sub-basin C:

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

$$T_c = 11.4(0.3121)^{0.5}(0.03)^{0.52}(28.8)^{-0.31}i^{-0.38}$$

$$T_c = 0.363i^{-0.38}$$

Estimate an initial T_c. Assume 4 fps velocity.

T_c = L/V = 1648/4*60 = 6.9 min

From Table A.16:

$$i = \big((6.9 - 5)/(10 - 5)\big) * (3.91 - 5.14) + 5.14 = 4.7\ inches/hour$$

$$T_c = 0.363(4.7)^{-0.38} = 0.202\ hours = 12.1\ minutes$$

Recompute i for T_c = 12.1 minutes

$$i = \big((12.1 - 10)/(15 - 10)\big) * (3.23 - 3.91) + 3.91 = 3.6\ inches/hour$$

$$T_c = 0.363(3.6)^{-0.38} = 0.223\ hours = 13.4\ minutes$$

Recompute i for T_c = 13.4 minutes

$$i = \big((13.4 - 10)/(15 - 10)\big) * (3.23 - 3.91) + 3.91 = 3.4\ inches/hour$$

$$T_c = 0.363(3.4)^{-0.38} = 0.228\ hours = 13.7\ minutes$$

Recompute i for T_c = 13.7 minutes

$$i = \big((13.7 - 10)/(15 - 10)\big) * (3.23 - 3.91) + 3.91 = 3.4\ inches/hour$$

$$T_c = 0.363(3.4)^{-0.38} = 0.228\ hours = 13.7\ minutes$$

Difference is less than 2%. Use T_c = 14 min, i = 3.4 inches/hour

Sub-basin A + B:

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

Use the longest L, which is sub-basin A, and the T_c from sub-basin A, assuming that a K_b of 0.034 will have negligible effect on T_c.

Use T_c = 14 min, i = 3.4 inches/hour

Sub-basin A + B + C:

$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$

L = 2268 + 918 = 3186 ft

S = (4321-4298)/3186/5280 = 38.1 feet/mile

$T_c = 11.4(0.6034)^{0.5}(0.03)^{0.52}(38.1)^{-0.31}i^{-0.38}$

$T_c = 0.462i^{-0.38}$

Estimate an initial T_c. Assume 4 fps velocity.

T_c = L/V = 3186/4*60 = 13.3 min

From Table A.16:

$i = \left((13.3 - 10)/(15 - 10)\right) * (3.23 - 3.91) + 3.91 = 3.5\ inches/hour$

$T_c = 0.462(3.5)^{-0.38} = 0.287\ hours = 17.2\ minutes$

Recompute i for T_c = 17.2 minutes

$i = \left((17.2 - 15)/(30 - 15)\right) * (2.18 - 3.23) + 3.23 = 3.1\ inches/hour$

$T_c = 0.462(3.1)^{-0.38} = 0.301\ hours = 18.1\ minutes$

Recompute i for T_c = 18.1 minutes

$i = \left((18.1 - 15)/(30 - 15)\right) * (2.18 - 3.23) + 3.23 = 3.0\ inches/hour$

$T_c = 0.462(3.0)^{-0.38} = 0.304\ hours = 18.3\ minutes$

Difference is less than 2%. Use T_c = 18.0 min, i = 3.0 inches/hour

To summarize:

Sub-basin A: T_c = 14 min, i = 3.4 inches/hour

Sub-basin B: Use T_c = 13 min, i = 3.5 inches/hour

Sub-basin C: Use T_c = 14 min, i = 3.4 inches/hour

Sub-basin A + B: Use T_c = 14 min, i = 3.4 inches/hour

Sub-basin A + B + C: Use T_c = 18.0 min, i = 3.0 inches/hour

Compute Q for each Sub-basin using the Combined Watershed Approach:

Sub-basin A: $Q_{10} = CiA = (0.53)(3.4)(35.61) = 64\ cfs$

Sub-basin B: $Q_{10} = CiA = (0.51)(3.5)(18.97) = 34\ cfs$

Sub-basin C: $Q_{10} = CiA = (0.73)(3.4)(16.80) = 42\ cfs$

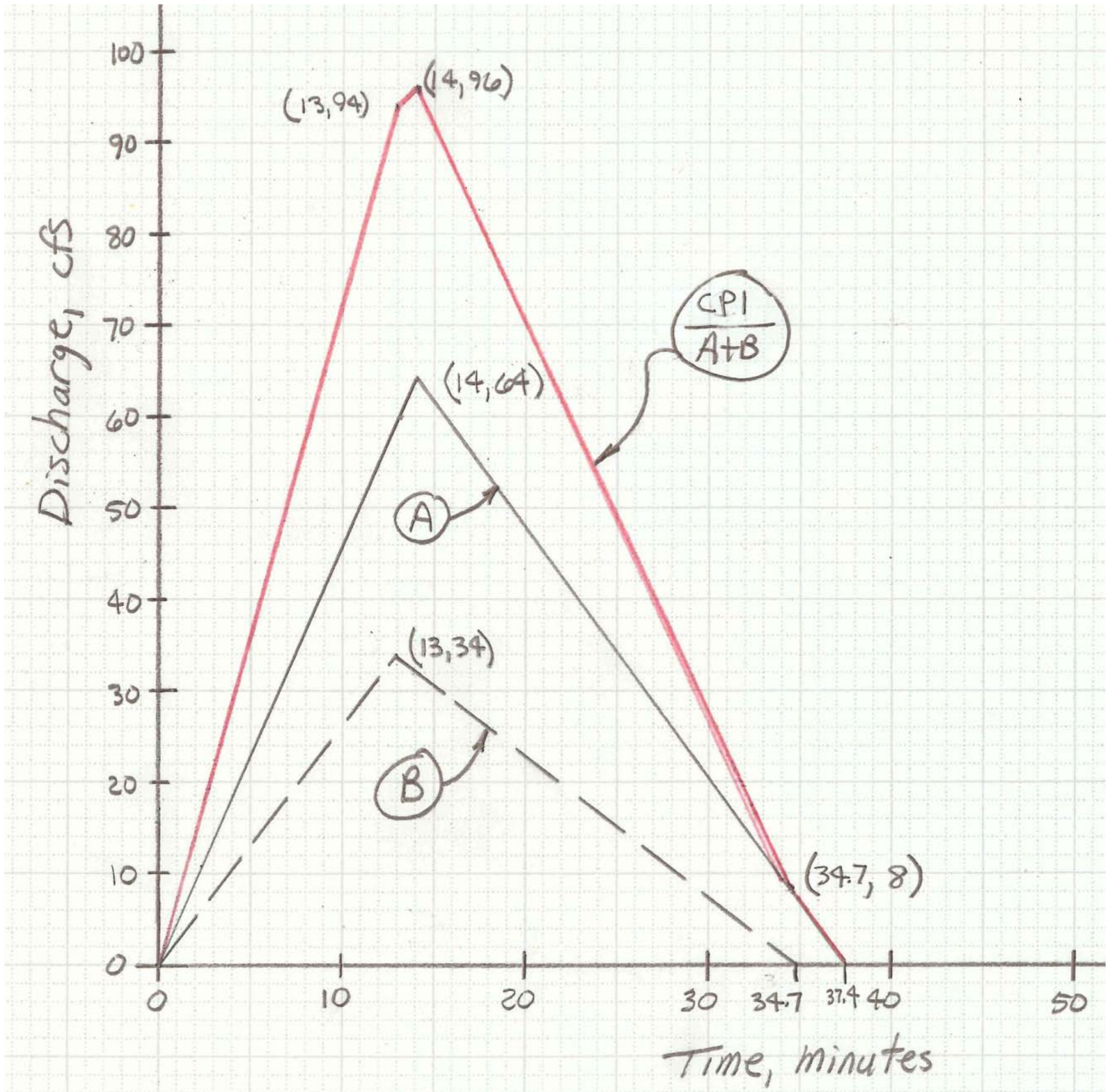
Sub-basin A + B: $Q_{10} = CiA = (0.52)(3.4)(54.58) = 97\ cfs$

Sub-basin A + B + C: $Q_{10} = CiA = (0.57)(3.0)(71.38) = 122\ cfs$

Compute Q for each sub-basin using the manual Triangular Hydrograph Approach:

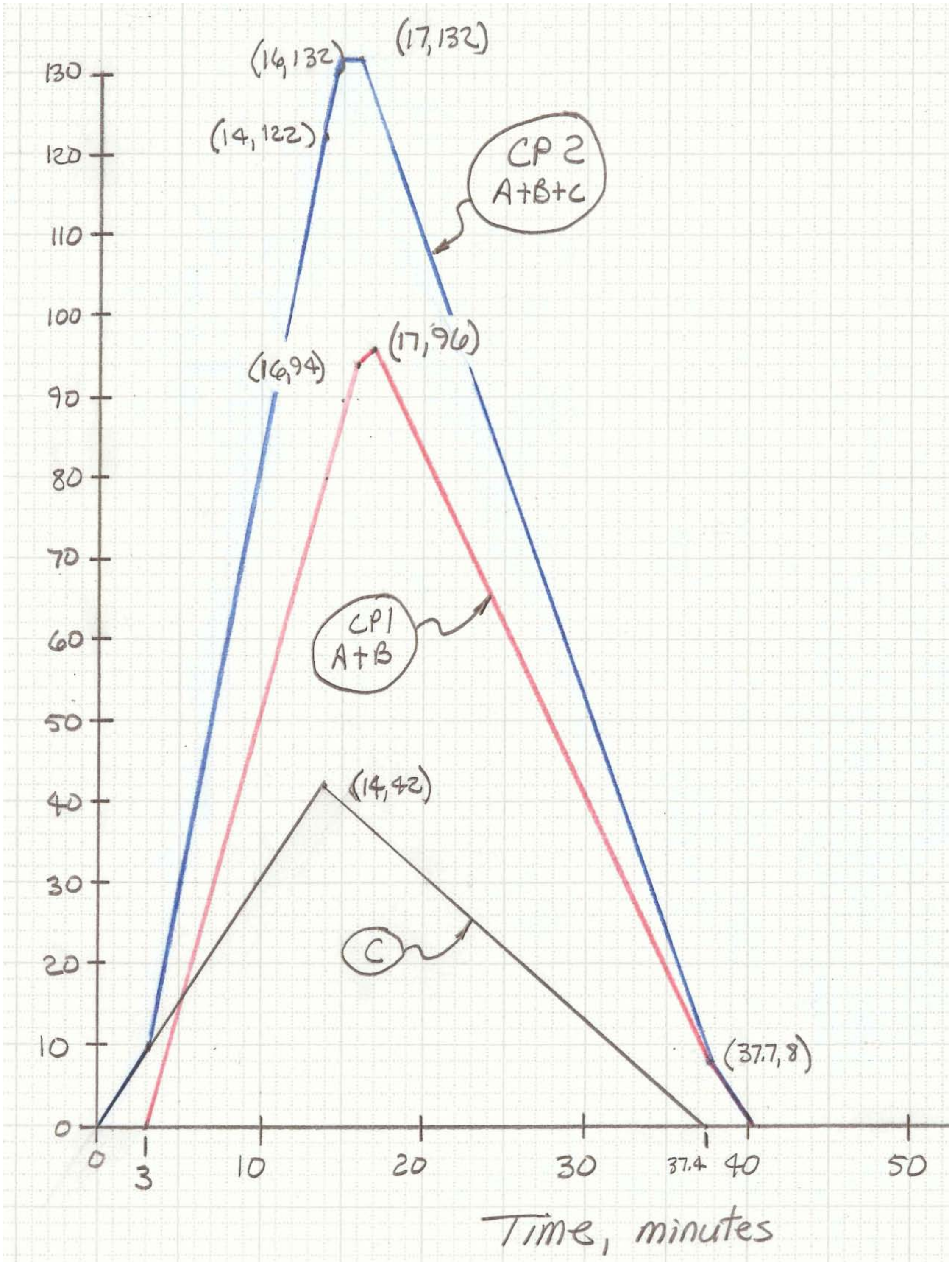
Use Figure 7.9 to construct a triangular hydrograph for both sub-basin A and sub-basin B. Then add the ordinates of the two hydrographs to estimate the total flow at CP 1 as shown on Figure A.14.

Figure A.14 10-year Rational Method hydrographs at CP 1



Lag the hydrograph for CP 1 in relation to the hydrograph for sub-basin C and plot as shown on Figure A.15. Assume that the travel time for flow from CP 1 to CP 2 is the length of the storm drain divided by 6 fps. The length of the storm drain is 918 ft. At 6 fps, the estimated travel time is about 3 minutes. Therefore, lag the hydrograph from CP 1 (sub-basin A + sub-basin B) by 3 minutes in relation to the hydrograph from sub-basin C. Then add the ordinates of the two hydrographs to estimate the total flow at CP 2.

Figure A.15 10-year Rational Method hydrographs at CP 2



The total peak discharge at the two concentration points is estimated to be:

CP 1: Q_{10} = 96 cfs at 14 minutes.

CP 2: Q_{10} = 133 cfs at 17 minutes.

The results of the two multiple basin approaches are summarized in Table A.19. Note that the results compare favorably with the exception of the peak discharge at CP 2. There is a 1-minute difference in time-to-peak between the two methods, contributing to the difference in peak discharge of 10 cfs.

The Triangular Hydrograph results should be revised using the actual velocity in the storm drain for a peak discharge of 96 cfs. Assuming a 54-inch diameter CMP storm drain, it is determined that the full flow capacity is only about 79 cfs. Therefore, the design is revised to use two 54-inch CMP's with a full flow capacity of about 157 cfs and a velocity of about 4.9 fps, which provides factor of safety. The design could be refined to use smaller pipes, and of course other physical constraints may affect the final pipe size selection. For a storm drain length of 918 feet, the travel time is approximately 3.1 minutes. The lag of 3 minutes is still a valid assumption.

In general, the accepted approach is to use the Triangular Hydrograph Method when applying the Rational Method in Mohave County; however, the Combined Watershed Method may be used when performing the hydrology computations manually.

A.2.4 SOLUTION USING DDMSW

The DDMSW computer program applies only the Triangular Hydrograph Method. The general steps for using the Rational Method under DDMSW are as follows:

1. *File|Select Project*. Create a new project and set the model project default to Rational.
2. *Hydrology|Rainfall*. Establish the rainfall criteria as described in Appendix A.1.1.
3. Sub-Basin and Land Use Data, GIS Method:
    a. Create shape files for the sub-basins, land use and Tc paths, making sure the required fields exist and are populated. Make sure the projection and coordinate system are the Mohave County standard.
    b. *Maps|Update Hydrology*. Set the pointers to the path and file name for the sub-basins, land use and T_c GIS shape files. Click *Save*, then click *Update*.
    c. *Hydrology|Sub Basins*. Check data to be sure it was imported properly. Click *Update*.
    d. *Hydrology|Land Use*. Check data to be sure it was imported properly. Click *Update*.

Sub-Basin and Land Use Data, Manual Method.

a. *Hydrology|Sub Basins*. Enter the sub-basin data manually and click *Update*.

b. *Hydrology|Land Use*. Enter land use data manually and click *Update*.

Hydrology|Rational Method|Network. Click Add and select *Type* sub-basin. Select the *ID* for the first sub-basin. Click Save. Repeat for all sub-basins.

Hydrology|Rational Method|Model. Select desired return periods and click *Run Model*. Click *Results,* then click *View* and select the return period you want to review first. Check for reasonableness. Click *Graph* and review hydrographs for reasonableness. Click *View* and select another return period (assuming you ran the model with multiple return periods selected). Repeat for all storm return periods modeled.

Hydraulics|Conveyance Facilities. If conveyance facilities such as storm drains are to be modeled, add them in.

Hydrology|Rational Method|Network. Add in the Conveyance Facilities defined, and add in any hydrograph combines. Place in the proper order to simulate the flow progression.

Repeat Step 6.

The DDMSW 10-year results for the example problem are shown on Figure A.16, Figure A.17, and Figure A.18. One of the many advantages of using DDMSW is that the results can easily be obtained for multiple return periods (not shown for this example).

Figure A.16 DDMSW 10-year Rational Method results

County of Mohave
Drainage Design Management System
RATIONAL METHOD FLOW SUMMARY
Project Reference: MOHAVE RATIONAL 1
Return Period: 10 Years

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Type	Model ID		Size	Area (acres)	CA (acres)	I (in/hr)	Q (cfs)	Velocity (ft/sec)	Length (feet)	Tp (min)	Tc (min)
Major Basin: 01											
Sub Basin	A			35.6	18.87	3.36	63.4				14
Sub Basin	B			19.0	9.67	3.49	33.7				13
Combine	C1			54.6	28.54	3.31	94.4				14
Convey	P1	*	2-54" Dia Pipe	54.6	28.54	3.36	95.9	4.9	918	3.1	14
Sub Basin	C			16.8	12.27	3.36	41.2				14
Combine	C2			71.4	40.81	3.20	130.5				17

A.2.5 COMPARISON OF RESULTS

The results prepared using DDMSW are compared with the Manual Method results in Table A.19. Note that the DDMSW method produces more accurate computations, but when rounded are nearly identical to the Manual Method results.

Figure A.17 DDMSW 10-year Rational Method hydrographs at CP 1

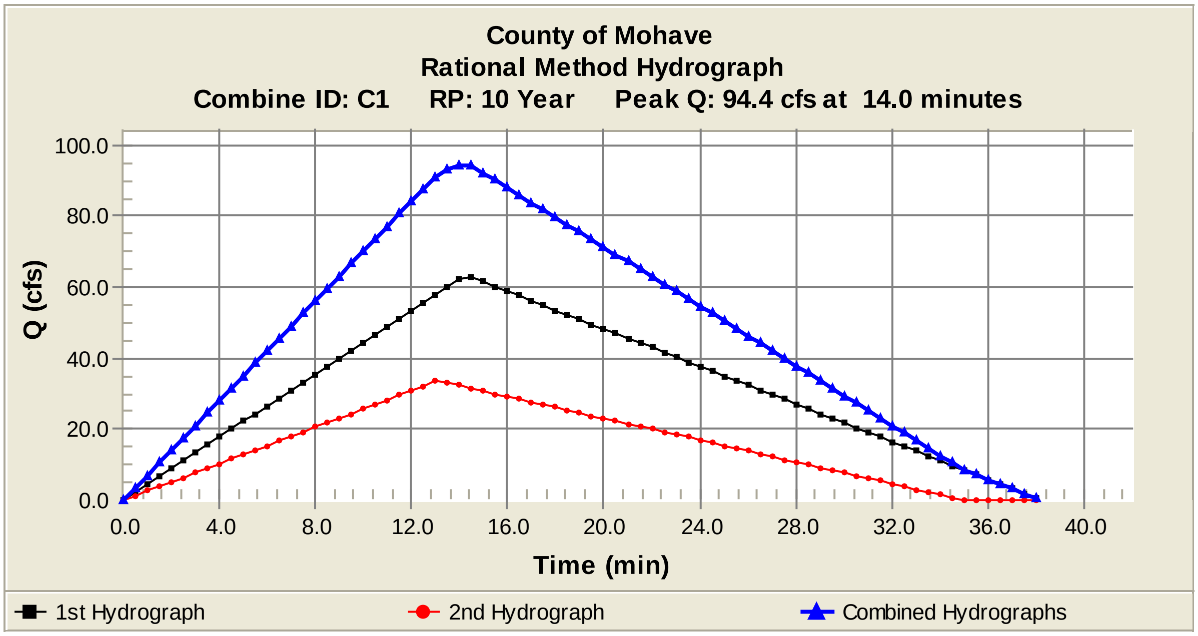


Figure A.18 DDMSW 10-year Rational Method hydrographs at CP 2

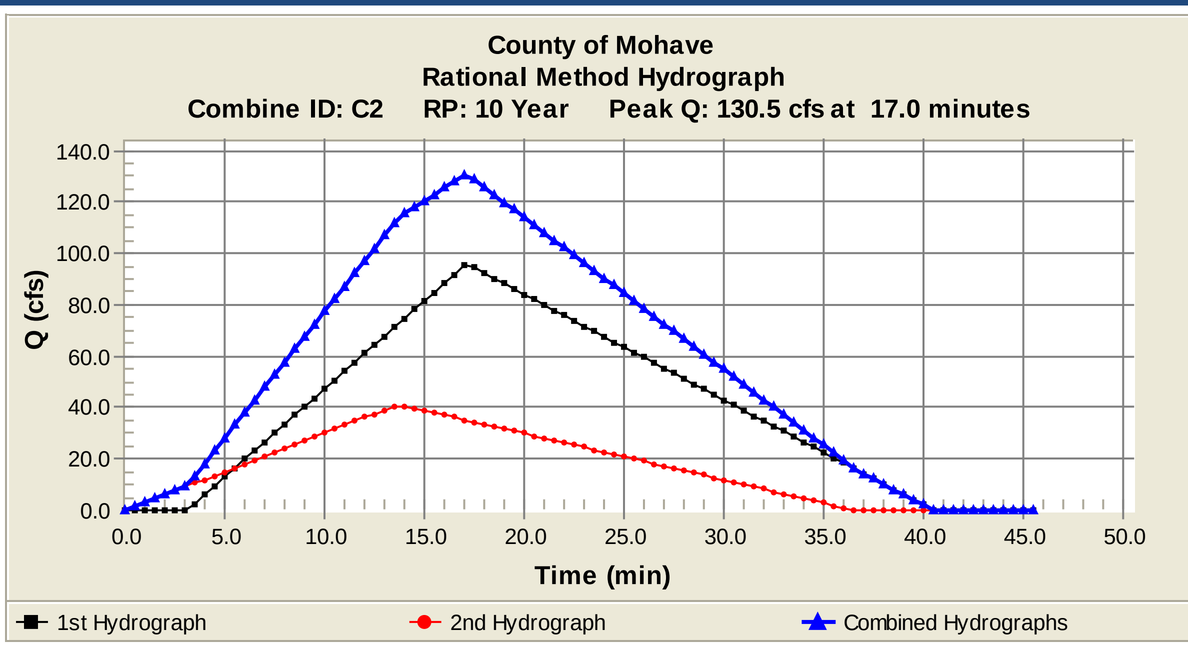


Table A.19 Summary of results for the various methods

Location	Manual Method		Triangular Hydrograph Method			
			Manual Method		DDMSW	
	Q_{10}, cfs	T_p, min.	T_p, min.	Q_{10}, cfs	T_p, min	Q_{10}, cfs
Sub-basin A	64	14	14	64	14.3	63.4
Sub-basin B	34	13	13	34	13.1	33.7
CP 1	97	14	14	96	14.0	95.9
Sub-basin C	42	14	14	42	13.7	41.2
CP 2	122	18	17	132	17.0	130.5

A.3 RAINFALL LOSSES EXAMPLE

This section pertains to estimating rainfall loss parameters for use with the unit hydrograph method. Refer to Section 7.4 for a description of the methodology used. Refer to Appendix D for a complete description of the Green and Ampt parameters used in Mohave County and derived from NCRS databases and GIS coverages.

A.3.1 EXAMPLE FOR GREEN AND AMPT METHOD

A.3.1.1 Problem Statement

Rainfall loss parameters for use with the Green and Ampt method are needed for a HEC-1 model of a large watershed within, and south of, Kingman, AZ. The site is located as shown on Figure A.6. Derive the parameters and prepare the HEC-1 rainfall loss records for the model using the instructions set forth in Section 7.4.4. There are three methods that can be used:

1. Manual Computations. Computations are performed by hand or with a calculator.
2. DDMSW Manual Input. Areas and other parameters are determined by the most expedient means available and then manually input to DDMSW. DDMSW then computes rainfall loss parameters for each sub-basin.
3. DDMSW GIS Method. Sub-basin boundaries, soil map unit boundaries and land use boundaries are created in ERSI GIS shape file format external to DDMSW, read into DDMSW, and then DDMSW performs the rainfall loss parameter computations for each sub-basin using the GIS information.

A.3.1.2 Problem Solution

The solution consists of several steps, which are common to all methods.

1. Watershed delineation.
2. Watershed slope evaluation.
3. Land use definition.
4. Soil Map Unit definition.
5. Concentration point definition and Sub-basin delineation.
6. Computation of sub-basin composite initial abstraction.
7. Computation of sub-basin composite bare ground XKSAT.
8. Assignment of PSIF and DTHETA.
9. Computation of sub-basin composite vegetation cover density (VCD).
10. Computation of XKSAT adjusted for vegetation canopy cover.

11. Estimation of sub-basin composite RTIMP.
12. Preparation of the HEC-1 rainfall loss input records.

Step 1. Watershed Delineation.

The bottom end of the study watershed is normally a known point that is the focus of the study. The upstream watershed should first be delineated using the best available topographic information. USGS quadrangle maps covering the watershed, in combination with the 10-meter resolution USGS digital elevation maps (DEM), were used for delineation of the watershed boundaries shown on Figure A.6.

Step 2. Watershed Slope Evaluation.

It is very helpful to assess the range of slopes present on the watershed. This information is useful when deciding how the watershed should be delineated into sub-basins, and for the assignment natural land use classifications (undeveloped desert, hillslopes, or mountain terrain), which are slope dependant. The USGS DEM's of the watershed were used to prepare Figure A.19. Slope ranges defined were less than 5%, greater than 5%, and greater than 20%. This information was used to define simplified natural terrain polygons for the three classifications, as shown on Figure A.20, which is the natural land use map. The land use codes (LUCODE) shown on Figure A.20 are related to terrain classification in Table A.20.

Table A.20 Natural land use codes

LUCODE	Description
500	Undeveloped Desert Rangeland. Little topographic relief, slopes <5%.
510	Hillslopes, Sonoran Desert. Moderate topographic relief, slopes >5%.
520	Mountain Terrain. High topographic relief, slopes >20%.

Step 3. Land Use Definition.

Definition of land use spatial limits is necessary to estimate the impervious area (RTIMP), developed vegetation canopy cover (VCD), Initial Abstraction (IA), and the areas where the soil moisture deficit at start of rainfall (DTHETA) are assumed to be have a normal value. The standard Mohave County land use/zoning map in GIS shape file format was used to define the land uses for the areas in the unincorporated County. Land use polygons for the area within Kingman were drawn in GIS using the USGS quadrangle maps and knowledge of the area. These land use types and limits are for the purposes of this example only and are not an accurate representation of actual land uses in the area. The urban land use map was combined with the natural land use map to produce a comprehensive land use GIS shape file coverage of the entire watershed. Refer to Figure A.21.

Figure A.19 Unit Hydrograph Method watershed slope variation map

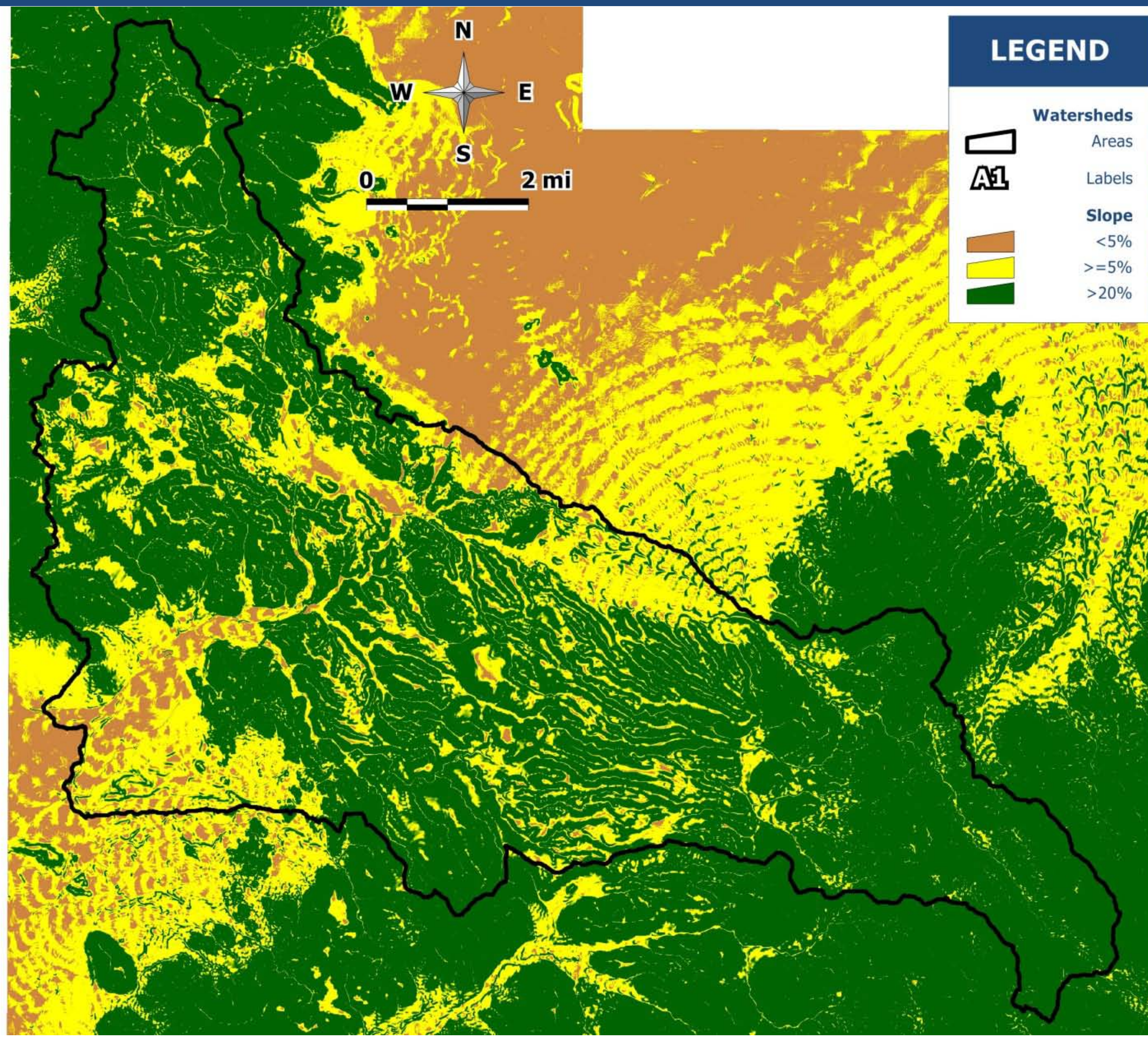


Figure A.20 Unit Hydrograph Method natural terrain classification map

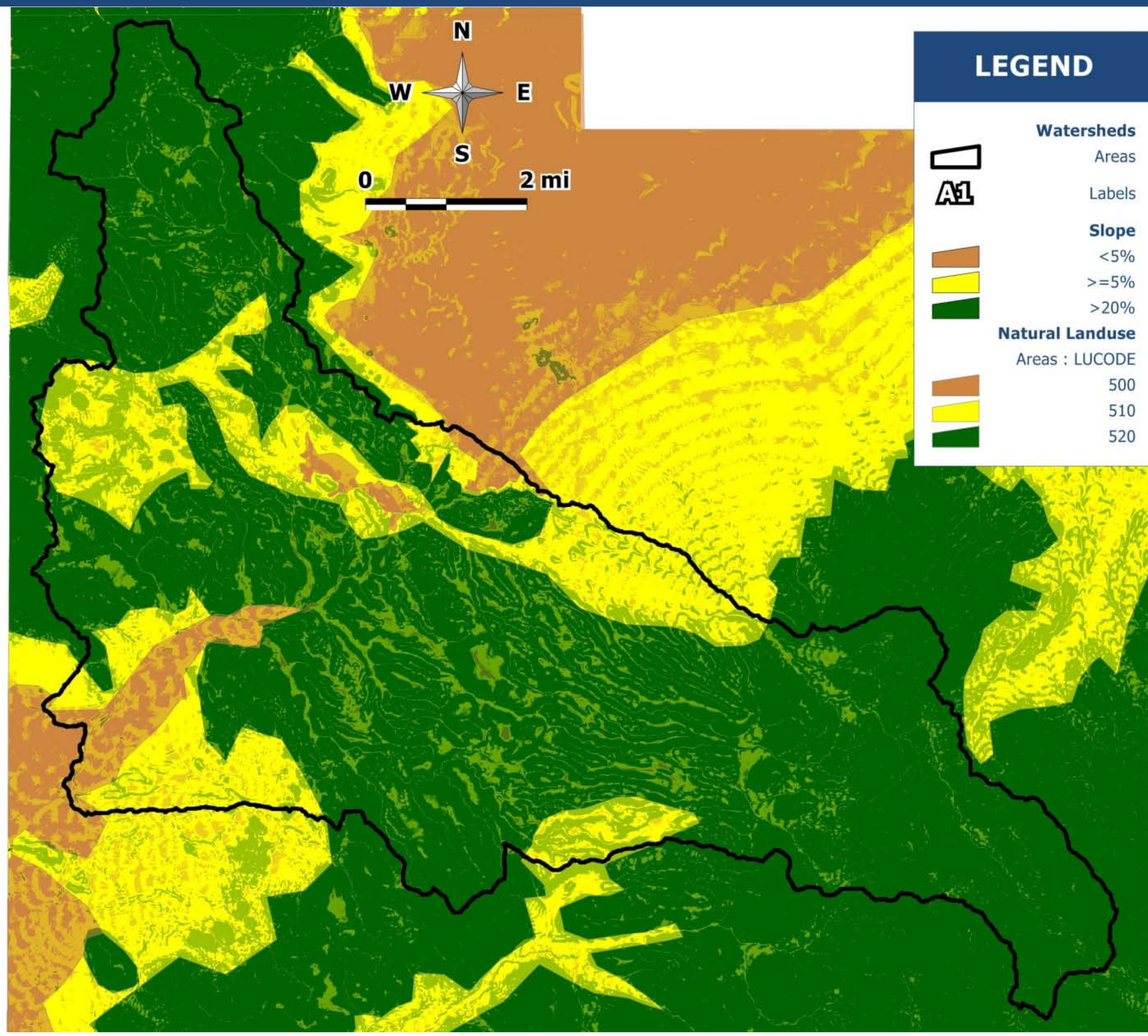
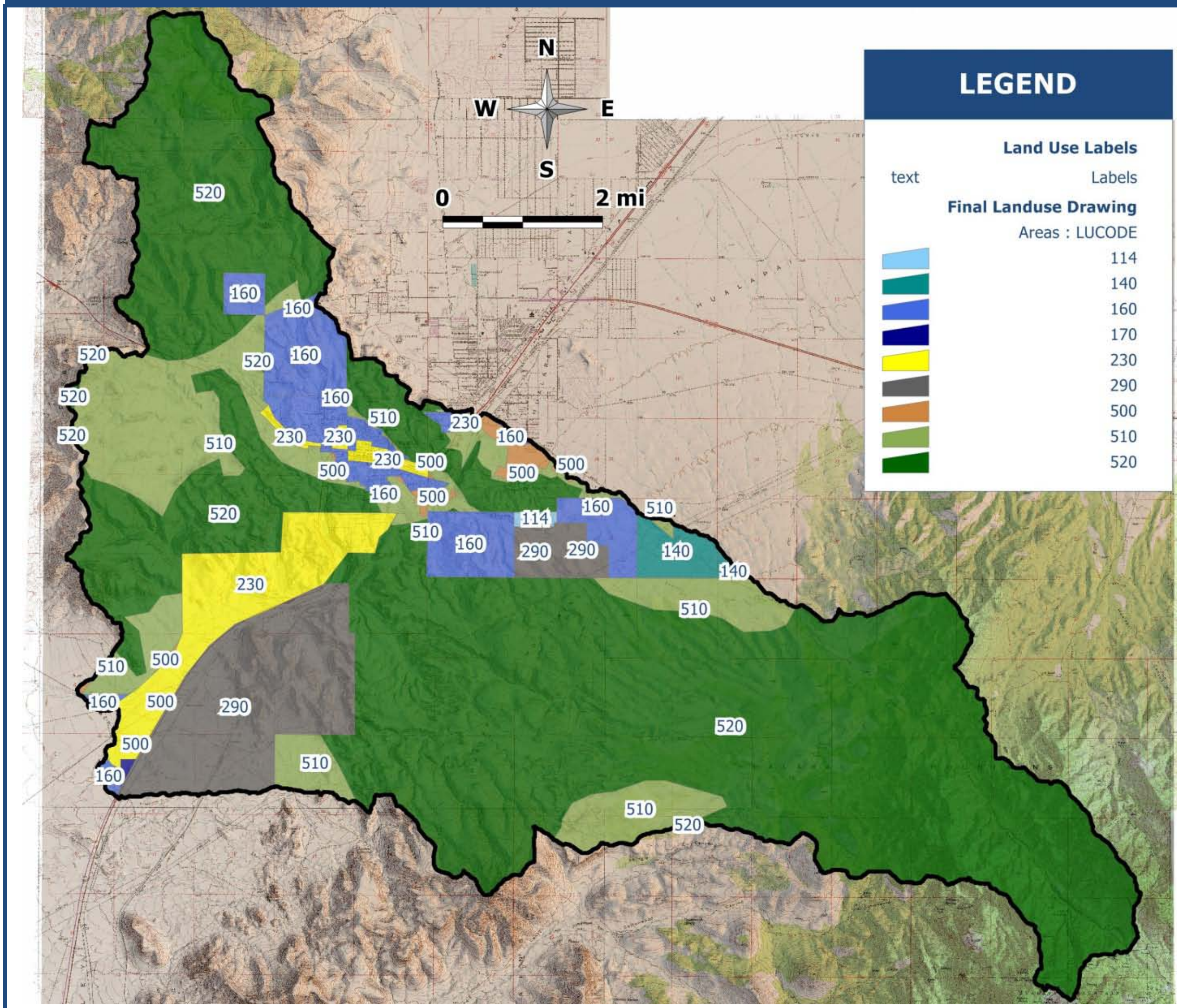


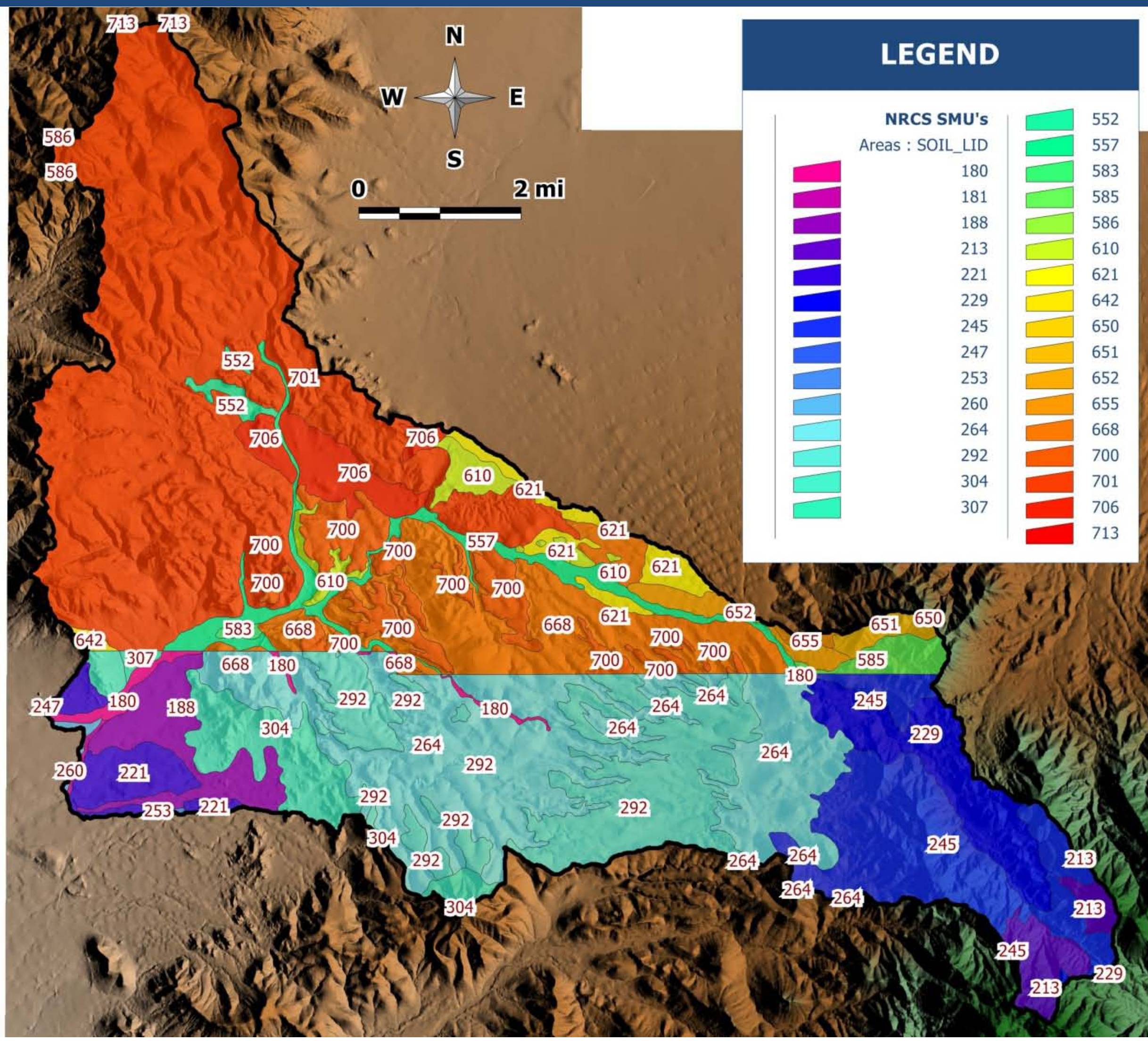
Figure A.21 Unit Hydrograph Method combined land use map



Step 4. Soil Map Unit Definition.

The NRCS soil map units (SMU) present in each sub-basin are needed for estimation of saturated hydraulic conductivity (XKSAT), the wetting front capillary suction (PSIF), and DTHETA. The NRCS soil map units for all Mohave County watersheds are available in GIS shape file format. The soil map unit boundaries for the watershed are shown on Figure A.22. The NRCS soils data for the watershed were used to define sub-areas for this example. Each sub-area polygon defines the limits of an NRCS soil map unit (SMU). These sub-area polygons are used to define natural impervious area and to estimate the Green and Ampt rainfall loss parameters.

Figure A.22 Unit Hydrograph Method soil map units map



Step 5. Concentration Point Definition and Sub-basin Delineation.

The watershed should be broken into sub-basins if hydrologic parameters such as topography, land use, soil characteristics, vegetation, or percent impervious area vary significantly. The sub-basins should be as homogeneous as possible in terms of those parameters. For this example, significant changes in slope and differences in land ownership occur between the upper and lower watersheds; therefore, the watershed is divided into nine (9) sub-basins as shown on Figure A.23. The land use types with the delineated sub-basins superimposed are shown on Figure A.24. The soil map units with the delineated sub-basins superimposed are shown on Figure A.25. Further delineation of sub-basins A2 and A3 would be warranted for an actual study because of the change in land use from natural to urban and the need for concentration points where off-site watersheds impact the developed area. Sub-basin A5 could also be split again because of slope change. Further sub-basin delineation would make this example more complex and harder to follow and therefore was not done.

Computation of the rainfall loss parameters using manual methods will be done for sub-basin A3. Computation of the rainfall loss parameters for the other sub-basins will be done using DDMSW.

Figure A.23 Unit Hydrograph Method sub-basin delineation map

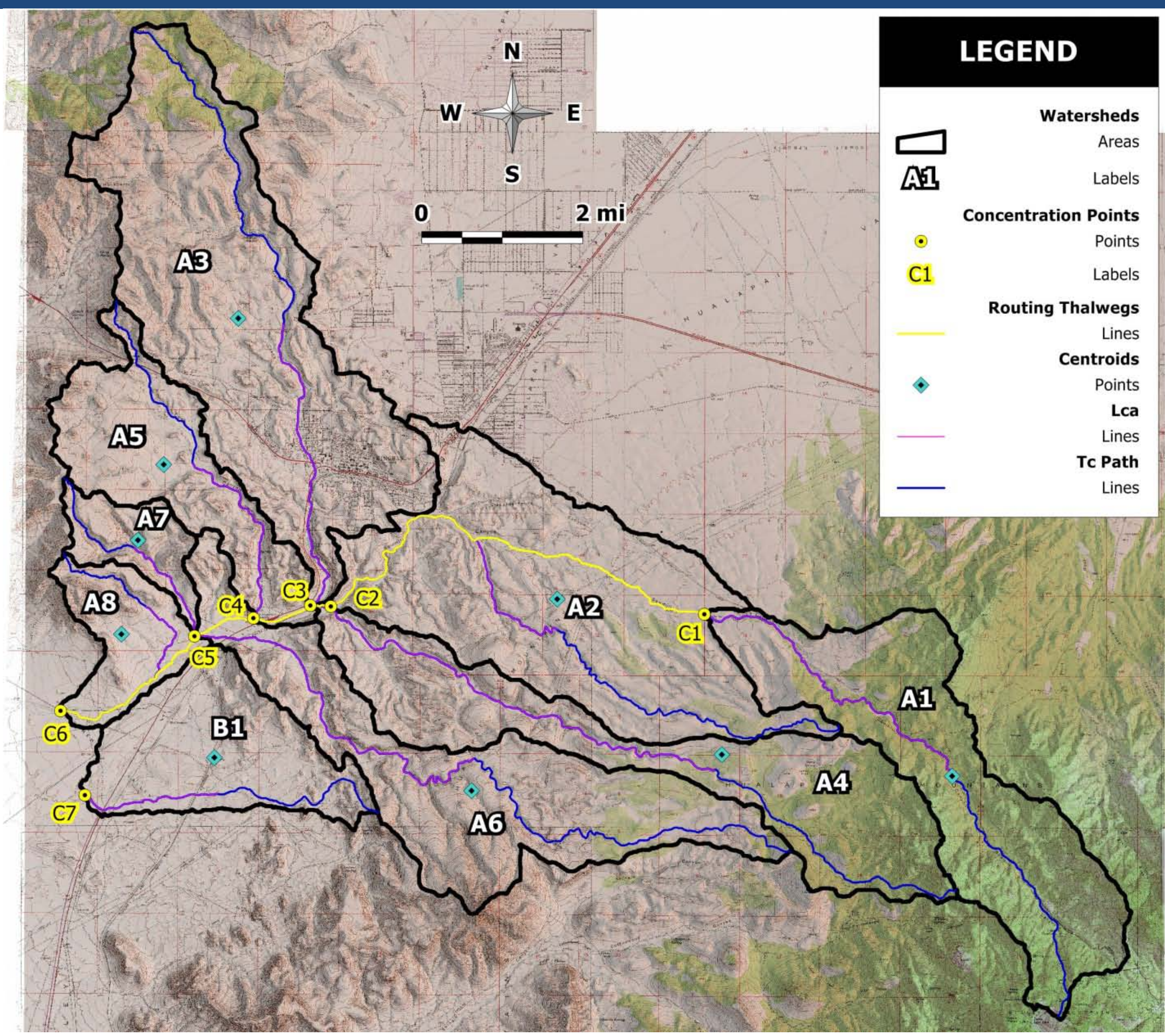
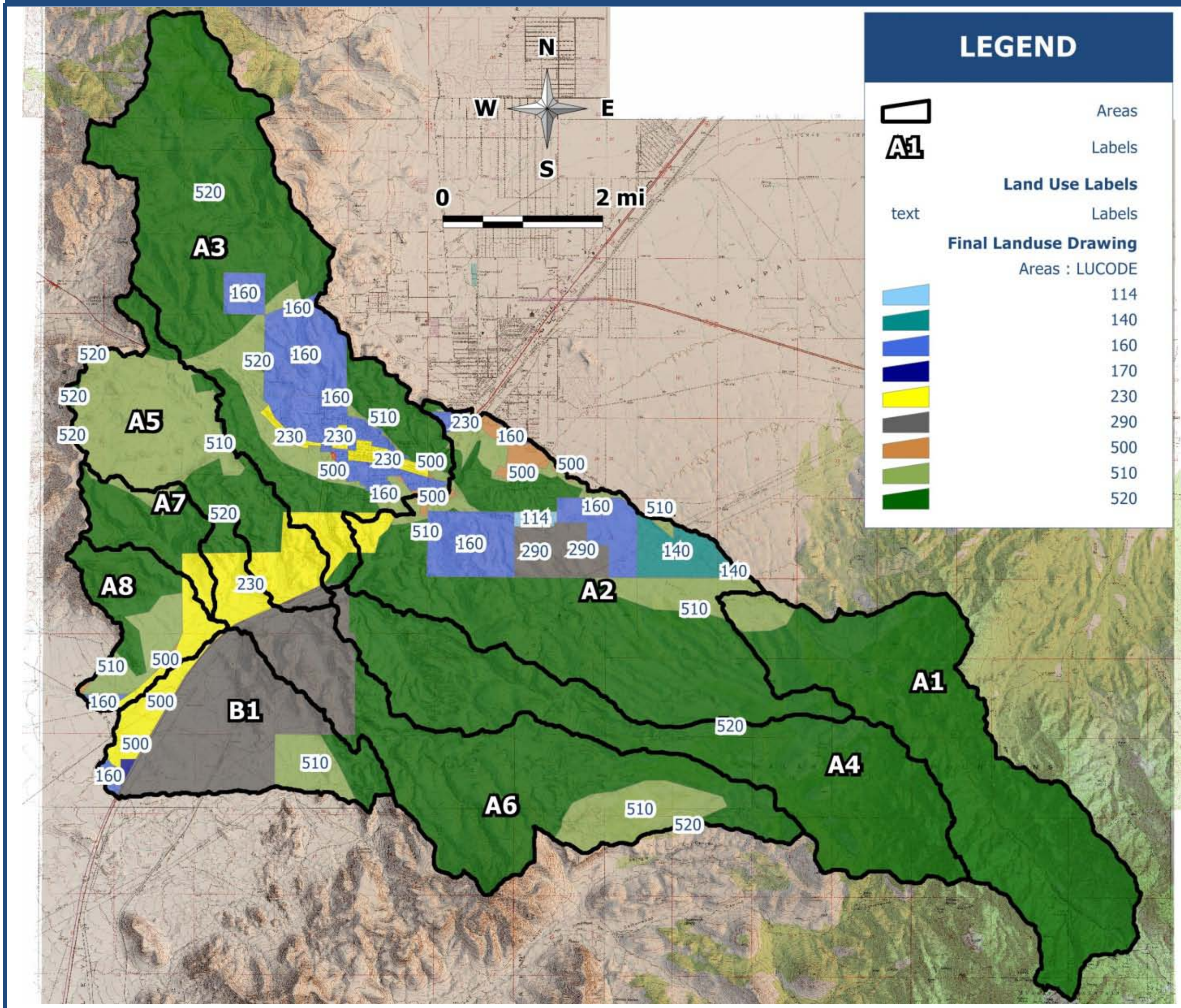


Figure A.24 Unit Hydrograph Method land use map



Step 6. Computation of sub-basin composite initial abstraction.

IA is estimated by calculating an area-weighted value for each sub-basin using standard values assigned for the land use sub-areas. The areas of the land use sub-areas can be determined by hand using a hard copy of the watershed land use map or digitally using CADD or GIS software. For this example, the areas were calculated using GIS. The sub-basin and land use sub-areas are summarized in Table A.22.

Figure A.25 Unit Hydrograph Method soils map

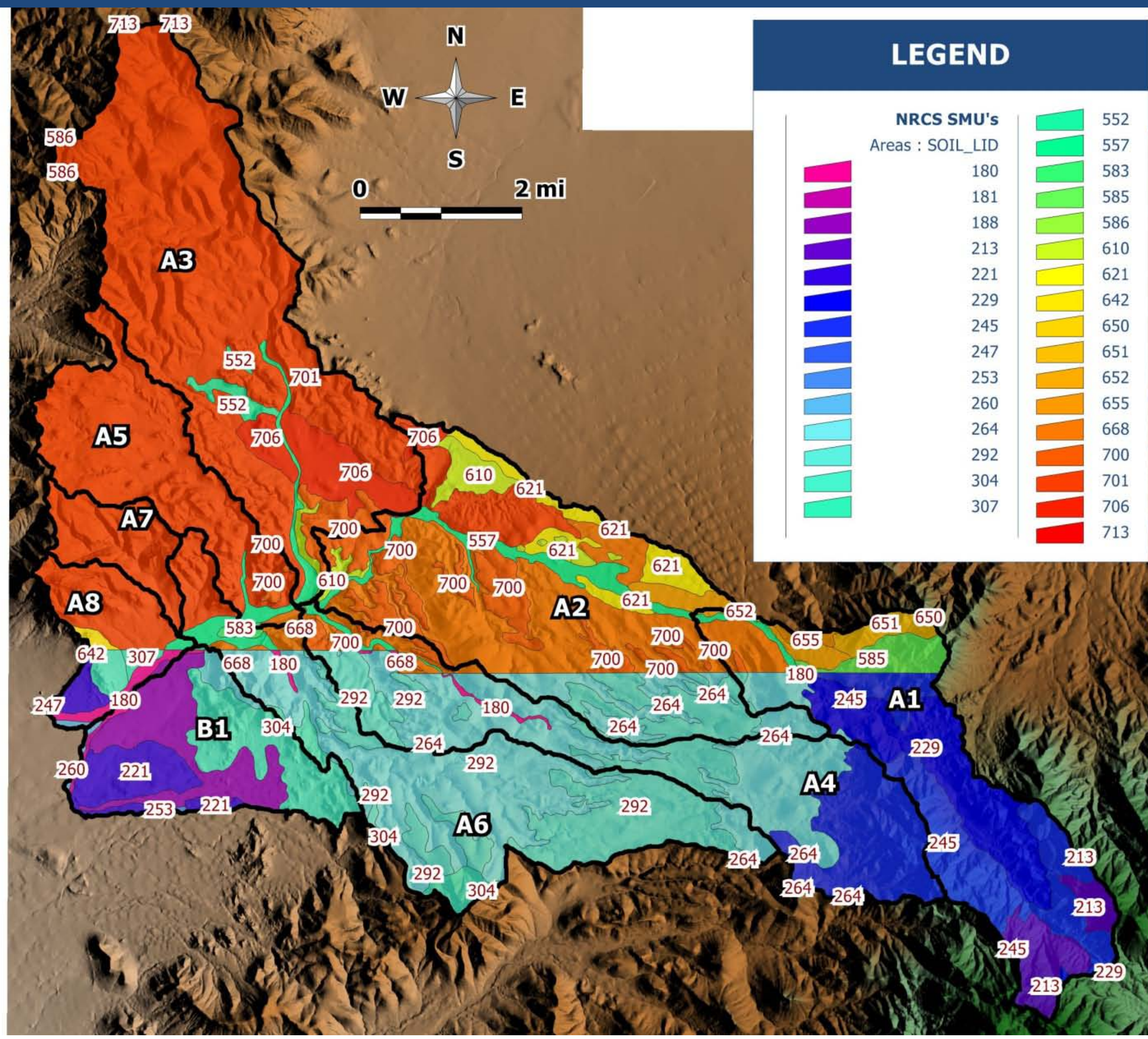


Table A.21 Unit hydrograph example soils and land use parameters

Basin	Soil	Land Use		XKSAT, in/hr				Area	XKSAT		VC	DTHETA		IA
ID	LID	CODE	Cond.	Nat	Dev	Assign	Log10	sm	x Area	VC	x Area	x Area	IA	x Area
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A1	557	510	N	1.03	0.63	1.03	0.0128	0.0718	0.0009	10	0.7178	0.0228	0.15	0.0108
A1	652	510	N	0.07	0.02	0.07	-1.1549	0.0500	-0.0578	10	0.5001	0.0159	0.15	0.0075
A1	668	510	N	0.3	0.13	0.3	-0.5229	0.2276	-0.1190	10	2.2757	0.0724	0.15	0.0341
A1	700	510	N	0.12	0.04	0.12	-0.9208	0.0024	-0.0022	10	0.0239	0.0008	0.15	0.0004
A1	557	520	N	1.03	0.63	1.03	0.0128	0.0479	0.0006	20	0.9581	0.0152	0.25	0.0120
A1	180	520	N	1.01	0.62	1.01	0.0043	0.0080	0.0000	20	0.1591	0.0025	0.25	0.0020
A1	585	520	N	0.41	0.21	0.41	-0.3872	0.5444	-0.2108	20	10.8883	0.1731	0.25	0.1361
A1	213	520	N	0.58	0.33	0.58	-0.2366	1.0740	-0.2541	20	21.4804	0.3415	0.25	0.2685
A1	229	520	N	0.45	0.22	0.45	-0.3468	2.3764	-0.8241	20	47.5289	0.7556	0.25	0.5941
A1	245	520	N	0.45	0.23	0.45	-0.3468	2.6347	-0.9137	20	52.6944	0.8378	0.25	0.6587
A1	264	520	N	0.3	0.13	0.3	-0.5229	0.3562	-0.1863	20	7.1246	0.1133	0.25	0.0891
A1	650	520	N	0.09	0.02	0.09	-1.0458	0.0033	-0.0034	20	0.0659	0.0010	0.25	0.0008
A1	651	520	N	0.43	0.21	0.43	-0.3665	0.3585	-0.1314	20	7.1692	0.1140	0.25	0.0896
A1	652	520	N	0.07	0.02	0.07	-1.1549	0.1953	-0.2256	20	3.9061	0.0621	0.25	0.0488
A1	655	520	N	0.06	0.02	0.06	-1.2218	0.1024	-0.1251	20	2.0483	0.0326	0.25	0.0256
A1	668	520	N	0.3	0.13	0.3	-0.5229	0.2336	-0.1221	20	4.6717	0.0743	0.25	0.0584
A1	292	520	N	0.12	0.04	0.12	-0.9208	0.0398	-0.0366	20	0.7953	0.0126	0.25	0.0099
A1	700	520	N	0.12	0.04	0.12	-0.9208	0.0370	-0.0341	20	0.7396	0.0118	0.25	0.0092
							Totals:	8.3632	-3.2447		163.7474	2.6593		2.0556
							Bare Ground XKSAT$_{Comp}$:		**0.41**		**VC$_{Avg}$:**	**19.58**	**A1**	
							PSIF:		**9.12**		**DTHETA$_{Avg}$:**	**0.32**		
							DTHETA$_{Dry}$:		**0.32**		**XKSAT$_{Adj}$:**	**0.45**		
							DTHETA$_{Normal}$:		**0.20**		**IA$_{Avg}$:**	**0.25**		
A2	557	114	N	1.03	0.63	1.03	0.0128	0.0053	0.0001	50	0.2644	0.0015	0.30	0.0016
A2	701	114	N	0.32	0.14	0.32	-0.4949	0.0911	-0.0451	50	4.5537	0.0265	0.30	0.0273
A2	557	140	D	1.03	0.63	0.63	-0.2007	0.0669	-0.0134	50	3.3469	0.0106	0.25	0.0167
A2	610	140	D	0.31	0.13	0.13	-0.8861	0.0101	-0.0089	50	0.5026	0.0016	0.25	0.0025
A2	621	140	D	0.29	0.12	0.12	-0.9208	0.3352	-0.3087	50	16.7600	0.0529	0.25	0.0838
A2	652	140	D	0.07	0.02	0.02	-1.6990	0.0922	-0.1567	50	4.6119	0.0145	0.25	0.0231
A2	668	140	D	0.3	0.13	0.13	-0.8861	0.1818	-0.1611	50	9.0920	0.0287	0.25	0.0455
A2	557	160	D	1.03	0.63	0.63	-0.2007	0.1635	-0.0328	50	8.1736	0.0258	0.25	0.0409
A2	610	160	D	0.31	0.13	0.13	-0.8861	0.0538	-0.0477	50	2.6919	0.0085	0.25	0.0135
A2	621	160	D	0.29	0.12	0.12	-0.9208	0.2370	-0.2182	50	11.8493	0.0374	0.25	0.0592
A2	668	160	D	0.3	0.13	0.13	-0.8861	0.7439	-0.6592	50	37.1965	0.1173	0.25	0.1860
A2	700	160	D	0.12	0.04	0.04	-1.3979	0.1958	-0.2737	50	9.7891	0.0309	0.25	0.0489
A2	701	160	D	0.32	0.14	0.14	-0.8539	0.1636	-0.1397	50	8.1815	0.0258	0.25	0.0409
A2	706	160	D	0.73	0.37	0.37	-0.4318	0.0676	-0.0292	50	3.3793	0.0107	0.25	0.0169
A2	610	230	D	0.31	0.13	0.13	-0.8861	0.0322	-0.0285	75	2.4158	0.0051	0.10	0.0032
A2	621	230	D	0.29	0.12	0.12	-0.9208	0.0003	-0.0003	75	0.0251	0.0001	0.10	0.0000
A2	700	230	D	0.12	0.04	0.04	-1.3979	0.1483	-0.2073	75	11.1230	0.0234	0.10	0.0148

Table A.21 Unit hydrograph example soils and land use parameters

Basin ID	Soil LID	Land Use		XKSAT, in/hr				Area sm	XKSAT x Area	VC	VC x Area	DTHETA x Area	IA	IA x Area
		CODE	Cond.	Nat	Dev	Assign	Log10							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A2	706	230	D	0.73	0.37	0.37	-0.4318	0.0330	-0.0142	75	2.4737	0.0052	0.10	0.0033
A2	557	290	D	1.03	0.63	0.63	-0.2007	0.1781	-0.0357	60	10.6833	0.0281	0.15	0.0267
A2	610	290	D	0.31	0.13	0.13	-0.8861	0.0220	-0.0195	60	1.3223	0.0035	0.15	0.0033
A2	621	290	D	0.29	0.12	0.12	-0.9208	0.0707	-0.0651	60	4.2438	0.0112	0.15	0.0106
A2	668	290	D	0.3	0.13	0.13	-0.8861	0.2180	-0.1932	60	13.0827	0.0344	0.15	0.0327
A2	700	290	D	0.12	0.04	0.04	-1.3979	0.2059	-0.2879	60	12.3553	0.0325	0.15	0.0309
A2	701	290	D	0.32	0.14	0.14	-0.8539	0.0169	-0.0145	60	1.0169	0.0027	0.15	0.0025
A2	557	500	N	1.03	0.63	1.03	0.0128	0.0255	0.0003	10	0.2546	0.0074	0.35	0.0089
A2	610	500	N	0.31	0.13	0.31	-0.5086	0.1656	-0.0842	10	1.6558	0.0482	0.35	0.0580
A2	621	500	N	0.29	0.12	0.29	-0.5376	0.1173	-0.0631	10	1.1733	0.0341	0.35	0.0411
A2	700	500	N	0.12	0.04	0.12	-0.9208	0.0027	-0.0025	10	0.0269	0.0008	0.35	0.0009
A2	701	500	N	0.32	0.14	0.32	-0.4949	0.0001	-0.0001	10	0.0012	0.0000	0.35	0.0000
A2	706	500	N	0.73	0.37	0.73	-0.1367	0.0066	-0.0009	10	0.0660	0.0019	0.35	0.0023
A2	557	510	N	1.03	0.63	1.03	0.0128	0.1312	0.0017	10	1.3120	0.0382	0.15	0.0197
A2	610	510	N	0.31	0.13	0.31	-0.5086	0.1817	-0.0924	10	1.8171	0.0528	0.15	0.0273
A2	621	510	N	0.29	0.12	0.29	-0.5376	0.1761	-0.0947	10	1.7606	0.0512	0.15	0.0264
A2	652	510	N	0.07	0.02	0.07	-1.1549	0.1881	-0.2173	10	1.8814	0.0547	0.15	0.0282
A2	668	510	N	0.3	0.13	0.3	-0.5229	0.3587	-0.1876	10	3.5869	0.1043	0.15	0.0538
A2	700	510	N	0.12	0.04	0.12	-0.9208	0.0690	-0.0635	10	0.6898	0.0201	0.15	0.0103
A2	701	510	N	0.32	0.14	0.32	-0.4949	0.1231	-0.0609	10	1.2313	0.0358	0.15	0.0185
A2	706	510	N	0.73	0.37	0.73	-0.1367	0.0244	-0.0033	10	0.2438	0.0071	0.15	0.0037
A2	557	520	N	1.03	0.63	1.03	0.0128	0.0878	0.0011	20	1.7552	0.0255	0.25	0.0219
A2	229	520	N	0.45	0.22	0.45	-0.3468	0.0000	0.0000	20	0.0003	0.0000	0.25	0.0000
A2	610	520	N	0.31	0.13	0.31	-0.5086	0.1496	-0.0761	20	2.9927	0.0435	0.25	0.0374
A2	621	520	N	0.29	0.12	0.29	-0.5376	0.0128	-0.0069	20	0.2567	0.0037	0.25	0.0032
A2	264	520	N	0.3	0.13	0.3	-0.5229	1.0784	-0.5639	20	21.5676	0.3136	0.25	0.2696
A2	668	520	N	0.3	0.13	0.3	-0.5229	2.3971	-1.2534	20	47.9421	0.6971	0.25	0.5993
A2	292	520	N	0.12	0.04	0.12	-0.9208	1.1843	-1.0905	20	23.6857	0.3444	0.25	0.2961
A2	700	520	N	0.12	0.04	0.12	-0.9208	1.1649	-1.0727	20	23.2989	0.3388	0.25	0.2912
A2	701	520	N	0.32	0.14	0.32	-0.4949	0.6074	-0.3006	20	12.1487	0.1766	0.25	0.1519
A2	706	520	N	0.73	0.37	0.73	-0.1367	0.0131	-0.0018	20	0.2617	0.0038	0.25	0.0033
							Totals:	11.5990	-8.1938		328.7450	2.9419		2.7079
								Bare Ground XKSAT$_{Comp}$:	**0.20**		**VC$_{Avg}$:**	**28.34**	**A2**	
								PSIF:	**14.43**		**DTHETA$_{Avg}$:**	**0.25**		
								DTHETA$_{Dry}$:	**0.29**		**XKSAT$_{Adj}$:**	**0.24**		
								DTHETA$_{Normal}$:	**0.16**		**IA$_{Avg}$:**	**0.23**		
A3	552	160	D	0.41	0.18	0.18	-0.7447	0.1372	-0.1022	50	6.8587	0.0243	0.25	0.0343
A3	557	160	D	1.03	0.63	0.63	-0.2007	0.0813	-0.0163	50	4.0642	0.0144	0.25	0.0203
A3	700	160	D	0.12	0.04	0.04	-1.3979	0.0196	-0.0275	50	0.9821	0.0035	0.25	0.0049
A3	701	160	D	0.32	0.14	0.14	-0.8539	1.3092	-1.1179	50	65.4617	0.2323	0.25	0.3273

Table A.21 Unit hydrograph example soils and land use parameters

Basin ID	Soil LID	Land Use		XKSAT, in/hr				Area sm	XKSAT x Area	VC	VC x Area	DTHETA x Area	IA	IA x Area
		CODE	Cond.	Nat	Dev	Assign	Log10							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A3	706	160	D	0.73	0.37	0.37	-0.4318	0.8179	-0.3532	50	40.8951	0.1451	0.25	0.2045
A3	557	230	D	1.03	0.63	0.63	-0.2007	0.0582	-0.0117	75	4.3626	0.0103	0.10	0.0058
A3	610	230	D	0.31	0.13	0.13	-0.8861	0.0528	-0.0468	75	3.9585	0.0094	0.10	0.0053
A3	700	230	D	0.12	0.04	0.04	-1.3979	0.1129	-0.1578	75	8.4673	0.0200	0.10	0.0113
A3	701	230	D	0.32	0.14	0.14	-0.8539	0.1627	-0.1389	75	12.2004	0.0289	0.10	0.0163
A3	706	230	D	0.73	0.37	0.37	-0.4318	0.2893	-0.1249	75	21.6993	0.0513	0.10	0.0289
A3	557	290	D	1.03	0.63	0.63	-0.2007	0.0082	-0.0016	60	0.4911	0.0015	0.15	0.0012
A3	610	290	D	0.31	0.13	0.13	-0.8861	0.0030	-0.0026	60	0.1793	0.0005	0.15	0.0004
A3	701	290	D	0.32	0.14	0.14	-0.8539	0.0005	-0.0004	60	0.0287	0.0001	0.15	0.0001
A3	700	500	N	0.12	0.04	0.12	-0.9208	0.0002	-0.0002	10	0.0024	0.0001	0.35	0.0001
A3	706	500	N	0.73	0.37	0.73	-0.1367	0.0414	-0.0057	10	0.4139	0.0126	0.35	0.0145
A3	552	510	N	0.41	0.18	0.41	-0.3872	0.0868	-0.0336	10	0.8679	0.0265	0.15	0.0130
A3	557	510	N	1.03	0.63	1.03	0.0128	0.0136	0.0002	10	0.1364	0.0042	0.15	0.0020
A3	610	510	N	0.31	0.13	0.31	-0.5086	0.0016	-0.0008	10	0.0165	0.0005	0.15	0.0002
A3	700	510	N	0.12	0.04	0.12	-0.9208	0.1497	-0.1379	10	1.4971	0.0456	0.15	0.0225
A3	701	510	N	0.32	0.14	0.32	-0.4949	0.8131	-0.4024	10	8.1314	0.2479	0.15	0.1220
A3	706	510	N	0.73	0.37	0.73	-0.1367	0.1193	-0.0163	10	1.1930	0.0364	0.15	0.0179
A3	552	520	N	0.41	0.18	0.41	-0.3872	0.0046	-0.0018	20	0.0929	0.0014	0.25	0.0012
A3	557	520	N	1.03	0.63	1.03	0.0128	0.0745	0.0010	20	1.4902	0.0227	0.25	0.0186
A3	586	520	N	0.43	0.21	0.43	-0.3665	0.0396	-0.0145	20	0.7927	0.0121	0.25	0.0099
A3	610	520	N	0.31	0.13	0.31	-0.5086	0.0644	-0.0328	20	1.2883	0.0196	0.25	0.0161
A3	700	520	N	0.12	0.04	0.12	-0.9208	0.1665	-0.1533	20	3.3297	0.0508	0.25	0.0416
A3	701	520	N	0.32	0.14	0.32	-0.4949	8.5099	-4.2111	20	170.1973	2.5943	0.25	2.1275
A3	706	520	N	0.73	0.37	0.73	-0.1367	0.0216	-0.0030	20	0.4317	0.0066	0.25	0.0054
A3	713	520	N	0.64	0.34	0.64	-0.1938	0.0068	-0.0013	20	0.1352	0.0021	0.25	0.0017
							Totals:	13.1665	-7.1153		359.6653	3.6250		3.0748
							Bare Ground XKSAT$_{Comp}$:		**0.29**		**VC$_{Avg}$:**	**27.32**	**A3**	
							PSIF:		**12.11**		**DTHETA$_{Avg}$:**	**0.28**		
							DTHETA$_{Dry}$:		**0.30**		**XKSAT$_{Adj}$:**	**0.35**		
							DTHETA$_{Normal}$:		**0.18**		**IA$_{Avg}$:**	**0.23**		
A4	557	290	D	1.03	0.63	0.63	-0.2007	0.0226	-0.0045	60	1.3556	0.0040	0.15	0.0034
A4	610	290	D	0.31	0.13	0.13	-0.8861	0.0042	-0.0037	60	0.2502	0.0007	0.15	0.0006
A4	668	290	D	0.3	0.13	0.13	-0.8861	0.0212	-0.0187	60	1.2692	0.0037	0.15	0.0032
A4	292	290	D	0.12	0.04	0.04	-1.3979	0.0173	-0.0241	60	1.0362	0.0030	0.15	0.0026
A4	700	290	D	0.12	0.04	0.04	-1.3979	0.0572	-0.0800	60	3.4350	0.0100	0.15	0.0086
A4	557	520	N	1.03	0.63	1.03	0.0128	0.0962	0.0012	20	1.9243	0.0292	0.25	0.0241
A4	180	520	N	1.01	0.62	1.01	0.0043	0.0819	0.0004	20	1.6375	0.0249	0.25	0.0205
A4	229	520	N	0.45	0.22	0.45	-0.3468	0.0126	-0.0044	20	0.2522	0.0038	0.25	0.0032
A4	245	520	N	0.45	0.23	0.45	-0.3468	2.1896	-0.7593	20	43.7913	0.6646	0.25	0.5474
A4	264	520	N	0.3	0.13	0.3	-0.5229	3.5589	-1.8609	20	71.1789	1.0803	0.25	0.8897

Table A.21 Unit hydrograph example soils and land use parameters

Basin ID	Soil LID	Land Use CODE	Land Use Cond.	XKSAT, in/hr Nat	XKSAT, in/hr Dev	XKSAT, in/hr Assign	XKSAT, in/hr Log10	Area sm	XKSAT x Area	VC	VC x Area	DTHETA x Area	IA	IA x Area
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A4	668	520	N	0.3	0.13	0.3	-0.5229	0.3376	-0.1765	20	6.7525	0.1025	0.25	0.0844
A4	292	520	N	0.12	0.04	0.12	-0.9208	1.3712	-1.2626	20	27.4243	0.4162	0.25	0.3428
A4	700	520	N	0.12	0.04	0.12	-0.9208	0.1861	-0.1714	20	3.7226	0.0565	0.25	0.0465
							Totals:	7.9566	-4.3647		164.0297	2.3994		1.9769
								Bare Ground XKSAT$_{Comp}$:	**0.28**		**VC$_{Avg}$:**	**20.62**	**A4**	
								PSIF:	**12.38**		**DTHETA$_{Avg}$:**	**0.30**		
								DTHETA$_{Dry}$:	**0.30**		**XKSAT$_{Adj}$:**	**0.31**		
								DTHETA$_{Normal}$:	**0.18**		**IA$_{Avg}$:**	**0.25**		
A5	557	230	D	1.03	0.63	0.63	-0.2007	0.0693	-0.0139	75	5.1939	0.0122	0.10	0.0069
A5	583	230	D	0.93	0.5	0.5	-0.3010	0.0009	-0.0003	75	0.0691	0.0002	0.10	0.0001
A5	700	230	D	0.12	0.04	0.04	-1.3979	0.0868	-0.1213	75	6.5084	0.0152	0.10	0.0087
A5	701	230	D	0.32	0.14	0.14	-0.8539	0.4857	-0.4147	75	36.4256	0.0852	0.10	0.0486
A5	557	290	D	1.03	0.63	0.63	-0.2007	0.0482	-0.0097	60	2.8895	0.0085	0.15	0.0072
A5	583	290	D	0.93	0.5	0.5	-0.3010	0.0070	-0.0021	60	0.4177	0.0012	0.15	0.0010
A5	668	290	D	0.3	0.13	0.13	-0.8861	0.0637	-0.0564	60	3.8214	0.0112	0.15	0.0096
A5	701	290	D	0.32	0.14	0.14	-0.8539	0.0044	-0.0037	60	0.2617	0.0008	0.15	0.0007
A5	701	510	N	0.32	0.14	0.32	-0.4949	2.6072	-1.2902	10	26.0725	0.7914	0.15	0.3911
A5	557	520	N	1.03	0.63	1.03	0.0128	0.0074	0.0001	20	0.1483	0.0023	0.25	0.0019
A5	701	520	N	0.32	0.14	0.32	-0.4949	1.2889	-0.6378	20	25.7777	0.3912	0.25	0.3222
							Totals:	4.6693	-2.5500		107.5857	1.3192		0.7979
								Bare Ground XKSAT$_{Comp}$:	**0.28**		**VC$_{Avg}$:**	**23.04**	**A5**	
								PSIF:	**12.38**		**DTHETA$_{Avg}$:**	**0.28**		
								DTHETA$_{Dry}$:	**0.30**		**XKSAT$_{Adj}$:**	**0.32**		
								DTHETA$_{Normal}$:	**0.18**		**IA$_{Avg}$:**	**0.17**		
A6	557	230	D	1.03	0.63	0.63	-0.2007	0.1140	-0.0229	75	8.5522	0.0180	0.10	0.0114
A6	583	230	D	0.93	0.5	0.5	-0.3010	0.0181	-0.0055	75	1.3601	0.0029	0.10	0.0018
A6	701	230	D	0.32	0.14	0.14	-0.8539	0.3631	-0.3101	75	27.2359	0.0573	0.10	0.0363
A6	557	290	D	1.03	0.63	0.63	-0.2007	0.1001	-0.0201	60	6.0036	0.0158	0.15	0.0150
A6	180	290	D	1.01	0.62	0.62	-0.2076	0.0327	-0.0068	60	1.9603	0.0052	0.15	0.0049
A6	583	290	D	0.93	0.5	0.5	-0.3010	0.0615	-0.0185	60	3.6883	0.0097	0.15	0.0092
A6	264	290	D	0.3	0.13	0.13	-0.8861	0.7748	-0.6866	60	46.4904	0.1222	0.15	0.1162
A6	668	290	D	0.3	0.13	0.13	-0.8861	0.1780	-0.1578	60	10.6823	0.0281	0.15	0.0267
A6	292	290	D	0.12	0.04	0.04	-1.3979	0.0550	-0.0768	60	3.2983	0.0087	0.15	0.0082
A6	304	290	D	0.39	0.17	0.17	-0.7696	0.1284	-0.0988	60	7.7042	0.0202	0.15	0.0193
A6	700	290	D	0.12	0.04	0.04	-1.3979	0.0108	-0.0151	60	0.6478	0.0017	0.15	0.0016
A6	264	510	N	0.3	0.13	0.3	-0.5229	0.0230	-0.0120	10	0.2299	0.0067	0.15	0.0034
A6	292	510	N	0.12	0.04	0.12	-0.9208	1.1133	-1.0252	10	11.1334	0.3237	0.15	0.1670
A6	245	520	N	0.45	0.23	0.45	-0.3468	0.0003	-0.0001	20	0.0069	0.0001	0.25	0.0001
A6	264	520	N	0.3	0.13	0.3	-0.5229	3.4407	-1.7991	20	68.8144	1.0005	0.25	0.8602
A6	292	520	N	0.12	0.04	0.12	-0.9208	1.7169	-1.5809	20	34.3371	0.4992	0.25	0.4292

Table A.21 Unit hydrograph example soils and land use parameters

Basin ID	Soil LID	Land Use CODE	Land Use Cond.	XKSAT, in/hr Nat	XKSAT, in/hr Dev	XKSAT, in/hr Assign	XKSAT, in/hr Log10	Area sm	XKSAT x Area	VC	VC x Area	DTHETA x Area	IA	IA x Area
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A6	304	520	N	0.39	0.17	0.39	-0.4089	0.3618	-0.1480	20	7.2362	0.1052	0.25	0.0905
A6	701	520	N	0.32	0.14	0.32	-0.4949	0.1974	-0.0977	20	3.9480	0.0574	0.25	0.0494
							Totals:	8.6900	-6.0818		243.3293	2.2825		1.8505
							Bare Ground $XKSAT_{Comp}$:		**0.20**		**VC_{Avg}:**	**28.00**		**A6**
							PSIF:		**14.43**		**$DTHETA_{Avg}$:**	**0.26**		
							$DTHETA_{Dry}$:		**0.29**		**$XKSAT_{Adj}$:**	**0.24**		
							$DTHETA_{Normal}$:		**0.16**		**IA_{Avg}:**	**0.21**		
A7	557	230	D	1.03	0.63	0.63	-0.2007	0.0003	-0.0001	75	0.0206	0.0000	0.10	0.0000
A7	701	230	D	0.32	0.14	0.14	-0.8539	0.1955	-0.1669	75	14.6594	0.0347	0.10	0.0195
A7	701	510	N	0.32	0.14	0.32	-0.4949	0.1577	-0.0780	10	1.5771	0.0481	0.15	0.0237
A7	701	520	N	0.32	0.14	0.32	-0.4949	1.1107	-0.5496	20	22.2144	0.3386	0.25	0.2777
							Totals:	1.4642	-0.7946		38.4715	0.4214		0.3209
							Bare Ground $XKSAT_{Comp}$:		**0.29**		**VC_{Avg}:**	**26.28**		**A7**
							PSIF:		**12.11**		**$DTHETA_{Avg}$:**	**0.29**		
							$DTHETA_{Dry}$:		**0.30**		**$XKSAT_{Adj}$:**	**0.34**		
							$DTHETA_{Normal}$:		**0.18**		**IA_{Avg}:**	**0.22**		
A8	180	160	D	1.01	0.62	0.62	-0.2076	0.0486	-0.0101	50	2.4305	0.0089	0.25	0.0122
A8	221	160	D	0.5	0.23	0.23	-0.6383	0.0027	-0.0017	50	0.1342	0.0005	0.25	0.0007
A8	260	160	D	0.23	0.09	0.09	-1.0458	0.0242	-0.0253	50	1.2113	0.0044	0.25	0.0061
A8	557	230	D	1.03	0.63	0.63	-0.2007	0.0449	-0.0090	75	3.3711	0.0082	0.10	0.0045
A8	180	230	D	1.01	0.62	0.62	-0.2076	0.1384	-0.0287	75	10.3763	0.0253	0.10	0.0138
A8	188	230	D	0.06	0.01	0.01	-2.0000	0.0397	-0.0795	75	2.9805	0.0073	0.10	0.0040
A8	221	230	D	0.5	0.23	0.23	-0.6383	0.0007	-0.0004	75	0.0494	0.0001	0.10	0.0001
A8	260	230	D	0.23	0.09	0.09	-1.0458	0.0136	-0.0142	75	1.0165	0.0025	0.10	0.0014
A8	304	230	D	0.39	0.17	0.17	-0.7696	0.0006	-0.0004	75	0.0419	0.0001	0.10	0.0001
A8	307	230	D	0.32	0.14	0.14	-0.8539	0.0244	-0.0209	75	1.8316	0.0045	0.10	0.0024
A8	701	230	D	0.32	0.14	0.14	-0.8539	0.1546	-0.1320	75	11.5934	0.0283	0.10	0.0155
A8	180	500	N	1.01	0.62	1.01	0.0043	0.0127	0.0001	10	0.1271	0.0039	0.35	0.0044
A8	221	500	N	0.5	0.23	0.5	-0.3010	0.0029	-0.0009	10	0.0288	0.0009	0.35	0.0010
A8	247	500	N	0.62	0.32	0.62	-0.2076	0.0108	-0.0023	10	0.1084	0.0033	0.35	0.0038
A8	260	500	N	0.23	0.09	0.23	-0.6383	0.0000	0.0000	10	0.0000	0.0000	0.35	0.0000
A8	304	500	N	0.39	0.17	0.39	-0.4089	0.0018	-0.0008	10	0.0184	0.0006	0.35	0.0006
A8	307	500	N	0.32	0.14	0.32	-0.4949	0.0021	-0.0010	10	0.0211	0.0007	0.35	0.0007
A8	180	510	N	1.01	0.62	1.01	0.0043	0.0091	0.0000	10	0.0909	0.0028	0.15	0.0014
A8	221	510	N	0.5	0.23	0.5	-0.3010	0.2203	-0.0663	10	2.2032	0.0680	0.15	0.0330
A8	247	510	N	0.62	0.32	0.62	-0.2076	0.0011	-0.0002	10	0.0105	0.0003	0.15	0.0002
A8	642	510	N	0.33	0.14	0.33	-0.4815	0.0266	-0.0128	10	0.2658	0.0082	0.15	0.0040
A8	304	510	N	0.39	0.17	0.39	-0.4089	0.1076	-0.0440	10	1.0760	0.0332	0.15	0.0161
A8	307	510	N	0.32	0.14	0.32	-0.4949	0.0684	-0.0339	10	0.6844	0.0211	0.15	0.0103
A8	701	510	N	0.32	0.14	0.32	-0.4949	0.2050	-0.1014	10	2.0500	0.0633	0.15	0.0308

Table A.21 Unit hydrograph example soils and land use parameters

Basin ID	Soil LID	Land Use CODE	Land Use Cond.	XKSAT, in/hr Nat	XKSAT, in/hr Dev	XKSAT, in/hr Assign	XKSAT, in/hr Log10	Area sm	XKSAT x Area	VC	VC x Area	DTHETA x Area	IA	IA x Area
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A8	221	520	N	0.5	0.23	0.5	-0.3010	0.0165	-0.0050	20	0.3310	0.0051	0.25	0.0041
A8	642	520	N	0.33	0.14	0.33	-0.4815	0.0614	-0.0296	20	1.2277	0.0189	0.25	0.0153
A8	304	520	N	0.39	0.17	0.39	-0.4089	0.1171	-0.0479	20	2.3417	0.0361	0.25	0.0293
A8	701	520	N	0.32	0.14	0.32	-0.4949	0.8596	-0.4254	20	17.1912	0.2653	0.25	0.2149
							Totals:	2.2154	-1.0935		62.8129	0.6219		0.4305
								Bare Ground $XKSAT_{Comp}$:	**0.32**		**VC_{Avg}:**	**28.35**	**A8**	
								PSIF:	**11.32**		**$DTHETA_{Avg}$:**	**0.28**		
								$DTHETA_{Dry}$:	**0.31**		**$XKSAT_{Adj}$:**	**0.39**		
								$DTHETA_{Normal}$:	**0.18**		**IA_{Avg}:**	**0.19**		
B1	181	160	D	1.03	0.63	0.63	-0.2007	0.0099	-0.0020	50	0.4930	0.0012	0.25	0.0025
B1	188	160	D	0.06	0.01	0.01	-2.0000	0.0041	-0.0081	50	0.2034	0.0005	0.25	0.0010
B1	221	160	D	0.5	0.23	0.23	-0.6383	0.0602	-0.0384	50	3.0120	0.0071	0.25	0.0151
B1	260	160	D	0.23	0.09	0.09	-1.0458	0.0098	-0.0103	50	0.4910	0.0012	0.25	0.0025
B1	221	170	D	0.5	0.23	0.23	-0.6383	0.0336	-0.0214	50	1.6798	0.0040	0.25	0.0084
B1	557	230	D	1.03	0.63	0.63	-0.2007	0.0017	-0.0003	75	0.1247	0.0002	0.10	0.0002
B1	180	230	D	1.01	0.62	0.62	-0.2076	0.0405	-0.0084	75	3.0403	0.0048	0.10	0.0041
B1	181	230	D	1.03	0.63	0.63	-0.2007	0.0408	-0.0082	75	3.0585	0.0048	0.10	0.0041
B1	188	230	D	0.06	0.01	0.01	-2.0000	0.2868	-0.5737	75	21.5127	0.0338	0.10	0.0287
B1	221	230	D	0.5	0.23	0.23	-0.6383	0.1291	-0.0824	75	9.6844	0.0152	0.10	0.0129
B1	260	230	D	0.23	0.09	0.09	-1.0458	0.0403	-0.0421	75	3.0216	0.0047	0.10	0.0040
B1	557	290	D	1.03	0.63	0.63	-0.2007	0.0073	-0.0015	60	0.4368	0.0009	0.15	0.0011
B1	180	290	D	1.01	0.62	0.62	-0.2076	0.0065	-0.0013	60	0.3877	0.0008	0.15	0.0010
B1	188	290	D	0.06	0.01	0.01	-2.0000	1.0805	-2.1610	60	64.8311	0.1273	0.15	0.1621
B1	221	290	D	0.5	0.23	0.23	-0.6383	0.8399	-0.5361	60	50.3941	0.0989	0.15	0.1260
B1	253	290	D	0.18	0.05	0.05	-1.3010	0.0084	-0.0110	60	0.5053	0.0010	0.15	0.0013
B1	264	290	D	0.3	0.13	0.13	-0.8861	0.1884	-0.1669	60	11.3012	0.0222	0.15	0.0283
B1	668	290	D	0.3	0.13	0.13	-0.8861	0.0012	-0.0011	60	0.0735	0.0001	0.15	0.0002
B1	304	290	D	0.39	0.17	0.17	-0.7696	0.9004	-0.6929	60	54.0247	0.1061	0.15	0.1351
B1	188	500	N	0.06	0.01	0.06	-1.2218	0.0004	-0.0005	10	0.0045	0.0001	0.35	0.0002
B1	221	500	N	0.5	0.23	0.5	-0.3010	0.0003	-0.0001	10	0.0029	0.0001	0.35	0.0001
B1	188	510	N	0.06	0.01	0.06	-1.2218	0.2885	-0.3525	10	2.8848	0.0739	0.15	0.0433
B1	221	510	N	0.5	0.23	0.5	-0.3010	0.0014	-0.0004	10	0.0145	0.0004	0.15	0.0002
B1	304	510	N	0.39	0.17	0.39	-0.4089	0.2830	-0.1157	10	2.8303	0.0725	0.15	0.0425
B1	264	520	N	0.3	0.13	0.3	-0.5229	0.0285	-0.0149	20	0.5698	0.0073	0.25	0.0071
B1	304	520	N	0.39	0.17	0.39	-0.4089	0.3806	-0.1556	20	7.6112	0.0975	0.25	0.0951
							Totals:	4.6721	-5.0070		242.1937	0.6863		0.7267
								Bare Ground $XKSAT_{Comp}$:	**0.08**		**VC_{Avg}:**	**51.84**	**B1**	
								PSIF:	**16.38**		**$DTHETA_{Avg}$:**	**0.15**		
								$DTHETA_{Dry}$:	**0.26**		**$XKSAT_{Adj}$:**	**0.12**		
								$DTHETA_{Normal}$:	**0.12**		**IA_{Avg}:**	**0.16**		

Table A.22 Sub-basin and land use areas

Sub-basin ID	Land Use Area, in sq. mi.									Totals
	114	140	160	170	230	290	500	510	520	
A1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.352	8.012	8.363
A2	0.096	0.686	1.625	0.000	0.214	0.712	0.318	1.252	6.696	11.599
A3	0.000	0.000	2.365	0.000	0.676	0.012	0.042	1.184	8.888	13.167
A4	0.000	0.000	0.000	0.000	0.000	0.122	0.000	0.000	7.834	7.957
A5	0.000	0.000	0.000	0.000	0.643	0.125	0.000	2.607	1.296	4.671
A6	0.000	0.000	0.000	0.000	0.495	1.344	0.000	1.136	5.717	8.692
A7	0.000	0.000	0.000	0.000	0.196	0.000	0.000	0.158	1.111	1.464
A8	0.000	0.000	0.076	0.000	0.417	0.000	0.030	0.638	1.055	2.215
B1	0.000	0.000	0.084	0.034	0.539	3.033	0.001	0.573	0.409	4.672
Totals	0.096	0.686	4.150	0.034	3.179	5.347	0.391	7.901	41.017	62.800

Per Table 7.20, the unit hydrograph land use parameters are listed in Table A.23 for each land use type present in the watershed:

Table A.23 Unit hydrograph land use parameters

DDMS ID	Mohave County Zoning Classification	Vegetation Cover Density	RTIMP	IA	DTHETA Condition
Commercial					
230	C-2: General Commercial (6,000 sf minimum, C2)	75	80	0.10	NORMAL
290	M-X: Heavy Manufacturing (1 acre minimum, I2)	60	60	0.15	NORMAL
Natural					
500	Undeveloped Desert Rangeland. Little topographic relief, slopes <5%	10 (varies)	varies	0.35	DRY
510	Hillslopes, Sonoran Desert. Moderate topographic relief, slopes >5%	10 (varies)	varies	0.15	DRY
520	Mountain Terrain. High topographic relief, slopes >20%	20 (varies)	varies	0.25	DRY
Residential					

Table A.23 Unit hydrograph land use parameters

DDMS ID	Mohave County Zoning Classification	Vegetation Cover Density	RTIMP	IA	DTHETA Condition
114	A-R, R-E, R-1, R-MH, R-TT, R-M, R-O, R-O/A (2-5 acre minimum, VLDR)	50	15	0.30	NORMAL
140	R-E, R-1, R-MH, R-TT, R-M, R-O (20,000 sf – 1 acre minimum, LDR)	50	25	0.25	NORMAL
160	R-1, R-MH, R-TT, R-M, R-O (7,000-10,000 sf minimum, MDR)	50	50	0.25	NORMAL
170	R-1, R-MH, R-TT, R-M, R-O (6,000-7,000 sf minimum, MDR)	50	60	0.25	NORMAL

Using sub-basin A7 as an example and the data in Table A.21, the area-weighted, or composite, value of IA is computed as follows, using Equation 7.11 in Section 7.4.4.2:

$$\overline{IA} = \left(\frac{\sum A_i IA_i}{A_T} \right)$$

where:

$\overline{IA}$ = composite value of IA, inches

IA_i = IA of each sub-area, inches

A_i = size of IA sub-area

A_T = size of the watershed or sub-basin

$$\overline{IA} = \left(\frac{0.0003 * 0.10 + 0.1955 * 0.10 + 0.1577 * 0.15 + 1.1107 * 0.25}{1.4642} \right) = 0.22\, inches$$

Using the same procedure, IA for the other sub-basins was computed. Refer to Table A.21. The results are summarized as follows:

	A1	A2	A3	A4	A5	A6	A7	A8	B1
IA	0.25	0.23	0.23	0.25	0.17	0.21	0.22	0.19	0.16

Step 7. Computation of sub-basin composite bare ground XKSAT.

The first step is to obtain the needed soil properties data. The most difficult part has already been completed on a countywide basis for Mohave County. This is the estimate for an average value of bare ground XKSAT for natural and developed conditions each NRCS soil map unit (SMU). The procedures used to accomplish this are described in Appendix D. The values of XKSAT for each SMU in each NRCS Soil Survey are tabulated in Appendix D.3.

To estimate an average value of bare ground XKSAT for each sub-basin, the area of each SMU within the sub-basin is needed. These areas can be measured by hand using a scaled map of the watershed overlaid on the NRCS soil map, in CAD software by importing the available GIS databases, using GIS software, or using the GIS Method within the DDMSW computer program. For this example the GIS Method within DDMSW was used. The computed soils sub-areas for sub-basin A7 are listed in Table A.21.

The sub-basin log-area-averaged value of bare ground XKSAT for sub-basin A7 is computed using Equation 7.12 in Section 7.4.4.3 and data from Table A.21 as follows:

$$\overline{XKSAT} = anti\log\left(\frac{\sum A_i \log_{10} XKSAT_i}{A_T}\right)$$

where:

$\overline{XKSAT}$ = composite bare ground hydraulic conductivity for the watershed sub-basin, inches/hour

$XKSAT_i$ = bare ground hydraulic conductivity of the soil map unit within a sub-basin, inches/hour

A_i = area of soil map unit subarea within a sub-basin

A_T = total area of the watershed or sub-basin

$$\overline{XKSAT} = a\log\left[\frac{0.0003\log_{10}(0.63)+0.1955\log_{10}(0.14)+0.1577\log_{10}(0.32)+1.1107\log_{10}(0.32)}{1.4642}\right]$$

$$\overline{XKSAT} = 0.29\ inches/hour$$

Using the same procedure, composite bare ground XKSAT for the other sub-basins was computed. The results are summarized as follows:

Bare Ground	A1	A2	A3	A4	A5	A6	A7	A8	B1
XKSAT	0.41	0.20	0.29	0.28	0.28	0.20	0.29	0.32	0.08

Step 8. Assignment of PSIF and DTHETA.

The values of PSIF and DTHETA for each sub-basin are estimated using the bare ground XKSAT computed in Step 7. Refer to Figure 7.13 and Figure 7.14, and Equation 7.8, Equation 7.9, and Equation 7.10 in Section 7.4.2.3. The bare ground XKSAT for sub-basin A7 is 0.29 in/hr. From Figure 7.13, the PSIF value corresponding to an XKSAT of 0.29 is approximately 12 in. Applying Equation 7.8, PSIF is:

$$PSIF = 1/\left(0.06149 - 0.03544(0.29) + 0.37264(0.29^2)\right)$$

$$PSIF = 12.11\ inches$$

From Figure 7.14, $DTHETA_{dry}$ and $DTHETA_{normal}$ are 0.30 and 0.18, respectively. Applying Equation 7.9 and Equation 7.10, $DTHETA_{dry}$ and $DTHETA_{normal}$ are:

$$DTHETA_{dry} = 0.35174 + 0.03787\log_e(0.29)$$

$$DTHETA_{dry} = 0.3049$$

$$DTHETA_{norm} = 0.26309(0.29^{0.31813})$$

$$DTHETA_{norm} = 0.1775$$

When a sub-basin contains a mix of natural and urban land uses, an area-weighted value of DTHETA should be computed. The total area of natural land use from Table A.22 (Types 510 and 520) for sub-basin A7 is 1.2684 square miles. The total area of developed land use from Table A.22 (Type 230) for sub-basin A7 is 0.1958 square miles. The area-weighted, or composite, value of DTHETA is computed as follows, using Equation 7.13 in Section 7.4.4.4:

$$\overline{DTHETA} = \left(\frac{\sum A_i DTHETA_i}{A_T}\right)$$

where:

$\overline{DTHETA}$ = composite value of DTHETA

$DTHETA_i$ = DTHETA of each subarea

A_i = size of DTHETA subarea

A_T = size of the watershed or sub-basin

$$\overline{DTHETA} = \left(\frac{1.2684 * 0.3049 + 0.1958 * 0.1775}{1.4642} \right) = 0.29$$

Using the same procedure, are-weighted DTHETA for the other sub-basins was computed. The results are summarized as follows:

	A1	A2	A3	A4	A5	A6	A7	A8	B1
PSIF	9.12	14.43	12.11	12.38	12.11	14.43	12.11	11.32	16.31
DTHETA	0.32	0.25	0.28	0.30	0.28	0.26	0.29	0.28	0.15

Step 9. Computation of sub-basin composite vegetation cover density (VCD).

VCD is estimated by calculating an area-weighted value for each sub-basin using standard values assigned for the land use sub-areas. The areas of the land use sub-areas can be determined by hand using a hard copy of the watershed land use map or digitally using CADD or GIS software. For this example, the areas were calculated using GIS. The sub-basin and land use sub-areas are summarized in Table A.22, the default values of VCD for each land use are listed in Table A.23.

Using sub-basin A7 as an example, the area-weighted, or composite, value of VCD is computed as follows, using Equation 7.14 in Section 7.4.4.5:

$$\overline{VCD} = \left(\frac{\sum A_i VCD_i}{A_T} \right)$$

where:

$\overline{VCD}$ = composite value of VCD, inches

VCD_i = VCD of each subarea, inches

A_i = size of VCD subarea

A_T = size of the watershed or sub-basin

$$\overline{VCD} = \left(\frac{0.1958 * 75 + 0.1577 * 10 + 1.1107 * 20}{1.4642} \right) = 26\%$$

Using the same procedure, VCD for the other sub-basins was computed. The results are summarized as follows, rounded to the nearest percent:

	A1	A2	A3	A4	A5	A6	A7	A8	B1
VCD	20	28	27	21	23	28	26	28	52

Note that the sub-basin VCD values are affected by having a significant percentage of both developed and undeveloped land uses within most of the sub-basins. The sub-basin VCD is significantly higher than the estimates for the undeveloped areas and significantly lower than the estimates for the developed areas. This is an example of why it is a preferred approach to breakout developed and undeveloped areas into separate sub-basins. The same effect can be seen in IA, DTHETA and RTIMP.

Step 10. Computation of XKSAT adjusted for vegetation canopy cover.

The sub-basin composite bare ground XKSAT values from Step 7 area adjusted for the effects of vegetation canopy cover using Figure 7.15 or Equation 7.15 in Section 7.4.4.5. The adjusted XKSAT for sub-basin A7 is computed using Equation 7.15 as follows:

$$XKSAT_{adj} = \overline{XKSAT}_{BG}\left(\frac{\overline{VCD}-10}{90}+1\right)$$

where:

$XKSAT_{adj}$ = $\overline{XKSAT}_{BG}$ adjusted for the effects of vegetation canopy cover, inches/hour

$\overline{XKSAT}_{BG}$ = sub-basin composite bare ground XKSAT, inches/hour

$\overline{VCD}$ = sub-basin composite value of vegetation canopy cover, percent

$$XKSAT_{adj} = 0.29\left(\frac{26-10}{90}+1\right) = 0.34\ inches/hour$$

Using the same procedure, $XKSAT_{adj}$ for the other sub-basins was computed. The results are summarized as follows:

	A1	A2	A3	A4	A5	A6	A7	A8	B1
$XKSAT_{adj}$	0.45	0.24	0.35	0.31	0.32	0.24	0.34	0.39	0.12

Step 11. Estimation of sub-basin composite RTIMP.

RTIMP is estimated by calculating an area-weighted value for each sub-basin for the natural areas and the developed areas separately, and then area weighting the natural and developed average values. The RTIMP computations for each sub-basin are listed in Table A.24.

Table A.24 Unit hydrograph example RTIMP calculations

Basin ID	Soil LID	Land Use CODE	Land Use Cond.	RTIMP Nat % Eff	RTIMP, % Nat.	RTIMP, % Adj	RTIMP, % Dev.	Area sm	Area x $RTIMP_N$	Area x $RTIMP_D$
1	2	3	4	5	6	7	8	9	10	11
A1	557	510	N	100	0	0	0	0.0718	0.0000	0.0000
A1	652	510	N	100	0	0	0	0.0500	0.0000	0.0000
A1	668	510	N	100	20	20	0	0.2276	4.5515	0.0000
A1	700	510	N	100	0	0	0	0.0024	0.0000	0.0000
A1	557	520	N	100	0	0	0	0.0479	0.0000	0.0000
A1	180	520	N	100	0	0	0	0.0080	0.0000	0.0000
A1	585	520	N	100	20	20	0	0.5444	10.8883	0.0000
A1	213	520	N	100	20	20	0	1.0740	21.4804	0.0000
A1	229	520	N	100	20	20	0	2.3764	47.5289	0.0000
A1	245	520	N	100	20	20	0	2.6347	52.6944	0.0000
A1	264	520	N	100	20	20	0	0.3562	7.1246	0.0000
A1	650	520	N	100	20	20	0	0.0033	0.0659	0.0000
A1	651	520	N	100	0	0	0	0.3585	0.0000	0.0000
A1	652	520	N	100	0	0	0	0.1953	0.0000	0.0000
A1	655	520	N	100	0	0	0	0.1024	0.0000	0.0000
A1	668	520	N	100	20	20	0	0.2336	4.6717	0.0000
A1	292	520	N	100	0	0	0	0.0398	0.0000	0.0000
A1	700	520	N	100	0	0	0	0.0370	0.0000	0.0000
							Totals:	8.3632	149.0057	0.0000
								$RTIMP_{Avg}$:	**17.82**	**0.00**
								Total RTIMP:	**18**	**A1**
A2	557	114	N	100	0	0	15	0.0053	0.0000	0.0793
A2	701	114	N	100	0	0	15	0.0911	0.0000	1.3661
A2	557	140	D	100	0	0	25	0.0669	0.0000	1.6735
A2	610	140	D	100	20	20	25	0.0101	0.2010	0.2513
A2	621	140	D	100	0	0	25	0.3352	0.0000	8.3800
A2	652	140	D	100	0	0	25	0.0922	0.0000	2.3059
A2	668	140	D	100	20	20	25	0.1818	3.6368	4.5460
A2	557	160	D	100	0	0	50	0.1635	0.0000	8.1736
A2	610	160	D	100	20	20	50	0.0538	1.0768	2.6919
A2	621	160	D	100	0	0	50	0.2370	0.0000	11.8493
A2	668	160	D	100	20	20	50	0.7439	14.8786	37.1965
A2	700	160	D	100	0	0	50	0.1958	0.0000	9.7891

Table A.24 Unit hydrograph example RTIMP calculations

Basin ID	Soil LID	Land Use		RTIMP	RTIMP, %			Area sm	Area x $RTIMP_N$	Area x $RTIMP_D$
		CODE	Cond.	Nat % Eff	Nat.	Adj	Dev.			
1	2	3	4	5	6	7	8	9	10	11
A2	701	160	D	100	0	0	50	0.1636	0.0000	8.1815
A2	706	160	D	100	0	0	50	0.0676	0.0000	3.3793
A2	610	230	D	100	20	20	80	0.0322	0.6442	2.5769
A2	621	230	D	100	0	0	80	0.0003	0.0000	0.0267
A2	700	230	D	100	0	0	80	0.1483	0.0000	11.8646
A2	706	230	D	100	0	0	80	0.0330	0.0000	2.6386
A2	557	290	D	100	0	0	60	0.1781	0.0000	10.6833
A2	610	290	D	100	20	20	60	0.0220	0.4408	1.3223
A2	621	290	D	100	0	0	60	0.0707	0.0000	4.2438
A2	668	290	D	100	20	20	60	0.2180	4.3609	13.0827
A2	700	290	D	100	0	0	60	0.2059	0.0000	12.3553
A2	701	290	D	100	0	0	60	0.0169	0.0000	1.0169
A2	557	500	N	100	0	0	0	0.0255	0.0000	0.0000
A2	610	500	N	100	20	20	0	0.1656	3.3117	0.0000
A2	621	500	N	100	0	0	0	0.1173	0.0000	0.0000
A2	700	500	N	100	0	0	0	0.0027	0.0000	0.0000
A2	701	500	N	100	0	0	0	0.0001	0.0000	0.0000
A2	706	500	N	100	0	0	0	0.0066	0.0000	0.0000
A2	557	510	N	100	0	0	0	0.1312	0.0000	0.0000
A2	610	510	N	100	20	20	0	0.1817	3.6342	0.0000
A2	621	510	N	100	0	0	0	0.1761	0.0000	0.0000
A2	652	510	N	100	0	0	0	0.1881	0.0000	0.0000
A2	668	510	N	100	20	20	0	0.3587	7.1738	0.0000
A2	700	510	N	100	0	0	0	0.0690	0.0000	0.0000
A2	701	510	N	100	0	0	0	0.1231	0.0000	0.0000
A2	706	510	N	100	0	0	0	0.0244	0.0000	0.0000
A2	557	520	N	100	0	0	0	0.0878	0.0000	0.0000
A2	229	520	N	100	20	20	0	0.0000	0.0003	0.0000
A2	610	520	N	100	20	20	0	0.1496	2.9927	0.0000
A2	621	520	N	100	0	0	0	0.0128	0.0000	0.0000
A2	264	520	N	100	20	20	0	1.0784	21.5676	0.0000
A2	668	520	N	100	20	20	0	2.3971	47.9421	0.0000
A2	292	520	N	100	0	0	0	1.1843	0.0000	0.0000
A2	700	520	N	100	0	0	0	1.1649	0.0000	0.0000
A2	701	520	N	100	0	0	0	0.6074	0.0000	0.0000
A2	706	520	N	100	0	0	0	0.0131	0.0000	0.0000
							Totals:	11.5990	111.8615	159.6746
								$RTIMP_{Avg}$:	**9.64**	**13.77**
								Total RTIMP:	**23**	**A2**
A3	552	160	D	100	0	0	50	0.1372	0.0000	6.8587

Table A.24 Unit hydrograph example RTIMP calculations

Basin ID	Soil LID	Land Use CODE	Land Use Cond.	RTIMP Nat % Eff	RTIMP, % Nat.	RTIMP, % Adj	RTIMP, % Dev.	Area sm	Area x $RTIMP_N$	Area x $RTIMP_D$
1	2	3	4	5	6	7	8	9	10	11
A3	557	160	D	100	0	0	50	0.0813	0.0000	4.0642
A3	700	160	D	100	0	0	50	0.0196	0.0000	0.9821
A3	701	160	D	100	0	0	50	1.3092	0.0000	65.4617
A3	706	160	D	100	0	0	50	0.8179	0.0000	40.8951
A3	557	230	D	100	0	0	80	0.0582	0.0000	4.6535
A3	610	230	D	60	20	12	80	0.0528	1.0556	4.2224
A3	700	230	D	100	0	0	80	0.1129	0.0000	9.0317
A3	701	230	D	100	0	0	80	0.1627	0.0000	13.0138
A3	706	230	D	100	0	0	80	0.2893	0.0000	23.1459
A3	557	290	D	100	0	0	60	0.0082	0.0000	0.4911
A3	610	290	D	60	20	12	60	0.0030	0.0598	0.1793
A3	701	290	D	100	0	0	60	0.0005	0.0000	0.0287
A3	700	500	N	100	0	0	0	0.0002	0.0000	0.0000
A3	706	500	N	100	0	0	0	0.0414	0.0000	0.0000
A3	552	510	N	100	0	0	0	0.0868	0.0000	0.0000
A3	557	510	N	100	0	0	0	0.0136	0.0000	0.0000
A3	610	510	N	60	20	12	0	0.0016	0.0329	0.0000
A3	700	510	N	100	0	0	0	0.1497	0.0000	0.0000
A3	701	510	N	100	0	0	0	0.8131	0.0000	0.0000
A3	706	510	N	100	0	0	0	0.1193	0.0000	0.0000
A3	552	520	N	100	0	0	0	0.0046	0.0000	0.0000
A3	557	520	N	100	0	0	0	0.0745	0.0000	0.0000
A3	586	520	N	100	0	0	0	0.0396	0.0000	0.0000
A3	610	520	N	60	20	12	0	0.0644	1.2883	0.0000
A3	700	520	N	100	0	0	0	0.1665	0.0000	0.0000
A3	701	520	N	100	0	0	0	8.5099	0.0000	0.0000
A3	706	520	N	100	0	0	0	0.0216	0.0000	0.0000
A3	713	520	N	50	10	5	0	0.0068	0.0676	0.0000
							Totals:	13.1665	2.5041	173.0281
								$RTIMP_{Avg}$:	**0.19**	**13.14**
								Total RTIMP:	**13**	**A3**
A4	557	290	D	100	0	0	60	0.0226	0.0000	1.3556
A4	610	290	D	100	20	20	60	0.0042	0.0834	0.2502
A4	668	290	D	100	20	20	60	0.0212	0.4231	1.2692
A4	292	290	D	100	0	0	60	0.0173	0.0000	1.0362
A4	700	290	D	100	0	0	60	0.0572	0.0000	3.4350
A4	557	520	N	100	0	0	0	0.0962	0.0000	0.0000
A4	180	520	N	100	0	0	0	0.0819	0.0000	0.0000
A4	229	520	N	100	20	20	0	0.0126	0.2522	0.0000
A4	245	520	N	100	20	20	0	2.1896	43.7913	0.0000

Table A.24 Unit hydrograph example RTIMP calculations

Basin ID	Soil LID	Land Use CODE	Land Use Cond.	RTIMP Nat % Eff	RTIMP, % Nat.	RTIMP, % Adj	RTIMP, % Dev.	Area sm	Area x $RTIMP_N$	Area x $RTIMP_D$
1	2	3	4	5	6	7	8	9	10	11
A4	264	520	N	100	20	20	0	3.5589	71.1789	0.0000
A4	668	520	N	100	20	20	0	0.3376	6.7525	0.0000
A4	292	520	N	100	0	0	0	1.3712	0.0000	0.0000
A4	700	520	N	100	0	0	0	0.1861	0.0000	0.0000
							Totals:	7.9566	122.4813	7.3461
								$RTIMP_{Avg}$:	**15.39**	**0.92**
								Total RTIMP:	**16**	**A4**
A5	557	230	D	100	0	0	80	0.0693	0.0000	5.5401
A5	583	230	D	100	0	0	80	0.0009	0.0000	0.0737
A5	700	230	D	100	0	0	80	0.0868	0.0000	6.9423
A5	701	230	D	100	0	0	80	0.4857	0.0000	38.8540
A5	557	290	D	100	0	0	60	0.0482	0.0000	2.8895
A5	583	290	D	100	0	0	60	0.0070	0.0000	0.4177
A5	668	290	D	100	20	20	60	0.0637	1.2738	3.8214
A5	701	290	D	100	0	0	60	0.0044	0.0000	0.2617
A5	701	510	N	100	0	0	0	2.6072	0.0000	0.0000
A5	557	520	N	100	0	0	0	0.0074	0.0000	0.0000
A5	701	520	N	100	0	0	0	1.2889	0.0000	0.0000
							Totals:	4.6693	1.2738	58.8004
								$RTIMP_{Avg}$:	**0.27**	**12.59**
								Total RTIMP:	**13**	**A5**
A6	557	230	D	100	0	0	80	0.1140	0.0000	9.1224
A6	583	230	D	100	0	0	80	0.0181	0.0000	1.4508
A6	701	230	D	100	0	0	80	0.3631	0.0000	29.0516
A6	557	290	D	100	0	0	60	0.1001	0.0000	6.0036
A6	180	290	D	100	0	0	60	0.0327	0.0000	1.9603
A6	583	290	D	100	0	0	60	0.0615	0.0000	3.6883
A6	264	290	D	100	20	20	60	0.7748	15.4968	46.4904
A6	668	290	D	100	20	20	60	0.1780	3.5608	10.6823
A6	292	290	D	100	0	0	60	0.0550	0.0000	3.2983
A6	304	290	D	100	15	15	60	0.1284	1.9260	7.7042
A6	700	290	D	100	0	0	60	0.0108	0.0000	0.6478
A6	264	510	N	100	20	20	0	0.0230	0.4597	0.0000
A6	292	510	N	100	0	0	0	1.1133	0.0000	0.0000
A6	245	520	N	100	20	20	0	0.0003	0.0069	0.0000
A6	264	520	N	100	20	20	0	3.4407	68.8144	0.0000
A6	292	520	N	100	0	0	0	1.7169	0.0000	0.0000
A6	304	520	N	100	15	15	0	0.3618	5.4272	0.0000
A6	701	520	N	100	0	0	0	0.1974	0.0000	0.0000
							Totals:	8.6900	95.6918	120.1000

Table A.24 Unit hydrograph example RTIMP calculations

Basin ID	Soil LID	Land Use CODE	Land Use Cond.	RTIMP Nat % Eff	RTIMP, % Nat.	RTIMP, % Adj	RTIMP, % Dev.	Area sm	Area x $RTIMP_N$	Area x $RTIMP_D$
1	2	3	4	5	6	7	8	9	10	11
								$RTIMP_{Avg}$:	**11.01**	**13.82**
								Total RTIMP:	**25**	**A6**
A7	557	230	D	100	0	0	80	0.0003	0.0000	0.0220
A7	701	230	D	100	0	0	80	0.1955	0.0000	15.6367
A7	701	510	N	100	0	0	0	0.1577	0.0000	0.0000
A7	701	520	N	100	0	0	0	1.1107	0.0000	0.0000
							Totals:	1.4642	0.0000	15.6587
								$RTIMP_{Avg}$:	**0.00**	**10.69**
								Total RTIMP:	**11**	**A7**
A8	180	160	D	100	0	0	50	0.0486	0.0000	2.4305
A8	221	160	D	100	0	0	50	0.0027	0.0000	0.1342
A8	260	160	D	100	0	0	50	0.0242	0.0000	1.2113
A8	557	230	D	100	0	0	80	0.0449	0.0000	3.5959
A8	180	230	D	100	0	0	80	0.1384	0.0000	11.0681
A8	188	230	D	100	0	0	80	0.0397	0.0000	3.1792
A8	221	230	D	100	0	0	80	0.0007	0.0000	0.0527
A8	260	230	D	100	0	0	80	0.0136	0.0000	1.0842
A8	304	230	D	100	15	15	80	0.0006	0.0084	0.0447
A8	307	230	D	100	0	0	80	0.0244	0.0000	1.9537
A8	701	230	D	100	0	0	80	0.1546	0.0000	12.3663
A8	180	500	N	100	0	0	0	0.0127	0.0000	0.0000
A8	221	500	N	100	0	0	0	0.0029	0.0000	0.0000
A8	247	500	N	100	0	0	0	0.0108	0.0000	0.0000
A8	260	500	N	100	0	0	0	0.0000	0.0000	0.0000
A8	304	500	N	100	15	15	0	0.0018	0.0275	0.0000
A8	307	500	N	100	0	0	0	0.0021	0.0000	0.0000
A8	180	510	N	100	0	0	0	0.0091	0.0000	0.0000
A8	221	510	N	100	0	0	0	0.2203	0.0000	0.0000
A8	247	510	N	100	0	0	0	0.0011	0.0000	0.0000
A8	642	510	N	100	15	15	0	0.0266	0.3987	0.0000
A8	304	510	N	100	15	15	0	0.1076	1.6140	0.0000
A8	307	510	N	100	0	0	0	0.0684	0.0000	0.0000
A8	701	510	N	100	0	0	0	0.2050	0.0000	0.0000
A8	221	520	N	100	0	0	0	0.0165	0.0000	0.0000
A8	642	520	N	100	15	15	0	0.0614	0.9208	0.0000
A8	304	520	N	100	15	15	0	0.1171	1.7563	0.0000
A8	701	520	N	100	0	0	0	0.8596	0.0000	0.0000
							Totals:	2.2154	4.7256	37.1209
								$RTIMP_{Avg}$:	**2.13**	**16.76**
								Total RTIMP:	**19**	**A8**

Table A.24 Unit hydrograph example RTIMP calculations

Basin	Soil	Land Use		RTIMP	RTIMP, %			Area	Area x	Area x
ID	LID	CODE	Cond.	Nat % Eff	Nat.	Adj	Dev.	sm	$RTIMP_N$	$RTIMP_D$
1	2	3	4	5	6	7	8	9	10	11
B1	181	160	D	100	0	0	50	0.0099	0.0000	0.4930
B1	188	160	D	100	0	0	50	0.0041	0.0000	0.2034
B1	221	160	D	100	0	0	50	0.0602	0.0000	3.0120
B1	260	160	D	100	0	0	50	0.0098	0.0000	0.4910
B1	221	170	D	100	0	0	60	0.0336	0.0000	2.0157
B1	557	230	D	100	0	0	80	0.0017	0.0000	0.1330
B1	180	230	D	100	0	0	80	0.0405	0.0000	3.2429
B1	181	230	D	100	0	0	80	0.0408	0.0000	3.2624
B1	188	230	D	100	0	0	80	0.2868	0.0000	22.9469
B1	221	230	D	100	0	0	80	0.1291	0.0000	10.3301
B1	260	230	D	100	0	0	80	0.0403	0.0000	3.2231
B1	557	290	D	100	0	0	60	0.0073	0.0000	0.4368
B1	180	290	D	100	0	0	60	0.0065	0.0000	0.3877
B1	188	290	D	100	0	0	60	1.0805	0.0000	64.8311
B1	221	290	D	100	0	0	60	0.8399	0.0000	50.3941
B1	253	290	D	100	0	0	60	0.0084	0.0000	0.5053
B1	264	290	D	100	20	20	60	0.1884	3.7671	11.3012
B1	668	290	D	100	20	20	60	0.0012	0.0245	0.0735
B1	304	290	D	100	15	15	60	0.9004	13.5062	54.0247
B1	188	500	N	100	0	0	0	0.0004	0.0000	0.0000
B1	221	500	N	100	0	0	0	0.0003	0.0000	0.0000
B1	188	510	N	100	0	0	0	0.2885	0.0000	0.0000
B1	221	510	N	100	0	0	0	0.0014	0.0000	0.0000
B1	304	510	N	100	15	15	0	0.2830	4.2455	0.0000
B1	264	520	N	100	20	20	0	0.0285	0.5698	0.0000
B1	304	520	N	100	15	15	0	0.3806	5.7084	0.0000
							Totals:	4.6721	27.8214	231.3079
								$RTIMP_{Avg}$:	**5.95**	**49.51**
								Total RTIMP:	**55**	**B1**

Using Equation 7.16 in Section 7.4.4.6, the developed RTIMP for sub-basin A5 is computed as follows:

$$\overline{RTIMP}_{N,D} = \left(\frac{\sum A_i RTIMP_i}{A_T} \right)$$

where:

$\overline{RTIMP}_{N,D}$ = natural or developed condition composite value of RTIMP, inches

$RTIMP_i$ = RTIMP of each subarea, inches

A_i = area of RTIMP subarea

A_T = area of the watershed or sub-basin

$$\overline{RTIMP}_N = \left(\frac{0.0637 * 20}{4.6693} \right)$$

$$\overline{RTIMP}_N = 0.27\,\%$$

$$\overline{RTIMP}_D = \left(\frac{0.6427 * 80 + 0.1233 * 60}{4.6693} \right)$$

$$\overline{RTIMP}_D = 12.60\,\%$$

$$\overline{RTIMP} = \overline{RTIMP}_N + \overline{RTIMP}_D$$

$$\overline{RTIMP} = 0.27 + 12.60 = 13\%$$

The impervious areas for Sub-basin A-5 are assumed to be hydraulically connected and 100% effective for the purposes of this example. Refer to Table A.24, column 5. If they are not, as with sub-basin A-3, then the impervious area is reduced based on engineering judgment. Using the same procedure, composite RTIMP for the other sub-basins was computed. The results, rounded to the nearest percent, are summarized as follows:

	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**B1**
RTIMP	18	23	13	16	13	25	11	19	55

<u>Step 12. Preparation of the HEC-1 rainfall loss input records.</u>

Code the HEC-1 LG record for sub-basin A3 as follows:

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10
LG  0.23     0.28    12.11     0.35     13.0
```

Where Field 1 is IA, Field 2 is DTHETA, Field 3 is PSIF, Field 4 is adjusted XKSAT and Field 5 is RTIMP.

The other sub-basin LG records are coded similarly.

A.3.2 EXAMPLE FOR INITIAL LOSS AND UNIFORM LOSS RATE METHOD

The Initial Loss and Uniform Loss Rate Method is not normally applied in Mohave County. This method may be applicable when the soils for a watershed are predominately sands with a bare ground XKSAT greater than 2 inches hour. Sub-basin A3 from Appendix A.3.1 is used to illustrate application of this method. Refer to Section 7.4.5 for the procedures for the Initial Loss and Uniform Loss Rate Method.

Steps 1 through 7, 9, 10 and 11 from Appendix A.3.1 should be followed to obtain sub-basin composite values of IA, adjusted bare ground XKSAT, and RTIMP. The adjusted bare ground XKSAT is assigned as CNSTL. For sub-basin A3, this is 0.35 inches/hour.

Estimate STRTL. STRTL is the sum of IA and the initial infiltration, II. IA for sub-basin A3 is computed to be 0.23 inches. Using Table 7.10, and a CNSTL of 0.35 inches/hour, II_{dry} is 0.6 inches and II_{normal} is 0.5 inches. II_{dry} is applicable for the natural portion of sub-basin A3, and II_{normal} is applicable to the developed areas. An area-weighted value of II is computed as follows, using a similar method to that applied in Green and Ampt Step 8 above for computing composite DTHETA:

$$\overline{II} = \left(\frac{\sum A_i II_i}{A_T} \right)$$

where:

$\overline{II}$ = composite value of II, inches

II_i = II of each subarea, inches

A_i = size of II subarea

A_T = size of the watershed or sub-basin

$$\overline{II} = \left(\frac{10.114 * 0.6 + 3.053 * 0.5}{13.167} \right) = 0.58\, inches$$

$$STRL = \overline{IA} + \overline{II}$$

$$STRTL = 0.23 + 0.58 = \ 0.81\ inches$$

Preparation of the HEC-1 rainfall loss input records.

Code the HEC-1 LU record for sub-basin A3 as follows:

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10
LU  0.81    0.35    13.0
```

Where Field 1 is STRTL, Field 2 is CNSTL, and Field 3 is RTIMP.

A.4 UNIT HYDROGRAPH EXAMPLE

A.4.1 PROBLEM STATEMENT

Clark unit hydrograph parameters are needed for a HEC-1 model of a large watershed within, and south of, Kingman, AZ. The site is located as shown on Figure A.6, and is the same watershed used for the Appendix A.3 example. Derive the parameters and prepare the HEC-1 unit hydrograph records for the model using the instructions set forth in Section 7.5.3. There are two methods that can be used:

1. Manual Computations. Computations are performed by hand or with a calculator.
2. DDMSW Manual Input. Lengths and other parameters are determined by the most expedient means available and then manually input to DDMSW. DDMSW then computes the Clark unit hydrograph parameters for each sub-basin.
3. DDMSW GIS Method. Sub-basin boundaries, land use boundaries, Tc paths, and Lca paths are created in ERSI GIS shape file format external to DDMSW, read into DDMSW, and then DDMSW computes Clark unit hydrograph parameters for each sub-basin using the GIS information.

A.4.2 PROBLEM SOLUTION

The manual solution consists of the following steps.

1. Watershed delineation.
2. Definition of the T_c and L_{ca} paths for each sub-basin.
3. Definition of the L_{ca} path for each sub-basin.
4. Calculation of T_c.
5. Calculation of R.
6. Determination of the time-area relationship for each sub-basin.
7. Preparation of the HEC-1 UC record for each sub-basin.\

Determine the NMIN and NQ Parameters for the HEC-1 Model.

Step 1. Watershed Delineation.

Refer to Appendix A.3.1.2, Step 1.

Step 2. Definition of the T_c and L_{ca} paths for each sub-basin.

The T_c and L_{ca} paths were delineated using the USGS 7.5 minute Quadrangle Maps and 10-meter Digital Elevation Maps (DEM) of the area. The results are shown on Figure A.23. The parameters derived from the USGS Quadrangle Maps and DEMs are listed in Table A.25.

Table A.25 Unit hydrograph T_c and L_{ca} parameters					
Sub-basin ID	T_c Path				L_{ca}
	Length, miles	Top Elevation	Bottom Elevation	Slope, ft/mi	Length, miles
A1	8.66	8054.4	4068.0	460.4	4.77
A2	9.98	5009.5	3162.2	185.1	5.06
A3	9.29	5161.0	3131.1	218.4	4.19
A4	10.60	6274.5	3131.1	296.4	6.54
A5	5.35	4311.9	3055.8	235.0	2.70
A6	11.03	4896.3	3001.6	171.8	5.44
A7	3.12	4110.7	3001.6	355.5	1.54
A8	4.25	3925.8	2840.1	255.7	2.78
B1	4.58	3827.5	2813.6	221.3	1.92

Step 3. Determination of sub-basin land uses.

The land uses present on the watershed are shown on Figure A.24. Based on an evaluation of the land uses for each sub-basin, the Tc equation appropriate to the dominate land use in each sub-basin was assigned as listed in Table A.26. Refer to Section 7.5.2.1.

Table A.26 Unit hydrograph T_c equation type assignment	
Sub-basin ID	T_c Equation Type
A1	Desert/Mountain
A2	Desert/Mountain
A3	Desert/Mountain
A4	Desert/Mountain
A5	Desert/Mountain
A6	Desert/Mountain
A7	Desert/Mountain
A8	Desert/Mountain
B1	Urban

Step 4. Calculation of T_c.

The time of concentration, T_c, for sub-basins A3 and B1 are computed using the appropriate T_c equation (Equation 7.17 or 7.19) and data from Appendix A.3.1.2 and Table A.25 as follows:

desert/mountain:

$$T_c = 2.4A^{0.1}L^{0.25}{L_{ca}}^{0.25}S^{-0.2}$$

urban

$$T_c = 3.2A^{0.1}L^{0.25}{L_{ca}}^{0.25}S^{-0.14}RTIMP^{-0.36} \quad \text{A.1}$$

where:

T_c	=	time of concentration, in hours,
A	=	area, in square miles,
S	=	watercourse slope, in feet/mile,
L	=	length of watercourse to the hydraulically most distant point, in miles,
L_{ca}	=	length measured from the concentration point along L to a point on L that is perpendicular to the watershed centroid, in miles, and
RTIMP	=	effective impervious area, in percent.

Sub-basin A3:

$$T_c = 2.4(13.167)^{0.1}(9.29)^{0.25}(4.19)^{0.25}(218.4)^{-0.2}$$

$$T_c = 2.64\ hours$$

Sub-basin B1:

$$T_c = 3.2(4.672)^{0.1}(4.58)^{0.25}(1.92)^{0.25}(221.3)^{-0.14}(55)^{-0.36}$$

$$T_c = 0.71\ hours$$

Step 5. Calculation of R.

The storage coefficient, R, for sub-basins A3 and B1 are computed using Equation 7.20 and data from Appendix A.3.1.2 and Table A.25 as follows:

$$R = 0.37{T_c}^{1.11}L^{0.80}A^{-0.57}$$

where: R is in hours and the variables are as defined for the T_c equations.

Sub-basin A3:

$$R = 0.37(2.64)^{1.11}(9.29)^{0.80}(13.167)^{-0.57}$$

$$R = 1.49\ hours$$

Sub-basin B1:

$$R = 0.37(0.71)^{1.11}(4.58)^{0.80}(4.672)^{-0.57}$$

$$R = 0.36\ hours$$

Using the same procedures, T_c and R for the other sub-basins were computed. The results are summarized as follows:

	A1	A2	A3	A4	A5	A6	A7	A8	B1
T_c	2.21	2.88	2.64	2.73	1.83	2.96	1.14	1.59	0.71
R	1.49	1.86	1.49	2.29	1.15	2.46	0.86	1.25	0.36

Step 6. Determination of the time-area relationship for each sub-basin.

A time-area relationship must be either computed, or assigned using one of the three synthetic relationships defined in Section 7.5.2.3. For the majority of cases in Mohave County, use of the synthetic relationships is appropriate. In general, the land use codes assigned in Appendix A.3.1.2 can be used as guidance for assigning the synthetic time-area relationship. The dominate land use and the assigned time-area relationship for each sub-basin are listed in Table A.27.

Table A.27 Assignment of the time-area relationship to each sub-basin

Sub-basin ID	Dominate Land Use	Assigned Time-Area Relationship
A1	520	Mountain, HEC-1 Default Curve B
A2	520	Mountain, HEC-1 Default Curve B
A3	520	Mountain, HEC-1 Default Curve B
A4	520	Mountain, HEC-1 Default Curve B
A5	510	Desert Rangeland, Curve C
A6	520	Mountain, HEC-1 Default Curve B
A7	520	Mountain, HEC-1 Default Curve B
A8	520	Mountain, HEC-1 Default Curve B
B1	290	Urban, Curve A

Land use codes 500 and 510, undeveloped desert rangeland and hillslope areas, are assigned curve C. Land use code 520, Mountain, areas are assigned curve B. Predominately urban areas are assigned curve A. Note that this is another instance where proper sub-basin delineation based on land use is very important. For instance, sub-basins A2 and A3 have a significant percentage of urban area. The urban areas should be delineated into separate sub-basins whenever possible so that an appropriate time-area relationship can be assigned.

Step 7. Preparation of the HEC-1 UC record for each sub-basin.

Code the HEC-1 UC record for the Clark unit hydrograph parameters for sub-basin A3 as follows:

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10
UC   2.64    1.49
```

Where Field 1 is T_c, and Field 2 is R.

Code the HEC-1 UA record for the time-area relationship for sub-basin A3 as follows. The UA records follow the UC record in the HEC-1 input file.

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10

UA       0      4.5     12.6     23.2     35.8     50.0     64.2     76.8     87.4     95.5
UA     100
```

Where Field 1 is percent of watershed area at time interval 0, Field 2 is percent of watershed area at time interval 2, etc. UC and UA records for the other sub-basins should be coded in a similar manner.

Step 8. Determine the NMIN and NQ Parameters for the HEC-1 Model.

As described in Section 7.9.2.4, NMIN is the integer number of minutes for the computation interval, which will usually be either 2 minutes or 5 minutes. To determine NMIN, estimate the time of concentration (T_c) for the smallest sub-basin. Using this value, estimate the number of hydrograph ordinates (NQ) required to provide an adequate time base for the HEC-1 model.

Per Step 6 above, the shortest T_c is 0.71 hours for sub-basin B1. NMIN should be between $0.1T_c$ and $0.25T_c$, or between 4 and 11 minutes. Select a T_c of 5-minutes.

The total length of channel reach routes for the model is 56,701 feet (refer to Appendix A.5). Assuming an average velocity of 5 fps, the total reach travel time is 3.15 hours. The storm duration for this example is 24-hours. Use a model duration of 24+4 hours = 28 hours. NQ is therefore 28*60/NMIN or 336. Use NQ = 400. NQ should be checked after the HEC-1 model is completed.

A.4.3 UNIT HYDROGRAPH METHOD HEC-1 MODEL RESULTS

DDMSW was used to model the unit hydrograph method example discussed in Appendixs A.3, A.4, A.5, and A.6. The resultant HEC-1 input file is listed in Figure A.26.

Figure A.26 Unit Hydrograph Method example HEC-1 input file

```
ID      County of Mohave
ID      UNIT HYDROGRAPH EX - Unit Hydrograph Method Example
ID      100 YEAR
ID      24 Hour Storm
ID      Unit Hydrograph: Clark
ID      08/16/2009
IT     5       0       0     400
IN    15
IO     3
*DIAGRAM
*
JD 4.484    0.01
PH                 0.706   1.332   2.220   2.659   2.877   3.229   3.677   4.484
JD 4.260      10
JD 4.116      20
JD 4.036      30
JD 3.932      50
JD 3.802     100
JD 3.731     150
JD 3.614     300
JD 3.511     500
*
KK    A1   BASIN
BA 8.363
LG  0.25    0.32    9.12    0.41      18
UC 2.207   1.493
UA     0     4.5    12.6    23.2    35.8    50.0    64.2    76.8    87.4    95.5
UA   100
*
KK001002   ROUTE
RS     8    FLOW      -1
RC 0.055   0.045   0.055   33573  0.0270 3575.00
RX  0.00  100.00  614.00  629.00  739.00  748.60  765.80  950.40
RY3624.2 3570.00 3569.00 3566.00 3566.00 3570.90 3573.10 3618.00
*
KK    A2   BASIN
BA11.599
LG  0.23    0.25   14.43    0.24      23
UC 2.877   1.863
UA     0     4.5    12.6    23.2    35.8    50.0    64.2    76.8    87.4    95.5
UA   100
*
KK    C2 COMBINE
HC     2
*
KK002003   ROUTE
RS     1    FLOW      -1
```

Figure A.26 Unit Hydrograph Method example HEC-1 input file

```
RC 0.055   0.045   0.055    1586  0.0196 3170.00
RX  0.00    0.10  253.00  274.00  336.20  359.40  380.70  394.80
RY3173.5 3166.40 3164.50 3162.20 3162.40 3164.90 3164.90 3173.50
*
KK    A3   BASIN
BA13.167
LG  0.23    0.28   12.11    0.35      13
UC 2.642   1.489
UA     0     4.5    12.6    23.2    35.8    50.0    64.2    76.8    87.4    95.5
UA   100
*
KK    A4   BASIN
BA 7.957
LG  0.25    0.30   12.38    0.31      16
UC 2.730   2.287
UA     0     4.5    12.6    23.2    35.8    50.0    64.2    76.8    87.4    95.5
UA   100
*
KK    C3 COMBINE
HC     3
*
KK003004   ROUTE
RS     1    FLOW      -1
RC 0.055   0.045   0.055    4417  0.0170 3123.00
RX  0.00   31.20   77.70  124.50  164.60  231.90  316.30  363.50
RY3123.3 3122.90 3116.10 3112.80 3114.20 3118.40 3121.00 3123.30
*
KK    A5   BASIN
BA 4.669
LG  0.17    0.28   12.11    0.33      13
UC 1.831   1.150
UA     0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
UA   100
*
KK    C4 COMBINE
HC     2
*
KK004005   ROUTE
RS     1    FLOW      -1
RC 0.055   0.045   0.055    4644  0.0117 3039.00
RX  0.00  256.30  462.90  620.20  673.90  826.70  936.90 1045.80
RY3044.2 3042.70 3035.70 3030.80 3030.40 3035.60 3041.50 3049.90
*
KK    A6   BASIN
BA 8.690
LG  0.21    0.26   14.43    0.24      25
UC 2.962   2.457
UA     0     4.5    12.6    23.2    35.8    50.0    64.2    76.8    87.4    95.5
UA   100
*
KK   C5L COMBINE
HC     2
*
KK    A7   BASIN
BA 1.464
LG  0.22    0.29   12.11    0.34      11
UC 1.140   0.856
UA     0     4.5    12.6    23.2    35.8    50.0    64.2    76.8    87.4    95.5
UA   100
```

Figure A.26 Unit Hydrograph Method example HEC-1 input file

```
*
KK    C5 COMBINE
HC     2
*
KK005006   ROUTE
RS     4    FLOW      -1
RC 0.055   0.045   0.055   12481  0.0129 2925.00
RX  0.00  102.40  200.20  285.30  391.40  478.90  530.80  619.50
RY2928.0 2922.70 2916.90 2918.30 2918.10 2916.00 2917.60 2928.00
*
KK    A8   BASIN
BA 2.215
LG  0.19    0.28   11.32    0.38      19
UC 1.589   1.250
UA     0     4.5    12.6    23.2    35.8    50.0    64.2    76.8    87.4    95.5
UA   100
*
KK    C6 COMBINE
HC     2
*
KK    B1   BASIN
BA 4.672
LG  0.16    0.15   16.31    0.13      55
UC 0.713   0.357
UA     0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
UA   100
ZZ
```

The output results are listed in Table A.28. There are several areas of interest in the results.

1. The Time-to-Peak (T_p) in column 4 for the last combine operation (C6) is 14.83 hours. Therefore, the total time base is 24 hours + 2.83 hours = 26.83 hours. The NQ value for the model could be reduced to: NQ = 26.83*60/5 = 321 minutes. The value used, 400, is a good estimate and does not need to be adjusted.

2. Check the Channel Route operations. In all cases the peak discharge is reduced as a result of attenuation in the reach. If any peak discharges had increased as a result of the route, the operation would need to be checked in detail as this is an indication of improper coding of parameters. The cross section should be plotted to make sure there are no input errors and all other parameters should be verified.

   Evaluate the combine operations. At C2 note that the combined peak discharge is less than the sum of the upstream peaks. The same is true for the combined runoff volume. All of the combine operations show this result. This is due to the use of the HEC-1 JD record option. The combine operation increases the total watershed area at the concentration point. The increased watershed area results in a greater areal reduction factor applied to the rainfall value.

   The JD record option causes HEC-1 to compute what are called index hydrographs, one for each JD record used. Each JD record specifies a watershed area and corresponding areally-reduced point precipitation value. The index hydrographs represent the runoff hydrograph for that specific watershed area and precipitation value. When a sub-basin operation is performed, HEC-1 computes all the index hydrographs and then computes a log-based interpolated hydrograph using the actual sub-basin area. The interpolated hydrograph results are what are reported.

The index hydrographs are carried forward. When a hydrograph operation such as a combine is performed, the index hydrographs from the upstream hydrograph operations are added and then the log-based interpolation is performed using the total watershed area at the combine operation concentration point. This process results in the areally-reduced peak discharge at the combine being lower than the total of the peak discharges being added.

The unit peak discharges in column 6 represent the peak discharge in column 5 divided by the watershed area in column 3. The unit peak discharges are very useful for checking the reasonableness of the model results by indirect methods, as described in Section 7.11.

Table A.28 Unit hydrograph method example HEC-1 results

HEC-1 Operation	ID	Area, sm	Time to Peak, hrs	Peak Discharge, cfs	Unit Discharge, cfs/sq mi	Rainfall Excess, in	Runoff Volume, ac-ft
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HYDROGRAPH AT	A1	8.36	13.92	2,406	288	1.547	690
ROUTED TO	001002	8.36	14.58	2,334	279	1.547	690
HYDROGRAPH AT	A2	11.60	14.50	3,138	271	1.846	1,142
2 COMBINED AT	C2	19.96	14.58	4,988	250	1.603	1,707
ROUTED TO	002003	19.96	14.58	4,987	250	1.603	1,707
HYDROGRAPH AT	A3	13.17	14.17	3,203	243	1.355	952
HYDROGRAPH AT	A4	7.96	14.42	1,710	215	1.532	650
3 COMBINED AT	C3	41.09	14.50	7,981	194	1.293	2,832
ROUTED TO	003004	41.09	14.58	7,959	194	1.293	2,832
HYDROGRAPH AT	A5	4.67	13.50	1,962	420	1.470	366
2 COMBINED AT	C4	45.75	14.50	8,506	186	1.251	3,054
ROUTED TO	004005	45.75	14.58	8,466	185	1.251	3,054
HYDROGRAPH	A6	8.69	14.67	2,095	241	1.933	896

Table A.28 Unit hydrograph method example HEC-1 results

HEC-1 Operation	ID	Area, sm	Time to Peak, hrs	Peak Discharge, cfs	Unit Discharge, cfs/sq mi	Rainfall Excess, in	Runoff Volume, ac-ft
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AT							
2 COMBINED AT	C5L	54.44	14.58	9,641	177	1.265	3,672
HYDROGRAPH AT	A7	1.46	13.00	723	495	1.399	109
2 COMBINED AT	C5	55.91	14.58	9,677	173	1.251	3,730
ROUTED TO	005006	55.91	14.92	9,601	172	1.251	3,730
HYDROGRAPH AT	A8	2.21	13.42	840	380	1.636	193
2 COMBINED AT	C6	58.12	14.83	9,739	168	1.241	3,846
HYDROGRAPH AT	B1	4.67	12.42	6,545	1401	3.105	774

A.5 CHANNEL ROUTING EXAMPLE

A.5.1 PROBLEM STATEMENT

Channel hydrograph routing parameters are needed for a HEC-1 model of a large watershed within, and south of, Kingman, AZ. The site is located as shown on Figure A.6, and is the same watershed used for the Appendixs A.3 and A.4 examples. Derive the parameters and prepare the HEC-1 channel route records for the model using the instructions set forth in Section 7.6.4. An excellent resource for guidance when performing hydrologic routing using HEC-1 is Hoggan (1997).

A.5.2 PROBLEM SOLUTION

The procedure consists of the following steps:

1. Watershed delineation.
2. Definition of the routing paths for each routing reach.
3. Evaluation the physical characteristics of each reach.
4. Determinations of the reach or sub-reach cross section.
5. Assignment of Manning's n-values.
6. Preparation of the HEC-1 channel route input records.
7. Estimation and optimization of routing computation steps.

Step 1. Watershed Delineation.

Refer to Appendix A.3.1.2, Step 1.

Step 2. Definition of the routing paths for each routing reach.

There are five (5) routing reaches for this example. They have been defined using the "blue" thalweg lines on the 7.5-minute USGS Quadrangle Maps and are shown on Figure A.23. Concentration points at the outlet of each sub-basin and at confluences have been defined and are also shown on Figure A.23. The routing reaches for this example are named by combining the concentration point identifiers for the upstream and downstream end of the reach. For example, the reach that routes the hydrograph from sub-basin A1 through sub-basin A2 is named '001002' because it connects concentration points C1 and C2. In HEC-1, the maximum length of a named for a hydrograph operation such as a reach route operation or a sub-basin designation is characters. Using this naming convention, a total of 999 concentration points could be defined for a given HEC-1 model. The reach names for this example are 001002, 002003, 003004, 004005, and 005006.

Step 3. Evaluation the physical characteristics of each reach.

The first characteristic to evaluate is slope. If there are significant changes in slope within the reach, it should be subdivided into sub-reaches. Reach 001002 is very long (33,573 feet) and does have significant change in slope. Before dividing up the reach, evaluate the second characteristic, which is the average cross section. Does it significantly change in configuration (ie. significant changes in the width, or the depth to width ratio)? Can the reach be subdivided to account for both characteristics? Other characteristics to consider are changes in roughness , soils, natural conditions versus constructed, and vegetation. All of these characteristics affect travel time in the reach and potential storage, which are the effects being modeled with the normal depth channel route method. A detailed examination of reaches 001002 and 005006, including field reconnaissance, would likely result in subdivision of both reaches. For the purposes of this example, no further subdivision will be made, but the hydrologist/engineer is expected to break routing reaches into sub-reaches where appropriate.

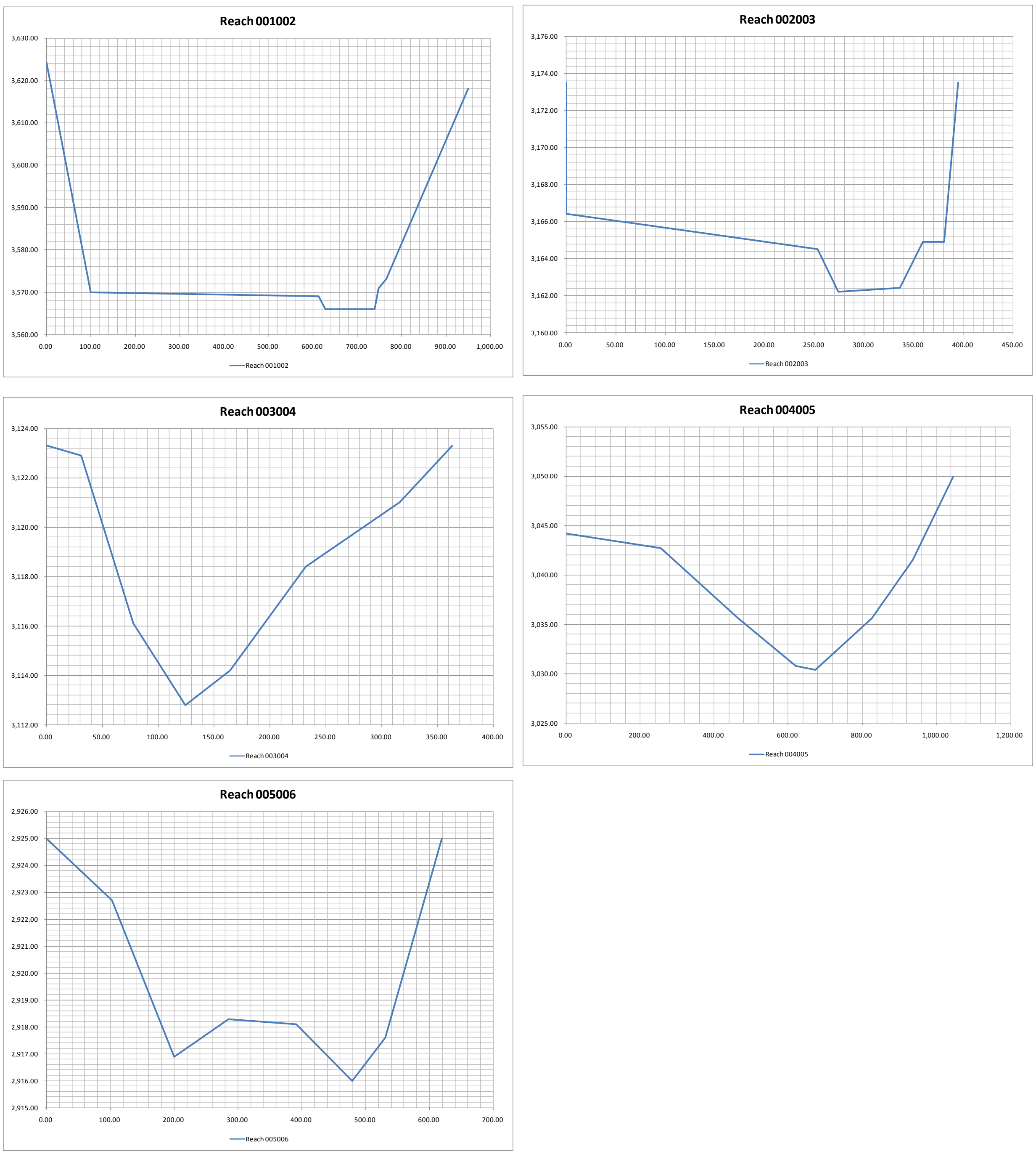
Table A.29 Reach route physical characteristics

Reach ID	In Sub-basin	Elevation		Length, ft	Slope, ft/ft
		Top	Bottom		
001002	A2	4068.0	3162.2	33,572.5	0.0270
002003	A4	3162.2	3131.1	1,585.7	0.0196
003004	A5	3131.1	3055.8	4,416.60	0.0170
004005	A6	3055.8	3001.6	4,644.1	0.0117
005006	A8	3001.6	2840.1	12,481.1	0.0129

Step 4. Determinations of the reach or sub-reach cross section.

The next step is to establish a cross section for each reach that is a reasonable approximation of the various cross section configurations present within the reach. This can be done by examining the available contour mapping covering each reach and by field reconnaissance. The cross sections for this example were defined using the USGS 7.5-minute Quadrangle Maps. In actual application, if the quad maps are the best available topography, the hydrologist/engineer should conduct a field reconnaissance and survey field cross sections at representative locations. Then a composite eight (8) point cross section that is representative of the reach can be prepared. HEC-1 normal depth routing reach cross sections are limited to eight (8) points to define cross section. The cross sections used for this example are shown in Figure A.27.

Figure A.27 Reach route cross sections



In general, use cross section points 1-3 and 6-8 to define the left and right overbank areas, respectively, and cross section points 3-6 should be used to define the main channel. As with HEC-2 and HEC-RAS, routing cross sections should be stationed from left to right looking downstream.

Step 5. Assignment of Manning's n-values.

Manning's n for the main channel and left and right overbanks should be determined using the procedures set forth in Chapter 13. For the purposes of this example, a value of 0.045 was used for the main channel for all five routing reaches. An n-value of 0.055 was assigned for the left and right overbank areas for all five reaches.

Step 6. Preparation of the HEC-1 channel route input records.

Using the data from Steps 1-5, the HEC-1 input data file records for reach route 001002 are coded as follows:

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10
KK001002  ROUTE
RS     8    FLOW      -1
RC 0.055   0.045   0.055   33573  0.0270 3575.00
RX  0.00  100.00  614.00  629.00  739.00  748.60  765.80  950.40
RY3624.2 3570.00 3569.00 3566.00 3566.00 3570.90 3573.10 3618.00
```

The KK record defines the hydrograph operation name.

The RS record establishes that this is a storage route. The type of storage route is not yet specified. The Normal Depth channel route is actually a form of storage route based on the Modified Puls method (refer to Hoggan, 1997). Field 1, NSTPS, is set equal to eight (8), which is the number of steps to be used in the route operation. This value should be computed through an optimization process as described in Step 7. "FLOW" is entered in Field 2, which specifies that the discharge rate for the beginning of the first time period will be in the next field. The next field (Field 3) is set to -1, which specifies the initial outflow rate is set equal to the initial inflow rate.

The RC record establishes that this is a Normal Depth Channel Routing operation. The fields are:

1. ANL, Left overbank Manning's n-value.
2. ANCH, Channel Manning's n-value.
3. ANR, Right overbank Manning's n-value.

4. RLNTH, Reach length, in feet.
5. SEL, Energy gradeline slope in ft/ft. Can be computed from a HEC-RAS model. If unknown, estimate using the average channel slope for the reach.
6. ELMAX, Maximum elevation for which storage and outflow values are to be computed.

The RX record is used to define the ground stations for each point on the cross section, increasing from left to right looking downstream. Note that the left and right bank are assumed to be located at points 3 and 6, respectively, on the cross section. A maximum of eight (8) points are allowed per cross section.

The RY record is used to define the ground elevation of each point on the cross section, corresponding to the stations defined on the RX record.

Step 7. Estimation and optimization of routing computation steps.

The NSTPS parameter, entered in Field 1 of the RS record, should be optimized as described in Section 7.9.2.9. The DDMSW computer program will perform the optimization but it is important to understand how the program accomplishes the optimization and there may be times when the hydrologist/engineer needs to perform the optimization manually. The process for accomplishing the optimization of NSTPS manually for reach 001002 is presented here.

1. Initial Estimation of NSTEPS. Determine an initial estimate of NSTPS by assuming an average velocity for the reach and using Equation 7.23. Assume an average velocity of 7 fps and use the reach data from Table A.29. Assume an NMIN of 5-minutes is used for the HEC-1 model.

$$\text{NSTPS} = \frac{L}{(V_{avg})(60)(NMIN)}$$

where:

L	=	the minimum reach length, in feet.
NSTPS	=	an integer with a minimum value of 1, but preferably more than 1.
V_{avg}	=	an estimate of the average velocity, in feet/second.
NMIN	=	the integer number of minutes for the computation interval.

$$\text{NSTPS} = \frac{33{,}572.5}{(7)(60)(5)} = 16$$

Iteration 1. After an initial estimate of NSTPS has been made for all routing reaches, the NSTPS values should be coded on the RS record and the HEC-1 model run. Then open the HEC-1 Output file with a text editor such as Notepad or TextPAD (http://www.textpad.com/) and evaluate the RUNOFF SUMMARY table at the end of the file. Refer to Figure A.28 for an excerpt from the the Runoff Summary table from the 100-year 24-hour HEC-1 model for this example using NSTPS = 16 for reach 001002.

Figure A.28 HEC-1 output Runoff Summary table excerpt, NSTPS=16

```
                                    RUNOFF SUMMARY

                               FLOW IN CUBIC FEET PER SECOND

                            TIME IN HOURS,  AREA IN SQUARE MILES

                              PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN
        OPERATION     STATION       FLOW     PEAK                                               AREA
+                                                  6-HOUR     24-HOUR     72-HOUR

        HYDROGRAPH AT
+                          A1       2406.   13.92       1146.       345.        251.       8.36
        ROUTED TO
+                      001002       2370.   14.58       1129.       345.        251.       8.36
```

Using the data in Figure A.28, compute the reach travel time by subtracting the Time-to-Peak at the beginning of the route from the Time-to-Peak at the end of the route:

Travel Time = 14.58-13.92 = 0.66 hours.

Compute the new estimate of NSTPS:

NSTPS Iteration 2 = (0.66)(60)/5 = 8

Iteration 2. Revise the RS record for reach 001002 by changing the NSTPS value from 16 to 8. Rerun the HEC-1 model and determine NSTPS from the Runoff Summary table. The results are shown in Figure A.29. Note that the travel time of 0.66 hours remains unchanged. The value of NSTPS = 8 is accepted for use in the model. NSTPS normally converges to no change within three (3) iterations. This technique is only accurate to +/- 1 time step. Sometimes the computed NSTPS value will oscillate by a value of +/- 1 between iterations. In this case, use engineering judgment to select which of the two values to use.

The current version of DDMSW uses the 100-year storm frequency to perform the NSTPS optimization. The optimized NSTPS values from 100-year HEC-1 model are then used for any other frequencies run. The hydrologist/engineer should keep this in mind when checking the results for frequencies other than the 100-year. The Runoff Summary table results for other frequencies should be checked to be sure the NSTPS values computed by HEC-1 are not significantly different than input. Manual adjustment may be necessary.

Figure A.29 HEC-1 output Runoff Summary table excerpt, NSTPS=8

```
                                                                              RUNOFF SUMMARY

                                                                      FLOW IN CUBIC FEET PER SECOND

                                                                   TIME IN HOURS,  AREA IN SQUARE MILES

                                                   PEAK    TIME OF      AVERAGE FLOW FOR MAXIMUM PERIOD        BASIN
MAXIMUM     TIME OF

          OPERATION       STATION       FLOW      PEAK                                                          AREA
STAGE     MAX STAGE

+                                                                       6-HOUR      24-HOUR      72-HOUR

          HYDROGRAPH AT

+                              A1       2406.    13.92         1146.         345.         251.          8.36

          ROUTED TO

+                          001002       2334.    14.58         1123.         345.         251.          8.36
```

Other items to check when evaluating the HEC-1 results of reach route operations are:

a. The routed peak discharge should not increase as a result of the routing operation. If it does, the cross section and other routing parameters should be carefully reviewed for errors.

The peak discharge entering the routing reach should not exceed the normal depth flow capacity of the cross section. If it does, the cross section should be extended.

If the reach travel time is less than 1, consider using the HEC-1 lag operation instead of a Normal Depth Channel route or no routing operation at all.

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A.6 STORAGE ROUTING EXAMPLES

A.6.1 MODIFIED PULS METHOD

The Modified Puls Method HEC-1 option can be used to model the effects of stormwater storage facilities used as detention basins or flood retarding structures. The steps for application are as follows:

1. Determine the Stage-Storage characteristics of the basin.
2. Determine the Stage-Discharge characteristics of the outlet(s).
3. Code the HEC-1 input records.

Step 1. Determine the Stage-Storage characteristics of the basin.

A rating curve of the available storage for storm water within the basin should be developed. This can be accomplished using the design topography for the basin and computing the storage for the basin in depth increments appropriate for physical characteristics affecting storage such as changes side slope ratios and horizontal shape changes. An example of data computed for a storage basin is shown in Table A.30 and graphically on Figure A.30.

Table A.30 Example stage-storage curve data

Depth, ft	Stage, ft	Surface Area, acres	Volume, ac-ft	
			Incremental	Cumulative
0.0	3570.0	1.00	0.00	0.00
0.5	3570.5	1.05	0.51	0.51
1.0	3571.0	1.25	0.57	1.09
1.5	3571.5	1.50	0.69	1.77
2.0	3572.0	2.00	0.87	2.65
2.5	3572.5	3.00	1.24	3.89
3.0	3573.0	3.50	1.62	5.51
4.0	3574.0	4.00	3.75	9.26
5.0	3575.0	5.00	4.49	13.75

The volume data can be calculated using Equation A.2 (USACE, 1998).

$$\Delta V_{1,2} = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 A_2}\right) \qquad A.2$$

where:

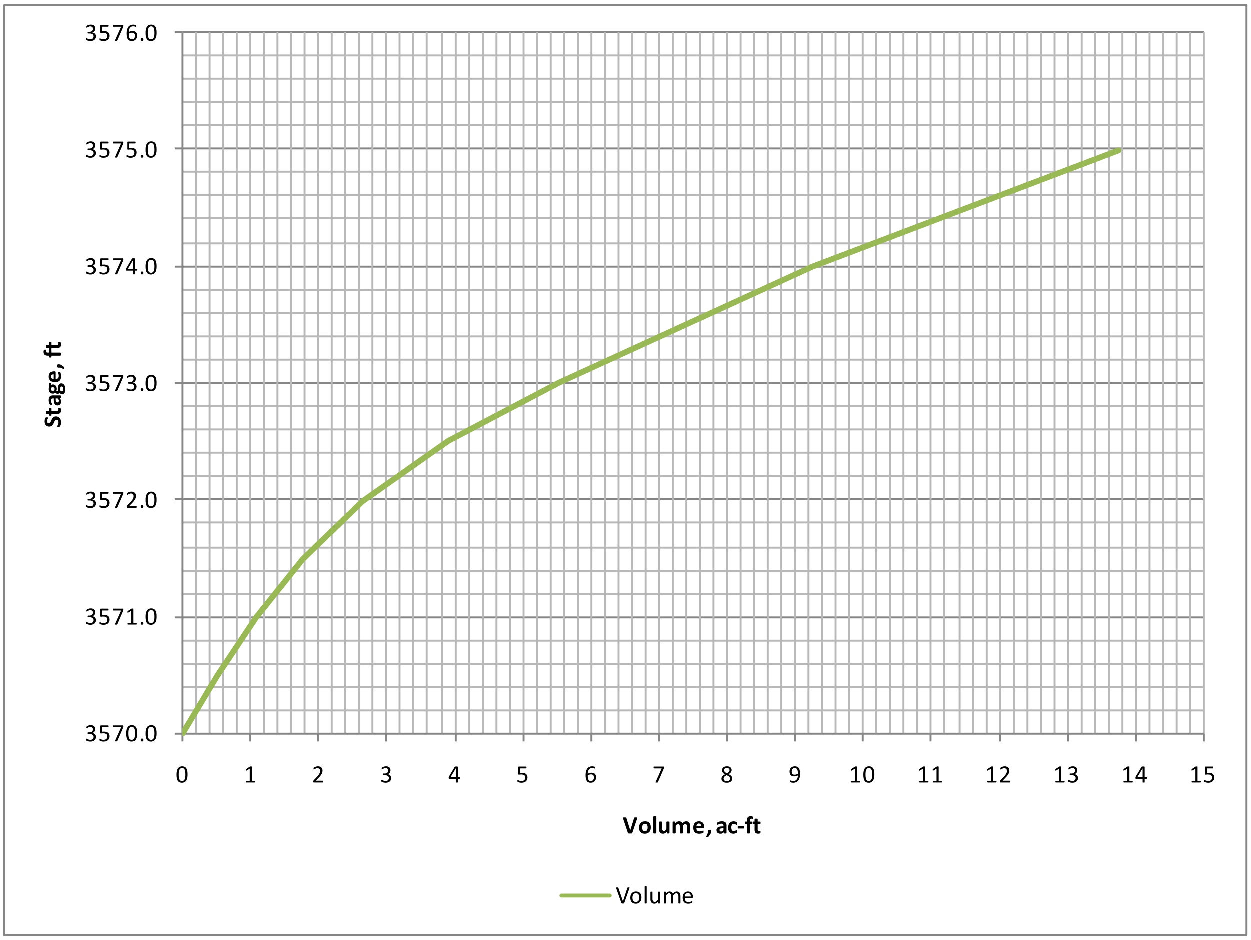
$\Delta A_{1,2}$ = volume between stage areas 1 and 2,

h = vertical distance (depth) between stage areas A1 and A2,

A_1 = surface area of stage 1, and

A_2 = surface area of stage 2.

Figure A.30 Example stage-storage rating curve



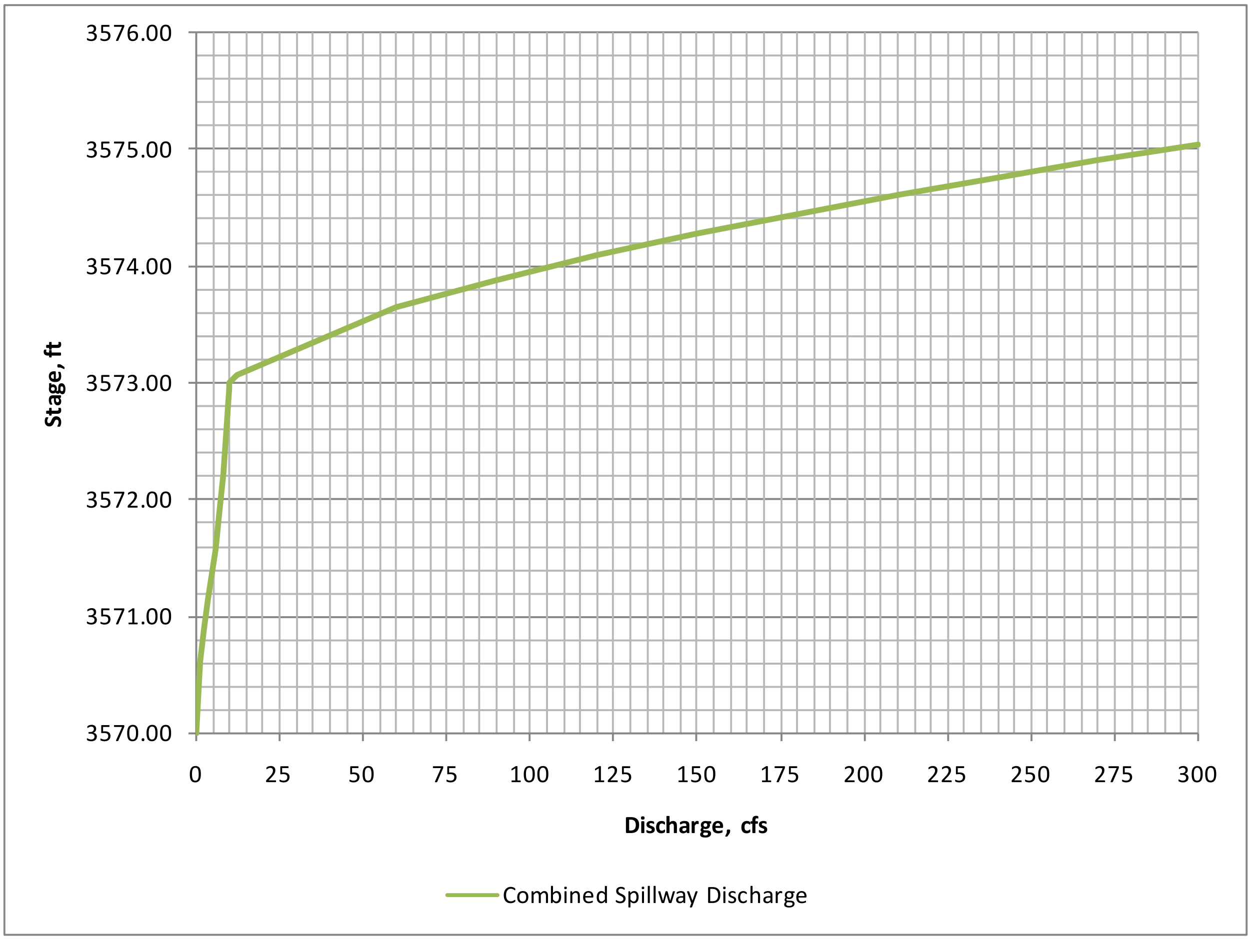
Step 2. Determine the Stage-Discharge characteristics of the outlet(s).

HEC-1 can model the effects of both principal spillways (culverts) and emergency spillways (overflow weirs or channels) through a combined hydraulic rating curve. The rating curves for both types of outlets should be developed using appropriate hydraulic modeling software such as HEC-RAS or HY-8 and then combined into a single rating table. For the above example, the principal spillway is an 18-inch CMP with headwalls on a slope of 1 percent. The culvert discharges into a riprap lined trapezoidal channel with 2:1 side slopes, a bottom width of 15 feet, and a slope of 0.8 percent. The emergency spillway is a broad-crested weir with a crest length of 25 feet, a crest width of 10 feet, and the flowline set at elevation 3573.0. HY-8 (USDOT, 2005b and 2007) was used to model the spillway hydraulics and the results are shown in Table A.31. The design criteria requires that a total 100-year peak discharge of 100 cfs be passed through the spillways with a freeboard of 1 foot (ie. water surface cannot exceed elevation 3574.0). Also, the total spillway capacity is to be determined and the basin must drain completely within 36 hours..

Table A.31 Example stage-discharge curve data

Outlet Control Depth, ft	Stage, ft	Spillway Discharge, cfs		
		Principal	Emergency	Combined
0.00	3570.00	0.0	0.0	0.0
0.62	3570.62	1.2	0.0	1.2
0.90	3570.90	2.4	0.0	2.4
1.14	3571.14	3.6	0.0	3.6
1.36	3571.36	4.8	0.0	4.8
1.58	3571.58	6.0	0.0	6.0
1.91	3571.91	7.2	0.0	7.2
2.23	3572.23	8.0	0.0	8.0
2.95	3572.95	9.6	0.0	9.6
3.00	3573.00	9.7	0.0	9.7
3.08	3573.08	9.9	2.1	12.0
3.65	3573.65	11.0	49.0	60.0
3.89	3573.89	11.4	78.5	90.0
4.10	3574.10	11.7	108.2	120.0
4.29	3574.29	11.6	138.2	150.0
4.46	3574.46	11.6	168.3	180.0
4.62	3574.62	11.6	198.2	210.0
4.77	3574.77	11.5	228.3	240.0
4.91	3574.91	11.5	258.4	270.0
5.05	3575.05	11.5	288.5	300.0

Figure A.31 Example stage-discharge rating curve



Note from examination of Table A.31 that the principal spillway is functioning under outlet control for the entire rating. Also note from examination of Figure A.31 that at stage 3574 the combined spillway discharge is about 105 cfs and the total combined spillway capacity at the crest of the basin is about 300 cfs. The average discharge for the principal spillway can be assumed to be 5 cfs. At that flow rate, the time to drain the basin, assuming it is filled to the crest of the emergency spillway at elevation 3573, is estimated as follows:

Drain Time = (5.51 ac-ft)(43,560 sf/ac-ft)/(5 ft^3/s)(3600s/hr) = 13.3 hours. Therefore, OK.

If the estimated drain time were close to 36 hours, a more detailed computation of drain time would be necessary. This can be accomplished using HEC-1 as described in Chapter 9 of the Hydraulics Manual.

Step 3. Code the HEC-1 input records.

Using the data from Steps 1 and 2, the HEC-1 input data file records for a storage route through the basin are coded as follows:

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10
KK BASIN STORAGE
RS     1    ELEV  3570.0
SV  0.00    0.51    1.09    1.77    2.65    3.89    5.51    9.26   13.75
SE3570.0  3570.5  3571.0  3571.5  3572.0  3572.5  3573.0  3574.0  3575.0
SQ   0.0     1.2     2.4     3.6     4.8     6.0     7.2     8.0     9.6     9.7
SQ  12.0    60.0    90.0   120.0   150.0   180.0   210.0   240.0   270.0   300.0
SE3570.0 3570.62 3570.90 3571.14 3571.36 3571.58 3571.91 3572.23 3572.95 3573.00
SE3573.1 3573.65 3573.89 3574.10 3574.29 3574.46 3574.62 3574.77 3574.91 3575.05
```

The KK record defines the hydrograph operation name.

The RS record establishes that this is a storage route. The type of storage route is not yet specified. Field 1, NSTPS, is set equal to one (1), which is the number of steps to be used in the route operation. "ELEV" is entered in Field 2, which specifies that the elevation for the beginning of the first time period will be in the next field. The next field (Field 3) is set to 3570.0, which is the bottom elevation of the storage basin.

The SV record establishes that this is a Modified Puls storage operation. The values are the storage in acre-feet from column five (5) of Table A.30. A total of 20 values may be entered on two SV records.

The first SE record contains the stage elevation values corresponding to the storage values in the same field on the SV record. The values are from column two (2) of Table A.30.

The SQ record contains the peak discharge values in cfs from column five (5) of Table A.31. A total of 20 values may be entered on two SQ records.

The second SE record contains the stage elevation values corresponding to the peak discharge values in the same field on the SQ record. The values are from column two (2) of Table A.31.

A.6.2 RETENTION BASIN STORAGE DIVERSIONS

When stormwater storage is in place for developments in a watershed it is usually appropriate to account for it in a HEC-1 model of the watershed. Normally, stormwater storage basins have relatively small watersheds and, in Mohave County, are sized to retain the 100-year 2-hour storm runoff volume. Due to the small scale of such watersheds in comparison with the sub-basin size of most HEC-1 models, it is not practical to model the retention basins using the procedure described in Appendix A.6.1. The preferred approach is to make an estimate of the total design storage capacity of the retention basins in each HEC-1 sub-basin and then divert that volume from the rising limb of the sub-basin runoff hydrograph. This is accomplished in HEC-1 using the diversion operation records.

Consider the B1 HEC-1 sub-basin from the example in Appendix A.4 that is 79 percent developed and has retention basins in place designed to retain all runoff from the 100-year 2-hour storm. The hydrologist has reviewed the as-built drawings for all the developments in the area and totaled the as-built retention basin design volumes. The hydrologist has also performed a field reconnaissance of the sub-basin to verify the retention basins are in place and sized per the as-built drawings. It was noted that on average the basins have 25 percent less capacity than the as-built drawings indicate due to sedimentation and changes made during landscaping. The total as-built storage volume is 533 ac-ft. Reduce this storage capacity by 25 percent and use 400 ac-ft.

The HEC-1 runoff computation records for sub-basin B1 are:

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10
KK    B1   BASIN
BA 4.672
LG  0.16    0.15   16.31    0.13      55
UC 0.713   0.357
UA     0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
UA   100
```

This HEC-1 operation generates the runoff hydrograph for sub-basin B1. Next, the retention volume is diverted from the B1 runoff hydrograph, which has the effect of removing it from the rising limb. The following KK record set is used to accomplish the diversion:

```
_______1_______2_______3_______4_______5_______6_______7_______8_______9______10
KK  B1DS  DIVERT
KO     1
DT B1DIV   400.0     0.0
DI   0.0   100.0   250.0   500.0   750.0  1000.0  2000.0  4000.0  6000.0 10000.0
DQ   0.0   100.0   250.0   500.0   750.0  1000.0  2000.0  4000.0  6000.0 10000.0
```

The KK record defines the name of the hydrograph that will continue downstream in the HEC-1 model after the diversion.

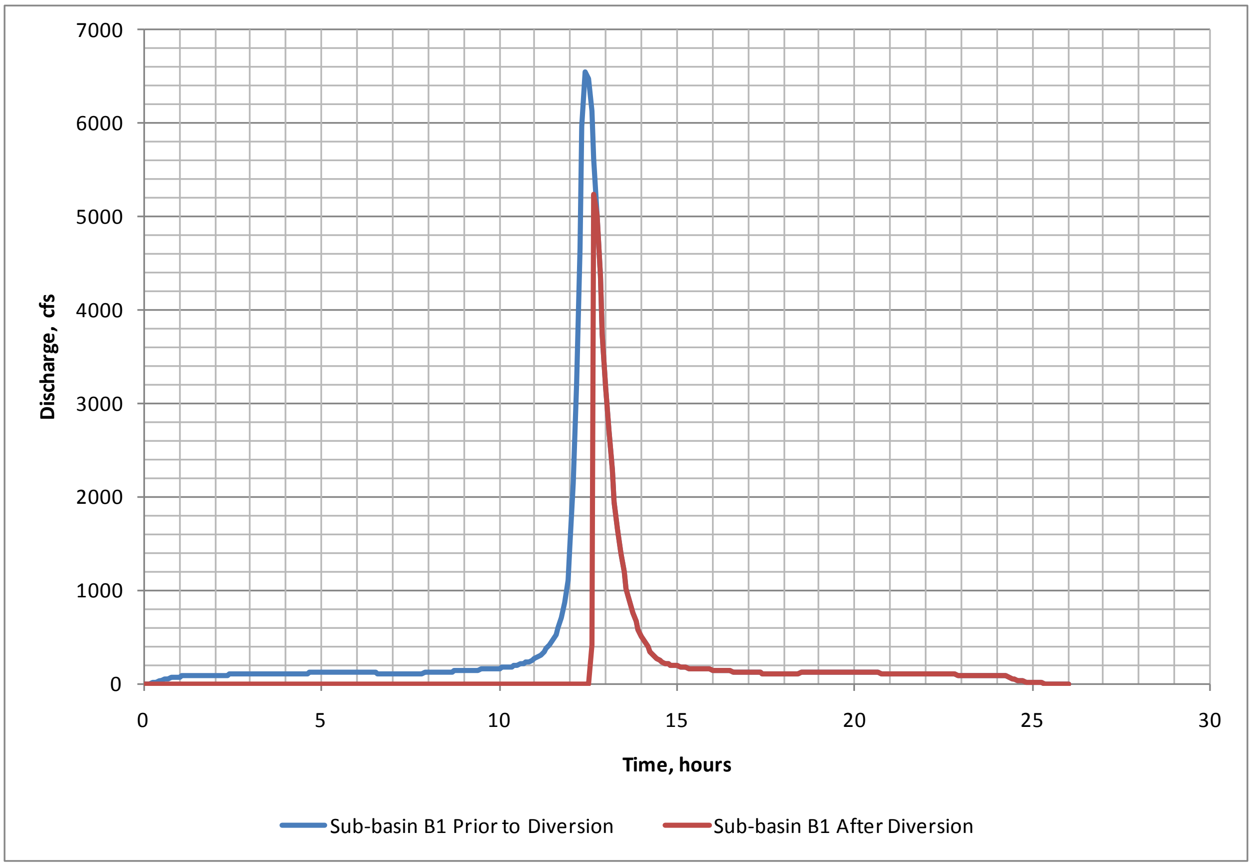
The DT record defines the name of the diverted flow hydrograph in Field 1 so it could be retrieved later in the model. However, for this example no retrieval is desired. Field 2 contains the total volume to be diverted in acre-feet.

The DI record contains a list of inflow values to the diversion operation.

The DQ record contains the list of flow rates to be diverted corresponding to the field values on the DI record. Note that for this example the flow rates are the same for both the DI and DQ records. This has the effect of diverting all flow up to 10,000 cfs until a total volume of 400 acre-feet has been diverted. Then no more flow is diverted.

The results are shown on Figure A.32. Note that the 100-year 24-hour peak discharge from sub-basin B1 is reduced from 6,545 cfs to 5,241 cfs as a result of the on-site retention.

Figure A.32 Example of retention basin diversion hydrographs



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A.7 INDIRECT METHODS EXAMPLE

The unit hydrograph method example results can be checked for reasonableness using indirect methods, as described in Section 7.11. The following is a discussion of the check made with each of the three methods. This approach is an example of what is expected by Mohave County for inclusion in drainage design reports when the unit hydrograph method is applied for estimating peak discharges.

A.7.1 INDIRECT METHOD 1

The Method 1 check is a comparison of the HEC-1 model results with unit peak discharge envelope curves of maximum observed floods of record from natural watersheds for differing hydrologic regions in the southwestern United States. The comparison is shown on Figure A.33. Note that all the model results with the exception of sub-basin B1 fall below the envelope curves. This is to be expected as the envelope curves are lines enveloping peak discharges from extreme events. The 100-year frequency is not necessarily an extreme event in comparison with this data. Sub-basin B1 is predominately an urban watershed and is expected to have a higher unit discharge than the other sub-basins. This check yields no reason to suspect the model results are unreasonable.

A.7.2 INDIRECT METHOD 2

Indirect Method 2 is a comparison with 100-year peak discharges for Arizona analyzed by the USGS from streamflow data using the Log-Pearson Type 3 statistical method. The comparison is shown on Figure A.34. The example peak discharges check very well against the data fit line and lie within the 75 percent tolerance limits. Sub-basin B1 lies just outside the upper 75 percent tolerance limit, which is to be expected as the Arizona LP3 data are from predominately natural watersheds. This check yields no reason to suspect the model results are unreasonable.

A.7.3 INDIRECT METHOD 3

Indirect Method 3 is a check against the data used to generate the USGS regional regression equation for Region 10, which covers Kingman and the example watershed. It is also a check against an envelope curve for that region. The comparison is shown on Figure A.35. The example results compare favorably with the regression equation data points. The example results plot just below the fit line for the regression equation and at the upper end of the majority of the data points. Sub-basin B1 again plots high, but is below the envelope line. This check yields no reason to suspect the model results are unreasonable.

Figure A.33 Indirect Method 1 check of Unit Hydrograph Method example

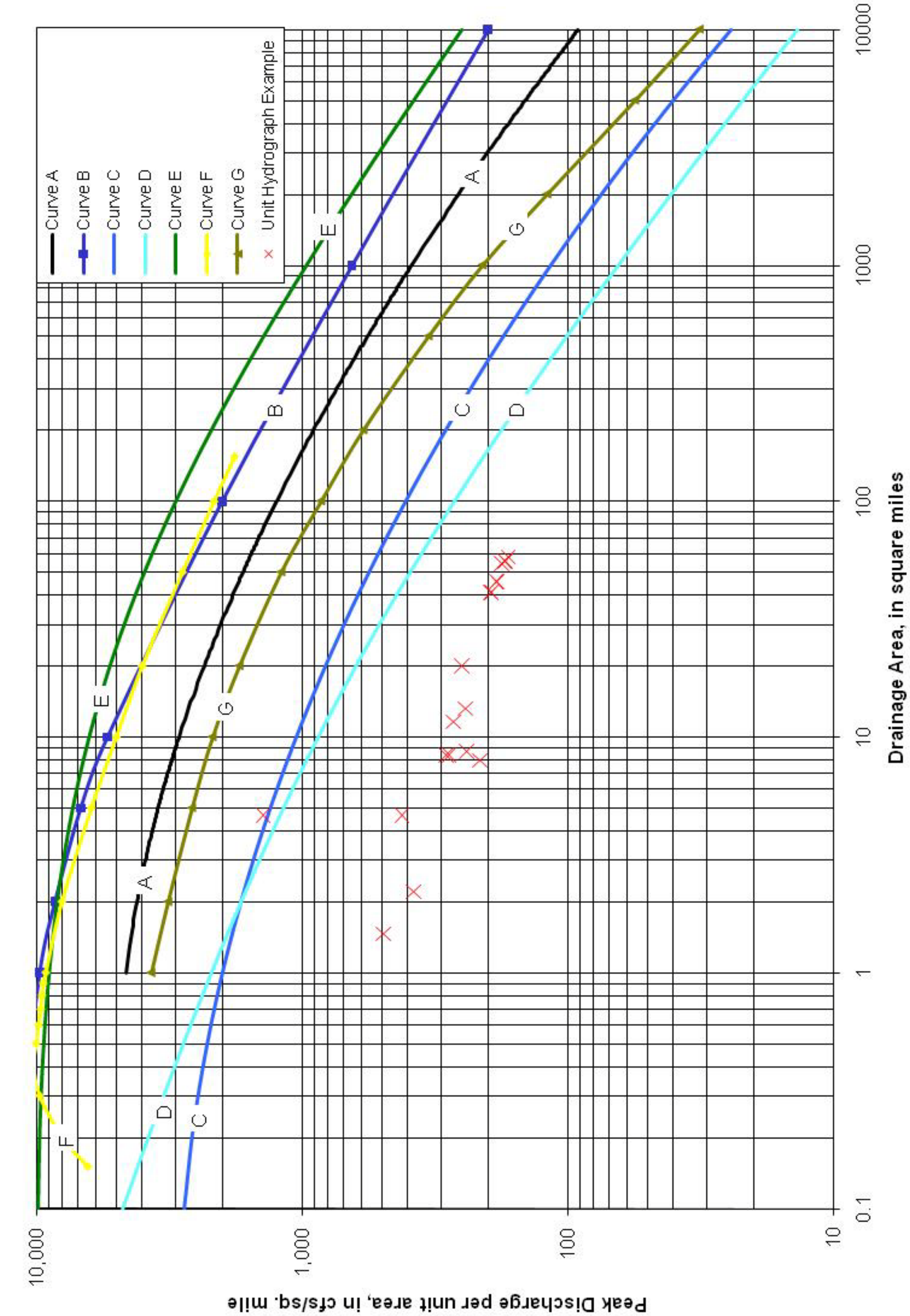


Figure A.34 Indirect Method 2 check of Unit Hydrograph Method example

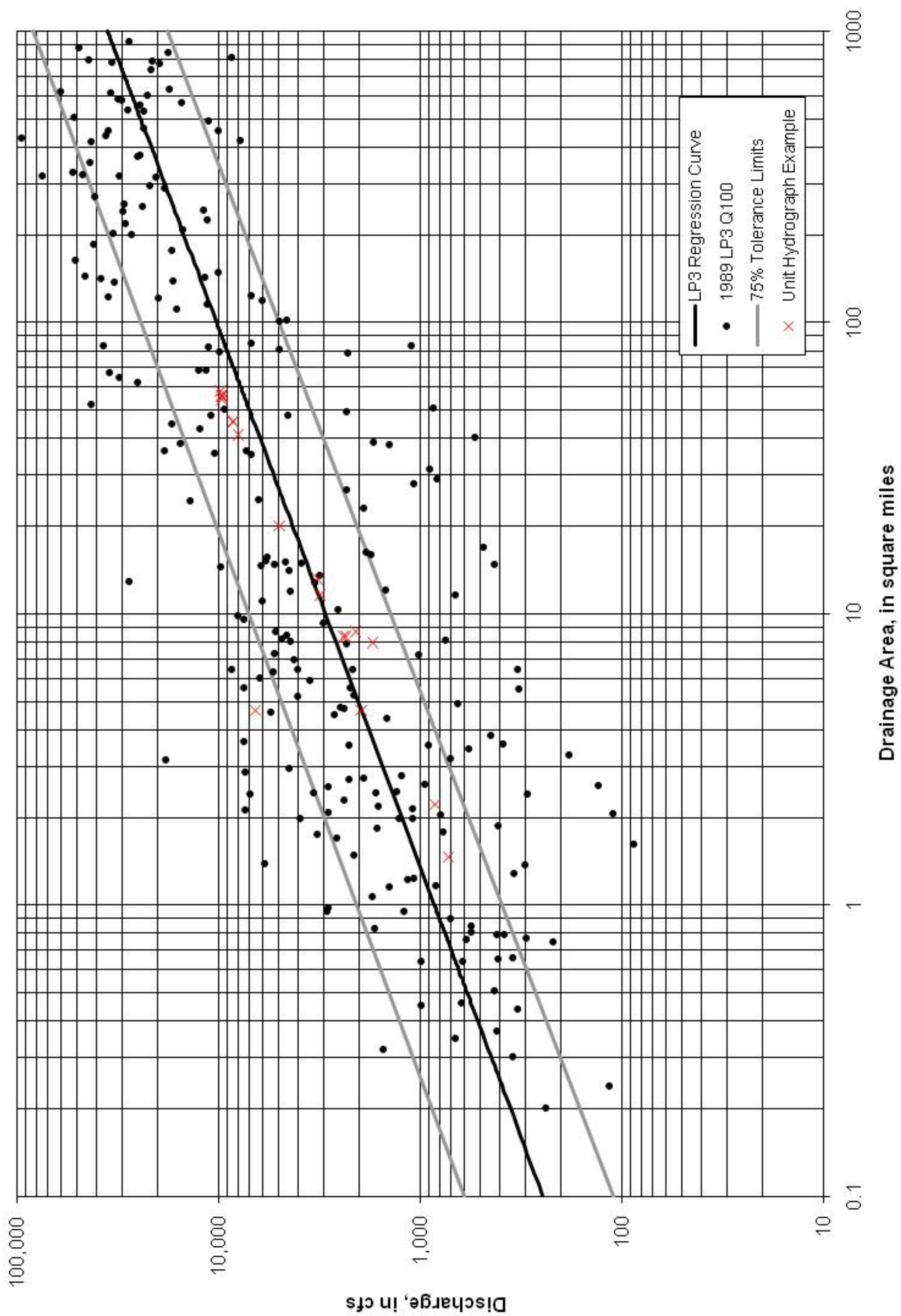
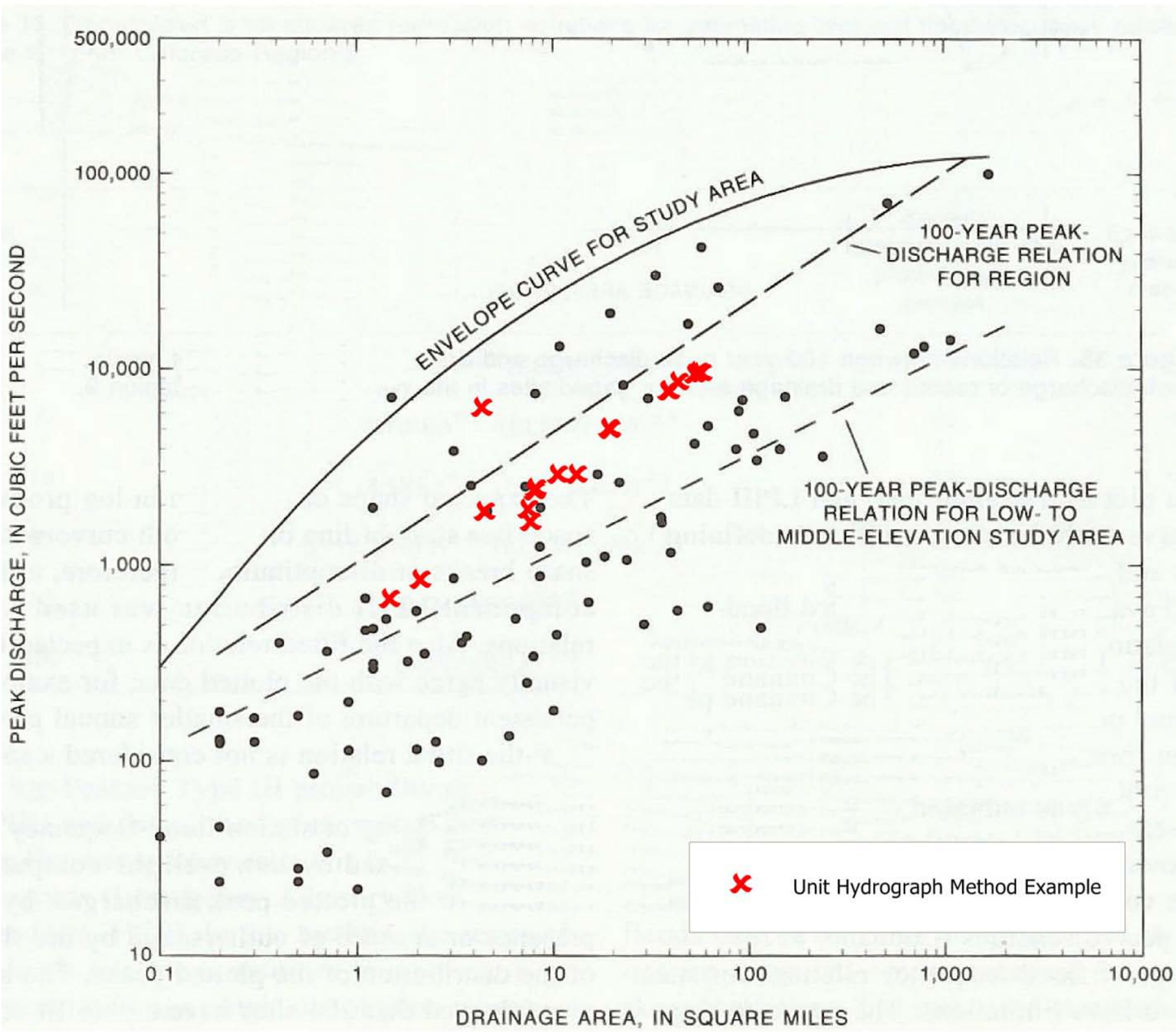


Figure A.35 Indirect Method 3 check of Unit Hydrograph Method example



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A.8 STORMWATER STORAGE EXAMPLE

A.8.1 PROBLEM STATEMENT

A stormwater storage basin is needed for the commercial parcel within sub-basin C from the Rational Method example in Appendix A.2. Refer to Figure A.13. The design storage volume is to be determined and basin characteristics recommended based on drain time and Mohave County minimum requirements for inclusion in a Preliminary Design Report for the project.

A.8.2 PROBLEM SOLUTION

A.8.2.1 Given Information

The physical information for the solution is derived from Table A.15, Table A.17 and Table A.18 as follows:

1. 100-year 2-hour Storm Point Precipitation: 2.546 inches
2. Area of Commercial Site: 9.19 acres
3. Rational C coefficient for C1 zoning: 0.83

A.8.2.2 Basin Sizing

The retention basin must be designed to contain the entire runoff volume from the site from a 100-year 2-hour storm. The required minimum design storage volume is determined using Equation 7.7:

$$V = C\left(\frac{P}{12}\right)A$$

where:
- V = runoff volume, in acre-feet,
- C = runoff coefficient (or C_{comp}),
- P = rainfall depth, in inches, and
- A = drainage area, in acres.

$$V = 0.83\left(\frac{2.546}{12}\right)9.19 = 1.62\ acre - feet$$

Prior to scheduling geotechnical testing for the proposed site, approximate basin dimensions are needed. The basin should have the following characteristics:

1. Depth: 4 feet total, 3-feet of depth at the crest of the emergency spillway.
2. Side slopes: 3:1

Approximate land area required is estimated as follows, assuming a square basin and applying Equation A.2:

Bottom area = x^2

Top area = $(x+2*3*3)^2$

$$\Delta V_{B,T} = \frac{d}{3}\left(\mathrm{A_B} + \mathrm{A_T} + \sqrt{\mathrm{A_B A_T}}\right)$$

where:

$\Delta A_{1,2}$	=	volume between the top and bottom of the basin,
d	=	vertical distance (depth) between top and bottom,
A_B	=	surface area of bottom of basin, and
A_T	=	surface area of top of basin.

$$(1.62)(43560) = \frac{3}{3}\left(\mathrm{x}^2 + (\mathrm{x}+18)^2 + \sqrt{\mathrm{x}^2(\mathrm{x}+18)^2}\right)$$

Solving for x:

$$x^2 + (x^2 + 36x + 324) + \sqrt{x^2(x+18)^2} = 70{,}567.2$$

$$2x^2 + 54x + 324 = 70{,}567.2$$

$$3x^2 + 36x + 324 + x(x+18) = 70{,}567.2$$

$$x^2 + 18x - 23{,}414.4 = 0$$

Solving the quadratic, X=144.28. Use X=150 feet

The basin bottom area is therefore = 150*150 = 22,500 sq ft

Per Table 15.2, the minimum number of soil log hole/percolation tests required for a basin bottom area of 22,500 feet is four.

A geotechnical firm was retained to perform testing in conformance with Section 15.4.1.4. The following are the results of the geotechnical investigation:

Test Location 1:

14-foot deep soil log hole (10 feet below bottom of basin).

0 to 5 inches	Gravelly sandy loam
5-inches to 9-feet	Gravelly loam
9-feet to 13-feet	Caliche
13-feet to 14-feet	Gravelly Clay loam

Measured percolation rate: 1.2 inches/hour

Test Location 2:

14-foot deep soil log hole (10 feet below bottom of basin).

0 to 5 inches Gravelly sandy loam

5-inches to 10-feet Gravelly loam

10-feet to 12-feet Caliche

12-feet to 14-feet Gravelly Clay loam

Measured percolation rate: 1.5 inches/hour

Test Location 3:

14-foot deep soil log hole (10 feet below bottom of basin).

0 to 8 inches Gravelly sandy loam

8-inches to 10-feet Gravelly loam

10-feet to 13-feet Caliche

13-feet to 14-feet Gravelly Clay loam

Measured percolation rate: 1.2 inches/hour

Test Location 4:

14-foot deep soil log hole (10 feet below bottom of basin).

0 to 5 inches Gravelly sandy loam

5-inches to 9-feet Gravelly loam

9-feet to 12-feet Caliche

12-feet to 14-feet Gravelly Clay loam

Measured percolation rate: 1.2 inches/hour

The lowest percolation rate of 1.2 inches/hour is selected for use in the design. An impermeable layer was found in the soil log hole at a depth of 6- to 9-feet below the basin bottom.

From Table 15.3, a Design Factor, D_r, of 4.0 is selected.

Applying Equation 15.1 to determine the design percolation rate:

$$P_d = \frac{P}{D_r}$$

where:

P_d = Design percolation rate, in inches/hour,
P = Lowest measured percolation rate, in inches/hour, and
D_r = Design Factor from Table 15.3.

$$P_d = \frac{1.2}{4} = 0.3\ inches/hour$$

Next, applying Equation 15.2 to estimate the minimum required basin bottom area:

$$T_d = \frac{V}{A_p \frac{P_d}{12}}$$

where:

T_d	=	Retention basin drain time in hours,
A_p	=	Percolation area (basin bottom), in acres
P_d	=	Design percolation rate, in inches/hour, and
V	=	Retention basin design storage volume, in acre-feet.

$$A_p = \frac{V}{T_d \frac{P_d}{12}}$$

$$A_p = \frac{1.62}{(36)\left(\frac{0.3}{12}\right)} = 1.80\ acres$$

The required basin bottom area is significantly greater than the minimum area of 2,500 sf. The new approximate basin dimensions are:

Design Ponding Depth = 36(0.3/12) = 0.9 feet

Design Freeboard = 1 foot.

Total Basin Design Depth = 1.9 feet

Side Slope = 3:1

Top Area = $((2)(1.9)(3)+280)^2$ = 84,914 sf or 1.95 acres

If a basin with a smaller land requirement is desired, the design will need to be supplemented with dry wells.

A.8.2.3 Emergency Spillway Design

In accordance with Section 15.4.3.7, all stormwater storage basins shall have an emergency spillway. The spillway must be designed to safely pass the 100-year peak discharge, which is 42 cfs for sub-basin C. In this case, the spillway discharges into a trapezoidal channel with the following characteristics:

Slope (S): 0.006 ft/ft

Base width (w): 10 feet

Available depth (d): 2 feet

Side slopes = 2:1

Lining: rock rip rap with a d_{50} of 6-inches

The spillway cannot have a flow depth greater than 1 foot without exceeding the maximum design basin depth of 4 feet. Assuming normal depth in the channel and no constrictions downstream that result in backwater effects that could impact the spillway area, the Manning equation may be used to determine the spillway characteristics. Assuming a flow depth of 1 foot:

$$Q = \left(\frac{1.486 R^{0.67} S^{0.5}}{n}\right) A$$

A = (12)(1) = 12 sf

P = 2(2.24)+10 = 14.5 ft

R = A/P = 12/14.5 = 0.83 ft

n = 0.040 (from Table 13.4)

$$Q = \left(\frac{1.486 (0.83^{0.67})(0.006^{0.5})}{0.040}\right) 12 = 30.5\ cfs$$

30.5 cfs<42 cfs therefore no good.

Try w = 15 feet

A = 17 sf

P = 19.5 ft

R = 17/19.5 = 0.87 ft

$$Q = \left(\frac{1.486 (0.87^{0.67})(0.006^{0.5})}{0.040}\right) 17 = 44.6\ cfs$$

44.6 cfs>42 cfs, therefore OK

The velocity is 2.6 fps. By inspection use of 6-inch riprap is acceptable.

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B. RAINFALL

B.1 2-YEAR STORM ISOPLUVIALS

Figure B.1 NOAA Atlas 14 2-year 5-minute isopluvial map

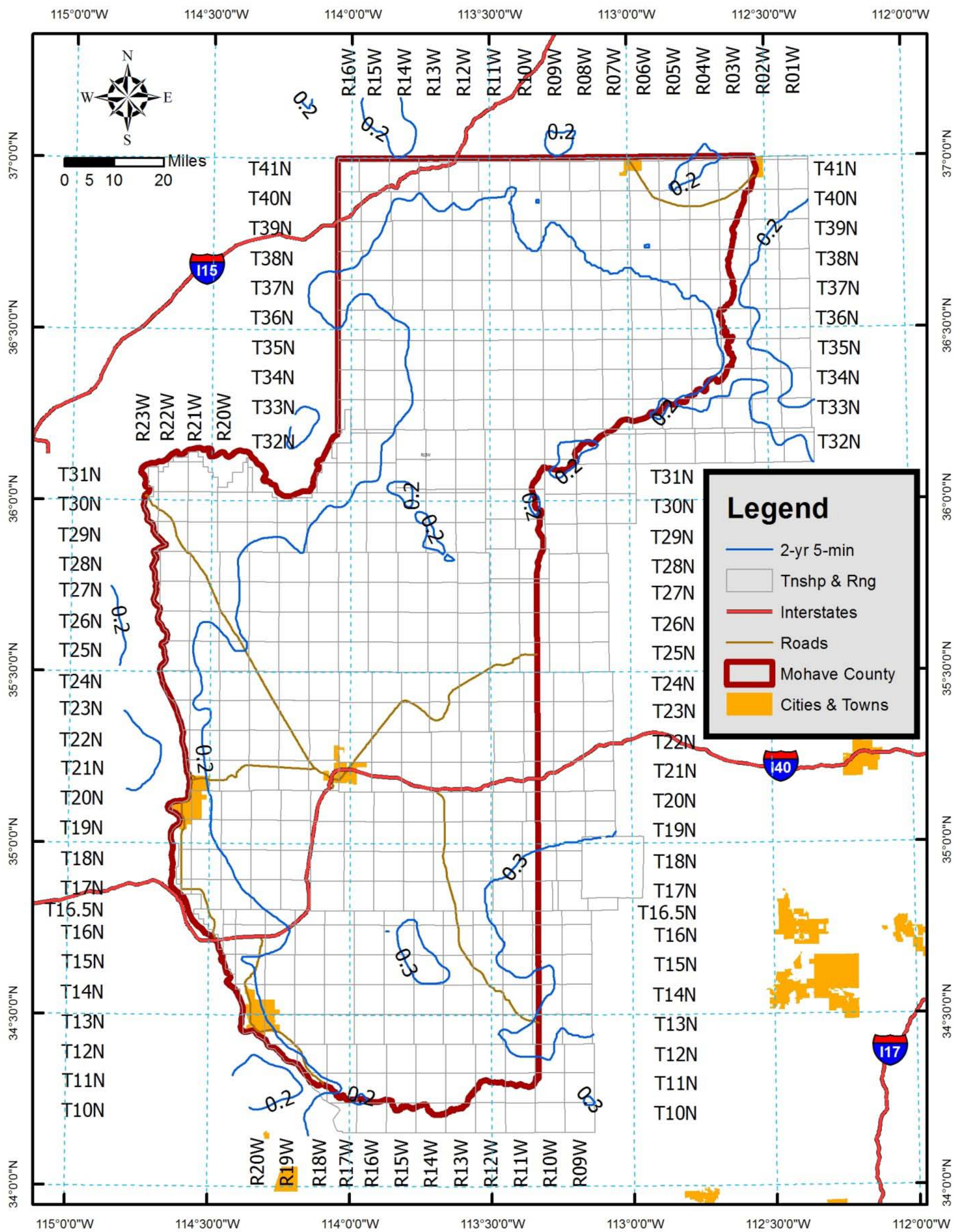


Figure B.2 NOAA Atlas 14 2-year 10-minute isopluvial map

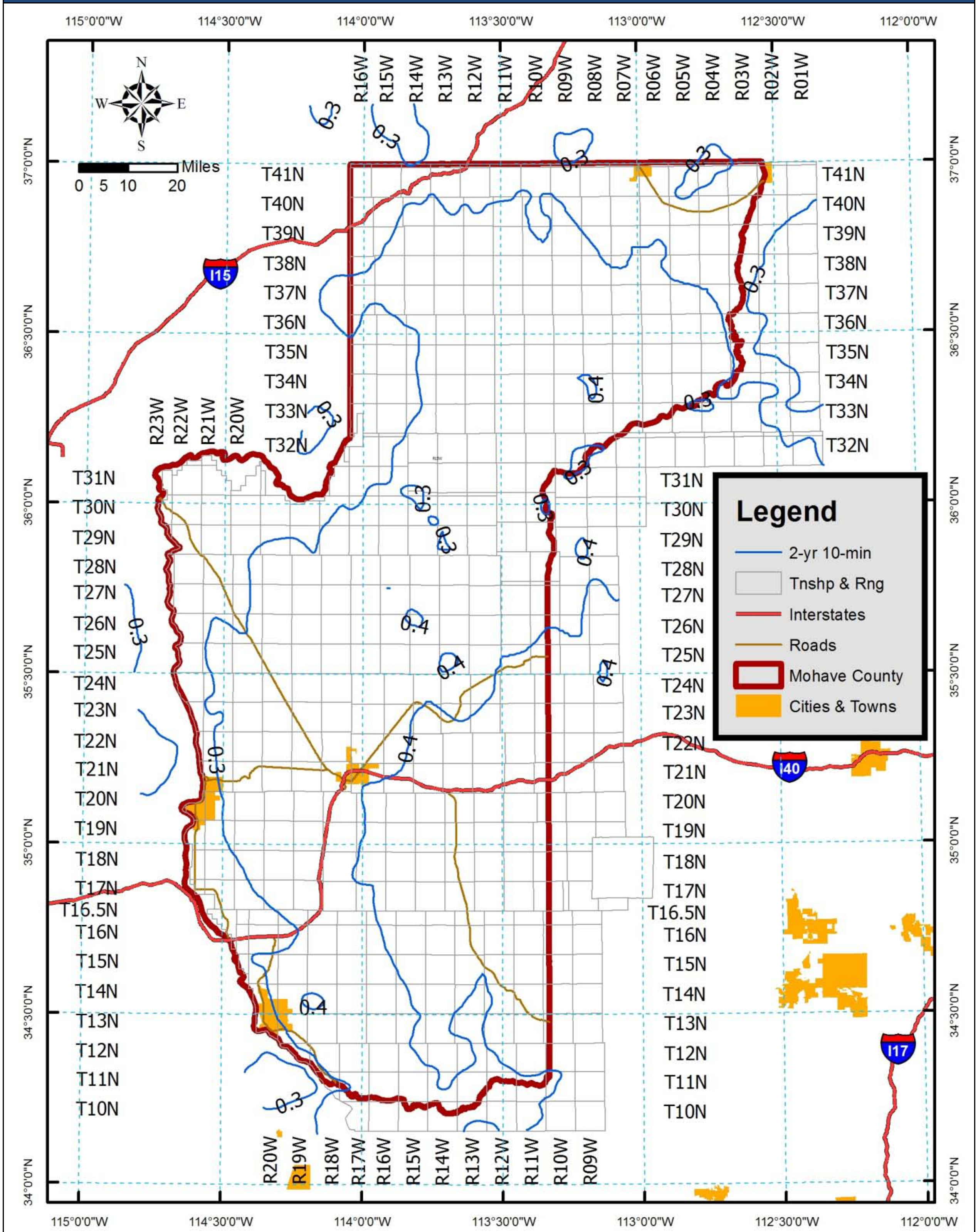


Figure B.3 NOAA Atlas 14 2-year 15-minute isopluvial map

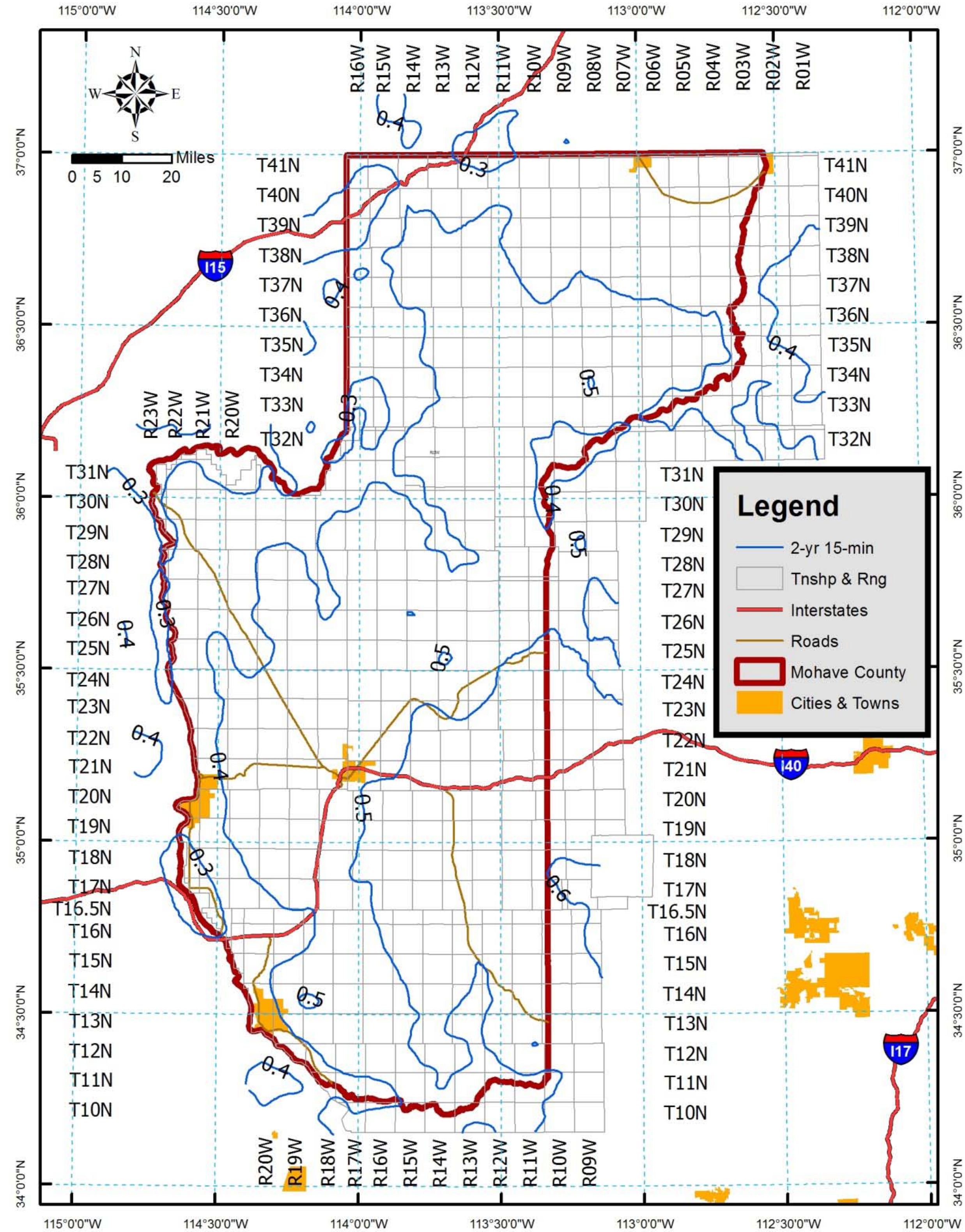


Figure B.4 NOAA Atlas 14 2-year 30-minute isopluvial map

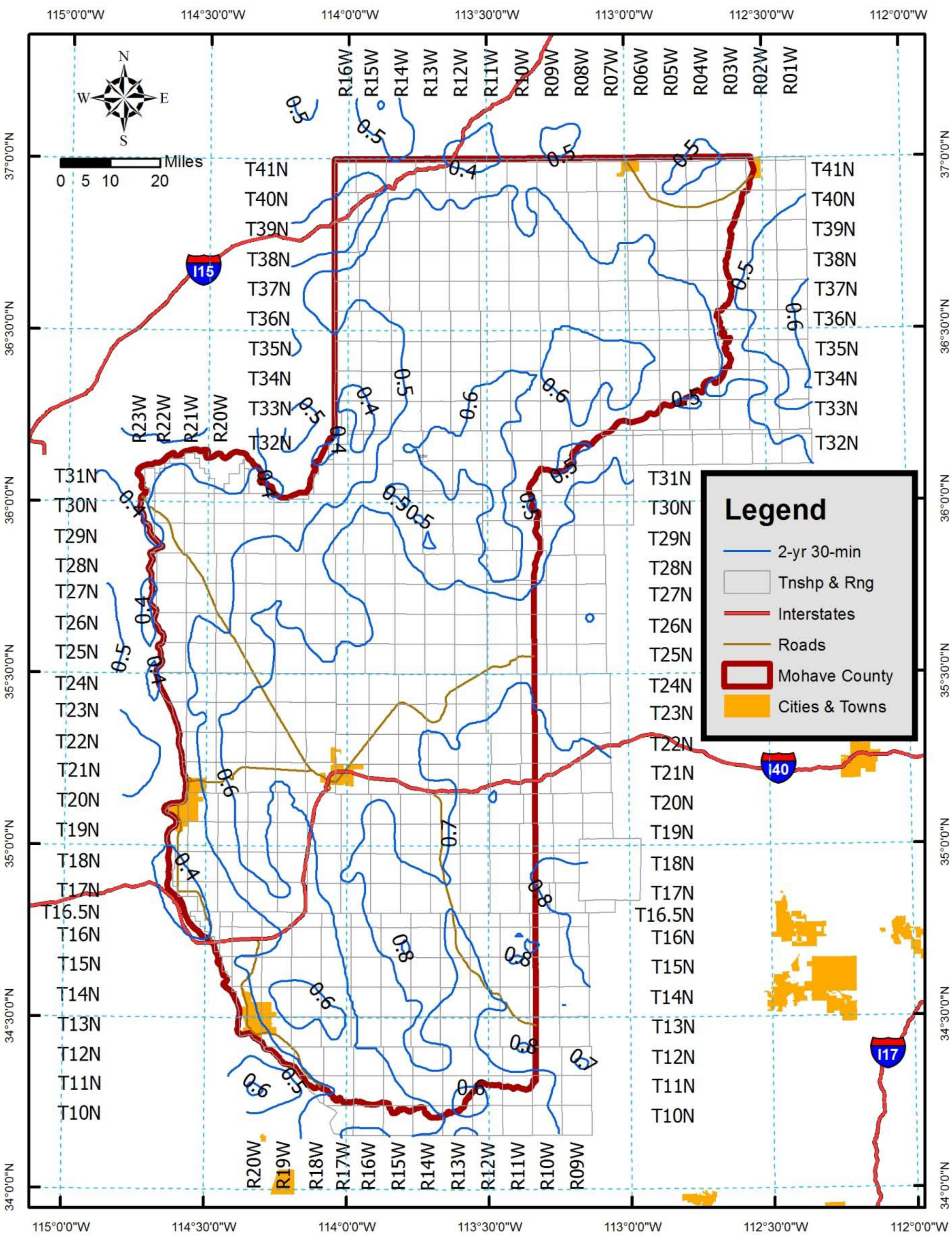


Figure B.5 NOAA Atlas 14 2-year 1-hour isopluvial map

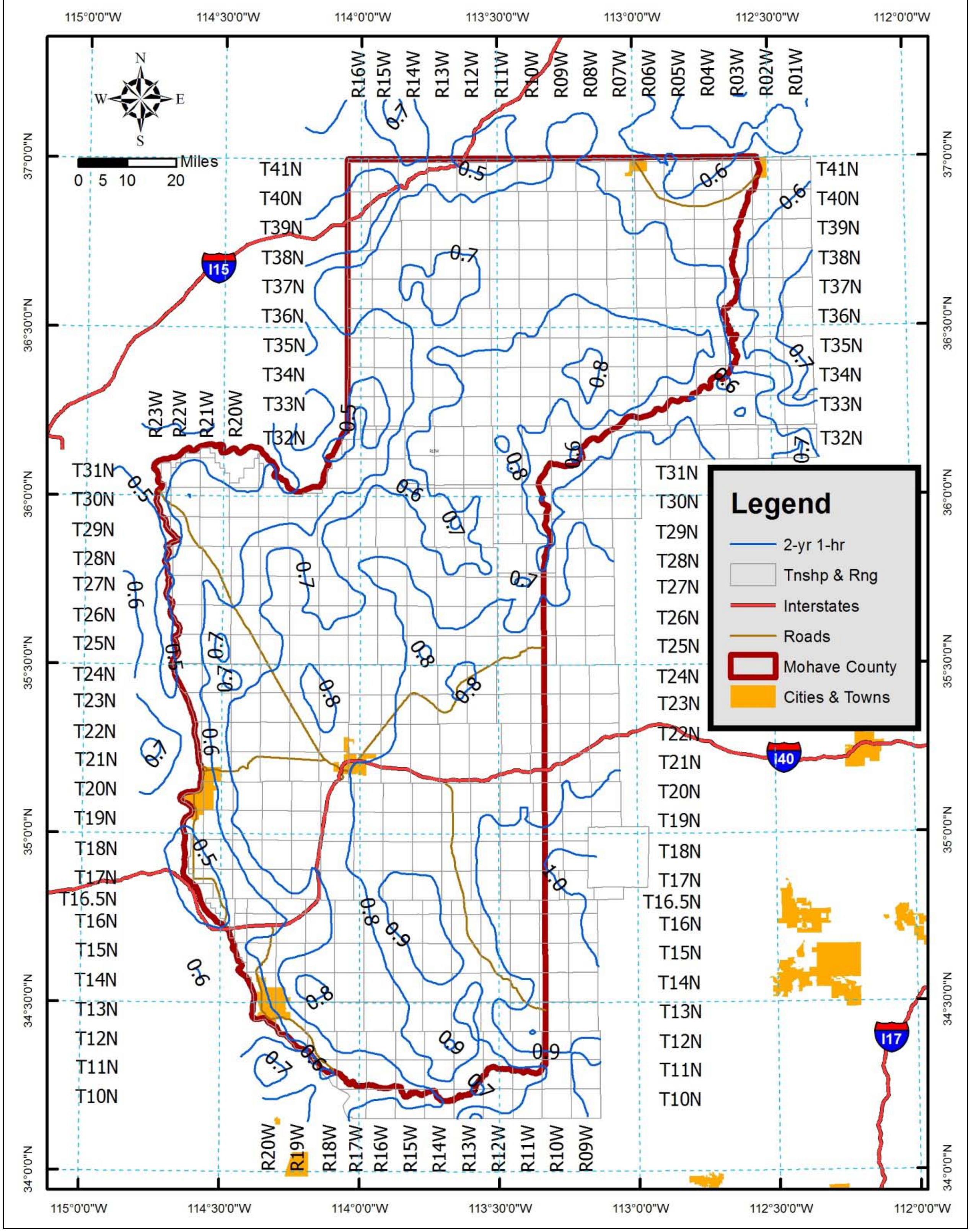


Figure B.6 NOAA Atlas 14 2-year 2-hour isopluvial map

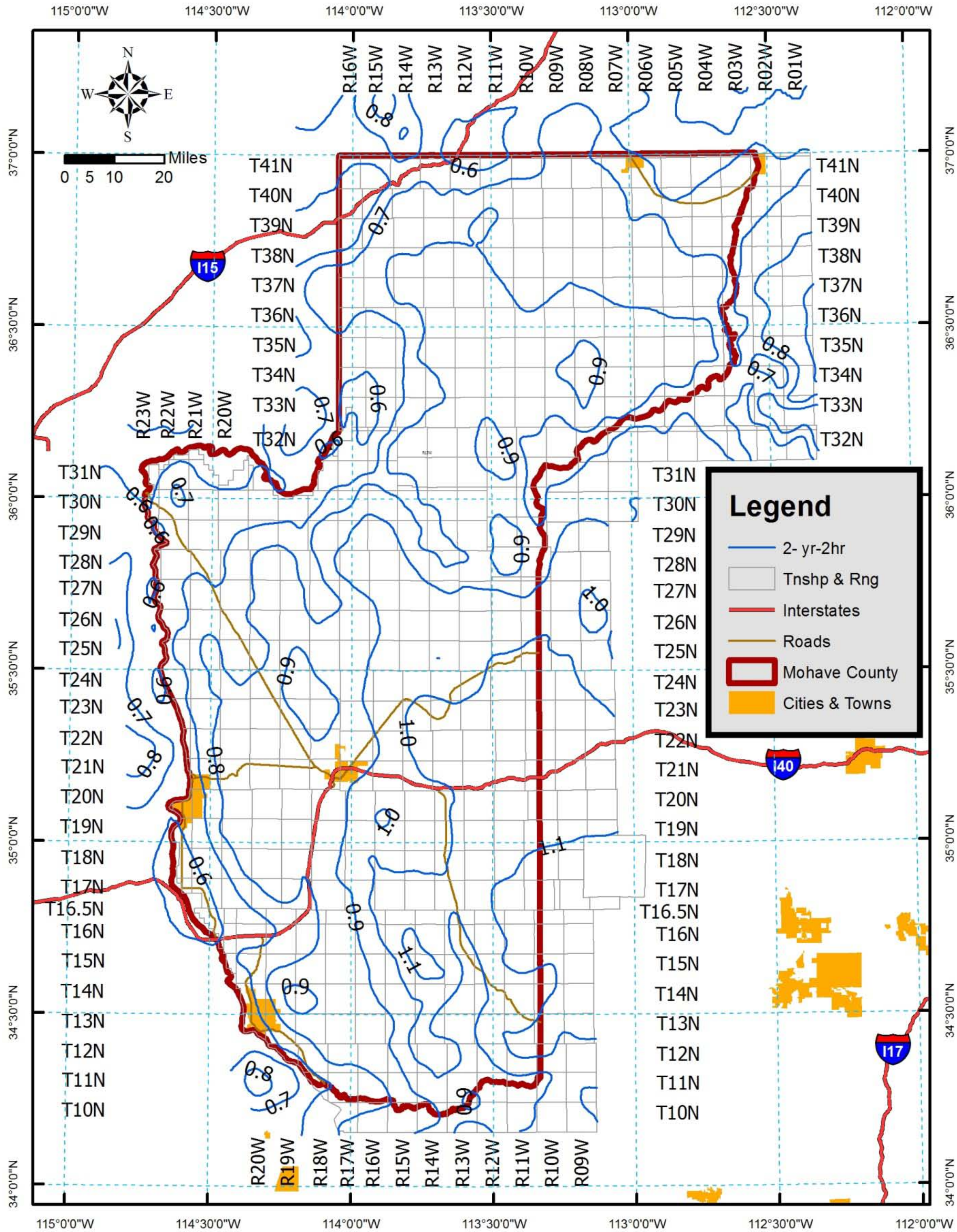


Figure B.7 NOAA Atlas 14 2-year 3-hour isopluvial map

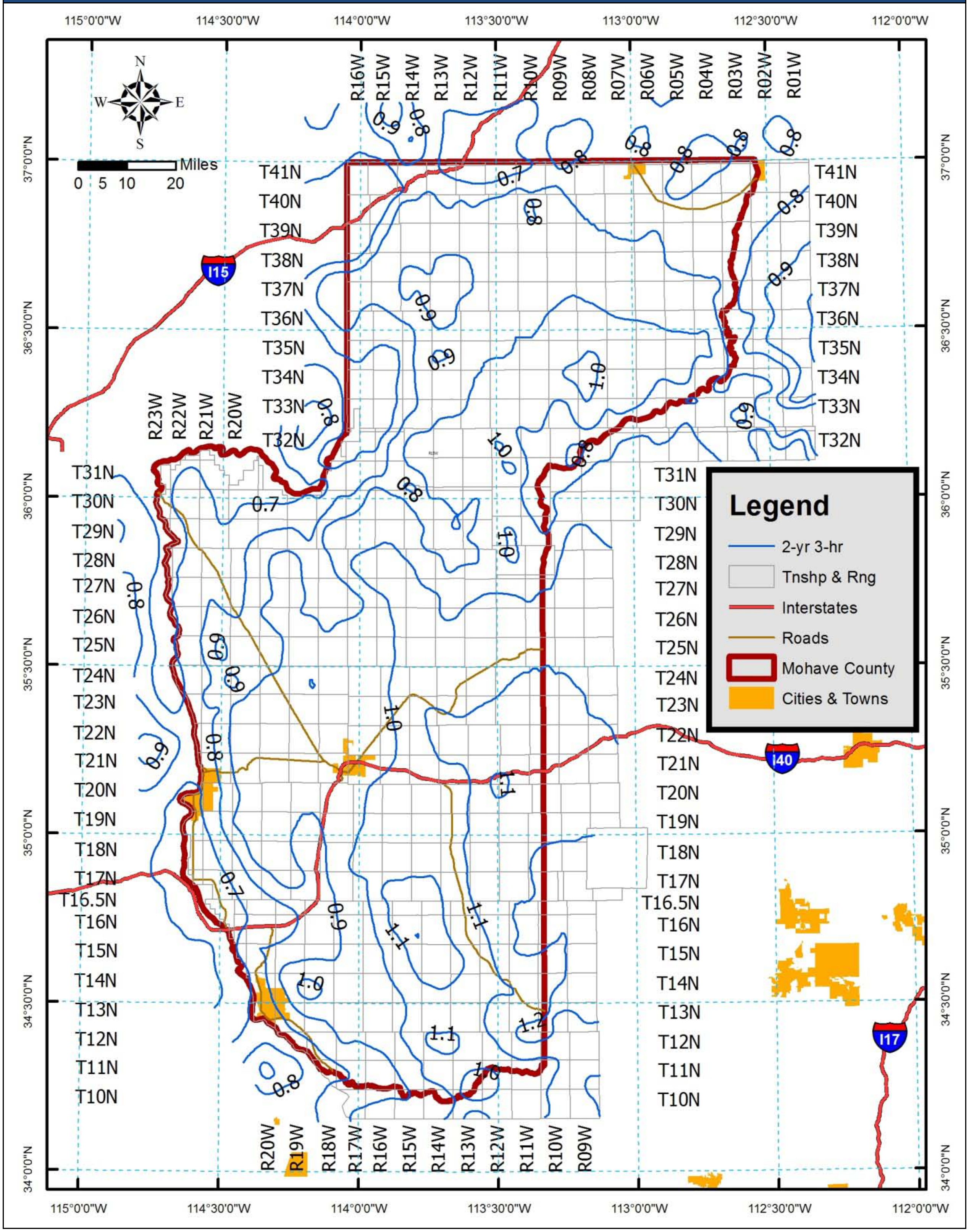


Figure B.8 NOAA Atlas 14 2-year 6-hour isopluvial map

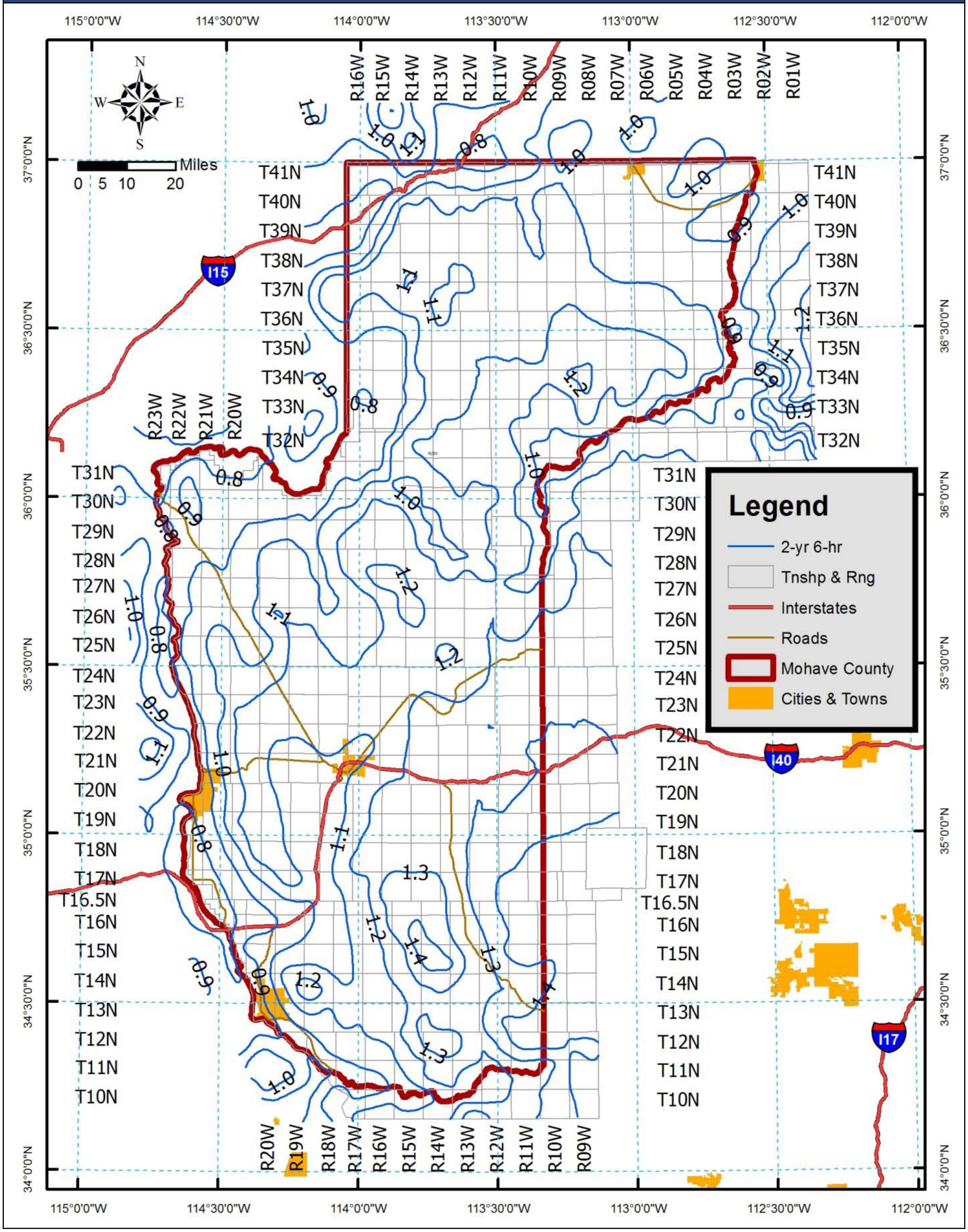


Figure B.9 NOAA Atlas 14 2-year 12-hour isopluvial map

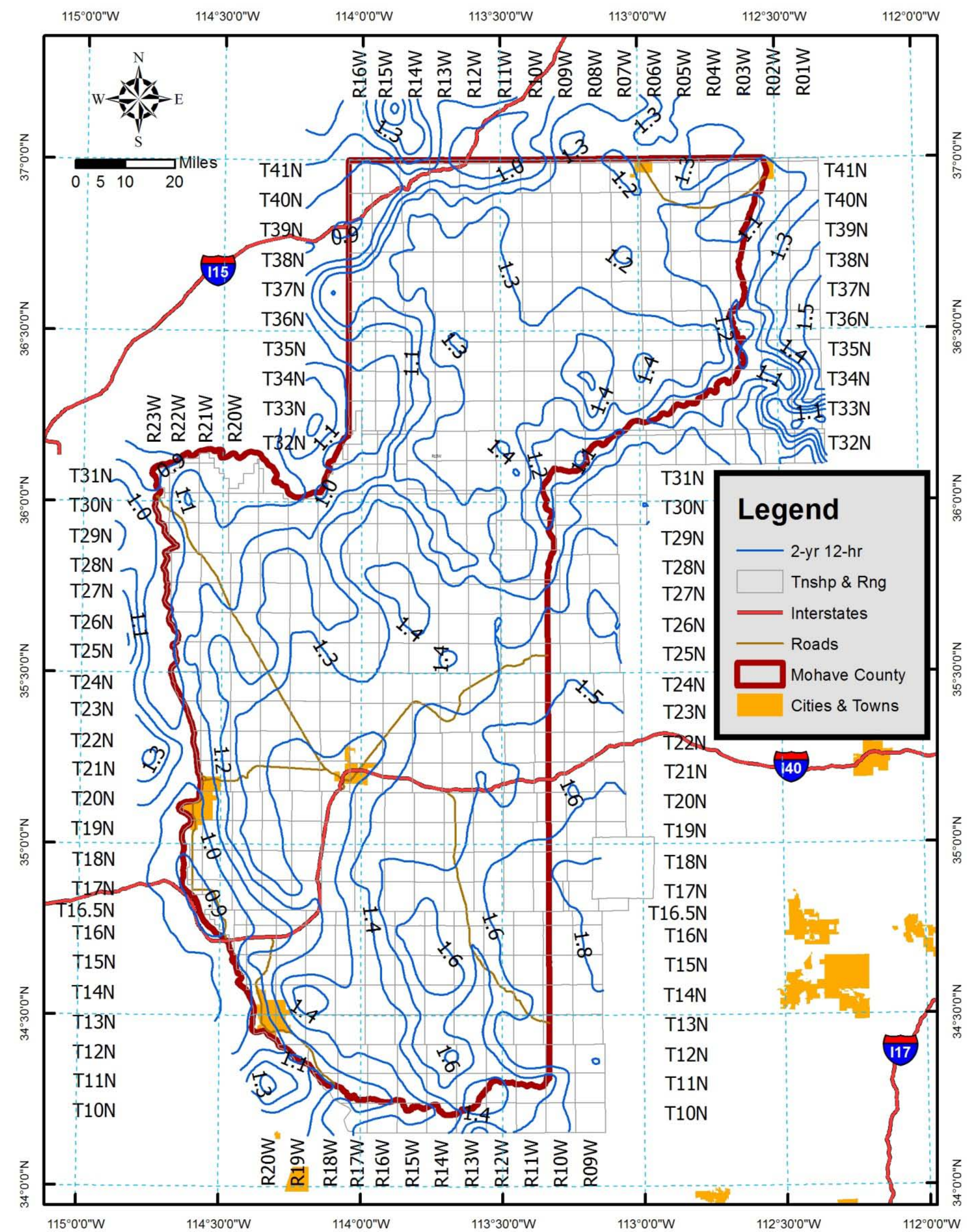
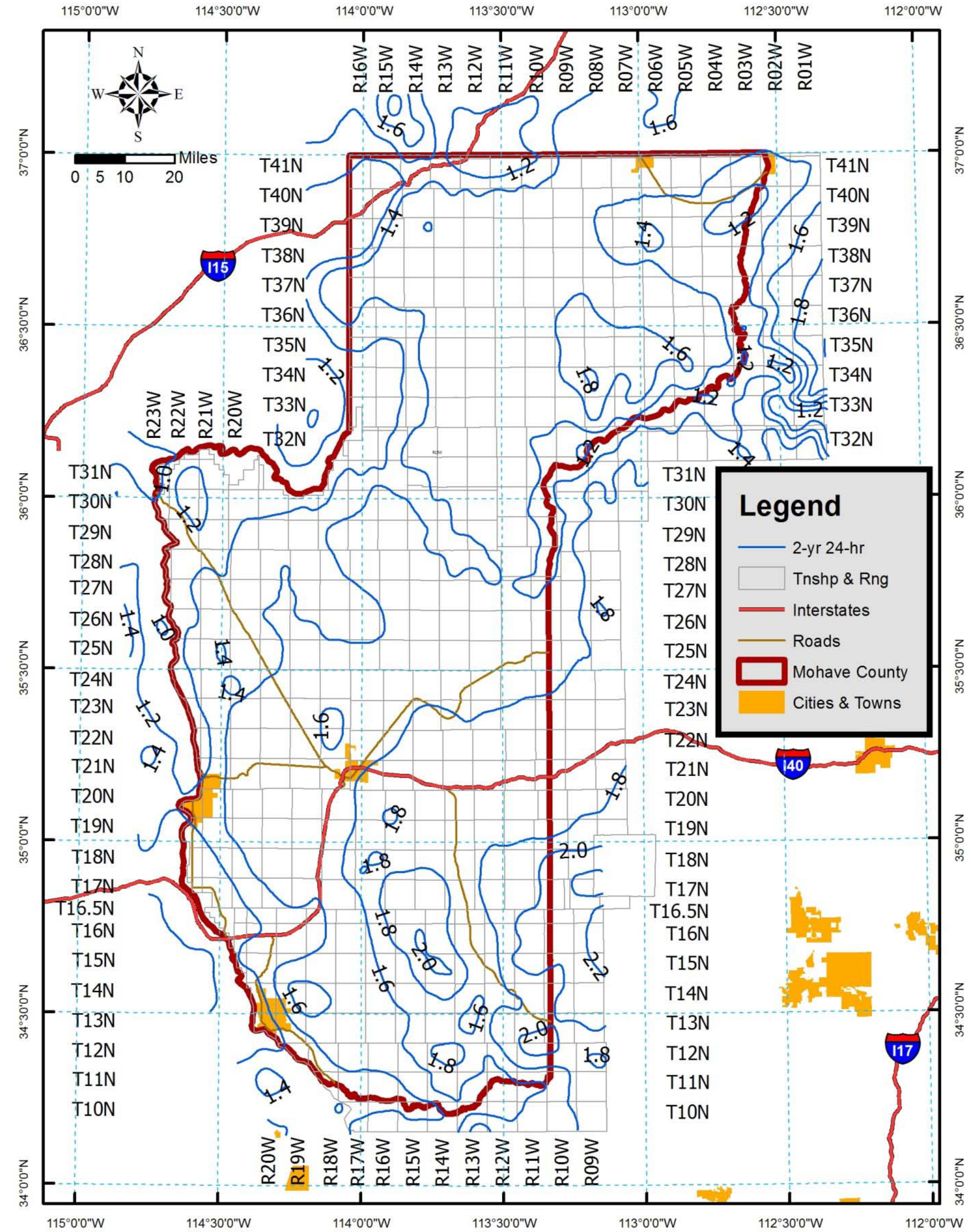


Figure B.10 NOAA Atlas 14 2-year 24-hour isopluvial map



B.2 5-YEAR STORM ISOPLUVIALS

Figure B.11 NOAA Atlas 14 5-year 5-minute isopluvial map

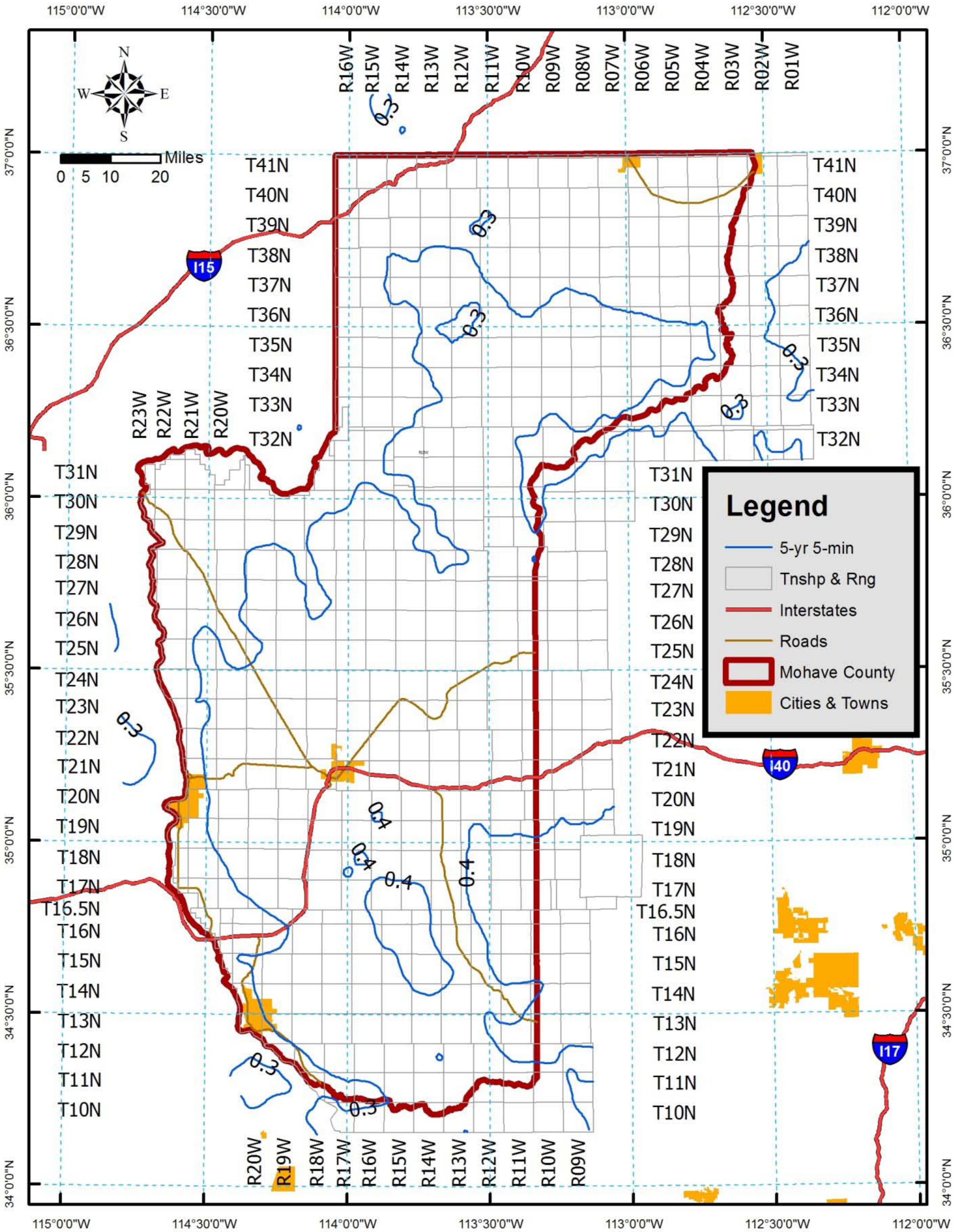


Figure B.12 NOAA Atlas 14 5-year 10-minute isopluvial map

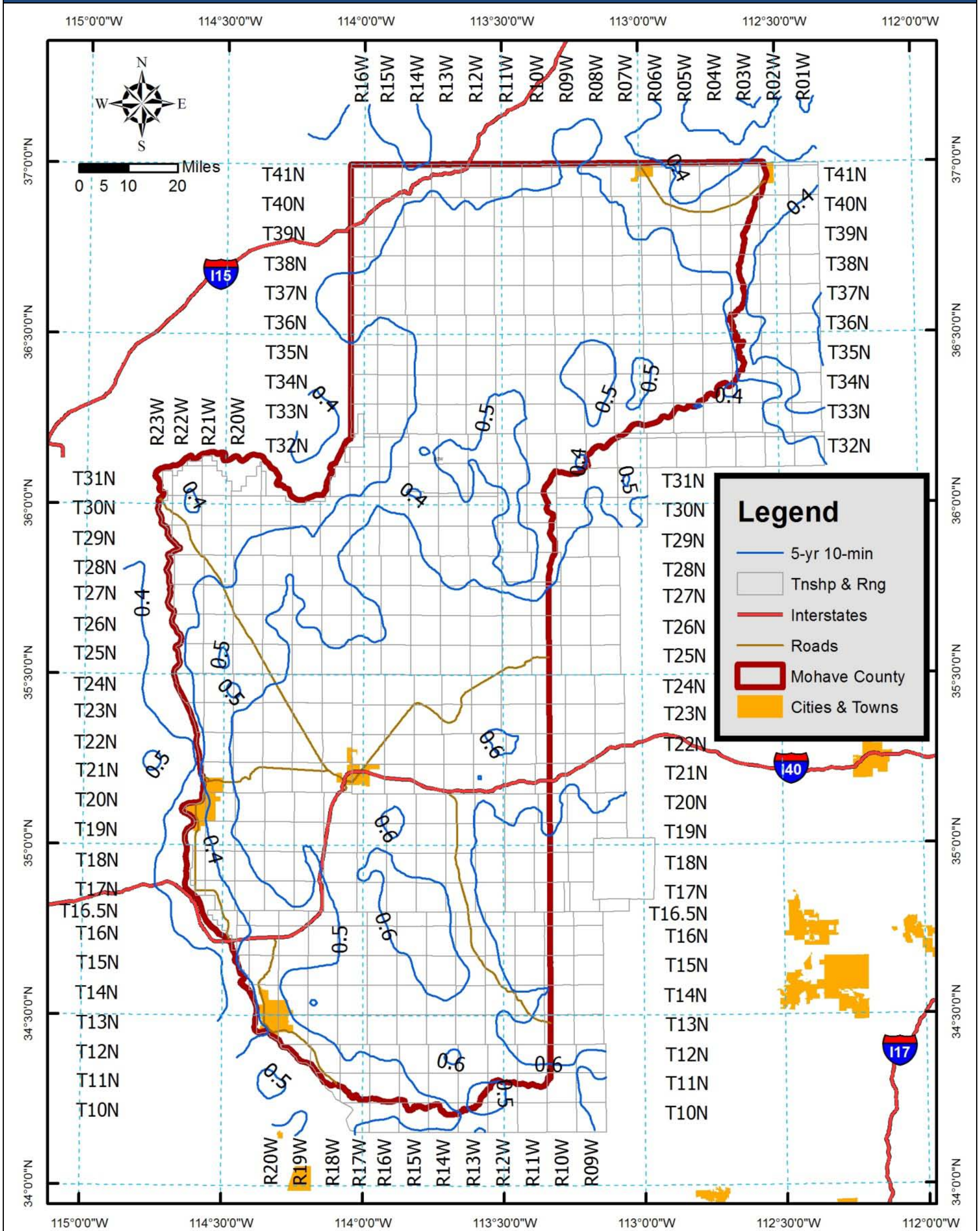


Figure B.13 NOAA Atlas 14 5-year 15-minute isopluvial map

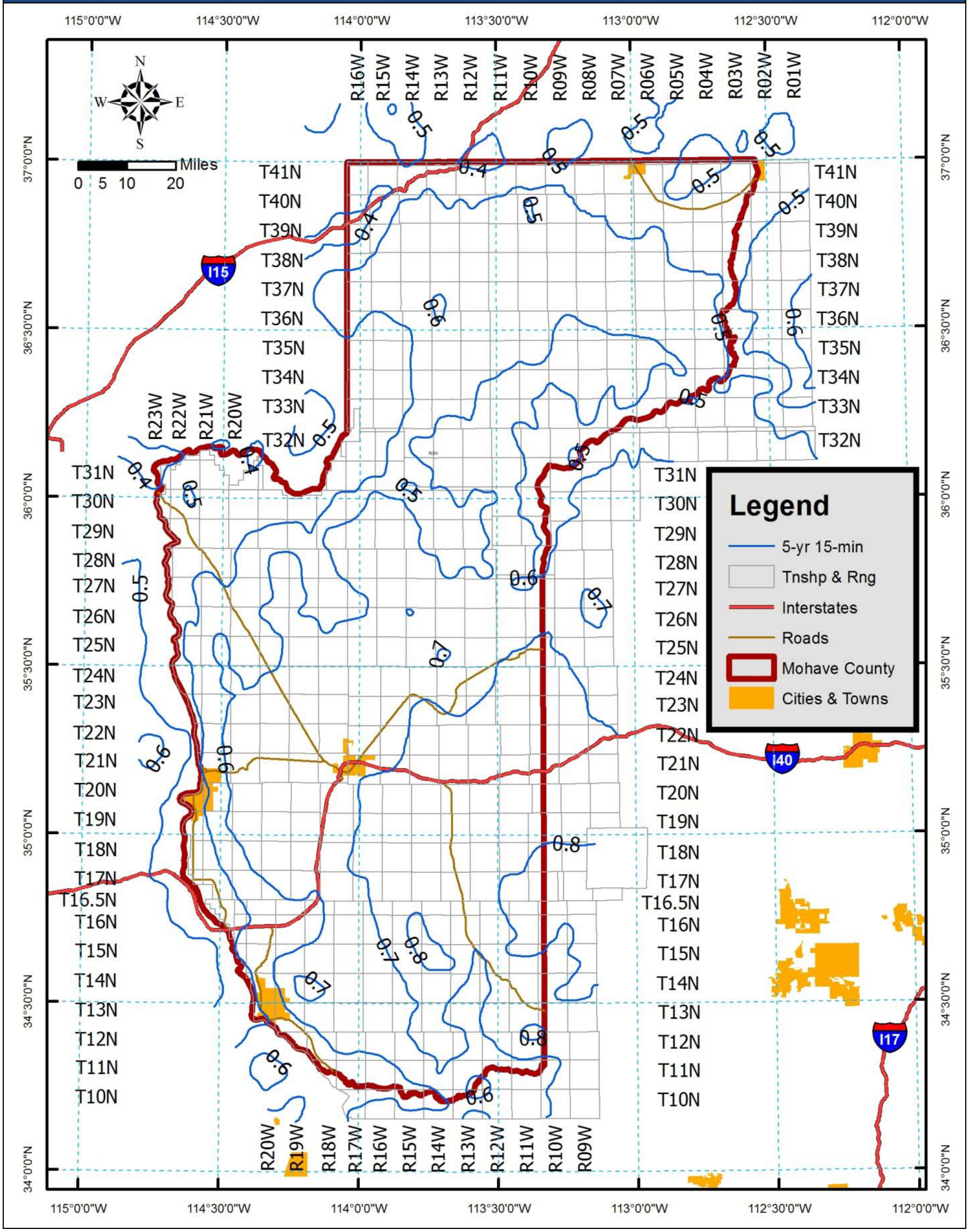


Figure B.14 NOAA Atlas 14 5-year 30-minute isopluvial map

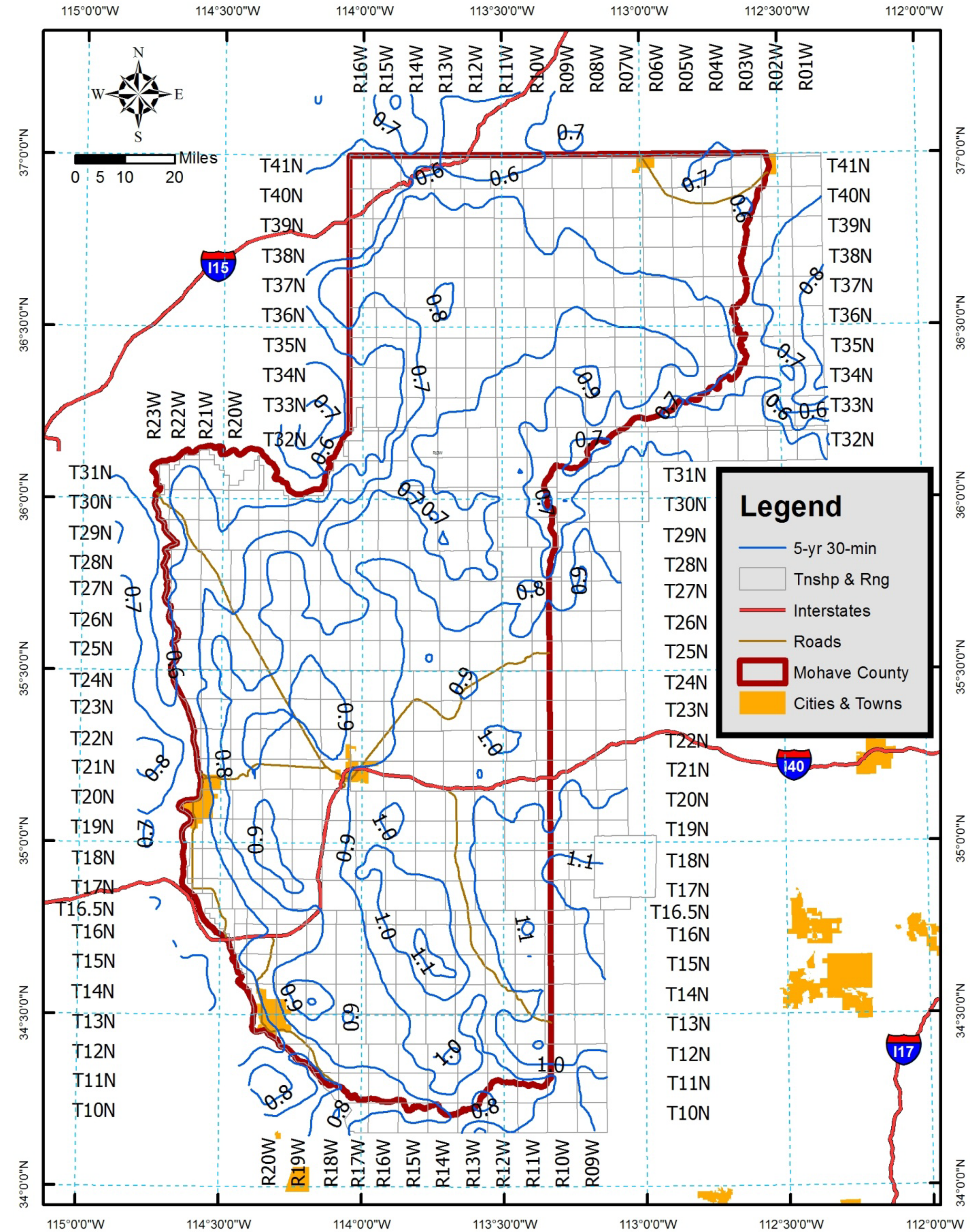


Figure B.15 NOAA Atlas 14 5-year 1-hour isopluvial map

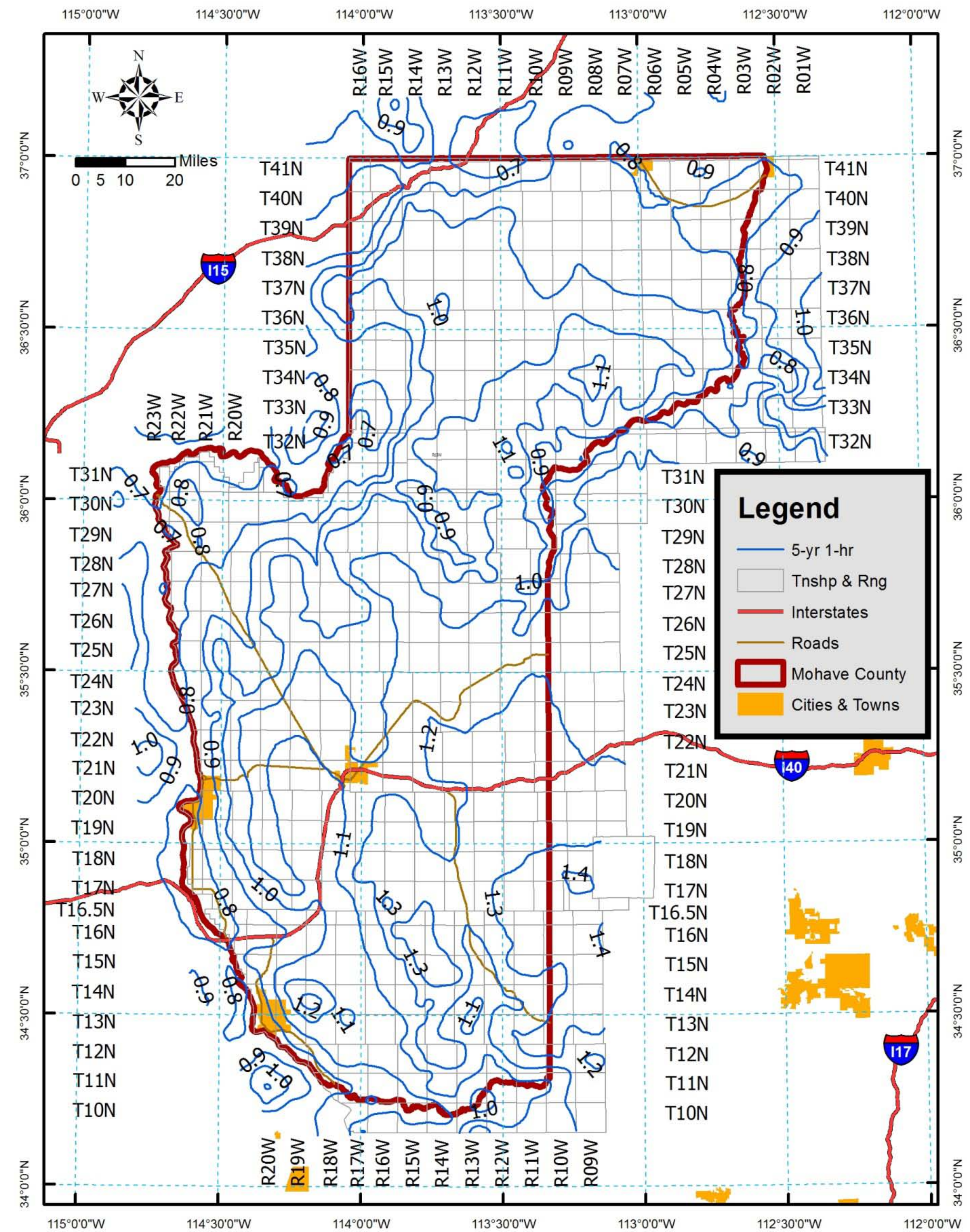


Figure B.16 NOAA Atlas 14 5-year 2-hour isopluvial map

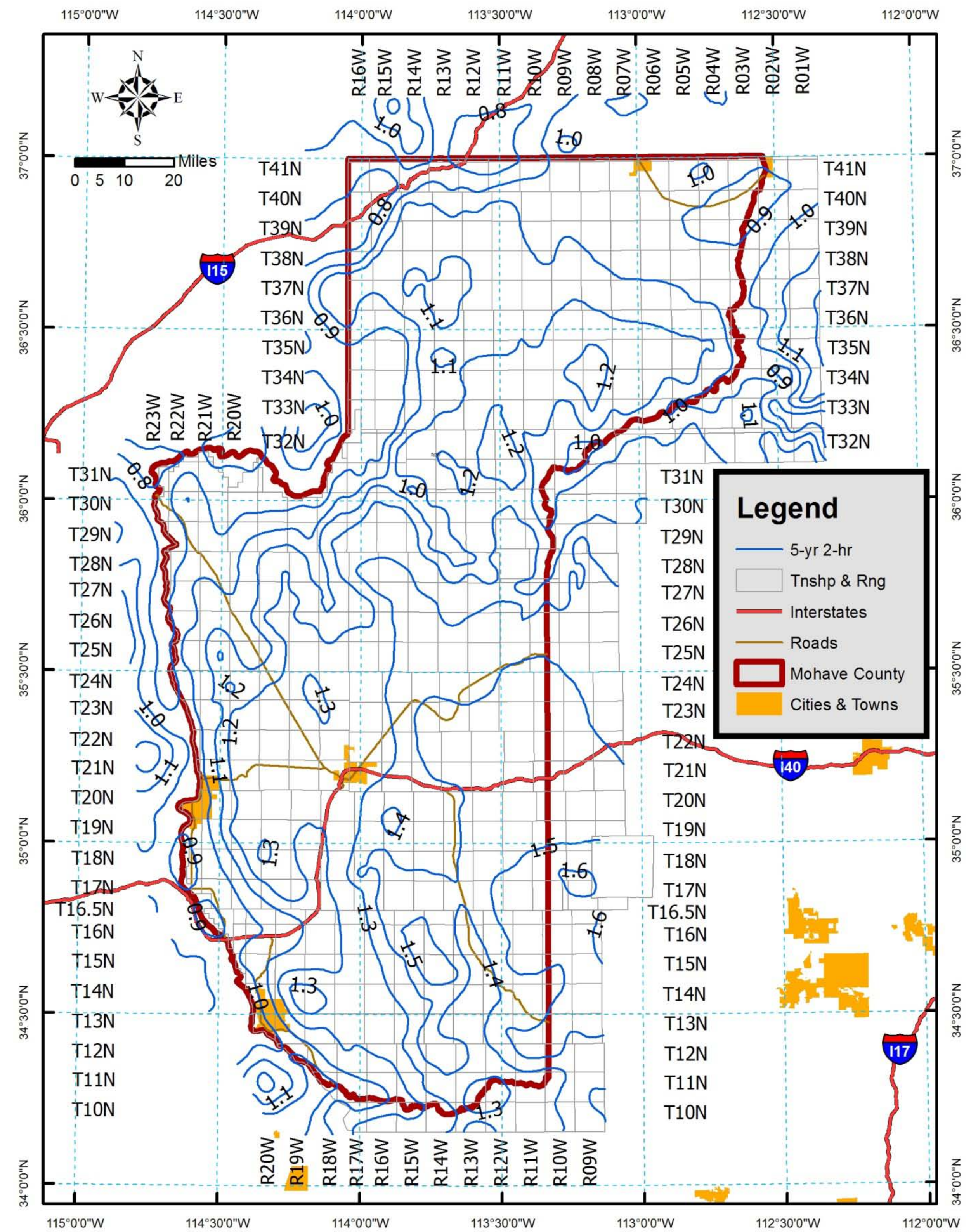


Figure B.17 NOAA Atlas 14 5-year 3-hour isopluvial map

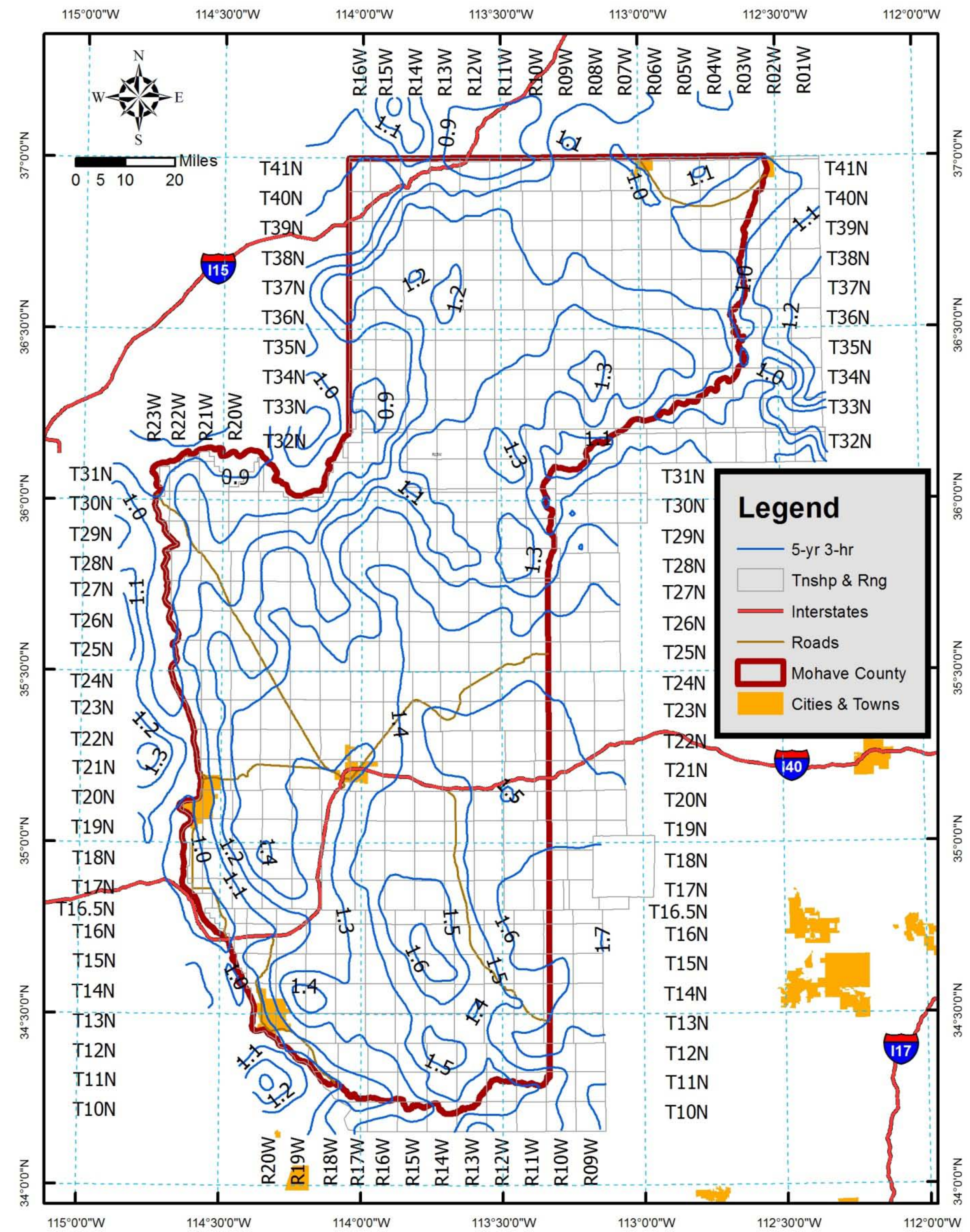


Figure B.18 NOAA Atlas 14 5-year 6-hour isopluvial map

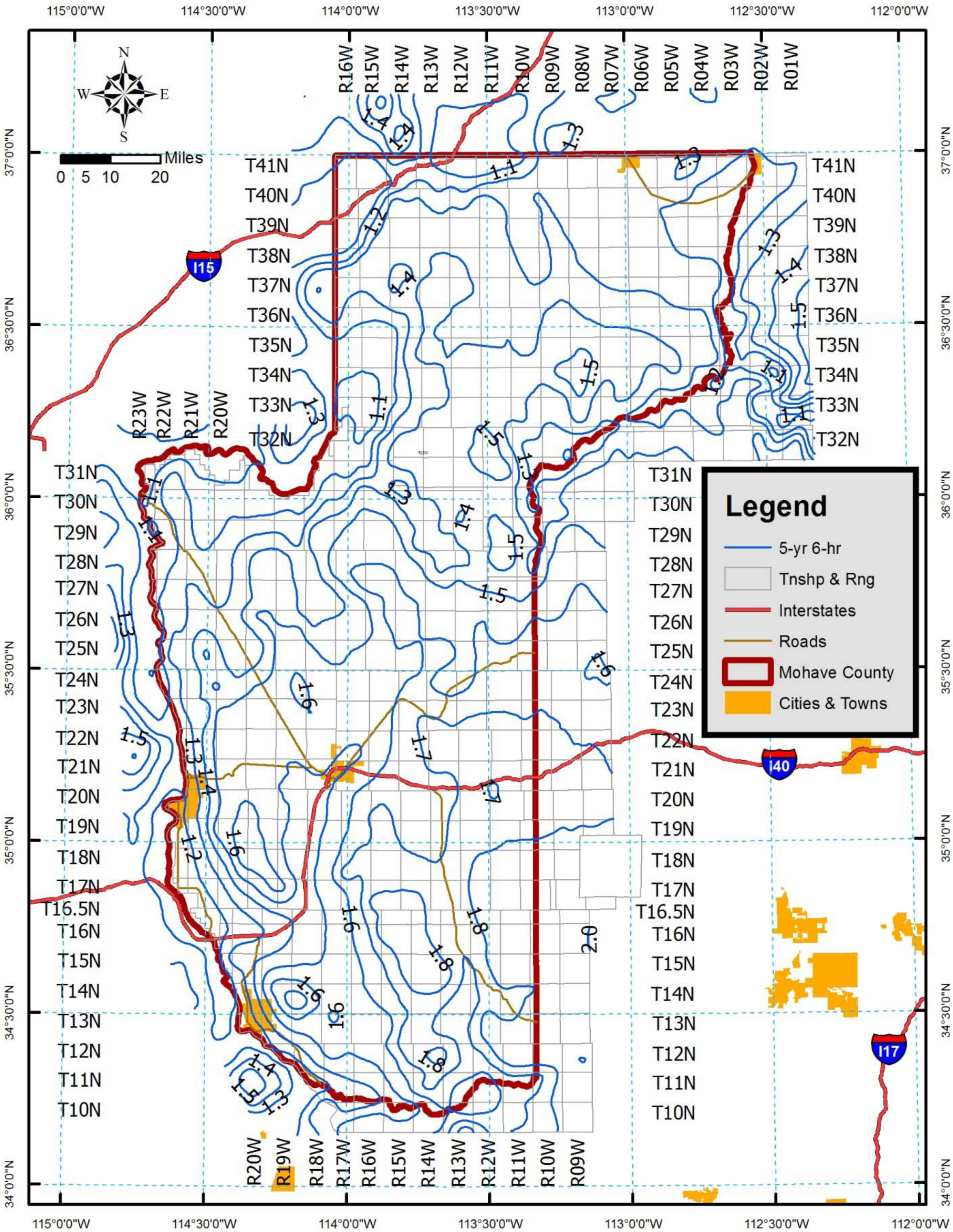


Figure B.19 NOAA Atlas 14 5-year 12-hour isopluvial map

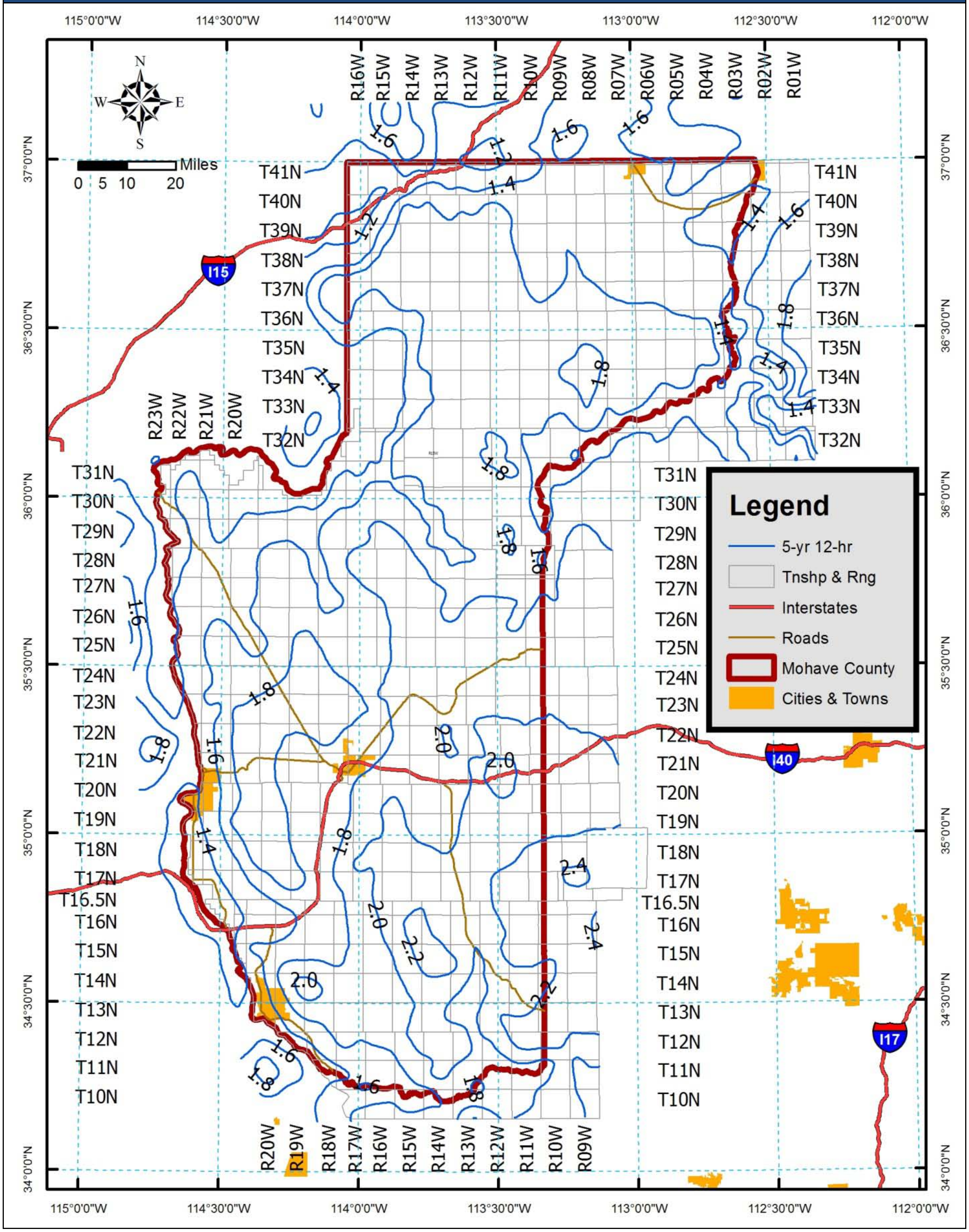
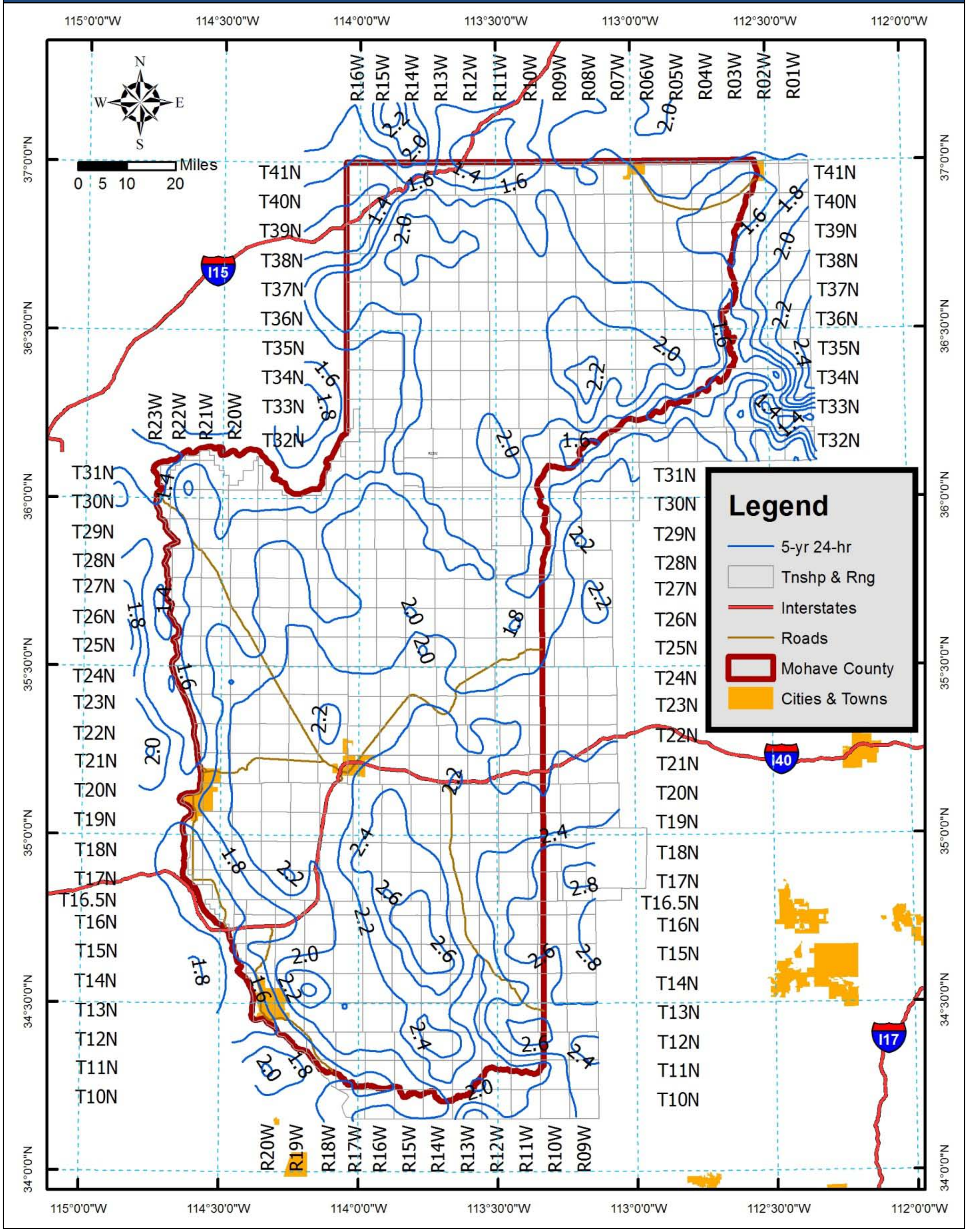


Figure B.20 NOAA Atlas 14 5-year 24-hour isopluvial map



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B.3 10-YEAR STORM ISOPLUVIALS

Figure B.21 NOAA Atlas 14 10-year 5-minute isopluvial map

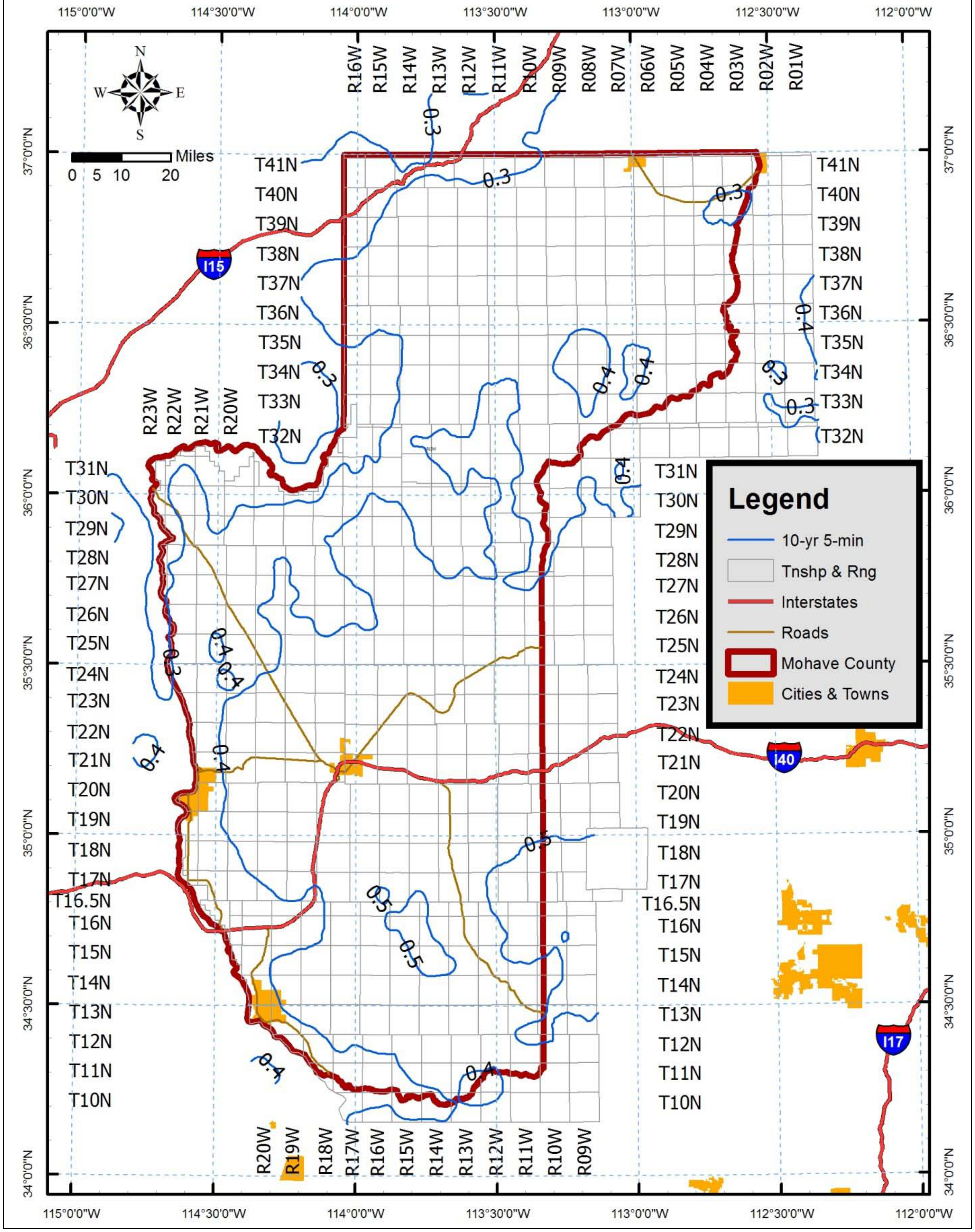


Figure B.22 NOAA Atlas 14 10-year 10-minute isopluvial map

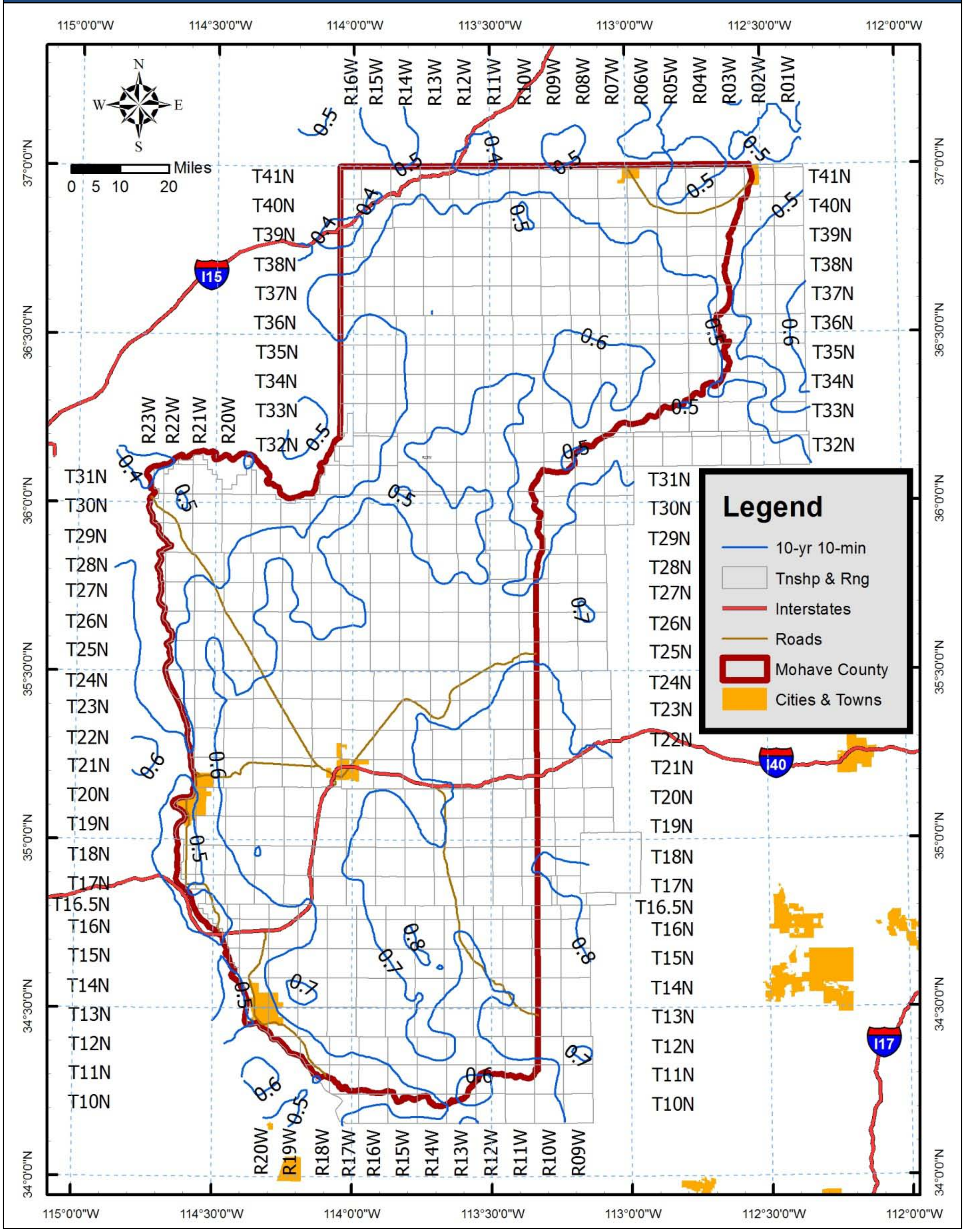


Figure B.23 NOAA Atlas 14 10-year 15-minute isopluvial map

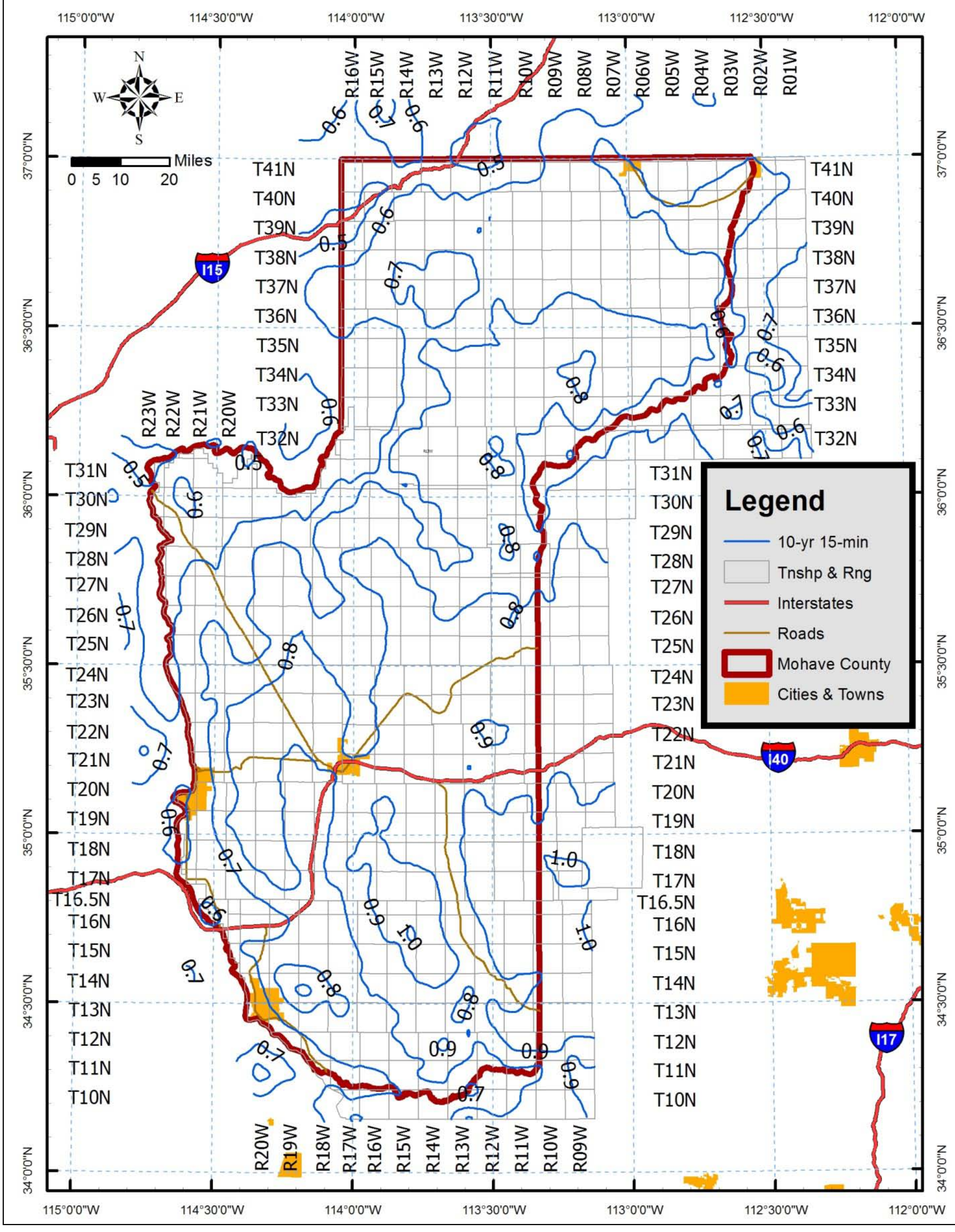


Figure B.24 NOAA Atlas 14 10-year 30-minute isopluvial map

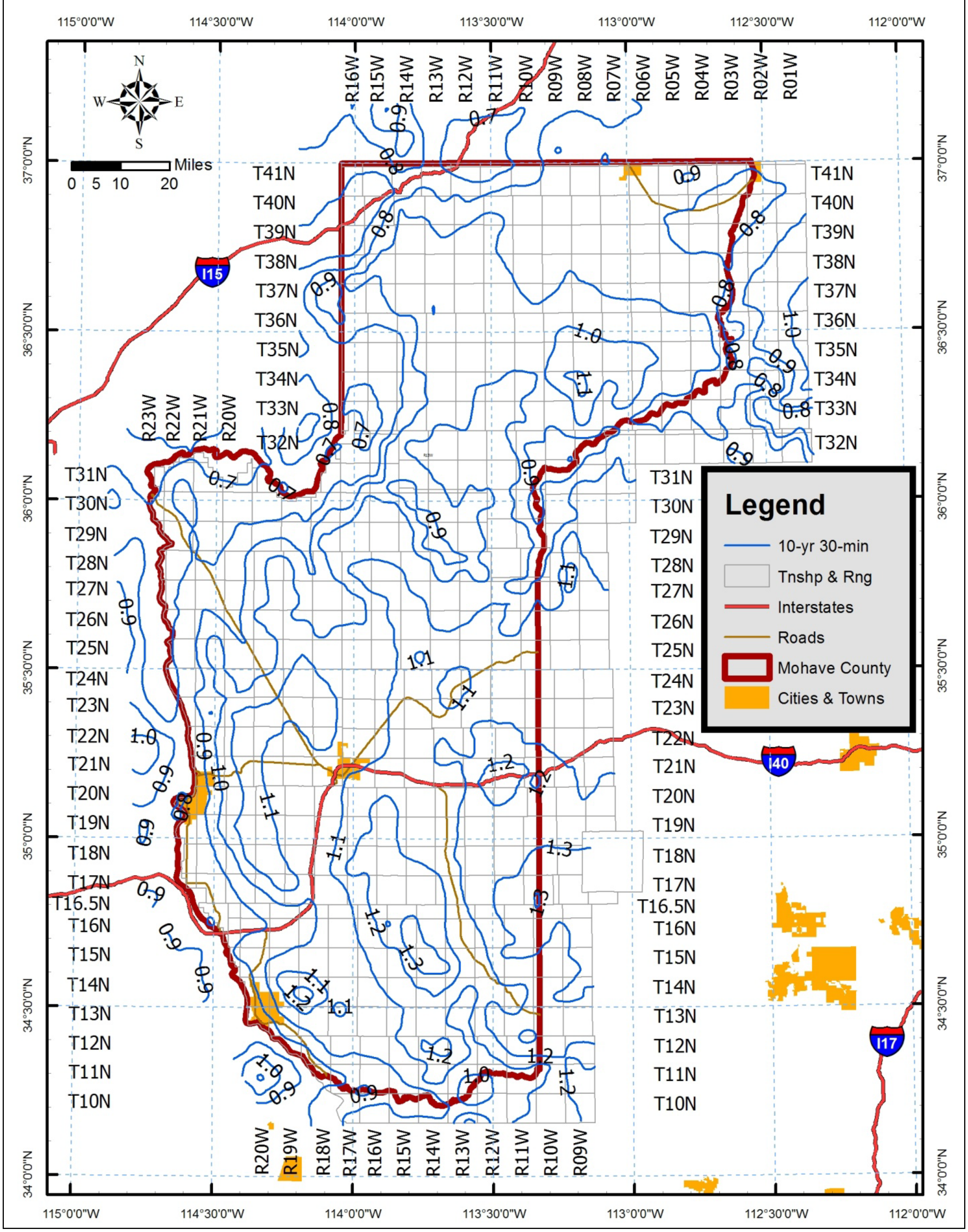


Figure B.25 NOAA Atlas 14 10-year 1-hour isopluvial map

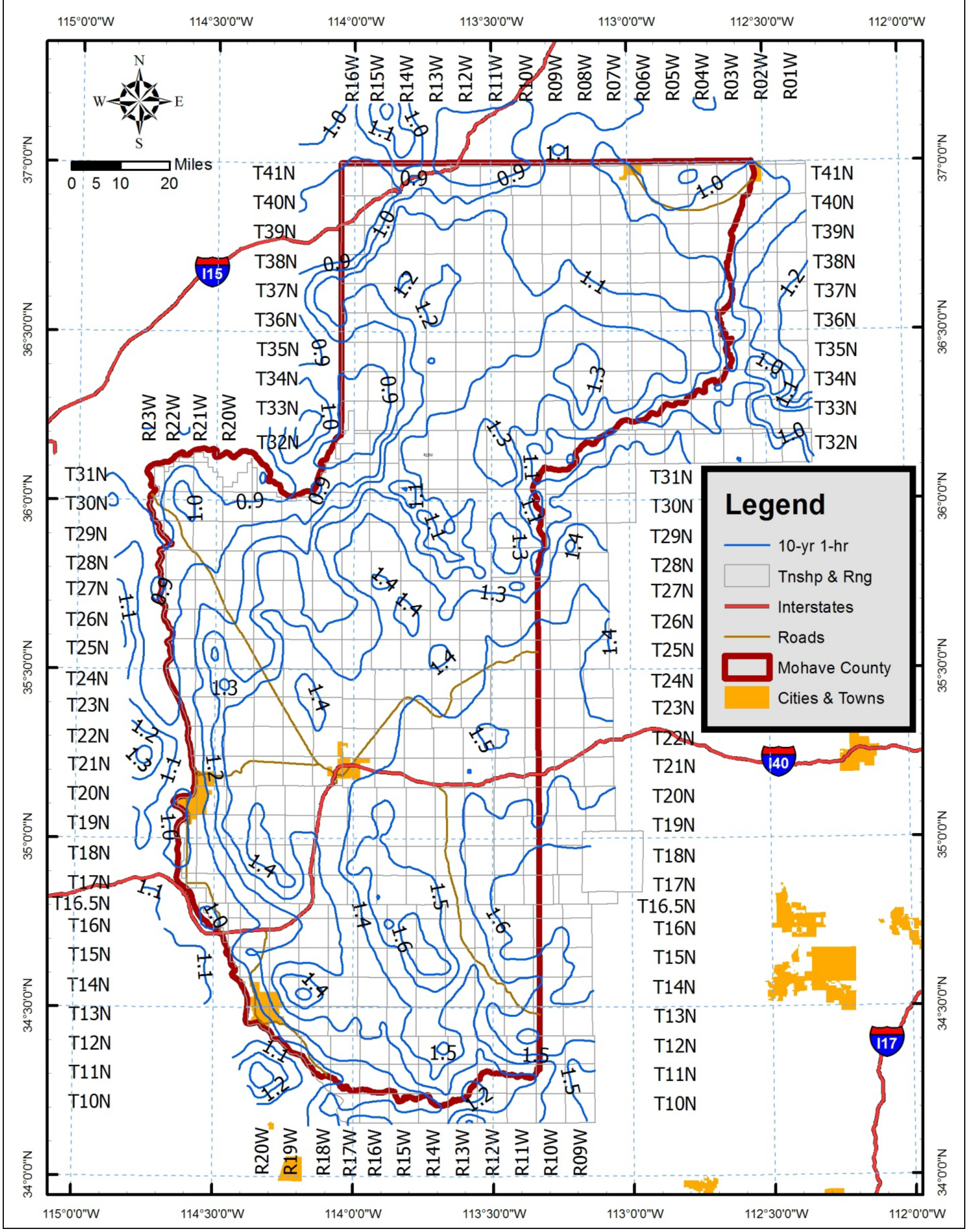


Figure B.26 NOAA Atlas 14 10-year 2-hour isopluvial map

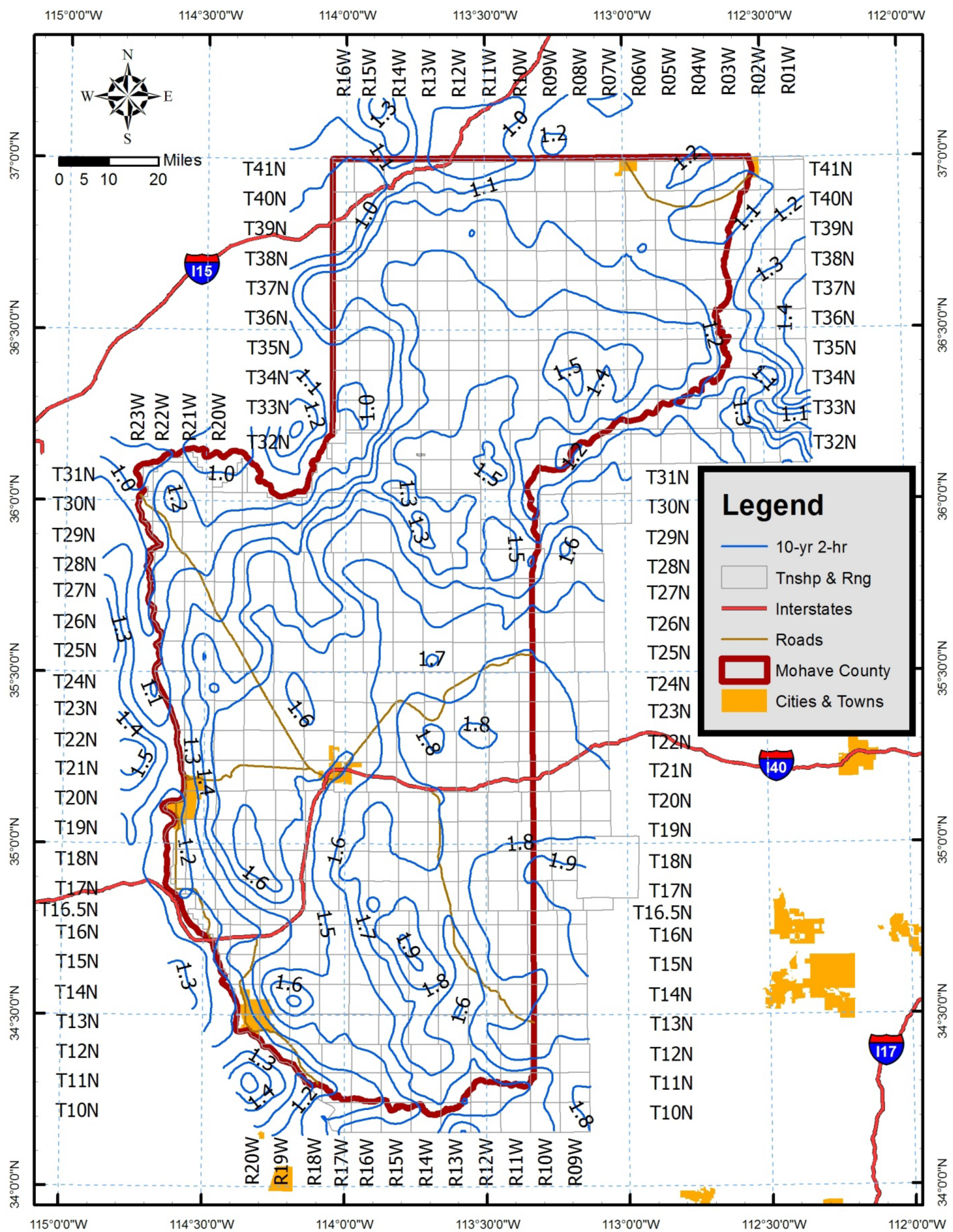


Figure B.27 NOAA Atlas 14 10-year 3-hour isopluvial map

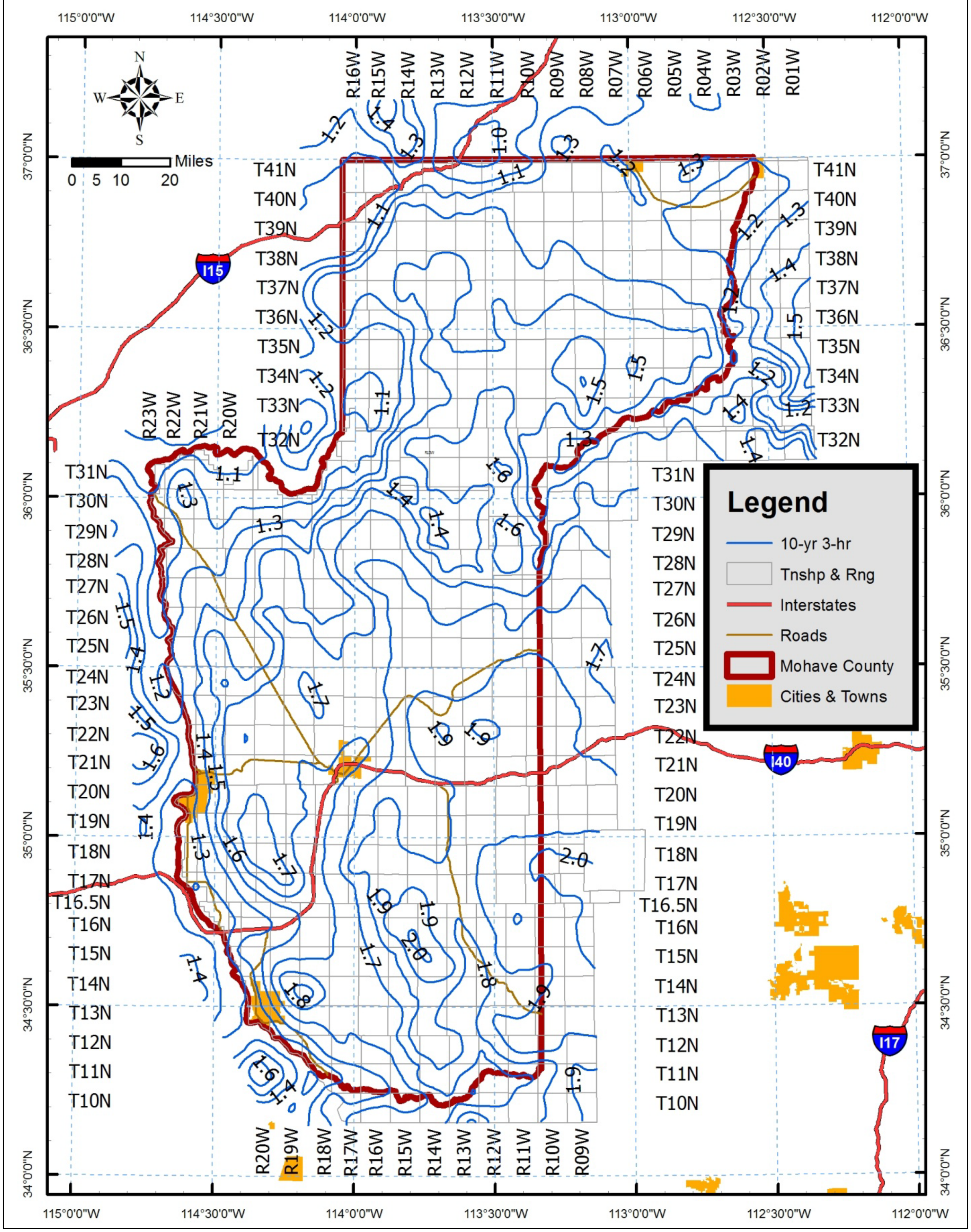


Figure B.28 NOAA Atlas 14 10-year 6-hour isopluvial map

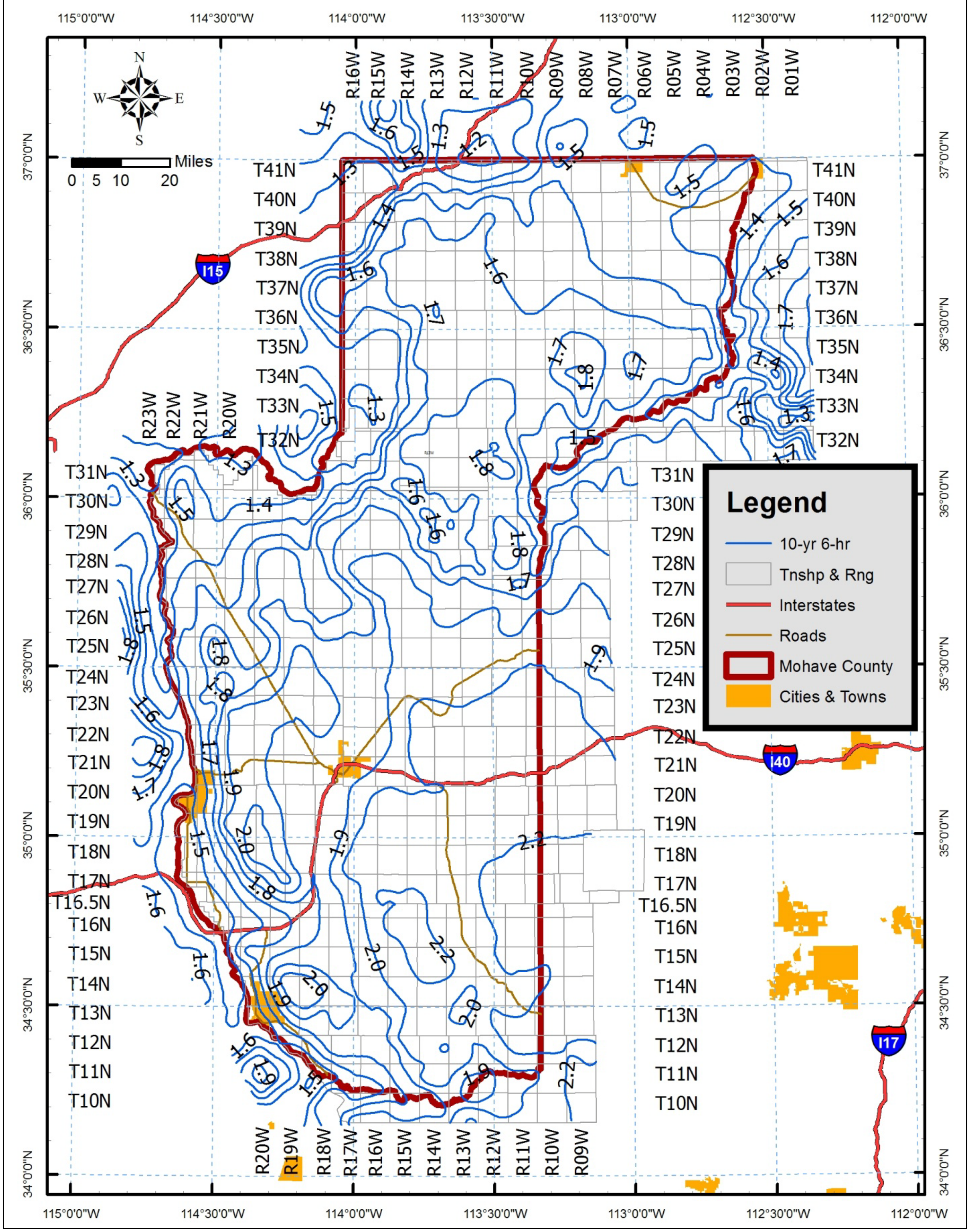


Figure B.29 NOAA Atlas 14 10-year 12-hour isopluvial map

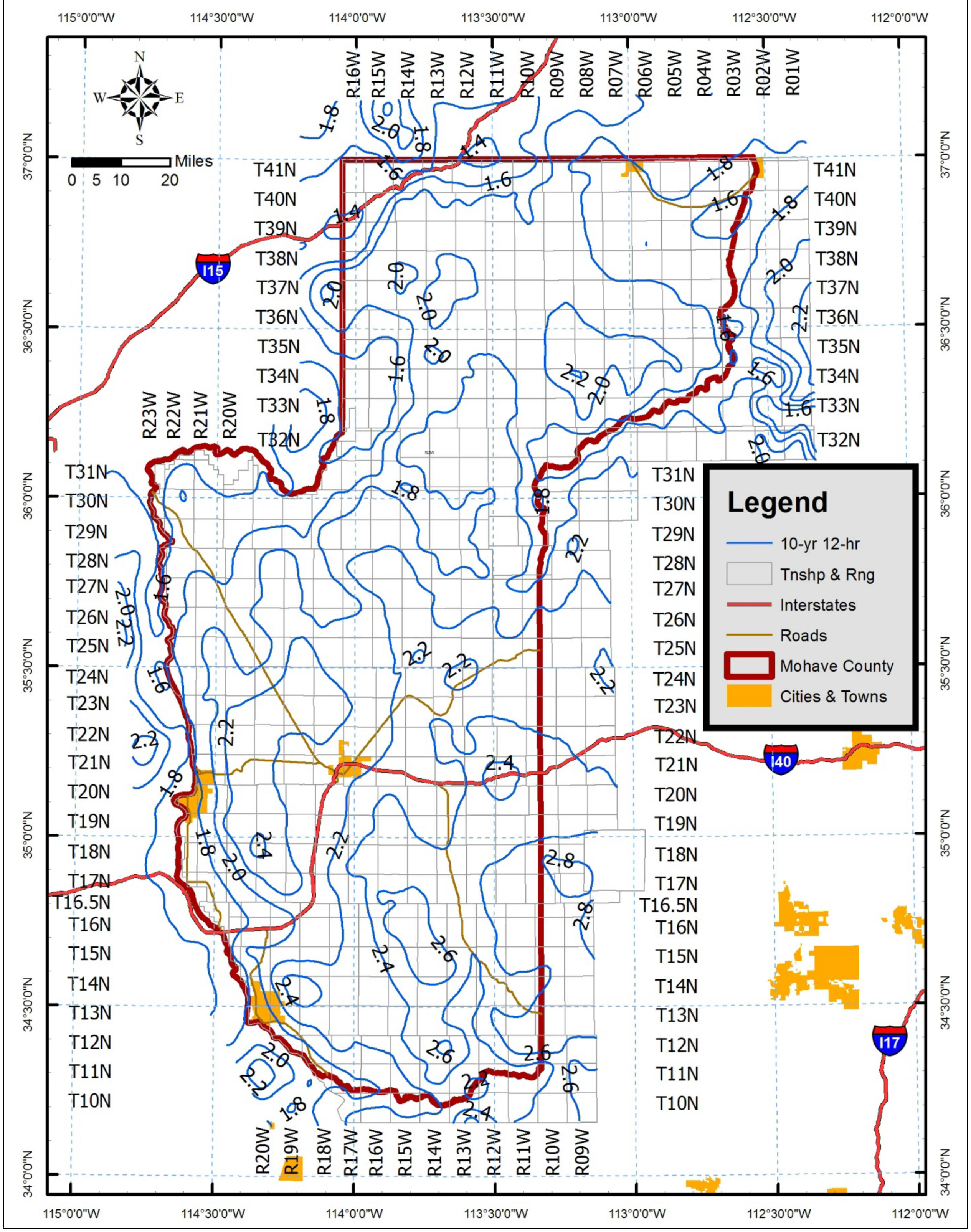
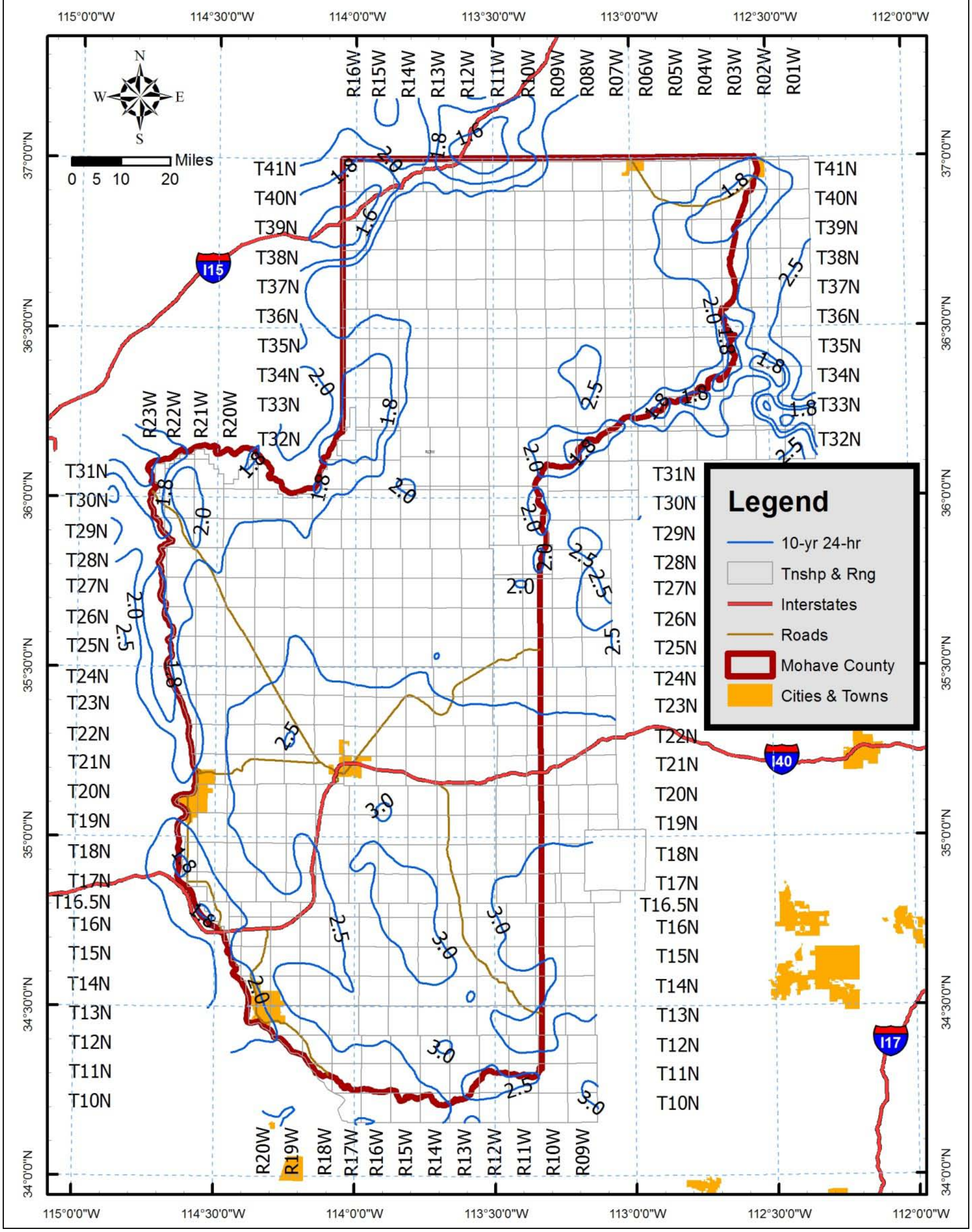


Figure B.30 NOAA Atlas 14 10-year 24-hour isopluvial map



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B.4 25-YEAR STORM ISOPLUVIALS

Figure B.31 NOAA Atlas 14 25-year 5-minute isopluvial map

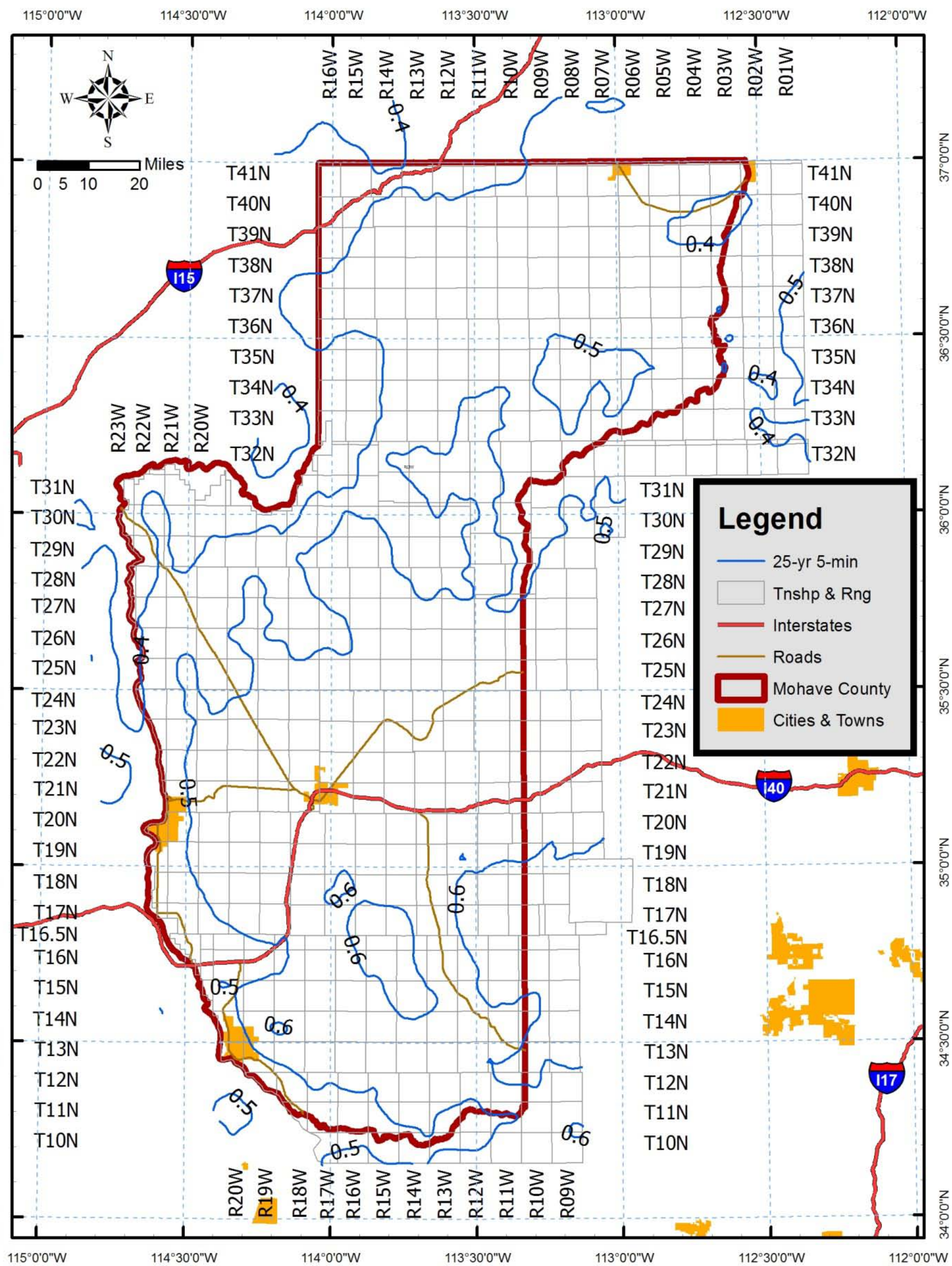


Figure B.32 NOAA Atlas 14 25-year 10-minute isopluvial map

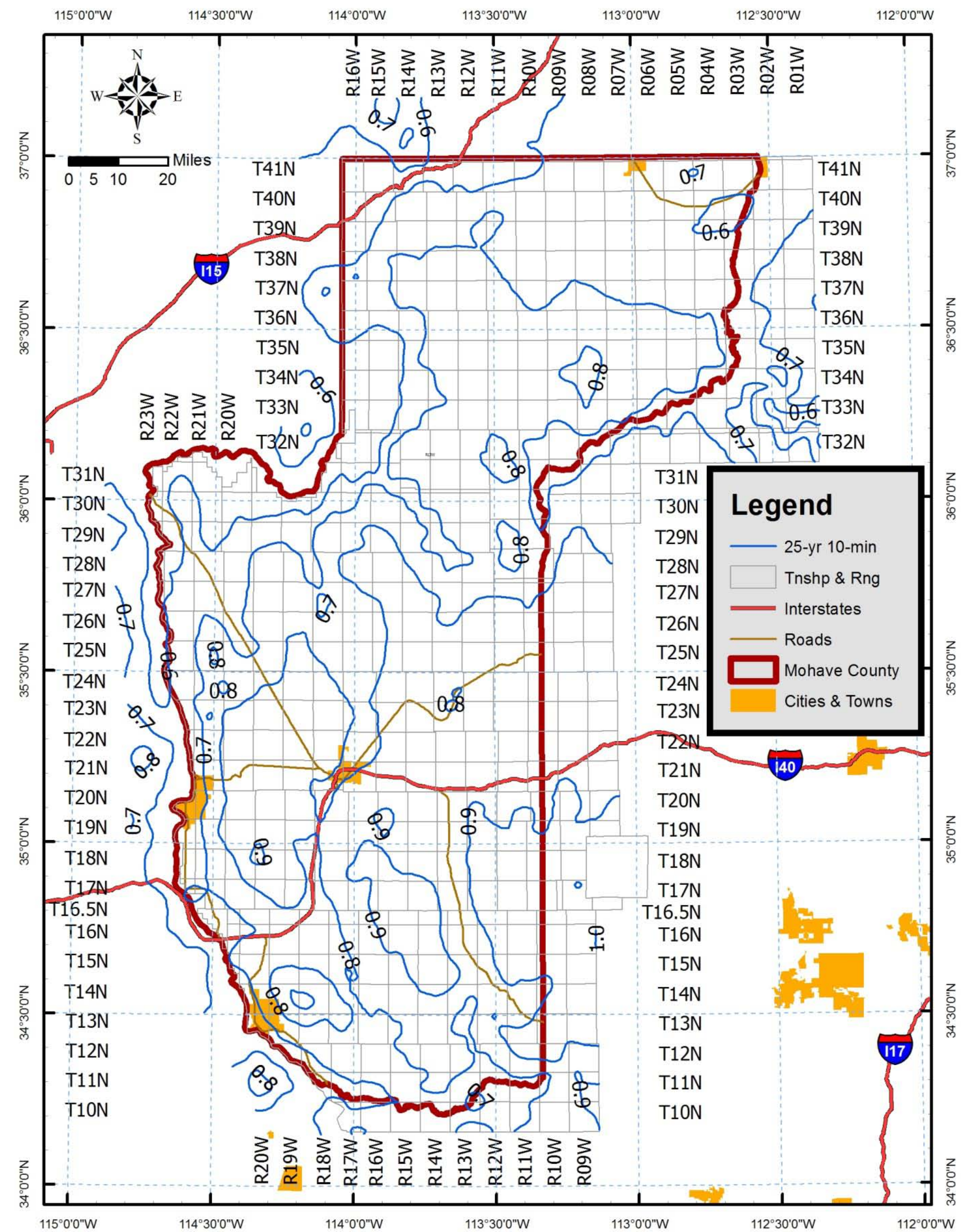


Figure B.33 NOAA Atlas 14 25-year 15-minute isopluvial map

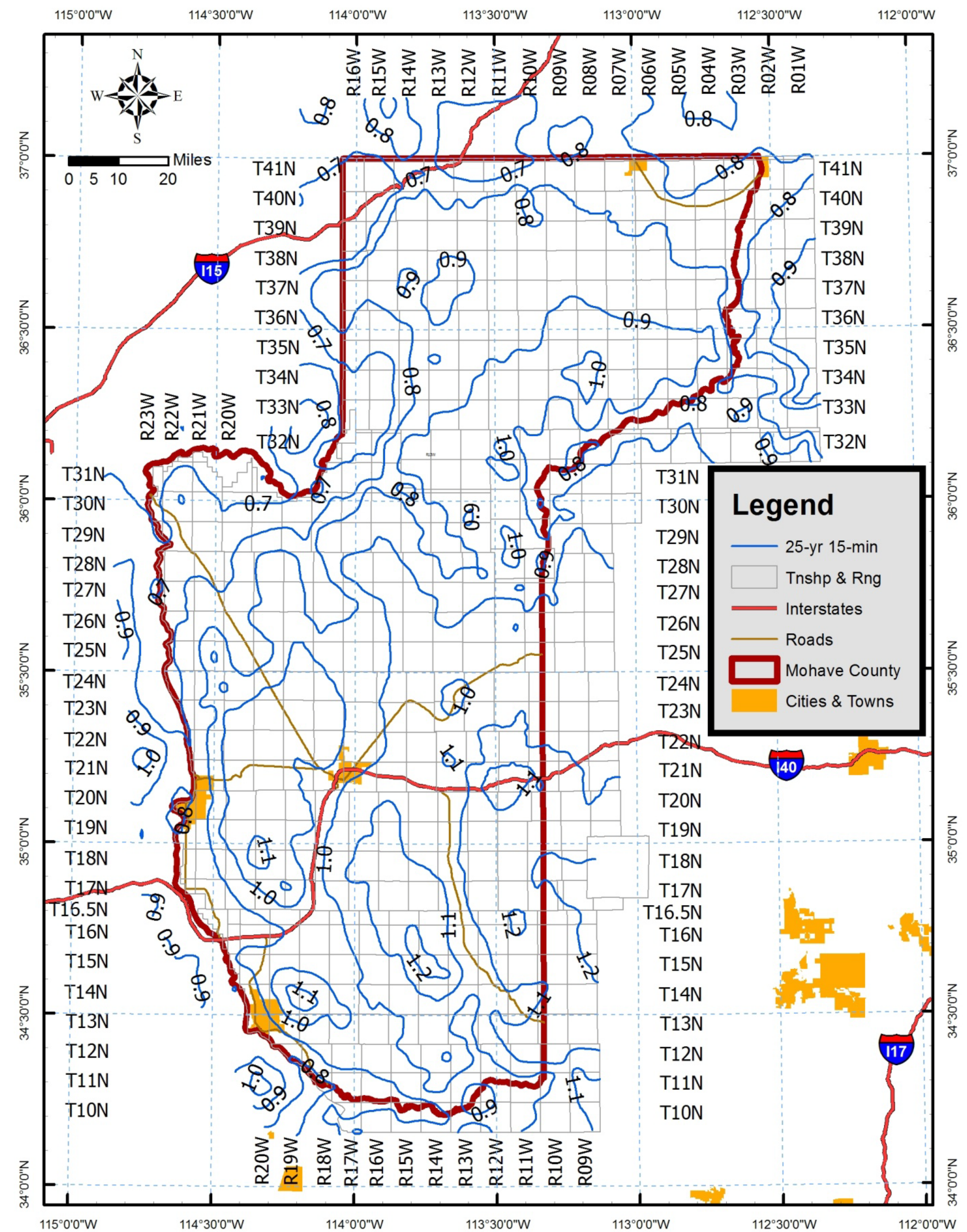


Figure B.34 NOAA Atlas 14 25-year 30-minute isopluvial map

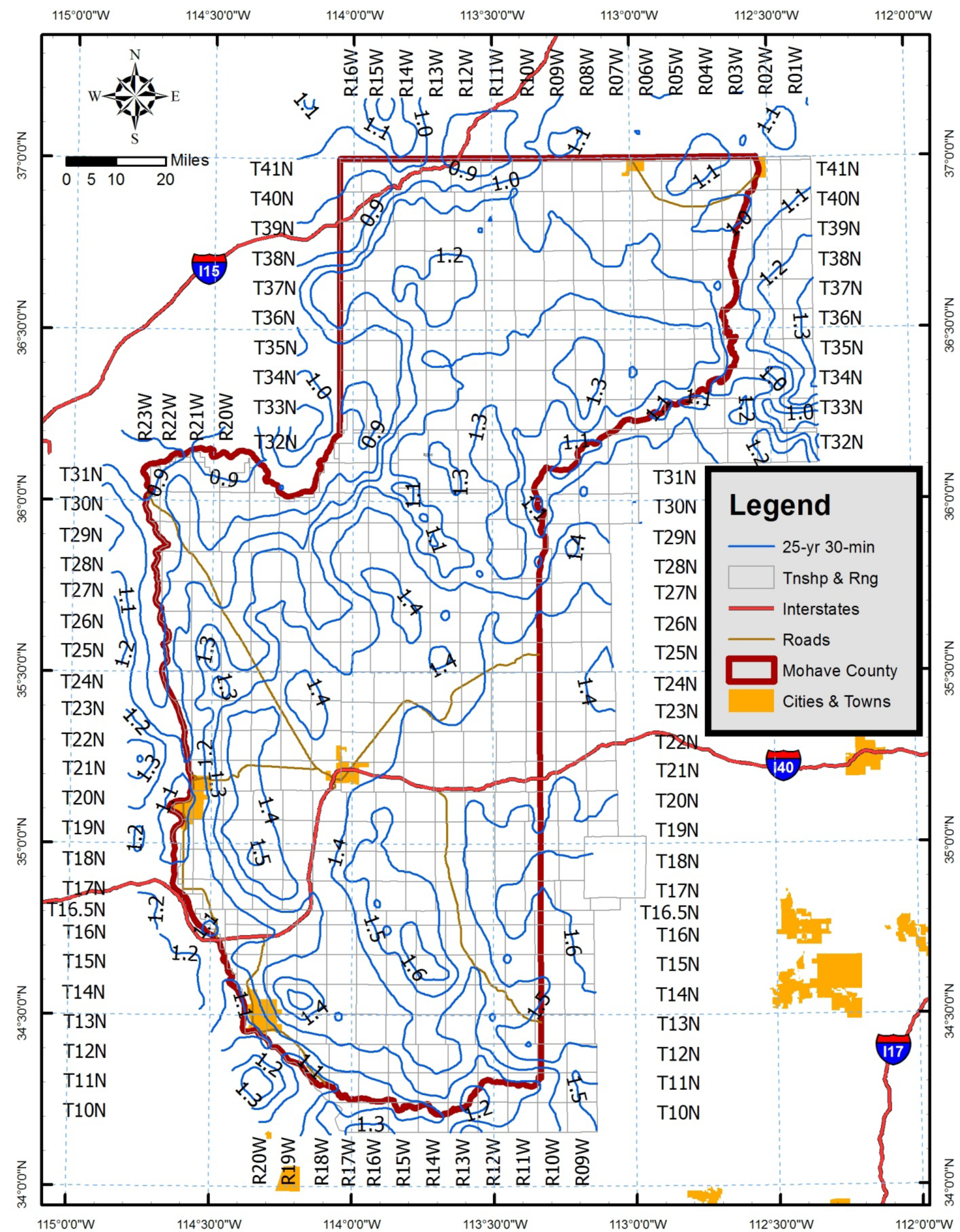


Figure B.35 NOAA Atlas 14 25-year 1-hour isopluvial map

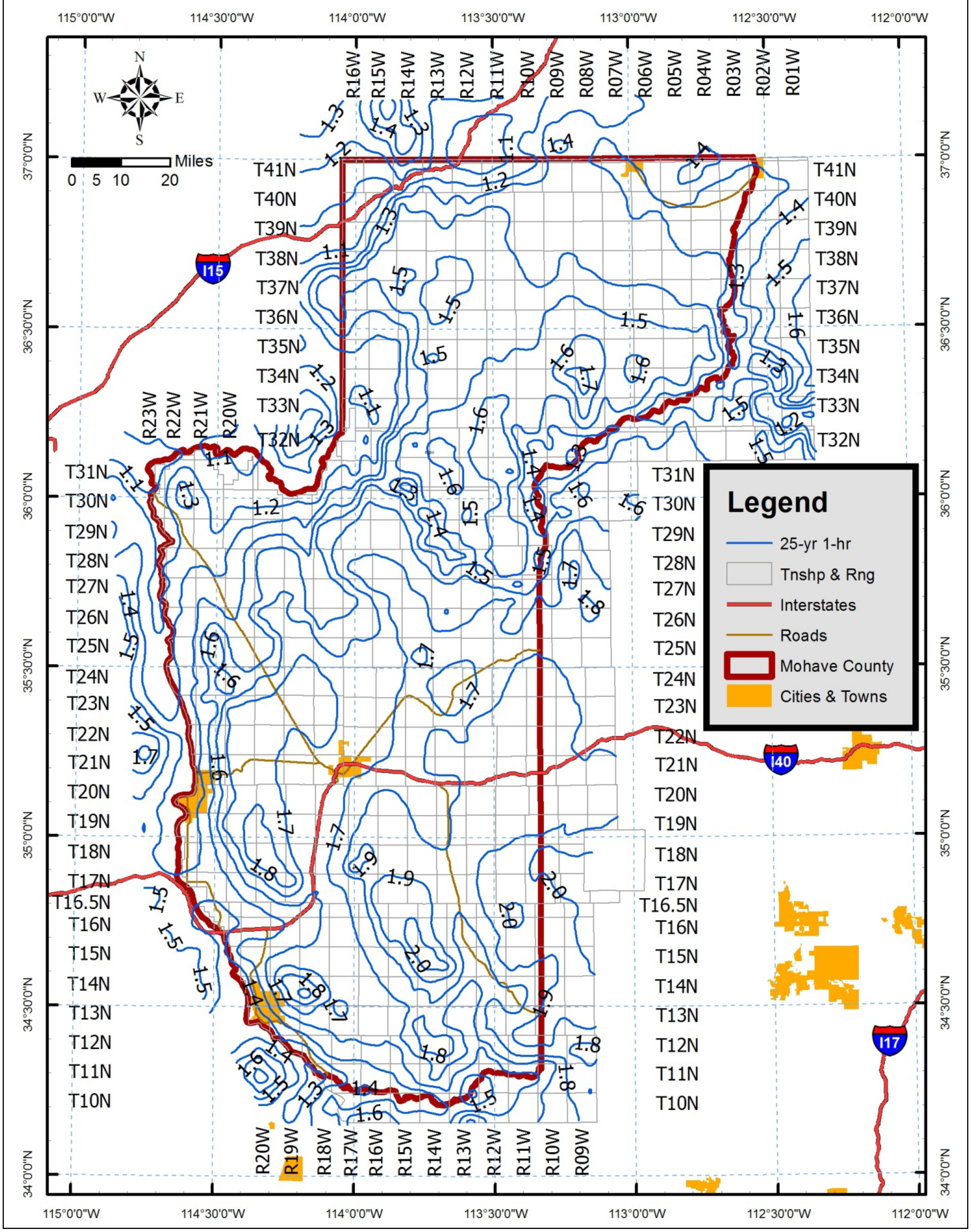


Figure B.36 NOAA Atlas 14 25-year 2-hour isopluvial map

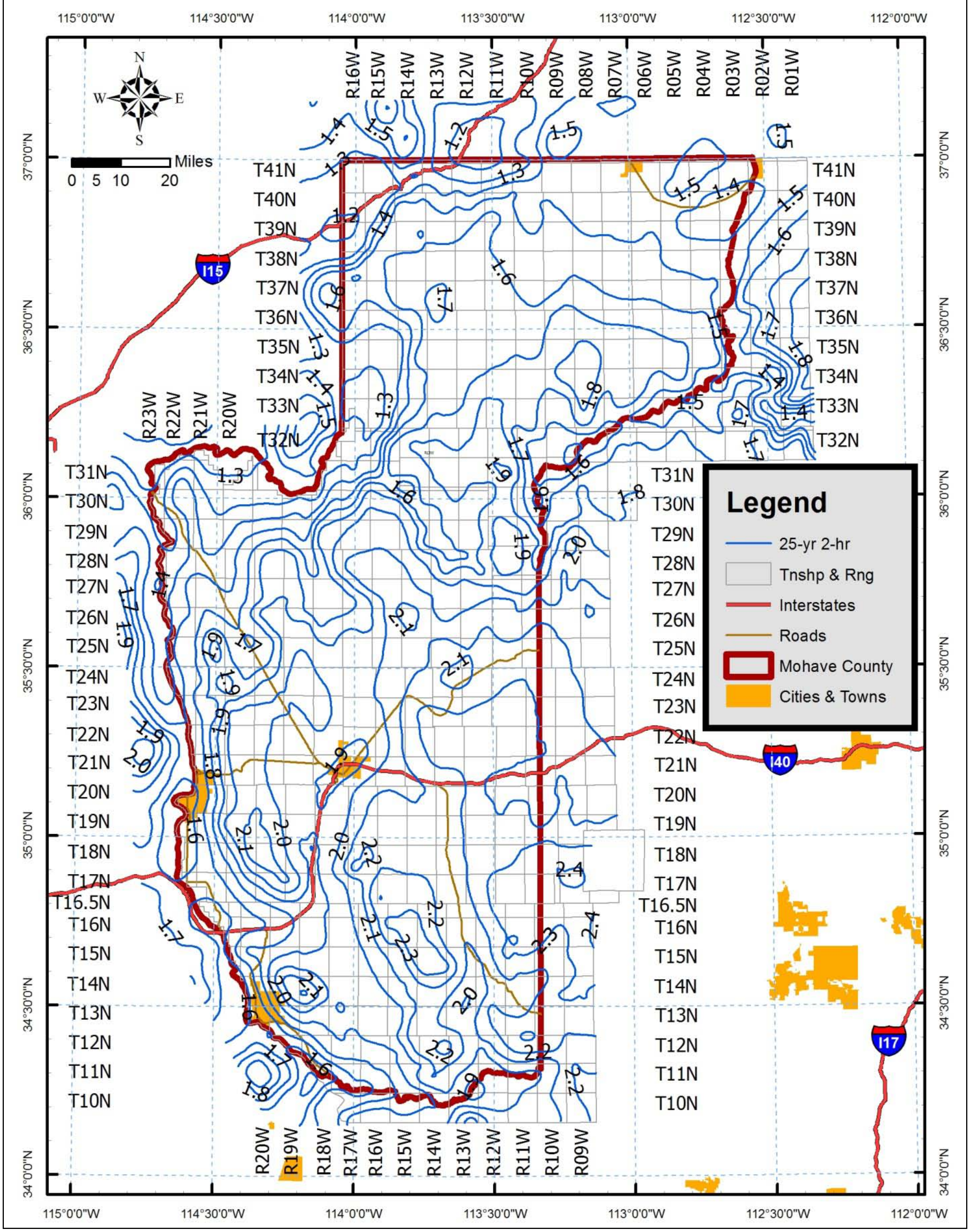


Figure B.37 NOAA Atlas 14 25-year 3-hour isopluvial map

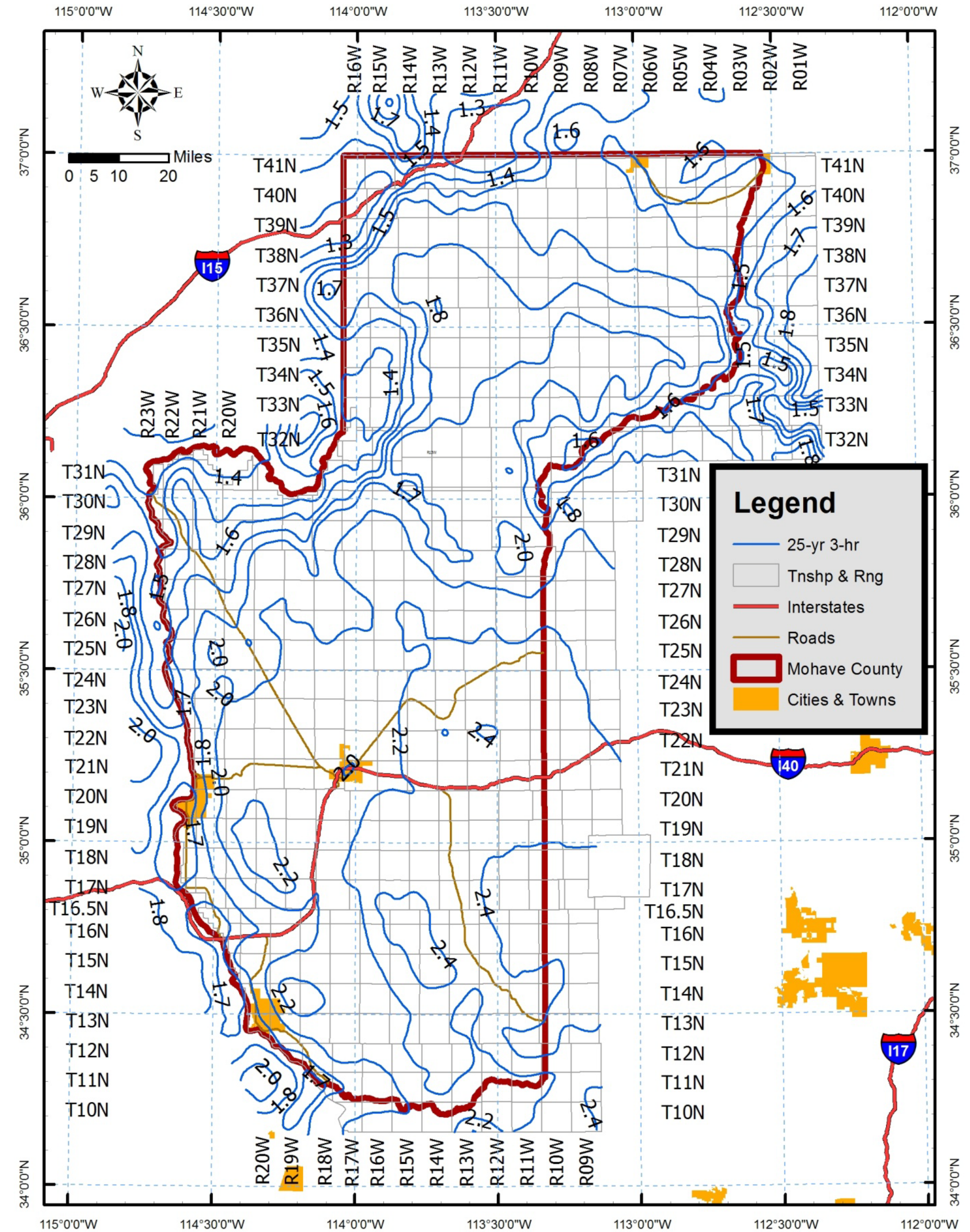


Figure B.38 NOAA Atlas 14 25-year 6-hour isopluvial map

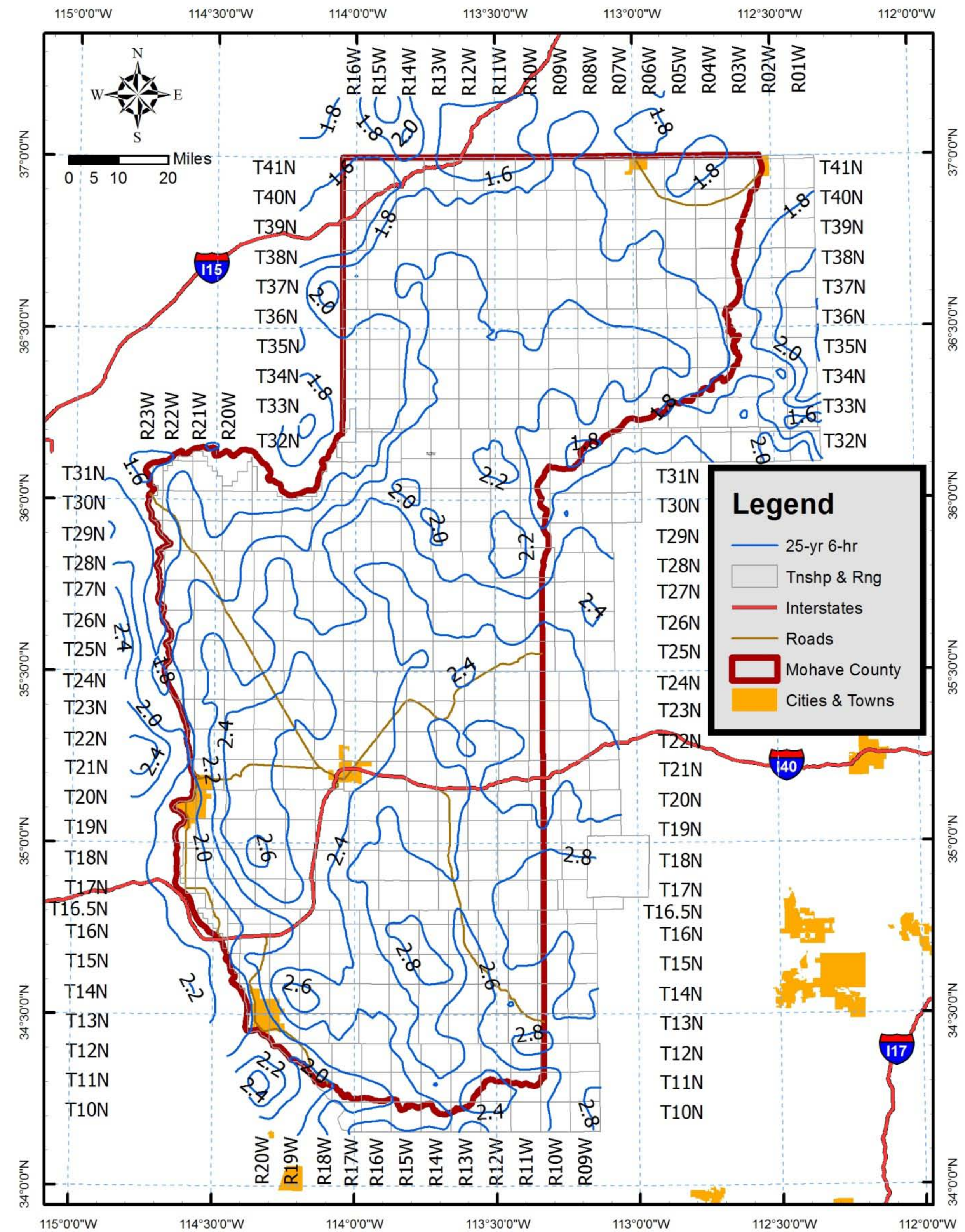


Figure B.39 NOAA Atlas 14 25-year 12-hour isopluvial map

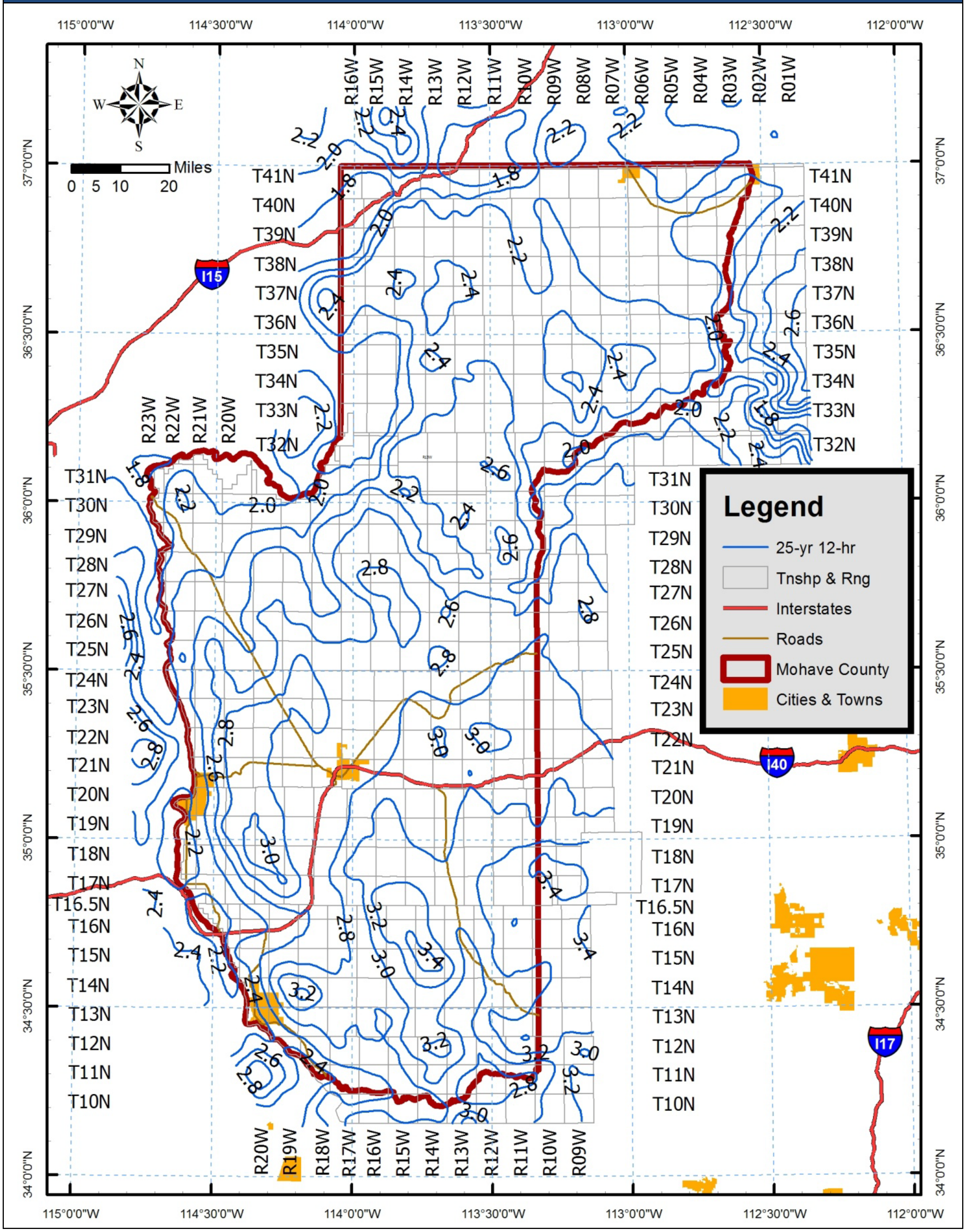
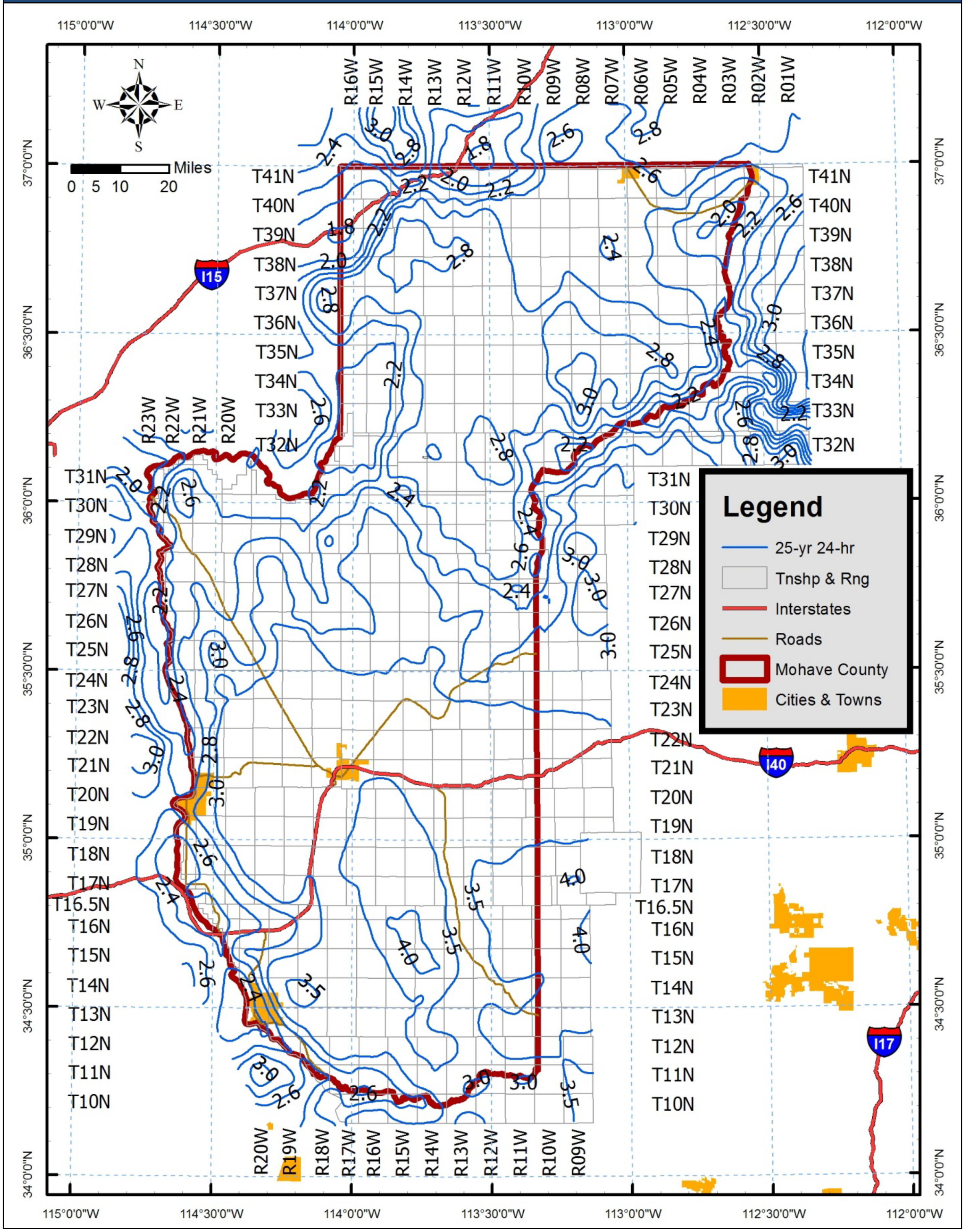


Figure B.40 NOAA Atlas 14 25-year 24-hour isopluvial map



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B.5 50-YEAR STORM ISOPLUVIALS

Figure B.41 NOAA Atlas 14 50-year 5-minute isopluvial map

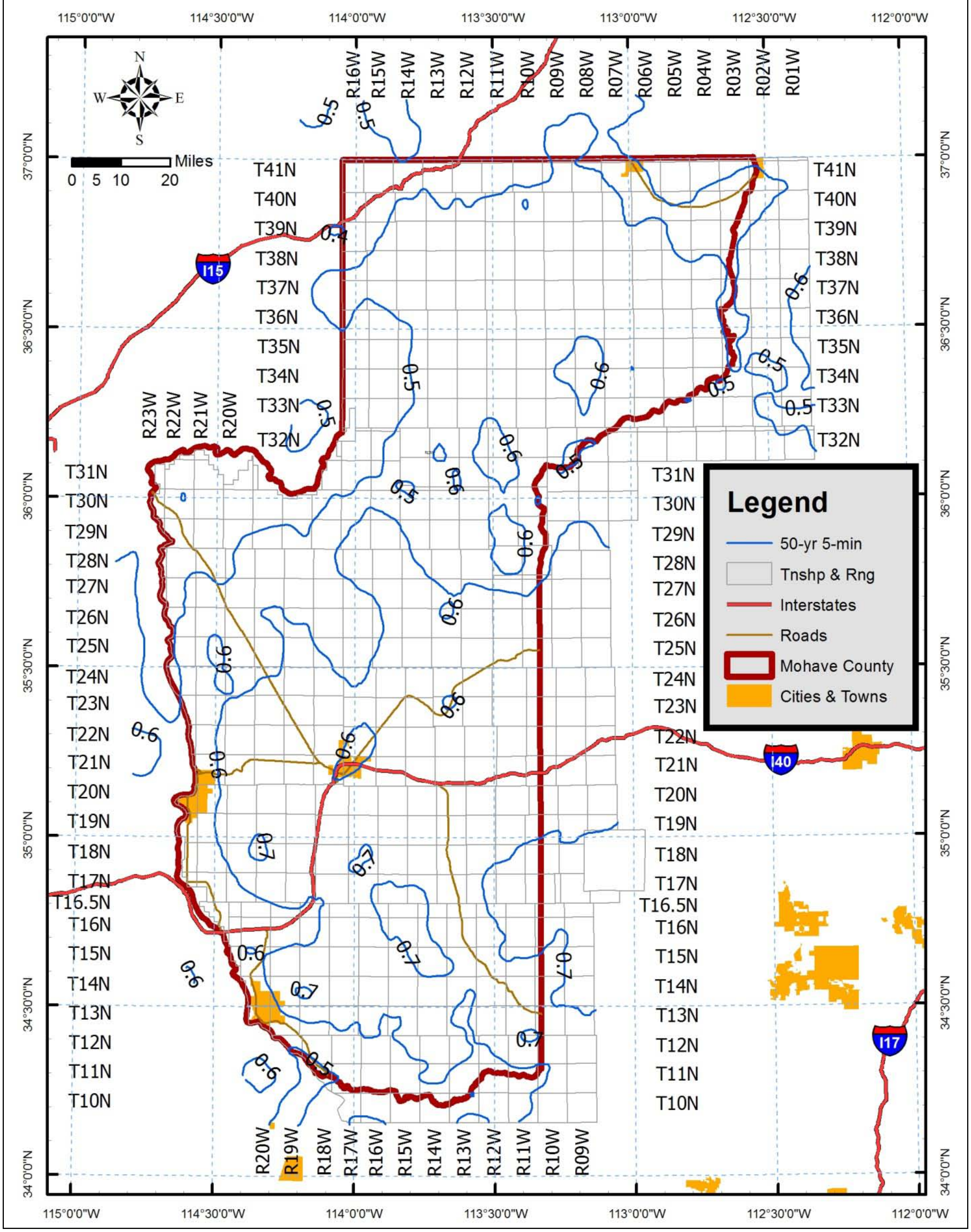


Figure B.42 NOAA Atlas 14 50-year 10-minute isopluvial map

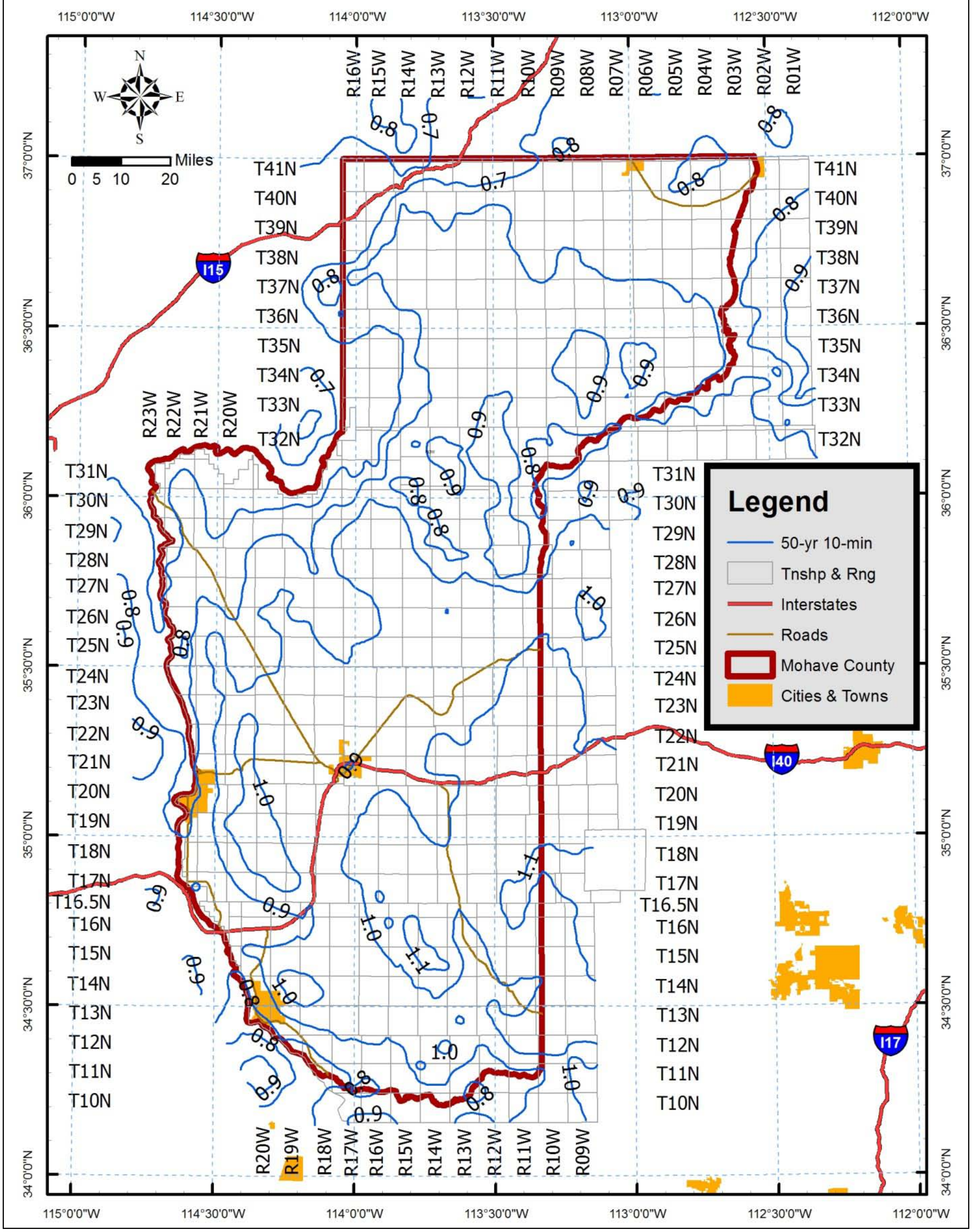


Figure B.43 NOAA Atlas 14 50-year 15-minute isopluvial map

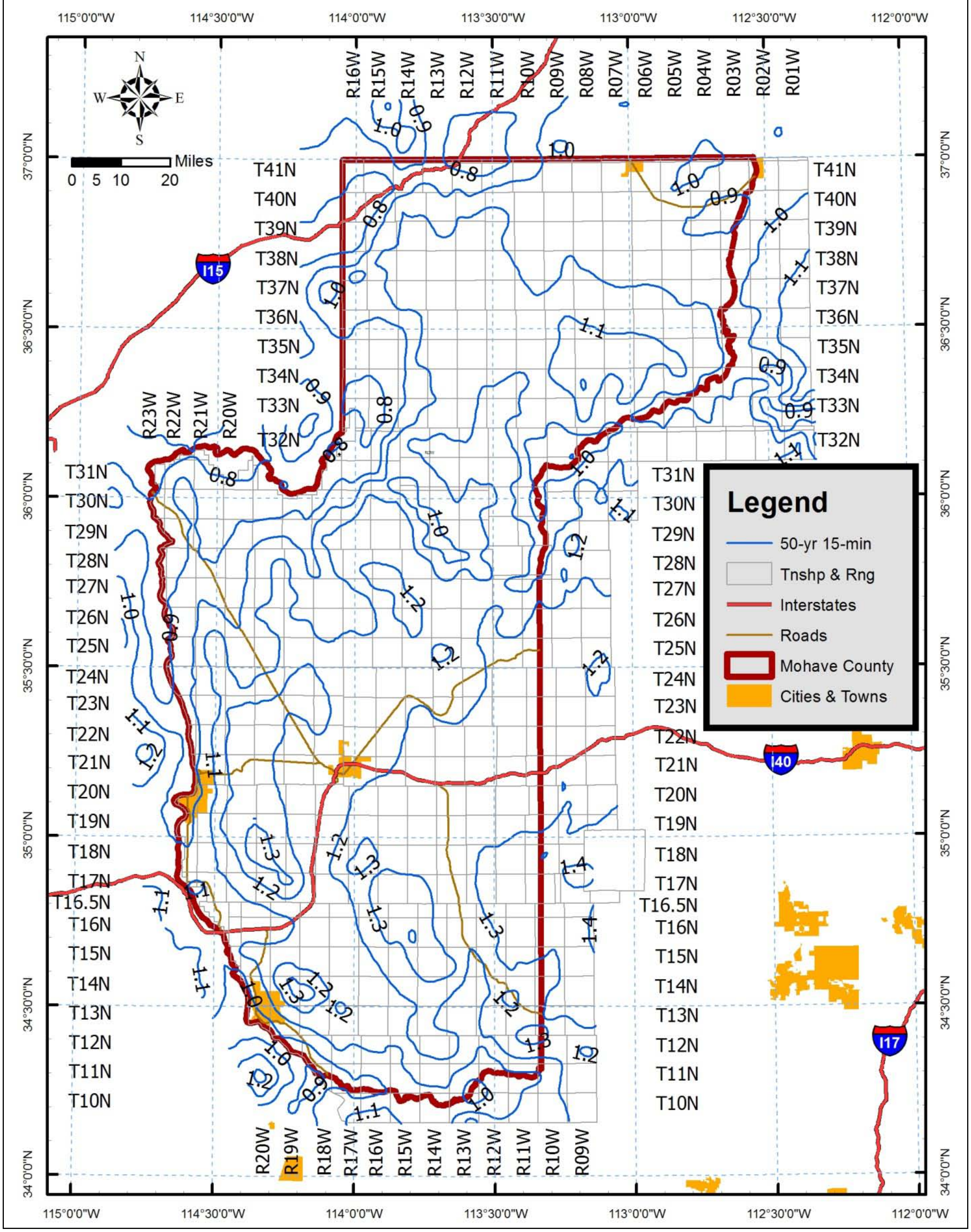


Figure B.44 NOAA Atlas 14 50-year 30-minute isopluvial map

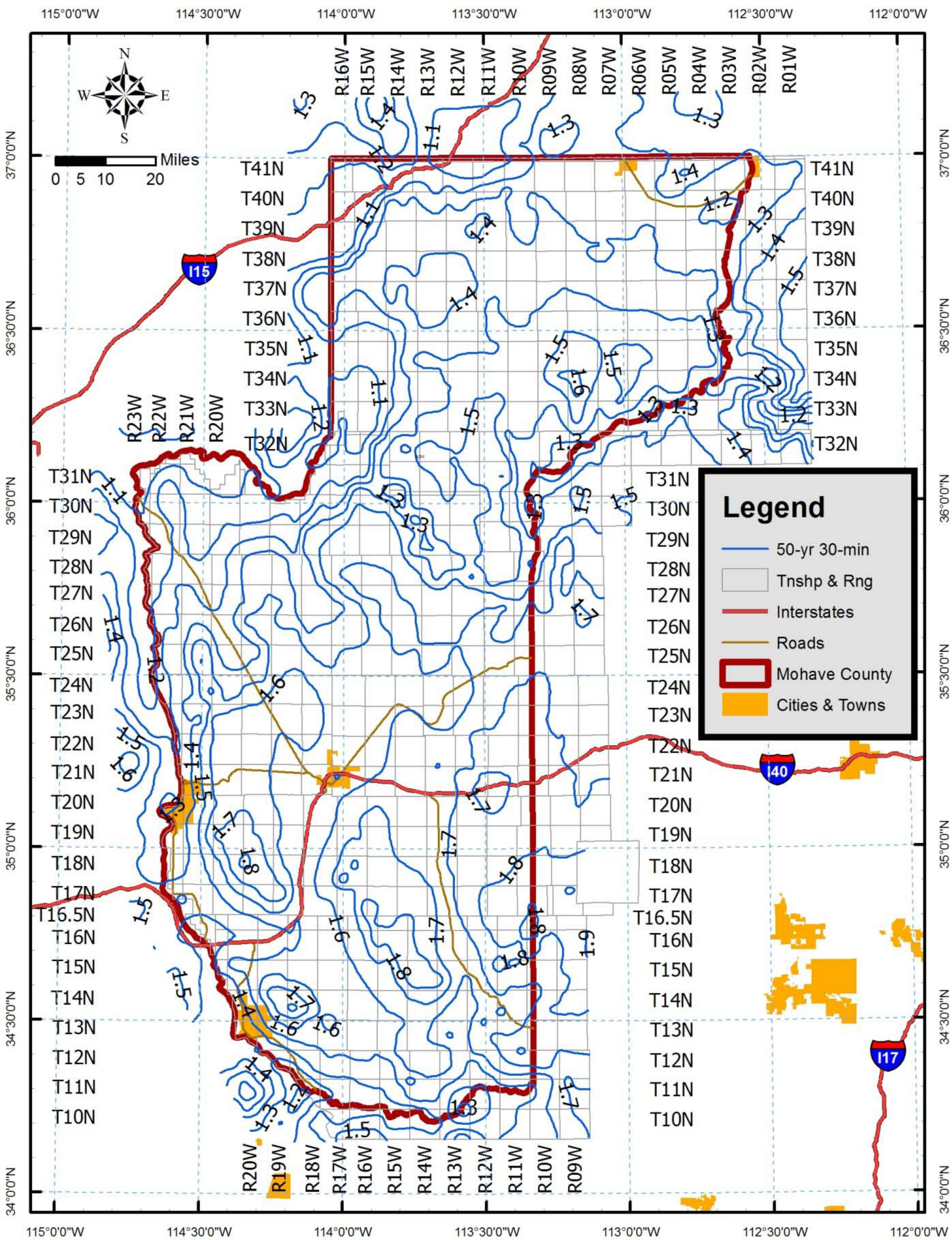


Figure B.45 NOAA Atlas 14 50-year 1-hour isopluvial map

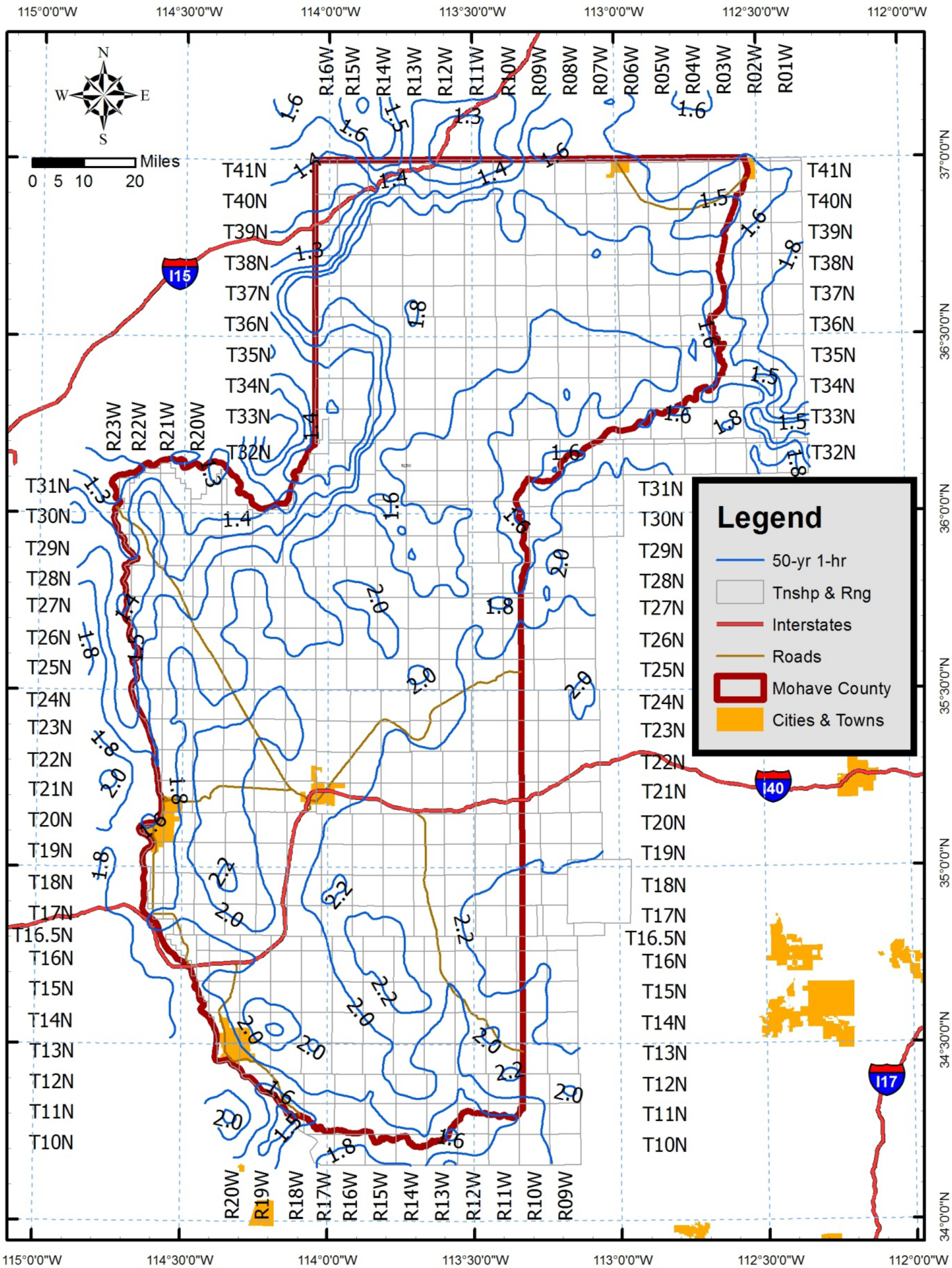


Figure B.46 NOAA Atlas 14 50-year 2-hour isopluvial map

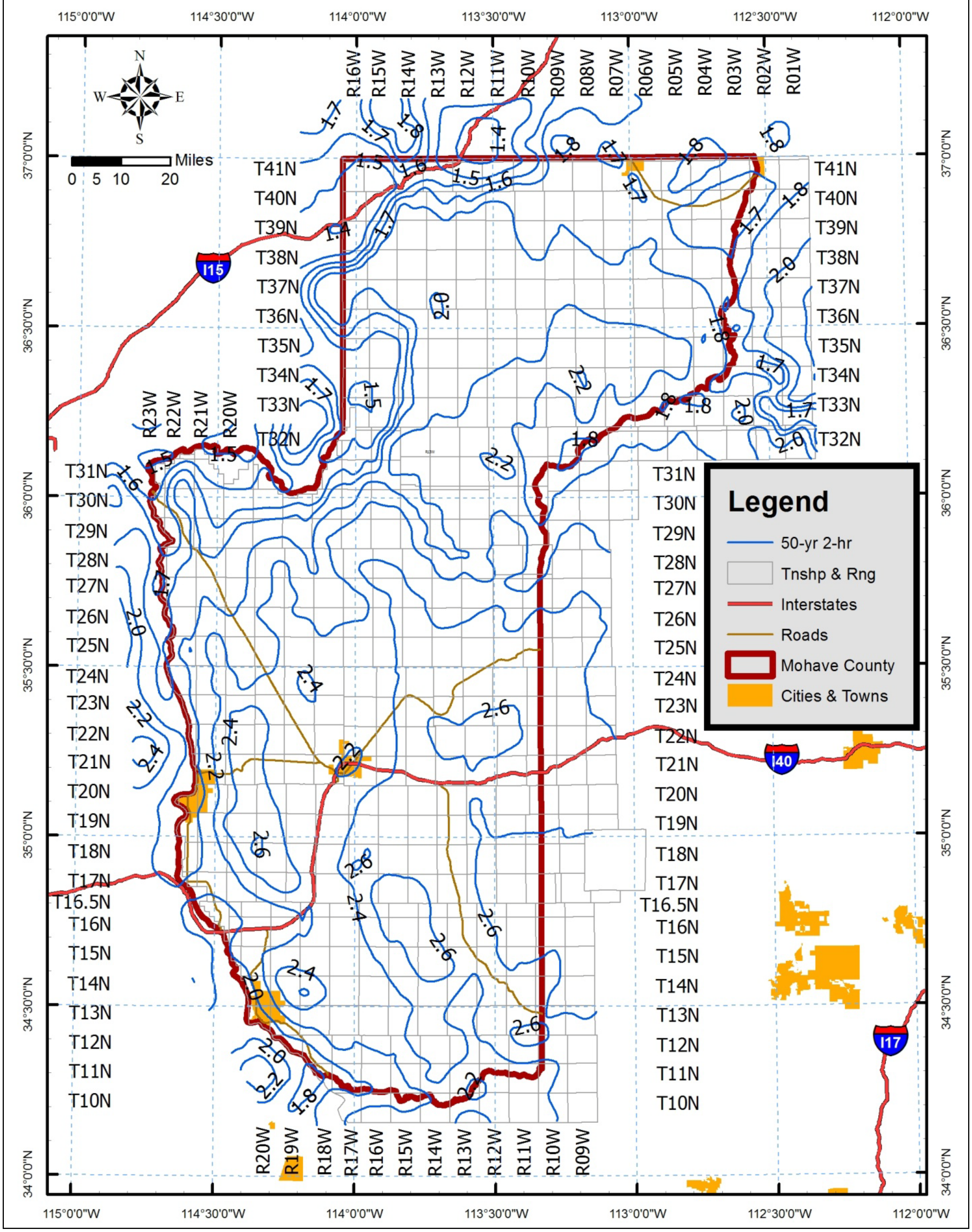


Figure B.47 NOAA Atlas 14 50-year 3-hour isopluvial map

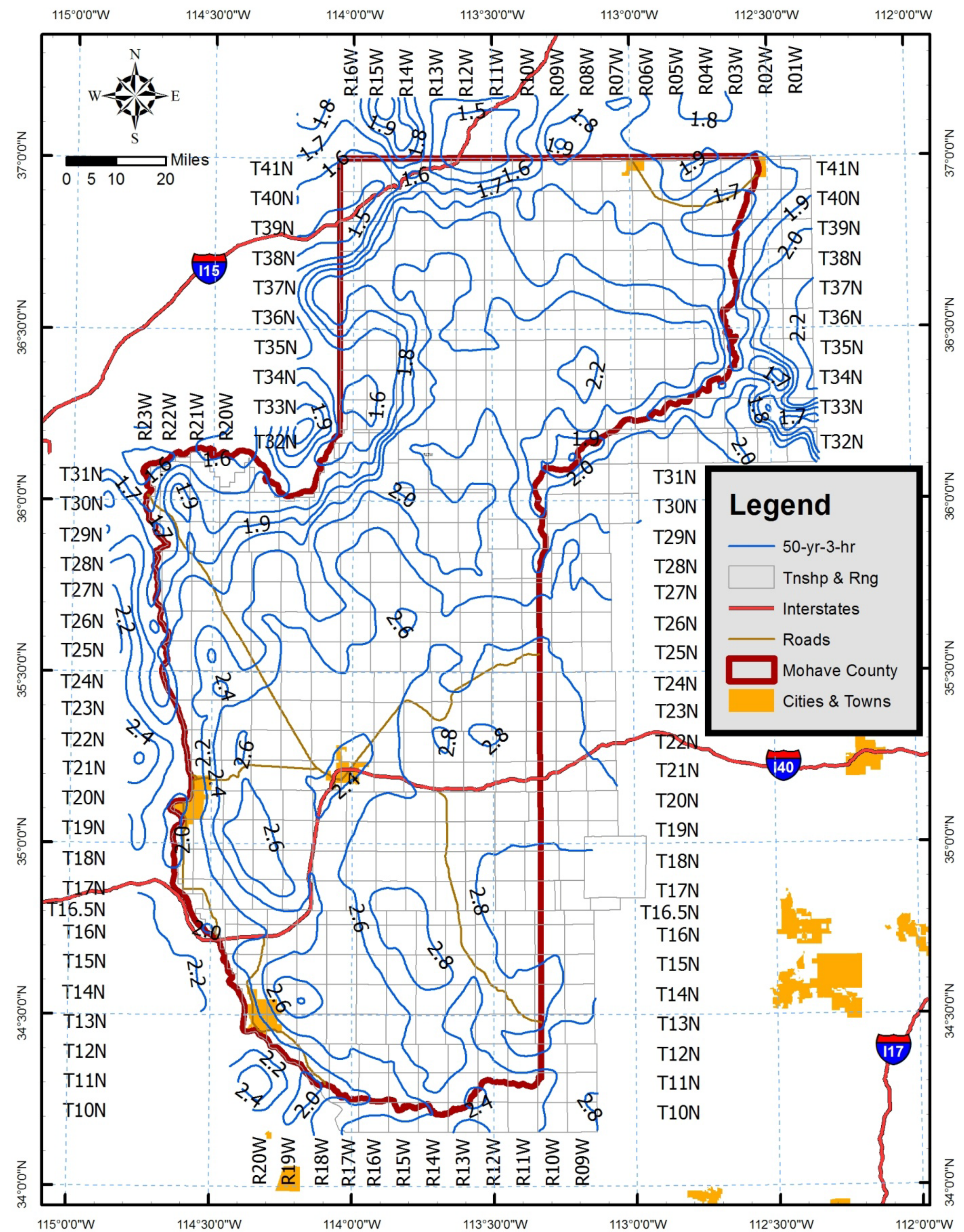


Figure B.48 NOAA Atlas 14 50-year 6-hour isopluvial map

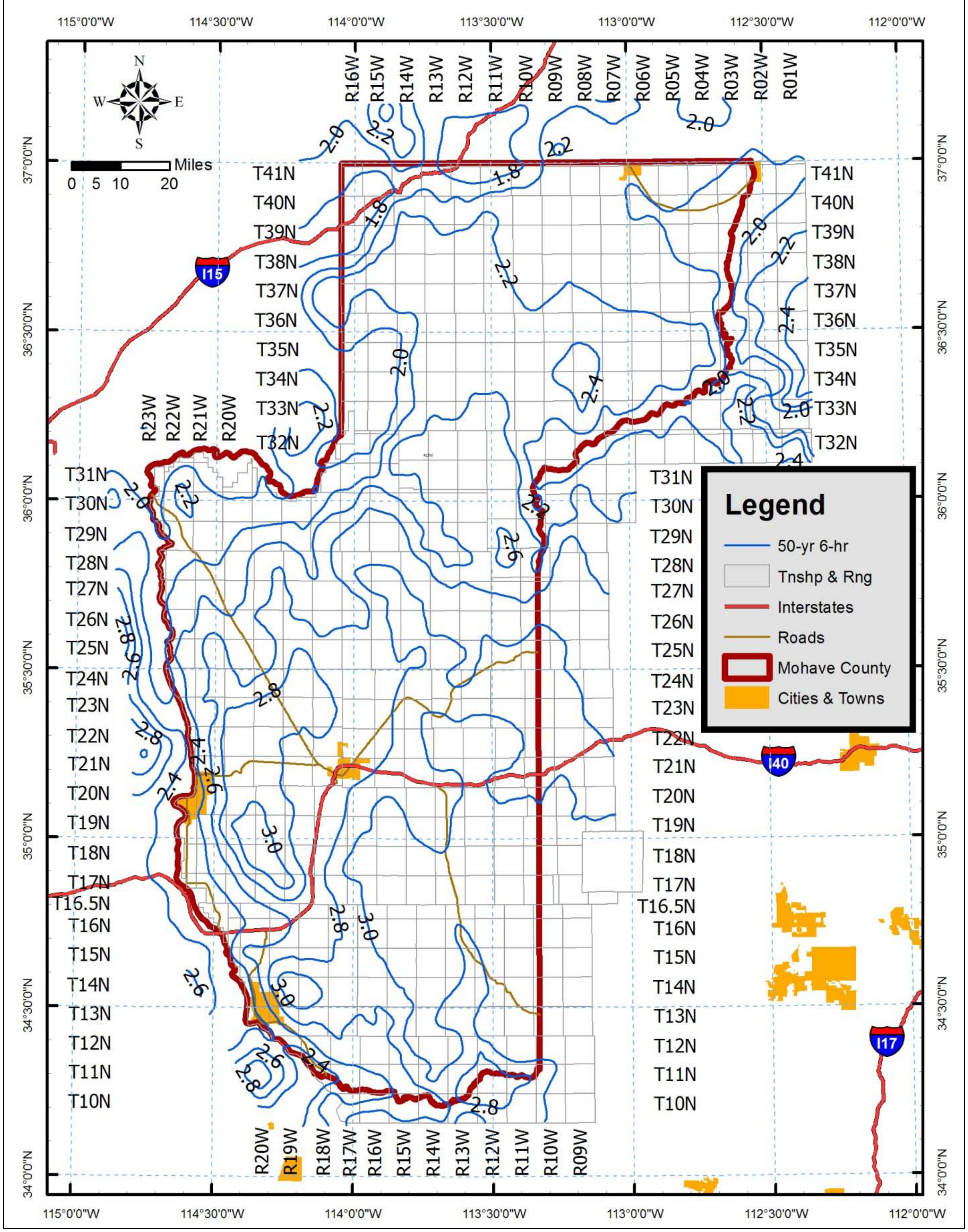


Figure B.49 NOAA Atlas 14 50-year 12-hour isopluvial map

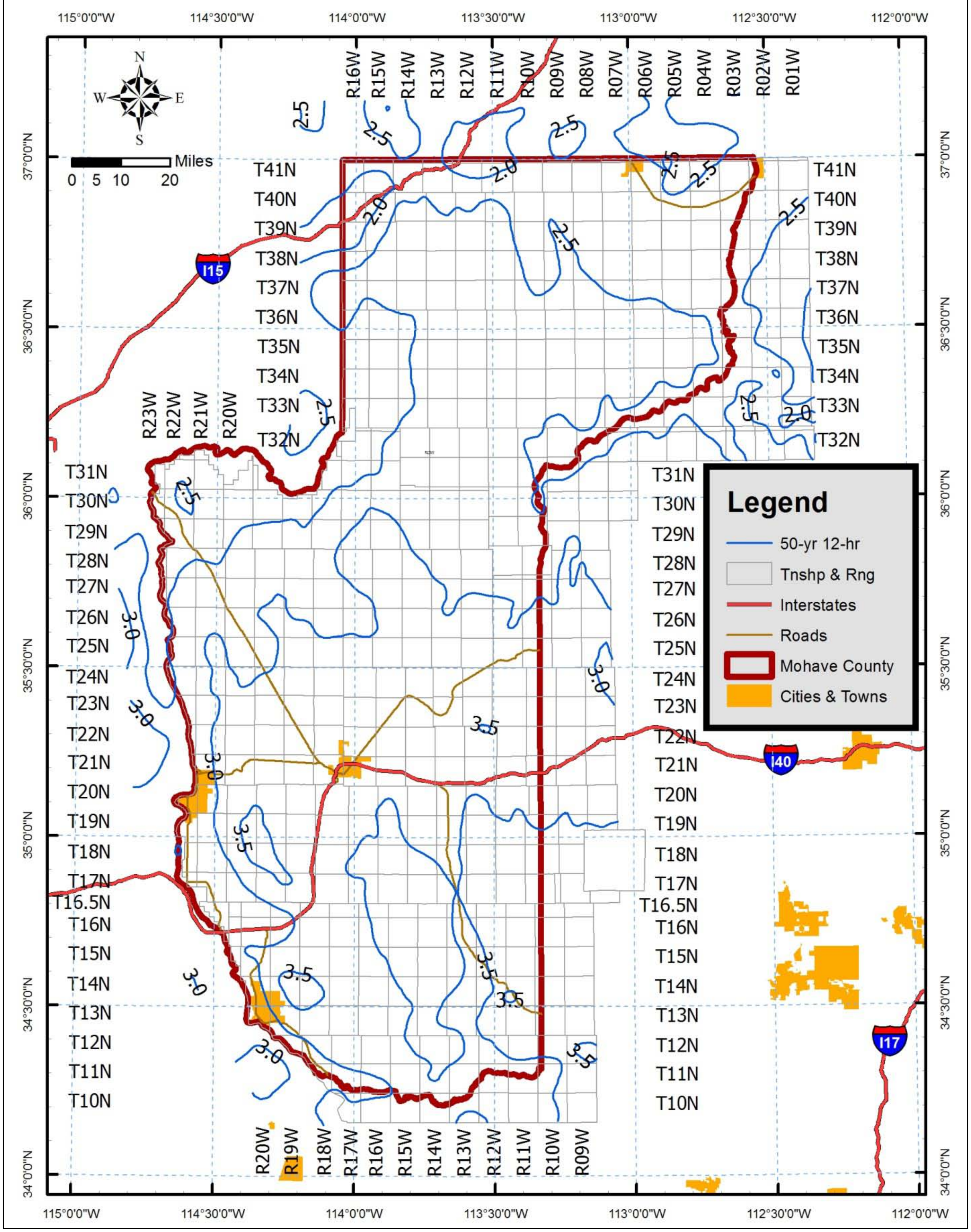
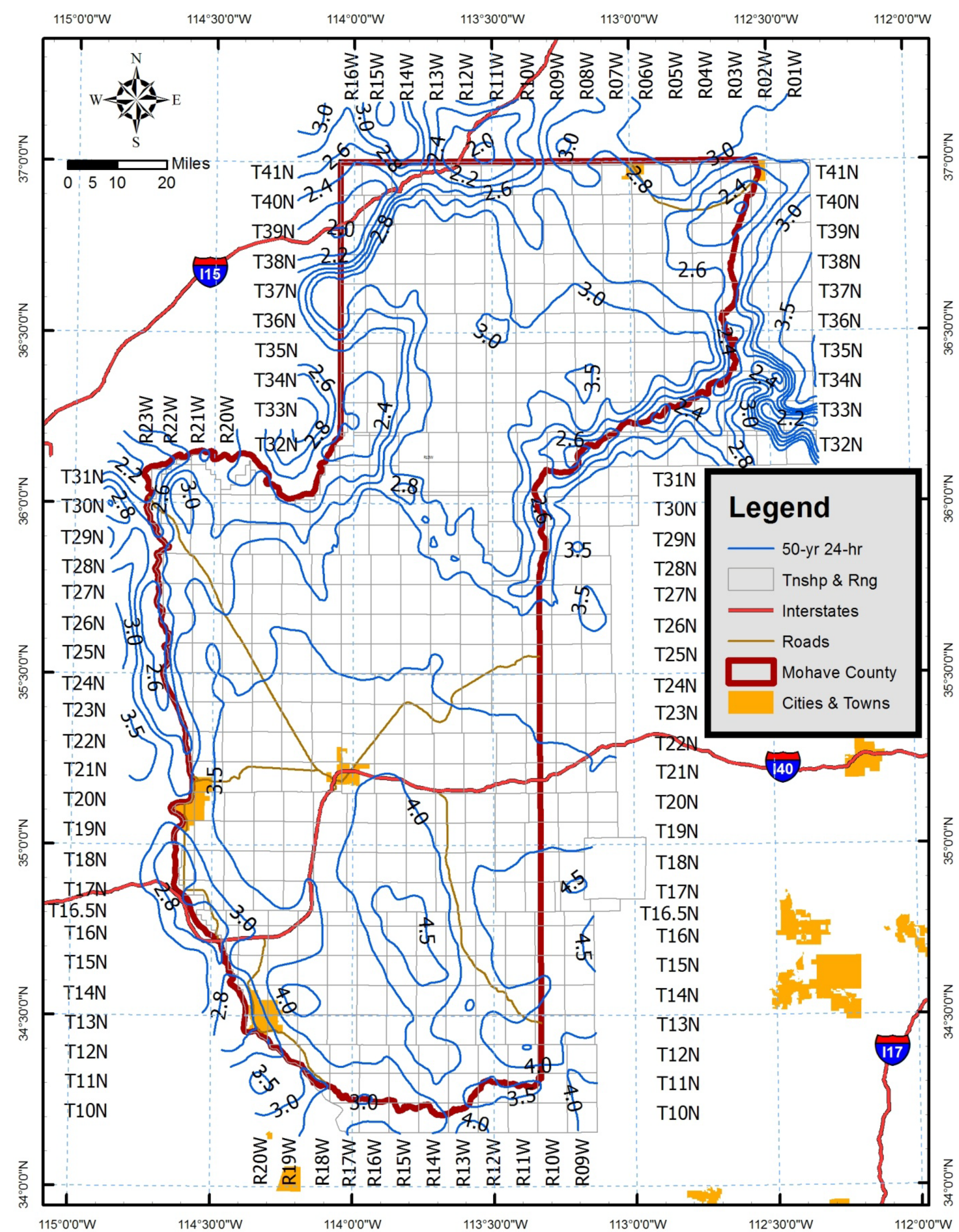


Figure B.50 NOAA Atlas 14 50-year 24-hour isopluvial map



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B.6 100-YEAR STORM ISOPLUVIALS

Figure B.51 NOAA Atlas 14 100-year 5-minute isopluvial map

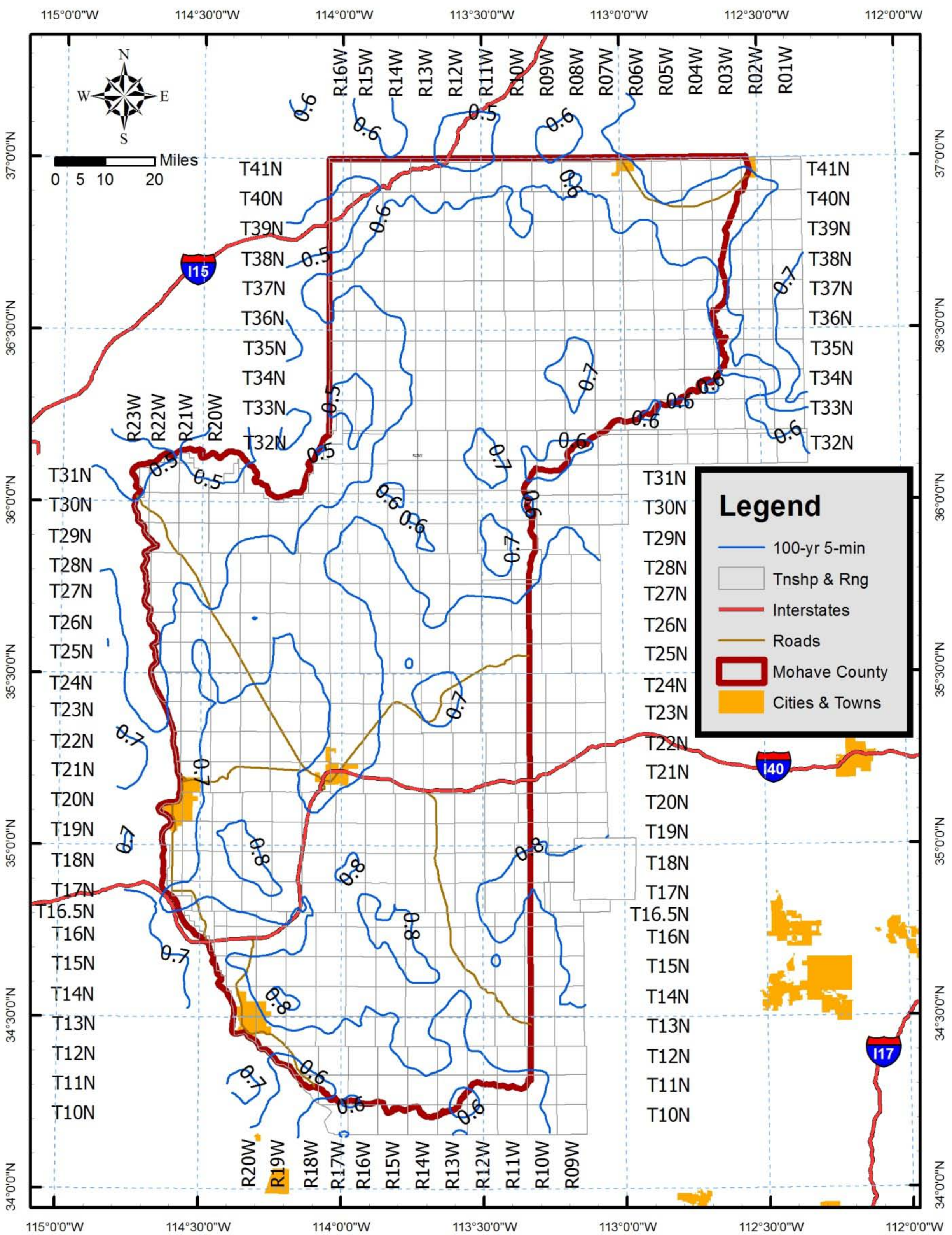


Figure B.52 NOAA Atlas 14 100-year 10-minute isopluvial map

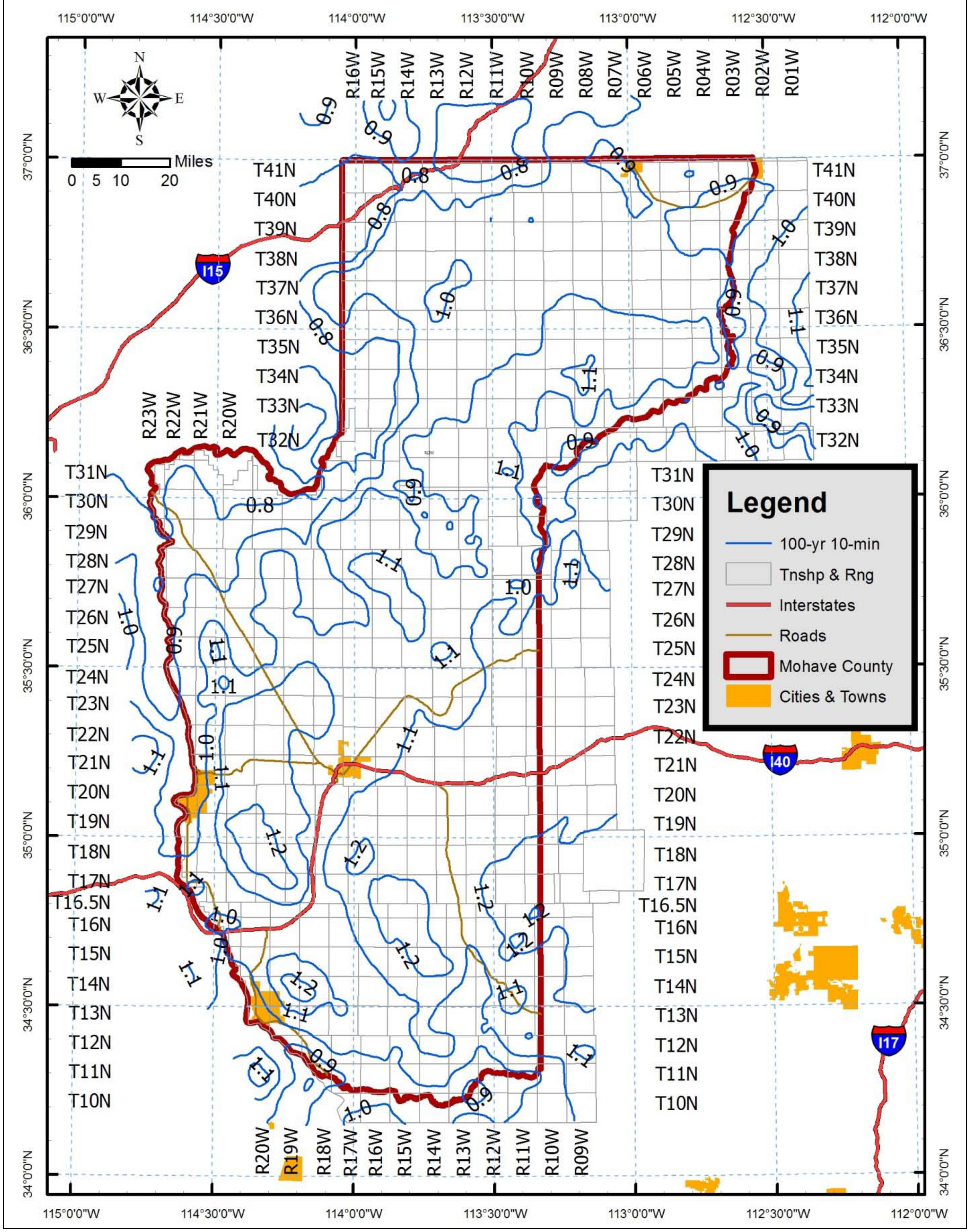


Figure B.53 NOAA Atlas 14 100-year 15-minute isopluvial map

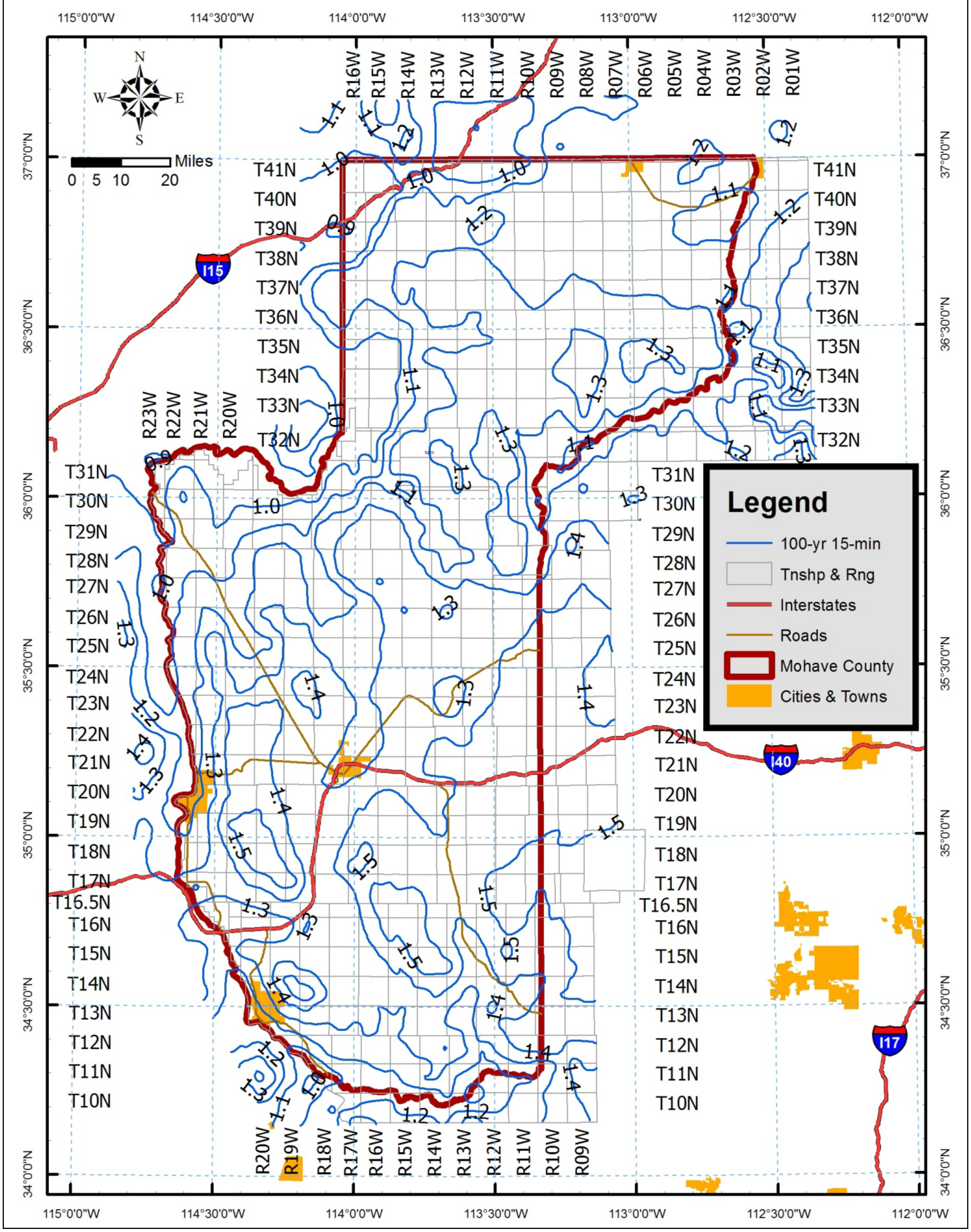


Figure B.54 NOAA Atlas 14 100-year 30-minute isopluvial map

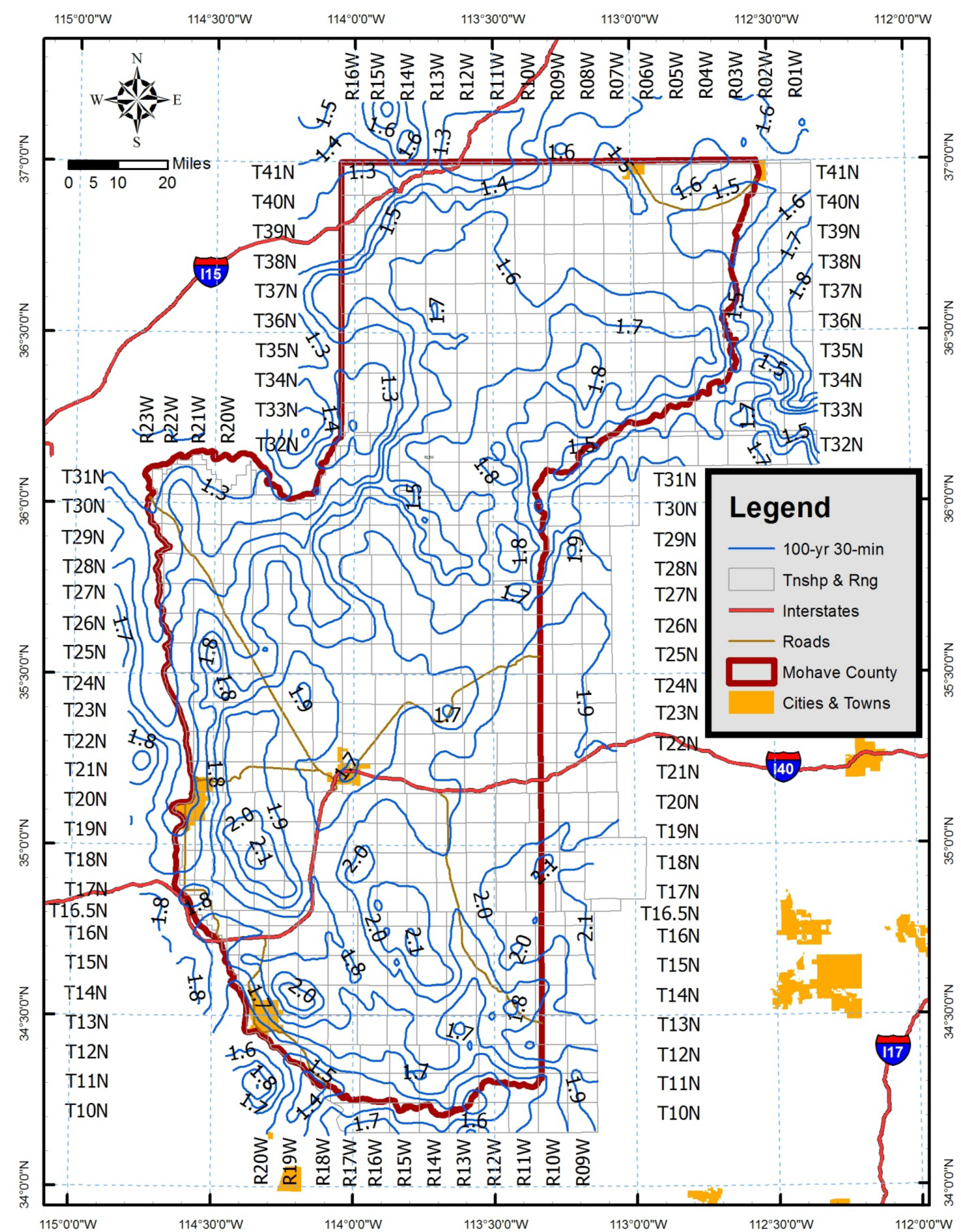


Figure B.55 NOAA Atlas 14 100-year 1-hour isopluvial map

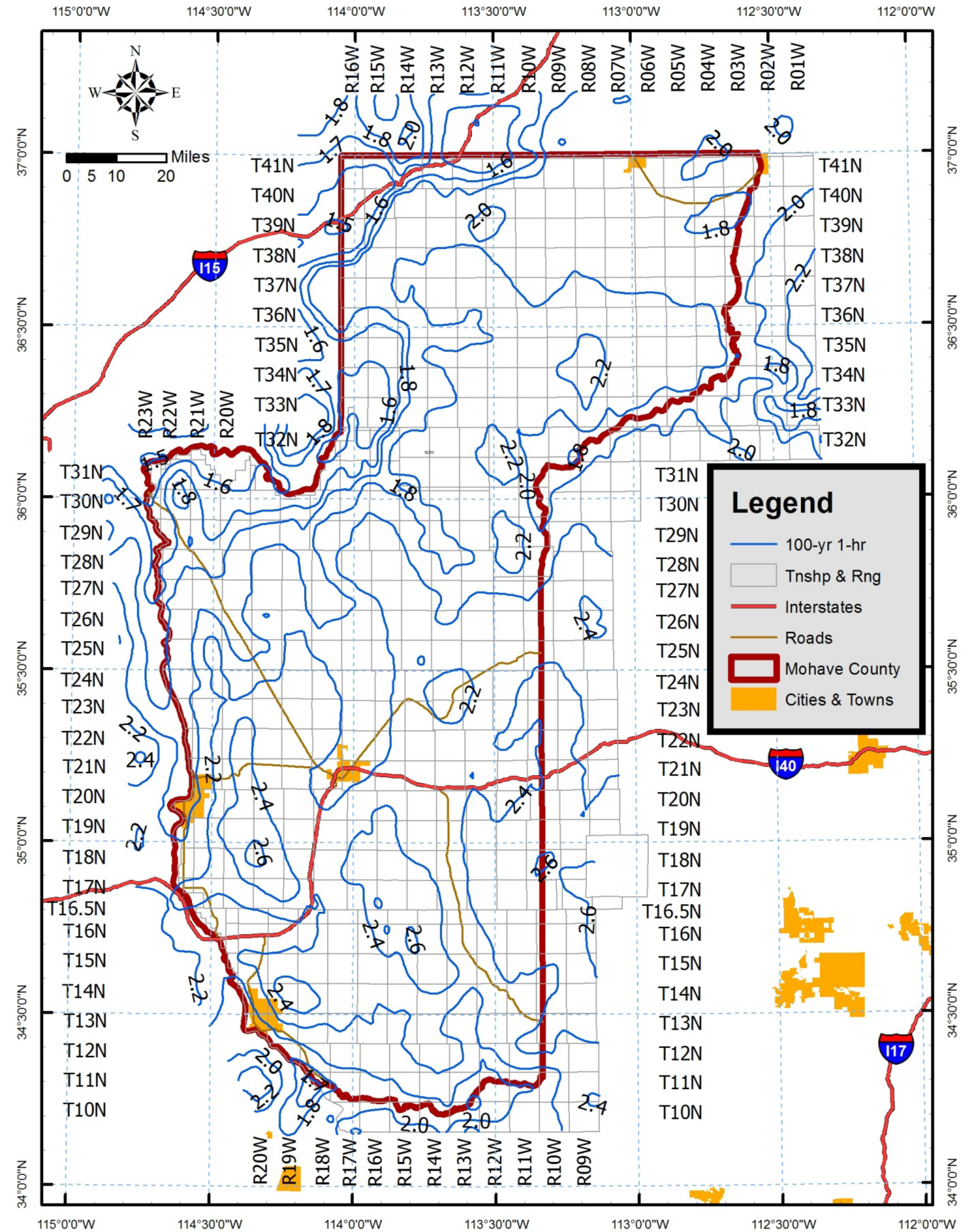


Figure B.56 NOAA Atlas 14 100-year 2-hour isopluvial map

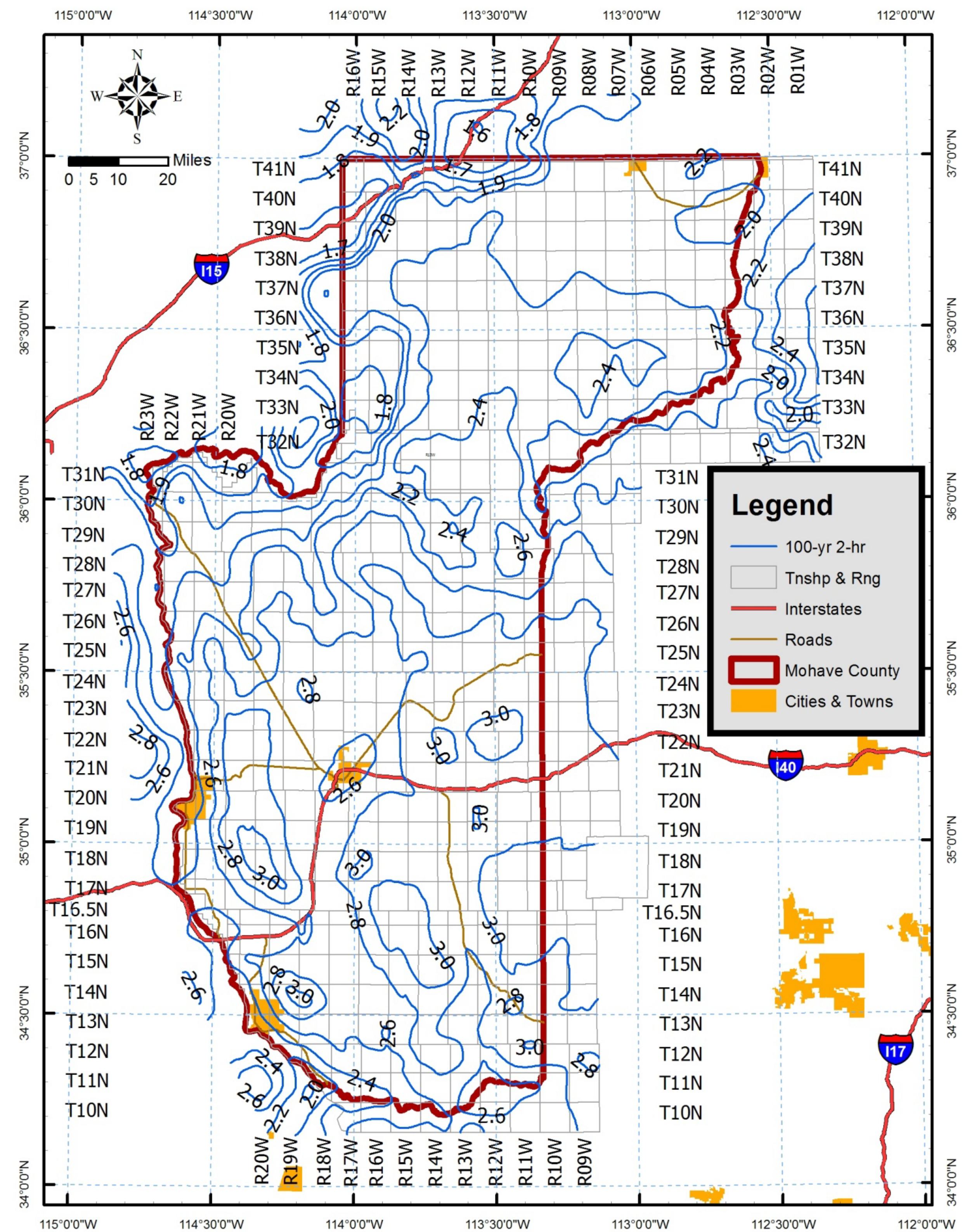


Figure B.57 NOAA Atlas 14 100-year 3-hour isopluvial map

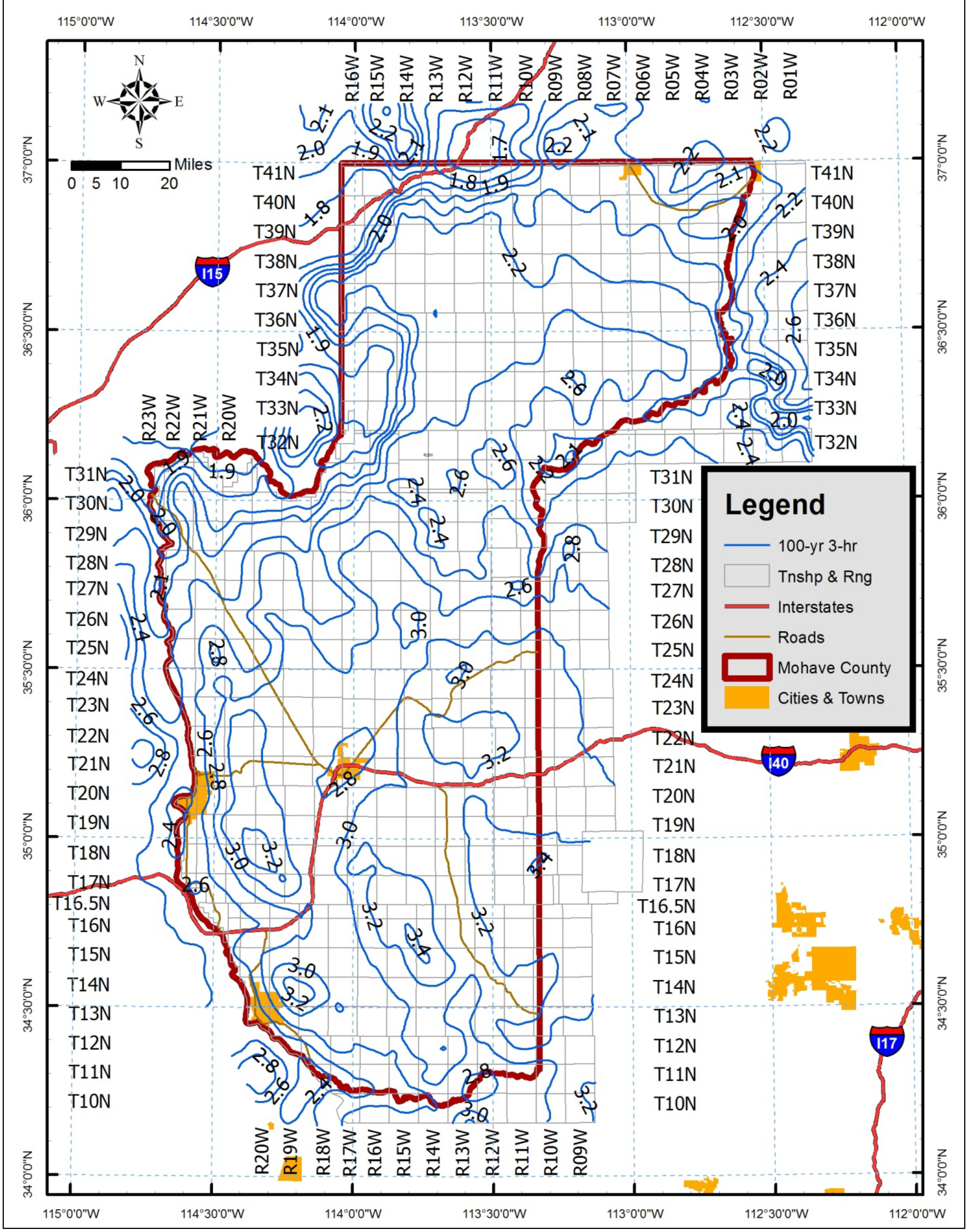


Figure B.58 NOAA Atlas 14 100-year 6-hour isopluvial map

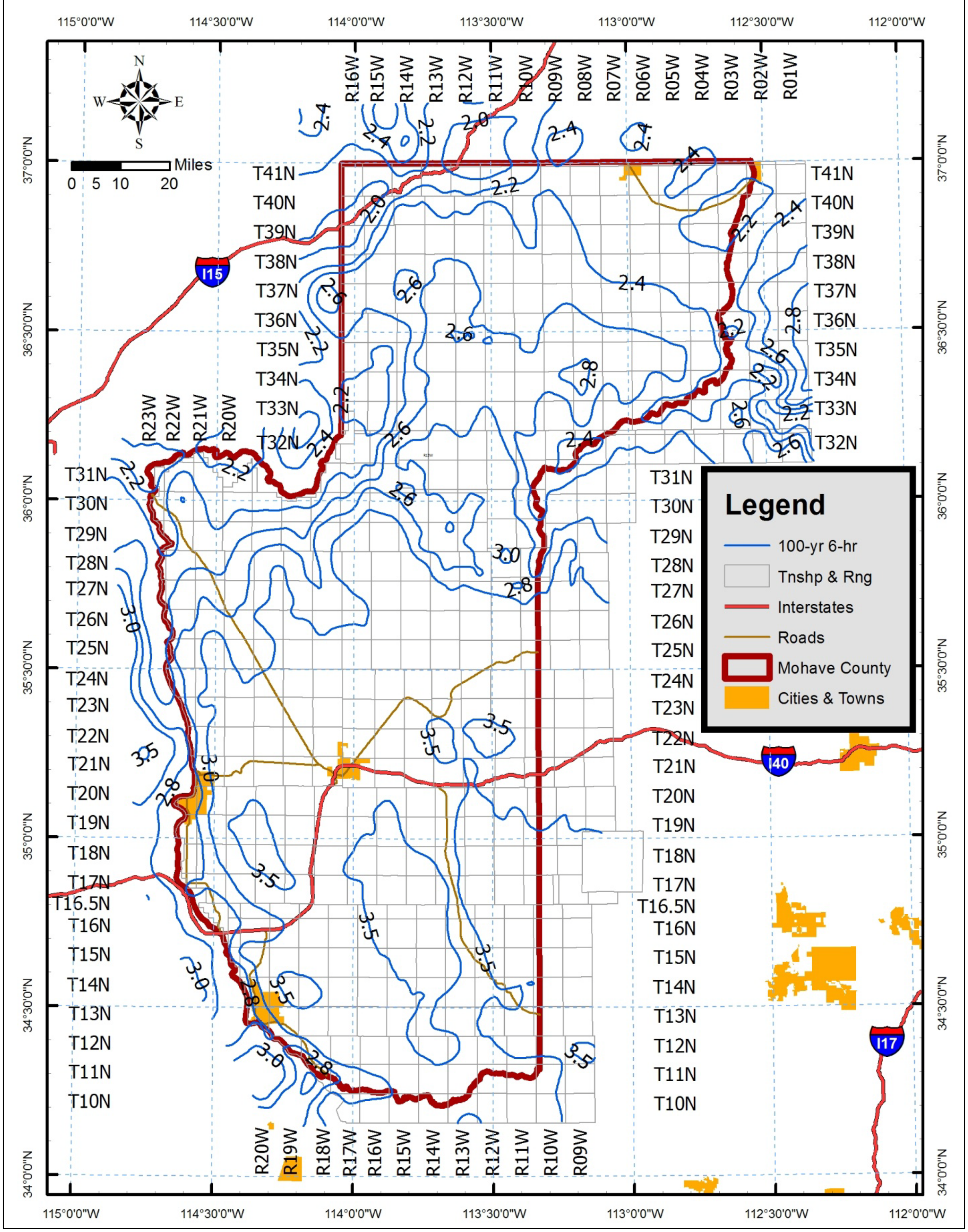


Figure B.59 NOAA Atlas 14 100-year 12-hour isopluvial map

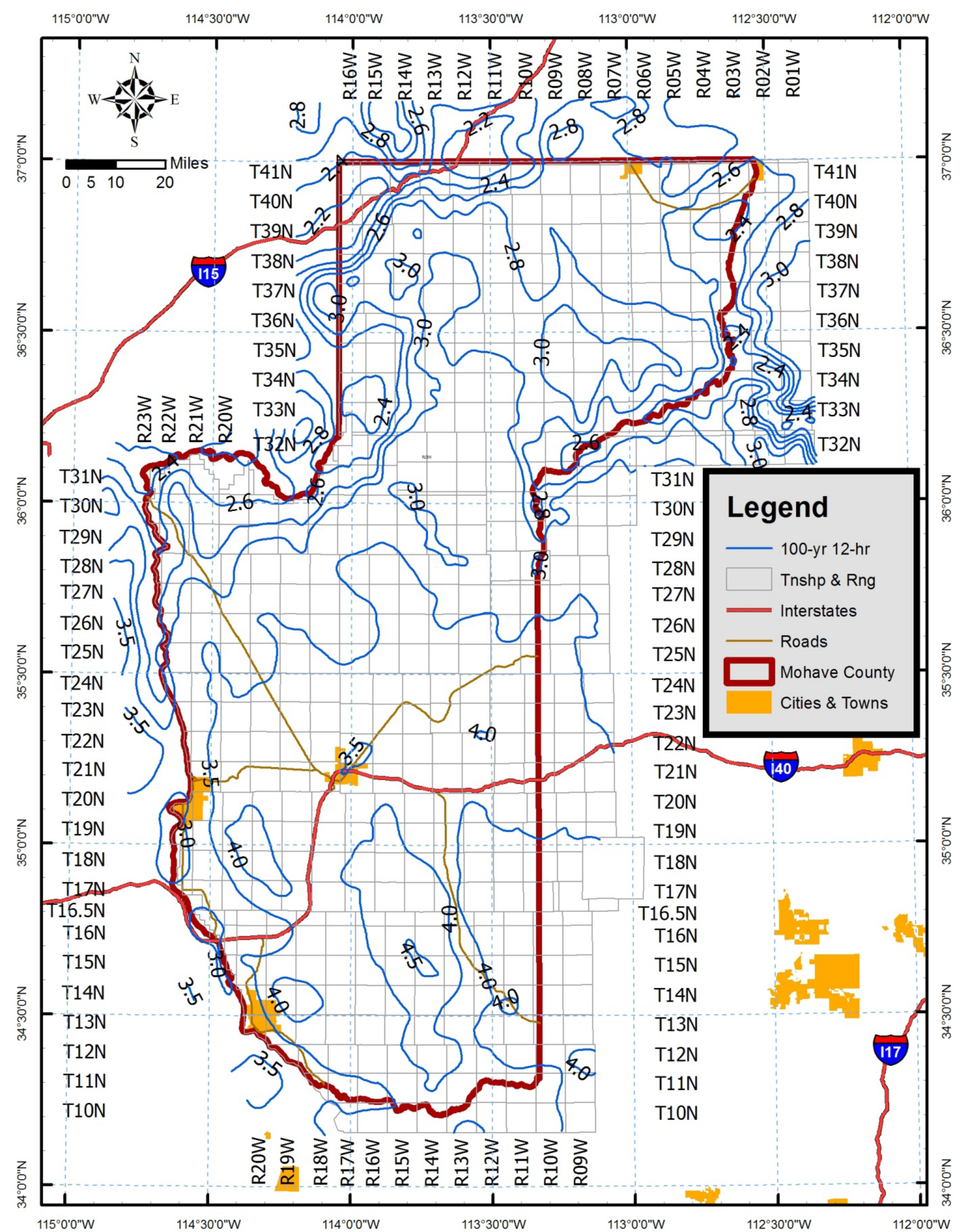
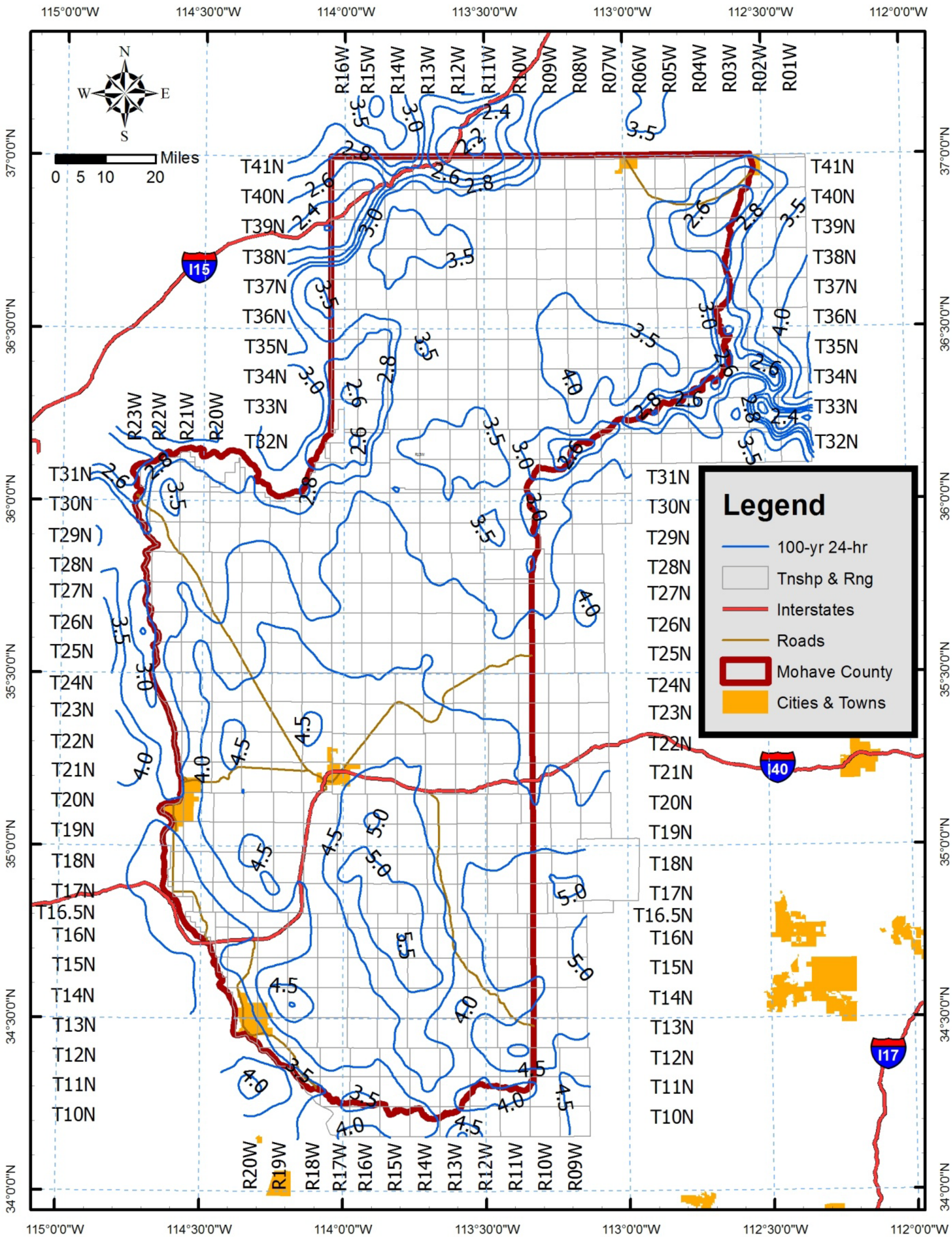


Figure B.60 NOAA Atlas 14 100-year 24-hour isopluvial map



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B.7 RAINFALL FORMS AND GRAPH PAPER

Rainfall Depth-Duration-Frequency Table						
Project No:				Date:		
Project Name:						
Location/Watershed:						
Designer:				Checked by:		
	Rainfall Depth$_{(i,j)}$, in inches					
	Storm Frequency$_{(j)}$, in years					
Duration$_{(i)}$	2	5	10	25	50	100
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5-min						
10-min						
15-min						
30-min						
1-hour						
2-hour						
3-hour						
6-hour						
12-hour						
24-hour						

Rainfall Intensity-Duration-Frequency Table						
Project No:			Date:			
Project Name:						
Location/Watershed:						
Designer:			Checked by:			
Duration$_{(i)}$	**Rainfall Intensity$_{(i,j)}$, in inches/hour**					
	Storm Frequency$_{(j)}$, in years					
	2	**5**	**10**	**25**	**50**	**100**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
5-min						
10-min						
15-min						
30-min						
1-hour						
2-hour						
3-hour						
6-hour						
12-hour						
24-hour						

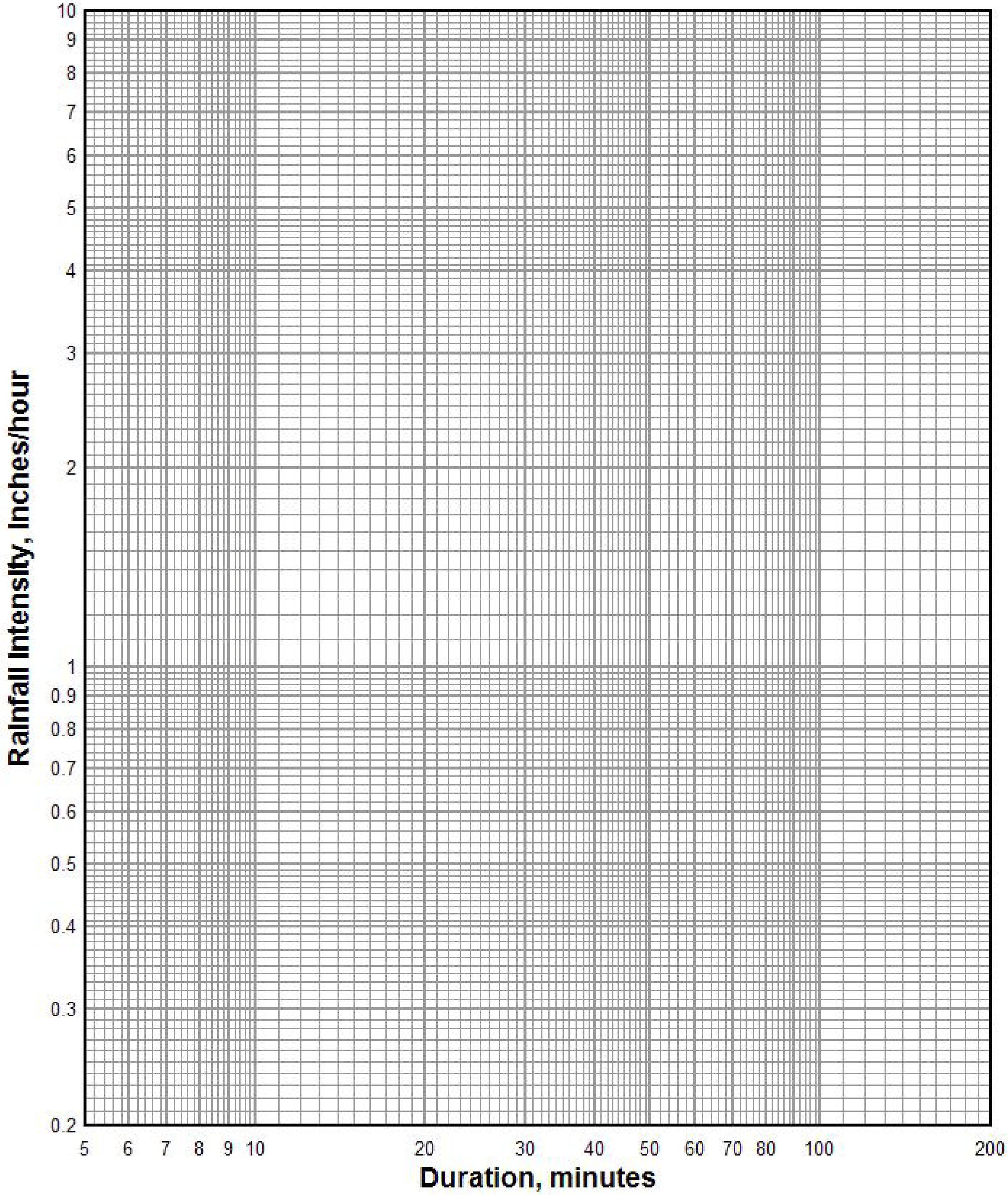
The rainfall intensity is computed as follows: $$Intensity_{(i,j)} = \frac{Depth_{(i,j)}}{(Duration_{(i)})(60)}$$

where:

- Depth$_{(i,j)}$ = Point rainfall corresponding to Duration$_{(i)}$ and Frequency$_{(j)}$ in inches.
- Duration$_{(i)}$ = Duration of point rainfall for Frequency$_{(j)}$ in minutes.
- Intensity$_{(i,j)}$ = Rainfall intensity corresponding to Duration$_{(i)}$ and Frequency$_{(j)}$ in inches/hour.

Figure B.61 Intensity-Duration-Frequency Graph

Location/Watershed:



C. PROCEDURE FOR ESTIMATION OF VEGETATIVE COVER

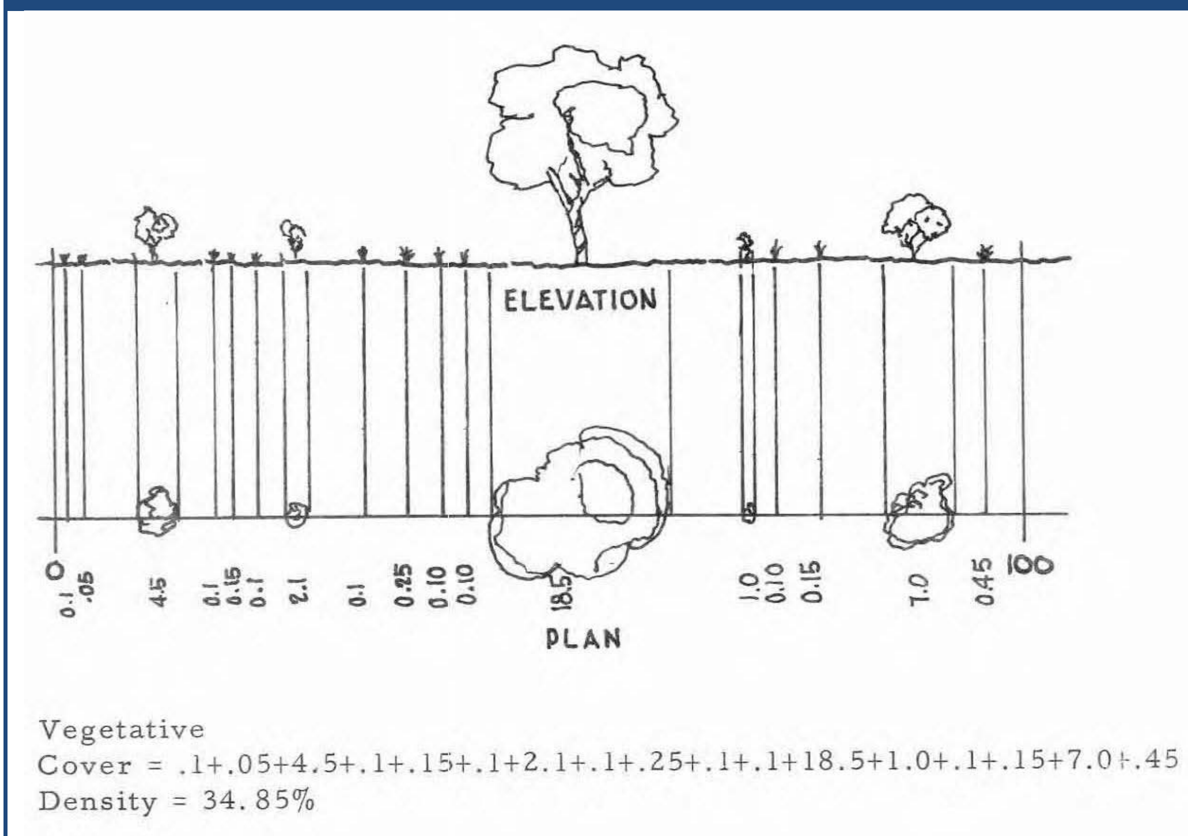
Vegetative cover densities are determined using one or both of the two following methods:

C.1 METHOD 1: PHYSICAL MEASUREMENT

1. An area representing the typical vegetative cover density for the drainage sub-basin or sub-area is selected.
2. A 100 foot chain is stretched out on the ground in a straight line in the area selected.
3. The intercepts of the vegetative canopy along the 100 foot length are noted.
4. The total distances covered by vegetation canopy along the 100 foot length are summed up and repre sent the percent of vegetative cover for the selected area.
5. Several determinations mayhave to be made to compute the average percent of cover for the drainage sub-basin or sub-area.

The following sketch (Jencsok, 1969) illustrates the field procedure:

Figure C.1 Physical measurement of vegetative canopy cover schematic



C.2 METHOD 2: AERIAL PHOTOGRAPH GIS/CAD POLYGONS

Fully rectified and scaled digital aerial photographs of the sub-basins or sub-areas can be used to estimate vegetative canopy cover. The photographs are used to define polygons covering the various areas of visible vegetation using CAD or GIS software. Then the percent coverage area of each sub-basin or sub-area is computed using CAD or GIS tools. This method should be verified and/or calibrated using Method 1 above.

D. RAINFALL LOSSES

D.1 PROCEDURES USED TO ASSIGN G&A PARAMETERS

D.1.1 BASE SOILS DATA

D.1.1.1 Source

The data used for estimation of Green and Ampt parameters was the SSURGO detailed soil survey data obtained from the NRCS. The web site the data was downloaded from is:

http://soildatamart.nrcs.usda.gov/

The information consisted of GIS polygon files in ESRI shape file format, and Microsoft Access format databases for the following soil surveys:

Table D.1 List of soil surveys

ID	Soil Survey Title
AZ623	SHIVWITS AREA, ARIZONA, PART OF MOHAVE COUNTY
AZ625	MOHAVE COUNTY AREA, AZ, NORTHEASTERN PART, AND PART OF COCONINO COUNTY
AZ627	MOHAVE COUNTY, AZ, SOUTHERN PART
AZ629	COCONINO COUNTY AREA, ARIZONA, NORTH KAIBAB PART
AZ631	COCONINO COUNTY AREA, ARIZONA, CENTRAL PART
AZ637	YAVAPAI COUNTY, ARIZONA, WESTERN PART
AZ657	KOFA AREA, ARIZONA, PARTS OF LA PAZ AND YUMA COUNTIES: Use AZ STATSGO clipped to AZ657 boundary.
AZ695	KAIBAB NATIONAL FORESTS, ARIZONA, PARTS OF COCONINO, MOHAVE AND YAVAPAI COUNTIES. Database not available yet. The AZ STATSGO coverages was used and clipped to AZ695 boundary.
AZ697	MOHAVE COUNTY, AZ. CENTRAL PART
AZ699	HUALAPAI-HAVASUPAI AREA, PARTS OF COCONINO, MOHAVE, AND YAVAPAI COUNTIES
AZ701	GRAND CANYON AREA, ARIZONA, PARTS OF COCONINO AND MOHAVE COUNTIES
NV608	VIRGIN RIVER AREA, NEVADA AND ARIZONA
NV613	MEADOW VALLEY AREA, NEVADA AND UTAH

Table D.1 List of soil surveys	
ID	**Soil Survey Title**
NV754	LINCOLN COUNTY, NEVADA, SOUTH PART
NV755	CLARK COUNTY AREA, NEVADA
UT634	IRON-WASHINGTON AREA, UTAH, PARTS OF IRON, KANE,AND WASHINGTON COUNTIES
UT636	PANGUITCH AREA, PARTS OF GARFIELD, IRON, KANE AND PIUTE COUNTIES, UTAH
UT641	WASHINGTON COUNTY AREA, UTAH
UT642	KANE COUNTY, UTAH: : The UT STATSGO coverages was used and clipped to UT642 boundary
UT646	DIXIE NATL.FOREST-PARTS OF GARFIELD,WASHINGTON, IRON,KANE & WAYNE COUNTIES. Database not available yet. The UT STATSGO coverages was used and clipped to UT646 boundary.
UT686	GRAND STAIRCASE - ESCALANTE NATIONAL MONUMENT, PARTS OF KANE AND GARFIELD COUNTIES, UTAH
AZ	ARIZONA GENERAL SOIL SURVEY
UT	UTAH GENERAL SOIL SURVEY

D.1.2 DATA EXTRACTION

The NRCS databases are very complex and contain a large amount of data in numerous tables. The data necessary for computation of Green and Ampt parameters was extracted from each soils database and stored in a new separate database file containing two tables. The procedures used to accomplish this are as follows. Familiarity with Microsoft Access 2003 is required and these instructions are specific to MS Access 2003. MS Access 2007 can also be used but the location of the commands is often slightly different.

1. Populate the NRCS template database with data using the procedures provided by the NRCS.

Create a new empty database named "?????_XKSAT.mdb". Use the NRCS soil survey ID number from Table D.1 in place of the question marks.

Open the NRCS database (soildb_US_2002.mdb).

Create a new Query using the “Simple Wizard” and adding the fields listed below. Name it "Query - XKSAT Computation Data." The table names are critical. A computer program was written to process the data in these databases and it looks for tables with specific names.

	1	2	3	4	5	6
Source	mapunit		component	chtexturegrp	chtexture	

Table:						
Source Field:	musym	muname	compname	texdesc	texcl	lieutex
Description	SMU	Map Unit Name	Component Name	Texture Description	Texture	in lieu Texture

	7	8	9	10	11	12
Source Table:	chorizon					
Source Field:	ksat_r	hzdept_r	hzdepb_r	sandtotal_r	silttotal_r	claytotal_r
Description	KSAT micrometers/s	Horizon, inches		Total Percentage by weight < 2mm		
		Top	Bottom	Sand	Silt	Clay

	13	14	15	16	17	18
Source Table:	chfrags		chorizon			component
Source Field:	fragsize_r	fragvol_r	om_r	dbthirdbar_r	dbovendry_r	mukey
Description	Gravel Size in mm	Percent of total volume	Organic Matter Percent of total volume	Dry Density, g/cc < 2mm 1/3 Bar	Total	Keys Map Unit

	19	20	21	22
Source Table:	component	chtexture	chorizon	chfrags
Source Field:	cokey	chtgkey	chkey	chfragskey
Description	Component	Horizon Texture	Horizon	Horizon Fragments

In "Design View", sort ascending on the fields “musym”, “compname”, “hzdept_r”, and “fragsize_r”.

In "Design View", set criteria for “hzdept_r”: <=6.

In "Design View", select the link between the “chtexture” and “chfrags” tables, right-click on the link, and select “Join Properties”. Set radio button 2, “Include ALL records from ‘chorizon’…”

Save Query.

Go to "Datasheet View". Copy and Paste Query. Rename copy to "Make-Table Query XKSAT Computation Data."

Open the Make-Table Query and enter "Design View".

Click on the "Query Type" icon and select "Make-Table Query." (in Access 2007, click on "Make Table")

Use the "Another Database" option and use table name ="XKSAT". Point to the "????_XKSAT" database file from Step 1.

Save the Query and hit the "Run" icon.

Save the work and open the new "????_XKSAT" database. Explore the database to verify the data was processed correctly.

Re-open the NRCS database.

Create a new Query using the “Simple Wizard” and adding the fields listed below. Name it "Query – SMU Component Percentages."

	1	2	3	4	5	6	7
Source Table:	mapunit		component				mapunit
Source Field:	musym	muname	compname	comppct_r	slope_r	cokey	mukey
Description	SMU	Map Unit Name	Component Name	Component Percentage	Average Slope	Keys Component	Map Unit

In "Design View", sort ascending on the fields “musym” and “compname”.

Save Query and go to "Datasheet View".

Copy and Paste Query. Rename copy to "Make-Table Query SMU Component Percentages."

Open the Make-Table Query and enter Design mode.

Click on the "Query Type" icon and select "Make-Table Query SMU Component Percentages." (in Access 2007, click on "Make Table")

Use the "Another Database" option and use table name ="SMU_Comp". Point to the "????_XKSAT" database file from Step 1.

Save the Query and hit the "Run" icon.

Save the work and open the new "????_XKSAT" database. Explore the database to verify the data was processed correctly.

Create a query named “Query_XKSAT” in the "????_XKSAT" database and populate it with all the fields in the XKSAT table. In "Design View", sort ascending on the fields “musym”, “compname”, “hzdept_r”, and “fragsize_r”. Save and return to "Datasheet View."

Create a query named “Query_SMU” in the "????_XKSAT" database and populate it with all the fields in the SMU_Comp table. In "Design View", sort ascending on the fields “musym” and “compname”. Save and return to "Datasheet View."

Check for records in the XKSAT table (not the Query) for blank “texcl” fields. Assign a texture if possible and appropriate. Leave impervious SMU’s blank. Use Saxton’s equations or program to determine the texture class based on the percent sand and clay if the sand OR clay fields are populated. If sand and clay are not populated, then leave “texcl” blank.

This data was used as described in Appendix D.2.2 below. Note that not all SMU’s and Component soils listed in the SMU_Comp database are included in the XKSAT database. There are a number of miscellaneous soils for which no laboratory data is available. These are addressed in Appendix D.2.5.

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D.2 COMPUTATION OF GREEN AND AMPT PARAMETERS

D.2.1 METHOD

D.2.1.1 General

A summary of the procedures used to compute Green and Ampt parameters follows:

2. The NRCS data is structured as follows:
   a. Soil Map Units (SMU). This is the identifier for a soil type and the name comes from the "musys" field. An SMU is composed of one or more major and minor soil types. The minor soils are neglected for these procedures. Each major soil is called a Component soil with the name coming from the "compname" field. The physical data needed for computation of Green and Ampt parameters and specific to each Component of an SMU is contained in the XKSAT table. The percentages of the area of each Component within each SMU are contained in the SMU_Comp table. Each component soil is made up of vertical soil layers called Horizons. The thickness of each Horizon is measured in inches and the depth to the top and bottom of each Horizon comes from the "hzdept_r" and "hzdepb_r" fields, respectively. The top 6-inches of each Component is evaluated to determine which Horizon is the limiting soil layer for infiltration. The XKSAT value for that layer is used to represent the infiltration ability of that Component.

   Sand, Silt and Clay. The percentage of sand, silt, and clay provided by the NRCS is the percentage by weight of the matric soil (all particles <2mm). This data is provided in fields "sandtotal_r", "silttotal_r", and "claytotal_r".

   Gravel. The gravel size in mm is provided in the field "fragsize_r" and the percentage by volume of the bulk soil in field "fragvol_r". Each Horizon soil contains either none, or one or more gravel size fractions.

Total the gravel for each Horizon. The total gravel volume for each Horizon must be computed by totaling the volumes for the size fractions. There are often multiple duplicate records for each size fraction in the table. The multiple records of a given size fraction are ignored.

Compute XKSAT for each horizon.

Determine the control horizon for each component.

Total RTIMP for each Horizon where multiple records exist.

Compute an area log-averaged value of XKSAT for each SMU.

Assign PSIF and DTHETA values to each SMU based on the relationship to XKSAT equations developed by regression analysis.

D.2.1.2 XKSAT by Sabol 1993

Sabol 1993 references the *Drainage Design Manual for Maricopa County – Hydrology*, by

George V. Sabol, first published in 1993. The relationships between soil texture and saturated hydraulic conductivity, XKSAT, from that publication are used to assign XKSAT to each Component Horizon based on texture. The basis for Sabols' work is a paper by Walter J. Rawls, Donald L. Brakensiek, and Norman Miller titled *Green-Ampt Infiltration Parameters From Soils Data* published in the ASCE Journal of Hydraulic Engineering, Volume 109, Number 1, January 1983.

D.2.1.3 XKSAT by Saxton and Rawls 2005

Saxton and Rawls 2005 references a paper titled *Soil Characteristic Estimates by Texture and Organic Matter for Hydrologic Solutions* by K.E. Saxton and W.J. Rawls. This is continuation of the 1983 work by Rawls, Brakensiek and Miller. XKSAT may now be computed based on the percent volume by weight of sand and clay for a given matric soil, and corrected based on the percentage of gravel and organic matter in the bulk soil, and the relative level of compaction of the bulk soil. The new procedures are based on extensive research using 2,000 A-Horizon and 2,000 B-Horizon samples from the NRCS. The A Horizon is the top soil layer, and the B Horizon the second layer below the surface. These two Horizons cover the top 6-inches of the surface soils, which is the area of concern for this analysis. The new procedure also provides the necessary information to directly computing PSIF and DTHETA for each Horizon using the equations included in Rawls, Brakensiek and Miller (1983). Refer to Appendix D.2.7. The equations used for computation of XKSAT, PSIF and DTHETA and the corrections for gravel content, organic matter and compaction are listed in Appendix D.2.1.4:

D.2.1.4 Green and Ampt Parameters Equations

Wilting Point

```
Predict = -0.024 * Sand + 0.487 * Clay + 0.006 * OrgMat + 0.005 * Sand
* OrgMat - 0.013 * Clay * OrgMat + 0.068 * Sand * Clay + 0.031
WPoint = Predict + (0.14 * Predict - 0.02)
```

Field Capacity

```
Predict = -0.251 * Sand + 0.195 * Clay + 0.011 * OrgMat + 0.006 * Sand
* OrgMat - 0.027 * Clay * OrgMat + 0.452 * Sand * Clay + 0.299
FCapac = Predict + (1.283 * Predict ^ 2 - 0.374 * Predict - 0.015)
```

Saturation

```
Predict = 0.278 * Sand + 0.034 * Clay + 0.022 * OrgMat - 0.018 * Sand *
OrgMat - 0.027 * Clay * OrgMat - 0.584 * Sand * Clay + 0.078
S33 = Predict + (0.636 * Predict - 0.107)
Sat = FCapac + S33 - 0.097 * Sand + 0.043
```

Adjustment for organic matter and compaction

```
DensityO = (1 - Sat) * 2.65
DensityC = DensityO * DensityFactor
PorO = 1 - (DensityC / 2.65)
PorC = PorO - (1 - DensityO / 2.65)
M33C = FCapac + 0.25 * PorC
PM33C = PorO - M33C
If PM33C < 0 Then PM33C = 0
```

XKSAT CALCULATION

```
Gadj = (1 - Gravel) / (1 - Gravel * (1 - 1.5 * ((DensityC) / 2.65)))
B = (Math.Log(1500) - Math.Log(33)) / (Math.Log(M33C) -
Math.Log(WPoint))
A = Math.Exp(Math.Log(33) + (B * Math.Log(M33C)))
Lamda = 1 / B
XKSAT = 1930 * (PM33C ^ (3 - Lamda)) * 0.0393700787 * Gadj
sngKsCF = CSng(frmOptions.txtKsCF.Text)
XKSAT = XKSAT * sngKsCF
If XKSAT < 0.01 Then
    XKSAT = 0.01
End If
```

DTHETA(dry And normal)CALCULATION

```
DTHETAdry = Sat - WPoint
DTHETAnormal = Sat - FCapac
```

PSIF CALCULATIONS

```
BubblingPressure = -21.674 * Sand - 27.932 * Clay - 81.975 * PM33C +
71.121 * Sand * PM33C + 8.294 * Clay * PM33C + 14.05 * Sand * Clay +
27.161
BPadj = BubblingPressure + (0.02 * BubblingPressure ^ 2 - 0.113 *
BubblingPressure - 0.7)
If BubblingPressure >= 0 Then
    PSIF = (2 * Lamda + 3) / (2 * Lamda + 2) * BubblingPressure / 2 *
4.014630787
Else
    PSIF = -999
End If
If BPadj >= 0 Then
    PSIFadj = (2 * Lamda + 3) / (2 * Lamda + 2) * BPadj / 2 *
4.014630787
Else
    PSIFadj = -999
End If
PSIFscp = Math.Exp(6.53 - 7.326 * PorO + 0.00158 * (Clay * 100) ^ 2 +
3.809 * PorO ^ 2 + 0.000344 * Sand * 100 * Clay * 100 - 0.04989 * Sand
* 100 * PorO + 0.0016 * (Sand * 100) ^ 2 * PorO ^ 2 + 0.0016 * (Clay *
100) ^ 2 * PorO ^ 2 - 0.0000136 * (Sand * 100) ^ 2 * Clay - 0.00348 *
(Clay * 100) ^ 2 * PorO - 0.000799 * (Sand * 100) ^ 2 * PorO) *
0.393700787
```

The documentation for Saxton and Rawls 2005 is found at:

http://hydrolab.arsusda.gov/SPAW/Index.htm

The documentation is included as a part of the SPAW computer program available on that web page. A spreadsheet available as a part of the "Soil Water Characteristics" portion of the SPAW download from this website can be used to check the computations made using these equations.

D.2.2 COMPUTATION OF PARAMETERS FOR EACH HORIZON

There is an Adobe PDF file provided that contains the data used for computation of the Green and Ampt parameters for each soil survey area. The file is available upon request to Mohave County Flood Control District. The PDF file contains groups of data by NRCS Soil Survey descriptioned as listed in Table D.2

Table D.2 List of summary results files

Number	File Name	Description
1	Study ID_NRCS XKSAT	Contains the data from the NRCS Soil Survey database tables used for computation of XKSAT, DTHETA, and PSIF.
2	Study ID _NRCS SMU Components	Contains the Component percentages from the NRCS component database table for each SMU.
3	Study ID _All Horizons XKSAT	Contains a list of all Horizons with the gravel volumes totaled, including the computed XKSAT, PSIF and DTHETA values from both methods.
4	Study ID _Control Horizons Sabol	Contains a listing of the results of the determination of the control Horizon for each Component based on the Sabol 1993 method.
5	Study ID _Control Horizons 2005	Contains a listing of the results of the determination of the control Horizon for each Component based on the Saxton and Rawls 2005 method.
6	Study ID _Composite XKSAT	Contains the computed area log-averaged values of XKSAT for each SMU for both the Sabol 1993 and Saxton and Rawls 2005 methods.

D.2.3 COMPUTING GREEN AND AMPT PARAMETERS FOR EACH COMPONENT HORIZON

The data in File 1 was used to create File 3. The gravel volumes for each horizon were totaled, and XKSAT, PSIF and DTHETA computed. The XKSAT 2005 values are based on a maximum of 50% gravel, 8% organic matter, and a density factor of 1.0 for natural land uses and 1.1 for developed land uses.

XKSAT assigned using Sabol 1993 was done using the values in Table D.3. No adjustments were made based on adjectives to the soil texture classification, such as “fine”, “very fine”, “gravelly” or “very gravelly”.

Table D.3 Green and Ampt parameters as a function of soil texture

(Source: Sabol, 1993)

Soil Texture Classification (1)	XKSAT inches/hour (2)	PSIF inches (3)	DTHETA[1] Dry (4)	DTHETA[1] Normal (5)	DTHETA[1] Saturated (6)
loamy sand & sand	1.20	2.4	0.35	0.30	0
sandy loam	0.40	4.3	0.35	0.25	0
loam	0.25	3.5	0.35	0.25	0
silty loam	0.15	6.6	0.40	0.25	0
silt	0.10	7.5	0.35	0.15	0
sandy clay loam	0.06	8.6	0.25	0.15	0
clay loam	0.04	8.2	0.25	0.15	0
silty clay loam	0.04	10.8	0.30	0.15	0
sandy clay	0.02	9.4	0.20	0.10	0
silty clay	0.02	11.5	0.20	0.10	0
clay	0.01	12.4	0.15	0.05	0

otes:

Selection of DTHETA

Dry = Nonirrigated lands, such as desert and rangeland;

Normal = Irrigated lawn, turf, and permanent pasture;

Saturated = Irrigated agricultural land.

D.2.4 DETERMINING THE CONTROL HORIZON FOR EACH COMPONENT SOIL

The control horizon for each Component is listed in Files 4 and 5, for the Sabol 1993 and Saxton and Rawls 2005 methods, respectively. The assignments were made using the data in File 3. The Horizon with the lowest value of XKSAT was selected as the control Horizon.

D.2.5 MISCELLANEOUS COMPONENT SOILS

The miscellaneous component soils were addressed before computing the composite values of XKSAT. A list of missing component soil types from the soil surveys evaluated is shown in Table D.5. A texture class was assigned for each missing Component using one of three approaches:

1. If the Component was listed in another soil survey, the texture was assigned based on that survey.
2. The NRCS Soil Taxonomy Handbook was consulted and the assignment made based on the typical texture for the soil order corresponding to that Component.
3. If methods 1 or 2 above could not be used, then the texture was assigned based on engineering judgment.

Assignment of XKSAT for both the Sabol 1993 and Saxton and Rawls 2005 methods was made using the assigned texture and the values in Table D.6.

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ	s289	rock outcrop
AZ	s293	rock outcrop
AZ	s294	rock outcrop
AZ	s295	rock outcrop
AZ	s314	rock outcrop
AZ	s315	rock outcrop
AZ	s316	rock outcrop
AZ	s317	rock outcrop
AZ	s318	rock outcrop
AZ	s318	torriorthents
AZ	s327	rock outcrop
AZ	s327	torriorthents
AZ	s329	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ	s330	rock outcrop
AZ	s334	rock outcrop
AZ	s335	rock outcrop
AZ	s337	riverwash
AZ	s337	rock outcrop
AZ	s337	typic torrifluvents
AZ	s338	rock outcrop
AZ	s339	rock outcrop
AZ	s340	torriorthents
AZ	s341	rock outcrop
AZ	s341	torriorthents
AZ	s342	rock outcrop
AZ	s344	badland
AZ	s344	rock outcrop
AZ	s345	rock outcrop
AZ	s345	typic torriorthents
AZ	s347	torriorthents
AZ	s351	rock outcrop
AZ	s356	rock outcrop
AZ	s362	cinder land
AZ	s362	lava flows
AZ	s362	rock outcrop
AZ	s364	rock outcrop
AZ	s364	ustic torriorthents
AZ	s366	rock outcrop
AZ	s366	ustic haplargids
AZ	s367	rock outcrop
AZ	s368	rock outcrop
AZ	s368	ustic haplargids
AZ	s369	rock outcrop
AZ	s372	rock outcrop
AZ	s375	rock outcrop
AZ	s383	rock outcrop
AZ	s383	ustic torriorthents
AZ	s384	badland
AZ	s384	rock outcrop
AZ	s384	torriorthents
AZ	s385	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ	s390	rock outcrop
AZ	s392	rock outcrop
AZ	s393	rock outcrop
AZ	s394	rock outcrop
AZ	s398	rock outcrop
AZ	s402	rock outcrop
AZ	s403	rock outcrop
AZ	s404	rock outcrop
AZ	s407	rock outcrop
AZ	s408	rock outcrop
AZ	s410	rock outcrop
AZ	s411	rock outcrop
AZ	s412	rock outcrop
AZ	s415	rock outcrop
AZ	s420	rock outcrop
AZ	s429	rock outcrop
AZ	s435	rock outcrop
AZ	s436	rock outcrop
AZ	s440	rock outcrop
AZ	s441	rock outcrop
AZ	s449	rock outcrop
AZ	s450	ustorthents
AZ	s451	badland
AZ	s453	badland
AZ	s454	badland
AZ	s455	lithic ustorthents family
AZ	s455	rock outcrop
AZ	s457	rock outcrop
AZ	s461	rock outcrop
AZ	s464	rock outcrop
AZ	s467	rock outcrop
AZ	s468	badland
AZ	s471	rock outcrop
AZ	s472	rock outcrop
AZ	s474	rock outcrop
AZ	s478	rock outcrop
AZ	s479	rock outcrop
AZ	s481	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ	s482	rock outcrop
AZ	s489	rock outcrop
AZ	s492	rock outcrop
AZ	s495	badland
AZ	s495	torriorthents
AZ	s499	rock outcrop
AZ	s1126	rock outcrop
AZ	s1126	rubble land
AZ	s1129	badland
AZ	s1131	lava flows
AZ	s1131	rock outcrop
AZ	s1131	rubble land
AZ	s1422	rock outcrop
AZ	s5068	rock outcrop
AZ	s5085	rock outcrop
AZ	s5087	rock outcrop
AZ	s5168	rock outcrop
AZ	s5169	rock outcrop
AZ	s5170	rock outcrop
AZ	s5177	rock outcrop
AZ	s5315	rock outcrop
AZ	s5325	rock outcrop
AZ	s5333	rock outcrop
AZ	s5396	rock outcrop
AZ	s5573	alluvial land
AZ	s5573	badland
AZ	s5573	riverwash
AZ	s5573	water
AZ	s5575	rock outcrop
AZ	s5576	rock outcrop
AZ	s5578	badland
AZ	s5578	riverwash
AZ	s5578	torrifluvents
AZ	s5579	alluvial land
AZ	s5579	badland
AZ	s5580	badland
AZ	s5580	rock land
AZ	s5581	badland

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ	s5581	haplocalcids
AZ	s5581	rock outcrop
AZ	s5581	torriorthents
AZ	s5586	rock outcrop
AZ	s5587	rock outcrop
AZ	s5588	badland
AZ	s5588	rock outcrop
AZ	s5590	badland
AZ	s5590	rock outcrop
AZ	s5592	rock outcrop
AZ	s5742	badland
AZ	s5742	riverwash
AZ	s5742	rough broken land
AZ	s7770	rock outcrop
AZ	s7771	rock outcrop
AZ	s7774	badland
AZ	s7774	rock outcrop
AZ	s8184	badland
AZ	s8184	rock outcrop
AZ	s8187	cinder land
AZ	s8187	gullied land
AZ	s8187	rock outcrop
AZ	s8196	rock outcrop
AZ	s8197	rock outcrop
AZ	s8198	rock outcrop
AZ	s8369	water
AZ	s9582	rock outcrop
AZ	s9583	badland
AZ	s9583	rock outcrop
AZ	s9583	torriorthents
AZ	s9584	rock outcrop
AZ623	6	badland
AZ623	10	rock outcrop
AZ623	17	rock outcrop
AZ623	20	rock outcrop
AZ623	28	badland
AZ623	32	gypsiorthids
AZ623	34	rock outcrop

Table D.4 List of miscellaneous component soils		
NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ623	42	rock outcrop
AZ623	45	rock outcrop
AZ623	45	torriorthents
AZ623	51	rock outcrop
AZ623	52	rock outcrop
AZ623	55	rock outcrop
AZ623	56	rock outcrop
AZ623	57	rock outcrop
AZ623	64	riverwash
AZ623	64	torrifluvents
AZ623	65	rock outcrop
AZ623	74	rock outcrop
AZ623	78	calciorthids
AZ623	78	rock outcrop
AZ623	78	torriorthents
AZ623	80	rock outcrop
AZ623	84	rock outcrop
AZ623	86	rock outcrop
AZ623	87	rock outcrop
AZ623	93	rock outcrop
AZ623	94	rock outcrop
AZ625	1	badland
AZ625	1	badland
AZ625	6	rock outcrop
AZ625	15	gypsiorthids
AZ625	26	lava flows
AZ625	51	riverwash
AZ625	63	rock outcrop
AZ625	63	torriorthents
AZ625	64	rock outcrop
AZ625	64	torriorthents
AZ625	65	torriorthents
AZ625	65	rock outcrop
AZ625	70	rock outcrop
AZ627	1	rock outcrop
AZ627	1	rubble land
AZ627	2	rock outcrop
AZ627	2	rubble land

Table D.4 List of miscellaneous component soils		
NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ627	8	rock outcrop
AZ627	9	riverwash
AZ627	10	riverwash
AZ627	20	riverwash
AZ627	21	riverwash
AZ627	22	riverwash
AZ627	25	rock outcrop
AZ627	26	rock outcrop
AZ627	27	rock outcrop
AZ627	40	rock outcrop
AZ627	40	rubble land
AZ627	41	rock outcrop
AZ627	42	rock outcrop
AZ627	48	rock outcrop
AZ627	49	rock outcrop
AZ627	55	rock outcrop
AZ627	58	rock outcrop
AZ627	62	rock outcrop
AZ627	63	rock outcrop
AZ627	63	rubble land
AZ627	69	riverwash
AZ627	70	riverwash
AZ627	73	rock outcrop
AZ627	74	rock outcrop
AZ627	75	rock outcrop
AZ627	79	marshes
AZ627	90	rock outcrop
AZ627	92	rock outcrop
AZ627	93	rock outcrop
AZ627	94	rock outcrop
AZ627	95	rock outcrop
AZ627	95	rubble land
AZ627	96	rock outcrop
AZ627	96	rubble land
AZ627	102	fluvaquents
AZ627	102	riverwash
AZ627	103	rock outcrop
AZ627	104	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ627	105	rock outcrop
AZ627	106	rock outcrop
AZ627	107	rock outcrop
AZ627	108	torriorthents
AZ627	109	torriorthents
AZ627	117	rock outcrop
AZ627	119	torriorthents
AZ627	120	torriorthents
AZ627	127	water
AZ627	132	rock outcrop
AZ627	133	rock outcrop
AZ627	134	rock outcrop
AZ627	137	rock outcrop
AZ627	138	rock outcrop
AZ629	6	rock outcrop
AZ629	9	torriorthents
AZ629	30	rock outcrop
AZ629	40	pits borrow
AZ629	41	rock outcrop
AZ629	42	rock outcrop
AZ629	43	rock outcrop
AZ629	43	torriorthents
AZ629	47	torriorthents
AZ629	48	rock outcrop
AZ629	48	torriorthents
AZ629	50	rock outcrop
AZ629	53	water
AZ631	5	torriorthents
AZ631	5	badland
AZ631	12	rock outcrop
AZ631	19	rock outcrop
AZ631	20	rock outcrop
AZ631	23	lava flows
AZ631	36	riverwash
AZ631	48	rock outcrop
AZ631	50	torrifluvents
AZ631	64	rock outcrop
AZ631	65	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ631	67	rock outcrop
AZ631	73	water
AZ637	AwE	rock outcrop
AZ637	Ba	badland
AZ637	BoF	rock outcrop
AZ637	CnC	rock outcrop
AZ637	CnF	rock outcrop
AZ637	CvB	loamy alluvial land
AZ637	DrC	rock outcrop
AZ637	FaC	rock outcrop
AZ637	JaC	rock outcrop
AZ637	JaD	rock outcrop
AZ637	Lh	rock outcrop
AZ637	LvE	rock land
AZ637	LxD	rock outcrop
AZ637	MkF	rock outcrop
AZ637	MoD	rock outcrop
AZ637	Ro	rock land
AZ637	Rr	rock land
AZ637	Rs	rough broken land
AZ637	Sa	gravelly alluvial land
AZ637	Sa	sandy alluvial land
AZ637	TmD	rock outcrop
AZ637	TnF	rock outcrop
AZ637	W	water
AZ697	4	aridic argiustolls
AZ697	4	lithic haplustolls
AZ697	6	riverwash
AZ697	7	riverwash
AZ697	8	riverwash
AZ697	9	riverwash
AZ697	10	riverwash
AZ697	16	riverwash
AZ697	17	riverwash
AZ697	22	riverwash
AZ697	23	rock outcrop
AZ697	33	rock outcrop
AZ697	34	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ697	40	rock outcrop
AZ697	41	rock outcrop
AZ697	42	rock outcrop
AZ697	46	rock outcrop
AZ697	53	gypsids
AZ697	54	haplogypsids
AZ697	55	rock outcrop
AZ697	56	rock outcrop
AZ697	59	rock outcrop
AZ697	65	rock outcrop
AZ697	67	rock outcrop
AZ697	68	rock outcrop
AZ697	75	rock outcrop
AZ697	82	riverwash
AZ697	83	rock outcrop
AZ697	86	rock outcrop
AZ697	91	rock outcrop
AZ697	99	rock outcrop
AZ697	108	rock outcrop
AZ697	109	rock outcrop
AZ697	112	pits-dumps mine
AZ697	113	playa
AZ697	114	rock outcrop
AZ697	117	rock outcrop
AZ697	118	rock outcrop
AZ697	122	rock outcrop
AZ697	123	rock outcrop
AZ697	124	rock outcrop
AZ697	125	rock outcrop
AZ697	125	torriorthents
AZ697	126	rock outcrop
AZ697	126	torriorthents
AZ697	127	rock outcrop
AZ697	129	rock outcrop
AZ697	130	rock outcrop
AZ697	139	rock outcrop
AZ697	142	rock outcrop
AZ697	144	torriorthents

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ697	145	haplocambids
AZ697	145	torriorthents
AZ697	146	rock outcrop
AZ697	146	torriorthents
AZ697	155	urban land
AZ697	156	rock outcrop
AZ697	156	ustorthents
AZ697	158	rock outcrop
AZ697	162	rock outcrop
AZ697	163	rock outcrop
AZ697	164	water
AZ697	169	rock outcrop
AZ697	170	rock outcrop
AZ699	10	rock outcrop
AZ699	18	rock outcrop
AZ699	23	rock outcrop
AZ699	33	rock outcrop
AZ699	36	rock outcrop
AZ699	38	rock outcrop
AZ699	39	rock outcrop
AZ699	39	torriorthents
AZ699	43	rock outcrop
AZ699	47	rock outcrop
AZ699	52	rock outcrop
AZ699	52	ustorthents
AZ699	54	rock outcrop
AZ699	55	rock outcrop
AZ699	57	rock outcrop
AZ699	59	rock outcrop
AZ699	60	water
AZ701	2	argic petrocalcids
AZ701	3	argic petrocalcids
AZ701	4	aridic haplustalfs
AZ701	4	lithic haplustalfs
AZ701	5	aridic haplustepts
AZ701	6	aridic lithic ustorthents
AZ701	6	rock outcrop
AZ701	10	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ701	14	calcic petrocalcids
AZ701	15	calcic petrocalcids
AZ701	15	rock outcrop
AZ701	16	calcic petrocalcids
AZ701	16	rock outcrop
AZ701	17	calcic petrocalcids
AZ701	17	typic haplocambids
AZ701	20	lava flows
AZ701	33	rock outcrop
AZ701	39	rock outcrop
AZ701	40	fluvaquents
AZ701	40	psamments
AZ701	41	fluvaquents
AZ701	41	psamments
AZ701	45	haplocalcids
AZ701	45	rock outcrop
AZ701	46	rock outcrop
AZ701	48	rock outcrop
AZ701	56	rock outcrop
AZ701	57	lava flows
AZ701	57	typic torriorthents
AZ701	58	lithic haplargids
AZ701	59	lithic haplargids
AZ701	59	rock outcrop
AZ701	60	lava flows
AZ701	60	lithic haplargids
AZ701	60	typic haplargids
AZ701	61	lithic haplocalcids
AZ701	62	lithic haplocalcids
AZ701	62	rock outcrop
AZ701	63	lithic haplargids
AZ701	63	lithic haplocambids
AZ701	64	lava flows
AZ701	64	lithic haplustalfs
AZ701	65	lithic haplustolls
AZ701	65	rock outcrop
AZ701	65	udic haplustolls
AZ701	66	lithic calciargids

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ701	66	lithic torriorthents
AZ701	67	lithic calciargids
AZ701	67	lithic torriorthents
AZ701	68	lithic torriorthents
AZ701	68	rock outcrop
AZ701	69	lithic torriorthents
AZ701	69	rock outcrop
AZ701	70	lithic torriorthents
AZ701	70	rock outcrop
AZ701	71	lithic torriorthents
AZ701	71	rock outcrop
AZ701	71	typic torriorthents
AZ701	72	lithic ustic torriorthents
AZ701	72	rock outcrop
AZ701	73	lithic ustic torriorthents
AZ701	73	rock outcrop
AZ701	74	lithic ustic torriorthents
AZ701	74	rock outcrop
AZ701	74	udic haplustolls
AZ701	80	rock outcrop
AZ701	82	rock outcrop
AZ701	88	orthents
AZ701	88	rock outcrop
AZ701	90	rock outcrop
AZ701	101	rock outcrop
AZ701	102	rock outcrop
AZ701	103	lithic torriorthents
AZ701	103	rock outcrop
AZ701	104	lithic torriorthents
AZ701	104	rock outcrop
AZ701	105	lithic torriorthents
AZ701	105	rock outcrop
AZ701	106	lithic torriorthents
AZ701	106	rock outcrop
AZ701	107	lithic torriorthents
AZ701	107	rock outcrop
AZ701	108	lithic torriorthents
AZ701	108	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ701	109	lithic torriorthents
AZ701	109	rock outcrop
AZ701	110	lithic torriorthents
AZ701	110	rock outcrop
AZ701	111	lithic ustic torriorthents
AZ701	111	rock outcrop
AZ701	112	lithic ustic torriorthents
AZ701	112	rock outcrop
AZ701	112	ustic haplocalcids
AZ701	113	rock outcrop
AZ701	114	rock outcrop
AZ701	114	torriorthents
AZ701	115	lithic torriorthents
AZ701	115	rock outcrop
AZ701	115	torriorthents
AZ701	116	rock outcrop
AZ701	116	typic torriorthents
AZ701	117	rock outcrop
AZ701	117	typic torriorthents
AZ701	119	rock outcrop
AZ701	120	rock outcrop
AZ701	126	lava flows
AZ701	127	haplogypsids
AZ701	127	torriorthents
AZ701	128	lithic haplargids
AZ701	128	rock outcrop
AZ701	128	torriorthents
AZ701	129	rock outcrop
AZ701	129	torriorthents
AZ701	134	lava flows
AZ701	134	typic calciargids
AZ701	135	typic haplocalcids
AZ701	136	typic haplocalcids
AZ701	137	typic calciargids
AZ701	137	typic haplocalcids
AZ701	138	typic haplocalcids
AZ701	138	typic petrocalcids
AZ701	139	typic haplocalcids

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ701	139	typic torriorthents
AZ701	140	typic haplogypsids
AZ701	141	haplogypsids
AZ701	141	rock outcrop
AZ701	141	typic petrocalcids
AZ701	142	rock outcrop
AZ701	142	typic petrocalcids
AZ701	143	typic torrifluvents
AZ701	144	typic torrifluvents
AZ701	144	typic torripsamments
AZ701	145	typic torrifluvents
AZ701	145	typic torripsamments
AZ701	146	badlands
AZ701	146	typic torriorthents
AZ701	147	typic torriorthents
AZ701	148	typic haplogypsids
AZ701	148	typic torriorthents
AZ701	149	lava flows
AZ701	149	ustic haplargids
AZ701	150	ustic haplocalcids
AZ701	150	ustic petrocalcids
AZ701	151	rock outcrop
AZ701	151	ustic haplocalcids
AZ701	151	ustic petrocalcids
AZ701	152	ustic haplocambids
AZ701	153	ustic haplocambids
AZ701	154	badlands
AZ701	154	ustic torriorthents
AZ701	155	ustic torriorthents
AZ701	156	ustic torriorthents
AZ701	157	ustic torriorthents
AZ701	158	lithic ustic haplargids
AZ701	158	lithic ustic torriorthents
AZ701	158	ustic torriorthents
AZ701	160	vitrandic haplocalcids
AZ701	161	vitrandic haplocalcids
AZ701	161	vitrandic haplocambids
AZ701	162	water

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
AZ701	165	rock outcrop
AZ701	166	rock outcrop
AZ701	171	rock outcrop
AZ701	172	rock outcrop
AZ701	173	rock outcrop
AZ701	174	rock outcrop
AZ701	175	rock outcrop
AZ701	176	rock outcrop
NV608	BD	badland
NV608	BLB	badland
NV608	BOB	rough broken land
NV608	BP	pits
NV608	BSG	rock outcrop
NV608	BZF	rock outcrop
NV608	GHF	rock outcrop
NV608	GP	pits
NV608	HHD	rock outcrop
NV608	HUF	badland
NV608	MAE	rock outcrop
NV608	MBG	badland
NV608	PME	rock outcrop
NV608	RBG	rock outcrop
NV608	RHF	rock outcrop
NV608	Ri	water
NV608	RME	rock land
NV608	RTF	rock land
NV608	SEG	rock outcrop
NV608	SQE	rock outcrop
NV608	STE	rock outcrop
NV608	STF	rock outcrop
NV608	Ty	badland
NV608	USE	badland
NV608	UWD	badland
NV608	VFG	rock outcrop
NV608	W	water
NV608	WHE	badland
NV608	ZAG	rock outcrop
NV613	BA	badland

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
NV613	BB	badland
NV613	BD2	badland
NV613	BR	rough broken land
NV613	CE	rock outcrop
NV613	CR	rock outcrop
NV613	GAB	rock outcrop
NV613	GAR	rock outcrop
NV613	GOV	rock outcrop
NV613	HA	rock outcrop
NV613	HC	rock outcrop
NV613	IO	rock outcrop
NV613	IR	rock outcrop
NV613	KER	rock outcrop
NV613	KO	rock outcrop
NV613	KR	rock outcrop
NV613	LD	badland
NV613	MO	riverwash
NV613	MR	rock outcrop
NV613	NR	rock outcrop
NV613	OTR	rock outcrop
NV613	PS	rock outcrop
NV613	RO	rock land
NV613	RR	rock outcrop
NV613	SH	badland
NV613	SLR	rock outcrop
NV613	TN	rock outcrop
NV613	TR	rock outcrop
NV613	UK	rock outcrop
NV613	US	badland
NV613	UT	rock outcrop
NV613	VBR	rock outcrop
NV613	W	water
NV613	WR	rock outcrop
NV613	ZR	rock outcrop
NV754	1040	rock outcrop
NV754	1041	rock outcrop
NV754	1060	rock outcrop
NV754	1061	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
NV754	1063	rock outcrop
NV754	1064	rock outcrop
NV754	1065	rock outcrop
NV754	1066	rock outcrop
NV754	1090	rock outcrop
NV754	1091	rock outcrop
NV754	1110	rock outcrop
NV754	1211	rock outcrop
NV754	1270	rock outcrop
NV754	1420	rock outcrop
NV754	1430	badland
NV754	1570	rock outcrop
NV754	1571	rock outcrop
NV754	1591	rock outcrop
NV754	1683	rock outcrop
NV754	1750	rock outcrop
NV754	1761	rock outcrop
NV754	1810	rock outcrop
NV754	1811	rock outcrop
NV754	1833	rock outcrop
NV754	1880	rock outcrop
NV754	1881	rock outcrop
NV754	1890	rock outcrop
NV754	1920	rock outcrop
NV754	1940	rock outcrop
NV754	1990	rock outcrop
NV754	1992	rock outcrop
NV754	1993	rock outcrop
NV754	2011	rock outcrop
NV754	2290	rock outcrop
NV754	2297	rock outcrop
NV754	3673	rock outcrop
NV755	100	rock outcrop
NV755	105	rock outcrop
NV755	106	rock outcrop
NV755	115	badland
NV755	134	rock outcrop
NV755	135	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
NV755	140	rock outcrop
NV755	141	rock outcrop
NV755	143	rock outcrop
NV755	144	rock outcrop
NV755	165	badland
NV755	167	badland
NV755	175	rock outcrop
NV755	176	rock outcrop
NV755	178	rock outcrop
NV755	195	rock outcrop
NV755	205	badland
NV755	207	badland
NV755	225	badland
NV755	226	badland
NV755	228	badland
NV755	232	badland
NV755	235	badland
NV755	241	rock outcrop
NV755	255	rock outcrop
NV755	270	rock outcrop
NV755	271	rock outcrop
NV755	272	rock outcrop
NV755	288	badland
NV755	289	badland
NV755	289	rock outcrop
NV755	290	rock outcrop
NV755	291	rock outcrop
NV755	292	rock outcrop
NV755	294	rock outcrop
NV755	298	rock outcrop
NV755	315	sodic haplocalcids
NV755	315	typic haplocalcids
NV755	320	rock outcrop
NV755	321	rock outcrop
NV755	322	rock outcrop
NV755	323	rock outcrop
NV755	330	badland
NV755	330	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
NV755	335	rock outcrop
NV755	340	rock outcrop
NV755	341	rock outcrop
NV755	342	rock outcrop
NV755	343	rock outcrop
NV755	351	rock outcrop
NV755	352	rock outcrop
NV755	355	rock outcrop
NV755	360	badland
NV755	365	badland
NV755	375	rock outcrop
NV755	376	rock outcrop
NV755	405	water
NV755	415	rock outcrop
NV755	421	rock outcrop
NV755	422	rock outcrop
NV755	460	badland
NV755	475	badland
NV755	475	rock outcrop
NV755	477	badland
NV755	478	badland
NV755	501	dams
NV755	504	pits quarry
NV755	506	dumps
NV755	506	pits
NV755	508	dumps
NV755	510	rubble land
NV755	520	rock outcrop
NV755	521	rock outcrop
NV755	522	rock outcrop
NV755	530	rock outcrop
NV755	531	rock outcrop
NV755	532	rock outcrop
NV755	535	rock outcrop
NV755	540	rock outcrop
NV755	541	rock outcrop
NV755	542	badland
NV755	542	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
NV755	552	rock outcrop
NV755	560	rock outcrop
NV755	565	badland
NV755	603	rock outcrop
NV755	604	rock outcrop
NV755	605	badland
NV755	606	rock outcrop
NV755	610	rock outcrop
NV755	612	rock outcrop
NV755	613	rock outcrop
NV755	640	rock outcrop
NV755	645	rock outcrop
NV755	646	rock outcrop
NV755	670	rock outcrop
NV755	673	rock outcrop
NV755	674	rock outcrop
NV755	674	rubble land
NV755	700	rock outcrop
NV755	701	rock outcrop
NV755	715	rock outcrop
NV755	721	badland
NV755	732	rock outcrop
NV755	733	rock outcrop
NV755	750	rock outcrop
NV755	750	rubble land
NV755	751	rock outcrop
NV755	753	rock outcrop
NV755	754	rock outcrop
NV755	772	rock outcrop
NV755	775	rock outcrop
NV755	790	rock outcrop
NV755	801	rock outcrop
NV755	805	rock outcrop
NV755	806	rock outcrop
NV755	810	rock outcrop
NV755	810	rubble land
NV755	815	rock outcrop
NV755	820	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
NV755	821	rock outcrop
NV755	830	rubble land
NV755	833	rock outcrop
NV755	840	rock outcrop
NV755	850	rock outcrop
NV755	851	rock outcrop
NV755	852	rock outcrop
NV755	853	rock outcrop
NV755	854	rock outcrop
NV755	860	rock outcrop
NV755	885	rock outcrop
NV755	900	urban land
NV755	905	rock outcrop
NV755	911	badland
NV755	915	rock outcrop
NV755	925	rock outcrop
NV755	930	badland
NV755	940	rock outcrop
NV755	951	badland
NV755	952	badland
NV755	955	badland
NV755	955	bluegyp
NV755	955	typic torrifolists
NV755	965	badland
NV755	970	rock outcrop
NV755	970	rubble land
NV755	981	rock outcrop
NV755	982	rock outcrop
NV755	998	miscellaneous water
NV755	999	water
UT	s342	rock outcrop
UT	s351	rock outcrop
UT	s362	cinder land
UT	s362	lava flows
UT	s362	rock outcrop
UT	s392	rock outcrop
UT	s393	rock outcrop
UT	s394	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s398	rock outcrop
UT	s1160	rock outcrop
UT	s1185	rock outcrop
UT	s1199	rock outcrop
UT	s1210	rock outcrop
UT	s1232	rock outcrop
UT	s1417	torrifluvents
UT	s1420	badland
UT	s1420	rock outcrop
UT	s1422	rock outcrop
UT	s1424	rock outcrop
UT	s1435	rock outcrop
UT	s1791	water
UT	s1844	rock outcrop
UT	s5228	badland
UT	s5228	rock outcrop
UT	s5228	water
UT	s5229	badland
UT	s5229	gullied land
UT	s5229	rock outcrop
UT	s5484	shalcar family
UT	s5563	rock outcrop
UT	s5598	rock outcrop
UT	s5742	badland
UT	s5742	riverwash
UT	s5742	rough broken land
UT	s5878	rock outcrop
UT	s7755	rock outcrop
UT	s7756	rock outcrop
UT	s7758	rock outcrop
UT	s7759	rock outcrop
UT	s7760	badland
UT	s7760	rock outcrop
UT	s7764	rock outcrop
UT	s7766	rock outcrop
UT	s7770	rock outcrop
UT	s7771	rock outcrop
UT	s7772	rock outcrop

Table D.4 List of miscellaneous component soils		
NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s7773	badland
UT	s7773	rock outcrop
UT	s7774	badland
UT	s7774	rock outcrop
UT	s7776	rock outcrop
UT	s7781	rock outcrop
UT	s7785	rock outcrop
UT	s7794	rock outcrop
UT	s7813	rock outcrop
UT	s7829	rock outcrop
UT	s7832	rock outcrop
UT	s7836	rock outcrop
UT	s7838	rock outcrop
UT	s7847	rock outcrop
UT	s7848	rock outcrop
UT	s7849	rock outcrop
UT	s7850	rock outcrop
UT	s7857	rock outcrop
UT	s7858	peteetneet
UT	s7867	rock outcrop
UT	s7868	rock outcrop
UT	s7870	badland
UT	s7870	rock outcrop
UT	s7873	badland
UT	s7873	rock outcrop
UT	s7874	rock outcrop
UT	s7875	rock outcrop
UT	s7876	rock outcrop
UT	s7878	rock outcrop
UT	s7879	rock outcrop
UT	s7880	rock outcrop
UT	s7881	badland
UT	s7881	rock outcrop
UT	s7883	badland
UT	s7883	rock outcrop
UT	s7884	rock outcrop
UT	s7886	rock outcrop
UT	s7888	badland

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s7888	rock outcrop
UT	s7889	rock outcrop
UT	s7890	rock outcrop
UT	s7891	rock outcrop
UT	s7892	rock outcrop
UT	s7893	rock outcrop
UT	s7894	rock outcrop
UT	s7896	rock outcrop
UT	s7899	rock outcrop
UT	s7900	rock outcrop
UT	s7901	badland
UT	s7902	water
UT	s7903	badland
UT	s7903	rock outcrop
UT	s7904	badland
UT	s7904	rock outcrop
UT	s7905	rock outcrop
UT	s7906	rock outcrop
UT	s7907	badland
UT	s7907	rock outcrop
UT	s7908	badland
UT	s7909	rock outcrop
UT	s7916	badland
UT	s7917	badland
UT	s7917	rock outcrop
UT	s7918	rock outcrop
UT	s7918	water
UT	s7919	rock outcrop
UT	s7919	rubble land
UT	s7921	rock outcrop
UT	s7922	rock outcrop
UT	s7923	badland
UT	s7923	rock outcrop
UT	s7924	badland
UT	s7925	badland
UT	s7925	rock outcrop
UT	s7928	rock outcrop
UT	s7929	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s7929	rubble land
UT	s7931	rock outcrop
UT	s7932	badland
UT	s7932	rock outcrop
UT	s7935	rock outcrop
UT	s7939	rock outcrop
UT	s7940	rock outcrop
UT	s7944	rock outcrop
UT	s7946	rock outcrop
UT	s7947	rock outcrop
UT	s7951	rock outcrop
UT	s7952	rock outcrop
UT	s7954	rock outcrop
UT	s7955	rock outcrop
UT	s7957	rock outcrop
UT	s7959	rock outcrop
UT	s7965	rubble land
UT	s7967	badland
UT	s7971	badland
UT	s7971	rock outcrop
UT	s7972	rock outcrop
UT	s7974	rock outcrop
UT	s7978	rock outcrop
UT	s7979	rock outcrop
UT	s7981	badland
UT	s7984	badland
UT	s7990	badland
UT	s7990	rock outcrop
UT	s7991	rock outcrop
UT	s7992	rock outcrop
UT	s7993	rock outcrop
UT	s7996	rock outcrop
UT	s7997	rock outcrop
UT	s8002	rubble land
UT	s8006	badland
UT	s8006	rock outcrop
UT	s8007	rock outcrop
UT	s8008	badland

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s8008	rock outcrop
UT	s8009	badland
UT	s8009	rock outcrop
UT	s8010	rock outcrop
UT	s8012	rock outcrop
UT	s8015	rock outcrop
UT	s8017	rock outcrop
UT	s8018	rock outcrop
UT	s8020	rock outcrop
UT	s8025	haulings
UT	s8026	rock outcrop
UT	s8028	rock outcrop
UT	s8029	rock outcrop
UT	s8030	rock outcrop
UT	s8031	rock outcrop
UT	s8034	rubble land
UT	s8036	rock outcrop
UT	s8037	rock outcrop
UT	s8038	rubble land
UT	s8040	water
UT	s8052	rock outcrop
UT	s8057	rock outcrop
UT	s8058	rock outcrop
UT	s8059	rock outcrop
UT	s8067	rock outcrop
UT	s8067	rubble land
UT	s8068	rock outcrop
UT	s8070	rock outcrop
UT	s8071	rubble land
UT	s8072	rock outcrop
UT	s8073	rubble land
UT	s8074	rubble land
UT	s8075	rock outcrop
UT	s8078	rock outcrop
UT	s8079	rock outcrop
UT	s8082	rock outcrop
UT	s8086	rock outcrop
UT	s8087	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s8088	rock outcrop
UT	s8090	rock outcrop
UT	s8093	rock outcrop
UT	s8102	water
UT	s8112	rock outcrop
UT	s8114	rock outcrop
UT	s8119	rock outcrop
UT	s8128	rock outcrop
UT	s8129	rock outcrop
UT	s8132	rock outcrop
UT	s8134	badland
UT	s8134	rock outcrop
UT	s8146	rock outcrop
UT	s8153	rock outcrop
UT	s8154	rock outcrop
UT	s8155	rock outcrop
UT	s8161	rock outcrop
UT	s8162	rock outcrop
UT	s8163	rock outcrop
UT	s8165	slickspots
UT	s8167	kjar
UT	s8167	peteetneet
UT	s8168	rock outcrop
UT	s8171	rock outcrop
UT	s8173	rock outcrop
UT	s8174	rock outcrop
UT	s8175	rock outcrop
UT	s8176	rock outcrop
UT	s8179	rock outcrop
UT	s8184	badland
UT	s8184	rock outcrop
UT	s8185	rock outcrop
UT	s8186	rock outcrop
UT	s8187	cinder land
UT	s8187	gullied land
UT	s8187	rock outcrop
UT	s8188	rock outcrop
UT	s8189	badland

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s8189	rock outcrop
UT	s8190	badland
UT	s8190	rock outcrop
UT	s8191	rock outcrop
UT	s8192	rock outcrop
UT	s8193	rock outcrop
UT	s8194	rock outcrop
UT	s8195	rock outcrop
UT	s8196	rock outcrop
UT	s8197	rock outcrop
UT	s8198	rock outcrop
UT	s8201	rock outcrop
UT	s8209	rock outcrop
UT	s8211	rock outcrop
UT	s8212	blown-out land
UT	s8213	rock outcrop
UT	s8214	rock outcrop
UT	s8217	rock outcrop
UT	s8218	rock outcrop
UT	s8219	rock outcrop
UT	s8228	rock outcrop
UT	s8230	rock outcrop
UT	s8232	rock outcrop
UT	s8233	badland
UT	s8233	rock outcrop
UT	s8234	badland
UT	s8235	badland
UT	s8235	rock outcrop
UT	s8236	rock outcrop
UT	s8239	rock outcrop
UT	s8240	rock outcrop
UT	s8241	rock outcrop
UT	s8242	rock outcrop
UT	s8243	rock outcrop
UT	s8244	rock outcrop
UT	s8249	badland
UT	s8249	rock outcrop
UT	s8252	rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT	s8253	rock outcrop
UT	s8254	rock outcrop
UT	s8255	haulings
UT	s8259	gypsum land
UT	s8260	rock outcrop
UT	s8369	water
UT	s9012	rock outcrop
UT	s9016	rock outcrop
UT	s9046	tepete
UT634	304	riverwash
UT634	313	badland
UT634	313	rock outcrop
UT634	314	badland
UT634	314	rock outcrop
UT634	319	rock outcrop
UT634	330	blown out land
UT634	331	riverwash
UT634	332	blown out land
UT634	345	rock outcrop
UT634	347	rock outcrop
UT634	348	rock outcrop
UT634	350	cinder land
UT634	373	dune land
UT634	377	poorly drained soils
UT634	385	rock outcrop
UT634	391	rock outcrop
UT634	403	lava flows
UT634	405	rock outcrop
UT634	423	riverwash
UT634	426	rock outcrop
UT634	428	riverwash
UT634	429	rock outcrop
UT634	435	rock outcrop
UT634	438	playas
UT634	441	rock outcrop
UT634	442	rock outcrop
UT634	448	dumps
UT634	448	pits

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT634	449	playas
UT634	459	rock outcrop
UT634	465	riverwash
UT634	467	badland
UT634	467	rock outcrop
UT634	472	rock outcrop
UT634	482	very saline soils
UT634	493	rock outcrop
UT634	495	rock outcrop
UT634	496	rock outcrop
UT634	497	rock outcrop
UT634	498	rock outcrop
UT634	502	rock outcrop
UT634	503	rock outcrop
UT634	504	playas
UT634	510	rock outcrop
UT634	518	water
UT636	8	badland
UT636	8	rock outcrop
UT636	9	badland
UT636	9	rock outcrop
UT636	34	rock outcrop
UT636	39	rock outcrop
UT636	53	rock outcrop
UT636	75	lava flows
UT636	76	badland
UT636	76	rock outcrop
UT636	116	rock outcrop
UT636	122	rock outcrop
UT636	124	rubble land
UT636	145	rock outcrop
UT636	149	rock outcrop
UT636	157	rock outcrop
UT636	163	rock outcrop
UT636	173	rock outcrop
UT636	174	water
UT636	176	pits borrow
UT636	177	miscellaneous water

Table D.4 List of miscellaneous component soils		
NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT641	BA	badland
UT641	BA	badland
UT641	BB	badland
UT641	BF	rock land
UT641	BP	borrow pits
UT641	CEF	riverwash
UT641	CFD	riverwash
UT641	CI	cinder land
UT641	CUF	rock outcrop
UT641	DrB	poorly drained soils
UT641	DU	dune land
UT641	EA	eroded land
UT641	EB	eroded land
UT641	FA	riverwash
UT641	GA	gullied land
UT641	GP	gravel pit
UT641	HD	rock land
UT641	HG	rock land
UT641	LA	lava flows
UT641	LcB	riverwash
UT641	MBG	rock outcrop
UT641	MEG	rock outcrop
UT641	MOG	rock outcrop
UT641	NNE	riverwash
UT641	PKE	rock outcrop
UT641	RE	rock land
UT641	RI	riverwash
UT641	RO	rock land
UT641	RP	rock land
UT641	RR	rock land
UT641	RT	rock outcrop
UT641	RU	rough broken land
UT641	SY	stony colluvial land
UT641	TG	rock land
UT641	W	water
UT641	WCF	rock outcrop
UT686	5004	navajo sandstone rock outcrop
UT686	5004	navajo sandstone rock outcrop

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT686	5007	navajo sandstone rock outcrop
UT686	5019	page sandstone carmel formation rock outcrop
UT686	5020	navajo sandstone rock outcrop
UT686	5026	entrada and carmel formation rock outcrop
UT686	5027	dakota formation rock outcrop
UT686	5028	cannonville member entrada formation badland
UT686	5029	straight cliffs formation rock outcrop
UT686	5031	morrison formation rock outcrop
UT686	5032	morrison and entrada formation rock outcrop
UT686	5038	entrada sandstone rock outcrop
UT686	5042	carmel formation rock outcrop
UT686	5043	morrison formation and romano mesa sandstone rock outcrop
UT686	5060	navajo sandstone rock outcrop
UT686	5061	navajo sandstone rock outcrop
UT686	5063	navajo sandstone and carmel formation rock outcrop
UT686	5069	entrada sandstone rock outcrop
UT686	5071	morrison formation rock outcrop
UT686	5077	straight cliffs formation rock outcrop
UT686	5081	straight cliffs and wahweap formation badland
UT686	5081	straight cliffs and wahweap formation rock outcrop
UT686	5087	kayenta formation rock outcrop
UT686	5092	navajo sandstone rock outcrop
UT686	5095	straight cliffs formation sandstone rock outcrop
UT686	5096	straight cliffs formation sandstone rock outcrop
UT686	5097	wahweap formation rock outcrop
UT686	5100	wingate formation rock outcrop
UT686	5104	shinarump member chinle formation rock outcrop
UT686	5105	shinarump member chinle formation rock outcrop
UT686	5106	moenkopi formation badland
UT686	5108	moenkopi formation rock outcrop
UT686	5109	moenkopi formation rock outcrop
UT686	5117	carmel and entrada formation badland
UT686	5118	carmel formation rock outcrop
UT686	5121	riverwash
UT686	5129	wahweap formation rock outcrop
UT686	5136	straight cliffs formation rock outcrop
UT686	5137	dakota and morrison formation rock outcrop
UT686	5139	hetz

Table D.4 List of miscellaneous component soils

NRCS Soil Survey	SMU	Miscellaneous Component Soil
(1)	(2)	(3)
UT686	5144	straight cliffs formation burnt sandstone rock outcrop
UT686	5149	straight cliffs formation rock outcrop
UT686	5157	wahweap formation rock outcrop
UT686	5158	timpoweap member moenkopi formation rock outcrop
UT686	5169	carmel formation rock outcrop
UT686	5180	navajo sandstone rock outcrop
UT686	5182	carmel formation rock outcrop
UT686	5183	navajo sandstone rock outcrop
UT686	5190	straight cliffs and wahweap formation rock outcrop
UT686	5191	straight cliffs and wahweap formation rock outcrop
UT686	5192	straight cliffs and dakota formation rock outcrop
UT686	5207	riverwash

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT			Include
						2005		
					1993	DF =1.0	DF =1.1	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
"alluvial land"'	Engineering judgement		Silt	"No":	0.10	0.56	0.28	"Yes"
"aquents"	NRCS Soil Taxonomy Handbook	Entisols, pg 138	Sand	"No":	4.60	2.82	2.00	"Yes"
"aquic argiustolls"	NRCS Soil Taxonomy Handbook	Mollisols, pg 174	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"aquic haplustolls"	NRCS Soil Taxonomy Handbook	Mollisols, pg 147	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"aquic ustipsamments"	NRCS Soil Taxonomy Handbook	Entisols, pg 139	Sand	"No":	4.60	2.82	2.00	"Yes"
"aquolls"	NRCS Soil Taxonomy Handbook	Mollisols, pg 144	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"arents earthen dam"	Engineering judgement	Entisols	Sand	"No":	4.60	2.82	2.00	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT			Include
					1993	2005 DF =1.0	2005 DF =1.1	
'"argic petrocalcids"'	NV755		Loam	"No":	0.25	0.42	0.20	"Yes"
'"aridic argiustolls"'	NRCS Soil Taxonomy Handbook	Mollisols, pg 174	Silt loam	"No":	0.15	0.44	0.21	"Yes"
'"aridic haplustalfs"'	AZ		Loam	"No":	0.25	0.42	0.20	"Yes"
'"aridic haplustepts"'	NRCS Soil Taxonomy Handbook	Inceptisols, pg 143	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"aridic lithic ustorthents"'	NRCS Soil Taxonomy Handbook	Entisols, pg 140	Sand	"No":	4.60	2.82	2.00	"Yes"
'"badland"'	AZ, UT		loam	"No":	0.25	0.42	0.20	"Yes"
'"badlands"'	AZ, UT, AZ701		loam	"No":	0.25	0.42	0.20	"Yes"
'"blown out land"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
'"blown-out land"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
'"bluegyp"'	Engineering judgement	Aridisols, pg 137	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"borohemists ponded"	NRCS Soil Taxonomy Handbook	Histosols, pg 142	Loam	"No":	0.25	0.42	0.20	"Yes"
'"borrow pit"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"No"
'"borrow pits"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"No"
'"bracken"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"calcic petrocalcids"'	NV755		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"calciorthids"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
"cannonville member entrada formation badland"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"carmel and entrada formation badland"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"carmel	Engineering		Clay	"Yes":	0.01	0.03	0.01	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT 1993	XKSAT 2005 DF =1.0	XKSAT 2005 DF =1.1	Include
formation badland"'	judgement							
'"carmel formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"chinle formation badland"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"cinder land"'	AZ, UT		Sand	"No":	4.60	2.82	2.00	"Yes"
"cryaquents"	NRCS Soil Taxonomy Handbook	Entisols, pg 138	Sand	"No":	4.60	2.82	2.00	"Yes"
"cryaquolls loamy-skeletal"	NRCS Soil Taxonomy Handbook	Mollisols, pg 144	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"cryofibrists"	NRCS Soil Taxonomy Handbook	Histosols, pg 141	Loam	"No":	0.25	0.42	0.20	"Yes"
"cryohemists"	NRCS Soil Taxonomy Handbook	Histosols, pg 142	Loam	"No":	0.25	0.42	0.20	"Yes"
"cumulic haplaquolls"	Engineering judgement	Mollisols, aquolls	Silt loam	"No":	0.15	0.44	0.21	"Yes"
'"dakota and morrison formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"dakota formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"dam"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
'"dams"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
'"dumps"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
'"dune land"'	AZ, UT		Sand	"No":	4.60	2.82	2.00	"Yes"
'"entrada and carmel formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"entrada sandstone rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"eroded land"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT			Include
						2005		
					1993	DF =1.0	DF =1.1	
"fluvaquentic haplaquoll"	Engineering judgement	Mollisols, aquolls	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"fluvaquentic haplaquolls"	Engineering judgement	Mollisols, aquolls	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"fluvaquentic haplustoll"	NRCS Soil Taxonomy Handbook	Mollisols, pg 147	Silt loam	"No":	0.15	0.44	0.21	"Yes"
"fluvaquentic haplustolls"	NRCS Soil Taxonomy Handbook	Mollisols, pg 147	Silt loam	"No":	0.15	0.44	0.21	"Yes"
'"fluvaquents"'	UT641		Sand	"No":	4.60	2.82	2.00	"Yes"
"fluvaquents frequently flooded"	UT641		Sand	"No":	4.60	2.82	2.00	"Yes"
'"gravel pit"'	Engineering judgement		Sand	"No":	4.60	2.82	2.00	"No"
'"gravelly alluvial land"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"gullied land"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
"gypsids shallow"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 137	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"gypsids"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 137	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"gypsiorthids"'	Engineering judgement		Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"gypsum land"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 137	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
"haplaquolls"	NRCS Soil Taxonomy Handbook	Mollisols, pg 144	Silt loam	"No":	0.15	0.44	0.21	"Yes"
'"haplocalcids"'	NV755, AZ701		Loam	"No":	0.25	0.42	0.20	"Yes"
'"haplocambids"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 138	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
"haplofibrists"	NRCS Soil Taxonomy Handbook	Histosols, pg 141	Loam	"No":	0.25	0.42	0.20	"Yes"
'"haplogypsids"'	NRCS Soil Taxonomy	Aridisols, pg 137	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT			Include
					1993	2005		
						DF =1.0	DF =1.1	
	Handbook							
"haulings"'	Engineering judgement		loam	"No":	0.25	0.42	0.20	"Yes"
'"hetz"'	UT686		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
"intermittent water"	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"kayenta formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"kjar"'	Engineering judgement		Silty clay loam	"No":	0.04	0.16	0.06	"Yes"
"las"	muname		Loamy sand	"No":	1.20	2.52	1.73	"Yes"
'"lava flows"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"lava flows"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"levee"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
'"lithic calciargids"'	NRCS Soil Taxonomy Handbook		Loam	"No":	0.25	0.42	0.20	"Yes"
'"lithic haplargids"'	NV755		Loam	"No":	0.25	0.42	0.20	"Yes"
'"lithic haplocalcids"'	NV755		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"lithic haplocambids"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 138	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"lithic haplustalfs"'	AZ		Clay loam	"No":	0.04	0.12	0.04	"Yes"
'"lithic haplustolls"'	AZ		Loam	"No":	0.25	0.42	0.20	"Yes"
'"lithic torriorthents"'	AZ, UT		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"lithic ustic haplargids"'	NV755		Loam	"No":	0.25	0.42	0.20	"Yes"
'"lithic ustic torriorthents"'	NV755		Loam	"No":	0.25	0.42	0.20	"Yes"
'"lithic ustorthents family"'	NRCS Soil Taxonomy Handbook	Entisols,1 40	Sand	"No":	4.60	2.82	2.00	"Yes"
'"loamy alluvial	Engineering		Loam	"No":	0.25	0.42	0.20	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT 1993	XKSAT 2005 DF =1.0	XKSAT 2005 DF =1.1	Include
land"'	judgement							
'"marshes"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"miscellaneous water"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"moenkopi formation badland"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"moenkopi formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"mollic fluvaquents"	NRCS Soil Taxonomy Handbook	Entisols, pg 138	Sand	"No":	4.60	2.82	2.00	"Yes"
"mollic halaquepts"	NRCS Soil Taxonomy Handbook	Inceptisol s, pg 142	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"morrison and entrada formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"morrison formation and romano mesa sandstone rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"morrison formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"navajo sandstone and carmel formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"navajo sandstone rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"not complete"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"No"
'"orthents"'	NRCS Soil Taxonomy Handbook	Entisols,1 39	Sand	"No":	4.60	2.82	2.00	"Yes"
"page sandstone carmel formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT			Include
					1993	2005 DF =1.0	2005 DF =1.1	
"peteetneet"'	Engineering judgement		Silty clay loam	"No":	0.04	0.16	0.06	"Yes"
"pits borrow"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"No"
"pits quarry"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"No"
'"pits"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"No"
"pits gravel"	Engineering judgement		Sand	"No":	4.60	2.82	2.00	"No"
'"pits-dumps complex"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"No"
"pits-dumps mine"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"No"
'"playa"'	NV754, UT634		Silty clay loam	"No":	0.04	0.16	0.06	"Yes"
'"playas"'	NV754, UT634		Silty clay loam	"No":	0.04	0.16	0.06	"Yes"
'"poorly drained soils"'	UT636		Loam	"No":	0.25	0.42	0.20	"Yes"
'"psamments"'	NRCS Soil Taxonomy Handbook	Entisols,1 38	Sand	"No":	4.60	2.82	2.00	"Yes"
"riverwash and water"	All surveys		Sand	"No":	4.60	2.82	2.00	"Yes"
'"riverwash"'	All surveys		Sand	"No":	4.60	2.82	2.00	"Yes"
'"rock land"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"rockland"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"rough broken land"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"rubble land"'	Engineering judgement		Loam	"Yes":	0.25	0.42	0.20	"Yes"
'"ruvaquents"'	NRCS Soil Taxonomy Handbook	Entisols,1 38	Sand	"No":	4.60	2.82	2.00	"Yes"
'"sandy alluvial land"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
"sandy and gravelly alluvial land""	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT 1993	XKSAT 2005 DF =1.0	XKSAT 2005 DF =1.1	Include
"'shalcar family"'	Engineering judgement		Silty clay	"No":	0.02	0.10	0.03	"Yes"
"shinarump member chinle formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"'slickspot"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
"'slickspots"'	Engineering judgement		Clay	"No":	0.01	0.03	0.01	"Yes"
"'small depressions"'	UT636		Sand	"No":	4.60	2.82	2.00	"Yes"
"'sodic haplocalcids"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 137	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
"somewhat poorly drained soils"	Engineering judgement		Silty clay	"No":	0.02	0.10	0.03	"Yes"
"'stony colluvial land"'	Engineering judgement		Silt	"No":	0.10	0.56	0.28	"Yes"
"'straight cliffs and dakota formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"'straight cliffs and wahweap formation badland"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"'straight cliffs and wahweap formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"'straight cliffs formation burnt sandstone rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"'straight cliffs formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"'straight cliffs formation sandstone rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"tepete"'	Engineering		Silty clay	"No":	0.04	0.16	0.06	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT			Include
					1993	2005 DF =1.0	2005 DF =1.1	
	judgement		loam					
"timpoweap member moenkopi formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"torrifluvents"'	AZ, UT		Sand	"No":	4.60	2.82	2.00	"Yes"
'"torriorthents"'	NV755, AZ		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"torripsamments "'	NRCS Soil Taxonomy Handbook	Entisols,1 39	Sand	"No":	4.60	2.82	2.00	"Yes"
"tropic formation shale badland"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
"tryon"	muname		Loamy sand	"No":	1.20	2.52	1.73	"Yes"
'"typic calciargids"'	NV755		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
"typic cryaquents"	NRCS Soil Taxonomy Handbook	Entisols, pg 138	Sand	"No":	4.60	2.82	2.00	"Yes"
'"typic haplaquolls"'	NV754, NV613		Silt loam	"No":	0.15	0.44	0.21	"Yes"
'"typic haplargids"'	NV755		Loam	"No":	0.25	0.42	0.20	"Yes"
'"typic haplocalcids"'	NV755		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"typic haplocambids"'	NV755		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"typic haplogypsids"'	NV755		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
"typic natraquolls"	NRCS Soil Taxonomy Handbook	Mollisols, pg 144	Silt loam	"No":	0.15	0.44	0.21	"Yes"
'"typic petrocalcids"'	NV755		Loam	"No":	0.25	0.42	0.20	"Yes"
"typic psammaquents"	NRCS Soil Taxonomy Handbook	Entisols,1 38	Sand	"No":	4.60	2.82	2.00	"Yes"
'"typic torrifluvents"'	NRCS Soil Taxonomy Handbook	Entisols,1 39	Sand	"No":	4.60	2.82	2.00	"Yes"
'"typic torrifolists"'	NRCS Soil Taxonomy	Histosols, pg 141	Loam	"No":	0.25	0.42	0.20	"Yes"

Table D.5 Assignment of XKSAT to miscellaneous component soils

Component Name	Source of Texture	Soil Order	Assumed Texture	Impervious	XKSAT 1993	XKSAT 2005 DF =1.0	XKSAT 2005 DF =1.1	Include
	Handbook							
'"typic torriorthents"'	NV754, AZ, AZ701, UT		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"typic torripsamments"'	NRCS Soil Taxonomy Handbook	Entisols,139	Sand	"No":	4.60	2.82	2.00	"Yes"
'"udic haplustolls"'	NRCS Soil Taxonomy Handbook	Mollisols, pg 174	Silt loam	"No":	0.15	0.44	0.21	"Yes"
'"urban land"'	Engineering judgement		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"ustic haplargids"'	NV755		Loam	"No":	0.25	0.42	0.20	"Yes"
'"ustic haplocalcids"'	NV755		Sandy loam	"No":	0.40	1.34	0.80	"Yes"
'"ustic haplocambids"'	NRCS Soil Taxonomy Handbook	Entisols,138	Sand	"No":	4.60	2.82	2.00	"Yes"
'"ustic petrocalcids"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 137	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"ustic torriorthents"'	NV755, UT, AZ701		Loam	"No":	0.25	0.42	0.20	"Yes"
'"ustorthents"'	NRCS Soil Taxonomy Handbook	Entisols,140	Sand	"No":	4.60	2.82	2.00	"Yes"
'"very saline soils"'	Engineering judgement		Silt	"No":	0.10	0.56	0.28	"Yes"
'"vitrandic haplocalcids"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 137	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"vitrandic haplocambids"'	NRCS Soil Taxonomy Handbook	Aridisols, pg 138	Sandy clay loam	"No":	0.06	0.31	0.14	"Yes"
'"wahweap formation rock outcrop"'	Engineering judgement		Clay	"Yes":	0.01	0.03	0.01	"Yes"
'"water"'	Engineering judgement		Clay	"Yes":	0.01	0.01	0.01	"Yes"

Table D.6 Average XKSAT values for bare ground

Texture	XKSAT		
	Rawls 1983	Saxton (2005)	
	in/hr	in/hr	mm/hr
1	2	3	4
Sand	4.60	2.82	71.63
Loamy sand	1.20	2.52	64.01
Sandy loam	0.40	1.34	34.04
Silt	0.10	0.56	14.22
Silt loam	0.15	0.44	11.18
Loam	0.25	0.43	10.92
Sandy clay loam	0.06	0.31	7.87
Silty clay Loam	0.04	0.16	4.06
Clay loam	0.04	0.12	3.05
Silty clay	0.02	0.11	2.79
Sandy clay	0.02	0.04	1.02
Clay	0.01	0.04	1.02

D.2.6 COMPUTATION OF COMPOSITE XKSAT FOR EACH SOIL MAP UNIT

The computed composite value of XKSAT for each SMU for both the 1993 and 2005 methods are listed in File 6. The data in File 2 in combination with the data in Files 4 and 5 was used for the computation. The computations were done using equation 1.

$$\overline{XKSAT} = a\log\left(\frac{\sum A_i \log XKSAT_i}{A_T}\right) \qquad \text{Eqn 1}$$

where:

$\overline{XKSAT}$ = composite bare ground hydraulic conductivity for the SMU (or watershed sub-basin), inches/hour

$XKSAT_i$ = bare ground hydraulic conductivity of the SMU component soil, inches/hour

A_i = component area in % of SMU from File 2

A_T = Total % of the SMU components

When the SMU component percentages do not total 100%, the percentages were normalized to total 100%.

D.2.7 COMPUTATION OF PSIF AND DTHETA

PSIF is the Green and Ampt wetting front capillary pressure term. Per Rawls, Brakensiek and Miller (1983) equation 5, PSIF can be calculated from the estimated Brooks and Corey constants using equation D.1:

$$PSIF = \frac{2\lambda + 3}{2\lambda + 2}\left(\frac{\psi_b}{2}\right) \qquad \text{D.1}$$

where:

PSIF = wetting front capillary pressure, in inches,

λ = the pore-size distribution index (defined as the slope of the logarithmic tension-moisture curve in Saxton and Rawls, 2005), and

ψ_b = bubbling pressure (defined as the tension at air entry, ψ_e, in Saxton and Rawls, 2005), in inches of water. The value used for Mohave County is adjusted as shown in the Excel spreadsheet provided by Saxton and Rawls (2005).

DTHETA is the Green and Ampt volumetric soil moisture deficit at start of rainfall term (defined as effective porosity, θ_e, in Rawls, Brakensiek and Miller, 1983), in cubic inches per cubic inch. Per Rawls, Brakensiek and Miller (1983) equation 6, DTHETA can be calculated using equation D.2:

$$DTHETA = \phi - \phi_r \qquad \text{D.2}$$

where:

DTHETA = volumetric soil moisture deficit, in cubic inches per cubic inch,

ϕ = total porosity (defined as the slope of the logarithmic tension-moisture curve in Saxton and Rawls, 2005), and

ϕ_r = bubbling pressure (defined as the tension at air entry, ψ_e, in Saxton and Rawls, 2005), in inches of water. The value used for Mohave County is adjusted as shown in the Excel spreadsheet provided by Saxton and Rawls (2005).

The PSIF and DTHETA values for Saxton and Rawls 2005 listed in File 2 for each horizon were used to prepare a relationship with XKSAT as an independent variable and PSIF and DTHETA as dependant variables. A nonlinear regression analysis was performed for each dependant variable. The results are shown on Figure D.1 and Figure D.2 in comparison with the curves from Sabol 1993.

The regression equations recommended for computing PSIF and DTHETA are:

$$PSIF = 1/(0.06149 - 0.03544 * XKSAT + 0.37264 * XKSAT^2)$$

$$DTHETA_{Dry} = 0.35174 + 0.03787 * \log_e XKSAT$$

$$DTHETA_{Normal} = 0.26309 * XKSAT^{0.31813}$$

D.2.8 PROPOSED XKSAT METHOD

The Saxton and Rawls 2005 Green and Ampt parameter method is accepted for use in surface water hydrology in Mohave County. The values of bare ground XKSAT for each SMU are listed Appendix D.3, organized by NRCS soil survey.

Figure D.1 PSIF as a function of XKSAT

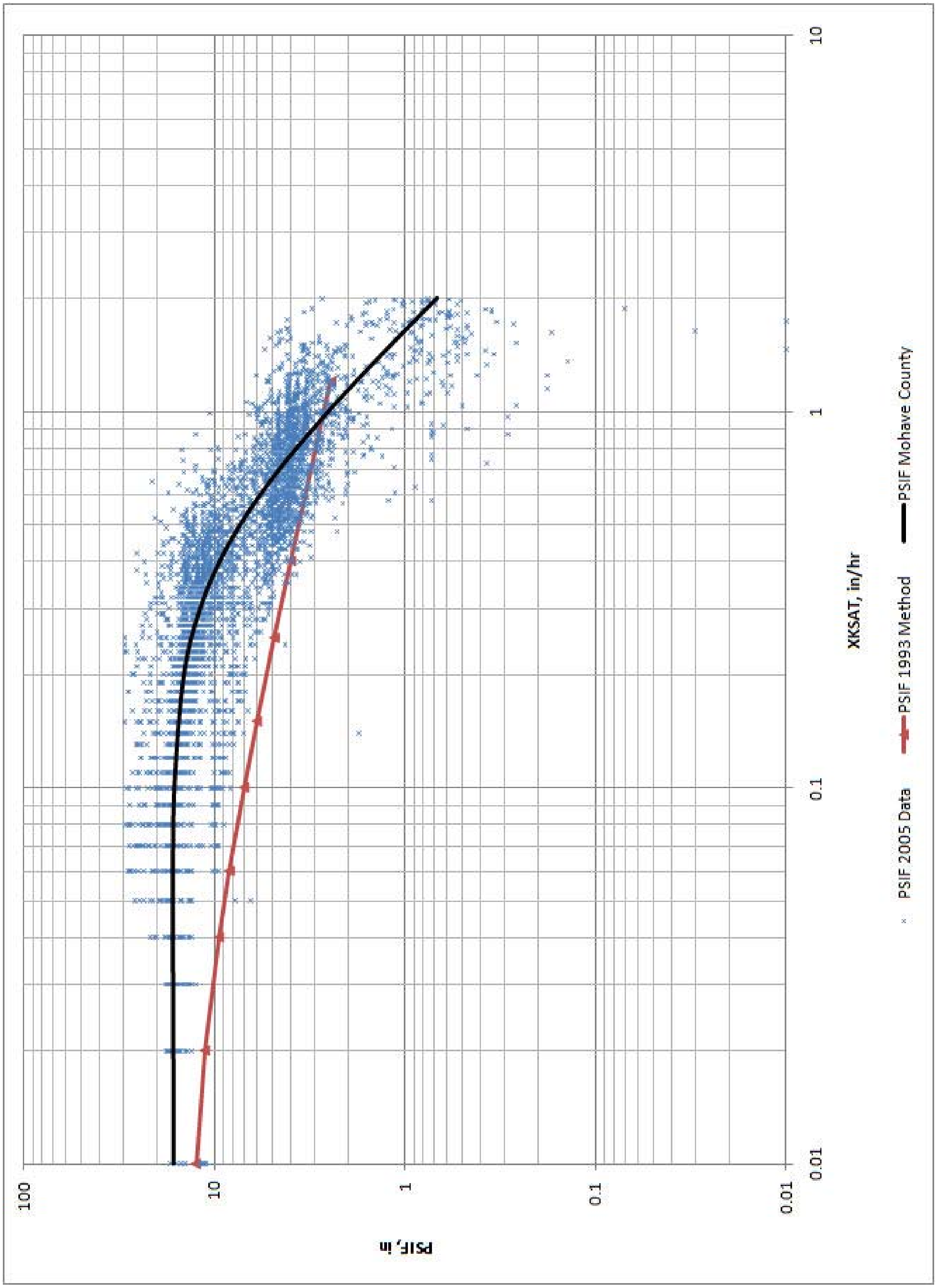
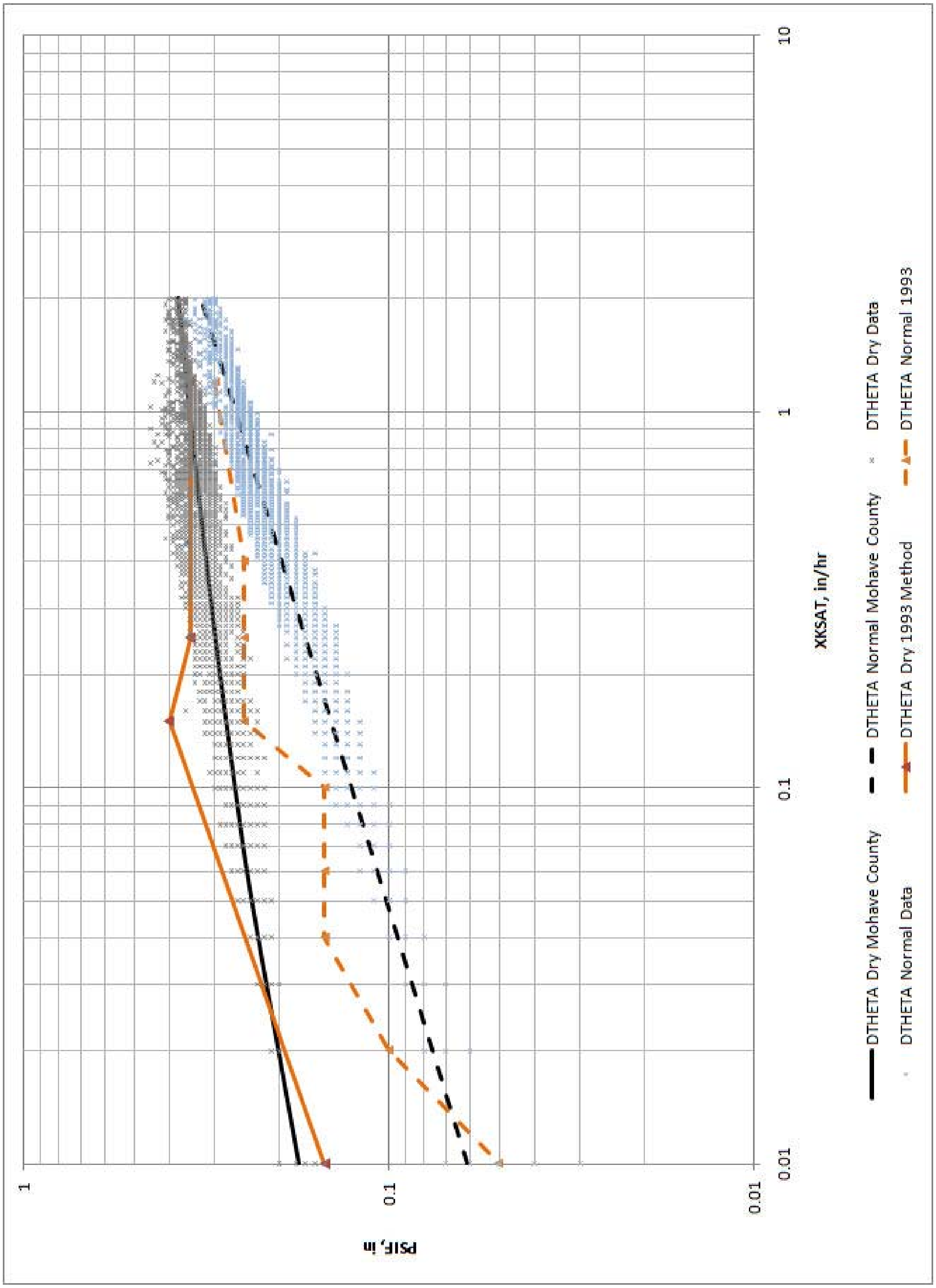


Figure D.2 DTHETA as a function of XKSAT



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D.3 XKSAT VALUES BY NRCS SOIL SURVEY

D.3.1 AZ623

Table D.7 AZ623 Shivwits Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1	Akinville-Mokaac association 2 to 20 percent slopes	0.63	0.32	0
2	Albers silty clay 0 to 1 percent slopes	0.03	0.01	0
3	Arada family loamy fine sand 1 to 10 percent slopes	2.00	1.41	0
4	Arizo gravelly sandy loam 1 to 5 percent slopes nonflooded	0.85	0.45	0
5	Arizo very gravelly sandy loam 1 to 5 percent slopes flooded	0.72	0.38	0
6	Badland	0.42	0.20	0
7	Bard family-Tonopah-Arada family association 1 to 10 percent slopes	1.92	1.28	0
8	Barx fine sandy loam 1 to 5 percent slopes	0.09	0.02	0
9	Barx-Strych complex 1 to 10 percent slopes	0.27	0.11	0
10	Berzatic family-Rock outcrop-Goblin complex 35 to 70 percent slopes	0.31	0.14	30
11	Bisoodi-Anasazi family complex 1 to 8 percent slopes	0.48	0.22	0
12	Blind family-Shelley complex 5 to 15 percent slopes moist	0.82	0.44	0
13	Blind family-Shelley complex 5 to 15 percent slopes stony	0.53	0.26	0
14	Boquillas family-Showlow complex 25 to 50 percent slopes	0.05	0.01	0
15	Carrizo complex 1 to 5 percent slopes	1.09	0.63	0
16	Cave-Harrisburg-Grapevine complex 1 to 15 percent slopes	0.85	0.45	0
17	Chic-Teesto-Rock outcrop complex 1 to 30 percent slopes	0.20	0.08	15
18	Childers-Rizno association 4 to 15 percent slopes	0.50	0.24	0
19	Dera very gravelly fine sandy loam 1 to 10 percent slopes	0.40	0.17	0

Table D.7 AZ623 Shivwits Area Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
20	Dermala family-Guy family-Rock outcrop complex 10 to 40 percent slopes	0.09	0.03	20
21	Disterheff-Natank-Yumtheska complex 2 to 15 percent slopes	0.15	0.04	0
22	Dutchman-McCullan complex 1 to 10 percent slopes	0.54	0.25	0
23	Goblin gravelly fine sandy loam 15 to 50 percent slopes	0.77	0.40	0
24	Goblin-Gyppocket complex 2 to 10 percent slopes	0.51	0.24	0
25	Goesling loam 1 to 5 percent slopes	0.58	0.29	0
26	Grapevine-Hobcan complex 1 to 5 percent slopes	0.85	0.45	0
27	Grapevine-Shelley complex 1 to 5 percent slopes	0.75	0.40	0
28	Gypill-Badland association 10 to 70 percent slopes	0.54	0.26	0
29	Gypill fine sandy loam 15 to 40 percent slopes	0.70	0.33	0
30	Gypill-Hobog complex 6 to 35 percent slopes	0.63	0.30	0
31	Gypill very cobbly sandy loam 15 to 40 percent slopes	0.64	0.34	0
32	Gypsiorthids-Gypsiorthids shallow complex 1 to 50 percent slopes	0.31	0.14	0
33	Havasupai very gravelly loam 1 to 5 percent slopes	0.28	0.12	0
34	Hindu-Rock outcrop-Gypill complex 35 to 70 percent slopes	0.30	0.12	30
35	Hobcan fine sandy loam 1 to 5 percent slopes	0.81	0.41	0
36	Hobog-Grapevine complex 2 to 35 percent slopes	0.61	0.32	0
37	Hobog-Grapevine complex 2 to 35 percent slopes moist	0.61	0.32	0
38	Hobog-Tidwell family complex 8 to 35 percent slopes	0.46	0.22	0
39	Hobog very gravelly sandy loam 5 to 30 percent slopes	0.49	0.25	0
40	Ivanpatch fine sandy loam 1 to 5 percent slopes	0.53	0.25	0

Table D.7 AZ623 Shivwits Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
41	Ives loam 1 to 3 percent slopes	0.33	0.13	0
42	Katzine-Rock outcrop-Yumtheska complex 35 to 70 percent slopes	0.36	0.17	25
43	Meadview-Cave complex 2 to 30 percent slopes stony	0.54	0.27	0
44	Meadview very gravelly sandy loam 2 to 18 percent slopes	0.74	0.39	0
45	Mellenthin-Rock outcrop-Torriorthents complex 10 to 70 percent slopes	0.49	0.24	20
46	Mellenthin-Strych complex 4 to 25 percent slopes cool	0.29	0.13	0
47	Mellenthin-Strych complex 4 to 25 percent slopes warm	0.29	0.13	0
48	Mellenthin-Tanbark complex 5 to 50 percent slopes cool	0.44	0.20	0
49	Mellenthin-Tanbark complex 5 to 50 percent slopes dry	0.45	0.21	0
50	Mellenthin-Tanbark complex 5 to 50 percent slopes warm	0.70	0.36	0
51	Meriwhitica-Rock outcrop-Strych complex 35 to 70 percent slopes	0.32	0.14	30
52	Meriwhitica-Rock outcrop-Strych complex 35 to 70 percent slopes warm	0.32	0.14	30
53	Mespun complex 2 to 10 percent slopes	2.00	1.24	0
54	Moenkopie-Goblin complex 5 to 50 percent slopes	0.57	0.26	0
55	Moenkopie-Pennell-Rock outcrop complex 10 to 50 percent slopes	0.61	0.29	20
56	Nikey family-Ruesh family-Rock outcrop complex 10 to 40 percent slopes	0.39	0.18	25
57	Nipton-Rock outcrop-Nickel family complex 10 to 50 percent slopes	0.48	0.22	20
58	Nutter-Gyppocket complex 2 to 20 percent slopes	0.41	0.18	0
59	Padilla silt loam 1 to 5 percent slopes	0.09	0.02	0
60	Pocum-Childers-Ubank complex 1 to 10 percent slopes	0.41	0.18	0
61	Pocum-Spenlo complex 1 to 10 percent slopes	0.38	0.16	0

Table D.7 AZ623 Shivwits Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
62	Pompeii family-Huevi complex 2 to 15 percent slopes	0.18	0.06	0
63	Radnik loam 1 to 5 percent slopes	0.52	0.24	0
64	Riverwash-Torrifluvents complex 1 to 3 percent slopes	2.00	1.99	0
65	Rizno-Bond-Rock outcrop complex 4 to 25 percent slopes	0.38	0.16	15
66	Robroost fine sandy loam 1 to 3 percent slopes	0.40	0.16	0
67	Ruesh very gravelly fine sandy loam 3 to 20 percent slopes	0.52	0.23	0
68	Sedillo very cobbly loam 1 to 8 percent slopes	0.06	0.01	0
69	Showlow-Thunderbird complex 2 to 25 percent slopes	0.04	0.01	0
70	Showlow very cobbly clay loam 1 to 15 percent slopes	0.08	0.02	0
71	Sponiker loam 1 to 10 percent slopes	0.57	0.30	0
72	Springerville-Delenbaw complex 3 to 25 percent slopes	0.07	0.02	0
73	Strych very gravelly loam 2 to 10 percent slopes	0.28	0.12	0
74	Tanbark family-Strych family-Rock outcrop complex 10 to 40 percent slopes	0.56	0.29	25
75	Tanbark loam 15 to 75 percent slopes	0.72	0.35	0
76	Tassi-Rizno complex 5 to 35 percent slopes	0.41	0.18	0
77	Tonopah gravelly loamy fine sand 1 to 10 percent slopes	2.00	1.57	0
78	Torriorthents-Calciorthids-Rock outcrop complex 10 to 40 percent slopes	1.34	0.80	15
79	Tours silt loam 1 to 3 percent slopes	0.10	0.02	0
80	Tsezhin family-Ashfork family-Rock outcrop complex 10 to 70 percent slopes	0.16	0.06	20
81	Tsezhin very cobbly sandy loam 5 to 15 percent slopes	0.26	0.12	0
82	Twist sandy loam 2 to 10 percent slopes	0.12	0.03	0
83	Twist very cobbly loam 1 to 8 percent slopes	0.08	0.02	0
84	Virgin Peak-Rock outcrop complex 10 to 70 percent slopes	0.38	0.18	30

Table D.7 AZ623 Shivwits Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
85	Whishey silt loam 1 to 4 percent slopes	0.39	0.18	0
86	Winkel-Rock outcrop complex 2 to 35 percent slopes	0.24	0.10	15
87	Winkel-Rock outcrop complex 2 to 35 percent slopes moist	0.24	0.10	15
88	Winkel very gravelly loam 2 to 25 percent slopes	0.24	0.10	0
89	Winkel very gravelly loam 2 to 25 percent slopes moist	0.24	0.10	0
90	Wutoma-Lozinta complex 15 to 50 percent slopes	0.30	0.13	0
91	Yellowhorse family silty clay o to 3 percent slopes	0.08	0.02	0
92	Yellowhorse-Luzena family complex 1 to 10 percent slopes	0.04	0.01	0
93	Yumtheska-Katzine-Rock outcrop complex 2 to 30 percent slopes	0.43	0.21	20
94	Yumtheska-Katzine-Rock outcrop complex 5 to 50 percent slopes moist	0.40	0.19	15
95	Yumtheska-Natank complex 10 to 45 percent slopes	0.33	0.14	0
96	Yurm family-Meadview association 15 to 40 percent slopes	0.38	0.17	0
97	Yurm family-Meadview association 15 to 40 percent slopes moist	0.38	0.17	0
98	Yurm family very gravelly loam 15 to 35 percent slopes	0.32	0.13	0
99	Yurm family very gravelly loam 15 to 35 percent slopes moist	0.32	0.13	0

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D.3.2 AZ625

Table D.8 AZ625 Mohave County Area, Northeastern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
1	Badland	0.42	0.20	0
2	Barx fine sandy loam 1 to 5 percent slopes	0.99	0.56	0
3	Barx loam 1 to 4 percent slopes	0.30	0.12	0
4	Begay fine sandy loam 1 to 3 percent slopes	1.14	0.66	0
5	Begay fine sandy loam 3 to 12 percent slopes	1.14	0.66	0
6	Bidonia-Bond-Rock outcrop complex 1 to 25 percent slopes	0.42	0.21	15
7	Bond-Bidonia complex 1 to 7 percent slopes	0.96	0.52	0
8	Brinkerhoff-Grieta complex 0 to 5 percent slopes	0.94	0.50	0
9	Campanile clay 1 to 6 percent slopes	0.03	0.01	0
10	Clayhole loam 1 to 3 percent slopes	0.21	0.07	0
11	Curhollow-Prieta complex 4 to 20 percent slopes	0.09	0.02	0
12	Godding gravelly loam 3 to 40 percent slopes	0.48	0.25	0
13	Grieta fine sandy loam 1 to 5 percent slopes	0.83	0.43	0
14	Grieta loam 1 to 5 percent slopes	0.36	0.15	0
15	Gypsiorthids-Gypsiorthids shallow complex 1 to 50 percent slopes	0.31	0.14	0
16	Hatknoll-Kinan complex 1 to 10 percent slopes	0.16	0.05	0
17	Havasupai-Mellenthin complex 2 to 12 percent slopes	0.19	0.07	0
18	Jocity loamy fine sand saline-sodic 1 to 3 percent slopes	2.00	1.26	0
19	Jocity-Clayhole complex 1 to 4 percent slopes	0.07	0.01	0
20	Jocity silty clay loam 1 to 4 percent slopes	0.08	0.02	0
21	Jocity silty clay loam 1 to 2 percent slopes flooded	0.07	0.01	0
22	Kinan gravelly loam 1 to 15 percent slopes	0.36	0.15	0
23	Kinan-Hatknoll-Grieta complex 1 to 5 percent slopes	0.27	0.09	0
24	Kinan-Pennell complex 1 to 20 percent slopes	0.35	0.15	0
25	Klondike sandy clay loam 2 to 15 percent slopes	0.06	0.01	0
26	Lava flows	0.01	0.01	100
27	Lozinta extremely gravelly loam 1 to 15 percent slopes	0.20	0.08	0

Table D.8 AZ625 Mohave County Area, Northeastern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
28	Lozinta extremely gravelly loam 15 to 45 percent slopes	0.20	0.08	0
29	Manikan silty clay loam 1 to 4 percent slopes	0.10	0.03	0
30	Mellenthin-Anasazi complex 1 to 15 percent slopes	0.67	0.35	0
31	Mellenthin-Barx complex 1 to 15 percent slopes	0.32	0.14	0
32	Mellenthin-Progresso complex 1 to 7 percent slopes	0.41	0.19	0
33	Mellenthin very gravelly loam 1 to 25 percent slopes	0.24	0.11	0
34	Mellenthin very gravelly loam 30 to 50 percent slopes	0.24	0.11	0
35	Mellenthin very gravelly loam cool 1 to 25 percent slopes	0.24	0.11	0
36	Mellenthin very gravelly loam warm 1 to 25 percent slopes	0.24	0.11	0
37	Mido fine sand 1 to 10 percent slopes	2.00	1.91	0
38	Mido loamy fine sand 1 to 4 percent slopes gullied	2.00	1.32	0
39	Milok gravelly loam 1 to 15 percent slopes	0.37	0.17	0
40	Moab loam 1 to 5 percent slopes	0.23	0.09	0
41	Moab-Mellenthin complex 1 to 20 percent slopes	0.23	0.10	0
42	Monue fine sandy loam 1 to 5 percent slopes	0.86	0.45	0
43	Padilla-Penistaja-Campanile complex 1 to 6 percent slopes	0.09	0.03	0
44	Palma loamy fine sand 1 to 5 percent slopes	2.00	1.24	0
45	Penistaja fine sandy loam 1 to 5 percent slopes	0.83	0.43	0
46	Pennell-Bacobi complex 1 to 7 percent slopes	0.49	0.21	0
47	Pennell gravelly loam 1 to 12 percent slopes	0.34	0.14	0
48	Poley cobbly silty clay loam 1 to 5 percent slopes	0.05	0.01	0
49	Poley-Moab complex 1 to 10 percent slopes	0.11	0.03	0
50	Radnik fine sandy loam 1 to 5 percent slopes	1.06	0.60	0
51	Riverwash	2.00	1.99	0
52	Royosa fine sand 2 to 10 percent slopes	2.00	1.24	0
53	Royosa-Tonalea complex 1 to 15 percent slopes	2.00	1.76	0
54	Saido-Brinkerhoff complex 1 to 5 percent slopes	0.18	0.05	0

Table D.8 AZ625 Mohave County Area, Northeastern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
55	Sheppard fine sand 1 to 7 percent slopes	2.00	1.33	0
56	Sheppard loamy fine sand 1 to 4 percent slopes gullied	2.00	1.33	0
57	Showlow-Section complex 1 to 15 percent slopes	0.18	0.07	0
58	Showlow-Thimble complex 1 to 15 percent slopes	0.07	0.03	0
59	Showlow very cobbly clay loam 1 to 15 percent slopes	0.08	0.02	0
60	Showlow very cobbly silty clay loam 15 to 35 percent slopes	0.08	0.03	0
61	Sponiker gravelly loam 1 to 15 percent slopes	0.48	0.25	0
62	Sponiker gravelly loam 15 to 40 percent slopes	0.48	0.25	0
63	Torriorthents-Rock outcrop complex 30 to 70 percent slopes	1.34	0.80	45
64	Torriorthents-Rock outcrop complex dry 30 to 70 percent slopes	1.34	0.80	45
65	Torriorthents-Rock outcrop complex warm 30 to 70 percent slopes	1.34	0.80	45
66	Whiskey silt loam 1 to 4 percent slopes	0.40	0.18	0
67	Wukoki-Lomaki complex 15 to 50 percent slopes	0.15	0.05	0
68	Wutoma-Lozinta complex 1 to 15 percent slopes	0.21	0.09	0
69	Wutoma-Lozinta complex 15 to 50 percent slopes	0.21	0.09	0
70	Wutoma-Rock outcrop complex 1 to 15 percent slopes	0.31	0.13	30
71	Yumtheska-Goesling complex 1 to 15 percent slopes	0.32	0.15	0
72	Yumtheska very gravelly loam 4 to 20 percent slopes	0.27	0.13	0
73	Yumtheska very gravelly loam 30 to 50 percent slopes	0.27	0.13	0

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D.3.3 AZ627

Table D.9 AZ627 Mohave County Southern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
1	Akela-Rock outcrop-Rubble land complex 40 to 70 percent slopes	0.30	0.13	40
2	Akela-Rock outcrop-Rubble land complex dry 40 to 70 percent slopes	0.30	0.13	40
3	Alko family cobbly loam 2 to 15 percent slopes	0.39	0.18	0
4	Alko family cobbly loam dry 2 to 15 percent slopes	0.39	0.18	0
5	Amole sandy loam 1 to 3 percent slopes	0.85	0.45	0
6	Amole sandy loam dry 1 to 3 percent slopes	0.84	0.44	0
7	Anthony-Dudleyville complex 1 to 3 percent slopes	0.95	0.53	0
8	Aquarius-Akela-Rock outcrop complex 1 to 25 percent slopes	0.17	0.06	20
9	Arizo-Franconia-Riverwash complex 1 to 3 percent slopes	1.01	0.62	0
10	Arizo-Franconia-Riverwash complex dry 1 to 3 percent slopes	1.03	0.63	0
11	Bartmus very gravelly sandy loam 2 to 15 percent slopes	0.18	0.07	0
12	Bonita family very cobbly silty clay loam 2 to 10 percent slopes	0.03	0.01	0
13	Bonita family-Gonzales complex 10 to 35 percent slopes	0.03	0.01	0
14	Brazito family sand 0 to 3 percent slopes	2.00	2.00	0
15	Bucklebar sandy loam 1 to 3 percent slopes	0.93	0.50	0
16	Cacique family extremely gravelly loam 1 to 7 percent slopes	0.13	0.04	0
17	Castaneda extremely gravelly loam 1 to 7 percent slopes	0.06	0.01	0
18	Castaneda extremely gravelly loam dry 1 to 7 percent slopes	0.06	0.01	0
19	Carrizo family very gravelly loamy sand 1 to 3 percent slopes	1.23	0.74	0
20	Carrizo family-Riverwash complex 1 to 3 percent slopes	1.38	0.93	0

Table D.9 AZ627 Mohave County Southern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
21	Carrizo-Riverwash complex 3 to 8 percent slopes	1.21	0.76	0
22	Carrizo-Riverwash complex 1 to 3 percent slopes	1.40	0.95	0
23	Cave gravelly sandy loam 10 to 35 percent slopes	0.72	0.38	0
24	Cave gravelly sandy loam dry 10 to 35 percent slopes	0.72	0.38	0
25	Cellar-Rock outcrop complex 20 to 60 percent slopes	0.55	0.28	25
26	Cellar-Rock outcrop complex dry 20 to 60 percent slopes	0.55	0.28	25
27	Cellar-Topock-Rock outcrop complex 5 to 35 percent slopes	0.11	0.07	20
28	Cherioni very cobbly loam 2 to 15 percent slopes	0.06	0.01	0
29	Chuckawalla-Riverbend complex 2 to 15 percent slopes	0.23	0.09	0
30	Chuckawalla-Riverbend families complex 2 to 15 percent slopes	0.22	0.08	0
31	Cipriano very stony loam 2 to 10 percent slopes	0.32	0.14	0
32	Cline very stony loam 2 to 15 percent slopes	0.12	0.04	0
33	Cline very stony loam dry 2 to 15 percent slopes	0.12	0.04	0
34	Continental-Tres Hermanos complex 2 to 15 percent slopes	0.12	0.03	0
35	Continental-Tres Hermanos complex dry 2 to 15 percent slopes	0.12	0.03	0
36	Continental-Rillino complex 2 to 15 percent slopes	0.15	0.04	0
37	Continental-Rillino complex dry 2 to 15 percent slopes	0.15	0.04	0
38	Coolidge-Denure complex 1 to 7 percent slopes	1.10	0.62	0
39	Coolidge-Denure families complex 1 to 7 percent slopes	0.71	0.37	0
40	Courthouse family-Rock outcrop-Rubble land complex 40 to 70 percent slopes	0.36	0.17	40
41	Courthouse family-Rock outcrop-Wagonbow complex 15 to 70 percent slopes	0.21	0.08	30
42	Far-Rock outcrop complex 10 to 45 percent slopes	0.58	0.33	20

Table D.9 AZ627 Mohave County Southern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
43	Dutchflat sandy loam 0 to 2 percent slopes	0.93	0.50	0
44	Dutchflat fine sandy loam dry 1 to 3 percent slopes	0.13	0.04	0
45	Gadsden silty clay 0 to 1 percent slopes	0.03	0.01	0
46	Gila-Glendale complex 1 to 3 percent slopes	0.37	0.15	0
47	Gila-Glendale complex dry 1 to 3 percent slopes	0.37	0.15	0
48	Goldroad-Rock outcrop complex 20 to 60 percent slopes	0.53	0.27	20
49	Gonzales-Rock outcrop complex 15 to 35 percent slopes	0.03	0.01	25
50	Goodsprings family gravelly sandy loam 1 to 15 percent slopes	0.50	0.23	0
51	Goodsprings family gravelly sandy loam dry 1 to 15 percent slopes	0.50	0.23	0
52	Goodsprings family gravelly sandy loam 10 to 35 percent slopes	0.50	0.23	0
53	Goodsprings family gravelly sandy loam dry 10 to 35 percent slopes	0.50	0.23	0
54	Graham-Arivaca complex 2 to 15 percent slopes	0.09	0.03	0
55	Graham-Rock outcrop complex 10 to 40 percent slopes	0.13	0.04	20
56	Gunsight very gravelly loam 2 to 15 percent slopes	0.23	0.09	0
57	Gunsight very gravelly sandy loam 10 to 40 percent slopes	0.62	0.32	0
58	Hassell family-Lampshire-Rock outcrop complex 10 to 30 percent slopes	0.45	0.22	20
59	Holtville silty clay 0 to 1 percent slopes	0.03	0.01	0
60	Huevi very gravelly loam 2 to 15 percent slopes	0.32	0.14	0
61	Huevi very gravelly loam 10 to 40 percent slopes	0.33	0.15	0
62	Akela-Rock outcrop complex 20 to 60 percent slopes	0.54	0.28	20
63	Hyder-Rock outcrop-Rubble land complex 40 to 70 percent slopes	0.30	0.13	40
64	Indio silt loam 0 to 1 percent slopes	0.16	0.05	0
65	Ireteba family-Arizo complex 1 to 3 percent slopes	0.77	0.41	0

Table D.9 AZ627 Mohave County Southern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
66	Kinley gravelly loamy sand 15 to 35 percent slopes	0.94	0.50	0
67	Kinley-Poachie complex 2 to 15 percent slopes	0.30	0.11	0
68	Kofa silty clay 0 to 1 percent slopes	0.06	0.01	0
69	Dudleyville-Vinton-Riverwash complex 1 to 3 percent slopes	1.40	0.91	0
70	Dudleyville-Vinton-Riverwash complex dry 1 to 3 percent slopes	1.40	0.91	0
71	Lagunita sand 0 to 1 percent slopes	2.00	1.91	0
72	Lagunita-Ripley complex 0 to 3 percent slopes	0.91	0.61	0
73	Lampshire-Rock outcrop complex 20 to 60 percent slopes	0.72	0.40	20
74	Lampshire-Rock outcrop complex cool 30 to 70 percent slopes	0.45	0.23	20
75	Lampshire-Rock outcrop complex 15 to 60 percent slopes stony	0.42	0.22	40
76	Lostman gravelly sandy loam moist 1 to 5 percent slopes	0.62	0.32	0
77	Lostman sandy loam dry 1 to 3 percent slopes	0.88	0.47	0
78	Lostman-Kinley complex 1 to 7 percent slopes	0.81	0.43	0
79	Marshes	0.01	0.01	100
80	Meloland very fine sandy loam 0 to 1 percent slopes	0.75	0.38	0
81	Mohon-Kinley complex 2 to 15 percent slopes	0.21	0.07	0
82	Mohon-Poachie complex 2 to 15 percent slopes	0.18	0.05	0
83	Mohon-Poachie complex dry 2 to 15 percent slopes	0.18	0.05	0
84	Nickel-Topawa-Eba families complex 10 to 50 percent slopes	0.31	0.22	0
85	Orwash family sandy loam 1 to 3 percent slopes	0.85	0.45	0
86	Orwash family sandy loam dry 1 to 3 percent slopes	0.85	0.45	0
87	Penthouse-Gonzales complex 5 to 35 percent slopes	0.08	0.02	0
88	Poachie very gravelly loam 1 to 4 percent slopes	0.23	0.09	0

Table D.9 AZ627 Mohave County Southern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
89	Poachie very gravelly loam dry 1 to 4 percent slopes	0.23	0.09	0
90	Quilotosa-Rock outcrop complex 20 to 60 percent slopes	0.53	0.27	20
91	Razorback extremely gravelly sandy loam 15 to 35 percent slopes	0.53	0.27	0
92	Razorback-Rock outcrop complex 1 to 25 percent slopes	0.30	0.13	20
93	Razorback-Rock outcrop complex 15 to 70 percent slopes	0.30	0.13	20
94	Razorback-Rock outcrop complex dry 15 to 70 percent slopes	0.30	0.13	20
95	Razorback-Rock outcrop-Rubble land complex 40 to 70 percent slopes	0.30	0.13	40
96	Razorback-Rock outcrop-Rubble land complex dry 40 to 70 percent slopes	0.30	0.13	40
97	Rillino gravelly loamy sand 15 to 35 percent slopes	0.21	0.08	0
98	Rillino-Tres Hermanos complex 2 to 15 percent slopes	0.14	0.05	0
99	Ripley silt loam 0 to 1 percent slopes	0.18	0.05	0
100	Riverbend family very cobbly sandy loam 2 to 15 percent slopes	0.58	0.30	0
101	Riverbend very cobbly sandy loam 2 to 15 percent slopes	0.54	0.27	0
102	Riverwash-Fluvaquents association 0 to 3 percent slopes	2.00	1.99	0
103	Rock outcrop-Hyder complex 35 to 65 percent slopes	0.30	0.13	45
104	Rock outcrop-Razorback complex 20 to 70 percent slopes	0.30	0.13	65
105	Rock outcrop-Sunrock complex 35 to 65 percent slopes	0.52	0.27	45
106	Romero-Chiricahua-Rock outcrop complex 5 to 35 percent slopes	0.04	0.02	20
107	Romero-Lampshire-Rock outcrop complex 35 to 70 percent slopes	0.18	0.07	15

Table D.9 AZ627 Mohave County Southern Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
108	Rositas family superstition and torriorthents soils 1 to 60 percent slopes	1.79	1.43	0
109	Rositas superstition family and torriorthents soils 1 to 60 percent slopes	1.82	1.56	0
110	Stagecoach very gravelly loam 2 to 15 percent slopes	0.33	0.15	0
111	Stagecoach very gravelly loam 10 to 40 percent slopes	0.33	0.15	0
112	Stagecoach very gravelly sandy loam 5 to 35 percent slopes	0.42	0.19	0
113	Stagecoach very gravelly sandy loam dry 5 to 35 percent slopes	0.42	0.19	0
114	Stagecoach-Topawa family-Eba complex 10 to 50 percent slopes	0.09	0.05	0
115	Stagecoach-Topawa family-Eba complex dry 10 to 50 percent slopes	0.09	0.05	0
116	Sunrock extremely gravelly sandy loam 15 to 35 percent slopes	0.49	0.25	0
117	Sunrock-Rock outcrop complex 30 to 65 percent slopes	0.49	0.25	20
118	Tombstone-Caralampi-Eloma complex 10 to 50 percent slopes	0.46	0.23	0
119	Torriorthents 35 to 65 percent slopes	1.34	0.80	0
120	Torriorthents dry 35 to 65 percent slopes	1.34	0.80	0
121	Tumarion very cobbly loam 2 to 15 percent slopes	0.12	0.04	0
122	Tumarion very cobbly loam dry 2 to 15 percent slopes	0.13	0.04	0
123	Tyro extremely stony sandy loam 3 to 35 percent slopes	0.51	0.26	0
124	Tyro very stony loam 2 to 10 percent slopes	0.30	0.13	0
125	Vekol family gravelly loamy sand 2 to 7 percent slopes	1.53	0.92	0
126	Vekol family gravelly loamy sand dry 2 to 7 percent slopes	1.53	0.92	0
127	Water	0.01	0.01	100
128	Whitehills very gravelly loam 1 to 5 percent slopes	0.22	0.09	0

Table D.9 AZ627 Mohave County Southern Part Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
129	Whitehills very gravelly loam dry 2 to 15 percent slopes	0.22	0.09	0
130	White House family very gravelly loamy sand 2 to 15 percent slopes	0.11	0.04	0
131	White House gravelly loamy sand 2 to 15 percent slopes	0.20	0.07	0
132	Wikieup-Mutang-Rock outcrop complex 5 to 35 percent slopes	0.55	0.29	20
133	Mutang-Wikieup-Rock outcrop complex 3 to 30 percent slopes	0.39	0.17	15
134	Wikieup-Rock outcrop complex dry 20 to 60 percent slopes	0.57	0.29	25
135	Yahana family silty clay loam 1 to 3 percent slopes	0.11	0.03	0
136	Tumarion-Nickel family complex 8 to 35 percent slopes	0.32	0.14	0
137	Valena-Rock outcrop-Carri family complex 1 to 25 percent slopes	0.54	0.26	20
138	Nodman-Rock outcrop complex 15 to 65 percent slopes	0.09	0.02	20
139	Nodman-Romero family complex 15 to 65 percent slopes	0.43	0.21	0

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D.3.4 AZ629

Table D.10 AZ629 Coconino County Area North Kaibab Part Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1	Aneth fine sand 2 to 16 percent slopes	1.83	1.10	0
2	Arches-Pensom complex 4 to 12 percent slopes	2.00	1.94	0
3	Arches-Pensom complex cool 4 to 12 percent slopes	2.00	1.95	0
4	Barx gravelly loam 1 to 6 percent slopes	0.35	0.15	0
5	Barx-Pensom complex 1 to 6 percent slopes	1.07	0.66	0
6	Bidonia-Rock outcrop complex 1 to 15 percent slopes	0.43	0.20	15
7	Bison-Curob complex 2 to 6 percent slopes	0.27	0.11	0
8	Clayhole silty clay loam 1 to 5 percent slopes	0.08	0.02	0
9	Clayhole-Torriorthents complex 2 to 25 percent slopes	0.53	0.24	0
10	Curhollow-Mellenthin complex 2 to 12 percent slopes	0.24	0.11	0
11	Curob loamy sand 2 to 10 percent slopes	2.00	1.37	0
12	Curob very gravelly loam 2 to 12 percent slopes	0.21	0.08	0
13	Disterheff very gravelly loam 2 to 15 percent slopes	0.28	0.13	0
14	Disterheff-Houserock complex 3 to 15 percent slopes	0.43	0.20	0
15	Doak fine sandy loam 1 to 6 percent slopes	0.11	0.03	0
16	Glenyon silty clay loam 0 to 2 percent slopes	0.06	0.01	0
17	Houserock-Disterheff complex 3 to 15 percent slopes	0.40	0.18	0
18	Jocity clay loam 1 to 3 percent slopes	0.07	0.01	0
19	Jocity silty clay loam 1 to 3 percent slopes	0.07	0.01	0
20	Keeseha loam 1 to 6 percent slopes	0.03	0.01	0
21	Kinan-Pennell complex 4 to 15 percent slopes	0.57	0.28	0
22	Kinan-Pennell complex dry 4 to 15 percent slopes	0.57	0.28	0
23	Klondike sandy clay loam 2 to 15 percent slopes	0.16	0.05	0
24	Manikan silty clay loam 1 to 3 percent slopes	0.09	0.03	0
25	Mellenthin very gravelly loam 1 to 25 percent slopes	0.24	0.11	0

Table D.10 AZ629 Coconino County Area North Kaibab Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
26	Mellenthin very gravelly loam 30 to 60 percent slopes	0.24	0.11	0
27	Monierco clay loam 2 to 15 percent slopes	0.05	0.01	0
28	Monue sandy loam 1 to 6 percent slopes	0.86	0.45	0
29	Monue-Seeg complex 1 to 6 percent slopes	0.81	0.42	0
30	Needle-Rock outcrop complex 4 to 15 percent slopes	2.00	1.43	15
31	Needle-Sheppard complex 2 to 12 percent slopes	2.00	1.56	0
32	Pagina loamy sand 1 to 3 percent slopes	1.87	1.13	0
33	Pagina-Wahweap complex 3 to 16 percent slopes	1.83	1.10	0
34	Pennell cobbly loam 3 to 10 percent slopes	0.28	0.11	0
35	Pennell gravelly sandy loam 20 to 45 percent slopes	0.53	0.25	0
36	Pennell sandy loam 20 to 45 percent slopes	0.83	0.43	0
37	Pensom fine sand 2 to 16 percent slopes	2.00	1.89	0
38	Pensom-Arches complex 4 to 12 percent slopes	2.00	1.34	0
39	Pensom-Arches complex moist 4 to 16 percent slopes	2.00	1.34	0
40	Pits borrow	0.03	0.01	0
41	Rock outcrop	0.01	0.01	85
42	Rock outcrop-Needle complex 4 to 50 percent slopes	2.00	1.43	55
43	Rock outcrop-Torriorthents complex warm 25 to 65 percent slopes	1.34	0.80	65
44	Sheppard loamy fine sand 1 to 5 percent slopes	2.00	1.85	0
45	Sheppard loamy fine sand 5 to 15 percent slopes	2.00	1.85	0
46	Strych loam 1 to 4 percent slopes	0.24	0.11	0
47	Torriorthents 3 to 50 percent slopes	1.34	0.80	0
48	Torriorthents-Rock outcrop complex 25 to 65 percent slopes	1.34	0.80	30
49	Wahweap loamy sand 0 to 5 percent slopes	1.70	1.02	0
50	Wahweap-Rock outcrop complex 1 to 15 percent slopes	0.76	0.40	35
51	Yumtheska very gravelly loam 4 to 30 percent slopes	0.27	0.13	0

Table D.10 AZ629 Coconino County Area North Kaibab Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
52	Yumtheska-Houserock association 4 to 20 percent slopes	0.31	0.15	0
53	Water	0.01	0.01	100

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D.3.5 AZ631

Table D.11 AZ631 Coconino County Central Part Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1	Ashfork gravelly clay loam 1 to 15 percent slopes	0.07	0.01	0
2	Aut gravelly loam 0 to 8 percent slopes	0.28	0.12	0
3	Aut-Cross association moderately sloping	0.17	0.07	0
4	Aut-Lynx association gently sloping	0.22	0.08	0
5	Badland-Torriorthents complex moderately steep	0.60	0.31	0
6	Boquillas-Seligman complex 1 to 15 percent slopes	0.17	0.06	0
7	Clovis loamy sand 1 to 8 percent slopes	2.00	1.35	0
8	Cross-Apache complex 2 to 15 percent slopes	0.09	0.02	0
9	Daze-Deama association moderately steep	0.35	0.15	0
10	Deama gravelly loam 2 to 15 percent slopes	0.25	0.10	0
11	Deama stony loam 1 to 15 percent slopes	0.20	0.08	0
12	Deama-Rock outcrop complex 8 to 30 percent slopes	0.21	0.08	30
13	Deama-Toqui complex 0 to 8 percent slopes	0.41	0.19	0
14	Deama-Tovar association steep	0.17	0.06	0
15	Disterheff very gravelly sandy clay loam 1 to 15 percent slopes	0.06	0.02	0
16	Disterheff-Kopie association moderately sloping	0.39	0.18	0
17	Epikom very cindery loamy sand 0 to 5 percent slopes	1.17	0.69	0
18	Epikom complex 0 to 15 percent slopes	0.54	0.27	0
19	Epikom-Rock outcrop complex 8 to 60 percent slopes	0.54	0.27	20
20	Faraway-Rock outcrop complex 20 to 80 percent slopes	0.37	0.18	30
21	Keeseha-Poley gravelly sandy loams 0 to 8 percent slopes	0.66	0.34	0
22	Kopie-Servilleta association moderately sloping	0.16	0.05	0
23	Lava flows	0.01	0.01	100
24	Lomaki-Nalaki very cindery loams 0 to 8 percent slopes	0.14	0.05	0

Table D.11AZ631 Coconino County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
25	Mespun-Palma complex 1 to 8 percent slopes	1.43	0.95	0
26	Navajo clay 0 to 5 percent slopes	0.02	0.01	0
27	Palma sandy loam 0 to 5 percent slopes	0.81	0.43	0
28	Pastura gravelly loam 0 to 8 percent slopes	0.20	0.07	0
29	Paymaster-Lynx association gently sloping	0.41	0.18	0
30	Poley sandy loam 0 to 5 percent slopes	0.60	0.29	0
31	Poley gravelly loam 0 to 8 percent slopes	0.28	0.12	0
32	Poley-Lynx association gently sloping	0.22	0.08	0
33	Poley-Tusayan association gently sloping	0.28	0.12	0
34	Purgatory gravelly fine sandy loam 0 to 8 percent slopes	0.70	0.36	0
35	Quivera very gravelly loam 0 to 8 percent slopes	0.13	0.05	0
36	Riverwash	2.00	1.99	0
37	Rune silty clay loam 0 to 8 percent slopes	0.17	0.07	0
38	Rune-Disterheff association gently sloping	0.11	0.04	0
39	Servilleta fine sandy loam 1 to 8 percent slopes	0.05	0.01	0
40	Servilleta-Tusayan complex 1 to 8 percent slopes	0.18	0.05	0
41	Showlow gravelly fine sandy loam 0 to 8 percent slopes	0.04	0.01	0
42	Showlow gravelly fine sandy loam 8 to 30 percent slopes	0.04	0.01	0
43	Springerville cobbly clay 0 to 8 percent slopes	0.02	0.01	0
44	Springerville very stony clay 0 to 8 percent slopes	0.02	0.01	0
45	Tajo-Springerville complex 0 to 15 percent slopes	0.07	0.03	0
46	Tenorio very gravelly sandy loam 0 to 8 percent slopes	0.99	0.58	0
47	Thunderbird-Cabezon complex 2 to 30 percent slopes	0.04	0.01	0
48	Thunderbird-Rock outcrop complex 30 to 60 percent slopes	0.04	0.01	30
49	Thunderbird-Springerville association strongly sloping	0.03	0.01	0
50	Torrifluvents saline	2.00	1.99	0

Table D.11 AZ631 Coconino County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
51	Tours silty clay loam 0 to 8 percent slopes	0.06	0.01	0
52	Tours-Ives association gently sloping	0.87	0.45	0
53	Tovar complex 2 to 25 percent slopes	0.31	0.13	0
54	Tovar complex 25 to 60 percent slopes	0.27	0.12	0
55	Tusayan-Lynx association gently sloping	0.20	0.07	0
56	Tuweep very gravelly loam 0 to 15 percent slopes	0.14	0.05	0
57	Valle gravelly silt loam 0 to 8 percent slopes	0.25	0.11	0
58	Wilaha cindery loam 2 to 30 percent slopes	0.21	0.08	0
59	Wilaha-Wukoki association steep	0.20	0.08	0
60	Winona gravelly loam 0 to 8 percent slopes	0.15	0.05	0
61	Winona stony loam 0 to 8 percent slopes	0.15	0.05	0
62	Winona-Boysag gravelly loams 0 to 8 percent slopes	0.22	0.08	0
63	Winona-Epikom association gently sloping	0.30	0.12	0
64	Winona-Rock outcrop complex 15 to 30 percent slopes	0.15	0.05	30
65	Winona-Rock outcrop complex 30 to 70 percent slopes	0.15	0.05	30
66	Winona-Tusayan association gently sloping	0.33	0.13	0
67	Wukoki-Rock outcrop complex 5 to 25 percent slopes	0.17	0.07	25
68	Wukoki-Wupatki very cindery loams 15 to 60 percent slopes	0.17	0.07	0
69	Wupatki-Wukoki very cindery loams 0 to 15 percent slopes	0.17	0.07	0
70	Ziegler gravelly loam 0 to 8 percent slopes	0.46	0.22	0
71	Ziegler-Cross association moderately sloping	0.26	0.10	0
72	Ziegler-Wilaha association strongly sloping	0.37	0.17	0
73	Water	0.01	0.01	100

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D.3.6 AZ637

Table D.12 AZ637 Yavapai County Western Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
AaB	Abra gravelly sandy loam 0 to 8 percent slopes	0.55	0.27	0
AbB	Abra-Lonti loams 0 to 5 percent slopes	0.39	0.18	0
AeB	Abra-Poley loams 0 to 5 percent slopes	0.22	0.08	0
AlC	Abra-Balon association rolling	0.22	0.08	0
AlD	Abra-Balon association hilly	0.23	0.09	0
AmC	Abra-Lynx association rolling	0.31	0.13	0
AnC	Abra-Wineg association rolling	0.25	0.10	0
AoC	Anthony gravelly loamy sand 8 to 15 percent slopes	0.46	0.22	0
ApB	Anthony gravelly sandy loam 0 to 8 percent slopes	0.46	0.22	0
ArA	Anthony-Mohave sandy loams 1 to 3 percent slopes	0.57	0.28	0
As	Apache gravelly loam	0.20	0.08	0
At	Apache very stony loam	0.18	0.07	0
AuC	Arp gravelly clay loam 0 to 20 percent slopes	0.03	0.01	0
AvD	Arp cobbly clay loam 10 to 25 percent slopes	0.03	0.01	0
AwE	Arp very rocky clay loam 20 to 40 percent slopes	0.03	0.01	20
AxD	Arp-Moano complex 0 to 30 percent slopes	0.07	0.03	0
AyC	Arp-Lynx association rolling	0.07	0.02	0
Ba	Badland	0.42	0.20	0
BdC	Balon sandy loam 0 to 15 percent slopes	0.59	0.29	0
BgD	Balon gravelly sandy clay loam 5 to 30 percent slopes	0.16	0.05	0
BlC	Balon-Lynx association rolling	0.15	0.05	0
BmF	Barkerville cobbly sandy loam 20 to 60 percent slopes	0.84	0.46	0
BnD	Barkerville very stony sandy loam 5 to 25 percent slopes	0.39	0.19	0
BoF	Barkerville extremely rocky sandy loam 20 to 60 percent slopes	0.84	0.46	20
BrD	Bridge gravelly loam 0 to 25 percent slopes	0.20	0.08	0

Table D.12 AZ637 Yavapai County Western Part Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
BsC	Brolliar very stony silt loam 0 to 15 percent slopes	0.46	0.27	0
BsD	Brolliar very stony silt loam 15 to 30 percent slopes	0.46	0.27	0
CaD	Cabezon-Springerville complex 5 to 25 percent slopes	0.03	0.01	0
CbC	Cabezon-Springerville cobbly complex 5 to 15 percent slopes	0.03	0.01	0
CdC	Cabezon-Thunderbird complex 5 to 15 percent slopes	0.03	0.01	0
CeE	Cabezon soils 8 to 45 percent slopes	0.03	0.01	0
CgC	Cave gravelly sandy loam 2 to 15 percent slopes	0.83	0.45	0
ClD	Cave-Continental gravelly sandy loams 2 to 30 percent slopes	0.71	0.37	0
CmD	Cellar very gravelly sandy loam 8 to 30 percent slopes	0.16	0.06	0
CnC	Cellar very rocky sandy loam 2 to 15 percent slopes	0.16	0.06	20
CnF	Cellar very rocky sandy loam 15 to 60 percent slopes	0.16	0.06	20
CoD	Cellar-Chiricahua complex 8 to 30 percent slopes	0.26	0.11	0
CrF	Cellar soils 20 to 60 percent slopes	0.16	0.06	0
CsC	Continental gravelly sandy loam 2 to 15 percent slopes	0.55	0.27	0
CtD	Continental-Cave gravelly sandy loams 8 to 30 percent slopes	0.64	0.33	0
CuC	Continental-Whitlock gravelly sandy loams 2 to 15 percent slopes	0.61	0.31	0
CvB	Continental-Loamy alluvial land association sloping	0.50	0.24	0
CwD	Continental soils 3 to 30 percent slopes	0.77	0.42	0
Cx	Cordes sandy loam	0.86	0.49	0
Cy	Cordes fine sandy loam red variant	0.89	0.51	0
CzC	Cross Cabezon and Apache soils 2 to 15 percent slopes	0.08	0.03	0
DaF	Dandrea gravelly loam 20 to 60 percent slopes	0.30	0.13	0

Table D.12 AZ637 Yavapai County Western Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
DgC	Dye gravelly loam 2 to 15 percent slopes	0.05	0.01	0
DrC	Dye very rocky loam 2 to 15 percent slopes	0.05	0.01	20
FaC	Faraway very rocky loam 0 to 15 percent slopes	0.24	0.10	25
FlE	Faraway-Luzena complex 20 to 40 percent slopes	0.27	0.12	0
FlF	Faraway-Luzena complex 40-60 percent slopes	0.28	0.12	0
GdD	Gaddes gravelly sandy loam 3 to 25 percent slopes	0.12	0.04	0
Go	Gila soils	0.73	0.37	0
GrB	Graham-Rimrock complex 0 to 8 percent slopes	0.06	0.02	0
GsE	Graham soils 8 to 45 percent slopes	0.04	0.01	0
HgB	Hogg gravelly loam 0 to 8 percent slopes	0.31	0.14	0
HgD	Hogg gravelly loam 8 to 30 percent slopes	0.31	0.14	0
HmE	House Mountain soils 15-40 percent slopes	0.14	0.05	0
JaC	Jacks very rocky loam 3 to 15 percent slopes	0.03	0.01	20
JaD	Jacks very rocky loam 15 to 30 percent slopes	0.03	0.01	20
La	Latene gravelly sandy loam	0.75	0.38	0
Lc	Latene-Mohave complex	0.78	0.40	0
Le	Lehmans gravelly clay loam 8 to 45 percent slopes	0.02	0.01	0
Lh	Lehmans extremely rocky clay loam 8 to 60 percent slopes	0.02	0.01	40
LkD	Lonti gravelly sandy loam 15 to 30 percent slopes	0.81	0.44	0
LlC	Lonti gravelly sandy loam high rainfall 0 to 15 percent slopes	0.81	0.44	0
LlD	Lonti gravelly sandy loam high rainfall 15 to 30 percent slopes	0.81	0.44	0
LmB	Lonti gravelly loam 0 to 8 percent slopes	0.28	0.12	0
LnC	Lonti cobbly loam 0 to 15 percent slopes	0.22	0.08	0
LnF	Lonti cobbly loam 30 to 60 percent slopes	0.22	0.08	0
LoD	Lonti complex 2 to 30 percent slopes	0.22	0.08	0
LpB	Lonti-Abra gravelly sandy loams 0 to 8 percent slopes	0.69	0.36	0
LrD	Lonti-Abra complex 8 to 30 percent slopes	0.37	0.17	0

Table D.12 AZ637 Yavapai County Western Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
LsC	Lonti-Pastura complex 0 to 20 percent slopes	0.24	0.09	0
LtB	Lonti-Cordes association undulating	0.83	0.46	0
LuC	Lonti-Wineg complex 3 to 15 percent slopes	0.46	0.22	0
LvE	Lonti-Rock land association hilly	0.28	0.12	35
LwD	Luzena cobbly loam 0 to 30 percent slopes	0.20	0.07	0
LxD	Luzena very rocky loam 10 to 30 percent slopes	0.16	0.06	25
Ly	Lynx soils	0.10	0.03	0
Ly2	Lynx soils eroded	0.10	0.03	0
Lz	Lynx soils wet variant	0.10	0.03	0
MbC	Mirabal gravelly sandy loam 8 to 20 percent slopes	0.70	0.37	0
MbF	Mirabal gravelly sandy loam 20 to 60 percent slopes	0.70	0.37	0
MdF	Mirabal-Dandrea complex 20 to 60 percent slopes	0.42	0.19	0
MgD	Moano gravelly loam 0 to 30 percent slopes	0.26	0.11	0
MkF	Moano very rocky loam 15 to 60 percent slopes	0.26	0.11	20
MoD	Moano extremely rocky loam 15 to 30 percent slopes	0.26	0.11	30
MrC	Moano-Lynx association rolling	0.28	0.12	0
MsB	Moenkopie association undulating	0.90	0.49	0
Mt	Mohave sandy loam	0.84	0.44	0
PaB	Palma sandy loam 1 to 8 percent slopes	0.86	0.45	0
PcE	Palos Verdes gravelly sandy loam 8 to 40 percent slopes	0.08	0.02	0
Pd	Partri loam	0.04	0.01	0
Pe	Partri gravelly clay loam	0.04	0.01	0
Pf	Partri-Abra loams	0.09	0.03	0
PgB	Pastura gravelly loam 0 to 8 percent slopes	0.18	0.06	0
PhD	Pastura complex 1 to 30 percent slopes	0.18	0.06	0
PlB	Pastura-Poley complex 2 to 8 percent slopes	0.14	0.04	0
PmB	Pastura-Lynx association undulating	0.22	0.08	0
PnB	Pastura-Rune association undulating	0.25	0.10	0
Po	Poley gravelly sandy loam	0.10	0.02	0

Table D.12 AZ637 Yavapai County Western Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
Pp	Poley-Partri loams	0.07	0.02	0
PrC	Purner gravelly loam 2 to 15 percent slopes	0.26	0.11	0
PsC	Purner very stony loam 2 to 15 percent slopes	0.23	0.09	0
PsD	Purner very stony loam 15 to 20 percent slopes	0.23	0.09	0
PuC	Purner-Boysag complex 2 to 15 percent slopes	0.12	0.04	0
PvD	Purner and Dye soils 2 to 30 percent slopes	0.14	0.04	0
PwD	Purner and Moenkopie soils 8 to 30 percent slopes	0.36	0.16	0
ReD	Retriever gravelly loam 2 to 30 percent slopes	0.22	0.08	0
Rk	Rimrock cobbly clay	0.01	0.01	0
Rm	Rimrock-Cave complex	0.04	0.04	0
Rn	Rimrock-Graham complex 3 to 15 percent slopes	0.02	0.01	0
Ro	Rock land	0.01	0.01	90
Rr	Rock land low rainfall	0.01	0.01	90
Rs	Rough broken land	0.01	0.01	95
Rt	Rune loam	0.49	0.25	0
Sa	Sandy and Gravelly alluvial land	1.34	0.80	0
ShB	Showlow gravelly sandy loam 0 to 8 percent slopes	0.66	0.35	0
SlB	Springerville cobbly clay 0 to 8 percent slopes	0.03	0.01	0
SmB	Springerville very stony clay 0 to 8 percent slopes	0.02	0.01	0
SnD	Springerville-Cabezon complex 3 to 30 percent slopes	0.03	0.01	0
SpB	Springerville-Pastura complex 1 to 5 percent slopes	0.05	0.02	0
StB	Springerville-Thunderbird complex 0 to 8 percent slopes	0.02	0.01	0
SuB	Springerville-Lonti association undulating	0.08	0.03	0
TaB	Tajo gravelly loam 0 to 8 percent slopes	0.21	0.08	0
TcC	Tajo-Springerville complex 0 to 15 percent slopes	0.10	0.04	0
TdC	Thunderbird cobbly clay loam 0 to 15 percent slopes	0.03	0.01	0

Table D.12 AZ637 Yavapai County Western Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
TdE	Thunderbird cobbly clay loam 15 to 40 percent slopes	0.03	0.01	0
ThC	Thunderbird-Cabezon complex 0 to 15 percent slopes	0.03	0.01	0
TlB	Tortugas gravelly loam 2 to 8 percent slopes	0.30	0.13	0
TmD	Tortugas very rocky loam 8 to 30 percent slopes	0.21	0.09	20
TnF	Tortugas extremely rocky loam 15 to 60 percent slopes	0.33	0.16	30
To	Tours loam	0.11	0.03	0
TwC	Tres Hermanos-Whitlock gravelly sandy loams 0 to 15 percent slopes	0.34	0.14	0
Vm	Vekol-Mohave complex	0.36	0.14	0
VnD	Venezia cobbly loam 0 to 30 percent slopes	0.45	0.23	0
VrF	Venezia very stony loam 30 to 60 percent slopes	0.39	0.20	0
VsC	Venezia-Springerville complex 0 to 20 percent slopes	0.16	0.07	0
VtC	Venezia-Thunderbird complex 5 to 15 percent slopes	0.17	0.07	0
VtE	Venezia-Thunderbird complex 15 to 40 percent slopes	0.17	0.07	0
W	Water	0.01	0.01	100
WcC	Waldroup-Cabezon association hilly	0.08	0.02	0
WgC	Whitlock gravelly sandy loam 0 to 15 percent slopes	0.72	0.38	0
WhC	Whitlock-Anthony gravelly sandy loams 0 to 15 percent slopes	0.62	0.32	0
WlF	Wilcoxson gravelly loam 30 to 60 percent slopes	0.20	0.08	0
Wm	Wineg sandy loam	0.20	0.08	0
Wn	Wineg-Abra complex	0.23	0.09	0
Wo	Wineg-Lynx association	0.24	0.10	0
Wp	Wineg and Poley soils	0.14	0.04	0

D.3.7 AZ697

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1	Alko family cobbly loam 0 to 25 percent slopes	0.41	0.18	0
2	Alko family gravelly sandy loam 1 to 15 percent slopes	0.41	0.19	0
3	Appleseed-Huevi association 4 to 30 percent slopes	0.39	0.18	0
4	Aridic Argiustolls-Lithic Haplustolls complex 1 to 40 percent slopes	0.43	0.21	0
5	Arizo-Detrital-Nickel complex 2 to 6 percent slopes	0.80	0.43	0
6	Arizo-Franconia-Riverwash complex 1 to 3 percent slopes	1.03	0.63	0
7	Arizo-Riverwash complex 0 to 1 percent slopes	1.59	1.14	0
8	Arizo-Riverwash complex 1 to 4 percent slopes	2.00	1.51	0
9	Arizo-Riverwash complex dry 0 to 1 percent slopes	2.00	1.51	0
10	Arizo-Riverwash complex moist 1 to 3 percent slopes	2.00	1.81	0
11	Azure-Detrital-Antares complex 5 to 30 percent slopes	0.44	0.22	0
12	Birdsbeak very channery loam 10 to 35 percent slopes	0.07	0.02	0
13	Bluebird-Detrital complex 2 to 15 percent slopes very stony	0.40	0.19	0
14	Bluebird-Lostman complex 1 to 5 percent slopes	0.35	0.16	0
15	Carrizo complex 1 to 5 percent slopes	0.40	0.19	0
16	Carrizo-Riverwash complex 0 to 1 percent slopes	1.03	0.62	0
17	Carrizo-Riverwash complex 3 to 8 percent slopes	1.21	0.76	0
18	Chuckawalla-Riverbend complex 2 to 15 percent slopes	0.23	0.09	0
19	Circular complex 1 to 3 percent slopes	0.48	0.21	0
20	Circular-Dusty complex 0 to 4 percent slopes	0.67	0.33	0
21	Cod gravelly sandy loam 2 to 6 percent slopes	0.57	0.28	0

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
22	Cordes-Manikan-Riverwash complex 1 to 6 percent slopes	1.03	0.59	0
23	Cupel-Rock outcrop complex 35 to 65 percent slopes	0.20	0.08	20
24	Cyclopic very stony loam 3 to 8 percent slopes	0.07	0.02	0
25	Deluge-Gotchell-Sunstroke complex 3 to 7 percent slopes	0.15	0.05	0
26	Detrital-Bluebird complex 2 to 12 percent slopes	0.32	0.14	0
27	Detrital-Nealy complex 1 to 6 percent slopes	0.40	0.17	0
28	Detrital-Nickel complex dry 1 to 6 percent slopes	0.58	0.29	0
29	Detrital-Nickel family complex 1 to 4 percent slopes	0.72	0.37	0
30	Detrital-Skelon family complex 1 to 5 percent slopes	0.42	0.20	0
31	Dusty-Kurstan family complex 1 to 6 percent slopes	0.39	0.16	0
32	Dutchflat sandy loam 0 to 2 percent slopes	0.93	0.50	0
33	Dye-Tovar-Rock outcrop complex 6 to 25 percent slopes	0.08	0.02	15
34	Faraway-Rock outcrop complex 30 to 70 percent slopes	0.41	0.21	20
35	Fig-Blind-Nodman complex 30 to 70 percent slopes	0.43	0.21	0
36	Filaree gravelly sandy loam 2 to 6 percent slopes	1.26	0.73	0
37	Filaree-Dutchflat complex 2 to 6 percent slopes	1.13	0.64	0
38	Garnet-Dutchflat complex 2 to 6 percent slopes	0.75	0.38	0
39	Goesling family silt loam 3 to 8 percent slopes	0.19	0.06	0
40	Goldroad-Rock outcrop complex 15 to 35 percent slopes	0.46	0.23	10
41	Goldroad-Rock outcrop complex 35 to 65 percent slopes	0.46	0.23	20
42	Gonzales-Rock outcrop complex 15 to 35 percent slopes	0.03	0.01	25
43	Goodsprings family gravelly sandy loam 10 to 35 percent slopes	0.50	0.23	0

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
44	Gotchell-Sunstroke complex 6 to 35 percent slopes	0.32	0.15	0
45	Graham-Arivaca complex 2 to 15 percent slopes	0.09	0.03	0
46	Graham-Rock outcrop complex 10 to 40 percent slopes	0.13	0.04	20
47	Grandwash extremely flaggy sandy loam 2 to 25 percent slopes	0.02	0.01	0
48	Greyeagle family extremely gravelly coarse sandy loam 15 to 40 percent slopes	0.26	0.11	0
49	Greyeagle family extremely gravelly sandy loam 35 to 60 percent slopes	0.53	0.27	0
50	Greyeagle family-Cyclopic complex 3 to 12 percent slopes	0.30	0.11	0
51	Greyeagle-Skelon families complex 2 to 12 percent slopes	0.32	0.14	0
52	Greyeagle-Skelon families complex moist 4 to 25 percent slopes	0.54	0.28	0
53	Gypsids 3 to 50 percent slopes	0.31	0.14	0
54	Haplogypsids eroded-Haplogypsids complex 35 to 75 percent slopes	0.31	0.14	0
55	Hassell family-Lampshire-Rock outcrop complex 10 to 30 percent slopes	0.45	0.22	20
56	Hindu-Rock outcrop complex 5 to 45 percent slopes	0.19	0.07	20
57	Hooks-Courtland families complex 1 to 5 percent slopes	0.94	0.50	0
58	Hosta family sandy loam 1 to 8 percent slopes	1.09	0.63	0
59	House Mountain family-Calvista family-Rock outcrop complex 10 to 35 percent slopes	0.31	0.13	20
60	Huevi extremely cobbly sandy loam 2 to 6 percent slopes	0.38	0.18	0
61	Huevi very gravelly loam 10 to 40 percent slopes	0.33	0.15	0
62	Huevi very gravelly sandy loam 15 to 35 percent slopes	0.46	0.23	0
63	Huevi-Carrizo complex 1 to 25 percent slopes	0.23	0.09	0
64	Huevi-Carrwash complex 2 to 75 percent slopes	0.71	0.40	0

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
65	Huevi-Sunrock-Rock outcrop complex 20 to 70 percent slopes	0.34	0.15	10
66	Hulda extremely gravelly sandy loam 20 to 65 percent slopes	0.60	0.32	0
67	Hulda-Rock outcrop complex 20 to 65 percent slopes	0.55	0.28	20
68	Hulda-Rock outcrop complex moist 35 to 70 percent slopes	0.76	0.40	35
69	Ireteba family-Arizo complex 1 to 3 percent slopes	0.77	0.41	0
70	Jagerson very gravelly loam 0 to 4 percent slopes	0.29	0.12	0
71	Jagerson-Nealy complex 1 to 3 percent slopes	0.16	0.05	0
72	Kingtut-Promontory complex 3 to 12 percent slopes	0.15	0.05	0
73	Kinley gravelly loamy sand 15 to 35 percent slopes	0.94	0.50	0
74	Kurstan family-Dusty complex 2 to 6 percent slopes	0.58	0.27	0
75	Lampshire-Rock outcrop complex 20 to 60 percent slopes	0.72	0.40	20
76	Lostman gravelly sandy loam moist 1 to 5 percent slopes	0.62	0.32	0
77	Lostman sandy loam 1 to 4 percent slopes	0.97	0.55	0
78	Luzena-Thunderbird complex 3 to 20 percent slopes	0.06	0.02	0
79	Lykorly gravelly loam 1 to 4 percent slopes	0.25	0.09	0
80	Lykorly silt loam moist 1 to 5 percent slopes	0.51	0.25	0
81	Manikan-Nuffel complex 1 to 3 percent slopes	0.57	0.27	0
82	Mathis family-Riverwash complex 1 to 4 percent slopes	0.89	0.60	0
83	Mayswell-Rock outcrop complex 5 to 40 percent slopes	0.08	0.02	15
84	Meadview extremely gravelly sandy loam 5 to 40 percent slopes	0.39	0.19	0
85	Meadview-Yurm family complex 4 to 25 percent slopes	0.39	0.18	0

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
86	Meriwhitica-Rock outcrop complex 5 to 35 percent slopes	0.69	0.38	15
87	Mextank very gravelly sandy loam 2 to 15 percent slopes	0.24	0.10	0
88	Milkweed-Quartermaster-Buckndoe complex 2 to 20 percent slopes	0.22	0.09	0
89	Milok-Pastern complex 4 to 12 percent slopes	0.49	0.23	0
90	Mutang-Dutchflat complex 0 to 3 percent slopes	0.55	0.25	0
91	Mutang-Wikieup-Rock outcrop complex 3 to 30 percent slopes	0.33	0.14	15
92	Nealy-Shamock family complex 2 to 8 percent slopes	0.43	0.19	0
93	Nealy-Skelon family-Detrital complex 3 to 10 percent slopes	0.53	0.26	0
94	Nickel family-Bluebird complex 15 to 45 percent slopes	0.19	0.08	0
95	Nickel-Skelon family-Detrital complex 3 to 10 percent slopes	0.51	0.25	0
96	Nickel-Topawa-Eba families complex 10 to 50 percent slopes	0.31	0.22	0
97	Nodman-Antares complex 3 to 15 percent slopes	0.17	0.06	0
98	Nodman-Courtland family complex 2 to 20 percent slopes	0.21	0.08	0
99	Nodman-Rock outcrop complex 15 to 65 percent slopes	0.09	0.02	20
100	Nodman-Romero family complex 15 to 65 percent slopes	0.43	0.21	0
101	Nolam family-Ustalfic Petrocalcids-Caralampi family complex 1 to 15 percent slopes	0.07	0.02	0
102	Ohaco family-Bluebird complex 2 to 8 percent slopes	0.40	0.18	0
103	Orejano gravelly sandy loam 4 to 35 percent slopes	0.06	0.02	0
104	Pantak family-Taine-Terino family complex 15 to 65 percent slopes	0.06	0.02	0
105	Pastern-Strych complex 4 to 20 percent slopes	0.24	0.10	0

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
106	Peachsprings-Havasupai complex 2 to 35 percent slopes	0.49	0.26	0
107	Pearce extremely stony loam 4 to 15 percent slopes	0.20	0.08	0
108	Pearce-Detrital-Rock outcrop complex 20 to 75 percent slopes	0.24	0.10	10
109	Pearce-Rock outcrop complex 5 to 65 percent slopes	0.19	0.07	15
110	Pedregosa-Tombstone families complex 1 to 15 percent slopes	0.55	0.28	0
111	Pidineen-Tricon families complex 2 to 10 percent slopes	0.49	0.22	0
112	Pits-Dumps complex	0.03	0.01	0
113	Playa	0.16	0.06	0
114	Prieta-Rock outcrop complex 2 to 35 percent slopes	0.08	0.02	15
115	Quagwa silt loam 1 to 3 percent slopes	0.32	0.13	0
116	Razorback extremely gravelly sandy loam 15 to 35 percent slopes	0.53	0.27	0
117	Razorback-Rock outcrop complex 15 to 70 percent slopes	0.30	0.13	20
118	Razorback-Rock outcrop complex 20 to 70 percent slopes	0.23	0.09	30
119	Rift silt loam 0 to 1 percent slopes frequently flooded	0.09	0.02	0
120	Rift silty clay loam 0 to 1 percent slopes	0.07	0.02	0
121	Rillino family-Shamock family-Dutchflat complex 1 to 4 percent slopes	0.86	0.45	0
122	Rock outcrop-Appleseed complex 35 to 75 percent slopes	0.53	0.28	50
123	Rock outcrop-Pearce complex 35 to 75 percent slopes	0.37	0.17	55
124	Rock outcrop-Razorback complex 20 to 70 percent slopes	0.30	0.13	65
125	Rock outcrop-Torriorthents complex 35 to 75 percent slopes	1.34	0.80	50
126	Rock outcrop-Torriorthents cool complex 35 to 75 percent slopes	1.34	0.80	50

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
127	Rock outcrop-Valena-Kopie family complex 5 to 35 percent slopes	0.63	0.31	50
128	Rolie-Dean complex 2 to 20 percent slopes	0.17	0.06	0
129	Romero-Chiricahua-Rock outcrop complex 5 to 35 percent slopes	0.04	0.02	20
130	Romero-Lampshire-Rock outcrop complex 35 to 70 percent slopes	0.18	0.07	15
131	Rositas sand 4 to 30 percent slopes	2.00	2.00	0
132	Shortbread loamy sand 1 to 4 percent slopes	1.99	1.23	0
133	Shortbread-Kurstan family-Dusty complex 0 to 7 percent slopes	0.85	0.39	0
134	Skelon family-Greyeagle family-Detrital complex 3 to 30 percent slopes	0.53	0.26	0
135	Skelon-Pinaleno families complex 1 to 4 percent slopes	0.38	0.17	0
136	Storybook very gravelly loam 1 to 3 percent slopes	0.44	0.21	0
137	Stronghold-McAllister families complex 2 to 15 percent slopes	0.23	0.09	0
138	Sunrock extremely gravelly sandy loam 15 to 35 percent slopes	0.49	0.25	0
139	Sunrock-Rock outcrop complex 30 to 65 percent slopes	0.51	0.26	20
140	Superstition family-Carrwash complex 35 to 75 percent slopes	1.31	0.78	0
141	Taine extremely cobbly loam 12 to 35 percent slopes	0.05	0.01	0
142	Thimble-Rock outcrop complex 35 to 65 percent slopes	0.03	0.01	10
143	Tombstone-Caralampi-Nolam families complex 2 to 30 percent slopes	0.44	0.21	0
144	Torriorthents 25 to 75 percent slopes	1.34	0.80	0
145	Torriorthents gypsic-Haplocambids gypsic complex 3 to 15 percent slopes	0.73	0.39	0
146	Torriorthents-Rock outcrop complex 25 to 75 percent slopes	1.34	0.80	15
147	Tovar-Grandwash complex 6 to 25 percent slopes	0.05	0.01	0

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
148	Truxton complex 1 to 3 percent slopes	0.25	0.09	0
149	Tumarion very cobbly loam 2 to 15 percent slopes	0.12	0.04	0
150	Tumarion-Nickel family complex 8 to 35 percent slopes	0.32	0.14	0
151	Tumarion-Nickel family complex moist 5 to 40 percent slopes	0.32	0.15	0
152	Tyro extremely stony sandy loam 3 to 35 percent slopes	0.46	0.23	0
153	Tyro very gravelly sandy loam 3 to 30 percent slopes	0.49	0.25	0
154	Tyro-Sunrock complex 3 to 15 percent slopes	0.44	0.21	0
155	Urban land-Calvista family complex 2 to 10 percent slopes	0.73	0.37	0
156	Ustorthents-Rock outcrop complex 35 to 90 percent slopes	2.00	1.99	30
157	Valena-Carri complex 3 to 15 percent slopes	0.51	0.24	0
158	Valena-Rock outcrop-Carri family complex 1 to 25 percent slopes	0.54	0.26	20
159	Vekol family gravelly loamy sand 2 to 7 percent slopes	1.53	0.92	0
160	Vekol family loam 1 to 3 percent slopes	0.38	0.16	0
161	Vekol family-Whitehills complex 2 to 7 percent slopes	0.07	0.02	0
162	Vock-Elements-Rock outcrop complex 30 to 65 percent slopes	0.64	0.34	10
163	Vock-Elements-Rock outcrop complex cool 30 to 65 percent slopes	0.63	0.34	10
164	Water	0.01	0.01	100
165	White House gravelly loamy sand 2 to 15 percent slopes	0.20	0.07	0
166	White House family very gravelly loamy sand 2 to 15 percent slopes	0.11	0.04	0
167	Whitehills very gravelly loam 1 to 5 percent slopes	0.22	0.09	0
168	Wodomont-Kydestea complex 5 to 40 percent slopes	0.40	0.19	0

Table D.13 AZ697 Mohave County Central Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
169	Wodomont-Metuck-Rock outcrop complex 25 to 45 percent slopes	0.56	0.29	15
170	Wodomont-Rock outcrop complex 5 to 40 percent slopes	0.22	0.09	20
171	Yahana family silty clay loam 1 to 3 percent slopes	0.11	0.03	0
172	Zibate family extremely gravelly sandy loam 5 to 35 percent slopes	0.05	0.01	0
173	Zibate family very stony loam 12 to 30 percent slopes	0.08	0.02	0
174	Zibate family-Dutchflat-Tumarion complex 4 to 30 percent slopes	0.21	0.07	0

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Table D.14 AZ699 Hualapai-Havasupai Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1	Albers silty clay loam 0 to 3 percent slopes	0.03	0.01	0
2	Arizo-Lostman complex 1 to 5 percent slopes	0.88	0.49	0
3	Arizo-Riverwash complex 1 to 3 percent slopes	2.00	1.70	0
4	Barx fine sandy loam 1 to 6 percent slopes	0.17	0.05	0
5	Bleumont-Frazwell association 2 to 20 percent slopes	0.27	0.11	0
6	Cowan family-Tobler complex 0 to 3 percent slopes	1.60	1.07	0
7	Curhollow-Puertecito complex 1 to 12 percent slopes	0.12	0.04	0
8	Curhollow-Rolie-Meriwhitica association 1 to 35 percent slopes	0.17	0.06	0
9	Curhollow-Tenderfoot complex 1 to 8 percent slopes	0.11	0.04	0
10	Deama-Rock outcrop complex 25 to 55 percent slopes	0.16	0.06	20
11	Disterheff gravelly fine sandy loam cool 1 to 8 percent slopes	0.22	0.08	0
12	Disterheff gravelly loam 1 to 4 percent slopes	0.22	0.08	0
13	Frazwell-Jacques complex 1 to 3 percent slopes	0.07	0.02	0
14	Grandwash extremely flaggy sandy loam 2 to 25 percent slopes	0.01	0.01	0
15	Havasupai very gravelly loam 1 to 8 percent slopes	0.18	0.06	0
16	Hermshale extremely flaggy fine sandy loam 15 to 35 percent slopes	0.21	0.08	0
17	Hidvalle very fine sandy loam 1 to 6 percent slopes	0.63	0.32	0
18	Hindu-Rock outcrop complex 5 to 45 percent slopes	0.19	0.07	20
19	Lostman family-Harrisburg complex 1 to 5 percent slopes	0.55	0.26	0
20	Luzena-Thunderbird complex 3 to 20 percent slopes	0.08	0.02	0
21	Lykorly gravelly loam 1 to 4 percent slopes	0.13	0.04	0

Table D.14AZ699 Hualapai-Havasupai Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
22	Lykorly silt loam moist 1 to 5 percent slopes	0.15	0.05	0
23	Metuck-Rock outcrop complex 15 to 60 percent slopes	0.35	0.17	30
24	Mextank-Lykorly-Disterheff complex 2 to 20 percent slopes	0.26	0.11	0
25	Milkweed-Quartermaster-Buckndoe complex 2 to 20 percent slopes	0.22	0.09	0
26	Milok-Pastern complex 4 to 12 percent slopes	0.48	0.22	0
27	Natank-Disterheff-Yumtheska complex 2 to 35 percent slopes	0.05	0.01	0
28	Nickel extremely gravelly sandy loam 2 to 35 percent slopes	0.39	0.19	0
29	Peachsprings-Havasupai complex 2 to 35 percent slopes	0.50	0.26	0
30	Pinntank fine sandy loam 1 to 8 percent slopes	0.65	0.34	0
31	Pinntank-Pocomate-Retsover complex 1 to 30 percent slopes	0.20	0.07	0
32	Plaintank-Barx complex 1 to 5 percent slopes	0.16	0.05	0
33	Pocomate-Rock outcrop complex 15 to 55 percent slopes	0.22	0.10	35
34	Poley loam 1 to 5 percent slopes	0.30	0.12	0
35	Poley-Rolie complex 1 to 8 percent slopes	0.11	0.02	0
36	Prieta-Rock outcrop complex 2 to 35 percent slopes	0.05	0.01	15
37	Quagwa silt loam 1 to 3 percent slopes	0.32	0.13	0
38	Rizno-Rock outcrop complex 2 to 15 percent slopes	1.00	0.56	25
39	Rock outcrop-Torriorthents complex 35 to 120 percent slopes	1.34	0.80	60
40	Rolie-Dean complex 2 to 20 percent slopes	0.17	0.05	0
41	Saemo extremely gravelly sandy loam 2 to 45 percent slopes	0.13	0.04	0
42	Sazi family very gravelly fine sandy loam 1 to 5 percent slopes	0.56	0.29	0
43	Courthouse-Rock outcrop complex 2 to 15 percent slopes	0.16	0.05	40
44	Sponiker loam 1 to 4 percent slopes	0.30	0.13	0

Table D.14 AZ699 Hualapai-Havasupai Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
45	Theecan-Pinespring association 2 to 35 percent slopes	0.19	0.07	0
46	Topocoba-Wodomont association 2 to 15 percent slopes	0.27	0.12	0
47	Dye-Tovar-Rock outcrop complex 1 to 15 percent slopes	0.29	0.12	20
48	Toqui-Yumtheska complex 2 to 30 percent slopes	0.07	0.02	0
49	Tovar extremely flaggy fine sandy loam 2 to 25 percent slopes	0.05	0.01	0
50	Tovar very fine sandy loam 1 to 10 percent slopes	0.29	0.12	0
51	Turkeytrack gravelly loam 1 to 6 percent slopes	0.24	0.10	0
52	Ustorthents-Rock outcrop complex 35 to 90 percent slopes	2.00	1.99	30
53	Winona-Curhollow complex 1 to 12 percent slopes	0.10	0.03	0
54	Winona-Rock outcrop complex 15 to 55 percent slopes	0.16	0.05	30
55	Winona-Rock outcrop-Tusayan complex 15 to 55 percent slopes	0.18	0.07	25
56	Wodomont-Coconino complex 2 to 15 percent slopes	0.26	0.11	0
57	Wodomont-Rock outcrop complex 5 to 40 percent slopes	0.17	0.07	20
58	Wukoki-Lomaki complex 15 to 50 percent slopes	0.12	0.04	0
59	Wyva-Rock outcrop complex 5 to 35 percent slopes	0.06	0.01	25
60	Water	0.01	0.01	100

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Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1	Albers clay loam 0 to 1 percent slopes	0.14	0.05	0
2	Argic Petrocalcids 8 to 15 percent slopes	0.42	0.20	0
3	Argic Petrocalcids warm 2 to 30 percent slopes	0.42	0.20	0
4	Aridic Haplustalfs-Lithic Haplustalfs complex 2 to 30 percent slopes	0.24	0.10	0
5	Aridic Haplustepts 0 to 8 percent slopes	0.31	0.14	0
6	Aridic Lithic Ustorthents-Rock outcrop complex supai group cool 15 to 55 percent slopes	2.00	1.99	30
7	Arizo very gravelly sandy loam 1 to 5 percent slopes	0.60	0.31	0
8	Bilburc very gravelly loam 2 to 6 percent slopes	0.38	0.19	0
9	Binsin-Bilburc-Yumtheska complex 2 to 15 percent slopes	0.31	0.16	0
10	Bluepoint-Rock outcrop complex 5 to 15 percent slopes	2.00	2.00	25
11	Bobzbulz extremely gravelly sandy loam 2 to 10 percent slopes	0.41	0.20	0
12	Bobzbulz extremely gravelly sandy loam 30 to 55 percent slopes	0.25	0.09	0
13	Bobzbulz-Snapcan association	0.22	0.09	0
14	Calcic Petrocalcids 2 to 15 percent slopes	1.34	0.80	0
15	Calcic Petrocalcids-Calcic Petrocalcids moderately steep-Rock outcrop complex hermit formation 2 to 50 percent slopes	1.34	0.80	30
16	Calcic Petrocalcids-Rock outcrop complex 15 to 55 percent slopes	1.34	0.80	20
17	Calcic Petrocalcids-Typic Haplocambids complex 15 to 30 percent slopes	1.34	0.80	0
18	Carrizo complex 1 to 5 percent slopes	1.53	0.93	0
19	Carrizo-Carrizo-Riverbend association	1.86	1.61	0
20	Childers-Lava flows association 4 to 15 percent slopes	0.19	0.06	35
21	Chilton-Teesto-Puertecito families complex 15 to 55 percent slopes	0.37	0.16	0

Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
22	Chunkmonk-Wodomont-Houserock families complex 15 to 40 percent slopes	0.23	0.09	0
23	Chunkmonk-Wodomont-Toqui families complex 2 to 15 percent slopes	0.21	0.08	0
24	Cliffdown moderately steep-Cliffdown families complex 15 to 40 percent slopes	0.27	0.11	0
25	Cliffdown-Izo families complex 2 to 8 percent slopes	0.59	0.29	0
26	Curhollow-Lapoint-Mellenthin families complex 2 to 15 percent slopes	0.14	0.05	0
27	Curhollow-Mellenthin complex 2 to 25 percent slopes	0.19	0.07	0
28	Curhollow-Meriwhitica complex 2 to 25 percent slopes	0.18	0.06	0
29	Curhollow-Puertecito complex 1 to 12 percent slopes	0.10	0.03	0
30	Curhollow-Puertecito-Mellenthin families complex 2 to 25 percent slopes	0.17	0.07	0
31	Curhollow-Tenderfoot complex 1 to 8 percent slopes	0.11	0.04	0
32	Curob-Whirlo families complex 15 to 30 percent slopes	0.41	0.20	0
33	Deama-Rock outcrop complex 25 to 55 percent slopes	0.16	0.06	20
34	Dera family 15 to 55 percent slopes	0.13	0.04	0
35	Disterheff-Albers association 1 to 3 percent slopes	0.06	0.02	0
36	Disterheff-Yumtheska complex 2 to 6 percent slopes	0.21	0.08	0
37	Elledge family 2 to 15 percent slopes	0.90	0.47	0
38	Elledge family 15 to 40 percent slopes	0.52	0.26	0
39	Firo family-Sandia-Rock outcrop complex 15 to 55 percent slopes	0.70	0.41	15
40	Fluvaquents-Psamments complex 2 to 6 percent slopes	2.00	1.99	0
41	Fluvaquents-Psamments complex warm 2 to 6 percent slopes	2.00	1.99	0

Table D.15 AZ701 Grand Canyon Area Soil Map Unit Composite XKSAT and RTIMP Values				
		XKSAT, in/hr		Natural RTIMP, %
SMU	Soil Map Unit Name	DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
42	Garr-Zibate families complex 2 to 15 percent slopes	0.06	0.01	0
43	Gypill fine sandy loam 15 to 40 percent slopes	1.23	0.69	0
44	Gypill-Meadview complex 2 to 15 percent slopes	0.63	0.31	0
45	Haplocalcids-Rock outcrop complex 1 to 19 percent slopes	0.42	0.20	15
46	Hindu-Rock outcrop complex 5 to 45 percent slopes	0.20	0.07	20
47	Huevi extremely gravelly fine sandy loam 2 to 4 percent slopes	0.54	0.28	0
48	Iceberg-Rock outcrop-Helkitchen association	0.29	0.13	25
49	Kaiparowits gravelly fine sandy loam 15 to 40 percent slopes	0.56	0.31	0
50	Kaiparowits-Plite family complex 2 to 8 percent slopes	0.82	0.48	0
51	Kanabownits fine sandy loam 15 to 40 percent slopes	1.68	1.10	0
52	Kanabownits-Kippers-Kaiparowits complex 2 to 15 percent slopes	0.74	0.47	0
53	Kanabownits-Kippers-Kaiparowits complex cool 2 to 15 percent slopes	0.59	0.32	0
54	Kanackey family 8 to 15 percent slopes	0.09	0.02	0
55	Kellypoint-Luzena complex 2 to 15 percent slopes	0.10	0.03	0
56	Kellypoint-Rock outcrop complex 15 to 35 percent slopes	0.11	0.04	15
57	Lava flows-Typic Torriorthents complex 30 to 60 percent slopes	1.34	0.80	80
58	Lithic Haplargids shinumo formation 8 to 15 percent slopes	0.42	0.20	0
59	Lithic Haplargids-Rock outcrop complex redwall formation 2 to 30 percent slopes	0.42	0.20	20
60	Lithic Haplargids-Typic Haplargids-Lava flows complex 2 to 35 percent slopes	0.42	0.20	15
61	Lithic Haplocalcids pakoon limestone 2 to 8 percent slopes	1.34	0.80	0
62	Lithic Haplocalcids-Rock outcrop complex esplanade formation 2 to 15 percent slopes	1.34	0.80	30

Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
63	Lithic Haplocambids-Lithic Haplargids complex bright angel and tapeats formations 2 to 15 percent slopes	0.35	0.16	0
64	Lithic Haplustalfs-Lava flows complex 30 to 60 percent slopes	0.12	0.04	45
65	Lithic Haplustolls-Udic Haplustolls-Rock outcrop complex kaibab torroweap and coconino formations 15 to 55 percent slopes	0.43	0.20	20
66	Lithic Torriorthents-Lithic Calciargids complex bright angel and tapeats formations hyperthermic 2 to 55 percent slopes	1.06	0.61	0
67	Lithic Torriorthents-Lithic Calciargids complex bright angel and tapeats formations thermic 2 to 55 percent slopes	0.95	0.53	0
68	Lithic Torriorthents-Rock outcrop complex dox formation 15 to 60 percent slopes	1.34	0.80	45
69	Lithic Torriorthents-Rock outcrop complex esplanade formation 2 to 8 percent slopes	1.34	0.80	30
70	Lithic Torriorthents-Rock outcrop complex muav and redwall formations 15 to 70 percent slopes	1.34	0.80	30
71	Lithic Torriorthents-Typic Torriorthents-Rock outcrop complex hermit formation 3 to 85 percent slopes	1.34	0.80	20
72	Lithic Ustic Torriorthents-Rock outcrop complex hermit formation 20 to 50 percent slopes	0.42	0.20	40
73	Lithic Ustic Torriorthents-Rock outcrop complex supai group 15 to 55 percent slopes	0.42	0.20	30
74	Lithic Ustic Torriorthents-Udic Haplustolls-Rock outcrop complex kaibab toroweap and coconino formations 15 to 55 percent slopes	0.43	0.20	15
75	Lostman family-Harrisburg complex 1 to 5 percent slopes	0.56	0.26	0
76	Luzena-Kellypoint complex 2 to 35 percent slopes	0.07	0.02	0
77	Lykorly gravelly loam 1 to 4 percent slopes	0.13	0.04	0
78	Lykorly loam 2 to 4 percent slopes	0.48	0.24	0
79	Meadview-Arizo complex 1 to 5 percent slopes	0.61	0.29	0
80	Meriwhitica-Rock outcrop complex 35 to 70 percent slopes	0.39	0.19	30

Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
81	Meriwhitica-Tassi complex 0 to 33 percent slopes	1.10	0.63	0
82	Metuck family-Rock outcrop complex 8 to 50 percent slopes	0.27	0.11	30
83	Natank-Disterheff-Yumtheska complex 2 to 35 percent slopes	0.05	0.01	0
84	Natank-Yumtheska complex 2 to 8 percent slopes	0.15	0.05	0
85	Nutter-Gyppocket complex 2 to 20 percent slopes	0.37	0.17	0
86	Orrubo very gravelly loam 15 to 35 percent slopes	0.23	0.09	0
87	Orrubo-Meadview-Meadview moderately steep complex 2 to 40 percent slopes	0.33	0.15	0
88	Orthents-Rock outcrop complex 2 to 6 percent slopes	2.00	1.99	20
89	Oxyaquic Torriorthents-Typic Endoaquents association 1 to 4 percent slopes	1.60	0.98	0
90	Phizphre-Rock outcrop complex 8 to 15 percent slopes	0.29	0.13	15
91	Pinntank-Retsover complex 2 to 8 percent slopes	0.45	0.23	0
92	Plite-Canburn families complex 2 to 8 percent slopes	1.00	0.60	0
93	Pocomate-Pinntank complex 15 to 30 percent slopes	0.18	0.07	0
94	Pocomate-Pinntank-Toqui complex 15 to 25 percent slopes	0.16	0.06	0
95	Pocomate-Pinntank-Ustifluvents complex 2 to 30 percent slopes	0.25	0.12	0
96	Pompeii family-Huevi-Huevi moderately steep complex 2 to 25 percent slopes	0.33	0.15	0
97	Puertecito family 2 to 8 percent slopes	0.27	0.11	0
98	Puertecito family 15 to 35 percent slopes	0.23	0.09	0
99	Puertecito-Meriwhitica-Progresso families complex 2 to 8 percent slopes	0.19	0.08	0
100	Robroost fine sandy loam 1 to 3 percent slopes	0.39	0.16	0
101	Rock outcrop-Akela family complex 15 to 60 percent slopes	0.50	0.25	45

Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
102	Rock outcrop-Cellar family complex 15 to 60 percent slopes	1.05	0.61	75
103	Rock outcrop-Lithic Torriorthents complex 15 to 60 percent slopes	1.34	0.80	70
104	Rock outcrop-Lithic Torriorthents complex cardenas formation 15 to 60 percent slopes	1.34	0.80	70
105	Rock outcrop-Lithic Torriorthents complex hakatai formation 15 to 60 percent slopes	1.34	0.80	80
106	Rock outcrop-Lithic Torriorthents complex kaibab toroweap and coconino formations 15 to 60 percent slopes	1.34	0.80	60
107	Rock outcrop-Lithic Torriorthents complex moenkopi kaibab and toroweap formations 15 to 60 percent slopes	1.34	0.80	70
108	Rock outcrop-Lithic Torriorthents complex nankoweap formation 2 to 8 percent slopes	1.34	0.80	70
109	Rock outcrop-Lithic Torriorthents complex supai group 15 to 60 percent slopes	1.34	0.80	60
110	Rock outcrop-Lithic Torriorthents complex vishnu schist formation 15 to 60 percent slopes	1.34	0.80	60
111	Rock outcrop-Lithic Ustic Torriorthents complex esplanade formation 2 to 8 percent slopes	0.42	0.20	60
112	Rock outcrop-Lithic Ustic Torriorthents-Ustic Haplocalcids complex tonto group and redwall formation 30 to 60 percent slopes	0.64	0.33	45
113	Rock outcrop-Skos-Seis families complex 30 to 60 percent slopes	0.46	0.22	40
114	Rock outcrop-Torriorthents complex kaibab formation 15 to 85 percent slopes	1.34	0.80	70
115	Rock outcrop-Torriorthents-Lithic Torriorthents complex supai group and redwall formation 2 to 60 percent slopes	1.34	0.80	50
116	Rock outcrop-Typic Torriorthents complex hermit formation 15 to 60 percent slopes	1.34	0.80	60
117	Rock outcrop-Typic Torriorthents complex tonto group and redwall formation 30 to 60 percent slopes	1.34	0.80	60
118	Rockyroad very cobbly silty clay loam 2 to 10 percent slopes	0.03	0.01	0

Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
119	Skos family-Rock outcrop complex 15 to 55 percent slopes	0.33	0.15	30
120	Skos family-Sandia-Rock outcrop complex 15 to 55 percent slopes	0.66	0.36	15
121	Tassi gravelly loamy very fine sand 0 to 3 percent slopes	1.25	0.70	0
122	Topocoba family 2 to 8 percent slopes	0.23	0.10	0
123	Topocoba-Wodomont association 2 to 15 percent slopes	0.28	0.13	0
124	Toqui gravelly loam 1 to 8 percent slopes	0.02	0.01	0
125	Toqui-Yumtheska complex 2 to 30 percent slops	0.07	0.02	0
126	Torriorthents-Haplocalcids-Lava flows complex 10 to 40 percent slopes	0.46	0.23	20
127	Torriorthents-Haplogypsids complex muddy creek formation 35 to 75 percent slopes	0.86	0.47	0
128	Torriorthents-Lithic Haplargids-Rock outcrop complex tonto group 15 to 60 percent slopes	0.95	0.53	15
129	Torriorthents-Rock outcrop complex hermit formation 2 to 40 percent slopes	1.34	0.80	30
130	Tovar loam 2 to 8 percent slopes	0.32	0.14	0
131	Tovar-Toqui-Yumtheska complex 2 to 8 percent slopes	0.23	0.09	0
132	Tunitcha-Valto family-Plite family complex 2 to 15 percent slopes	0.89	0.49	0
133	Twist very cobbly loam 1 to 8 percent slopes	0.08	0.02	0
134	Typic Calciargids-Lava flows complex 2 to 30 percent slopes	1.34	0.80	30
135	Typic Haplocalcids 2 to 8 percent slopes	1.34	0.80	0
136	Typic Haplocalcids 15 to 55 percent slopes	1.34	0.80	0
137	Typic Haplocalcids-Typic Calciargids complex 2 to 15 percent slopes	1.34	0.80	0
138	Typic Haplocalcids-Typic Petrocalcids complex 15 to 25 percent slopes	0.84	0.46	0
139	Typic Haplocalcids-Typic Torriorthents complex 2 to 15 percent slopes	1.34	0.80	0
140	Typic Haplogypsids hermit formation 8 to 15 percent slopes	1.34	0.80	0

Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
141	Typic Petrocalcids-Haplogypsids-Rock outcrop complex hermit formation 8 to 45 percent slopes	0.38	0.18	20
142	Typic Petrocalcids-Rock outcrop complex hermit formation 2 to 50 percent slopes	0.42	0.20	30
143	Typic Torrifluvents 0 to 1 percent slopes	2.00	1.99	0
144	Typic Torrifluvents-Typic Torripsamments complex 0 to 6 percent slopes	2.00	1.99	0
145	Typic Torrifluvents-Typic Torripsamments complex cool 0 to 6 percent slopes	2.00	1.99	0
146	Typic Torriorthents soils and badlands chuar group 15 to 65 percent slopes	0.75	0.40	0
147	Typic Torriorthents 2 to 8 percent slopes	1.34	0.80	0
148	Typic Torriorthents-Typic Haplogypsids complex hermit formation 15 to 40 percent slopes	1.34	0.80	0
149	Ustic Haplargids-Lava flows complex 2 to 20 percent slopes	0.42	0.20	30
150	Ustic Haplocalcids-Ustic Petrocalcids complex 2 to 4 percent slopes	1.00	0.56	0
151	Ustic Haplocalcids-Ustic Petrocalcids-Rock outcrop complex hermit formation 8 to 60 percent slopes	0.87	0.48	15
152	Ustic Haplocambids 1 to 2 percent slopes	2.00	1.99	0
153	Ustic Haplocambids 2 to 15 percent slopes	2.00	1.99	0
154	Ustic Torriorthents soils and badlands chuar group 15 to 65 percent slopes	0.42	0.20	0
155	Ustic Torriorthents 0 to 1 percent slopes	0.42	0.20	0
156	Ustic Torriorthents 2 to 4 percent slopes	0.42	0.20	0
157	Ustic Torriorthents 4 to 15 percent slopes	0.42	0.20	0
158	Ustic Torriorthents-Lithic Ustic Torriorthents-Lithic Ustic Haplargids complex tonto group and redwall formation 8 to 60 percent slopes	0.42	0.20	0
159	Valleycity-Berzatic-Seeg families complex 8 to 60 percent slopes	0.24	0.10	0
160	Vitrandic Haplocalcids 15 to 40 percent slopes	0.31	0.14	0
161	Vitrandic Haplocambids-Vitrandic Haplocalcids complex 15 to 40 percent slopes	0.31	0.14	0
162	Water	0.01	0.01	100

Table D.15 AZ701 Grand Canyon Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
163	Wauquie-Houserock families complex 2 to 65 percent slopes	0.11	0.04	0
164	Winkel family 15 to 55 percent slopes	0.41	0.19	0
165	Winkel-Rock outcrop complex 2 to 12 percent slopes	0.51	0.26	15
166	Winona-Rock outcrop-Tusayan complex 15 to 55 percent slopes	0.18	0.07	25
167	Wodomont-Topocoba-Plumasano families complex 2 to 15 percent slopes	0.41	0.19	0
168	Wutoma-Lozinta complex 15 to 60 percent slopes	1.11	0.65	0
169	Yellowhorse-Luzena-Sponiker association 2 to 15 percent slopes	0.13	0.04	0
170	Yumtheska-Bilburc association 10 to 45 percent slopes	0.20	0.09	0
171	Yumtheska-Katzine-Rock outcrop complex 2 to 30 percent slopes	0.22	0.09	20
172	Yumtheska-Rock outcrop complex 0 to 2 percent slopes	0.25	0.11	40
173	Yumtheska-Rock outcrop complex 2 to 8 percent slopes	0.28	0.14	15
174	Yumtheska-Rock outcrop complex 15 to 45 percent slopes	0.25	0.12	25
175	Yumtheska-Toqui-Rock outcrop complex 2 to 8 percent slopes	0.27	0.10	15
176	Yumtheska-Toqui-Rock outcrop complex 15 to 40 percent slopes	0.17	0.06	15
177	Zibate family 2 to 8 percent slopes	0.05	0.01	0

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D.3.10 ARIZONA GENERAL SOIL SURVEY

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s1126	Tecopa-Rock outcrop-Lithic Torriorthents (s1126)	0.72	0.37	58
s1129	Rositas-Beeline-Badland (s1129)	0.63	0.35	0
s1131	Rock outcrop (s1131)	0.38	0.18	65
s1140	Rillito-Gunsight (s1140)	0.24	0.09	0
s1422	Uzona-Rock outcrop-Myton family-Clraysprings (s1422)	0.06	0.01	10
s274	Carrizo-Brios-Antho (s274)	0.81	0.42	0
s275	Rositas-Ripley-Indio-Gilman (s275)	0.25	0.07	0
s276	Denure-Dateland (s276)	0.67	0.34	0
s277	Glenbar-Gadsden-Brios (s277)	0.07	0.02	0
s278	Sasco-Marana-Denure (s278)	0.29	0.10	0
s279	Yahana-Indio-Gadsden (s279)	0.19	0.07	0
s280	Pahaka-Mohall-Laveen-Denure (s280)	0.50	0.21	0
s281	Momoli-Denure-Carrizo (s281)	0.62	0.32	0
s282	Why-Wellton-Gunsight-Growler-Denure (s282)	0.59	0.29	0
s283	Mohall-Denure-Coolidge (s283)	0.48	0.22	0
s284	Mohall-Contine (s284)	0.10	0.02	0
s285	Yahana-Shontik-Casa Grande (s285)	0.48	0.20	0
s286	Tremant-Pinamt-Ebon (s286)	0.07	0.02	0
s287	Suncity-Cipriano-Carefree (s287)	0.11	0.04	0
s288	Rillito-Gunsight-Denure-Chuckawalla (s288)	0.39	0.17	0
s289	Hyder-Coolidge-Cipriano-Cherioni (s289)	0.32	0.14	9
s290	Ligurta-Gunsight-Cristobal (s290)	0.07	0.01	0
s291	Pinamt-Gunsight-Cavelt (s291)	0.21	0.08	0
s292	Pinamt-Momoli-Cipriano (s292)	0.26	0.11	0
s293	Rock outcrop-Quilotosa-Momoli (s293)	0.54	0.28	34
s294	Rock outcrop-Quilotosa-Hyder-Gachado (s294)	0.30	0.12	15
s295	Schenco-Rock outcrop-Laposa (s295)	0.15	0.05	30
s296	Laveen-Kamato-Casa Grande (s296)	0.10	0.02	0
s297	Toltec-La Palma-Casa Grande (s297)	0.40	0.15	0
s298	Mohall-Dateland-Casa Grande (s298)	0.21	0.06	0
s299	Pahaka-Estrella-Antho (s299)	1.00	0.53	0

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s300	Valencia-Estrella-Cuerda (s300)	0.88	0.47	0
s301	Superstition-Rositas (s301)	2.00	2.00	0
s302	Guest-Glendale-Gila (s302)	0.08	0.02	0
s303	Riveroad-Comoro-Arizo (s303)	0.72	0.37	0
s305	Mohave-Guest-Continental (s305)	0.08	0.03	0
s306	Tres Hermanos-Pajarito-Mohave (s306)	0.39	0.17	0
s307	Sonoita-Hayhook-Continental (s307)	0.69	0.34	0
s308	Sahuarita-Mohave-Cave (s308)	0.31	0.13	0
s309	Cacique-Bucklebar-Alko (s309)	0.88	0.47	0
s310	Stagecoach-Nahda-Delnorte-Agustin (s310)	0.17	0.09	0
s311	Pinaleno-Eba (s311)	0.16	0.06	0
s312	Nickel-Greyeagle-Continental (s312)	0.10	0.04	0
s313	Pinaleno-Palos Verdes-Nickel (s313)	0.17	0.05	0
s314	Tumarion-Rock outcrop-Lehmans-House Mountain-Akela (s314)	0.09	0.04	15
s315	Rock outcrop-Luzena-Faraway (s315)	0.26	0.11	25
s316	Rock outcrop-Lehmans-Gran (s316)	0.01	0.01	30
s317	Rock outcrop-Lajitas-Delthorny-Anklam (s317)	0.27	0.13	25
s318	Torriorthents-Rock outcrop (s318)	1.34	0.80	90
s319	Tovar-Toqui-Deama (s319)	0.31	0.12	0
s320	Santo Tomas-Pima-Comoro (s320)	0.45	0.22	0
s321	Hondale-Gothard-Bluepoint (s321)	0.32	0.13	0
s322	Sontag-Bonita (s322)	0.06	0.01	0
s323	Tubac-Forrest-Enzian-Diaspar (s323)	0.36	0.16	0
s324	Winkel-Harrisburg-Cave (s324)	0.97	0.53	0
s325	White House-Hathaway-Bernardino (s325)	0.11	0.04	0
s326	Tombstone-Stronghold-Jerag (s326)	0.37	0.17	0
s327	Torriorthents-Rock outcrop-Gypill (s327)	0.87	0.49	20
s328	White House-Hathaway-Caralampi-Bernardino (s328)	0.14	0.05	0
s329	Romero-Rock outcrop-Lampshire (s329)	0.32	0.14	31
s330	Zukan-Rock outcrop-Goblin (s330)	1.21	0.68	10
s331	Tanbark-Mellenthin-Calciorthids (s331)	0.23	0.09	0

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s332	Thunderbird-Collbran-Boquillas (s332)	0.08	0.03	0
s333	Yumtheska-Natank-Disterheff (s333)	0.08	0.02	0
s334	Sponiker-Rock outcrop-Cross (s334)	0.32	0.14	10
s335	Rock outcrop-Mabray-Lemitar (s335)	0.10	0.03	15
s336	Pennell-Bacobi (s336)	0.56	0.27	0
s337	Tours saline-Sodic-Riverwash-Jocity saline-Sodic-Ives saline-Sodic-Burnswick (s337)	0.26	0.09	1
s338	Marcou-Jocity saline-Sodic-Burnswick (s338)	0.29	0.12	1
s339	Wepo-Polacca-Jocity-Jeddito (s339)	0.34	0.13	2
s340	Sheppard sodic-Sheppard-Joraibi-Jocity (s340)	0.50	0.22	0
s341	Torriorthents-Tewa-Sheppard-Jeddito (s341)	0.67	0.32	6
s342	Rock outcrop-Moenkopie (s342)	0.92	0.52	50
s343	Nakai-Monue-Blackston (s343)	1.59	1.07	0
s344	Purgatory-Epikom-Claysprings-Badland (s344)	0.18	0.07	3
s345	Sheppard-Nakai-Monue (s345)	1.03	0.56	2
s346	Kinan-Hatknoll-Grieta (s346)	0.50	0.22	0
s347	Torriorthents-Sheppard-Pennell-Monue-Jocity-Clayhole (s347)	0.33	0.12	0
s348	Pennell-Pagina-Kinan (s348)	0.66	0.33	0
s349	Mellenthin-Curhollow (s349)	0.26	0.12	0
s350	Yumtheska-Showlow-Lozinta (s350)	0.19	0.08	0
s351	Wayneco-Sazi-Rock outcrop-Rizno-Palma-Mespun (s351)	1.28	0.81	10
s352	Winona-Tenderfoot-Curhollow (s352)	0.13	0.05	0
s353	Rudd-Arches (s353)	0.53	0.25	0
s354	Poley-Palma-Clovis (s354)	0.15	0.04	0
s355	Winona-Tusayan-Boysag (s355)	0.17	0.06	0
s356	Rock outcrop-Needle-Epikom (s356)	0.43	0.20	26
s357	Sheppard-Palma-Hubert-Clovis (s357)	0.86	0.46	0
s358	Strych-Monue-Bison (s358)	0.39	0.18	0
s359	Spenlo-Schmutz-Redbank family-Palma family-Naplene-Lavate-Ildefonso family-Clovis family-Caval (s359)	0.50	0.20	0
s360	Wupatki-Wukoki-Tuweep (s360)	0.16	0.06	0

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s361	Stagecoach-Hindu (s361)	0.22	0.08	0
s362	Rock outcrop (s362)	0.48	0.22	83
s363	Sheppard-Grieta (s363)	1.02	0.62	0
s364	Ustic Torriorthents-Penistaja-Mido-Begay (s364)	0.69	0.36	7
s365	Milkweed-Deama-Cabezon (s365)	0.08	0.03	0
s366	Ubank-Cerrillos-Barx (s366)	0.31	0.12	5
s367	Rock outcrop-Mellenthin-Leanto-Kech-Bisoodi (s367)	0.37	0.17	30
s368	Nuffel-Kech-Barx (s368)	0.34	0.14	9
s369	Rock outcrop-Deama (s369)	0.17	0.06	42
s370	Toqui-Topocoba-Deama (s370)	0.32	0.14	0
s371	Ziegler-Wilaha-Showlow (s371)	0.19	0.07	0
s372	Virgin Peak-Rock outcrop-Hualapai (s372)	0.39	0.20	15
s373	Moano-Barkerville (s373)	0.57	0.29	0
s374	Tortugas-Purner-Jacks (s374)	0.24	0.09	0
s375	Thunderbird-Rock outcrop-Luzena (s375)	0.11	0.04	15
s376	Typic Haplustalfs (s376)	0.16	0.05	0
s377	Thunderbird-Springerville-Rudd-Cabezon (s377)	0.05	0.02	0
s378	Whitlock-Continental-Cave (s378)	0.68	0.35	0
s379	Springerville-Cabezon (s379)	0.04	0.01	0
s380	Venezia-Thunderbird-Cabezon (s380)	0.06	0.02	0
s381	Poley-Pastura-Partri-Lynx-Abra (s381)	0.10	0.03	0
s382	Lynx-Lonti-Balon (s382)	0.21	0.07	0
s383	Zyme-Tonalea-Kydestea (s383)	0.17	0.06	7
s384	Torriorthents-Badland (s384)	0.95	0.53	3
s385	Telephone-Rock outcrop-Overgaard-Elledge (s385)	0.82	0.46	10
s386	Spudrock-Elledge-Docdee (s386)	0.33	0.14	0
s387	Gordo-Baldy (s387)	0.17	0.03	0
s388	Sponseller-Ess (s388)	0.34	0.16	0
s389	Thunderbird-Showlow (s389)	0.04	0.01	0
s390	Typic Haplustalfs-Rock outcrop-Aridic Haplustalfs (s390)	0.20	0.07	20
s391	Typic Haplustalfs-Lithic Haplustalfs (s391)	0.37	0.15	0

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s392	Sogzie-Sheppard-Rock outcrop-Aneth (s392)	1.66	1.19	10
s393	Shedado-Rock outcrop-Mespun-Begay-Anasazi (s393)	1.49	0.99	15
s394	Ustollic Haplargids-Rock outcrop-Namon (s394)	0.79	0.46	30
s395	Abreu (s395)	0.80	0.44	0
s396	Typic Eutroboralfs (s396)	0.33	0.15	0
s397	Typic Eutroboralfs (s397)	0.34	0.16	0
s398	Sheppard-Rock outcrop-Monue-Moepitz (s398)	1.74	1.37	10
s399	Pinamt-Momoli-Hickiwan-Gunsight-Denure (s399)	0.31	0.14	0
s400	Retriever-Calciorthids (s400)	0.20	0.07	0
s401	Vertic Haplustalfs-Aridic Ustochrepts (s401)	0.09	0.02	0
s402	Rock outcrop-Lama-Fragua (s402)	0.36	0.15	30
s403	Winona-Spudrock-Rock outcrop (s403)	0.54	0.28	10
s404	Winona-Spudrock-Rock outcrop (s404)	0.44	0.21	30
s405	Quintana (s405)	0.25	0.10	0
s406	Typic Paleboralfs-Eutric Glossoboralfs (s406)	0.24	0.09	0
s407	Typic Cryoboralfs-Rock outcrop-Eutric Glossoboralfs (s407)	0.21	0.07	20
s408	Rock outcrop-Eutric Glossoboralfs (s408)	0.24	0.10	30
s409	Typic Haplustalfs-Fluventic Ustochrepts (s409)	0.22	0.07	0
s410	Rock outcrop-Aridic Ustochrepts-Aridic Haplustolls (s410)	0.11	0.03	10
s411	Typic Paleboralfs-Typic Cryoboralfs-Rock outcrop (s411)	0.30	0.13	10
s412	Vertic Haplustalfs-Typic Haplustalfs (s412)	0.04	0.01	7
s413	Typic Haplustalfs (s413)	0.79	0.42	0
s414	Typic Haplustalfs (s414)	0.16	0.05	0
s415	Typic Haplustalfs-Rock outcrop-Eutric Glossoboralfs (s415)	0.17	0.06	20
s416	Silkie-Espiritu (s416)	0.20	0.06	0
s417	Wineg-Quintana-Amos (s417)	0.12	0.01	0
s418	Typic Haplustalfs-Lithic Haplustalfs (s418)	0.14	0.04	0
s419	Mollic Eutroboralfs (s419)	0.31	0.14	0

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s420	Rock outcrop-Mollic Cryoboralfs-Eutric Glossoboralfs (s420)	0.27	0.11	30
s421	Mirand-Derecho (s421)	0.20	0.08	0
s422	Silkie-Mirand (s422)	0.08	0.01	0
s423	Vibo-Casto (s423)	0.32	0.10	0
s424	Typic Haplustalfs-Mollic Eutroboralfs (s424)	0.24	0.09	0
s425	Mirand-Maes (s425)	0.18	0.07	0
s426	Eutric Glossoboralfs (s426)	0.16	0.05	0
s427	Heflin-Casto (s427)	0.08	0.01	0
s428	Rillino-Gila-Continental (s428)	0.25	0.10	0
s429	Tombstone-Romero-Rock outcrop (s429)	0.39	0.18	30
s430	Tubac-Pajarito-Hayhook-Glendale-Bucklebar (s430)	0.53	0.24	0
s431	Tres Hermanos-Pinamt-Artesia (s431)	0.21	0.08	0
s432	Eicks-Eba-Cloverdale (s432)	0.21	0.07	0
s433	Limpia-Graham-Bonita-Atascosa (s433)	0.07	0.03	0
s434	Mabray-Chiricahua-Atascosa (s434)	0.08	0.03	0
s435	Rock outcrop-Mokiak-Faraway (s435)	0.41	0.20	20
s436	Rock outcrop-Luzena-Fallsam (s436)	0.08	0.03	40
s437	Tapco-Peloncillo-Artesia (s437)	0.07	0.01	0
s438	Wampoo-Signal-Bonita (s438)	0.04	0.02	0
s439	Selevin-Eloma-Alsco (s439)	0.04	0.01	0
s440	Yumtheska-Virgin Peak-Rock outcrop-Katzine (s440)	0.35	0.16	22
s441	Rock outcrop-Piute-Bluechief (s441)	1.84	1.25	15
s442	Uzona-Shumbegay-Escavada (s442)	0.18	0.07	0
s443	Millett-Farview-Doakum (s443)	0.68	0.35	0
s444	Mido-Blanding-Arches (s444)	1.27	0.77	0
s445	Tunitcha-Klizhin-Akhoni (s445)	0.99	0.57	0
s446	Abreu (s446)	0.33	0.15	0
s447	Altar (s447)	0.20	0.08	0
s448	Altar (s448)	0.20	0.08	0
s449	Rock outcrop-Garr (s449)	0.06	0.01	40
s450	Ustorthents-Rizno-Metuck (s450)	0.91	0.57	0

Table D.16 AZ STATSGO Arizona General Soils Survey Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s451	Vibo-Ustochrepts-Badland (s451)	0.33	0.11	0
s452	Telescope-Royosa-Augustine (s452)	1.45	0.93	0
s453	Badland-Aridic Ustochrepts-Aridic Haplustolls (s453)	0.15	0.05	0
s454	Shoegame-McNeal-Badland (s454)	0.32	0.13	0
s455	Rock outcrop-Lithic Ustorthents family-Hogris (s455)	1.15	0.85	30
s456	Torriorthents-Cellar (s456)	0.37	0.17	0
s457	Spudrock-Rock outcrop-Cellar (s457)	0.69	0.36	30
s458	Yaqui-Werlog (s458)	0.91	0.49	0
s459	Werlog-Santo Tomas-Riverwash (s459)	0.89	0.52	0
s460	Torriorthents (s460)	0.25	0.11	0
s461	Rock outcrop-Moenkopie (s461)	0.65	0.34	30
s462	Typic Ustifluvents-Fluventic Ustochrepts (s462)	0.74	0.37	0
s463	Fluventic Ustochrepts-Aquic Ustifluvents (s463)	0.54	0.26	0
s464	Vessilla-Rock outcrop (s464)	0.55	0.27	35
s465	Teromote-Kopie (s465)	0.17	0.05	0
s466	Quintana-Kopie (s466)	0.23	0.08	0
s467	Typic Ustochrepts-Typic Haplustalfs-Rock outcrop (s467)	0.41	0.17	25
s468	Shoegame-Badland-Aridic Ustochrepts (s468)	0.32	0.14	0
s469	Ransect (s469)	0.12	0.04	0
s470	Typic Ustochrepts-Lithic Ustochrepts (s470)	0.57	0.28	0
s471	Typic Ustochrepts-Typic Haplustalfs-Rock outcrop (s471)	0.21	0.07	30
s472	Typic Dystrochrepts-Spudrock-Rock outcrop (s472)	0.59	0.31	30
s473	Typic Dystrochrepts-Dystric Cryochrepts (s473)	0.44	0.22	0
s474	Typic Dystrochrepts-Rock outcrop-Dystric Cryochrepts (s474)	0.48	0.24	20
s475	Dystric Cryochrepts (s475)	0.59	0.30	0
s476	Sobega-Quintana-Kopie (s476)	0.40	0.18	0
s477	Dystric Cryochrepts (s477)	0.59	0.30	0
s478	Rock outcrop-Lithic Ustochrepts (s478)	0.49	0.24	30

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s479	Typic Dystrochrepts-Rock outcrop-Lithic Ustochrepts (s479)	0.46	0.23	30
s480	Quintana (s480)	0.25	0.10	0
s481	Spudrock-Sobega-Rock outcrop (s481)	0.67	0.36	40
s482	Spudrock-Rombo-Rock outcrop (s482)	0.25	0.08	30
s483	Timhus-Quintana-Flugle (s483)	0.33	0.14	0
s484	Riverwash-Prewitt-Lynx (s484)	0.37	0.17	0
s485	Ess-Cundiyo (s485)	0.42	0.21	0
s486	Hereford (s486)	0.16	0.06	0
s487	Vertic Argiborolls (s487)	0.11	0.03	0
s488	Pachic Udic Argiborolls (s488)	0.21	0.08	0
s489	Rock outcrop-Lithic Haplustolls (s489)	0.33	0.15	30
s490	Nakai-Monue-Blackston (s490)	1.59	1.07	0
s491	Ustochreptic Calciorthids (s491)	0.81	0.44	0
s492	Rock outcrop-Bond-Bidonia (s492)	0.78	0.41	15
s493	Winona-Pastura-Cibeque (s493)	0.15	0.05	0
s494	Sponiker-Godding (s494)	0.41	0.20	0
s495	Torriorthents-Calciorthids-Badland (s495)	0.49	0.24	0
s496	Faraway-Barkerville (s496)	0.72	0.39	0
s497	Tours-Showlow-Cibeque (s497)	0.13	0.04	0
s498	Rond-Jacks-Chevelon (s498)	0.21	0.08	0
s499	Tortugas-Roundtop-Rock outcrop (s499)	0.22	0.09	15
s500	Lemitar-Lampshire-Chiricahua (s500)	0.06	0.02	0
s501	Tuloso-Tinaja (s501)	0.48	0.23	0
s502	Riverwash-Prewitt-Pinetop-Lynx (s502)	0.43	0.18	0
s5061	Vertic Haplustalfs-Typic Haplustalfs (s5061)	0.11	0.02	0
s5065	Typic Eutroboralfs-Lithic Haplustalfs (s5065)	0.22	0.08	0
s5068	Typic Haplustalfs-Rock outcrop-Eutric Glossoboralfs (s5068)	0.16	0.05	30
s5085	Typic Ustorthents-Typic Ustochrepts-Typic Udorthents-Rock outcrop (s5085)	0.90	0.49	25
s5087	Typic Ustochrepts-Rock outcrop-Aridic Ustochrepts (s5087)	0.55	0.26	30
s5094	Udic Ustochrepts-Typic Ustochrepts (s5094)	0.41	0.19	0

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s5108	Fluventic Haploborolls-Aquic Ustifluvents (s5108)	0.68	0.35	0
s5116	Typic Argiborolls (s5116)	0.25	0.10	0
s5168	Rock outcrop-Flugle-Catman (s5168)	0.51	0.22	13
s5169	Rock outcrop-Nogal (s5169)	0.24	0.10	22
s5170	Teco-Rock outcrop-Montecito-Cabezon-Atarque (s5170)	0.19	0.08	11
s5172	Stout-Kiln-Hesperus (s5172)	0.65	0.34	0
s5173	Telescope-Royosa (s5173)	2.00	1.32	0
s5177	Weska-Travessilla-Rock outcrop-Oelop (s5177)	0.13	0.03	30
s5249	Ojocal-Alicia (s5249)	0.16	0.05	0
s5315	Rock outcrop-Lehmans-Chiricahua-Chamberino (s5315)	0.25	0.10	20
s5325	Rock outcrop-Muzzler-Luzena (s5325)	0.10	0.04	20
s5331	Thunderbird-Rudd-Hubbell-Cabezon (s5331)	0.32	0.14	0
s5333	Mion-Jacee-Goesling-Celacy-Augustine (s5333)	0.45	0.23	3
s5396	Loarc-Guy-Dioxice-Datil (s5396)	0.46	0.22	2
s5397	Manzano-Hickman-Catman (s5397)	0.11	0.03	0
s5573	Water-Virgin River-Toquop-Riverwash-Black Butte-Alluvial land (s5573)	0.46	0.21	10
s5575	Naye-Mormon Mesa (s5575)	0.63	0.32	1
s5576	St. Thomas-Rock outcrop-Kyler (s5576)	0.30	0.13	15
s5577	Cave family-Cave-Ajo (s5577)	0.29	0.12	0
s5578	Harrisburg-Cave-Arizo (s5578)	0.90	0.50	0
s5579	Toquop-Black Butte-Arada (s5579)	0.90	0.54	0
s5580	Tonopah-Colorock-Badland (s5580)	0.38	0.18	1
s5581	Yurm family-Winkel-Torriorthents (s5581)	0.41	0.19	9
s5586	Zeheme-St. Thomas-Rock outcrop (s5586)	0.55	0.27	19
s5587	Zeheme-Virgin Peak-Rock outcrop-Hobog (s5587)	0.40	0.19	14
s5588	Nickel-Bitter Spring-Arizo (s5588)	0.68	0.33	2
s5589	Rositas-Pompeii-Gunsight-Carrizo-Ajo (s5589)	0.35	0.15	0
s5590	Rock outcrop-Hindu-Gypill-Badland (s5590)	0.41	0.18	25
s5592	Rock outcrop-Kanackey-Dedas-Calvista-Breko (s5592)	0.64	0.32	20

Table D.16 AZ STATSGO Arizona General Soils Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s5742	Typic Torriorthents-Gypill-Cave-Badland (s5742)	0.59	0.30	5
s7770	Sheppard-Rock outcrop-Oljeto-Neskahi-Mota (s7770)	0.74	0.25	10
s7771	Rock outcrop-Piute-Moenkopie-Hoskinnini (s7771)	0.55	0.26	20
s7774	Rock outcrop-Lithic Torriorthents-Badland (s7774)	0.38	0.17	50
s8181	Tobler-St. George-Nikey-Junction-Harrisburg (s8181)	0.71	0.35	0
s8182	Winkel-Renbac-Hobog-Bermesa (s8182)	0.72	0.40	0
s8184	Shalet-Badland (s8184)	0.34	0.14	5
s8187	Pastura family-Magotsu-Curhollow (s8187)	0.33	0.14	5
s8196	Rock outcrop-Mespun-Arches (s8196)	1.94	1.66	10
s8197	Yarts-Palma-Neville family-Barx-Atchee (s8197)	0.53	0.24	5
s8198	Skos-Rock outcrop (s8198)	0.09	0.03	20
s8369	Water (s8369)	0.01	0.01	100
s9582	Leanto-Bisoodi-Arntz (s9582)	0.68	0.33	4
s9583	Torriorthents-Marcou-Claysprings-Burnswick-Badland (s9583)	0.38	0.18	6
s9584	Strych-Rock outcrop-Monue (s9584)	0.51	0.25	18
s9585	Vecont-Trix-Mohall-Denure-Dateland-Casa Grande (s9585)	0.31	0.13	0
s9586	Selevin-Kimrose-Keysto-Caralampi (s9586)	0.07	0.03	0

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Table D.17 NV608 Virgin River Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
Ad	Alluvial land	0.55	0.26	0
Ae	Anthony fine sandy loam	0.55	0.26	0
Af	Anthony fine sandy loam gravelly substratum	0.55	0.26	0
Ah	Anthony fine sandy loam watertable	0.50	0.22	0
AMC	Arada fine sand 2 to 8 percent slopes	1.75	1.60	0
AOB	Arada fine sand gravelly substratum 0 to 4 percent slopes	1.87	1.77	0
ASC	Arada fine sand hardpan variant 2 to 8 percent slopes	2.00	2.00	0
ATA	Arizo fine sand 0 to 2 percent slopes	2.00	2.00	0
AVB	Arizo gravelly fine sand 2 to 4 percent slopes	2.00	2.00	0
AXC	Arizo very gravelly loamy sand 2 to 8 percent slopes	1.74	1.09	0
AYD	Arrolime gravelly silt loam 2 to 15 percent slopes	0.11	0.03	0
BD	Badland	0.42	0.20	0
BFD	Bard gravelly fine sand 4 to 15 percent slopes	2.00	2.00	0
BHC	Bard gravelly fine sandy loam 2 to 8 percent slopes	0.52	0.25	0
BLB	Blacknat-Arada association	1.90	1.81	0
BMD	Bard very gravelly fine sandy loam 2 to 15 percent slopes	0.52	0.25	0
BNB	Bard very stony loam 2 to 4 percent slopes	0.25	0.10	0
BOB	Bard-Rough broken land association gently sloping	0.45	0.21	30
BP	Pits borrow	0.03	0.01	0
BRB	Bard-Tonopah association gently sloping	0.37	0.16	0
BSG	Boxspring-Seralin-Rock outcrop association	0.25	0.11	15
BTC	Bitter Spring-Arizo association moderately sloping	0.58	0.26	0
Bu	Black Butte silt loam	0.11	0.02	0
Bv	Black Butte silt loam watertable	0.11	0.02	0
Bw	Bluepoint loamy fine sand	2.00	1.28	0
By	Bluepoint fine sandy loam strongly saline	1.31	0.75	0

Table D.17 NV608 Virgin River Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
BZF	Boxspring-Zeheme-Rock outcrop association	0.30	0.13	15
Ca	Calico fine sandy loam	1.03	0.55	0
CAC	Carrizo association	1.88	1.22	0
Cc	Calico fine sandy loam drained	1.02	0.54	0
Cd	Calico fine sandy loam strongly saline	1.03	0.55	0
CID	Crosgrain-Irongold association	0.30	0.13	0
Cm	Calico clay loam	0.09	0.02	0
Cn	Calico loamy fine sand coarse variant drained	2.00	1.29	0
Co	Calico loamy fine sand coarse variant strongly saline	1.87	1.18	0
CRD	Carrizo-Carrizo-Riverbend association	1.45	0.92	0
CTC	Colorock-Tonopah association moderately sloping	0.25	0.10	0
CYB	Crystal Springs gravelly sandy loam 2 to 4 percent slopes	0.69	0.34	0
Ea	Eastland gravelly sandy loam	1.03	0.59	0
FLC	Flattop gravelly clay loam 2 to 8 percent slopes	0.08	0.02	0
Gd	Gila fine sand	2.00	2.00	0
Ge	Gila loam	0.27	0.10	0
Gf	Gila loam strongly saline	0.38	0.15	0
GHF	Goldroad-Haleburu-Rock outcrop association	0.56	0.28	15
Gm	Gila loam water table	0.43	0.19	0
Gn	Gila loam water table strongly saline	0.43	0.19	0
Go	Glendale fine sand	2.00	2.00	0
GP	Pits gravel	0.03	0.01	0
Gr	Glendale loam	0.43	0.18	0
Gs	Glendale loam strongly saline	0.43	0.18	0
Gv	Grapevine loam	0.51	0.22	0
HEE	Heleweiser association	0.54	0.27	0
HHD	Huevi-Hiller association	0.48	0.23	1
HUF	Huevi-Badland association	0.47	0.23	0
HYB	Hypoint-Bluepoint-Arizo association	1.22	0.71	0
Ir	Ireteba loam	0.45	0.20	0
It	Ireteba loam overflow	0.45	0.20	0

Table D.17 NV608 Virgin River Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
IUC	Irongold-Wechech association	0.38	0.17	0
IWD	Irongold-Weiser association	0.33	0.14	0
La	Land loamy fine sand	2.00	1.51	0
Lc	Land silty clay loam	0.12	0.04	0
Ld	Land silty clay loam wet	0.12	0.04	0
MAE	Moapa-Bluepoint-Rock outcrop association	2.00	1.74	20
MBG	Monger-Bard-Typic Torriorthents association	0.72	0.36	0
MMB	Mormon Mesa loamy fine sand 0 to 4 percent slopes	0.80	0.41	0
MOB	Mormon Mesa fine sandy loam 0 to 8 percent slopes	0.82	0.43	0
NBC	Naye-Bitter Spring association	0.58	0.27	0
NIC	Nickel-Bitter Spring association	0.46	0.21	0
Oc	Overton silty clay	0.06	0.01	0
Oe	Overton silty clay slightly saline	0.07	0.02	0
On	Overton silty clay strongly saline	0.07	0.02	0
Or	Overton clay overwash saline	0.03	0.01	0
Os	Overton silt loam loamy variant slightly saline	0.61	0.33	0
Ot	Overton silt loam loamy variant strongly saline	0.61	0.33	0
Ox	Oxyaquic Torriorthents-Toquop complex 0 to 8 percent slopes	1.02	0.61	0
PL	Playas	0.05	0.01	0
PME	Pulsipher-Rock outcrop complex 15 to 30 percent slopes	0.35	0.14	20
PPE	Pulsipher association hilly	0.18	0.05	0
PRE	Pulsipher gravelly clay loam fine variant 15 to 30 percent slopes	0.06	0.01	0
RBG	Rock outcrop-Moapa-Bluepoint association	1.95	1.73	45
Re	Riverwash	2.00	1.76	0
RHF	Rock outcrop-Redneedle-Heleweiser association	0.74	0.39	35
Ri	Riverwash-Water complex 0 to 2 percent slopes	1.88	1.59	30
RME	Rock land-Moapa association hilly	2.00	2.00	60
RTF	Rock land-St. Thomas association very steep	0.28	0.12	60
SAE	Sandpan-Rositas association	1.69	1.27	0

Table D.17 NV608 Virgin River Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
SEG	Seralin extremely gravelly loam 30 to 75 percent slopes	0.24	0.10	4
SP	Spring silty clay loam	0.06	0.01	0
SQE	St. Thomas association	0.27	0.11	5
STE	St.Thomas-Rock outcrop-Zeheme assocation	0.66	0.35	20
STF	St. Thomas-Rock outcrop complex	0.29	0.12	20
SWC	Sweetspring-Carrizo association	0.22	0.09	0
TAC	Teebar-Sandpan association	0.82	0.45	0
Tb	Tobler fine sandy loam	0.77	0.40	0
Tc	Tobler fine sandy loam strongly saline	0.77	0.40	0
Td	Tobler silt loam wet	0.30	0.11	0
Te	Tobler clay strongly saline	0.03	0.01	0
TGC	Tonopah-Arizo association	0.77	0.41	0
THB	Tonopah gravelly sandy loam 0 to 4 percent slopes	0.85	0.45	0
TMD	Tonopah very gravelly sandy loam 4 to 15 percent slopes	0.65	0.34	0
TnA	Toquop fine sand 0 to 2 percent slopes	2.00	1.94	0
TnB	Toquop fine sand 2 to 8 percent slopes	2.00	1.94	0
TqA	Toquop complex 0 to 2 percent slope	2.00	1.94	0
TsA	Toquop fine sand watertable 0 to 2 percent slopes	2.00	1.78	0
TtA	Toquop fine sandy loam 0 to 2 percent slopes	1.28	0.72	0
TuA	Toquop fine sandy loam watertable 0 to 2 percent slopes	1.28	0.71	0
TvA	Toquop silty clay loam strongly saline 0 to 2 percent slopes	1.31	0.74	0
Ty	Typic Torriorthents-Badland association	0.62	0.32	0
UNB	Underton extremely gravelly fine sandy loam 2 to 8 percent slopes	0.32	0.15	0
UPE	Upperline very gravelly sandy loam 8 to 30 percent slopes	0.72	0.38	0
USE	Upperline-St. Thomas-Upperline association	0.56	0.28	0
UWD	Upperline-Weiser-Whitebasin association	0.68	0.36	0
Vd	Vinton fine sandy loam	0.70	0.35	0

Table D.17 NV608 Virgin River Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
VFG	Virgin Peak-Rock outcrop association	0.42	0.21	15
Vg	Virgin River silty clay	0.09	0.03	0
Vn	Virgin River silty clay strongly saline	0.09	0.03	0
Vr	Virgin River silty clay loam wet variant	0.06	0.01	0
W	Water	0.01	0.01	100
WAC	Wechech association	0.66	0.34	0
WBE	Wechech very gravelly fine sandy loam 8 to 30 percent slopes	0.49	0.23	0
WCE	Wechech-Ifteen association	1.91	1.66	0
WDC	Wechech-Weiser association	0.52	0.26	0
WEE	Weiser cobbly sandy loam 15 to 30 percent slopes	0.65	0.33	0
WFC	Weiser-Arizo association	0.77	0.42	0
WGC	Weiser-Oldspan-Wechech association	0.46	0.21	0
WHE	Whitebasin-Upperline-Hardbasin association	0.93	0.50	0
ZAG	Zeheme-Rock outcrop association	0.47	0.23	20

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D.3.12 NV613

Table D.18 NV613 Meadow Valley Area Nevada and Utah Soil Map Unit Composite XKSAT and RTIMP Values				
		XKSAT, in/hr		
SMU	Soil Map Unit Name	DF = 1.0	DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
ACC	Acana gravelly sandy loam 2 to 8 percent slopes	0.99	0.56	0
ADC	Acoma-Decan-Cath association	0.47	0.22	0
AE	Acana-Ursine association	0.79	0.42	0
ANC	Aned sandy loam 2 to 8 percent slopes	1.19	0.72	0
BA	Badland	0.42	0.20	0
BAB	Brier-Acoma-Bellehelen association	0.35	0.18	0
BB	Badland-Bit association	0.52	0.25	0
BD2	Badland-Buster eroded-Holsine association	0.75	0.43	0
BEB	Bellehelen-Brier association	0.46	0.24	0
BKF	Basket gravelly fine sandy loam 30 to 50 percent slopes	0.90	0.50	0
BL	Basket-Lize-Satt association	0.51	0.25	0
Bm	Bicondoa sandy loam	1.23	0.74	0
Bn	Bicondoa silty clay loam drained	0.17	0.07	0
Bo	Bicondoa complex	0.20	0.08	0
BR	Buster-Rough broken land association	1.08	0.62	25
CAC	Cath gravelly loam 2 to 8 percent slopes	0.42	0.20	0
CC	Chuska-Checkett gravelly loams 8 to 25 percent slopes	0.22	0.08	0
CD	Cedaran-Decan association	0.23	0.09	0
CE	Cedaran-Rock outcrop complex	0.35	0.17	35
CG	Cliffdown-Geer association	0.78	0.42	0
CR	Checkett-Rock outcrop complex 8 to 25 percent slopes	0.23	0.09	15
DA	Decan-Uana association	0.14	0.05	0
DC	Deerlodge-Checkett gravelly loams 2 to 8 percent slopes	0.21	0.08	0
DCC	Decathon gravelly loam 2 to 8 percent slopes	0.53	0.27	0
DED	Decathon-Basket association moderately steep	0.61	0.32	0
DEE	Decathon-Basket association steep	0.69	0.37	0
DH	Deerlodge-Ursine association	0.63	0.32	0
DMD	Denmark gravelly loam 2 to 15 percent slopes	0.28	0.12	0

Table D.18 NV613 Meadow Valley Area Nevada and Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
DN	Denmark-Linco association	0.39	0.18	0
FAC	Fanu gravelly fine sandy loam 0 to 8 percent slopes	0.97	0.56	0
GAB	Gabbvally-Brier-Rock outcrop association	0.20	0.09	15
GAR	Gabbvally-Rock outcrop association	0.16	0.06	15
GE	Geer fine sandy loam gravel substratum	1.03	0.58	0
Gf	Geer silt loam	0.39	0.17	0
Gg	Geer silt loam slightly saline	0.39	0.17	0
Gh	Geer silt loam strongly saline	0.46	0.26	0
Gk	Geer silt loam wet	0.46	0.26	0
GM	Geer-Heist association	1.02	0.57	0
GOV	Gomine-Vennob-Rock outcrop complex 15 to 40 percent slopes	0.10	0.03	15
HA	Hamtah-Tica-Rock outcrop association	0.19	0.08	15
HC	Hamtah-Udel-Rock outcrop association	0.26	0.12	15
HDC	Heist gravelly sandy loam 0 to 8 percent slopes	0.76	0.40	0
HEC	Heist gravelly sandy loam sand substratum 0 to 8 percent slopes	0.76	0.40	0
HN	Holsine-Usine-Buster association	0.88	0.51	0
HOC	Holtle loam 0 to 8 percent slopes	1.06	0.63	0
HR	Holtle-Four Star association	0.95	0.55	0
HSC	Homestake gravelly sandy loam 4 to 8 percent slopes	0.75	0.41	0
HTC	Homestake very stony sandy loam 2 to 8 percent slopes	0.64	0.35	0
IND	Itca stony clay loam 2 to 15 percent slopes	0.03	0.01	0
IO	Itca-Cedaran-Rock outcrop association	0.07	0.03	25
IR	Itca-Rock outcrop association	0.03	0.01	25
JCD	Jarab cobbly loam 2 to 15 percent slopes	0.67	0.37	0
KER	Kyler-Eaglepass-Rock outcrop association	0.28	0.12	20
KO	Kyler-Rock outcrop complex	0.30	0.13	30
KR	Kyler-Rock outcrop-Kyler variant association	0.32	0.14	25
LAB	Lien gravelly fine sandy loam 2 to 4 percent slopes	0.92	0.51	0
LC	Linco-Acana association	0.84	0.46	0

Table D.18 NV613 Meadow Valley Area Nevada and Utah Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
LD	Linco-Badland association	0.65	0.34	0
LE	Lize association	0.72	0.41	0
LT	Lize-Tica association	0.42	0.21	0
MO	Monroe loam 0 to 2 percent slopes	0.36	0.16	0
MR	Motoqua-Rock outcrop association	0.82	0.48	15
MU	Met-Ursine association	0.75	0.38	0
MVC	Minu gravelly sandy loam 2 to 8 percent slopes	0.84	0.46	0
MW	Monroe-Wales silt loams 0 to 2 percent slopes	0.25	0.10	0
MWC	Minu stony sandy loam 0 to 8 percent slopes	0.59	0.31	0
NR	Nevtah-Rock outcrop association	0.75	0.44	20
NSD	Nevu gravelly sandy loam 4 to 15 percent slopes	0.64	0.34	0
OTR	Onaqui-Tolman-Rock outcrop complex 15 to 50 percent slopes	0.33	0.16	15
Pa	Pahranagat silt loam drained strongly saline	0.56	0.33	0
Pd	Pahranagat silt loam strongly saline	0.56	0.33	0
Pe	Pahranagat silty clay loam	0.39	0.22	0
Pg	Pahranagat silty clay loam drained	0.39	0.22	0
PH	Patter-Heist association	0.70	0.35	0
PMC	Pamsdel gravelly loam 2 to 8 percent slopes	0.29	0.13	0
PN	Patter-Geer association	0.77	0.40	0
PO	Patter-Heist-Geer association	0.35	0.14	0
PS	Pioche-Rock outcrop complex	0.03	0.01	25
PTB	Poorma very fine sandy loam 0 to 4 percent slopes	1.02	0.58	0
PV	Poorma variant silt loam	0.38	0.17	0
RB	Radec-Bodacious complex 15 to 60 percent slopes	0.25	0.11	0
RO	Rock land	0.01	0.01	100
RR	Radec-Rock outcrop complex 8 to 25 percent slopes	0.23	0.10	20
RRD	Roval gravelly loam 2 to 15 percent slopes	0.17	0.06	0
RV	Roval-Acana association	0.29	0.12	0
SAD2	Satt stony sandy loam 4 to 15 percent slopes eroded	0.21	0.08	0

Table D.18 NV613 Meadow Valley Area Nevada and Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
SC	Slidymtn-Capsus association	0.17	0.07	0
SCC2	Satt stony fine sandy loam 2 to 8 percent slopes eroded	0.21	0.08	0
SD	Satt association	0.21	0.08	0
SEF	Seval extremely gravelly sandy loam 30 to 50 percent slopes	0.73	0.42	0
SGA	Stewval-Gabbvally association	0.10	0.03	0
SGD	Shroe gravelly loam 2 to 15 percent slopes	0.34	0.16	0
SH	Shroe-Badland association	0.20	0.08	0
SKC	Sierocliff gravelly sandy loam 2 to 8 percent slopes	0.95	0.54	0
SL	Slickens	0.18	0.04	0
SLR	Stewval-Lomoine-Rock outcrop association	0.18	0.05	10
ST	Stampede gravelly loam	0.42	0.20	0
SUD	Studhorse gravelly loam 2 to 15 percent slopes	0.28	0.12	0
SWC	Swisbob very stony loam 4 to 8 percent slopes	0.52	0.27	0
TA	Turba-Acti association	0.31	0.18	0
TN	Tica-Nevtah-Rock outcrop association	0.36	0.18	30
TR	Tica-Rock outcrop association	0.23	0.10	25
TTB	Timpahute gravelly loam 0 to 4 percent slopes	0.18	0.07	0
UG	Ursine-Geer association	0.32	0.14	0
UK	Udel-Rock outcrop association	0.58	0.33	35
UL	Ursine-Lomoine association	0.39	0.17	0
UMB	Umil gravelly loam 2 to 4 percent slopes	0.22	0.08	0
UR	Ursine association	0.24	0.10	0
URD	Ursine gravelly loam 2 to 15 percent slopes	0.34	0.15	0
URE	Ursine gravelly loam 15 to 30 percent slopes	0.34	0.15	0
US	Ursine-Badland association	0.36	0.16	0
UT	Urtah-Rock outcrop association	0.51	0.28	40
UWD	Urwil stony fine sandy loam 2 to 15 percent slopes	0.15	0.05	0
VBR	Vennob-Bodacious-Rock outcrop association 15 to 50 percent slopes	0.07	0.02	15
VCC	Vicu stony sandy loam 2 to 8 percent slopes	0.63	0.33	0

Table D.18 NV613 Meadow Valley Area Nevada and Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
VGC	Vil gravelly loam 2 to 8 percent slopes	0.38	0.18	0
VM	Veet-Mosida association	0.60	0.31	0
W	Water	0.01	0.01	100
WMF	Wilpar very stony sandy loam 30 to 50 percent slopes	0.57	0.30	0
WNG	Winu extremely stony loam 50 to 75 percent slopes	0.14	0.04	0
WR	Winu-Rock outcrop association	0.14	0.04	20
WS	Winz association	0.56	0.30	0
ZOF	Zoate cobbly loam 15 to 50 percent slopes	0.03	0.01	0
ZR	Zoate-Rock outcrop association	0.03	0.01	30

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D.3.13 NV754

Table D.19 NV754 Lincoln County Nevada South Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
1000	Weiser-Tencee-Arizo association	0.56	0.29	0
1001	Weiser-Tencee association	0.43	0.21	0
1010	Tencee-Weiser association	0.42	0.20	0
1016	Tencee association	0.37	0.17	0
1017	Tencee-Bard-Arizo association	0.46	0.22	0
1020	Kurstan-Tencee association	0.58	0.29	0
1021	Kurstan-Knob Hill association	0.88	0.47	0
1030	Arizo-Bluepoint association	1.89	1.19	0
1031	Arizo association	1.85	1.16	0
1040	Akela-Rock outcrop association	0.86	0.48	20
1041	Akela-Rochpah-Rock outcrop association	0.61	0.32	10
1052	Knob Hill-Arizo association	0.94	0.53	0
1060	St. Thomas-Chinkle-Rock outcrop association	0.42	0.19	20
1061	St. Thomas-Zeheme-Rock outcrop association	0.66	0.35	20
1062	Zeheme-Chinkle-Shankba association	0.38	0.16	0
1063	Zeheme-Kanesprings-Rock outcrop association	0.46	0.21	15
1064	Zeheme-Kanackey-Rock outcrop association	0.08	0.05	20
1065	Zeheme-Rock outcrop association	0.44	0.22	35
1066	Zeheme-Boxspring-Rock outcrop association	0.30	0.12	20
1070	Bellehelen-Brier association	0.46	0.24	0
1080	Kaspal-Canutio association	0.09	0.02	0
1090	Logring-Rock outcrop association	0.45	0.23	20
1091	Logring-Eaglepass-Rock outcrop complex	0.37	0.17	15
1100	Geta-Arizo association	0.88	0.46	0
1101	Geta gravelly sandy loam 2 to 4 percent slopes	0.72	0.37	0
1102	Geta-Bluepoint-Arizo association	1.29	0.74	0
1110	Kanesprings-Kanackey-Rock outcrop association	0.14	0.09	15
1111	Nuhelen-Farepeak association	0.53	0.31	0
1113	Kanesprings-Gabbvally association	0.27	0.11	0
1133	Lojet-Qwynn-Littleailie association	1.07	0.59	0
1160	Silent-Koyen association	0.85	0.45	0

Table D.19 NV754 Lincoln County Nevada South Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
1170	Alko-Arizo association	0.66	0.34	0
1172	Alko-Geta assocation	1.31	0.75	0
1180	Acoma-Decan-Cath association	0.48	0.23	0
1190	Minu-Shroe-Acoma association	0.62	0.32	0
1210	Brier-Acoma-Bellehelen association	0.35	0.18	0
1211	Brier-Rock outcrop association	0.62	0.36	30
1220	Lien-Devildog association	0.67	0.36	0
1230	Pahranagat association	0.56	0.33	0
1250	Patter-Heist association	0.70	0.35	0
1260	Hollace-Gabbvally association	0.08	0.02	0
1261	Hollace-Rochpah-Wyva association	0.14	0.05	0
1262	Hollace-Winklo-Wyva association	0.12	0.04	0
1270	Laross-Rock outcrop association	0.66	0.38	20
1300	Mormount-Arizo association	0.87	0.47	0
1302	Mormount very gravelly sandy loam 2 to 8 percent slopes	0.63	0.33	0
1303	Mormount-Canutio association	0.73	0.38	0
1340	Aymate-Canutio association	0.65	0.33	0
1341	Aymate sandy loam 0 to 2 percent slopes	0.81	0.42	0
1342	Aymate-Mormount-Arizo association	0.78	0.41	0
1350	Bard gravelly fine sandy loam 2 to 8 percent slopes	0.53	0.25	0
1360	Canutio-Arizo association	0.74	0.39	0
1370	Mormon Mesa association	0.78	0.40	0
1371	Mormon Mesa-Naye-Dalian association	0.59	0.30	0
1372	Mormon Mesa-Tonopah-Arada association	0.75	0.43	0
1380	Bracken gravelly fine sandy loam 2 to 8 percent slopes	1.06	0.59	0
1390	Shankba-Chinkle-Kanackey association	0.21	0.11	0
1400	Cave-Canutio association	0.38	0.18	0
1401	Cave-Arizo association	0.47	0.24	0
1403	Cave-Tencee association	0.36	0.17	0
1404	Cave-Mormount-Canutio association	0.48	0.23	0
1405	Cave-Zeheme association	0.40	0.19	0

Table D.19 NV754 Lincoln County Nevada South Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
1406	Cave very gravelly sandy loam 4 to 30 percent slopes	0.36	0.17	0
1420	Kanackey-Rock outcrop association	0.01	0.01	15
1430	Typic Torriorthents-Badland association	0.53	0.26	0
1460	Pintwater-Rochpah association	0.44	0.21	0
1470	Tybo-Keefa-Koyen association	0.70	0.36	0
1471	Tybo-Koyen association	0.76	0.39	0
1472	Tybo-Geer association	0.74	0.38	0
1473	Tybo-Leo association	0.70	0.36	0
1474	Tybo-Delamar association	0.77	0.40	0
1475	Treadwell-Veet association	0.60	0.31	0
1490	Keefa-Penoyer association	0.64	0.28	0
1491	Keefa warm-Penoyer association	0.58	0.25	0
1510	Koyen gravelly sandy loam 2 to 4 percent slopes	0.88	0.48	0
1512	Koyen-Penoyer association	0.36	0.12	0
1520	Geer-Penoyer association	0.61	0.25	0
1530	Delamar-Leo association	1.03	0.58	0
1531	Delamar-Veet association	1.02	0.58	0
1533	Delamar-Tybo-Koyen association	1.05	0.58	0
1534	Delamar-Koyen association	1.08	0.62	0
1535	Delamar gravelly sandy loam 2 to 8 percent slopes	1.13	0.65	0
1540	Oleman-Leo association	0.09	0.02	0
1541	Oleman-Cave association	0.11	0.03	0
1542	Oleman gravelly sandy loam 4 to 15 percent slopes	0.06	0.01	0
1550	Pahroc-Leo association	0.41	0.19	0
1551	Pahroc very gravelly very fine sandy loam 4 to 15 percent slopes	0.38	0.18	0
1570	Kyler-Eaglepass-Rock outcrop association	0.28	0.12	20
1571	Kyler-Logring-Rock outcrop association	0.38	0.18	20
1590	Winklo-Wyva assocation	0.10	0.03	0
1591	Winklo-Rochpah-Rock outcrop association	0.54	0.27	15

Table D.19 NV754 Lincoln County Nevada South Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1650	Handpah-Veet association	0.16	0.04	0
1660	Dewrust-Veet association	0.64	0.34	0
1680	Rochpah-Hollace-Gabbvally association	0.23	0.09	0
1681	Rochpah-Veet association	0.54	0.27	0
1683	Rochpah-Rock outcrop-Leo association	0.52	0.26	30
1690	Jolan-Geer association	0.69	0.33	0
1700	Sierocliff-Veet association	0.89	0.50	0
1710	Cliffdown gravelly sandy loam 4 to 8 percent slopes	0.73	0.37	0
1730	Cath-Veet association	0.99	0.55	0
1734	Qwynn-Devildog association	0.96	0.53	0
1741	Slaw silt loam 0 to 2 percent slopes	0.19	0.06	0
1750	Chanybuck-Brier-Rock outcrop	0.62	0.36	15
1761	Wyva-Rock outcrop association	0.07	0.02	20
1762	Wyva-Slidymtn association	0.19	0.07	0
1770	Veet-Mosida association	0.61	0.32	0
1810	Boxspring-Rock outcrop association	0.23	0.09	20
1811	Boxspring-Theriot-Rock outcrop association	0.27	0.11	15
1821	Turba-Acti association	0.31	0.18	0
1830	Zaqua-Winklo association	0.60	0.32	0
1831	Zaqua-Boxspring association	0.49	0.24	0
1832	Zaqua-Winklo-Kanesprings association	0.61	0.32	0
1833	Zaqua-Rock outcrop association	0.62	0.33	30
1850	Rapado-Oleman association	0.26	0.09	0
1851	Rapado-Veet association	0.55	0.30	0
1870	Faleria-Laross association	0.91	0.56	0
1880	Tejabe-Pintwater-Rock outcrop association	0.41	0.20	15
1881	Richinde-Pintwater-Rock outcrop association	0.57	0.29	15
1885	Richinde-Chubard-Richinde very stony association	0.55	0.28	0
1890	Welring-Rock outcrop association	0.31	0.14	20
1900	Glendale-Bluepoint association	0.61	0.28	0
1910	Land silt loam 0 to 2 percent slopes	0.18	0.06	0

Table D.19 NV754 Lincoln County Nevada South Part

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1920	Motoqua-Rock outcrop association	0.82	0.48	15
1921	Motoqua-Thunderbird association	0.56	0.30	0
1940	Chubard stony-Rock outcrop association	0.42	0.21	20
1941	Slidymtn-Capsus association	0.17	0.07	0
1942	Richinde-Chubard association	0.51	0.26	0
1950	Ursine-Lomoine association	0.30	0.13	0
1951	Ursine association	0.26	0.11	0
1952	Ursine-Geer association	0.36	0.16	0
1955	Treadwell-Chuckridge-Handpah association	0.27	0.09	0
1960	Crystal Springs gravelly sandy loam 2 to 8 percent slopes	0.77	0.40	0
1980	Longjim-Arizo association	0.40	0.17	0
1990	Gabbvally-Rock outcrop association	0.16	0.06	15
1991	Gabbvally-Hollace association	0.13	0.04	0
1992	Gabbvally-Brier-Rock outcrop association	0.20	0.09	15
1993	Richinde-Rock outcrop association	0.60	0.31	15
2000	Playas	0.04	0.01	0
2010	Stewval-Gabbvally association	0.10	0.03	0
2011	Stewval-Lomoine-Rock outcrop association	0.18	0.05	10
2123	Littleailie-Lojet association	1.19	0.68	0
2290	Richinde-Chubard-Rock outcrop association	0.53	0.27	20
2292	Chubard-Richinde association	0.51	0.26	0
2297	Chubard-Richinde-Rock outcrop association steep	0.50	0.25	15
2298	Chubard-Richinde association steep	0.49	0.24	0
2320	Blackcan association	0.38	0.17	0
3192	Saltydog-Ambush-Panacker association	0.50	0.23	0
3193	Ewelac-Playas association	0.08	0.02	0
3194	Ambush-Panacker-Playas association	0.61	0.29	0
3673	Kyler very stony-Rock outcrop-Kyler association	0.61	0.31	25

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D.3.14 NV755

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
100	Newera association	0.13	0.04	3
101	Glencarb very fine sandy loam saline	0.64	0.31	0
105	Galehills extremely gravelly fine sandy loam 15 to 50 percent slopes	0.65	0.34	3
106	Galehills-Zeheme association	0.62	0.32	5
107	Galehills-Calwash association	0.30	0.11	0
110	Tenwell-Crosgrain association	0.48	0.22	0
111	Tenwell-Shamock association	0.88	0.47	0
112	Arizo very gravelly loamy sand flooded 0 to 4 percent slopes	1.28	0.76	0
113	Arizo very gravelly fine sandy loam gypsiferous substratum 2 to 8 percent slopes	1.46	0.89	0
115	Whitebasin-Upperline-Hardbasin association	0.47	0.20	0
120	Crosgrain-Tenwell association	0.38	0.16	0
121	Sweetspring-Carrizo association	0.27	0.12	0
125	Bobzbulz-Snapcan association	0.24	0.10	0
134	Newera-Nipton association	0.18	0.07	2
135	Nippeno-Mountmcull-Newera association	0.17	0.06	3
140	Haleburu extremely gravelly sandy loam 4 to 15 percent slopes	0.48	0.24	6
141	Nipton-Haleburu-Rock outcrop association	0.52	0.26	20
143	Haleburu association	0.44	0.21	2
144	Haleburu extremely cobbly-Hiddensun association	0.55	0.28	4
146	Haleburu-Nipton association	0.47	0.23	0
147	Haleburu-Nipton association dry	0.49	0.25	0
148	Haleburu-Seanna association	0.51	0.26	0
150	Hypoint gravelly sandy loam 0 to 4 percent slopes	1.36	0.80	0
151	Bluepoint-Arizo association	1.51	0.97	0
155	Bitterridge-Helkitchen association	0.18	0.06	0
160	Lanip-Kidwell association	0.44	0.20	0
165	Upperline-Weiser-Whitebasin association	0.68	0.36	0

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
167	Upperline-St. Thomas-Upperline association	0.56	0.28	0
168	Upperline very gravelly sandy loam 8 to 30 percent slopes	0.72	0.38	0
170	Tenwell-Lanip association	0.61	0.30	0
175	St. Thomas-Rock outcrop complex	0.29	0.12	20
176	St. Thomas association	0.27	0.11	5
177	St. Thomas-Upperline-Whitebasin complex	0.51	0.24	0
178	St. Thomas-Iceberg-Rock outcrop association	0.29	0.12	25
180	Kidwell-Tenwell association	0.76	0.42	0
185	Lastchance-Commski association	0.32	0.14	0
186	Lastchance-Ferrogold-Commski association	0.34	0.15	0
190	Filaree-Lanip-Nickel association	0.55	0.27	0
191	Bluepoint-Grapevine association	1.82	1.20	0
192	Bluepoint association	1.98	1.25	0
195	Cruzspring-Schader-Rock outcrop association	0.34	0.16	15
200	Commski-Weiser-Threelakes association	0.45	0.21	0
201	Commski extremely gravely loam 8 to 30 percent slopes	0.23	0.09	0
202	Commski-Lastchance association	0.42	0.20	0
203	Commski-Oldspan-Lastchance association	0.48	0.23	0
205	Callville-Badland-Guardian association	0.71	0.36	0
207	Callville association	0.78	0.40	0
210	Nickel-Arizo association	1.05	0.60	0
211	Nickel-Crosgrain association	0.64	0.34	0
220	Haymont-Bluepoint association	0.34	0.12	0
221	Haymont association	0.25	0.07	0
225	Baseline-Callville-Badland association	0.59	0.30	0
226	Baseline extremely gravelly fine sandy loam 2 to 8 percent slopes	0.55	0.28	0
227	Baseline-Gypwash association	0.56	0.28	0
228	Baseline-Guardian association	0.68	0.35	0
230	Wechech-Weiser association	0.52	0.26	0
231	Wechech very gravelly fine sandy loam 2 to 8 percent slopes	0.64	0.34	0

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
232	Wechech-Upperline association	0.67	0.35	0
233	Wechech-Ifteen association	1.91	1.66	0
234	Wechech very gravelly fine sandy loam 8 to 30 percent slopes	0.49	0.23	0
235	Gypwash-Callville-Carrizo association	0.67	0.35	0
237	Wechech association	0.66	0.34	0
240	Crosgrain-Irongold-Nickel association	0.30	0.12	0
241	Crosgrain-Typic Torriorthents-Nickel association	0.42	0.19	4
250	Mormon Mesa-Naye association	0.72	0.38	0
255	Tumarion-Nipton association	0.32	0.14	10
260	Naye-Bitter Spring association	0.58	0.27	0
261	Vace-Jean association	0.86	0.52	0
265	Azureridge very gravelly sandy loam 15 to 50 percent slopes	0.62	0.32	0
270	Bard-Nickel-Limewash association	0.87	0.47	8
271	Moapa-Bluepoint association	1.78	1.40	5
272	Moapa-Bluepoint-Rock outcrop association	2.00	1.74	20
285	Heleweiser-Carrizo-Teebar association	0.59	0.31	0
286	Heleweiser-Carrizo association	0.82	0.45	0
287	Heleweiser association	0.69	0.36	0
288	Heleweiser-Teebar association	0.65	0.34	0
289	Heleweiser-Upperline-Nickel association	0.71	0.37	1
290	Rock outcrop-Moapa-Bluepoint association	1.95	1.73	45
291	Rock outcrop-Highland association	0.29	0.12	50
292	Rock outcrop-Nupper association	0.71	0.37	65
294	Rock outcrop sandstone	0.52	0.26	90
298	Rock outcrop-Redneedle-Heleweiser association	0.74	0.39	35
310	Weiser-Arizo association	0.77	0.42	0
311	Weiser-Threelakes association	0.58	0.30	0
313	Weiser-Oldspan-Wechech association	0.46	0.21	0
314	Weiser-Wechech association	0.59	0.30	0
315	Weiser Association	0.64	0.34	0

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
320	Boxspring-Zeheme-Rock outcrop association	0.30	0.13	15
321	Boxspring-Seralin-Rock outcrop association	0.25	0.11	15
322	Boxspring-Potosi-Rock outcrop association	0.26	0.11	10
323	Boxspring-Scrapy-Rock outcrop association	0.37	0.16	15
325	Sandpan-Rositas association	1.69	1.27	0
330	Ramshead-St. Thomas-Rock outcrop association	0.30	0.13	15
335	Teebar very cobbly fine sandy loam 0 to 4 percent slopes	0.56	0.29	7
336	Teebar-Sandpan association	0.82	0.45	0
340	Zeheme-Rock outcrop association	0.47	0.23	20
341	Zeheme extremely gravelly fine sandy loam 8 to 30 percent slopes	0.46	0.23	4
342	Zeheme-Potosi-Rock outcrop association	0.39	0.19	15
343	Zeheme-Rock outcrop-Boxspring association	0.40	0.19	20
351	Seralin extremely gravelly loam 30 to 75 percent slopes	0.24	0.10	4
352	Seralin-Traley-Rock outcrop association	0.29	0.13	15
355	Seralin-Devilsthumb-Ednagrey association	0.27	0.11	3
360	Bracken-Arizo-Badland association	0.97	0.54	0
365	Callville-Gypwash-Badland association	0.47	0.23	0
375	Iceberg-Rock outcrop-Helkitchen association	0.33	0.14	25
376	Iceberg-St. Thomas-Rock outcrop association	0.36	0.16	20
380	Tonopah-Arizo association	0.83	0.46	0
390	Tipnat-Hypoint-Grapevine association	1.38	0.83	0
391	Tipnat-Bluepoint-Hypoint association	1.72	1.04	0
400	Arizo-Cafetal association	0.80	0.42	0
405	Oxyaquic Torrifluvents-Gypwash association	0.76	0.39	8
411	Bludiamond-Diamondhil association	0.19	0.07	0
415	Valatier-Goldbutte association	0.23	0.09	2
421	Moentria extremely gravelly loam 15 to 50 percent slopes	0.27	0.11	5
422	Moentria-Purob Association	0.29	0.13	2
430	Bluepoint-Tipnat-Grapevine association	1.50	0.96	0

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
431	Hypoint-Vegastorm association	1.55	0.96	0
441	Corbilt gravelly loamy fine sand 0 to 4 percent slopes	1.68	1.00	0
450	Arizo association	1.09	0.64	0
451	Arizo-Peskah-Crosgrain association	0.46	0.22	0
454	Arizo-Riverwash association	0.85	0.54	0
455	Arizo-Tenwell association	0.51	0.25	0
460	Pahrump-Wodavar-Vegastorm association	0.61	0.30	0
461	Pahrump-Bluepoint association	0.55	0.27	0
470	Filaree-Seanna association	0.63	0.33	0
475	Guardian-Sunrock-Badland association	0.74	0.38	1
477	Guardian-Baseline-Guardian association	0.82	0.43	0
478	Guardian-Baseline association	0.72	0.37	0
480	Vace-Arizo association	0.47	0.21	0
481	Vace-Wechech association	0.48	0.22	0
490	Ifteen extremely gravelly very fine sandy loam 2 to 8 percent slopes	0.65	0.33	0
500	Playas	0.09	0.02	0
501	Dams concrete	0.03	0.01	0
504	Pits quarry	0.03	0.01	0
505	Pits gravel	2.00	2.00	0
506	Pits-Dumps assocation	0.03	0.01	0
508	Landfill	0.03	0.01	0
510	Railroad association	0.63	0.33	2
520	Nolena-Rock outcrop association	0.38	0.17	35
521	Nolena-Nipton association	0.46	0.23	3
522	Nolena-Meadview association	0.51	0.26	1
523	Nolena association	0.49	0.24	0
530	Seanna-Botleg association	0.26	0.09	7
531	Seanna-Rock outcrop association	0.48	0.23	25
532	Seanna-Goldroad-Rock outcrop association	0.50	0.25	15
535	Blackmesa-Sunrock association	0.78	0.41	3
540	Sunrock-Rock outcrop association	0.55	0.28	25

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
541	Sunrock-Haleburu-Rock outcrop association	0.53	0.27	20
542	Sunrock-Callville-Badland association	0.65	0.34	1
550	Cheme-Riverbend-Carrizo association	0.41	0.19	0
551	Cheme-Carrizo-Huevi association	0.58	0.29	0
552	Cheme-Huevi association	0.43	0.20	1
560	Rositas-Riverbend association	1.88	1.68	5
565	Govwash-Guardian-Badland association	0.49	0.22	0
570	Carrizo association	1.68	1.04	0
571	Carrizo-Carrizo-Riverbend association	1.45	0.92	0
572	Carrizo very cobbly coarse sand 2 to 8 percent slopes	1.76	1.12	0
573	Carrizo-Riverbend association	1.05	0.60	0
574	Carrizo-Sunrock association	1.06	0.60	0
575	Carrizo complex 1 to 5 percent slopes	1.49	0.92	0
581	Threelakes-Weiser association	0.60	0.31	0
590	Riverbend-Carrizo association	1.09	0.63	0
591	Riverbend-Carrwash association	0.88	0.50	0
592	Riverbend-Carrizo frequently flooded association	0.78	0.43	0
593	Riverbend-Cheme-Carrizo association	0.63	0.32	0
600	Huevi-Cheme association	0.41	0.19	0
601	Huevi association	0.51	0.25	0
603	Huevi extremely gravelly sandy loam 8 to 30 percent slopes	0.48	0.24	1
604	Huevi-Hiller association	0.57	0.30	1
605	Huevi-Badland association	0.47	0.23	0
606	Huevi-Huevi-Cheme association	0.57	0.29	2
610	Goldroad-Rock outcrop association	0.57	0.30	25
612	Goldroad-Seanna-Rock outcrop association	0.53	0.27	15
613	Goldroad-Haleburu-Rock outcrop association	0.56	0.28	15
620	Arizo-Lanip association	0.58	0.29	0
621	Orwash gravelly loamy coarse sand 2 to 4 percent slopes	1.43	0.83	0
622	Orwash-Arizo-Lanip association	0.73	0.38	0

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
630	Tenwell very gravelly sandy loam 2 to 4 percent slopes	0.60	0.31	0
635	Aguachiquita-Azureridge association	0.70	0.36	0
640	Cetrepas-Nolena-Rock outcrop association	0.50	0.25	15
645	Goldbutte-Nolena association	0.52	0.26	2
646	Goldbutte-Jumbopeak-Rock outcrop association	0.73	0.40	20
650	Peskah-Crosgrain association	0.37	0.16	0
651	Peskah-Arizo association	0.51	0.25	0
660	Crosgrain extremely gravelly loam 4 to 15 percent slopes	0.23	0.09	0
661	Crosgrain very stony loam 8 to 30 percent slopes	0.28	0.11	0
662	Crosgrain-Arizo association	0.32	0.13	0
663	Crosgrain-Kidwell-Arizo association	0.42	0.20	0
665	Crosgrain-Vace association	0.31	0.12	0
670	Nipton-Highland-Rock outcrop association	0.42	0.20	15
673	Nolena-Newera association	0.24	0.10	3
674	Nipton-Rubble land-Railroad association	0.55	0.28	27
680	Lanfair-Hoppswell association	0.44	0.21	0
690	Hoppswell-Ustidur association	0.22	0.09	0
691	Hoppswell-Jetmine association	0.27	0.11	0
700	Mountmcull-Nippeno association	0.22	0.09	4
701	Nippeno-Nipton association	0.18	0.07	4
705	Charkiln-Woodspring-Buckspring association	0.73	0.40	0
710	Arizo-Lanfair-Riverwash association	0.73	0.42	0
715	Troughspring-Charkiln-Buckspring association	0.51	0.28	2
716	Troughspring very gravelly loam 4 to 15 percent slopes	0.46	0.26	0
721	Corncreek-Badland-Pahrump association	0.46	0.22	0
723	Corncreek-Haymont association	0.32	0.12	0
725	Mackscanyon-Purob association	0.33	0.15	0
731	Purob-Irongold association	0.31	0.13	0
732	Purob extremely gravelly loam 8 to 30 percent slopes	0.30	0.13	1

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
733	Purob extremely gravelly loam 2 to 8 percent slopes	0.28	0.12	2
734	Purob-Niavi association	0.59	0.31	0
740	Varwash association	0.25	0.10	0
741	Varwash-Carrizo association	0.33	0.14	0
750	Haleburu-Crosgrain-Rock outcrop association	0.44	0.21	11
751	Nipton-Nolena association	0.41	0.19	3
752	Nipton-Newera association	0.28	0.12	0
753	Nipton-Hiddensun-Haleburu association	0.55	0.28	2
754	Haleburu-Hiddensun association	0.53	0.27	3
760	Searchlight extremely gravelly sandy loam 2 to 4 percent slopes	0.72	0.38	0
772	Lamadre-Robbersfire association	0.34	0.17	3
775	Ladyofsnow-Robbersfire-Maryjane association	0.37	0.19	2
780	Prisonear fine sand 2 to 8 percent slopes	1.66	1.50	0
781	Prisonear-Bluepoint association	1.79	1.63	0
790	McClanahan-Beerbo association	0.17	0.07	6
801	Nippeno-Newera association	0.10	0.03	2
805	Buckspring-Fletcherpeak-Seralin association	0.28	0.12	3
806	Buckspring-Scrapy association	0.44	0.22	2
810	Straycow-Newera-Rubble land association	0.20	0.07	14
815	Wheelerwell-Wheelerpass association	0.15	0.06	5
820	Newera-Rock outcrop association	0.12	0.04	15
821	Helkitchen-St. Thomas complex 15 to 50 percent slopes	0.39	0.18	4
830	Puelzmine extremely gravelly fine sandy loam 4 to 15 percent slopes	0.26	0.11	4
833	Virgin Peak-Rock outcrop association	0.42	0.21	15
840	Potosi-Zeheme-Rock outcrop association	0.34	0.16	10
845	Leecanyon-Goodwater association	0.46	0.22	0
850	Birdspring association	0.27	0.11	6
851	Birdspring-Zeheme-Rock outcrop association	0.31	0.14	15
852	Birdspring-Rock outcrop association	0.64	0.34	20

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
853	Birdspring-St. Thomas-Rock outcrop association	0.42	0.20	15
854	Birdspring-Birdspring warm-Rock outcrop association	0.59	0.31	20
860	Straycow-Highland association	0.11	0.03	3
865	Mackscanyon very gravelly silt loam 15 to 50 percent slopes	0.33	0.16	0
866	Goodwater-Doespring association 15 to 50 percent slopes	0.51	0.26	0
867	Goodwater very gravelly sandy loam 15 to 50 percent slopes	0.49	0.25	0
868	Mackscanyon-Goodwater association	0.36	0.17	0
870	Irongold extremely gravelly loam 2 to 8 percent slopes	0.30	0.12	0
871	Irongold-Weiser association	0.33	0.14	0
872	Irongold-Wechech association	0.38	0.17	0
875	Kylecanyon-Goodwater association	0.46	0.22	0
880	Nonamewash-Rositas association	1.89	1.29	0
885	Luckystrike gravelly loam 8 to 30 percent slopes	0.61	0.34	2
890	Ripley-Holtville complex	0.22	0.07	0
900	Urban land-Riverbend-Huevi association	1.05	0.60	0
905	Mountmummy-Thesisters-Maryjane association	0.39	0.21	3
910	Carrwash-Riverbend association	0.86	0.48	0
911	Carrwash association	0.89	0.50	0
915	Maryjane-Robbersfire-Kitgram complex 30 to 75 percent slopes	0.46	0.26	1
916	Maryjane extremely gravelly loam 8 to 30 percent slopes	0.62	0.39	0
920	Tanazza-Wechech-Wodavar association	0.80	0.43	0
925	Lastone association	0.27	0.12	1
930	Cololag-Badland association	0.47	0.23	0
940	Mesabase-Azsand association	1.00	0.66	3
941	Mesabase extremely gravelly sandy loam 2 to 8 percent slopes	0.73	0.39	0
950	Drygyp association	0.84	0.45	0

Table D.20 NV755 Clark County Area

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
951	Drygyp-Guardian-Baseline association	0.75	0.39	0
952	Drygyp fine sandy loam 2 to 4 percent slopes	0.95	0.49	0
955	Drygyp-Bluegyp association	0.65	0.32	0
965	Azsand-Mesabase-Rositas association	1.22	0.92	0
970	Rubble land-Charpeak-Rock outcrop complex	0.53	0.28	60
980	Orrubo very gravelly loam 15 to 35 percent slopes	0.25	0.10	0
981	Torriorthents-Haplocalcids-Lava flows complex 10 to 40 percent slopes	0.37	0.17	20
982	Winkel-Rock outcrop complex 2 to 12 percent slopes	0.26	0.11	15
998	Miscellaneous water	0.01	0.01	100
999	Water	0.01	0.01	100

D.3.15 UT634

Table D.21 UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
300	Abela cobbly loam 2 to 8 percent slopes	0.35	0.16	0
301	Abela very gravelly sandy loam 8 to 25 percent slopes	0.57	0.31	0
302	Acord extremely cobbly loam 15 to 40 percent slopes	0.19	0.08	0
303	Annabella very gravelly coarse sandy loam 2 to 8 percent slopes	0.79	0.44	0
304	Annabella very gravelly loam 2 to 15 percent slopes	0.17	0.06	0
305	Antelope Springs loam 0 to 2 percent slopes	0.26	0.10	0
306	Antelope Springs silt loam reclaimed 0 to 2 percent slopes	0.25	0.10	0
307	Ashdown clay loam 0 to 2 percent slopes	0.12	0.04	0
308	Ashdown fine sandy loam 0 to 5 percent slopes	0.65	0.33	0
309	Ashdown loam 2 to 5 percent slopes	0.25	0.09	0
310	Ashdown loam gypsiferous substratum 2 to 5 percent slopes	0.25	0.10	0
311	Ashdown silty clay loam 0 to 1 percent slopes	0.12	0.04	0
312	Baboon very cobbly loam 15 to 50 percent slopes	0.21	0.09	0
313	Badland	0.42	0.20	15
314	Badland-Moondog-Rock outcrop complex 30 to 70 percent slopes	0.17	0.06	15
315	Baird Hollow-Mord complex 15 to 40 percent slopes	0.49	0.28	0
316	Bamos extremely cobbly loam 15 to 40 percent slopes	0.09	0.02	0
317	Bamos extremely gravelly loam 2 to 15 percent slopes	0.10	0.03	0
318	Bamos-Lucero complex 2 to 25 percent slopes	0.18	0.07	0
319	Bamos-Rock outcrop complex 2 to 25 percent slopes	0.11	0.04	25
320	Bandag loam 0 to 2 percent slopes	0.27	0.11	0
321	Bannion gravelly loam 2 to 5 percent slopes	0.21	0.08	0
322	Behanin-Ess complex 25 to 60 percent slopes	0.55	0.32	0

Table D.21UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
323	Berent loamy fine sand 0 to 10 percent slopes	2.00	2.00	0
324	Beron-Plegomir gravelly sandy loams 2 to 8 percent slopes	0.46	0.21	0
325	Beryl sandy loam 2 to 5 percent slopes	0.71	0.37	0
326	Bess fine sandy loam 2 to 15 percent slopes	1.01	0.59	0
327	Biblesprings fine sandy loam 0 to 2 percent slopes	1.10	0.62	0
328	Biblesprings loam 0 to 2 percent slopes	0.34	0.15	0
329	Biblesprings-Bannion complex 2 to 5 percent slopes	0.94	0.52	0
330	Biblesprings-Blown out land complex 0 to 5 percent slopes	0.45	0.30	0
331	Birdow loam 0 to 5 percent slopes	0.43	0.21	0
332	Blown out land	0.03	0.01	0
333	Braffits loam 0 to 2 percent slopes	0.27	0.11	0
334	Bullion silt loam 0 to 2 percent slopes	0.18	0.06	0
335	Bullion silt loam 0 to 5 percent slopes	0.39	0.17	0
336	Bullion-Antelope Springs complex 0 to 2 percent slopes	0.20	0.07	0
337	Bullion-Berent complex 0 to 10 percent slopes	0.42	0.21	0
338	Bullion-Biblesprings complex 0 to 2 percent slopes	0.23	0.08	0
339	Bullion-Taylorsflat complex 0 to 5 percent slopes	0.42	0.18	0
340	Bushvalley very stony loam 15 to 40 percent slopes	0.31	0.16	0
341	Calcross loam 0 to 2 percent slopes	0.25	0.09	0
342	Calcross loam 2 to 5 percent slopes	0.25	0.09	0
343	Calcross silty clay loam 0 to 1 percent slopes	0.12	0.04	0
344	Canburn silty clay loam 0 to 5 percent slopes	0.21	0.09	0
345	Cathedral-Posant-Rock outcrop complex 25 to 60 percent slopes	0.58	0.34	15
346	Checkett gravelly loam 5 to 40 percent slopes	0.21	0.08	0
347	Checkett-Rock outcrop complex 5 to 40 percent slopes	0.21	0.08	25

Table D.21UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
348	Checkett-Rock outcrop complex 8 to 25 percent slopes	0.23	0.09	15
349	Chuska-Checkett gravelly loams 8 to 25 percent slopes	0.22	0.08	0
350	Cinder land	2.00	1.99	0
351	Cranbay-Winnemucca complex 10 to 60 percent slopes	0.37	0.21	0
352	Crestline gravelly sandy loam 0 to 5 percent slopes	1.06	0.61	0
353	Crestline sandy loam 0 to 2 percent slopes	1.22	0.71	0
354	Crestline-Sevy sandy loams 0 to 2 percent slopes	1.02	0.57	0
355	Dalcan cobbly loam 2 to 25 percent slopes	0.31	0.14	0
356	Dalcan cobbly loam 15 to 40 percent slopes	0.15	0.06	0
357	Decca sandy loam 0 to 5 percent slopes	0.73	0.38	0
358	Deerlodge gravelly loam 2 to 8 percent slopes	0.22	0.09	0
359	Deerlodge gravelly loam 2 to 15 percent slopes	0.22	0.08	0
360	Deerlodge gravelly loam 5 to 15 percent slopes	0.22	0.08	0
361	Deerlodge-Bannion complex 2 to 5 percent slopes	0.38	0.18	0
362	Deerlodge-Checkett gravelly loams 2 to 8 percent slopes	0.22	0.09	0
363	Deerlodge-Monox gravelly sandy loams 2 to 8 percent slopes	0.44	0.20	0
364	Denmark gravelly loam 2 to 15 percent slopes	0.35	0.16	0
365	Denmark loam 2 to 15 percent slopes	0.32	0.14	0
366	Denmark-Saxby complex 2 to 15 percent slopes	0.30	0.13	0
367	Dennot very gravelly loam 2 to 10 percent slopes	0.21	0.09	0
368	Detra complex 2 to 15 percent slopes	0.19	0.07	0
369	Detra fine sandy loam 15 to 40 percent slopes	1.15	0.71	0
370	Dixie gravelly loam 2 to 8 percent slopes	0.22	0.09	0
371	Dixie-Checkett complex 5 to 40 percent slopes	0.19	0.07	0
372	Doyce loam 2 to 15 percent slopes	0.15	0.05	0
373	Dune land	2.00	1.99	0

Table D.21UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
374	Elenore gravelly loam 2 to 8 percent slopes	0.28	0.12	0
375	Escalante sandy loam 0 to 5 percent slopes	1.15	0.67	0
376	Escalante sandy loam 1 to 5 percent slopes	1.19	0.69	0
377	Faim clay loam 4 to 25 percent slopes	0.32	0.16	0
378	Faim clay loam 4 to 40 percent slopes	0.32	0.16	0
379	Festus gravelly sandy loam 2 to 8 percent slopes	0.67	0.35	0
380	Fughes-Sheckle loams 4 to 25 percent slopes	0.65	0.38	0
381	Garbo gravelly sandy loam 2 to 5 percent slopes	0.88	0.48	0
382	Garbo-Biblesprings complex 2 to 5 percent slopes	0.94	0.52	0
383	Garbo-Deerlodge complex 2 to 8 percent slopes	0.37	0.16	0
384	Garbo-Sevy complex 2 to 5 percent slopes	0.44	0.18	0
385	Gomine-Vennob-Rock outcrop complex 15 to 40 percent slopes	0.10	0.03	15
386	Gordonpoint loam 1 to 10 percent slopes	0.50	0.27	0
387	Hatu silty clay 0 to 2 percent slopes	0.08	0.02	0
388	Hiko Peak gravelly loam 2 to 25 percent slopes	0.27	0.11	0
389	Hiko Peak gravelly sandy loam 2 to 15 percent slopes	0.83	0.46	0
390	Hoye sandy loam 2 to 5 percent slopes	0.16	0.05	0
391	Ikit-Rock outcrop-Lorhunt complex 25 to 60 percent slopes	0.21	0.08	35
392	Ironco-Quilt complex 25 to 60 percent slopes	0.19	0.08	0
393	Jigsaw silty clay loam 0 to 2 percent slopes	0.12	0.04	0
394	Junkett cobbly sandy loam 2 to 8 percent slopes	0.68	0.37	0
395	Kanarra extremely cobbly clay loam 8 to 25 percent slopes	0.09	0.03	0
396	Kanarra sandy clay loam 2 to 8 percent slopes	0.31	0.13	0
397	Kolob-Detra association 2 to 40 percent slopes	0.49	0.27	0
398	Komo gravelly loam 2 to 15 percent slopes	0.21	0.08	0
399	Krueger loam 2 to 5 percent slopes	0.56	0.31	0

Table D.21UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
400	Kunz-Detra complex 2 to 40 percent slopes	0.52	0.29	0
401	Kunz-Ramps complex 8 to 25 percent slopes	1.26	0.79	0
402	Lagnaf-Rypod complex 15 to 40 percent slopes	0.26	0.12	0
403	Lava flows	0.01	0.01	85
404	Lavate very cobbly sandy loam 8 to 25 percent slopes	0.60	0.32	0
405	Lodar-Rock outcrop complex 15 to 50 percent slopes	0.24	0.11	25
406	Lucero gravelly sandy loam 2 to 8 percent slopes	0.98	0.57	0
407	Lucero-Checkett complex 15 to 40 percent slopes	0.18	0.07	0
408	Magna silty clay loam 0 to 2 percent slopes	0.12	0.04	0
409	Manderfield gravelly sandy loam 2 to 8 percent slopes	0.98	0.57	0
410	Manselo loam 0 to 2 percent slopes	0.63	0.31	0
411	Manselo loam 0 to 3 percent slopes	0.34	0.15	0
412	Manselo-Antelope Springs silt loams 0 to 2 percent slopes	0.22	0.08	0
413	Manselo-Ashdown complex 0 to 5 percent slopes	0.50	0.23	0
414	Manselo-Berent complex 0 to 10 percent slopes	1.23	0.85	0
415	Manselo-Biblesprings complex 0 to 5 percent slopes	0.60	0.30	0
416	Manselo-Sevy loams 0 to 8 percent slopes	0.29	0.10	0
417	Medburn sandy loam 0 to 2 percent slopes	0.79	0.42	0
418	Medburn sandy loam 2 to 5 percent slopes	1.25	0.73	0
419	Medburn sandy loam saline-alkali 0 to 2 percent slopes	1.28	0.74	0
420	Melling very gravelly loam 8 to 25 percent slopes	0.33	0.17	0
421	Minu gravelly sandy loam 2 to 8 percent slopes	0.67	0.35	0
422	Monox gravelly sandy loam 2 to 8 percent slopes	0.26	0.10	0
423	Monroe loam 0 to 2 percent slopes	0.36	0.16	0
424	Monroe-Wales silt loams 0 to 2 percent slopes	0.25	0.10	0

Table D.21UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
425	Moondog cobbly loam 15 to 40 percent slopes	0.23	0.09	0
426	Moondog-Lorhunt-Rock outcrop complex 30 to 70 percent slopes	0.12	0.04	15
427	Mord gravelly loam 4 to 25 percent slopes	0.53	0.31	0
428	Mosida fine sandy loam 0 to 2 percent slopes	1.05	0.61	0
429	Motoqua-Rock outcrop complex 15 to 40 percent slopes	0.19	0.08	30
430	Muleypoint very cobbly loam 15 to 40 percent slopes	0.27	0.12	0
431	Musinia silty clay loam 0 to 2 percent slopes	0.19	0.08	0
432	Naplene loam 2 to 5 percent slopes	0.24	0.09	0
433	Ocambee extremely cobbly loam 25 to 40 percent slopes	0.19	0.08	0
434	Ocambee extremely gravelly loam 8 to 25 percent slopes	0.19	0.08	0
435	Onaqui-Tolman-Rock outcrop complex 15 to 50 percent slopes	0.33	0.16	15
436	Orcap very gravelly clay loam 15 to 50 percent slopes	0.17	0.08	0
437	Paragonah silty clay loam 0 to 2 percent slopes	0.09	0.02	0
438	Parowan silt loam 0 to 2 percent slopes	0.10	0.02	0
439	Pass Canyon extremely cobbly loam 15 to 40 percent slopes	0.19	0.08	0
440	Pass Canyon-Lucero complex 4 to 40 percent slopes	0.15	0.05	0
441	Pass Canyon-Red Butte-Rock outcrop association 15 to 40 percent slopes	0.22	0.10	20
442	Pass Canyon-Rock outcrop complex 25 to 60 percent slopes	0.23	0.10	25
443	Paunsaugunt extremely stony loam 25 to 60 percent slopes	0.28	0.14	0
444	Paunsaugunt-Kolob gravelly loams 10 to 40 percent slopes	0.18	0.07	0
445	Pavant cobbly loam 2 to 15 percent slopes	0.28	0.12	0
446	Pavant-Abela complex 2 to 25 percent slopes	0.38	0.18	0
447	Pavant-Lucero cobbly loams 2 to 25 percent slopes	0.28	0.12	0

Table D.21UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
448	Pits-Dumps complex	0.03	0.01	0
449	Playas	0.16	0.06	0
450	Plegomir gravelly sandy loam 2 to 15 percent slopes	0.69	0.36	0
451	Plegomir-Deerlodge gravelly sandy loams 2 to 8 percent slopes	0.37	0.16	0
452	Plegomir-Manselo complex 2 to 15 percent slopes	0.40	0.18	0
453	Plite sandy loam 2 to 8 percent slopes	1.08	0.65	0
454	Pyrat gravelly loam 2 to 15 percent slopes	0.48	0.23	0
455	Quichipa silty clay loam 0 to 2 percent slopes	0.10	0.03	0
456	Radec very cobbly loam 2 to 15 percent slopes	0.05	0.01	0
457	Radec-Bodacious complex 15 to 60 percent slopes	0.25	0.11	0
458	Radec-Checkett association 8 to 25 percent slopes	0.10	0.03	0
459	Radec-Rock outcrop complex 8 to 25 percent slopes	0.23	0.10	20
460	Red Butte extremely gravelly loam 15 to 40 percent slopes	0.19	0.08	0
461	Red Butte very gravelly loam 2 to 15 percent slopes	0.23	0.10	0
462	Repmis gravelly loam 2 to 15 percent slopes	0.29	0.13	0
463	Revor gravelly loam 2 to 8 percent slopes	0.29	0.13	0
464	Ripgut gravelly loam 2 to 8 percent slopes	0.23	0.09	0
465	Riverwash	2.00	1.99	0
466	Rob Roy extremely cobbly loam 15 to 50 percent slopes	0.22	0.10	0
467	Rock outcrop	0.42	0.20	85
468	Rustico silty clay loam 0 to 2 percent slopes	0.28	0.13	0
469	Rypod very gravelly loam 15 to 40 percent slopes	0.31	0.15	0
470	Sackett loam 2 to 8 percent slopes	0.25	0.10	0
471	Sanpete extremely cobbly loam 8 to 25 percent slopes	0.19	0.08	0

Table D.21UT634 Iron-Washington Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
472	Saxby-Rock outcrop-Checkett complex 15 to 40 percent slopes	0.22	0.09	25
473	Seth loam 2 to 15 percent slopes	0.57	0.32	0
474	Seth stony loam 15 to 40 percent slopes	0.45	0.25	0
475	Sevy loam 2 to 8 percent slopes	0.12	0.03	0
476	Sevy sandy loam 0 to 2 percent slopes	0.79	0.42	0
477	Sevy sandy loam 2 to 8 percent slopes	0.77	0.41	0
478	Sevy-Ardnas complex 0 to 5 percent slopes	0.63	0.31	0
479	Sevy-Taylorsflat complex 2 to 8 percent slopes	0.31	0.11	0
480	Simper gravelly loam 2 to 15 percent slopes	0.29	0.13	0
481	Siroco cobbly loam 8 to 25 percent slopes	0.15	0.06	0
482	Skumpah silt loam 0 to 2 percent slopes	0.10	0.02	0
483	Soutin loam 2 to 5 percent slopes	0.24	0.09	0
484	Squawcave silt loam 2 to 15 percent slopes	0.21	0.07	0
485	Streuling-Fontreen very gravelly loams 15 to 50 percent slopes	0.24	0.11	0
486	Studhorse gravelly loam 2 to 8 percent slopes	0.29	0.13	0
487	Studhorse gravelly loam 2 to 15 percent slopes	0.29	0.13	0
488	Syrett-Mudcree complex 25 to 60 percent slopes	0.23	0.09	0
489	Taylorsflat loam 0 to 2 percent slopes	0.33	0.15	0
490	Taylorsflat loam 2 to 5 percent slopes	0.32	0.14	0
491	Taylorsflat loam saline 0 to 5 percent slopes	0.27	0.10	0
492	Taylorsflat-Escalante sandy loams 2 to 5 percent slopes	1.19	0.70	0
493	Tiki-Kinghorn-Rock outcrop complex 15 to 40 percent slopes	0.20	0.08	15
494	Tolman extremely cobbly loam 4 to 25 percent slopes	0.19	0.08	0
495	Tolman-Dalcan-Rock outcrop complex 25 to 60 percent slopes	0.35	0.17	15
496	Tolman-Rock outcrop complex 15 to 40 percent slopes	0.60	0.32	15
497	Tolman-Rock outcrop-Dalcan complex 15 to 50 percent slopes	0.20	0.08	30

Table D.21UT634 Iron-Washington Area Utah Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
498	Tolman-Waltershow-Rock outcrop complex 15 to 40 percent slopes	0.45	0.23	15
499	Tombar cobbly loam 2 to 15 percent slopes	0.29	0.13	0
500	Tombar extremely cobbly loam 15 to 40 percent slopes	0.19	0.08	0
501	Trag stony loam 15 to 60 percent slopes	0.45	0.24	0
502	Vennob-Bodacious-Rock outcrop association 15 to 50 percent slopes	0.07	0.02	15
503	Vennob-Rock outcrop complex 15 to 40 percent slopes	0.04	0.01	30
504	Wales loam 0 to 2 percent slopes	0.27	0.10	0
505	Wales loam 2 to 5 percent slopes	0.12	0.04	0
506	Wales loam flooded 0 to 2 percent slopes	0.27	0.10	0
507	Wales sandy loam 0 to 2 percent slopes	1.25	0.73	0
508	Wales silty clay loam 0 to 2 percent slopes	0.12	0.04	0
509	Wales very fine sandy loam 0 to 2 percent slopes	1.18	0.68	0
510	Welring-Menefee-Rock outcrop complex 40 to 80 percent slopes	0.27	0.11	15
511	Wenzel cobbly loam 15 to 40 percent slopes	0.42	0.22	0
512	Whiteman very cobbly very fine sandy loam 1 to 6 percent slopes	0.09	0.03	0
513	Winnemucca loam 2 to 15 percent slopes	0.64	0.37	0
514	Winnemucca-Hoodle association 5 to 30 percent slopes	0.45	0.23	0
515	Woodrow silty clay loam 0 to 2 percent slopes	0.12	0.04	0
516	Woodrow silty clay loam saline 0 to 2 percent slopes	0.10	0.03	0
517	Wye very gravelly loam 15 to 40 percent slopes	0.19	0.07	0
518	Water	0.01	0.01	100

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Table D.22 UT636 Panguitch Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
1	Ahlstrom-Osote complex 1 to 15 percent slopes	0.30	0.14	0
2	Alldown clay loam 1 to 2 percent slopes	0.10	0.02	0
3	Alldown clay loam 2 to 5 percent slopes	0.10	0.02	0
4	Alldown loam alkali 1 to 2 percent slopes	0.28	0.10	0
5	Alldown clay loam moist 2 to 5 percent slopes	0.10	0.02	0
6	Andys loam 2 to 15 percent slopes	0.28	0.11	0
7	Andys very cobbly loam 8 to 25 percent slopes	0.35	0.16	0
8	Badland-Cannonville-Rock outcrop complex 30 to 50 percent slopes	0.15	0.06	15
9	Badland-Rock outcrop-Paunsaugunt complex 2 to 20 percent slopes	0.32	0.15	30
10	Baldfield clay 2 to 4 percent slopes	0.03	0.01	0
11	Baldfield clay 2 to 8 percent slopes eroded	0.03	0.01	0
12	Barx fine sandy loam 2 to 10 percent slopes	0.85	0.46	0
13	Bayfield clay 2 to 8 percent slopes	0.03	0.01	0
14	Befar clay 4 to 8 percent slopes	0.03	0.01	0
15	Behanin loam 30 to 70 percent slopes	0.50	0.25	0
16	Blanchard family sand 30 to 70 percent slopes	2.00	2.00	0
17	Borollic Natrargids 0 to 1 percent slopes	0.07	0.01	0
18	Broncho very gravelly sandy loam 2 to 5 percent slopes	0.39	0.18	0
19	Bruman loam 2 to 5 percent slopes	0.43	0.19	0
20	Bruman gravelly loam 2 to 10 percent slopes	0.37	0.16	0
21	Bruman cobbly loam moist 10 to 30 percent slopes	0.41	0.18	0
22	Bruman cobbly loam moist 30 to 50 percent slopes	0.41	0.18	0
23	Bruman very cobbly loam 5 to 30 percent slopes	0.27	0.11	0
24	Bruman very cobbly loam 30 to 50 percent slopes	0.27	0.11	0
25	Brycan very fine sandy loam 1 to 6 percent slopes	1.46	0.91	0

Table D.22 UT636 Panguitch Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
26	Brycan very fine sandy loam 6 to 15 percent slopes	1.46	0.91	0
27	Bushvalley very stony loam 15 to 40 percent slopes	0.25	0.11	0
28	Callings-Winnemucca association 5 to 15 percent slopes	0.68	0.41	0
29	Cannonville clay 30 to 50 percent slopes	0.03	0.01	0
30	Cannonville very stony clay 30 to 50 percent slopes	0.02	0.01	0
31	Castino-Behanin association 20 to 70 percent slopes	0.46	0.25	0
32	Castino-Tica family complex 20 to 70 percent slopes	0.35	0.18	0
33	Castino-Winnemucca association 5 to 30 percent slopes	0.53	0.30	0
34	Circleville-Rock outcrop complex 25 to 60 percent slopes	0.09	0.03	35
35	Clapper cobbly loam 5 to 30 percent slopes	0.17	0.06	0
36	Clapper cobbly loam 30 to 60 percent slopes	0.17	0.06	0
37	Codley silt loam 1 to 2 percent slopes	0.11	0.03	0
38	Codley silt loam 2 to 5 percent slopes	0.11	0.03	0
39	Comodore-Rock outcrop complex 15 to 40 percent slopes	0.07	0.02	30
40	Crestline fine sandy loam 2 to 4 percent slopes	0.94	0.50	0
41	Dalcan very cobbly loam dry 4 to 25 percent slopes	0.17	0.07	0
42	Descot silt loam dry 1 to 2 percent slopes	0.26	0.10	0
43	Descot silt loam 2 to 5 percent slopes	0.26	0.10	0
44	Dimyaw family gravelly loam 4 to 25 percent slopes eroded	0.18	0.06	0
45	Echard loam 5 to 30 percent slopes	0.42	0.20	0
46	Ess-Callings association 15 to 45 percent slopes	0.91	0.55	0
47	Evanston loam 2 to 8 percent slopes	0.54	0.26	0
48	Evanston very cobbly loam 4 to 25 percent slopes	0.34	0.16	0

Table D.22 UT636 Panguitch Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
49	Frandsen loam dry 1 to 15 percent slopes	0.26	0.11	0
50	Frandsen-Neto association 1 to 8 percent slopes	0.28	0.10	0
51	Frandsen dry-Wiggler complex 15 to 50 percent slopes	0.20	0.08	0
52	Fughes silty clay loam 0 to 4 percent slopes	0.21	0.09	0
53	Gerst family-Rock outcrop complex 20 to 70 percent slopes	0.22	0.08	35
54	Greenhalgh silt loam 1 to 2 percent slopes	0.11	0.03	0
55	Greenhalgh silt loam 2 to 5 percent slopes	0.11	0.03	0
56	Grimm sandy loam 1 to 5 percent slopes	1.08	0.60	0
57	Guben gravelly loam dry 1 to 25 percent slopes	0.45	0.23	0
58	Guben-Showalter complex 2 to 30 percent slopes	0.36	0.17	0
59	Harol very cobbly loam 2 to 15 percent slopes	0.26	0.12	0
60	Harol very cobbly loam 15 to 40 percent slopes	0.26	0.12	0
61	Harol very cobbly loam moist 25 to 50 percent slopes	0.25	0.12	0
62	Hatch-Pahreah complex 5 to 25 percent slopes	0.09	0.02	0
63	Hatch-Swapps complex 5 to 25 percent slopes	0.11	0.03	0
64	Henrieville sandy loam 1 to 2 percent slopes	0.99	0.54	0
65	Henrieville sandy loam 2 to 5 percent slopes	0.99	0.54	0
66	Henrieville sandy loam 5 to 10 percent slopes	0.99	0.54	0
67	Henrieville sandy loam moist 2 to 8 percent slopes	0.99	0.54	0
68	Hernandez family-Clapper complex 2 to 8 percent slopes	0.20	0.07	0
69	Ipson cobbly loam 8 to 25 percent slopes	0.36	0.17	0
70	Ipson very cobbly loam 25 to 60 percent slopes	0.32	0.15	0
71	Ipson very stony loam dry 5 to 25 percent slopes	0.29	0.13	0
72	Jodero loam 1 to 2 percent slopes	0.38	0.18	0

Table D.22 UT636 Panguitch Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
73	Jodero loam moist 2 to 8 percent slopes	0.38	0.18	0
74	Kade silt loam 0 to 2 percent slopes	0.56	0.32	0
75	Lava flows	0.01	0.01	100
76	Lazear-Rock outcrop-Badland complex 8 to 20 percent slopes	0.60	0.30	25
77	Losee gravelly loam 3 to 15 percent slopes	0.46	0.23	0
78	Losee gravelly sandy loam dry 10 to 25 percent slopes	0.99	0.57	0
79	Losee very gravelly loam 30 to 60 percent slopes	0.46	0.23	0
80	Luhon loam 2 to 5 percent slopes	0.20	0.07	0
81	Luhon loam gravelly substratum 1 to 2 percent slopes	0.21	0.07	0
82	Luhon loam gravelly substratum 2 to 5 percent slopes	0.21	0.07	0
83	Luhon loam moist 3 to 15 percent slopes	0.20	0.07	0
84	Luhon very cobbly sandy loam 2 to 15 percent slopes	0.58	0.30	0
85	Mespun loamy fine sand 1 to 3 percent slopes	1.70	1.20	0
86	Mespun loamy fine sand 3 to 8 percent slopes	2.00	1.59	0
87	Mespun loamy fine sand 8 to 15 percent slopes	2.00	1.59	0
88	Mikim sandy loam 2 to 8 percent slopes	0.82	0.43	0
89	Mikim loam dry 1 to 2 percent slopes	0.22	0.08	0
90	Mikim loam 2 to 4 percent slopes	0.22	0.08	0
91	Mikim clay loam dry 1 to 2 percent slopes	0.10	0.02	0
92	Mikim clay loam dry 2 to 5 percent slopes	0.10	0.02	0
93	Mitch silt loam 0 to 3 percent slopes	0.38	0.18	0
94	Mitch-Riverwash association 0 to 3 percent slopes	0.22	0.05	0
95	Mivida fine sandy loam 2 to 10 percent slopes	0.98	0.54	0
96	Neto fine sandy loam 1 to 5 percent slopes	0.84	0.44	0
97	Neto very fine sandy loam wet 0 to 2 percent slopes	0.77	0.40	0
98	Notter loam 1 to 4 percent slopes	0.49	0.23	0

Table D.22 UT636 Panguitch Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
99	Notter loam moist 1 to 8 percent slopes	0.47	0.22	0
100	Notter loam thick surface 4 to 8 percent slopes	0.25	0.10	0
101	Notter gravelly coarse sandy loam 2 to 8 percent slopes	1.31	0.78	0
102	Notter gravelly loam 8 to 25 percent slopes	0.42	0.20	0
103	Notter very cobbly loam 4 to 25 percent slopes	0.33	0.15	0
104	Notter variant loam 1 to 4 percent slopes	0.29	0.12	0
105	Pahreah-Sheege complex 1 to 20 percent slopes	0.54	0.31	0
106	Pahreah-Sielo complex 2 to 25 percent slopes	0.39	0.20	0
107	Pahreah-Swapps complex 25 to 65 percent slopes	0.35	0.17	0
108	Panguitch-Mitch association 0 to 5 percent slopes	0.75	0.42	0
109	Panguitch-Riverwash association 5 to 15 percent slopes	0.23	0.06	0
110	Paunsaugunt gravelly loam 2 to 15 percent slopes	0.22	0.09	0
111	Paunsaugunt-Syrett gravelly loams 2 to 20 percent slopes	0.27	0.12	0
112	Playas	0.07	0.01	0
113	Plite sandy loam 2 to 8 percent slopes	1.14	0.70	0
114	Podo loamy sand 1 to 12 percent slopes	2.00	1.27	0
115	Podo-Wiggler complex 10 to 50 percent slopes	0.14	0.05	0
116	Podo-Rock outcrop complex 10 to 40 percent slopes	0.70	0.37	15
117	Quilt very cobbly loam 4 to 25 percent slopes	0.22	0.09	0
118	Quilt very cobbly loam 25 to 40 percent slopes	0.22	0.09	0
119	Redcreek gravelly sandy loam dry 10 to 40 percent slopes	0.52	0.25	0
120	Redcreek cobbly loam 15 to 50 percent slopes	0.18	0.06	0
121	Riverwash	0.12	0.01	0
122	Rock outcrop	0.01	0.01	100
124	Rubble land	0.01	0.01	100
126	Ruko-Podo complex 15 to 60 percent slopes	0.18	0.06	0

Table D.22 UT636 Panguitch Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
127	Schauson loam 2 to 4 percent slopes	0.69	0.40	0
128	Schauson loam 4 to 15 percent slopes	0.69	0.40	0
129	Sevier-Skutum association 5 to 35 percent slopes	1.25	0.78	0
130	Sheege-Swapps complex 30 to 50 percent slopes	0.26	0.11	0
131	Showalter-Guben complex dry 0 to 8 percent slopes	0.33	0.16	0
132	Shupert silty clay loam wet 0 to 1 percent slopes	0.13	0.05	0
133	Sielo very fine sandy loam 2 to 12 percent slopes	0.74	0.39	0
134	Skutum very fine sandy loam 1 to 6 percent slopes	1.16	0.72	0
135	Skutum fine sandy loam 10 to 35 percent slopes	1.24	0.78	0
136	Swapps gravelly loam 5 to 25 percent slopes	0.41	0.19	0
137	Swapps gravelly loam 25 to 65 percent slopes	0.30	0.13	0
138	Syrett gravelly loam 2 to 12 percent slopes	0.40	0.22	0
139	Syrett-Frandsen association 1 to 12 percent slopes	0.26	0.11	0
140	Syrett-Vanet gravelly loams 20 to 40 percent slopes	0.27	0.12	0
141	Tebbs sandy loam 2 to 5 percent slopes	1.17	0.65	0
142	Tebbs loam 1 to 2 percent slopes	0.22	0.08	0
143	Tebbs loam moist 1 to 2 percent slopes	0.22	0.08	0
144	Tolman very cobbly silt loam 8 to 35 percent slopes	0.14	0.05	0
145	Tolman-Rock outcrop complex 25 to 40 percent slopes	0.30	0.14	25
146	Tridell loam 2 to 4 percent slopes	0.53	0.26	0
147	Tridell gravelly loam moist 4 to 25 percent slopes	0.45	0.22	0
148	Tridell cobbly loam 4 to 25 percent slopes	0.53	0.27	0
149	Tridell moist-Rock outcrop complex 25 to 50 percent slopes	0.19	0.08	15

Table D.22 UT636 Panguitch Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
150	Ustic Torrifluvents occasionally flooded 2 to 8 percent slopes	0.95	0.51	0
151	Venture cobbly loam 4 to 30 percent slopes	0.37	0.17	0
152	Venture very cobbly silt loam 4 to 25 percent slopes	0.22	0.10	0
153	Venture cobbly loam dry 8 to 25 percent slopes	0.37	0.17	0
154	Villy family silty clay loam 0 to 2 percent slopes	0.33	0.17	0
155	Waltershow extremely cobbly loam 8 to 40 percent slopes	0.19	0.08	0
156	Waltershow extremely cobbly loam 40 to 60 percent slopes	0.19	0.08	0
157	Waltershow-Venture-Rock outcrop complex 4 to 40 percent slopes	0.22	0.09	15
158	Whiteman very cobbly very fine sandy loam 1 to 6 percent slopes	0.09	0.03	0
159	Whiteman-Skutum association 10 to 70 percent slopes	0.24	0.10	0
160	Widtsoe gravelly sandy loam 8 to 40 percent slopes	0.51	0.26	0
161	Wiggler channery loam 20 to 50 percent slopes	0.19	0.07	0
162	Wiggler-Guben complex 25 to 50 percent slopes	0.27	0.12	0
163	Wiggler-Rock outcrop-Podo complex 50 to 70 percent slopes	0.12	0.04	25
164	Winetti gravelly sandy loam 2 to 7 percent slopes	0.63	0.29	0
165	Winnemucca-Hoodle association 5 to 30 percent slopes	0.44	0.21	0
166	Yarts loam 1 to 2 percent slopes	0.49	0.22	0
167	Yarts sandy loam 2 to 5 percent slopes	0.74	0.37	0
168	Yarts sandy loam 5 to 10 percent slopes	0.74	0.37	0
169	Yenlo loam 2 to 8 percent slopes	0.11	0.03	0
170	Zillion very cobbly loam 5 to 25 percent slopes	0.30	0.14	0
171	Zinzer loam 3 to 15 percent slopes	0.29	0.12	0

Table D.22 UT636 Panguitch Area Utah Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
172	Zyme very cobbly loam 30 to 60 percent slopes	0.03	0.01	0
173	Zyme-Lazear-Rock outcrop complex 8 to 60 percent slopes	0.10	0.04	15
174	Water	0.01	0.01	100
175	Pits gravel	2.00	2.00	0
176	Pits borrow	0.03	0.01	0
177	Miscellaneous water	0.01	0.01	100

D.3.17 UT641

Table D.23 UT641 Washington County Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
BA	Badland	0.42	0.20	0
BB	Badland very steep	0.42	0.20	0
BED	Bermesa fine sandy loam 1 to 10 percent slopes	1.45	0.87	0
BF	Bermesa-Rock land association	2.00	1.48	20
BOD	Bond sandy loam 1 to 10 percent slopes	0.14	0.04	0
BP	Borrow pits	1.34	0.80	0
CaD	Caval fine sandy loam 2 to 10 percent slopes	1.13	0.65	0
CEF	Cave very gravelly sandy loam 7 to 30 percent slopes	0.54	0.30	0
CFD	Cave very gravelly sandy loam low rainfall 2 to 7 percent slopes	0.51	0.27	0
CHF	Chilton gravelly loam 5 to 30 percent slopes	0.38	0.17	0
CI	Cinder land	2.00	1.99	0
CoC	Clovis fine sandy loam 1 to 5 percent slopes	0.78	0.40	0
CPD	Clovis-Pastura complex 1 to 10 percent slopes	0.46	0.20	0
CRF	Collbran very cobbly clay loam 2 to 30 percent slopes	0.12	0.04	0
CSE	Curhollow very gravelly fine sandy loam 2 to 10 percent slopes	0.99	0.58	0
CUF	Curhollow-Rock outcrop complex 10 to 30 percent slopes	0.99	0.58	15
DAG	Dagflat-Motoqua complex 30 to 70 percent slopes	0.47	0.24	0
DBD	Dalcan cobbly loam 0 to 15 percent slopes	0.20	0.08	0
DKG	Detra-Kolob complex 20 to 50 percent slopes	0.56	0.30	0
DrB	Draper loam 2 to 5 percent slopes	0.39	0.19	0
DU	Dune land	2.00	1.99	0
EA	Eroded land-Shalet complex	0.50	0.21	0
EB	Eroded land-Shalet complex warm	0.77	0.38	0
FA	Fluvaquents and Torrifluvents sandy	2.00	2.00	0
GA	Gullied land	1.34	0.80	0
GP	Gravel pits	2.00	1.99	0

Table D.23UT641 Washington County Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
Ha	Hantz silty clay loam	0.09	0.02	0
HbC	Harrisburg fine sandy loam 1 to 5 percent slopes	1.64	0.97	0
HD	Harrisburg-Rock land association	1.64	0.97	15
HG	Hobog-Rock land association	0.26	0.11	40
IAF	Isom cobbly sandy loam 3 to 30 percent slopes	0.83	0.46	0
Ib	Ivins loamy fine sand	2.00	2.00	0
Ic	Ivins loamy fine sand hummocky	2.00	2.00	0
JaB	Junction fine sandy loam 1 to 2 percent slopes	1.54	0.91	0
JaC	Junction fine sandy loam 2 to 5 percent slopes	1.54	0.91	0
KAE	Kinesava fine sandy loam 15 to 25 percent slopes	1.22	0.71	0
KBD	Kinesava-Detra fine sandy loams 2 to 15 percent slopes	1.17	0.69	0
KCE	Kinesava complex 2 to 30 percent slopes	0.56	0.28	0
KD	Kolob-Detra association	0.93	0.54	0
KHC	Kolob-Hogg complex 2 to 8 percent slopes	0.83	0.47	0
KLG	Kolob-Paunsaugunt complex 20 to 60 percent slopes	0.56	0.30	0
LA	Lava flows	0.01	0.01	100
Lb	Lavate sandy loam	1.01	0.57	0
LcB	LaVerkin fine sandy loam 1 to 2 percent slopes	1.59	0.96	0
LcC	LaVerkin fine sandy loam 2 to 5 percent slopes	1.58	0.94	0
LdB	LaVerkin silty clay loam 1 to 2 percent slopes	0.09	0.02	0
LeA	Leeds silty clay loam 0 to 1 percent slopes	0.12	0.04	0
LeB	Leeds silty clay loam 1 to 2 percent slopes	0.12	0.04	0
LeD	Leeds silty clay loam 5 to 10 percent slopes	0.12	0.04	0
MAE	Magotsu-Pastura complex 2 to 20 percent slopes	0.11	0.04	0
MBG	Mathis-Rock outcrop complex 20 to 50 percent slopes	1.84	1.15	20
MEG	Menefee-Rock outcrop complex 25 to 60 percent slopes	0.13	0.03	25

Table D.23UT641 Washington County Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
MFD	Mespun fine sand 0 to 10 percent slopes	2.00	2.00	0
MMG	Motoqua-Mokiak very cobbly sandy loams 30 to 70 percent slopes	0.62	0.33	0
MOG	Motoqua-Rock outcrop complex 30 to 70 precent slopes	0.40	0.19	15
NaC	Naplene silt loam 2 to 6 percent slopes	0.13	0.04	0
NEF	Nehar very stony sandy loam 3 to 30 percent slopes	0.73	0.40	0
NIF	Nehar-Ildefonso complex 3 to 30 percent slopes	0.64	0.34	0
NkC	Nikey sandy loam 1 to 3 percent slopes	1.26	0.72	0
NLE	Nikey sandy loam 3 to 15 percent slopes	1.26	0.72	0
NME	Nikey very stony sandy loam 2 to 15 percent slopes	0.89	0.49	0
NNE	Nikey-Isom complex 3 to 30 percent slopes	1.07	0.62	0
PAC	Palma loamy fine sand 1 to 5 percent slopes	2.00	1.51	0
PbC	Palma fine sandy loam 1 to 5 percent slopes	1.75	1.05	0
PcC	Pastura loam 2 to 5 percent slopes	0.16	0.05	0
PED	Pastura-Esplin complex 0 to 10 percent slopes	0.20	0.07	0
PFG	Paunsaugunt gravelly silt loam 30 to 50 percent slopes	0.38	0.20	0
PG	Paunsaugunt-Kolob association	0.47	0.25	0
PKE	Paunsaugunt-Rock outcrop complex 2 to 30 percent slopes	0.18	0.07	15
PnC	Pintura loamy fine sand 1 to 5 percent slopes	1.95	1.18	0
PoD	Pintura loamy fine sand hummocky 1 to 10 percent slopes	1.95	1.18	0
PTE	Pintura-Toquerville complex 1 to 20 percent slopes	1.97	1.49	0
QMG	Quazo-Motoqua very gravelly sandy loams 30 to 70 percent slopes	0.28	0.12	0
RaC	Redbank fine sandy loam 1 to 5 percent slopes	0.87	0.46	0
RbA	Redbank silty clay loam 0 to 2 percent slopes	0.09	0.02	0
RE	Renbac-Rock land association	0.02	0.01	25
RI	Riverwash	2.00	1.99	0

Table D.23UT641 Washington County Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
RO	Rock land	0.01	0.01	80
RP	Rock land stony	0.01	0.01	100
RR	Rock land-Hobog association	0.07	0.03	40
RT	Rock outcrop	0.01	0.01	100
RU	Rough broken land	0.01	0.01	100
Sa	St. George silt loam	0.23	0.09	0
Sb	St. George silt loam strongly saline	0.38	0.16	0
Sc	St. George silty clay loam	0.15	0.05	0
Sd	St. George silty clay loam moderately saline	0.15	0.05	0
Se	St. George silty clay loam shallow water table	0.15	0.05	0
SH	Schmutz loam	0.32	0.13	0
SPD	Spenlo very fine sandy loam 2 to 10 percent slopes	1.50	0.89	0
SrC	Springerville clay 0 to 5 percent slopes	0.03	0.01	0
SY	Stony colluvial land	0.56	0.28	0
TAG	Tacan very stony sandy loam 30 to 70 percent slopes	1.05	0.65	0
TBF	Tobish very cobbly clay loam 5 to 30 percent slopes	0.06	0.01	0
Tc	Tobler fine sandy loam	0.85	0.44	0
Td	Tobler silty clay loam	0.09	0.02	0
TG	Tortugas-Rock land association	0.19	0.07	20
VeA	Vekol sandy loam 0 to 2 percent slopes	0.57	0.26	0
VFD	Vekol sandy loam 2 to 10 percent slopes	0.57	0.26	0
VHD	Veyo-Curhollow complex 3 to 10 percent slopes	0.19	0.05	0
VPD	Veyo-Pastura complex 1 to 10 percent slopes	0.09	0.02	0
W	Water	0.01	0.01	100
WAG	Welring-Tortugas very gravelly loams 20 to 70 percent slopes	0.20	0.08	0
WBD	Winkel gravelly fine sandy loam 1 to 8 percent slopes	1.28	0.74	0
WCF	Winkel-Rock outcrop complex 8 to 30 percent slopes	1.28	0.74	25
YAF	Yaki very cobbly loam 3 to 35 percent slopes	0.15	0.05	0

Table D.23UT641 Washington County Area Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
YZE	Yaki-Zukan complex 1 to 35 percent slopes	0.28	0.11	0

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D.3.18 UT686

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah Soil Map Unit Composite XKSAT and RTIMP Values				
SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
5001	Mido loamy fine sand 2 to 15 percent slopes	2.00	2.00	0
5002	Dune land	2.00	2.00	0
5003	Milok cool-Barx dry complex 1 to 5 percent slopes	1.23	0.71	0
5004	Rock outcrop (Navajo Sandstone)	0.01	0.01	100
5006	Milok fine sandy loam cool 2 to 8 percent slopes	1.07	0.61	0
5007	Rock outcrop (Navajo Sandstone)-Nalcase complex 2 to 30 percent slopes	2.00	2.00	65
5008	Simel complex 2 to 60 percent slopes	0.08	0.02	0
5009	Wayneco sandy loam dry 2 to 15 percent slopes	1.50	0.90	0
5010	Retsabal-Lemrac complex 2 to 60 percent slopes	0.64	0.31	0
5011	Badland (Carmel Formation)-Rizno cool-Nonip complex 5 to 25 percent slopes	0.19	0.07	0
5012	Santrick-Nalcase-Bispen complex 2 to 30 percent slopes	2.00	1.75	0
5013	Mido-Yarts complex 2 to 15 percent slopes	2.00	1.76	0
5015	Mespun fine sand 2 to 15 percent slopes	2.00	2.00	0
5017	Skos dry-Mido-Arches dry complex 2 to 15 percent slopes	2.00	1.58	0
5018	Skos channery loam dry 5 to 30 percent slopes	0.13	0.05	0
5019	Skos dry-Rock outcrop (Carmel Formation)-Arches dry complex 15 to 60 percent slopes	0.34	0.16	30
5020	Rock outcrop (Navajo Sandstone)-Mespun-Nalcase complex 2 to 30 percent slopes	2.00	2.00	40
5021	Milok cool-Anasazi cool complex 2 to 8 percent slopes	1.09	0.62	0
5023	Tsaya channery loam 5 to 25 percent slopes	0.19	0.07	0
5025	Yarts sandy loam 2 to 8 percent slopes	0.74	0.37	0
5026	Rock outcrop (Entrada and Carmel Formation sandstone)	0.01	0.01	95

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
5027	Badland (Tropic Formation Shale)-Cannonville-Rock outcrop (Dakota Formation) complex 30 to 50 percent slopes	0.04	0.01	15
5028	Badland (Entrada Formation)	0.01	0.01	95
5029	Rock outcrop (Straight Cliffs Formation)-Atchee family steep-Chilton family complex 50 to 80 percent slopes	0.76	0.43	40
5030	Catahoula-Clapper dry complex 15 to 60 percent slopes	0.41	0.19	0
5031	Moclom-Rock outcrop (Morrison Formation) complex 2 to 15 percent slopes	2.00	2.00	30
5032	Remorris-Kenzo steep-Rock outcrop (Morrison and Entrada Formations) complex 30 to 60 percent slopes	0.23	0.09	25
5033	Yarts fine sandy loam 15 to 40 percent slopes eroded	1.13	0.64	0
5034	Nonip very channery loam 5 to 25 percent slopes	0.11	0.04	0
5035	Earlweed-Mido complex 2 to 30 percent slopes	2.00	2.00	0
5037	Barx fine sandy loam 2 to 10 percent slopes	0.89	0.49	0
5038	Mido-Rock outcrop (Entrada Formation) complex 5 to 40 percent slopes	2.00	2.00	20
5040	Sazi-Milok cool complex 2 to 30 percent slopes	0.99	0.55	0
5041	Seeg warm-Pagina complex 2 to 15 percent slopes	1.62	0.99	0
5042	Moenkopie warm-Moepitz-Rock outcrop (Carmel Formation) complex 10 to 30 percent slopes	2.00	1.63	25
5043	Daklos steep-Rock outcrop (Morrison Formation and Romana Mesa Sandstone) complex 30 to 70 percent slopes	0.68	0.37	40
5044	Dient very stony loam 15 to 50 percent slopes	0.22	0.08	0
5046	Moffat-Sheppard-Nakai complex 2 to 30 percent slopes	1.52	0.96	0
5047	Moffat-Seeg warm-Mack moist complex 2 to 15 percent slopes	1.83	1.13	0

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
5049	Moffat-Mack moist complex 1 to 5 percent slopes	1.84	1.29	0
5050	Daklos-Arches dry complex 2 to 15 percent slopes	0.75	0.47	0
5052	Yarts-Suwanee complex 1 to 8 percent slopes	0.46	0.21	0
5053	Milok fine sand 2 to 8 percent slopes	2.00	2.00	0
5055	Mivida-Barx dry complex 1 to 8 percent slopes	1.00	0.55	0
5057	Arches dry-Mident-Yarts complex 2 to 40 percent slopes	2.00	1.82	0
5058	Earlweed-Mivida complex 2 to 20 percent slopes	1.48	0.97	0
5059	Mivida-Yarts moist complex 2 to 8 percent slopes	1.52	0.91	0
5060	Ranion-Suzipon-Rock outcrop (Navajo Sandstone) complex 2 to 30 percent slopes	2.00	1.86	20
5061	Rock outcrop (Navajo Sandstone)-Suzipon-Peekaboo complex 2 to 30 percent slopes	2.00	1.39	50
5062	Peekaboo-Spooky-Suzipon complex 2 to 15 percent slopes	2.00	1.85	0
5063	Rock outcrop (Navajo and Carmel Formations)-Moenkopie warm-Needle complex 15 to 35 percent slopes	0.70	0.40	40
5065	Trail-Sheppard complex 2 to 10 percent slopes	2.00	1.73	0
5067	Ranion-Peekaboo complex 2 to 20 percent slopes	2.00	1.45	0
5068	Seeg warm-Moffat-Needle complex 2 to 25 percent slopes	2.00	1.86	0
5069	Rock outcrop (Entrada Formation)-Nepalto moist complex 2 to 8 percent slopes	1.41	0.84	60
5071	Somorent-Rock outcrop (Morrison Formation) complex 15 to 40 percent slopes	0.81	0.42	40
5073	Kenzo-Nalcase complex 2 to 15 percent slopes	2.00	1.50	0
5074	Evpark-Vessilla complex 2 to 15 percent slopes	1.24	0.73	0
5075	Shalona sandy loam 2 to 8 percent slopes	1.29	0.79	0
5076	Daklos-Catahoula complex 2 to 30 percent slopes	0.35	0.15	0

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
5077	Gompers family-Rock outcrop (Straight Cliffs Formation)-Sheecal family complex 50 to 80 percent slopes	0.38	0.19	30
5078	Arabrab-Vessilla-Colskel complex 2 to 15 percent slopes	0.65	0.32	0
5079	Colskel-Arabrab-Vessilla complex 15 to 50 percent slopes	0.48	0.24	0
5080	Moffat-Moepitz complex 2 to 25 percent slopes	0.86	0.45	0
5081	Badland and Rock outcrop (Straight Cliffs and Wahweap Formations)-Kydestea family complex 50 to 80 percent slopes	0.19	0.08	70
5082	Colskel-Menefee-Arabrab complex 2 to 15 percent slopes	0.34	0.15	0
5083	Colskel-Menefee complex 15 to 50 percent slopes	0.20	0.09	0
5085	Hillburn very channery loam 10 to 70 percent slopes	0.13	0.05	0
5086	Mespun-Bispen-Santrick complex 2 to 15 percent slopes	2.00	2.00	0
5087	Kenzo steep-Rock outcrop (Kayenta Formation) complex 15 to 50 percent slopes	1.42	0.86	25
5088	Calcree-Bowington-Mespun complex 0 to 20 percent slopes	2.00	2.00	0
5089	Bowington-Mespun complex 0 to 15 percent slopes	2.00	2.00	0
5090	Baldfield clay saline 2 to 8 percent slopes	0.03	0.01	0
5091	Brumley fine sandy loam 2 to 8 percent slopes	1.30	0.78	0
5092	Rock outcrop (Navajo Formation)-Navigon complex 30 to 60 percent slopes	2.00	1.42	50
5093	Robay-Strell complex 5 to 30 percent slopes	2.00	1.82	0
5094	Aridic Ustorthents-Yatne complex 15 to 70 percent slopes	0.21	0.09	0
5095	Daklos-Hideout-Rock outcrop (Straight Cliffs Formation) complex 2 to 15 percent slopes	0.48	0.23	15
5096	Daklos steep-Rock outcrop (Straight Cliffs Formation) complex 15 to 50 percent slopes	0.35	0.17	15

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
5097	Skyvillage-Daklos saline-Rock outcrop (Wahweap Formation) complex 2 to 15 percent slopes	0.76	0.39	15
5098	Daklos saline-Skyvillage saline-Cannonville complex 15 to 50 percent slopes	0.47	0.26	0
5100	Rock outcrop (Wingate Formation)-Arches dry complex 2 to 10 percent slopes	0.87	0.46	75
5101	Polychrome family-Badland (Chinle Formation)-Gaddes family complex 15 to 60 percent slopes	0.56	0.26	0
5102	Chinchin-Badland (Chinle Formation) complex 25 to 50 percent slopes	0.10	0.03	0
5103	Barx-Remorris complex 5 to 45 percent slopes	0.70	0.33	0
5104	Rock outcrop (Shinarump Conglomerate)-Hideout complex 5 to 50 percent slopes	0.88	0.51	75
5105	Atchee-Lazear dry-Rock outcrop (Shinarump Conglomerate) complex 5 to 60 percent slopes	0.25	0.09	15
5106	Hillburn dry-Badland (Moenkopi Formation) complex 25 to 60 percent slopes	0.10	0.03	35
5107	Simel-Hillburn dry complex 5 to 45 percent slopes	0.10	0.03	0
5108	Hillburn dry-Rock outcrop (Moenkopi Formation) complex 10 to 60 percent slopes	0.07	0.02	25
5109	Nonip dry-Rock outcrop (Moenkopi Formation) complex 15 to 50 percent slopes	0.18	0.07	20
5110	Reef very channery sandy loam 5 to 25 percent slopes	0.24	0.10	0
5111	Nonip extremely channery sandy loam dry 5 to 50 percent slopes	0.08	0.02	0
5112	Barx-Radnik moist-Progresso dry complex 2 to 8 percent slopes	1.14	0.64	0
5114	Meriwhitica moist-Mellenthin complex 5 to 15 percent slopes	0.18	0.07	0
5115	Sanostee warm-Daklos-Hideout complex 2 to 15 percent slopes	0.87	0.47	0
5116	Stent-Minchey complex 2 to 15 percent slopes	0.57	0.28	0
5117	Sheppard-Badland (Carmel and Entrada Formations) complex 5 to 30 percent slopes	2.00	1.32	25

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
5118	Mido-Kenzo-Rock outcrop (Carmel Formation) complex 2 to 30 percent slopes	1.06	0.63	15
5120	Pinepoint-Flatnose complex 2 to 8 percent slopes	2.00	1.81	0
5121	Trail-Riverwash complex 0 to 5 percent slopes	2.00	1.82	0
5122	Mido-Mivida complex 2 to 15 percent slopes	2.00	1.71	0
5123	Billings-Jocity saline complex 0 to 8 percent slopes	0.14	0.03	0
5125	Clapper very gravelly loam 2 to 15 percent slopes	0.19	0.07	0
5126	Pinepoint-Parkwash complex 2 to 15 percent slopes	2.00	2.00	0
5127	Skyvillage-Mikim-Badland (Kaiparowits Formation) complex 2 to 15 percent slopes	1.08	0.59	0
5128	Curecanti-Zibetod families complex 30 to 70 percent slopes	0.31	0.14	0
5129	Skyvillage-Rock outcrop (Wahweap Formation) complex 2 to 15 percent slopes	1.45	0.85	35
5130	Progresso-Begay dry complex 1 to 8 percent slopes	0.40	0.16	0
5131	Badland (Kaiparowits Formation)-Lazear steep complex 15 to 60 percent slopes	0.69	0.31	0
5132	Strych-Horsemountain-Barx complex 2 to 15 percent slopes	0.77	0.40	0
5133	Menefee-Badland (Kaiparowits Formation) complex 5 to 30 percent slopes	0.67	0.33	0
5136	Suzmayne-Colskel-Rock outcrop (Straight Cliffs Formation) complex 10 to 40 percent slopes	0.20	0.08	15
5137	Casmos-Pariette families-Rock outcrop (Dakota and Morrison Formation) complex 2 to 30 percent slopes	0.40	0.17	15
5138	Nakai-Sheppard complex 2 to 15 percent slopes	2.00	2.00	0
5139	Hetz sandy loam 0 to 3 percent slopes	1.27	0.75	0
5140	Green River-Radnik moist-Suwanee saline complex 0 to 5 percent slopes	0.59	0.30	0

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
5141	Radnik moist-Suwanee saline-Escavada complex 0 to 8 percent slopes	0.83	0.50	0
5142	Alvey-Atrac complex 1 to 15 percent slopes	0.41	0.18	0
5143	Elias-Mikim complex 1 to 7 percent slopes	0.29	0.12	0
5144	Tsaya-Rock outcrop (Straight Cliffs Formation) complex 10 to 60 percent slopes	0.11	0.03	25
5146	Moffat-Pagina-Sheppard complex 2 to 20 percent slopes	1.94	1.30	0
5149	Tsaya saline-Rock outcrop (Straight Cliffs Formation)-Lithic Torriorthents complex 50 to 80 percent slopes	0.09	0.02	30
5150	Chipeta-Hanksville-Badland (Tropic Shale) complex 2 to 30 percent slopes	0.06	0.01	0
5151	Pinepoint dry-Tenneycanyon-Parkwash complex 2 to 25 percent slopes	2.00	1.78	0
5154	Dient-Crotoncanyon complex 15 to 50 percent slopes	0.14	0.05	0
5155	Sanostee warm-Milok-Lazear warm complex 2 to 15 percent slopes	1.52	1.01	0
5156	Daklos steep-Fourmilebench complex 15 to 50 percent slopes	0.15	0.04	0
5157	Daklos family-Rock outcrop (Wahweap Formation) complex 50 to 80 percent slopes	0.20	0.08	35
5158	Mellenthin moist-Rock outcrop (Moenkopi Formation) complex 25 to 60 percent slopes	0.22	0.10	40
5159	Mellenthin moist-Bowdish complex 2 to 30 percent slopes	0.21	0.09	0
5160	Timpoweap-Evpark-Atarque complex 2 to 15 percent slopes	0.82	0.44	0
5163	Horsemountain fine sandy loam moist 2 to 8 percent slopes	0.74	0.38	0
5164	Badland (Chinle Formation)	0.05	0.01	0
5166	Hillburn dry-Sazi moist complex 2 to 30 percent slopes	0.42	0.22	0
5167	Progresso cool-Atchee family complex 2 to 15 percent slopes	0.47	0.22	0
5169	Lazear steep-Simel-Rock outcrop (Carmel Formation) complex 20 to 60 percent slopes	0.29	0.13	20

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
5170	Lemrac-Simel-Humbug moist complex 2 to 20 percent slopes	0.31	0.13	0
5171	Kenzo-Retsabal-Progresso cool complex 2 to 30 percent slopes	0.30	0.13	0
5172	Ruinpoint-Barx complex 2 to 8 percent slopes	0.17	0.05	0
5173	Simel-Strych moist-Kenzo complex 2 to 20 percent slopes	0.20	0.08	0
5174	Strych-Sazi moist complex 15 to 50 percent slopes	0.77	0.42	0
5180	Pinepoint-Rock outcrop (Navajo Sandstone)-Parkwash complex 15 to 50 percent slopes	2.00	1.81	30
5181	Parkelei-Plumasano moist-Pinepoint complex 2 to 15 percent slopes	1.63	1.12	0
5182	Arabrab-Colskel-Rock outcrop (Carmel Formation) complex 15 to 50 percent slopes	0.95	0.60	20
5183	Parkwash-Rock outcrop (Navajo Sandstone)-Vessilla complex 30 to 65 percent slopes	0.89	0.54	30
5185	Nomrah-Upler complex 2 to 15 percent slopes	0.59	0.30	0
5186	Bodot cool-Sili complex 2 to 8 percent slopes	0.07	0.01	0
5187	Zigzag-Aridic Ustorthents complex 15 to 70 percent slopes	0.15	0.05	0
5188	Frandsen loam 1 to 15 percent slopes	0.39	0.18	0
5189	Widtsoe-Emlin complex 5 to 25 percent slopes	0.51	0.25	0
5190	Podo-Rock outcrop (Straight Cliffs and Wahweap Formations) complex 15 to 50 percent slopes	1.10	0.61	40
5191	Ruko-Rock outcrop (Straight Cliffs and Wahweap Formations)-Podo complex 30 to 70 percent slopes	0.16	0.04	30
5192	Gerst family-Cannonville-Rock outcrop (Straight Cliffs and Dakota Formation) complex 20 to 50 percent slopes	0.11	0.04	15
5193	Badland (Kaiparowits Formation)	1.42	0.81	0
5195	Henrieville sandy loam 2 to 8 percent slopes	1.40	0.85	0
5198	Bigpack clay loam 1 to 8 percent slopes	0.13	0.04	0
5199	Quagmeier-Parkelei complex 2 to 30 percent slopes	0.73	0.40	0

Table D.24 UT686 Grand Staircase-Escalante National Monument Utah

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
5200	Sojourn family-Retsabal-Colskel complex 10 to 50 percent slopes	0.53	0.27	0
5201	Sojourn family-Aridic Ustorthents complex 15 to 50 percent slopes	1.69	1.06	0
5203	Wiggler-Curecanti family cool complex 25 to 65 percent slopes	0.19	0.07	0
5205	Curecanti families cool-Widtsoe complex 2 to 25 percent slopes	0.22	0.10	0
5206	Upler cobbly loam 5 to 50 percent slopes	0.32	0.15	0
5207	Winetti-Riverwash complex 2 to 5 percent slopes	0.64	0.37	0
5210	Elpedro moist-Flatnose complex 2 to 8 percent slopes	0.72	0.38	0
5211	Yarts moist-Sazi moist complex 2 to 8 percent slopes	1.13	0.65	0

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D.3.19 UTAH GENERAL SOIL SURVEY

Table D.25UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s1159	Youngston-Willwood-Tipperary-Clapper-Chroder (s1159)	0.81	0.42	0
s1160	Winona-Travessilla-Schooner-Rock outcrop-Rentsac-Duffymont-Crago (s1160)	0.59	0.29	30
s1161	Zillion-Layoint-Forelle-Emlin-Cathedral (s1161)	0.50	0.25	0
s1185	Rock outcrop-Rentsac-Moyerson-Mikim family-Atchee (s1185)	0.26	0.12	10
s1186	Wallson-Walknolls-Turley-Potts-Penistaja family-Abra (s1186)	0.68	0.34	0
s1199	Ustollic Haplargids-Ustollic Calciorthids-Ustic Torriorthents-Rock outcrop (s1199)	0.75	0.41	30
s1210	Potts-Palma-Kech-Hagerman-Cahona-Begay (s1210)	0.87	0.47	5
s1232	Zyme-Torriorthents-Rock outcrop (s1232)	0.06	0.01	35
s1417	Youngston-Torrifluvents (s1417)	0.23	0.08	0
s1420	Rock outcrop-Redlands-Myton family-Moenkopie-Mack-Farb-Badland (s1420)	0.47	0.21	15
s1422	Uzona-Rock outcrop-Myton family-Claysprings (s1422)	0.06	0.01	10
s1424	Romberg-Rock outcrop-Rizno-Littlenan-Cragola-Bodot (s1424)	0.08	0.02	15
s1435	Rock outcrop-Rizno-Mido-Ignacio-Begay (s1435)	0.34	0.14	25
s1436	Strych-Redbank-Moab-Begay (s1436)	0.62	0.30	0
s1437	Witt-Northdale-Monticello-Chaseville-Bond (s1437)	0.54	0.26	0
s1778	Richville-Leavitt-Dagan-Cokeville-Boundridge variant (s1778)	0.36	0.17	0
s1791	Windernot-Preston-Kidman (s1791)	0.76	0.44	5
s1811	Manila-Lonigan-Copenhagen-Broadhead (s1811)	0.39	0.19	0
s1815	Parleys-Logan-Langless-Lagonot-Hans-Fridlo (s1815)	0.40	0.20	0
s1826	Ridgecrest-Hondoho (s1826)	0.44	0.23	0
s1834	Strevell-Stanrod-Mellor-Idahome-Declo-	0.37	0.15	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
	Darkbull (s1834)			
s1836	Declo-Darkbull (s1836)	0.45	0.20	0
s1844	Rock outcrop-Ola-Itca-Birchcreek-Arbone (s1844)	0.53	0.27	16
s1846	Coalbank-Chen-Bluehill (s1846)	1.26	0.77	0
s1975	Wilsongulch-Tomsherry-Cottonthomas-Coalbank-Bluehill (s1975)	1.06	0.62	0
s2168	Nielsen-Dranyon-Dra (s2168)	0.35	0.17	0
s2179	Sprollow-Cooley variant-Bezzant (s2179)	0.39	0.18	0
s2180	Zeale-Geneva-Dateman-Aspen (s2180)	0.51	0.28	0
s342	Rock outcrop-Moenkopie (s342)	0.92	0.52	50
s343	Nakai-Monue-Blackston (s343)	1.59	1.07	0
s351	Wayneco-Sazi-Rock outcrop-Rizno-Palma-Mespun (s351)	1.28	0.81	10
s359	Spenlo-Schmutz-Redbank family-Palma family-Naplene-Lavate-Ildefonso family-Clovis family-Caval (s359)	0.50	0.20	0
s362	Rock outcrop (s362)	0.48	0.22	83
s392	Sogzie-Sheppard-Rock outcrop-Aneth (s392)	1.66	1.19	10
s393	Shedado-Rock outcrop-Mespun-Begay-Anasazi (s393)	1.49	0.99	15
s394	Ustollic Haplargids-Rock outcrop-Namon (s394)	0.79	0.46	30
s398	Sheppard-Rock outcrop-Monue-Moepitz (s398)	1.74	1.37	10
s5228	Tocito-Mesa-Cudei-Badland (s5228)	0.28	0.10	7
s5229	Persayo-Nataani-Littlehat-Awet (s5229)	0.26	0.09	2
s5453	Zadvar-Sanpete-Breko (s5453)	0.57	0.29	0
s5484	Paranat-Equis-Duffer (s5484)	0.14	0.05	0
s5563	Segura-Rock outcrop-Itca family-Cropper (s5563)	0.21	0.09	10
s5571	Tarnach-Cliffdown (s5571)	0.21	0.08	0
s5577	Cave family-Cave-Ajo (s5577)	0.29	0.12	0
s5598	Pioche-Motoqua-Gabbvally (s5598)	0.15	0.06	1
s5742	Typic Torriorthents-Gypill-Cave-Badland (s5742)	0.59	0.30	5

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s5878	Rock outcrop-Podmor family-Logring-Kyler-Flygare family-Eaglepass (s5878)	0.42	0.21	10
s7755	Waas-Tomasaki-Nortez-Herm-Fivepine-Falcon (s7755)	0.38	0.17	5
s7756	Thedalund family-Shalako-Rock outcrop-Killpack-Hanksville family (s7756)	0.13	0.04	10
s7757	Toddler family-Redbank family-Ravola family-Leeko (s7757)	0.12	0.03	0
s7758	Shalako-Rock outcrop-Reva family-Falcon family-Dast family (s7758)	0.65	0.33	20
s7759	Utso-Tosca-Sula family-Seeprid-Reva family-Razorba family (s7759)	0.74	0.42	5
s7760	Walknolls-Rock outcrop-Potts-Gaynor-Badland (s7760)	0.26	0.11	15
s7761	Uffens-Mikim family-Clapper (s7761)	0.22	0.08	0
s7762	Yamac-Stunner-Poposhia-McFadden-Luhon-Grieves (s7762)	0.34	0.14	0
s7763	Dahlquist variant-Dahlquist-Brownsto variant-Brownsto (s7763)	0.74	0.39	0
s7764	Thermopolis-Sinkson-Rock outcrop-Delphill-Blazon (s7764)	0.22	0.08	10
s7765	Morset-McFadden-Luhon-Fluetsch (s7765)	0.42	0.18	0
s7766	Uinta-Lail-Gelkie-Barrett-Amsden (s7766)	0.48	0.23	3
s7767	Turner-Fluetsch (s7767)	0.63	0.35	0
s7768	Strych-Sandoval-Persayo-Fruita-Barx-Avalon (s7768)	0.29	0.11	0
s7769	Witt-Sharps-Ruinpoint-Rizno-Cahona (s7769)	0.26	0.09	0
s7770	Sheppard-Rock outcrop-Oljeto-Neskahi-Mota (s7770)	0.74	0.25	10
s7771	Rock outcrop-Piute-Moenkopie-Hoskinnini (s7771)	0.55	0.26	20
s7772	Whit-Sogzie-Sheppard-Rock outcrop (s7772)	0.66	0.34	10
s7773	Rock outcrop-Piute-Pickrell-Badland (s7773)	0.71	0.27	15
s7774	Rock outcrop-Lithic Torriorthents-Badland (s7774)	0.38	0.17	50
s7775	Skumpah-Playas (s7775)	0.12	0.03	0
s7776	Rock outcrop-Promo-Cliffdown (s7776)	0.41	0.19	15

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s7777	Lembos-Kunzler-Kawich-Acana (s7777)	0.47	0.22	0
s7778	Tosser-Sitar-Hiko Peak-Bezzant (s7778)	0.40	0.18	0
s7779	Kapod-Fontreen-Donnardo-Collard (s7779)	0.36	0.17	0
s7780	Raftriver-Dahar-Codquin-Bullump (s7780)	0.69	0.37	0
s7781	Rock outcrop-Rexmont-Clavicon (s7781)	0.38	0.19	27
s7782	Tarnach-Cliffdown (s7782)	0.21	0.08	0
s7783	Ridgecrest family-Parkay family-Eyre family-Broad Canyon family-Bickmore family (s7783)	1.10	0.77	0
s7784	Ridgecrest family-Parkay family-Broad Canyon family-Bickmore family (s7784)	0.97	0.66	0
s7785	Sterling-Sheep Creek-Richmond-Foxol-Elzinga-Agassiz (s7785)	0.37	0.19	5
s7786	Middle-Broad (s7786)	0.47	0.26	0
s7787	Sterling-Samaria (s7787)	0.49	0.26	0
s7788	Timpanogos-Parleys-Kearns-Fielding (s7788)	0.29	0.12	0
s7789	Thiokol-Stingal-Sanpete-Hansel (s7789)	0.35	0.16	0
s7790	Kilburn-Kidman-Fielding (s7790)	0.51	0.25	0
s7791	Thiokol-Mellor-Heydlauff-Bram (s7791)	0.21	0.08	0
s7792	Roshe Springs-Logan-Kirkham-Honeyville-Greenson-Collett (s7792)	0.30	0.14	0
s7793	Stokes-Placeritos-Lasil-Fridlo-Airport (s7793)	0.27	0.11	0
s7794	Rock outcrop-Ridd-Barton (s7794)	0.77	0.43	25
s7795	Pleasant View-Kilburn-Francis (s7795)	0.89	0.53	0
s7796	Preston-Kidman-Francis (s7796)	1.90	1.73	0
s7797	Timpanogos-Parleys-Kidman (s7797)	0.51	0.24	0
s7798	Layton-Kidman (s7798)	1.45	0.95	0
s7799	Sunset-Steed-Refuge-Martini-Kirkham (s7799)	0.56	0.29	0
s7800	Logan-Leland-Ironton-Harrisville-Draper (s7800)	0.57	0.32	0
s7801	Warm Springs-Syracuse-Layton (s7801)	1.23	0.73	0
s7802	Warm Springs-Syracuse-Payson-Leland (s7802)	0.46	0.21	0
s7803	Salt Lake-Logan-Cardon-Airport (s7803)	0.31	0.15	0
s7804	Trenton-Jordan-Cache (s7804)	0.16	0.06	0
s7805	Roshe Springs-Nibley-Millville-Greenson-	0.30	0.14	0

Table D.25 UT STATSGO Utah General Soil Survey Soil Map Unit Composite XKSAT and RTIMP Values				
		XKSAT, in/hr		Natural RTIMP, %
SMU	Soil Map Unit Name	DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	Collett (s7805)			
s7806	Quinney-Lewiston-Layton-Kidman (s7806)	1.07	0.61	0
s7807	Wheelon-Mendon-Curtis Creek (s7807)	0.34	0.16	0
s7808	Wheelon-Parleys-Collinston (s7808)	0.20	0.07	0
s7809	Timpanogos-Sterling-Ricks-Parleys-Nibley-McMurdie (s7809)	0.39	0.19	0
s7810	Sterling-Nebeker-Hendricks-Crowshaw (s7810)	0.57	0.33	0
s7811	Yeates Hollow-Obray-LaPlatta-Goring-Ant Flat (s7811)	0.27	0.12	0
s7812	Sheep Creek-Hoskin-Curtis Creek-Agassiz (s7812)	0.35	0.17	0
s7813	Dateman-Bradshaw-Bickmore-Agassiz (s7813)	0.29	0.14	5
s7814	Poleline-Lucky Star-Cluff-Bickmore (s7814)	0.70	0.44	0
s7815	Wader variant-Wader-Saleratus-Bear Lake (s7815)	0.44	0.22	0
s7816	Saleratus-Rich-Cowco (s7816)	0.21	0.07	0
s7817	Cowco-Bockston (s7817)	0.48	0.24	0
s7818	Woodpass-Wiscow-Poposhia-Pancheri-Lariat-Alhark (s7818)	0.23	0.08	0
s7819	Slinger-Duckree (s7819)	0.54	0.29	0
s7820	Thatcher-Richsum-Kearl-Econ (s7820)	0.28	0.11	0
s7821	Jebo-Dennot-Cutoff (s7821)	0.52	0.28	0
s7822	Solak-Rexmont-Highams variant-Gridge-Falula-Ellett (s7822)	0.33	0.15	0
s7823	Yeljack-Lucky Star-Charcol-Baird Hollow (s7823)	0.74	0.45	0
s7824	Sambrito-Lucky Star-Condie (s7824)	0.77	0.47	0
s7825	Utaba-Sunset-Steed-Redola-Pringle-Eastcan-Crooked Creek-Brownlee (s7825)	0.55	0.29	0
s7826	Stoda-Parleys-Nebeker-Manila-Lamondi (s7826)	0.41	0.20	0
s7827	Ostler-Manila-Hawkins-Donner-Bertag (s7827)	0.33	0.16	0
s7828	Yeates Hollow-Durfee (s7828)	0.34	0.17	0
s7829	Wallsburg-Van Wagoner-Rock outcrop-	0.51	0.27	30

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	Harkers (s7829)			
s7830	Kilfoil-Isbell-Hades-Croydon (s7830)	0.39	0.20	0
s7831	Yeates Hollow-Guilder-Etchen-Bullnel (s7831)	0.36	0.18	0
s7832	Smarts-Rock outcrop-Horrocks-Durst-Burgi (s7832)	0.43	0.22	10
s7833	Yeates Hollow-St marys-Moweba-Hoskin-Holmes (s7833)	0.32	0.15	0
s7834	Sessions-Poleline-Patio (s7834)	0.39	0.21	0
s7835	Lucky Star-Charcol (s7835)	0.75	0.46	0
s7836	Rock outcrop-Geertson-Cristo-Broad Canyon (s7836)	0.37	0.18	10
s7837	Yence-Richens-Lucky Star-Herd-Ercan (s7837)	0.33	0.16	0
s7838	Rock outcrop-Patio-Nagisty-Broad Canyon (s7838)	0.39	0.20	25
s7839	Timpanogos-Parleys-Kearns-Fielding (s7839)	0.29	0.12	0
s7840	Picayune family-Lucky Star-Hades-Ant Flat (s7840)	0.52	0.28	0
s7841	Tooele-Timpie-Cliffdown (s7841)	0.46	0.20	0
s7842	Yenrab-Skumpah-Dynal (s7842)	0.29	0.10	0
s7843	Kapod-Donnardo-Borvant-Abela (s7843)	0.42	0.21	0
s7844	Taylorsflat-Medburn-Hiko Peak-Berent (s7844)	0.50	0.24	0
s7845	Skumpah-Saltair-Logan-Kanosh-Bramwell (s7845)	0.27	0.10	0
s7846	Timpanogos-Parleys-Bluffdale-Bingham (s7846)	0.27	0.11	0
s7847	Wallsburg-Rock outcrop-Harkers-Broad-Agassiz (s7847)	0.41	0.22	15
s7848	Wallsburg-Rock outcrop-Horrocks-Butterfield-Agassiz (s7848)	0.31	0.15	10
s7849	Rock outcrop-Henefer-Harkers-Gappmayer (s7849)	0.42	0.22	10
s7850	Wasatch-Ridd-Kilburn (s7850)	0.83	0.49	7
s7851	Woodrow-Mellor-Harding-Genola-Cheebe (s7851)	0.12	0.04	0
s7852	Terminal-Saltair-Lasil-Decker-Bramwell variant (s7852)	0.30	0.13	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s7853	Taylorsville-Hillfield-Harrisville-Bramwell-Bluffdale (s7853)	0.22	0.09	0
s7854	Wagonbox-Magna-Ironton-Decker-Bramwell (s7854)	0.36	0.17	0
s7855	Welby-Parleys-Kidman (s7855)	0.46	0.21	0
s7856	Wasatch-Knutsen-Kearns-Bingham (s7856)	1.11	0.68	0
s7857	Rock outcrop-Picayune-Emigration-Deer Creek-Brad-Agassiz (s7857)	0.37	0.18	20
s7858	Provo Bay-McBeth-Holdaway-Chipman (s7858)	0.31	0.15	0
s7859	Typic Fluvaquents-Payson-Logan-Jordan-Arave (s7859)	0.29	0.12	0
s7860	Welby-Vineyard-Taylorsville-Bramwell (s7860)	0.25	0.10	0
s7861	Sunset-Pleasant Vale-Martini-Kirkham-Benjamin (s7861)	0.50	0.25	0
s7862	Steed-Redola-Provo-Pleasant View-Pleasant Vale-Keigley (s7862)	0.74	0.41	0
s7863	Kirkham-Benjamin (s7863)	0.15	0.06	0
s7864	Pleasant Grove-Kilburn-Cleverly (s7864)	0.84	0.51	0
s7865	Preston-Layton-Lakewin (s7865)	1.22	0.81	0
s7866	Welby-Taylorsville-Hillfield (s7866)	0.29	0.12	0
s7867	Rake-Picayune variant-Picayune (s7867)	0.27	0.12	5
s7868	Towave-Podo-Minnimaud-Cabba family (s7868)	0.29	0.12	5
s7869	Uinta family-Trag-Senchert family-Senchert-Midfork family-Croydon (s7869)	0.82	0.51	0
s7870	Walknolls-Casmos-Badland (s7870)	0.20	0.07	5
s7871	Pathead-Guben-Curecanti family (s7871)	0.54	0.29	0
s7872	Trag-Senchert-Midfork family-Falcon-Beje (s7872)	0.48	0.25	0
s7873	Nelman-Lanver-Atchee (s7873)	0.49	0.24	5
s7874	Rock outcrop-Mikim family-Atchee (s7874)	0.51	0.25	10
s7875	Winteridge-Towave-Castner-Atchee (s7875)	0.24	0.09	4
s7876	Whetrock-Towave-Rock outcrop-Pathead-Castner-Atchee (s7876)	0.35	0.17	10
s7877	Walknolls family-Thedalund family-Pennell	0.28	0.10	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	(s7877)			
s7878	Thedalund family-Dast family (s7878)	0.21	0.07	5
s7879	Travessilla family-Travessilla-Rock outcrop-Gerst (s7879)	0.34	0.15	25
s7880	Walknolls-Rock outcrop-Casmos-Atchee (s7880)	0.24	0.09	10
s7881	Tipperary-Denco-Badland (s7881)	0.39	0.17	7
s7882	Yeates Hollow-Obrast-Deer Creek-Bagard (s7882)	0.21	0.09	0
s7883	Towave-Tosca-Sheepcan-Badland-Atchee (s7883)	0.27	0.12	5
s7884	Roundy-Fitzgerald-Daybell (s7884)	0.41	0.20	3
s7885	Flygare-Clayburn-Baird Hollow (s7885)	0.73	0.45	0
s7886	Yeates Hollow-Lucky Star-Hoskin-Horrocks-Gappmayer-Cloud Rim-Bradshaw-Ant Flat (s7886)	0.43	0.22	5
s7887	Trag-Skutum family-Kovich-Coberly variant (s7887)	0.38	0.19	0
s7888	Zillion family-Luhon family-Blazon-Abra family (s7888)	0.31	0.13	3
s7889	Zillion family-Uinta-Senchert-Geertson-Croydon (s7889)	0.55	0.30	4
s7890	Little Pole-Broadhead-Ayoub (s7890)	0.30	0.14	5
s7891	Poleline-Hailman-Fitzgerald (s7891)	0.56	0.31	3
s7892	Yeates Hollow-Wallsburg-Manila-Henefer-Gappmayer (s7892)	0.42	0.22	3
s7893	Van Wagoner-Rock outcrop-McPhie-Cloud Rim (s7893)	0.63	0.34	13
s7894	Yeates Hollow-Watkins Ridge-Deer Creek-Clegg (s7894)	0.39	0.19	5
s7895	Rasband-Kovich-Holmes-Center Creek (s7895)	0.64	0.36	0
s7896	Kovich variant-Kovich-Fluventic Haploborolls-Cudahy-Crooked Creek (s7896)	0.57	0.32	5
s7897	Moweba-Manila-Kovich (s7897)	0.58	0.33	0
s7898	Watkins Ridge-Sowcan-Pringle-Kovich-Irim family-Ant Flat (s7898)	0.89	0.56	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr DF = 1.0	XKSAT, in/hr DF = 1.1	Natural RTIMP, %
(1)	(2)	(3)	(4)	(5)
s7899	Richsum-Cutoff family-Ayoub (s7899)	0.26	0.11	3
s7900	Starley-Rock outcrop-Poleline (s7900)	0.41	0.21	35
s7901	Tipperary-Nakoy-Hiko Springs-Fruitland (s7901)	1.13	0.66	0
s7902	Turzo-Poganeab-Green River (s7902)	0.14	0.04	1
s7903	Travessilla family-Rock outcrop-Montwel-Begay (s7903)	0.51	0.23	10
s7904	Winona-Rock outcrop-Honlu-Clapper (s7904)	0.27	0.12	10
s7905	Travessilla family-Strell-Rock outcrop-Reepo (s7905)	1.26	0.98	30
s7906	Tyzak-Tridell-Atchee (s7906)	0.32	0.14	5
s7907	Tipperary-Nakoy-Montwel-Mivida (s7907)	0.72	0.36	3
s7908	Worland family-Montwel-Gerst-Denco-Badland (s7908)	0.21	0.08	0
s7909	Winona-Tridell-Honlu-Clapper (s7909)	0.27	0.11	4
s7910	Hanksville (s7910)	0.08	0.01	0
s7911	Utaline-Avalon (s7911)	0.31	0.12	0
s7912	Werlog-Turzo-Fruitland (s7912)	0.21	0.07	0
s7913	Morval family-Flynncove-Diagulch (s7913)	0.53	0.28	0
s7914	Zillion family-Namon-Flynncove-Dahlquist family (s7914)	0.35	0.17	0
s7915	Tolman family-Namon-Lap family-Grapit (s7915)	0.31	0.14	0
s7916	Utaline-Minchey-Leeko-Greybull-Avalon (s7916)	0.27	0.10	0
s7917	Walknolls-Rock outcrop-Muff family-Motto-Crustown-Casmos (s7917)	0.23	0.09	20
s7918	Vasquez-Shakespeare-Mirror Lake-Marsell-Duchesne (s7918)	0.84	0.50	6
s7919	Vasquez-Teewinot-Rubble land-Rock outcrop-Mirror-Haverly (s7919)	0.48	0.20	25
s7920	Sessions family-Mirror Lake-Clark Fork family (s7920)	0.59	0.32	0
s7921	Yarts-Tridell-Travessilla family-Strell-Honlu-Henrieville-Boxwell family (s7921)	0.60	0.31	5
s7922	Tridell-Flynncove-Dahlquist family-Clapper-	0.52	0.26	2

Table D.25 UT STATSGO Utah General Soil Survey

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SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	Brownsto (s7922)			
s7923	Utaline-Uffens-Turzo-Muff family-Greybull-Badland (s7923)	0.29	0.11	5
s7924	Greybull-Clapper-Badland-Abra family (s7924)	0.32	0.14	0
s7925	Yarts-Paradox family-Hillto-Clapper-Ashley (s7925)	0.49	0.23	2
s7926	Uinta-Skutum-Lucky Star (s7926)	0.65	0.38	0
s7927	Yarts-Mivida-Henrieville-Gerst-Clapper (s7927)	0.48	0.22	0
s7928	Swissvale-Rentsac family-Circleville-Brownsto (s7928)	0.28	0.12	5
s7929	Windham family-Namon family (s7929)	0.35	0.17	3
s7930	Yarts-Tebbs-Patent family-Mikim family-Henrieville-Glendive-Countryman (s7930)	0.69	0.34	0
s7931	Henefer-Gappmayer-Fitzgerald (s7931)	0.36	0.18	7
s7932	Mespun-Honlu-Hillto-Clapper (s7932)	0.76	0.46	5
s7933	Turzo-Stutzman family-Green River variant-Gotho-Fruitland (s7933)	0.24	0.08	0
s7934	Menefee-Lockerby-Hovenweep (s7934)	0.13	0.04	0
s7935	Rock outcrop-Montvale-Monticello (s7935)	0.50	0.26	20
s7936	Northdale-Monticello-Hovenweep (s7936)	0.46	0.22	0
s7937	Shay-Northdale-Monticello (s7937)	0.45	0.21	0
s7938	Ruinpoint-Rizno-Cahona (s7938)	0.09	0.02	0
s7939	Rock outcrop-Rizno-Mellenthin-Littlenan-Bodot (s7939)	0.16	0.05	12
s7940	Strych-Rock outcrop-Rizno-Montvale-Monticello (s7940)	0.40	0.19	30
s7941	Strych-Shay-Pack-Menefee-Abajo (s7941)	0.23	0.09	0
s7942	Strych-Pring-Cahona (s7942)	0.77	0.41	0
s7943	Strych-Skos-Bookcliff (s7943)	0.32	0.15	0
s7944	Rock outcrop-Myton family-Moenkopie (s7944)	0.66	0.35	37
s7945	Nakai-Limeridge-Bluechief (s7945)	0.79	0.40	0
s7946	Skos-Rock outcrop-Piute-Mido (s7946)	0.41	0.20	53
s7947	Sheppard-Rock outcrop-Piute (s7947)	2.00	1.61	41
s7948	Strych-Rizno (s7948)	0.31	0.14	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s7949	Yarts-Rizno-Barx (s7949)	0.57	0.28	0
s7950	Skos-Rizno-Myton family-Milok (s7950)	0.16	0.06	0
s7951	Rock outcrop-Moenkopie (s7951)	1.61	0.98	78
s7952	Rock outcrop-Moenkopie-Hoskinnini (s7952)	0.82	0.40	22
s7953	Thoroughfare-Sheppard-Nakai (s7953)	0.28	0.14	0
s7954	Ustic Torriorthents-Rock outcrop-Lithic Torriorthents (s7954)	0.92	0.52	26
s7955	Rock outcrop-Rizno-Mido (s7955)	0.49	0.23	65
s7956	Redbank-Moab-Kidman (s7956)	0.61	0.28	0
s7957	Rock outcrop-Rizno (s7957)	0.17	0.06	36
s7958	Hagerman-Cahona-Begay (s7958)	1.19	0.69	0
s7959	Rock outcrop-Rizno (s7959)	0.17	0.06	44
s7960	Ustollic Haplargids-Ustollic Calciorthids-Ustic Torriorthents (s7960)	0.76	0.42	0
s7961	Waas-Tomasaki-Herm-Falcon (s7961)	0.79	0.47	0
s7962	Toone-Tomasaki-Herm-Falcon (s7962)	0.81	0.50	0
s7963	Toone-Skylick-Flygare (s7963)	1.24	0.86	0
s7964	Leighcan-Duchesne-Broad Canyon (s7964)	0.47	0.25	0
s7965	Rubble land-Meredith-Leighcan (s7965)	0.38	0.19	50
s7966	Ravola-Hunting-Billings (s7966)	0.26	0.10	0
s7967	Persayo-Chipeta-Badland (s7967)	0.18	0.06	0
s7968	Ravola-Persayo-Moffat (s7968)	0.37	0.16	0
s7969	Travessilla-Strych-Stormitt (s7969)	0.58	0.28	0
s7970	Strych-Mivida-Hernandez family (s7970)	0.49	0.24	0
s7971	Travessilla-Strych-Gerst (s7971)	0.51	0.25	5
s7972	Travessilla-Rock outcrop-Midfork family (s7972)	0.59	0.33	33
s7973	Podo-Pathead-Beje (s7973)	0.38	0.19	0
s7974	Rock outcrop-Midfork family-Guben (s7974)	0.62	0.38	27
s7975	Yenrab-Uvada family-Uvada-Lynndyl-Hiko Springs family (s7975)	0.96	0.51	0
s7976	Trook-Sagers-Ravola (s7976)	0.26	0.09	0
s7977	Sheppard-Nakai-Moffat (s7977)	2.00	1.58	0
s7978	Sheppard-Rock outcrop-Moenkopie (s7978)	1.31	0.83	29

Table D.25 UT STATSGO Utah General Soil Survey

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SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s7979	Rock outcrop-Moffat-Moenkopie (s7979)	1.45	0.95	20
s7980	Nakai-Moenkopie-Milok (s7980)	1.26	0.70	0
s7981	Casmos-Badland-Antelope Springs (s7981)	0.23	0.09	0
s7982	Sagers-Killpack-Chipeta (s7982)	0.11	0.03	0
s7983	Trachute-Sandbench-Moenkopie (s7983)	1.59	1.10	0
s7984	Stormitt-Chipeta-Badland (s7984)	0.17	0.06	0
s7985	Welring-Strych (s7985)	0.27	0.12	0
s7986	Roshe Springs-Logan-Fridlo-Airport (s7986)	0.44	0.22	0
s7987	Wayneco-Travessilla-Milok (s7987)	1.19	0.68	0
s7988	Mesa-Mack-Chipeta (s7988)	0.48	0.20	0
s7989	Skumpah-Killpack-Blueflat (s7989)	0.11	0.02	0
s7990	Rock outcrop-Moenkopie-Badland (s7990)	0.42	0.20	36
s7991	Rock outcrop-Nakai-Moenkopie (s7991)	0.88	0.46	18
s7992	Rock outcrop-Rizno-Begay (s7992)	0.96	0.53	24
s7993	Rogert family-Myton family-Kamack-Castino family (s7993)	0.42	0.20	2
s7994	Ute-Richens-Kildor-Embargo-Cluff-Castino (s7994)	0.32	0.13	0
s7995	Zeesix-Sessions-Perinos-Pahreah-Adobe (s7995)	0.42	0.22	0
s7996	Repp family-Falcon family-Detra (s7996)	0.27	0.10	5
s7997	Wiggler family-Repp family-Podo-Pathead-Caval-Ahlstrom (s7997)	0.28	0.08	5
s7998	Rabbitex family-Guben-Doney family-Datino family (s7998)	0.58	0.31	0
s7999	Senchert family-Pando family-Elwood-Bundo (s7999)	0.68	0.40	0
s8000	Faim-Embargo-Cluff-Clayburn family (s8000)	0.43	0.20	0
s8001	Tolman family-Harpole-Falcon family-Cabin-Bookcliff (s8001)	0.39	0.18	0
s8002	Namon family-Flygare family-Dranyon-Broad Canyon family (s8002)	0.65	0.38	5
s8003	Tomasaki-Sessions-Richens-Harpole-Broad Canyon family (s8003)	0.42	0.22	0
s8004	Sheppard-Moffat-Blackston (s8004)	1.12	0.75	0

Table D.25 UT STATSGO Utah General Soil Survey Soil Map Unit Composite XKSAT and RTIMP Values				
		XKSAT, in/hr		Natural RTIMP, %
SMU	Soil Map Unit Name	DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s8005	Sheppard-Robroost-Mivida-Goblin-Farb (s8005)	1.03	0.60	0
s8006	Hanksville-Chipeta (s8006)	0.12	0.04	5
s8007	Pennell-Moenkopie-Farb (s8007)	1.05	0.60	5
s8008	Rock outcrop-Farb-Chipeta-Badland (s8008)	0.39	0.18	20
s8009	Rock outcrop-Moenkopie-Arches (s8009)	1.09	0.66	55
s8010	Rock outcrop-Mido (s8010)	2.00	1.32	90
s8011	Yarts-Wayneco-Moffat-Milok-Mido-Begay (s8011)	1.74	1.15	0
s8012	Wayneco-Moffat-Mido-Mellenthin-Begay-Arches (s8012)	1.77	1.22	5
s8013	Yarts-Wayneco-Travessilla-Stormitt-Shedado (s8013)	0.81	0.42	0
s8014	Rizno-Chipeta-Begay (s8014)	0.59	0.31	0
s8015	Tolman-Stormitt-Montosa family-Circleville-Blazon (s8015)	0.29	0.12	5
s8016	Stormitt-Makoti family-Delson-Datino family-Circleville (s8016)	0.36	0.18	0
s8017	Rogert-Rock outcrop-Pando family-Olnes family (s8017)	0.55	0.31	30
s8018	Rock outcrop-Redcreek family (s8018)	0.47	0.22	40
s8019	Riverwash-Neto-Fluvaquents-Bruman (s8019)	0.73	0.38	0
s8020	Parkay-Forsey-Faim (s8020)	0.34	0.16	5
s8021	Parkay-Forsey-Faim (s8021)	0.41	0.20	0
s8022	Dune land-Bushvalley (s8022)	0.94	0.70	0
s8023	Handy-Eldgin (s8023)	0.19	0.07	0
s8024	Watkins Ridge-Wallsburg-Vicking-Trove-Henefer-Acord (s8024)	0.34	0.16	0
s8025	Krueger-Haulings-Eldgin-Dacore (s8025)	0.34	0.15	0
s8026	Tolman family-Rock outcrop-Paunsaugunt-Panguitch-Circleville (s8026)	0.19	0.07	10
s8027	Spager family-Neponset-Goldrun-Etchen-Declo-Crestline (s8027)	0.40	0.18	0
s8028	Vicking-Van Wagoner-Rock outcrop-Noobab-Horrocks (s8028)	0.39	0.19	15
s8029	Van Wagoner-Rock outcrop-Pastorius-	0.51	0.27	25

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SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	Horrocks (s8029)			
s8030	Vicking-Van Wagoner-Rock outcrop-Horrocks-Agassiz (s8030)	0.29	0.13	20
s8031	Saxby-Rock outcrop-Noobab-Lodar family-Agassiz (s8031)	0.15	0.06	40
s8032	Spager family-Noobab-Neponset-Mountainville-Hiko Peak family (s8032)	0.21	0.08	0
s8033	Sterling-Mountainville (s8033)	0.44	0.23	0
s8034	Teton-Rubble land-Parkay-Hoosan-Elwood-Condie (s8034)	0.44	0.23	15
s8035	Sessions-Merino family-Hoodle-Herd-Faim-Cebone (s8035)	0.52	0.29	0
s8036	Zinzer-Youga-Rock outcrop-Redcreek family-Patent family-Evanston family-Cabbart (s8036)	0.36	0.17	10
s8037	Rock outcrop-Redcreek family-Patent family-Mayoworth-Luhon family-Grobutte (s8037)	0.29	0.12	10
s8038	Seitz-Rubble land-Namon-Knep-Embargo-Beardall (s8038)	0.26	0.09	10
s8039	Scandard-Rogert family-Hechtman-Elwood-Bickmore (s8039)	0.44	0.22	0
s8040	Water-Parkay-Namon-Granile-Forsey (s8040)	0.49	0.25	20
s8041	Kamack-Hourglass-Elwood-Bickmore family-Adel family (s8041)	0.69	0.43	0
s8042	Scandard-Passar-Nielsen family-Granile-Elwood-Bickmore family (s8042)	0.64	0.37	0
s8043	Parkay-Forsey-Embargo-Croydon-Condie (s8043)	0.27	0.10	0
s8044	Youga-Patent family-Hatch-Faim-Bowen-Almy (s8044)	0.29	0.13	0
s8045	Sanpitch-Poorman-Eoj-Eldgin-Dacore-Carstump (s8045)	0.22	0.09	0
s8046	Youga-Skutum-Sessions-Passar-Clayburn family-Bear Basin (s8046)	0.70	0.41	0
s8047	Whitecap-Sessions-Mirror Lake-Merino family-Croydon-Clayburn (s8047)	0.84	0.51	0
s8048	Youga-Ranruff-Neponset-Golsum-Eoj-Eldgin (s8048)	0.35	0.16	0
s8049	Zegro-Teton-Sessions-Faim-Ellett-Duncom	0.37	0.18	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	(s8049)			
s8050	Tiki-Sanpitch-Hymas-Hansel family-Ellett-Eldgin (s8050)	0.35	0.16	0
s8051	Siroco-Ellett-Eldgin-Dacore-Agassiz (s8051)	0.17	0.06	0
s8052	Zinzer-Rock outcrop-Redcreek family-Patent family-Mirror Lake-Cabbart (s8052)	0.46	0.21	15
s8053	Kinghorn-Hiko Peak family-Entmoot family-Credo-Alhark-Agassiz (s8053)	0.30	0.13	0
s8054	Namon-Mine-Kamack-Granile-Croydon-Clayburn (s8054)	0.70	0.40	0
s8055	Nielsen family-Hoodle-Genoa-Embargo-Bickmore family (s8055)	0.35	0.14	0
s8056	Swapps-Sula family-Scout family-Orcap-Mirror Lake (s8056)	0.20	0.07	0
s8057	Rock outcrop-Hiko Peak family-Ellett-Dacore-Bowen-Agassiz (s8057)	0.23	0.09	10
s8058	Tellura-Rock outcrop-Pando family-Cebone-Bowen-Bickmore (s8058)	0.36	0.17	10
s8059	Rock outcrop-Hiko Peak family-Denay-Dacore-Agassiz (s8059)	0.26	0.11	15
s8060	Sessions-Mortenson-Kamack-Faim-Behanin (s8060)	0.52	0.28	0
s8061	Sessions-Faim-Embargo-Elwood-Clayburn family-Bickmore family (s8061)	0.42	0.19	0
s8062	Pando family-Herd-Condie-Cluff-Cebone-Bickmore family (s8062)	0.43	0.22	0
s8063	Passar-Eldgin-Dacore-Bowen-Agassiz (s8063)	0.27	0.11	0
s8064	Tellura-Sessions-Golsum-Gabica (s8064)	0.40	0.20	0
s8065	Scout-Parkay-Hourglass-Condie (s8065)	0.51	0.26	0
s8066	Scout-Granile-Condie-Bickmore family (s8066)	0.48	0.24	0
s8067	Scout-Scandard-Rubble land-Rogert family-Rock outcrop-Blanca (s8067)	0.70	0.37	30
s8068	Tatiyee-Rock outcrop-Nielsen family-Golsum-Condie (s8068)	0.38	0.18	15
s8069	Nielsen family-Nayped-Golsum-Deer Creek-Castino family (s8069)	0.44	0.23	0
s8070	Tellura-Sessions-Rock outcrop-Reywat-	0.31	0.14	10

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	Golsum-Clayburn (s8070)			
s8071	Scout-Rubble land-Dateman family-Condie (s8071)	0.51	0.26	10
s8072	Tatiyee-Rock outcrop-Nielsen family-Genoa-Forsey (s8072)	0.46	0.26	35
s8073	Scout-Rubble land-Losee-Blanca (s8073)	0.65	0.34	10
s8074	Scout-Rubble land-Hoodle-Genoa-Forsey-Condie (s8074)	0.39	0.18	30
s8075	Scout-Nielsen family-Condie (s8075)	0.51	0.26	5
s8076	Tatiyee-Scout-Forsey-Condie (s8076)	0.47	0.24	0
s8077	Tatiyee-Sessions-Relley-Parkay-Golsum-Faim (s8077)	0.39	0.17	0
s8078	Rock outcrop-Reywat-Promo-Pernty-Golsum-Dahlquist (s8078)	0.30	0.13	20
s8079	Van Wagoner-Rock outcrop-Relley-Golsum-Dunford-Belmill (s8079)	0.32	0.12	20
s8080	Reywat-Red Butte-Pharo family-Kanarra-Bowen-Amtoft family (s8080)	0.15	0.05	0
s8081	Sessions-Poorman-Deer Creek-Dateman family-Clayburn-Castino family (s8081)	0.50	0.27	0
s8082	Rock outcrop-Pernty-Genoa-Forsey-Clayburn-Agassiz (s8082)	0.18	0.07	15
s8083	Forsey-Faim-Embargo-Dateman family-Clayburn-Adel family (s8083)	0.59	0.32	0
s8084	Relley-Golsum-Gabica-Deer Creek-Dacore-Castino family (s8084)	0.27	0.10	0
s8085	Reywat-Pernty-Mountainville-Hiko Peak-Golsum-Dacore (s8085)	0.20	0.07	0
s8086	Shotwell-Rock outcrop-Ranruff-Puett-Promo-Ellett (s8086)	0.33	0.15	20
s8087	Pernty-Leaps-Holmes-Dacore-Agassiz (s8087)	0.14	0.04	5
s8088	Rock outcrop-Nielsen family-Namon-Hourglass-Hoodle-Condie (s8088)	0.63	0.37	15
s8089	Whiteman-Parkay-Nielsen family-Namon-Elwood-Duchesne (s8089)	0.49	0.27	0
s8090	Rock outcrop-Ranruff-Elwood-Ellett-Condie (s8090)	0.34	0.16	20

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s8091	Yeates Hollow-Snowville-Rake-Ostler-Dunford (s8091)	0.36	0.18	0
s8092	Winnemucca-Passar-Forsey-Condie-Clayburn-Adel family (s8092)	0.35	0.16	0
s8093	Rock outcrop-Kamack-Hourglass-Eyre family-Elwood-Condie (s8093)	0.71	0.42	15
s8094	Yeates Hollow-Pernty-Ostler-Dunford-Bowen-Agassiz (s8094)	0.25	0.10	0
s8095	Winnemucca-Passar-Forsey-Entmoot family-Condie-Clayburn (s8095)	0.35	0.17	0
s8096	Tatiyee-Parkay-Golsum-Condie (s8096)	0.45	0.23	0
s8097	Vanajo-Poganeab-Green River-Fluvaquents-Anco-Abcal (s8097)	0.26	0.10	0
s8098	Logan-Hiko Peak-Bertelson (s8098)	0.54	0.29	0
s8099	Playas (s8099)	0.05	0.01	0
s8100	Yuba family-Uvada family-Playas-Mondey family (s8100)	0.07	0.02	0
s8101	Ursine-Uffens family-Skumpah family (s8101)	0.23	0.08	0
s8102	Skumpah-Saltair-Playas-Dynal (s8102)	0.12	0.03	3
s8103	Swingler family-Penoyer family-Mazuma family-Goshute family (s8103)	0.17	0.05	0
s8104	Tosser-Sitar-Hiko Peak (s8104)	0.49	0.24	0
s8105	Yuba-Yenrab family-Biddleman family (s8105)	0.42	0.18	0
s8106	Yenrab-Uvada family-Uvada-Lynndyl-Hiko Springs family (s8106)	0.96	0.51	0
s8107	Sugarloaf-Nehar-Heist family-Goldrun family (s8107)	1.32	0.88	0
s8108	Uvada family-Papoose family-Goshute family-Dera family (s8108)	0.15	0.04	0
s8109	Sanpete family-Dera family (s8109)	0.28	0.11	0
s8110	Shabliss-Red Butte-Hiko Peak (s8110)	0.50	0.25	0
s8111	Robozo-Avalon family (s8111)	0.35	0.15	0
s8112	Rock outcrop-Hiko Peak-Cliffdown-Checkett family-Amtoft (s8112)	0.38	0.17	16
s8113	Lodar family-Amtoft family (s8113)	0.20	0.08	0
s8114	Reywat family-Lodar family-Kyler-Eaglepass	0.37	0.18	9

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	(s8114)			
s8115	Manassa-Bayfield family (s8115)	0.02	0.01	0
s8116	Yuba-Uvada-Uffens-Playas-Abbott (s8116)	0.11	0.03	0
s8117	Poganeab-Anco-Abraham-Abbott (s8117)	0.13	0.04	0
s8118	Toddler-Saltair-Playas (s8118)	0.09	0.02	0
s8119	Uvada-Rock outcrop-Hiko Springs-Checkett-Bluewing family (s8119)	0.38	0.16	13
s8120	Yenrab-Drum (s8120)	0.41	0.19	0
s8121	Sheeprock-Hiko Peak-Decca (s8121)	0.48	0.22	0
s8122	Penoyer variant-Kessler-Hiko Peak-Escalante-Antelope Springs (s8122)	0.30	0.12	0
s8123	Ushar-Red Butte-Phage-Manderfield-Flowell-Deer Creek (s8123)	0.26	0.11	0
s8124	Ushar-Snake Hollow-Sheeprock-Phage-Blue Star-Blackett (s8124)	0.69	0.35	0
s8125	Ushar-Pharo-Mill Hollow (s8125)	0.21	0.08	0
s8126	Ushar-Mosida-Etta (s8126)	0.43	0.20	0
s8127	Pharo-Pass Canyon (s8127)	0.34	0.15	0
s8128	Shotwell-Oakden-McQuarrie-Firmage (s8128)	0.23	0.09	5
s8129	Paice-Black Ridge (s8129)	0.18	0.06	5
s8130	Deer Creek-Clegg (s8130)	0.34	0.17	0
s8131	Yardley-Wallsburg-Mineral Mountain-Maple Mountain (s8131)	0.27	0.12	0
s8132	Rock outcrop-May Day-Cowers-Bearskin (s8132)	0.79	0.44	40
s8133	Riverwash-Poganeab-James Canyon family-Draper-Chipman (s8133)	0.35	0.17	0
s8134	Rock outcrop-Ravola variant-Hiko Peak-Badland (s8134)	0.32	0.13	15
s8135	Rypod-Musinia-McCornick-Ebbs-Boxelder (s8135)	0.35	0.15	0
s8136	Uvada-Hiko Springs-Curdli (s8136)	0.35	0.14	0
s8137	Woodrow-Toddler-Swingler family (s8137)	0.11	0.03	0
s8138	Uvada-Goldrun (s8138)	0.87	0.49	0
s8139	Yenrab-McCornick-Kessler-Kanosh-Goldrun (s8139)	1.00	0.64	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s8140	Kanosh-Deseret (s8140)	0.33	0.12	0
s8141	Pavant-Doyce-Donnardo-Borvant (s8141)	0.34	0.16	0
s8142	Yeates Hollow-Rake-Millard-Flowell (s8142)	0.24	0.10	0
s8143	Pavant-Donnardo-Calita (s8143)	0.31	0.14	0
s8144	Ephraim-Calita-Abcal (s8144)	0.23	0.09	0
s8145	Saltair-Roshe Springs-Provo Bay-Bramwell-Benjamin (s8145)	0.23	0.09	0
s8146	Tridell-Rock outcrop-Comodore-Bruman (s8146)	0.23	0.09	10
s8147	Medburn-Linoyer-Genola (s8147)	0.45	0.20	0
s8148	Truesdale-Linoyer (s8148)	0.74	0.38	0
s8149	Scalade-Medburn-Jericho-Hiko Peak (s8149)	0.58	0.29	0
s8150	Goldrun-Dune land (s8150)	1.56	1.24	0
s8151	Nephi-Juab (s8151)	0.27	0.11	0
s8152	Yenrab-Uvada (s8152)	1.31	1.03	0
s8153	Xeric Torriorthents-Rock outcrop-Lodar (s8153)	0.29	0.12	20
s8154	Wallsburg-Rock outcrop-Broadhead-Agassiz (s8154)	0.30	0.14	25
s8155	Rock outcrop-Parkay-Kitchell-Flygare-Agassiz (s8155)	0.54	0.30	25
s8156	Woodrow-Quaker-Linoyer-Genola (s8156)	0.20	0.07	0
s8157	Sanpete-Lisade-Freedom-Denmark-Arapien (s8157)	0.65	0.32	0
s8158	Stillman-Sigurd-Sanpete (s8158)	0.66	0.34	0
s8159	Moroni-Keigley-Doyce-Collard-Birdow (s8159)	0.46	0.22	0
s8160	Watkins Ridge-Toehead-Manila-Deer Creek-Ant Flat (s8160)	0.34	0.16	0
s8161	Lodar-Fontreen-Borvant (s8161)	0.35	0.17	2
s8162	Sanpete-Rock outcrop-Amtoft (s8162)	0.47	0.23	10
s8163	Rock outcrop-Atepic-Amtoft (s8163)	0.16	0.06	50
s8164	Pavant-Mountainville-Doyce-Donnardo-Borvant (s8164)	0.42	0.20	0
s8165	Slickspots-Skumpah-Ravola-Mayfield (s8165)	0.06	0.02	0
s8166	Xerofluvents-Quaker-Mellor-Manassa-	0.19	0.06	0

Table D.25 UT STATSGO Utah General Soil Survey

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SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	Harding-Dyreng (s8166)			
s8167	Shumway-Poganeab-Peteetneet-Kjar-Fluvaquents-Chipman-Abcal (s8167)	0.28	0.12	0
s8168	Rock outcrop-Mower-Lundy-Lizzant-Hamtah-Agassiz (s8168)	0.30	0.14	10
s8169	Povey-Pavohroo-Northwater-Hymas-Clayburn (s8169)	0.50	0.26	0
s8170	Zeesix-Toze-Tingey-Skylick-Pritchett-Mortenson (s8170)	0.57	0.32	0
s8171	Starley family-Losee family-Kamack family-Cowood family-Bickmore family (s8171)	0.28	0.12	5
s8172	Tatiyee family-Security family-Scout family-Quilt family-Parkay family-Jemez family-Hesperus family (s8172)	0.28	0.13	0
s8173	Tingey-Scout family-Namon family (s8173)	0.27	0.11	5
s8174	Windwhistle family-Telephone family-Seleez family-Security family-Rock outcrop-Bond family-Atchee family (s8174)	0.66	0.33	20
s8175	Rock outcrop-Pinitos family-Montez-Canlon family (s8175)	0.35	0.15	40
s8176	Rock outcrop-Olot family-Gralic family-Falcon family-Eyre family (s8176)	0.26	0.10	30
s8177	Pioche family-McQuarrie family-Kanarra family-Indiano family-Decan family-Bodacious family (s8177)	0.22	0.09	0
s8178	Security family-Podmor family-Pastorius family-Fughes family-Dalcan family (s8178)	0.22	0.09	0
s8179	Rock outcrop-Motoqua family-Falcon family-Dotsero family-Bernal family (s8179)	0.17	0.05	40
s8180	Wye family-Sampson family-Pastorius family-Nehar family-Muzzler family-Mokiak family-Bernal family (s8180)	0.10	0.03	0
s8181	Tobler-St. George-Nikey-Junction-Harrisburg (s8181)	0.71	0.35	0
s8182	Winkel-Renbac-Hobog-Bermesa (s8182)	0.72	0.40	0
s8183	Toquerville-Tobler-Pintura-Ivins-Dune land (s8183)	1.81	1.25	0
s8184	Shalet-Badland (s8184)	0.34	0.14	5

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SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s8185	Mathis-Bond family (s8185)	0.27	0.09	3
s8186	Rock outcrop-Redbank family-Mespun-Caval (s8186)	1.09	0.68	15
s8187	Pastura family-Magotsu-Curhollow (s8187)	0.33	0.14	5
s8188	Walknolls family-Rock outcrop-Rizno-Moenkopie (s8188)	0.80	0.42	55
s8189	Rock outcrop-Clapper-Badland (s8189)	0.39	0.17	30
s8190	Rock outcrop-Chipeta-Casmos family-Badland (s8190)	0.16	0.05	10
s8191	Rock outcrop-Mellenthin (s8191)	0.63	0.33	30
s8192	Windwhistle-Rock outcrop-Rizno-Palma (s8192)	0.85	0.45	15
s8193	Skyvillage-Palma-Mellenthin-Clapper-Atchee (s8193)	0.39	0.17	5
s8194	Palma-Gerst family-Barx-Arches (s8194)	0.43	0.20	3
s8195	Rock outcrop-Palma-Mespun-Arches (s8195)	1.43	1.02	25
s8196	Rock outcrop-Mespun-Arches (s8196)	1.94	1.66	10
s8197	Yarts-Palma-Neville family-Barx-Atchee (s8197)	0.53	0.24	5
s8198	Skos-Rock outcrop (s8198)	0.09	0.03	20
s8199	Sedillo-Gaynor-Clapper (s8199)	0.09	0.02	0
s8200	Dune land (s8200)	2.00	2.00	0
s8201	Rock outcrop-Mathis-Krueger-Arches (s8201)	1.44	0.90	60
s8202	Uana family-Nevu family-Minu family-Decathon family-Buster family-Aned family (s8202)	0.37	0.17	0
s8203	Tombar-Pavant-Hiko Peak-Denmark-Bamos (s8203)	0.19	0.06	0
s8204	Garbo-Deerlodge family-Biblesprings (s8204)	0.47	0.22	0
s8205	Unius family-Taylorsflat-Sevy-Manselo-Hiko Peak-Escalante (s8205)	0.40	0.16	0
s8206	Wales-Taylorsflat-Sevy (s8206)	0.39	0.17	0
s8207	Wales-Taylorsflat-Medburn-Kanarra-Ashdown (s8207)	0.23	0.08	0
s8208	Sevy-Manderfield-Komo-Calcross-Ashdown (s8208)	0.18	0.05	0

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SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s8209	Rock outcrop-Ocambee-Kinghorn (s8209)	0.19	0.08	15
s8210	Red Butte-Pavant-Hiko Peak-Dixie-Checkett-Bamos (s8210)	0.21	0.08	0
s8211	Rock outcrop-Pass Canyon-Bamos-Abela (s8211)	0.18	0.06	12
s8212	Uvada-Manselo-Antelope Springs (s8212)	0.25	0.10	0
s8213	Tolman family-Rob Roy-Doyce (s8213)	0.21	0.08	6
s8214	Wye-Motoqua-Lucero-Ironco (s8214)	0.26	0.11	3
s8215	Rypod-Poorman-Lagnaf-Acord (s8215)	0.32	0.15	0
s8216	Winnemucca-Seth-Faim (s8216)	0.37	0.19	0
s8217	Paunsaugunt-Kolob-Detra-Dalcan (s8217)	0.46	0.22	4
s8218	Welring-Tortugas family-Rock outcrop-Chilton family (s8218)	0.21	0.08	25
s8219	Tobish-Tacan-Nehar-Collbran family (s8219)	0.20	0.06	6
s8220	Villy family-Tebbs-Alldown (s8220)	0.44	0.19	0
s8221	Descot-Codley (s8221)	0.16	0.05	0
s8222	Yarts-Mikim-Henrieville-Befar-Barx (s8222)	0.20	0.08	0
s8223	Playas-Frandsen (s8223)	0.19	0.07	0
s8224	Zillion-Showalter-Panguitch-Notter-Guben (s8224)	0.43	0.21	0
s8225	Yenlo-Mikim-Lazear-Clapper-Cannonville-Bayfield (s8225)	0.08	0.03	0
s8226	Venture-Tridell-Notter-Ipson-Bruman (s8226)	0.48	0.22	0
s8227	Zinzer-Yenlo-Tridell-Notter-Luhon (s8227)	0.31	0.12	0
s8228	Tridell-Ipson (s8228)	0.36	0.17	4
s8229	Zillion-Waltershow-Venture-Quilt-Ipson-Harol-Andys (s8229)	0.26	0.11	0
s8230	Waltershow-Tolman-Rock outcrop-Ipson-Comodore (s8230)	0.18	0.07	10
s8231	Tolman-Harol-Fughes-Dalcan-Bushvalley (s8231)	0.28	0.13	0
s8232	Syrett-Swapps-Skutum-Sheege-Ruko-Rock outcrop-Frandsen (s8232)	0.30	0.12	17
s8233	Zyme-Vanet-Syrett-Rock outcrop-Badland (s8233)	0.21	0.08	20
s8234	Syrett-Swapps-Skutum-Pahreah-Badland	0.45	0.22	0

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SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
	(s8234)			
s8235	Ruko-Rock outcrop-Podo-Lazear-Dimyaw family-Cannonville-Badland (s8235)	0.22	0.09	15
s8236	Rock outcrop-Circleville-Castino (s8236)	0.30	0.14	29
s8237	Winnemucca-Echard-Callings-Behanin-Beardall (s8237)	0.62	0.34	0
s8238	Winnemucca-Tica family-Hoodle-Castino-Callings (s8238)	0.49	0.26	0
s8239	Shedado-Rock outcrop-Mespun-Batterson (s8239)	1.39	0.89	50
s8240	Rock outcrop-Rizno-Chilton family (s8240)	0.43	0.19	25
s8241	Sheppard-Rock outcrop-Arches (s8241)	1.70	1.37	50
s8242	Rock outcrop-Rizno (s8242)	1.26	0.73	70
s8243	Sheppard-Nakai-Monue-Deleco-Cataract-Bluechief (s8243)	1.42	0.91	6
s8244	Yarts-Shedado-Rock outcrop-Rizno-Palma-Mivida-Barx (s8244)	0.68	0.34	10
s8245	Uvada-Sevy-McLoughlin-Decca-Crestline (s8245)	0.16	0.04	0
s8246	Rustico-Musinia-Monroe-Hiko Peak-Bandag (s8246)	0.26	0.10	0
s8247	McLoughlin-Hiko Peak-Decca-Avalon (s8247)	0.23	0.09	0
s8248	McLoughlin-Hiko Peak-Decca-Crestline (s8248)	0.34	0.15	0
s8249	Sanpete-Rock outcrop-Hiko Peak-Badland-Amtoft (s8249)	0.33	0.15	10
s8250	Redview-Redfield-Quaker-Naser (s8250)	0.16	0.06	0
s8251	Monroe-Genola-Bertelson-Annabella variant (s8251)	0.38	0.16	0
s8252	Rock outcrop-Red Butte-Logan-Hoye-Hiko Peak (s8252)	0.38	0.19	10
s8253	Rock outcrop-Red Butte-Pernty-Hiko Peak-Handy-Dacore (s8253)	0.23	0.09	20
s8254	Rock outcrop-Hiko Peak-Dacore-Checkett (s8254)	0.21	0.08	15
s8255	Poganeab-Linoyer-Haulings-Green River-Fluvaquents-Anco (s8255)	0.39	0.18	0

Table D.25 UT STATSGO Utah General Soil Survey

Soil Map Unit Composite XKSAT and RTIMP Values

SMU	Soil Map Unit Name	XKSAT, in/hr		Natural RTIMP, %
		DF = 1.0	DF = 1.1	
(1)	(2)	(3)	(4)	(5)
s8256	Tosser-Hiko Peak-Bertelson (s8256)	0.56	0.28	0
s8257	Monroe-Medburn-Green River (s8257)	0.78	0.42	0
s8258	Poganeab-Manassa-Kirkham (s8258)	0.12	0.04	0
s8259	Trook-Gypsum land-Goblin (s8259)	0.48	0.23	0
s8260	Travessilla-Rock outcrop-Gerst (s8260)	0.50	0.24	40
s8369	Water (s8369)	0.01	0.01	100
s9012	Uinta-Scout-Rock outcrop-Miracle-Millpot-Leavitt-Chittum (s9012)	0.68	0.36	10
s9014	Turson-Tetonville-Moslander (s9014)	0.52	0.27	0
s9016	Terada-Spool-Rock outcrop-Huguston-Blackhall (s9016)	1.22	0.71	40
s9017	Pando-Libeg-Lail-Bear Basin-Amsden variant-Amsden (s9017)	0.55	0.29	0
s9046	Outlet-McKinney-Gas Creek-Dobrow-Canburn-Absher (s9046)	0.46	0.24	0

E. CHECKLISTS

E.1 PURPOSE

These checklists are intended for two purposes as follows:

1. Internal use by County/District employees as a guide for reviewing drainage studies, reports and construction plans, including those submitted by the public and prepared internally at the County/District and by other agencies.
2. External use by the public for preparing drainage studies, reports and construction plans that will be reviewed by the County/District.

This should help expedite the review process and help the public better understand what the County/District will be looking for when performing a review. These checklists are not intended to be applicable for every situation. They are intended to be helpful and not mandatory. Checklist items that do not apply to a given situation should have the "N/A" box checked. The column headed with an "*" should be checked if more information or comments are necessary. Additional information and comments should be placed in the "COMMENTS" section provided at the end of each table, with the appropriate checklist item number listed at the start of the comment. Such additional information or comments may also be provided on additional pages. The engineer is encouraged to provide the appropriate checklist as a part of the study or report, as shown in Section 18. The general intended uses for each checklist are as follows:

Checklist 1: Drainage Design Report Checklist. Drainage Design Reports for subdivision preliminary and final plats, street improvement projects and drainage improvement projects. Portions of the checklist may also be appropriate for grading and drainage plans.

Checklist 2: Hydrology Specific Checklist. This checklist is to be applied for flood insurance studies, drainage planning studies, and for Drainage Design Reports where new hydrology calculations or modeling is prepared.

Checklist 3: HEC-RAS Hydraulics Specific Checklist. This checklist is to be applied for flood insurance studies, drainage planning studies, and for Drainage Design Reports and drainage and grading plans where new hydraulic modeling is done using HEC-RAS (preferable) or HEC-2.

Checklist 4: Technical Data Notebook Checklist. This checklist is to be applied for flood insurance studies.

E.2 CHECKLIST 1: DRAINAGE DESIGN REPORT CHECKLIST

Checklist 1: Drainage Design Report Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
SECTION 1: GENERAL					
1	PROJECT NAME: REVISION NO: DATE:				
2	SELECT PROJECT TYPE: Preliminary Plat [ ] Final Plat [ ] Street Imp. [ ] Drainage Design [ ] Grading and Drainage Plan [ ] Other [ ]				
3	REVIEWED BY:				
4	Is this a complete drainage report, sealed by a professional Civil Engineer currently licensed to practice in Arizona?				
5	Is the *Hydrology Specific Checklist* included and completed, if appropriate?				
6	Is the *HECRAS Hydraulics Specific Checklist* included and completed, if appropriate?				
7	Is this report for floodplain delineation purposes, requiring use of the TDN format and checklist?				
8	Does the report discuss whether the site is in a subsidence area or if there are fissures present?				
9	If in a subsidence area or fissures are present, are facilities appropriately sited and designed?				
10	If a construction project, has an SWPPP been developed and an NOI submitted per ADEQ requirements?				
11	If a construction project, has a copy of the SWPPP and NOI been included in the report?				
12	Have all permit requirements been met (ie. Floodplain, Drainage Clearance, Right-of-Way, Zoning, Stormwater Quality, 401/404, etc)?				
13	Is there a section on Conclusions and Recommendations, and is it adequate?				
SECTION 2: FIELD SURVEY AND MAPPING					
1	Are company name, project number, and dates of surveying specified?				
2	Is the report sealed and signed by a professional Land Surveyor currently registered in the State of Arizona?				
3	Are the mapping and map control used in the study fully described?				
4	Are both horizontal and vertical mapping datums specified?				
5	Are the date of aerial photography, mapping scale, and contour interval specified?				
6	Other.				
SECTION 3: DRAINAGE AREA MAP					
1	Is there a drainage area map at an appropriate scale?				
2	Is each sub-basin area delineated and uniquely labeled with alpha-numeric characters in a consistent manner on the Drainage Area Map?				
3	Are directional drainage arrows shown on all streets, parking lots, paved areas, and vacant land?				
4	Is the existing zoning shown on each parcel?				

Checklist 1: Drainage Design Report Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
5	Are existing and proposed catch basins shown and clearly identified?				
6	Does each catch basin number correspond to the number of the sub-basin area which contributes to it?				
7	Are catch basins numbered, beginning with number 1 as the first catch basin contributing to the storm drain at the upstream end? The following catch basins contributing should be numbered consecutively.				
8	Is the same catch basin number used throughout the project – on the drainage area map, in the design report, on the Storm Drain Design Summary Sheet, and on the plans?				
SECTION 4: STORMWATER COLLECTION SYSTEMS					
1	Is the hydrologic design criteria described and does it match the jurisdiction's requirements?				
2	Is the street drainage network described (i.e. longitudinal and cross slopes, curb height, gutter width).				
3	Is the storm drain network described (i.e. inlet and catch basin design).				
4	Is a Storm Drain Design Summary Sheet included?				
5	Is conformance with previous drainage studies checked and differences discussed?				
6	Has a Hydraulic & Energy Grade Line Profile been submitted?				
7	Is the pipe velocity for $0.5*Q_{design} \geq 3$ fps, $Q_{design} \geq 5$ fps, and ≤ 15 fps?				
8	Are dry lane requirements met?				
9	Are appropriate drainage runoff volumes and discharges used?				
10	Are the diameter, length, slope, and construction material of storm drainpipe (RCP, CMP, or other) specified?				
11	Are appropriate clogging factors applied for inlets, in conformance with the jurisdiction's requirements?				
12	Is the maximum hydraulic grade line ≥ 1 ft below the grate elevation of all catch basins and inlets?				
13	Is the maximum energy grade line at or below the adjacent gutter flow line elevation?				
14	Other.				
SECTION 5: CULVERTS					
1	Is the application described (ie, roadway classification, design setting, erosion/deposition concerns)				
2	Is the hydrologic design criteria used described and does it meet or exceed the minimum standards?				
3	Is the number, diameter, length, and construction material specified appropriately? (ie, CMP, RCP, or other)				
4	For existing condition studies, are appropriate n-values assigned for pipe condition?				
5	Are appropriate clogging factors applied for inlets, in conformance with the jurisdiction's requirements?				
6	Does the culvert design for Q_{design} meet the requirements of Table 6.7?				

Checklist 1: Drainage Design Report Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
7	Does the inlet headwater elevation for Q_{100} meet the requirements of Table 6.7?				
8	Does the flow depth over the road for Q_{100} meet the requirements of Table 6.7?				
9	Does backwater at the inlet overtop adjacent land features and drain elsewhere, other than through the culvert?				
10	Does backwater at the inlet affect adjacent parcels of land, requiring ponding easements or establishment of minimum finish floor elevations?				
11	Is the outlet velocity ≤ 15 fps?				
12	Is outlet protection necessary?				
13	If a low water crossing is specified, are cut-off walls provided along the upstream and downstream edges of pavement to limits of flow?				
14	Is a profile provided for each culvert depicting length, slope, cover, road side slopes, design headwater elevation, and any utility conflicts?				
15	Other.				
SECTION 6: RETENTION BASINS					
1	Is the hydrologic design criteria used described and does it match the jurisdiction's requirements?				
2	Have stormwater storage and first flush requirements been met?				
3	Are stormwater storage and first flush calculations included and documented in the report?				
4	Does the maximum basin depth meet the jurisdiction's criteria?				
5	Is an emergency spillway/overflow identified in an appropriate location, and adequately protected from scour?				
6	Are side slopes 4:1 or flatter?				
7	Are appropriate clogging factors applied for inlets, in conformance with the jurisdiction's requirements?				
8	Are debris barriers specified for inlets?				
9	Are access barriers specified for outlets 18 inches in diameter and greater?				
10	Is an upstream siltation basin included if necessary?				
11	Other.				
SECTION 7: FCD FLOOD RETARDING STRUCTURES					
1	Name of structure(s):				
2	Identify phase of FCD Structures Assessment Program and any hydrologic investigations performed as part of the program.				
3	Specify hydrologic design criteria for reservoir, i.e. SPF, 100-yr.				
4	Specify inflow design flood for spillway, i.e. 100-yr, or % PMF (dependent on hazard classification).				
5	Other.				
SECTION 8: CANALS					
1	Are any canals located within the project boundaries?				

Checklist 1: Drainage Design Report Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
2	Is a discussion of backwater and overtopping issues provided, and are they adequately addressed?				
3	Other.				
SECTION 9: CONSTRUCTION PLANS					
1	Are all underground utilities identified in plan & profile?				
2	Is a utility “potholes requested” letter (as needed) for capital improvement projects provided?				
3	Are water, and sewer, and natural gas service taps shown in plan & profile?				
4	Are all sanitary sewer manhole rim and invert elevations shown on plans?				
5	Is any existing Portland Cement concrete pavement underlay shown?				
6	Are storm drain conflicts with other utilities identified and addressed?				
7	Have SRP, RID, and private irrigation facilities been checked for conflicts?				
8	Are waterline thrust block conflicts identified and addressed?				
9	Are pipe support locations for sanitary sewer lines above main storm drains identified?				
10	Are existing topography and buildings shown at least 30 feet beyond street R.O.W.?				
11	Are intersecting side street elevations at least 100 feet beyond curb returns noted on plans?				
12	Are potential ponding locations behind sidewalks checked and resolved?				
13	Are driveway/catch basin conflicts checked and resolved?				
14	Are finished floors appropriately elevated relative to the peak 100-year water surface elevations?				
15	Is one typical full-street cross-section with storm drain and applicable other underground utilities shown to scale on each storm drain profile sheet?				
16	Does the mainline storm drain have a minimum of 5-foot of cover (unless otherwise approved)?				
17	Is the farthest upstream catch basin located to meet the flow depth criteria in Table 6.7?				
18	Do all catch basins have a maximum spacing meeting the criteria in Table 6.9?				
19	Have soil boring(s) extending at least 2 feet below the proposed storm drain been taken and shown on the plans or provided in a report?				
20	Are soil boring logs and information including pH and resistivity shown on plans or provided in a report?				
21	Are pipe materials designed to accommodate soil conditions? Do existing soil conditions meet requirements for cast-in-place concrete pipe or concrete lined corrugated metal pipe?				
22	Are existing and proposed ground elevations shown for all mainline and connector pipe profiles?				
23	Is a *Storm Drain Key Map* included?				
24	Is a complete alternate pipe chart included?				

Checklist 1: Drainage Design Report Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
25	Does the alternate pipe chart show storm drain pipe diameters 6-inches larger than designed pre-cast concrete pipe diameters? The calculated pipe wall thickness for cast-in-place pipe is based on the required larger size.				
26	Does the alternate pipe chart show cast-in-place concrete pipe to be no smaller than 30 inches in diameter?				
27	Check for permanent pipe supports.				
28	Are there any ACP waterline crossings?				
29	Is there a completed *Storm Drain Design Summary* sheet included with plans?				
30	Are temporary construction easement lines for drainage work shown, if required? Are easement and right-of-way lines shown?				
31	Is the type of work on existing facilities indicated?				
32	Is the direction of flow indicated for ditches, channels, natural waterways, etc.?				
33	Are inlet and outlet elevations shown for all drainage facilities?				
34	Are existing ground line (dashed line) and finished grade line (solid line) profiles shown and labeled?				
35	Is the design slope of profile lines for drainage facilities (ditch, channel, etc.) shown as decimal in ft/ft?				
36	Are pipe culvert material and dimensions labeled?				
37	Are inlet and outlet facilities, if any, such as headwalls, wingwalls, cutoff walls and erosion protection shown and dimensioned?				
38	Are reinforced concrete box culvert dimensions and number of cells shown coupled with wingwall type/dimensions?				
39	Are the type and thickness of drainage facility linings shown?				
SECTION 10: *ADDITIONAL COMMENTS					

Checklist 1: Drainage Design Report Checklist					
Item	Description	YES	NO	N/A	*

E.3 CKECKLIST 2: HYDROLOGY SPECIFIC CHECKLIST

Checklist 2: Hydrology Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
SECTION 1: PROJECT DETAILS					
1	PROJECT NAME: REVISION NO: DATE:				
2	SELECT PROJECT TYPE: ADMS[ ] ADMP [ ] WCMP [ ] FDS [ ] Development Review [ ] Regulatory Review [ ] Hydrology Study [ ] Other [ ]				
3	REVIEWED BY:				
4	Are both hard and electronic copies of HEC-1 input and output files included with submittal?				
5	Is the report sealed and signed by a professional Civil Engineer currently licensed to practice in Arizona?				
6	REPORT TITLE:				
7	CONSULTANT:				
8	LIST SOFTWARE, VERSION, and FILE NAMES:				
9	Is this a CIP PROJECT?				
10	Is the development located in a flood hazard area? Check Category: Floodway[ ] Floodplain: A [ ] AH [ ] AE [ ] AO [ ] X [ ] EHZ [ ]				
11	Is there a section on Conclusions and Recommendations, and is it adequate?				
SECTION 2: HYDROLOGY MAPS					
1	Is a map provided that shows study area boundary, sub-basin boundaries, and concentration points?				
2	Check the sub-basin delineation. Are areas, soil and land use types, and topography homogenous for each sub-basin?				
3	Check sub-basin areas. Are areas measured correctly?				
4	Is the naming convention for sub-basins, concentration points, routing reaches, reservoir routes, and flow diversions identified?				
5	Is a map provided that shows time of concentration and hydrograph routing paths?				
6	Is a map provided that shows soils boundaries?				
7	Is a map provided that shows land use boundaries for both existing and developed conditions?				
8	Is the basis and method for estimating vegetation cover (existing and developed) described? Is the method appropriate?				
9	Was "no contributing runoff" assumed for properties with existing 100-year on-site retention, or properties with plans for 100-year on-site retention, which have been reviewed and approved by Maricopa County Planning & Development Services?				
10	Is there a description of watershed condition and watershed resistance? Is selection of K_b and/or K_n values discussed appropriately in that context?				
11	Other.				
SECTION 3: RATIONAL METHOD					
1	Is the maximum individual basin area less than or equal to 160 acres?				
2	If not, then the unit hydrograph method must be used.				
3	Are Runoff C Coefficients and K_b values selected appropriately for each land use type per Tables 6.3 and 6.4?				

Checklist 2: Hydrology Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
4	Have existing land-use runoff coefficients been used where contributory land is vacant or developed prior to storm water storage requirements?				
5	If the Runoff C Coefficients or K_b values do not match the values for the appropriate land use categories in Tables 6.3 and 6.4, is there appropriate written justification and computations?				
6	Are there multiple land use types within individual basins?				
7	If so, are Runoff C Coefficients and K_b values area-averaged appropriately?				
8	Are site specific Depth-Duration-Frequency (D-D-F) values computed properly using PREFRE, and a printout and digital input/output files provided?				
9	Is the T_c path of appropriate location and length on the map?				
10	Is the T_c computed using the District's Rational Method computer program?				
11	If so, is a printout provided and do the input parameters match the report values?				
12	If not, check the iterative computations closely for each basin. Are they correct?				
13	Is each T_c value at least 10-minutes?				
14	Is the peak discharge for each basin computed properly and are the values reasonable?				
15	Is the Rational Method being used to compute peak discharges at intermediate locations within a drainage area less than 160 acres in size?				
16	If so, is the procedure outlined in Section 3.6.2 of the Hydrology Manual followed?				
17	Other.				
SECTION 4: UNIT HYDROGRAPH METHOD					
1	HEC-1 JOB CONTROL RECORDS				
a.	ID record. Are dates, project name, and modeler's name specified? Are they consistent with reports?				
b.	ID record. Are model revisions clearly identified on subsequent ID records?				
c.	IT record (NMIN). If NMIN has been revised, or changed for different models, were dependent parameters (UI, RM, NSTPS) adjusted appropriately?				
d.	IT record (NMIN). Is $0.1\ T_c \leq NMIN \leq 0.25\ T_c$ for the average value of T_c for the watershed, and the maximum and minimum values? Double check sub-basin delineation if extreme values of T_c make NMIN significantly outside the range.				
e.	IT record (NMIN). Is NMIN < $0.25*T_c$ for the sub-basin with the shortest T_c?				
f.	IT record (NMIN). Can NMIN be adjusted so that NMIN is approximately equal to $0.15\ T_c$ for the average value of T_c?				
g.	IT record (NMIN). Is 60/NMIN an integer?				
h.	IT record (NMIN). Is NMIN equal to or evenly divisible by JXMIN on the IN record?				
I.	IT record (NMIN, NQ). Is NMIN*NQ at least as long as the storm duration?				

Checklist 2: Hydrology Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*
j.	IN record (JXMIN). Is the IN record used correctly?				
k.	Is *DIAGRAM specified for at least one HEC-1 model in the study? One for each model with differences other than storm frequency.				
l.	IO record (IPRT). Is Level 3 or lower output used for at least one HEC-1 model in the study? One for each model with differences other than storm frequency? Level 3 should be used for the model of the largest storm.				
m.	JP record. Is (NPLAN*NRATIO) < 45?				
n.	JP record. Is (NPLAN*NRATIO*NQ) < 4800?				
o.	JD record. Are JD records used and applied appropriately?				
p.	JD record. When using JD records for FRS volume computation, were the interpolated volumes from each sub-basin used?				
q.	Other.				
2	PRECIPITATION AND RAINFALL DISTRIBUTION				
a.	Check rainfall frequency and duration in the report and HEC-1 files. Identify the source of rainfall data, i.e. NOAA Atlas 2, HMR-49. Is the source appropriate for the study area and type?				
b.	PB record. Specify rainfall depth. Is areal reduction applied correctly and discussed in the text?				
c.	PI and PC records. Were PC or PI records checked against the IN record?				
d.	PI and PC records. Were PC or PI records checked against distribution patterns?				
e.	Are design storm distributions applied correctly?				
f.	Other.				
3	RAINFALL LOSSES				
a.	Are Green-Ampt loss rate parameters specified and are the selected values for IA, DTHETA, XKSAT, PSIF, and RTIMP reasonable?				
b.	Is the watershed moisture condition assumption described for the selection of DTHETA?				
c.	Are there different moisture condition land uses present within individual sub-basins (agricultural and natural, for instance)?				
d.	If so, are the values area averaged appropriately?				
e.	Is area averaging of Green & Ampt parameters performed using the current version of DDMSW, or by external means or old versions of DDMSW/MCUHP? Check those that use older versions of DDMSW/MCUHP more closely. Check those using external means very closely.				
f.	Is bare ground XKSAT adjusted for vegetation cover? Is the adjustment appropriate?				
g.	Does the watershed span multiple NRCS (SCS) Soil Surveys? Are differences in soil texture between adjacent soil surveys discussed in the text and addressed if necessary in the models?				
h.	Is there a discussion of natural RTIMP present in the watershed?				
I.	Is natural RTIMP assumed to be hydraulically connected, have any adjustments been made to the percentages listed for the soil types, and are the revisions reasonable and adequately documented?				
j.	Other.				
4	HYDROGRAPHS				
a.	Specify method of hydrograph generation, i.e. Clark, S-graph. Is the method appropriate?				

Checklist 2: Hydrology Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
b.	UC record (T_c). Are T_c parameters L, S, and K_b reasonable?				
c.	Is T_c < 90 minutes for each sub-basin?				
d.	Does T_c exceed the duration of rainfall excess for any sub-basin? This should be documented in the text.				
e.	UC record (R). Is R ≥ 0.5xNMIN?				
f.	UC record (T_c). Check against similar sub-basins. Are T_c values reasonable?				
g.	UC record (T_c). Were Tc values checked to ensure that average velocities throughout the watershed are reasonable?				
h.	HC record. Are hydrographs combined properly?				
i.	HC record. Is HC ≤ 5?				
j.	HC record (TAREA). Is total area correct? Was area above the concentration point manually recalculated for diverted hydrographs?				
k.	Other.				
5	CHANNEL/PIPE ROUTING METHODS				
a.	Are specific channel/pipe routing method(s) specified, i.e. modified Puls, normal depth, Muskingum, Muskingum-Cunge, kinematic wave, and are the methods appropriate?				
b.	RC record (RLNTH). Check reach lengths. Were lengths measured correctly?				
c.	RC record (ANL, ANCH, ANR). Were Manning's "n" values developed using methodology in *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona* (April 1991)?				
d.	RC record (ANL, ANCH, ANR). Are Manning's "n" values reasonable?				
e.	RX and RY records. Are cross sections typical for the routing reach? If not, does the reach need to be broken into multiple reaches?				
f.	Are NSTPS generally equal to L/(V_{avg} * NMIN)?				
g.	Is NSTEP for each reach within +/- 1 of TT/NMIN, where TT is the travel time for the reach computed by HEC-1?				
h.	Are transmission losses modeled? If so, is there an acceptable discussion of the reasons for modeling losses, and the source of the parameters?				
i.	Are there questionable routing operations identified above that warrant plotting and visual examination of the hydrograph?				
j.	Other.				
6	RESERVOIR (STORAGE) ROUTING METHODS				
a.	Are USGS, FCD, NWS, or other rain or stream gages used in hydrologic analysis or model calibration identified and discussed?				
b.	Are stage-storage relationships modeled correctly?				
c.	Are stage-discharge relationships modeled correctly?				
d.	RS record. Are NSTPS = 1? If NSTPS is changed, travel time and attenuation will be affected.				
e.	RS record (ITYP, RSVRIC). Are starting conditions modeled appropriately?				
f.	Are rating curves for storage and outflow hydraulics included? Are the rating curves reasonable?				

Checklist 2: Hydrology Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
g.	Is there an acceptable discussion of the basis for estimation of storage and outflow parameters in the text, and a discussion of reservoir routing results?				
h.	Other.				
7	DIVERSION DATA				
a.	DI/DQ records. Are diversions/split flows modeled correctly?				
b.	Are hydraulic computations for diversions done appropriately and included in the report?				
c.	Are rating curves for each diversion plotted and included in the report?				
d.	Are watershed areas corrected using the HC record where diverted hydrographs are recalled into the model?				
e.	Other.				
SECTION 5: HEC-1 OUTPUT					
1	ERROR AND WARNING MESSAGES				
a.	Are there error or warning messages related to hydrograph generation or combination that are not adequately addressed in the test, or are critical?				
b.	Are there error or warning messages related to routing that are not adequately addressed in the text? Specifically check for peak discharge outside of specified range warnings and lack of hydraulic capacity for the reach cross-section.				
c.	Have error and warning messages been checked and corrected? Are error and warning messages explained adequately?				
d.	Other.				
2	SCHEMATIC DIAGRAM				
a.	Compare the schematic to the watershed map. Is the structure logical? Are all points labeled clearly? Specify any problems.				
b.	Are there < 9 hanging hydrographs?				
c.	Have all of the diverted hydrographs been accounted for?				
d.	Are all sub-areas attached and combined in the proper sequence?				
e.	Other.				
3	DRAINAGE AREA				
a.	Has the area associated with all returned diverted hydrographs been returned?				
b.	Check total drainage area. Is it accurate?				
c.	Other.				
4	RAINFALL LOSSES				
a.	Check the total rainfall, total losses, and total runoff for each sub-basin. Are there zeros or very small numbers? Explain.				
b.	Other.				
5	HYDROGRAPH ROUTING				
a.	Is outflow peak discharge < inflow peak discharge?				
b.	Is flow contained within x-sections?				
c.	Check travel time. Does travel time appear to be too short or too long? If so, check input parameters for routing. Check routing steps in the input against the output velocity.				
d.	Is attenuation of peak flows reasonable?				
e.	For kinematic wave routing, is the peak flow attenuated? If so, check model and revise.				

Item	Description	YES	NO	N/A	*
f.	Other.				
6	PEAK RUNOFF				
a.	Is specific yield (cfs/sq mi) for each sub-basin included in the report?				
b.	Other.				
7	TIME TO PEAK				
a.	Check the time to peak column in the HEC-1 summary table. Do times to peak increase with increasing drainage area?				
b.	Are all times to peak very close or identical to one another? If so, NMIN and routing operations may need to be revised.				
c.	Do all times to peak occur after the most intense period of rainfall (about half the rainfall duration)?				
d.	Other.				
8	RUNOFF VOLUMES				
a.	Are runoff volumes reasonable?				
b.	Other.				
SECTION 6: MODEL CALIBRATION AND INDIRECT METHODS VERIFICATION					
1	INSTRUMENTATION				
a.	Identify USGS, FCD, NWS, or other rain or stream gages used in hydrologic analysis or model calibration.				
b.	Have any gages been relocated during the period of record? Discuss.				
c.	Other.				
2	INDIRECT METHODS/STATISTICAL ANALYSES				
a.	Have statistical analyses been performed and are the results discussed?				
b.	Are USGS regression equations used, the sources identified, and are they appropriate and implemented correctly?				
c.	Is the period of record adequate for use with *Water Resources Council Bulletin 17B* (March 1982)?				
d.	Are any other Indirect Methods used, the sources identified, and are they appropriate and implemented correctly?				
e.	Are the model results reasonable based on comparisons with the results of the application of Indirect Methods?				
f.	Other.				
SECTION 7: ADDITIONAL COMMENTS					

Checklist 2: Hydrology Specific Checklist

Item	Description	YES	NO	N/A	*

E.4 CHECKLIST 3: HEC-RAS HYDRAULICS SPECIFIC CHECKLIST

Checklist 3: HEC-RAS Hydraulics Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
SECTION 1: PROJECT DESCRIPTION					
1	PROJECT NAME: REVISION NO: DATE:				
2	SELECT PROJECT TYPE: ADMS[ ] ADMP [ ] WCMP [ ] FDS [ ] Development Review [ ] Regulatory Review [ ] Hydrology Study [ ] Other [ ]				
3	REVIEWED BY:				
4	Is there a project description?				
5	Does the description include the study name, District contract number, consultant name and address?				
6	Does the description include the purpose of the model (floodplain delineation study, channel project, …)?				
7	Are the data sources identified?				
8	Are general assumptions listed?				
9	Are the events being modeled identified (100-year, SPF, multiple year, …)?				
10	Is the project file name appropriate for the project? Names like a, b, job 1, and FIS are not acceptable.				
11	Is there an adequate map that shows the topography, cross sections, thalwegs, labels, floodplain and floodway limits, and left and right bank locations?				
12	Is the version of the hydraulic model used to do the study listed?				
13	Is there a section on Conclusions and Recommendations, and is it adequate?				
SECTION 2: FILES					
1	Note the number of geometry, flow data, and plan files. Should multiple models be created?				
2	Are the file names appropriate?				
3	Do the file names reflect the project name, and what each file includes?				
SECTION 3: FLOW DATA					
1	Are the changes in discharge input at the correct locations, and are the values correct?				
2	For floodplain studies are Floodplain (or FP) and Floodway (or FW) being used for the profile names?				
3	For other studies do the profile names reflect what is being modeled (25-yr, 50-yr, …)?				
4	Are the upstream and downstream boundary conditions appropriate for the model?				
5	Are any internal rating curves or fixed changes in water surface elevations being used?				
SECTION 4: GEOMETRY FILE					
1	Are rivers and reaches named correctly? Names like a, b, and Job 1 are not acceptable.				
2	Are the junction names acceptable?				
3	Are the cross sections identified in river miles for floodplain delineations (feet may be used for Non-FEMA delineations)?				
4	Do cross section start and stop locations and length on the map				

Checklist 3: HEC-RAS Hydraulics Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
	match the geometry file?				
5	Are cross sections oriented with stationing from left to right looking downstream?				
6	Are cross sections stationed using 10,000 at the thalweg?				
7	Are comments included where appropriate in the cross section descriptions?				
8	Are reach lengths measured correctly? They should be measured at the center of the mass of flow.				
9	Are the bank station locations appropriate? Bank stations can be different for different events.				
10	Are contraction/expansion coefficients appropriate? (note: culverts may use larger values than bridges)				
11	Are blocked flow, levees, or ineffective flow being used, and used correctly?				
12	Are the n values appropriate? (for design projects there should be a range of n values)				
13	Are bridges and culverts being modeled correctly? Is there pressure flow, weir flow, or both?				
14	Are any inline weirs or spillways being used?				
15	If yes, are weir coefficients acceptable and are they modeled appropriately?				
16	Are interpolated cross sections being used? If yes, why?				
SECTION 5: CALCULATIONS					
1	Does the plan file have an adequate description?				
2	Are the correct flow and geometry files being used?				
3	Is an appropriate starting WSEL method used and explained, and is it applied correctly?				
4	Are ineffective flow areas identified and addressed appropriately?				
5	Are there any breakouts?				
6	Are bridges and culverts modeled appropriately, including ineffective flow?				
6	Is the correct flow regime (sub, mixed, or super) being used (subcritical only for floodplain studies)?				
8	Are encroachments used?				
9	If encroachments are used, are they applied properly using the water surface or energy grade line and show < 1.0 foot increases at every cross section?				
10	Are the floodplain and floodway delineations done in accordance ADWR State Standards 2-96, 3-94 and 9-02?				
11	Is the flow distribution option turned on, if appropriate?				
12	Is the appropriate method used for conveyance calculations and the friction slope?				
SECTION 6: REPORT FILE					
1	Does the Report File printouts of all the input data including (geometry, flow, plan)?				
2	Are all the profiles included in the output results?				
3	Are appropriate summary tables included?				
SECTION 7: REVIEWING THE RESULTS					
1	Check the Froude numbers, does critical flow (or close to critical				

Checklist 3: HEC-RAS Hydraulics Specific Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
	flow) occur anywhere?				
2	Does at least a portion of the flow occupy the channel?				
3	Is the percentage of flow in the main channel less than 25%? Examine model carefully if yes.				
4	Are there large changes in depth and/or velocity between cross sections?				
SECTION 8: ERRORS					
1	Are there any extended cross sections?				
2	Does divided flow occur?				
SECTION 9: *ADDITIONAL COMMENTS					

E.5 CHECKLIST 4: TECHNICAL DATA NOTEBOOK CHECKLIST

Checklist 4: Technical Data Notebook Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****
SECTION 1: COVER SHEET					
1	Is the Study Name included, and is it correct?				
2	Is the date correct?				
3	Are revision dates included?				
4	Is the consultant's name (address and telephone number) included?				
5	Is the District's contract number included?				
6	Are the cover and Table of Contents sealed by a professional Civil Engineer currently licensed to practice in Arizona?				
SECTION 2: DOCUMENT FORMAT AND LAYOUT					
1	Is the document prepared in accordance with ADWR SS 1-96?				
2	If new topographic mapping, survey notes and data are included, are they sealed by professional Land Surveyor currently licensed to practice in Arizona?				
3	Does the TDN Binder include all the labels and logos of the study partners, including FEMA?				
4	Are Section Corners labeled on the Study Maps?				
SECTION 3: MODEL PRINTOUT					
1	Are printouts from the hydrologic and hydraulic models included? Hydrologic and hydraulic models need to be fully documented in a way that isn't subject to change, therefore printouts of the models must be included in the TDN.				
2	Do the printouts include the input data and the results?				
3	For HEC-RAS models, is a HEC-RAS generated report included?				
4	Do HEC-RAS report files include both the input data and the detailed calculation results? Printouts which contain only HEC-RAS summary tables are not acceptable.				
5	Do the units shown on the flood profiles, such as River Miles, match those used in the hydraulic models?				
6	Are all modeled reaches included in the Floodway tables?				
SECTION 4: COMPACT DISKS					
1	Are electronic copies of the hydrologic and hydraulic models included on CD? (mandatory) CDs are the only acceptable mediums at this time.				
2	Are all of the input and output files for all computer models used included on CD? (mandatory) In general the input files shouldn't be zipped, but if space is a problem it is acceptable to zip the output files.				
3	Is the CD labeled with such items as the study name, contract number, consultant's name, date, general description of what is on the CD, the names of all the watercourses studied or the names of all the files on the CD? (mandatory)				
4	Is a "README" file included on the CD, and in ASCII text file format?				

Checklist 4: Technical Data Notebook Checklist

Item	Description	YES	NO	N/A	*
5	Does the minimum information in the “README” file include: Name and address of study contractor; name, county and state of the community; name of the hydrologic/hydraulic computer program used; and the name of each input and output file including a model description, stream name and date of creation? The consultant should include additional information as is necessary.				
6	Is a printed copy of the “README” file located in the TDN next to the CD? (mandatory)				
7	In the case of multiple models, is a simple line diagram included depicting the relative location of the models to each other?				
8	Are all file names unique to the project, and worded in a manner related to the project and the scenario(s) being modeled? File names like a, b, c, job 1, floodplain, and FIS are not acceptable types of names and their use should be avoided.				
9	Has the consultant included on the CD scanned images of the final (signed and sealed) drawings or exhibits, original CAD files, the TDN in electronic format, and any other electronic files the consultant may have generated? (not mandatory, but preferred)				
SECTION 5: *ADDITIONAL COMMENTS					

Checklist 4: Technical Data Notebook Checklist					
Item	**Description**	**YES**	**NO**	**N/A**	*****

F. DATA FOR INDIRECT METHODS

F.1 METHOD 2 USGS DATA LISTING

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09404310	0.20	237
09384200	0.24	116
09429510	0.30	346
09400200	0.32	1,520
09385800	0.35	672
09478600	0.37	417
09520110	0.44	327
09487140	0.45	987
09483040	0.46	627
09479200	0.51	431
09505900	0.64	619
09424700	0.64	993
09536350	0.65	413
09498600	0.66	348
09503740	0.75	220
09536100	0.76	589
09428545	0.77	296
09401245	0.79	419
09471600	0.79	385
09482330	0.81	560
09468300	0.83	1,690
09504100	0.85	561
09520300	0.90	710
09512420	0.95	2,910
09483010	0.95	1,210
09379980	0.98	2,850
09512700	1.07	1,730

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09504400	1.15	1,430
09483042	1.17	842
09396400	1.22	1,150
09419590	1.23	1,080
09395100	1.28	345
09379060	1.37	301
09379100	1.38	5,880
09520230	1.49	2,130
09489080	1.61	87
09424430	1.70	2,610
09512200	1.75	3,220
09400560	1.78	770
09427700	1.84	1,640
09400680	1.87	413
09429150	1.98	1,270
09520400	1.99	3,930
09424410	1.99	1,090
09483200	2.04	793
09400660	2.06	111
09483250	2.08	2,870
09483030	2.11	7,390
09485950	2.15	1,090
09520160	2.18	1,620
09482950	2.30	2,390
09472400	2.40	6,960
09400740	2.41	293
09483025	2.43	3,360
09519600	2.43	1,670
09487400	2.44	1,300
09496800	2.55	2,850
09429400	2.56	131

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09510170	2.60	950
09471700	2.71	2,270
09485550	2.72	1,920
09517200	2.79	1,240
09403800	2.85	7,350
09482480	2.94	4,460
09404350	3.15	18,400
09403930	3.18	708
09400910	3.28	182
09505600	3.42	573
09483045	3.53	2,260
09383020	3.54	913
09400530	3.57	387
09473200	3.63	7,490
09404050	3.83	449
09473600	4.37	1,460
09510100	4.49	2,670
09510070	4.58	5,530
09520130	4.72	2,380
09507700	4.79	2,480
09485900	4.93	652
09392800	5.22	4,030
09470900	5.25	2,140
09400700	5.52	326
09515800	5.57	7,450
09400580	5.57	2,220
09379560	5.88	3,530
09502700	6.01	6,250
09516600	6.31	5,330
09498900	6.44	4,070
09507600	6.44	8,600

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09400565	6.45	2,150
09484510	6.46	329
09424480	6.95	4,250
09482410	7.24	1,020
09415050	7.27	5,300
09400100	7.85	2,320
09472100	8.02	4,410
09400650	8.11	748
09483000	8.20	4,890
09423760	8.47	4,590
09520100	8.70	5,220
09400290	9.30	3,030
09485570	9.58	7,460
09510080	9.80	8,030
09481700	10.30	2,540
09513820	11.10	6,070
09444100	11.60	667
09487100	11.90	4,400
09520200	12.10	1,490
09488600	12.80	3,340
09519780	12.90	27,600
09424407	13.50	3,130
09484580	14.10	4,480
09503750	14.50	9,820
09428550	14.60	6,170
09423900	14.70	5,290
09489200	14.80	426
09503720	14.90	3,860
09456400	15.00	4,640
09510180	15.20	5,790
09478200	15.60	5,710

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09371100	16.00	1,760
09484200	16.30	1,850
09383600	16.90	485
09482400	23.00	1,900
09501300	24.30	13,900
09505300	24.60	6,290
09482420	26.50	2,310
09397800	27.90	1,070
09383400	29.10	822
09423780	31.30	892
09467120	35.20	6,910
09484000	35.50	10,400
09503000	36.30	7,310
09508300	36.40	18,500
09489070	38.10	1,420
09484570	38.40	15,400
09492400	38.80	1,700
09490800	40.20	535
09483100	43.00	12,300
09485000	44.80	17,100
09517400	47.80	4,560
09505250	48.00	10,900
09400300	49.60	2,320
09484590	50.50	9,340
09400600	51.00	861
09510150	52.30	42,700
09497900	62.10	25,300
09513860	64.60	31,000
09513780	67.30	34,600
09390500	68.60	11,600
09519750	68.80	12,600

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09491000	78.20	2,280
09537200	79.10	9,880
09379030	80.70	4,970
09480000	82.20	11,200
09513800	83.30	37,500
09383500	83.30	1,100
09517280	85.20	6,910
09403000	101.00	4,970
09445500	102.00	4,620
09505200	111.00	16,100
09519760	116.00	11,400
09489700	119.00	6,040
09512300	121.00	20,000
09498870	122.00	35,400
09503800	124.00	6,890
09516800	137.00	32,900
09512100	139.00	16,800
09505350	142.00	38,200
09424200	143.00	11,700
09478500	144.00	46,100
09446000	149.00	10,000
09510200	164.00	51,400
09481750	176.00	17,100
09513835	185.00	41,800
09497980	200.00	27,000
09496000	203.00	33,200
09481500	209.00	15,100
09484500	219.00	29,100
09494300	225.00	11,300
09505800	241.00	30,000
09520170	243.00	11,800

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09486300	250.00	23,900
09502800	255.00	29,200
09397500	271.00	41,000
09484560	289.00	18,500
09497800	295.00	21,800
09489100	315.00	20,500
09513890	317.00	75,100
09398500	317.00	31,100
09513910	323.00	47,100
09507980	328.00	52,800
09504500	355.00	43,700
09404340	370.00	25,300
09446500	377.00	24,600
09515500	417.00	43,000
09514200	420.00	7,840
09498800	430.00	95,500
09496500	439.00	36,400
09388400	456.00	10,100
09484600	457.00	35,000
09486800	465.00	23,600
09395900	493.00	11,200
09444200	506.00	52,300
09480500	533.00	23,600
09473000	537.00	28,200
09489499	560.00	24,500
09535100	569.00	15,200
09401220	579.00	30,200
09512500	585.00	31,700
09485500	602.00	22,600
09447000	613.00	34,200
09399000	621.00	60,900

Table F.1 USGS stream gage LP3 data listing

Drainage areas between 0.1 and 2,000 square miles.

(Source: Pope, Rigas and Smith, 1998)

Drainage Area, sm	USGS Gage Number	LP3 Q_{100}
09494000	632.00	17,600
09499000	675.00	101,000
09470500	737.00	21,500
09487000	776.00	19,500
09398000	781.00	33,800
09423820	787.00	21,200
09516500	796.00	43,900
09456000	814.00	8,660
09393500	846.00	17,900
09513970	880.00	49,000
09486000	918.00	27,700
09537500	1023.00	5,750
09468500	1026.00	54,500
09403780	1028.00	7,140
09512800	1110.00	182,000
09424900	1128.00	37,900
09487250	1170.00	12,500
09490500	1232.00	97,900
09535300	1250.00	7,250
09382000	1410.00	20,200
09425500	1439.00	69,600
09517000	1470.00	49,200
09401260	1629.00	17,300
09482000	1682.00	36,500
09471550	1730.00	28,000
09488500	1782.00	29,000

F.2 METHOD 3 USGS DATA LISTING

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID	Gage Location	Flood Region	Record Length, yrs	Drainage Area, sm	Gage Elev.	Mean Annual Evap, in
(1)	(2)	(3)	(4)	(5)	(6)	(7)
09415480	White River Tributary near Preston, Nev.	6	20	26	6,560	43.5
09415560	White River Tributary near Sunnyside, Nev.	6	15	20	6,240	40
09415600	Pahragut Valley Tributary near Hiko, Nev.	6	18	17	5,750	54.8
09415800	Muddy River Tributary near Alamo, Nev.	6	18	2	3,340	57.6
09418100	Patterson Wash Tributary near Pioche, Nev.	6	18	5	6,250	43.3
09418150	Caselton Wash near Panaca, Nev.	6	19	70.2	5,830	52.4
09418450	Meadow Valley Wash Tributary near Caliente, Nev.	6	18	0.5	5,970	55
09418500	Meadow Valley Wash near Caliente, Nev.	6	32	1,670.00	6,180	55
10172700	Vernon Creek near Vernon, Utah	6	27	25	7,100	40.6
10172720	East Government Creek Tributary near Vernon, Utah	6	10	0.98	6,340	39.7
10172740	Rush Valley Tributary near Fairfield, Utah	6	11	0.26	5,850	43.6
10172760	Clover Creek near Clover, Utah	6	15	4.45	7,190	40.6
10172790	Settlement Canyon near Tooele, Utah	6	11	5.77	7,900	41.2
10172800	South Willow Creek near Grantsville, Utah	6	26	4.19	8,370	39.5

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10172810	Mack Canyon near Grantsville, Utah	6	12	2.84	7,200	39.4
10172830	North Fork Muskrat Canyon near Timpie, Utah	6	11	1.78	7,080	40
10172835	Skull Valley Tributary near Delle, Utah	6	12	1.5	5,780	46.4
10172870	Trout Creek near Callao, Utah	6	28	8.8	9,100	44.9
10172885	Great Salt Lake Desert Tributary No. 2 near Dugway, Utah	6	12	5.48	5,570	54.1
10172890	Government Creek near Dugway, Utah	6	11	59	6,080	42.3
10172895	Deep Creek near Ibapah, Utah	6	10	460	6,100	58.7
10172900	Bar Creek near Ibapah, Utah	6	15	12	5,460	58.7
10172902	Dead Cedar Wash near Wendover, Utah	6	18	5	6,910	40.2
10172905	Great Salt Lake Desert Tributary near Delle, Utah	6	11	0.97	6,010	44.2
10172909	Burnt Creek near Shores, Nev.	6	17	10.5	7,320	40
10172913	Loray Wash Tributary near Cobre, Nev.	6	18	24	6,590	40.2
10172920	Cotton Creek near Grouse Creek, Utah	6	10	19.1	6,560	40
10172925	Great Salt Lake Desert Tributary No. 3 near Park Valley, Utah	6	12	10.1	6,120	57.5
10172940	Dove Creek near Park Valley, Utah	6	15	33.2	6,620	40

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10172970	Rock Creek near Holbrook,Idaho	6	18	44	5,610	40
10172990	Blue Spring Creek near Snowville, Utah	6	14	78	5,300	40
10242420	Shoal Creek near Enterprise, Ut.ah	6	13	19	6,158	48.6
10242460	Escalante Valley Tributary near Panaca, Nev.	6	18	7.9	6,790	50.1
10243240	Baker Creek at Narrows, near Baker, Nev.	6	23	16.4	9,500	39.8
10243660	Connors Pass Creek near Shoshone, Nev.	6	19	0.45	7,920	39.6
10243700	Cleve Creek near Ely, Nev.	6	29	31.8	8,770	40
10243950	Millick Canyon Tributary near Currie, Nev.	6	12	1.4	6,470	45
10244220	Maverick Canyon near Oasis, Nev.	6	11	3.02	7,150	43.6
10244240	Clover Valley Tributary near Arthur, Nev.	6	16	3	6,370	45.1
10244360	Dixie Valley Tributary near Eastgate, Nev.	6	26	11	5,550	40
10244460	Rawhide Flats Tributary near Schurz, Nev.	6	16	0.96	4,770	51.7
10244480	Gabbs Valley Tributary near Gabbs, Nev.	6	13	7	5,190	45.7
10244490	Finger Rock Wash near Gabbs, Nev.	6	11	207	5,150	49.9
10244620	Teels Marsh Tributary at Basalt, Nev.	6	16	1.07	6,450	40

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10244720	Franklin River near Arthur, Nev.	6	19	10.3	8,300	39.9
10244745	Overland Creek near Ruby Val.ley, Nev.	6	22	9	8,400	40
10244950	Steptoe Creek near Ely, Nev.	6	20	11.1	8,940	42.3
10245080	Nelson Creek Tributary near Currie, Nev.	6	25	0.7	6,000	44.8
10245270	Drylake Valley Tributary near Caliente, Nev.	6	15	11	5,910	55
10245450	Illipah Creek Tributary near Hamilton, Nev.	6	25	5.47	7,100	52.4
10245800	Newark Valley Tributary near Hamilton, Nev.	6	25	157	6,920	49.6
10245950	Bean Flat Tributary near Austin, Nev.	6	21	1.1	6,400	38.7
10246000	Garden Pass Creek Tributary near Eureka, Nev.	6	25	2.12	7,010	39.9
10246010	Garden Pass Creek near Eureka, Nev.	6	15	19.2	6,510	39.8
10246845	Currant Creek Tributary near Currant, Nev.	6	20	3.13	6,970	52.7
10246846	Little Currant Creek near Currant, Nev.	6	20	12.9	8280	55.3
10246847	Currant Creek below Little Currant near Currant, Nev.	6	15	30	7,850	54.1
10247010	Hot Creek Tributary near Warm Springs, Nev.	6	17	0.77	5,300	42.9

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10247220	Black Rock Summit Tributary near Current, Nev.	6	15	6.35	6,300	40
10247230	Railroad Valley Tributary near Currant, Nev.	6	21	0.37	5,200	43.4
10247860	Penoyer Valley Tributary near Tempiute, Nev.	6	18	1.48	5,680	55.1
10248970	Stonewall Flat Tributary near Goldfield, Nev.	6	20	0.53	5,630	52.9
10248980	Lida Pass Tributary near Lida, Nev.	6	14	1.59	7,990	49.9
10249050	Sarcobatus Flat Tributary near Springdale, Nev.	6	21	37.1	5,140	55.1
10249135	San Antonio Wash Tributary near Tonopah, Nev.	6	19	3.42	6,920	39
10249140	Ralston Valley Tributary near Tonopah, Nev.	6	21	0.2	5,980	45
10249180	Saulsbury Wash near Tonopah, Nev.	6	21	56	6,810	41.4
10249300	South Twin River near Round Mountain, Nev.	6	22	20	9,130	40
10249411	Campbell Creek Tributary near Eastgate, Nev.	6	22	2.14	7,450	39.6
10249417	Smith Creek Valley Tributary near Austin, Nev.	6	15	0.63	6,440	40

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10249620	Big Smokey Valley Tributary near Tonopah, Nev.	6	21	2.39	6,100	50.7
10249680	Big Smokey Valley Tributary near Blair Junction, Nev.	6	25	11.4	5,440	49.6
10249850	Palmetto Wash Tributary near Lida, Nev.	6	14	4.73	7,440	49.4
10249855	Palmetto Wash near Oasis, Calif.	6	13	0.24	6,090	47.5
10249900	Chiatovich Creek near Dyer, Nev.	6	22	37.3	9,960	38.8
10325500	Reese River near lone, Nev.	6	30	53	8,800	40
10326400	Reese River Tributary near Austin, Nev.	6	14	8.27	6,590	40
10326650	Silver Creek near Austin, Nev.	6	19	25	7,120	40.3
10326850	Reese River Tributary near Battle Mountain, Nev.	6	20	0.2	5,200	44.3
10351850	Pyramid Lake Tributary near Nixon, Nev.	6	18	1.94	5,000	44
10173450	Mammoth Creek above West Hatch Ditch near Hatch, Utah	7	22	105	8,996	40
10174500	Sevier River at Hatch, Utah	7	62	340	8,480	40
10174800	Red Canyon Tributary near Bryce Canyon, Utah	7	12	2.2	7,860	40
10185000	Antimony Creek near Antimony, Utah	7	21	50.3	9,560	43.7

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10187300	Otter Creek near Koosharem, Utab	7	18	23.5	9,580	39.9
10194999	Clear Creek (composite) near Sevier, Utah	7	60	166	7,880	43.2
10205030	Salina Creek near Emery, Utah	7	23	51.8	8,720	40
10205070	Cottonwood Creek near Salina, Utah	7	10	7.8	7,470	40.5
10205700	Salina Creek above Diversion near Salina, Utah	7	16	280	7,950	42.4
10208500	Oak Creek near Fairview, Utah	7	22	11.8	7,560	39.8
10210000	Pleasant Creek near Mount Pleasant, Utah	7	21	16.4	8,830	40.1
10211000	Twin Creek near Mount Pleasant, Utah	7	12	5.9	8,900	40.1
10215700	Oak Creek near Spring City, Utah	7	17	8	9,140	40
10215900	Manti Creek below Dugway Creek, near Manti, Utah	7	18	26.4	9,080	39.9
10216300	Sixmile Creek near Sterling, Utah	7	16	29	8,703	40.5
10216400	Twelvemile Creek near Mayfield, Utah	7	21	59.4	8,570	40.1
10219200	Chicken Creek near Levan, Utah	7	24	27.9	7,480	45.1
10220300	Tintic Wash Tributary near Nephi, Utah	7	14	18	6,070	40.8
10224100	Oak Creek above Little Creek near Oak City, Utah	7	21	5.58	7,710	40.9

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10232500	Chalk Creek near Fillmore, Utah	7	29	58.7	8,020	48.6
10233000	Meadow Creek near Meadow, Utah	7	11	11.6	8,380	46.3
10233500	Corn Creek near Kanosh, Utah	7	17	68	7,400	43.6
10234500	Beaver River near Beaver, Utah	7	73	91	9,280	41.1
10235000	South Creek near Beaver, Utah	7	12	15	8,730	40.3
10236000	North Fork North Creek near Beaver, Utah	7	18	14.1	8,340	40.2
10236500	South Fork North Creek near Beaver, Utah	7	11	23	9,370	39.7
10237500	Indian Creek near Beaver, Utah	7	13	18.5	8,370	40
10240600	Big Wash near Milford, Utah	7	10	51	6,120	59.1
10241300	Fremont Wash near Paragonah, Utah	7	16	120	7,240	39.9
10241400	Little Creek near Partagonah, Utah	7	21	15.8	7,470	43.9
10241470	Center Creek above Parowan Creek, near Parowan, Utah	7	22	11.6	8,450	41.5
09166500	Dolores River at Dolores, Colo.	8	72	5	9,800	46.1
09168100	Disappointment Creek near Dove Creek, Colo.	8	29	147	8,000	45.1
09172500	San Miguel River near Placerville, Colo.	8	49	308	10,200	42.1
09174500	Cottonwood Creek near Nuela, Colo.	8	10	38.8	7,700	44.5

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09175500	San Miguel River at Naturita, Colo.	8	53	1,069.00	9,000	45.9
09175900	Dry Creek near Naturita, Colo.	8	12	78.6	7,400	45.2
09177000	San Miguel River at Uravan, Colo.	8	23	1,499.00	8,400	45.6
09181000	Onion Creek near Moab, Utah	8	13	18.8	5,702	50.6
09182000	Castle Creek above Diversions near Moab, Utah	8	24	7.58	9,480	45.9
09182600	Salt Wash near Thompson, Utah	8	15	3.9	5,508	40
09183000	Courthouse Wash near Moab, Utah	8	28	162	4,810	53.7
09184000	Mill Creek near Moab, Utah	8	40	74.9	7,170	55.7
09185200	Kane Springs Canyon near Moab, Utah	8	15	17.8	6,620	51
09185500	Hatch Wash near La Sal, Utah	8	22	378	6,550	51.9
09186500	Indian Creek above Cottonwood Creek near Monticello, Utah	8	22	31.2	8,590	46.3
09187000	Cottonwood Creek near Monticello, Utah	8	17	115	7,210	51.1
09313000	Price River near Heiner, Utah	8	37	415	8,160	37.3
09313500	Price River near Helper, Utah	8	28	530	7,920	45
09314200	Miller Creek near Price, Utah	8	13	62	7,040	40
09314280	Desert Seep Wash near Wellington, Utah	8	15	191	5,813	40

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09314400	Coleman Wash near Woodside, Utah	8	10	3.6	5,540	40
09314500	Price River at Woodside, Utah	8	43	1,540.00	6,490	40
09315150	Saleratus Wash Tributary near Woodside, Utah	8	15	10	5,070	40
09315200	Saleratus Wash Tributary No. 2 near Woodside, Utah	8	15	4.4	5,030	40
09315400	Saleratus Wash above Creek Wash near Green River, Utah	8	10	120	5,430	40
09315500	Saleratus Wash at Green River, Utah	8	22	180	5,050	40.5
09315900	Browns Wash Tributary near Green River, Utah	8	15	3.89	4,300	40
09316000	Browns Wash near Green River, Utah	8	19	75	5,220	40
09318000	Huntington Creek near Huntington, Utah	8	71	190	9,000	40
09324500	Cottonwood Creek near Orangeville, Utah	8	52	208	8,940	39.9
09326500	Ferron Creek (upper station) near Ferron, Utah	8	51	138	8,800	39.9
09327600	Ferron Creek Tributary near Ferron, Utah	8	12	0.96	6,300	40
09328050	Dry Wash near Moore, Utah	8	15	14	6,320	40
09328300	Sids Draw near Castle Dale, Utah	8	15	17.6	6,380	39.6
09328500	San Rafael River near Green River,Utah	8	50	1,628.00	6,910	45.1

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09328600	Georges Draw near Hanksville, Utah	8	14	6.63	7,010	39
09328700	Temple Wash near Hanksville, Utah	8	10	38.2	5,630	39.3
09328720	Old Woman Wash near Hanksville,Utah	8	10	17.6	5,450	39.2
09328900	Crescent Wash near Crescent Junction,Utah	8	10	23.3	6,180	39.9
09329900	Pine Creek near Bicknell, Utah	8	16	104	9,300	40.9
09330120	Sulphur Creek near Fruita, Utah	8	16	56.7	7,400	39.9
09330200	Pleasant Creek at Notom, Utah	8	14	80.6	7,980	39.6
09330300	Neilson Wash near Caineville, Utah	8	15	22.3	4,830	49.9
09330400	Fremont River near Hanksville, Utah	8	15	1,900.00	7,450	56
09330500	Muddy Creek near Emery, Utah	8	43	105	8,850	40
09331500	Ivie Creek above diversions near Emery, Utah	8	24	50	8,870	40.1
09333900	Butler Canyon near Hite, Utah	8	16	14.7	5,150	54.4
09334000	North Wash near Hanksville (Hite), Utah	8	21	136	5,400	55.2
09334400	Fry Canyon near Hite, Utah	8	15	20.9	6,250	50.2
09334500	White Canyon near Hanksville, Utah	8	20	276	6,090	55.4
09336400	Upper Valley Creek near Escalante, Utah	8	16	53	7,620	39.9
09337000	Pine Creek near Escalante, Utah	8	34	68.1	8,890	40

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09337500	Escalante River near Escalante, Utah	8	31	320	8,030	39.7
09338900	Deer Creek near Boulder, Utah	8	16	63	7,680	39.9
09339200	Twentymile Wash near Escalante, Utah	8	10	140	6,170	47.3
09342500	San Juan River at Pagosa Springs, Colo.	8	56	298	9,700	41.2
09343500	Rito Blanco near Pagosa Springs, Colo.	8	18	23.3	9,400	41.6
09345500	Little Navajo River at Chromo, Colo.	8	17	21.9	8,900	38.4
09346000	Navajo River at Edith, Colo.	8	36	172	9,200	40.2
09346200	Rio Amargo at Dulce, N. Mex.	8	30	168	7,930	42.4
09346400	San Juan River near Carracas. N. Mex.	8	25	1230	8,500	48.4
09349500	Piedra River near Piedra. Colo.	8	34	371	9,400	43.5
09349800	Piedra River near Arboles. Colo.	8	24	629	8.3	47.4
09350500	San Juan River at Rosa. N. Mex.	8	43	1990	9.8	49.5
09350800	Vaqueros Canyon near Gobernador, N. Mex.	8	31	60.5	7.5	51.5
09355000	Spring Creek .at La Boca. Colo.	8	36	58	7,300	50.7
09355700	Gobernador Canyon near Gobernador. N. Mex.	8	30	19.8	6.9	53.4
09356400	Manzanares Canyon near Turley. N. Mex.	8	30	3.2	7,000	55.1
09356520	Burro Canyon near Lindrith. N. Mex.	8	14	9.11	6.965	51.2

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09357200	Gallegos Canyon Tributary near Nageezi, N. Mex.	8	35	0.2	6.75	54.6
09361000	Hermosa Creek near Hermosa. Colo.	8	50	172	9.6	40.2
09361500	Animas River at Durango. Colo.	8	63	692	10.2	43
09362000	Lightner Creek near Durango. Colo.	8	22	66	8.4	35
09363000	Florida River near Durango. Colo.	8	45	96	9.9	40.9
09363100	Salt Creek near Oxford. Colo.	8	23	17.7	6,800	48.9
09363500	Animas River near Cedar Hill, N. Mex.	8	52	1090	9.3	51.6
09364500	Animas River at Farmington. N. Mex.	8	73	1360	9.5	55.1
09366500	La Plata River at ColoradoNew Mexico State line	8	66	331	7.712	52.5
09367400	La Plata River Tributary near Farmington. N. Mex.	8	17	1.03	5.38	54.9
09367530	Locke Arroyo near Kirtland. N. Mex.	8	35	2.96	5.5	55.3
09367840	Yazzie Wash near Mexican Springs. N. Mex.	8	37	2.1	7.4	50
09367860	Chusca Wash near Mexican Springs. N. Mex.	8	29	8.7	6.8	50
09367880	Catron Wash near Mexican Springs. N. Mex.	8	18	26.9	6.6	50

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09367900	Black Springs Wash near Mexican Springs, N. Mex.	8	34	7.05	5.916	50
09368500	West Mancos River near Mancos. Colo.	8	16	39.4	9.3	43
09369000	East Mancos River near Mancos. Colo.	8	15	11.9	9.7	42.8
09371000	Mancos River near Towaoc, Colo.	8	53	526	7.2	55.6
09372000	McElmo Creek near ColoradoUtah State line	8	36	346	6.3	55.1
09372200	McElmo Creek near Bluff. Utah	8	13	720	6.2	59.8
09378630	Recapture Creek near Blanding. Utah	8	21	3.77	8.88	44.8
09378700	Cottonwood Wash near Blanding. Utah	8	28	205	6.82	47.3
09378950	Comb Wash near Blanding, Utah	8	10	10.3	5,760	45.9
09379000	Comb Wash near Bluff, Utah	8	10	280	6,060	55.9
09379030	Black Mountain Wash near Chinle, Ariz.	8	15	80.7	5,920	55.1
09379060	Lukachukai Creek Tributary near Lukachukai, Ariz.	8	14	1.37	5,820	55.3
09379100	Long House Wash near Kayenta, Ariz.	8	15	1.38	6,920	54.7
09379300	Lime Creek near Mexican Hat, Utah	8	15	67.2	5,360	53.9
09379560	El Capitan Wash near Kayenta, Ariz.	8	14	5.88	5,699	54.9
09379800	Coyote Creek near Kanab, Utah	8	14	89	5,110	54.2

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09379820	Buck Tank Draw near Kanab, Utah	8	10	5.25	5,030	56.5
09379980	Jack Bench Wash Tributary near Page, Ariz.	8	15	0.98	6,180	60.1
09381100	Henrieville Creek at Henrieville, Utah	8	16	34	7,120	39.7
09381500	Paria River near Cannonville, Utah	8	21	220	6,890	39
09381800	Pari a River near Kanab, Utah	8	15	668	6,390	54.7
09382000	Paria River at Lees Ferry, Ariz.	8	63	1,410.00	6,150	62.5
09383020	House Rock Wash Tributary near Marble Canyon, Ariz.	8	13	3.54	5,290	57.7
09403000	Bright Angel Creek near Grand Canyon, Ariz.	8	50	101	7,390	55
09403500	Kanab Creek near Glendale, Utah	8	16	72	7,250	41
09403600	Kanab Creek near Kanab, Utah	8	18	198	6,670	53.7
09403700	Johnson Wash near Kanab, Utah	8	16	237	6,300	54
09403750	Sagebrush Draw near Fredonia, Ariz.	8	15	0.68	5,290	55
09403780	Kanab Creek near Fredonia, Ariz.	8	16	1,085.00	6,100	55.4
09403800	Bitter Seeps Wash Tributary near Fredonia, Ariz.	8	14	2.85	5,120	55.7
09404450	East Fork Virgin River near Glendale, Utah	8	20	69.2	7,300	39.5

Table F.2 USGS data for stream gages used for regional regression equations

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Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09404500	Mineral Gulch near Mt. Carmel, Utah	8	14	7.6	6,110	46
09405420	North Fork Virgin River below Bullock Canyon, near Glendale, Utah	8	11	29.6	7,670	39.9
09405500	North Fork Virgin River near Springdale, Utah	8	63	344	7,350	53.2
09406000	Virgin River near Virgin, Utah	8	70	934	6,400	54.2
09406300	Kanarra Creek at Kanarraville, Utah	8	23	9.85	7,950	44.6
09406700	South Ash Creek below Mill Creek near Pintura, Utah	8	16	11	7,210	45.6
09406800	South Ash Creek near Pintura, Utah	8	14	14	6,720	55.9
09408000	Leeds Creek near Leeds, Utah	8	23	15.5	6,360	50
9408150	Virgin River near Hurricane, Utah	8	20	1,499.00	6,350	57.3
09408200	Fort Pierce Wash near St. George, Utah	8	11	1,650.00	4,870	59.4
09408400	Santa Clara River near Pine Valley, Utah	8	27	18.7	8,720	43.8
09409500	Moody Wash near Veyo, Utah	8	15	33	6,070	45.2
09410000	Santa Clara River "above Windsor Dam near Santa Clara, Utah	8	30	338	5,900	55.2
10242000	Coal Creek near Cedar City, Utah	8	56	80.9	8,640	43.7
10242100	Shirts Creek near Cedar City, Utah	8	16	12.8	8,032	45.3
10242440	Cottonwood Creek near Enterprise, Utah	8	11	6	6,110	57.4

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09404310	Yampai Canyon Tributary, near Peach Springs, Ariz.	10	13	0.2	5,360	71.6
09404350	Valentine Wash at Valentine, Ariz.	10	14	3.15	4,490	59.6
09415050	Big Bend Wash Tributary near Littlefield, Ariz.	10	13	7.27	2,240	59.6
09415100	Pulsipher Wash near Mesquite, Nev.	10	18	4.58	1,950	62.3
09417100	Dry Lake Tributary near Nellis Air Force Base, Nev.	10	12	10	2,690	64.5
09418990	Weiser Wash near Glendale, Nev ..	10	16	43	2,480	64.3
09419590	Detrital Wash Tributary near Chloride, Ariz.	10	15	1.23	3,710	64.4
09419620	Mormon Wells Wash near Las Vegas, Nev.	10	25	115	6,500	54.5
09419630	Telephone Canyon near Charleston Park, Nev.	10	25	7.2	7,880	65.2
09419640	Kyle Canyon near Charleston Park, Nev.	10	26	35.9	8,020	65.3
09419647	Las Vegas Wash Tributary near Las Vegas, Nev.	10	24	62	3,790	60.2
09419650	Las Vegas Wash at North Las Vegas, Nev.	10	21	700		64.3
09419663	Las Vegas Wash Tributary south of Nellis Air Force Base, Nev.	10	23	1.2	2,510	67.8
09419670	Red Rock Wash near Blue Diamond, Nev.	10	25	8.09	6,030	67

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09419675	Flamingo Wash at Las Vegas, Nev.	10	18	86	3,790	76
09419677	Flamingo Wash at Maryland Parkway at Las Vegas, Nev.	10	18	106	3,200	75.6
09419680	Cottonwood Valley near Blue Diamond, Nev.	10	26	18.3	5,400	70.1
09419690	Duck Creek at Whitney, Nev.	10	26	239	3,420	75.9
09419697	Las Vegas Wash Tributary near Henderson, Nev.	10	18	1.17	2,370	79.1
09421800	Ringbolt Wash near Hoover Dam, Ariz.	10	14	1.21	2,590	80.8
09423300	Piute Wash Tributary at Searchlight, Nev.	10	17	3.4	3,670	74.7
09423400	Tin Can Creek near Needles, Calif.	10	15	0.04	2,600	76
09423760	Little Meadow Creek near Oatman, Ariz.	10	12	8.47	3,400	71.8
09423820	Sacramento Wash near Yucca, Ariz.	10	12	787	3,400	73
09423900	Sacramento Wash Tributary near Topock, Ariz.	10	14	14.7	1,450	74.2
09424050	Chemehuevi Wash Tributary near Needles, Calif.	10	14	2.04		88.4
09427700	Monkeys Head Wash near Parker, Ariz.	10	14	1.84	1,130	74.9
09428530	Arch Creek near Earp, Calif.	10	14	1.52	840	79.3

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09428560	Colorado River Tributary No 2 near Vidal, Calif.	10	14	0.42	880	74.7
09428570	Colorado River Tributary near Vidal, Calif.	10	14	1.12		74.5
09429150	Creosote Wash near Ehrenberg, Ariz.	10	12	1.98	509	89
09429240	Ogilby Wash near Palo Verde, Calif.	10	14	0.04		100
09429250	Ogilby Wash No.2 near Palo Verde, Calif.	10	14	0.01		100
09429400	Indian Wash Tributary near Yuma, Ariz.	10	15	2.56	1,190	68.7
09429510	Mittry Lake Tributary near Yuma, Ariz.	10	12	0.3	346	73.6
10248490	Indian Springs Valley Tributary near Indian Spring, Nev.	10	22	29	6,140	66
10248510	Eldorado Valley Tributary near Nelson, Nev.	10	18	1.41	2,900	80.1
10250600	Wildrose Creek near Wildrose Station, Nev.	10	15	23.7	6,400	75
10250720	Onyx Creek near Ballarat, Nev.	10	11	0.52		75
10251000	Big Dip Creek near Stovepipe Wells, Nev.	10	15	0.95	2,200	62.7
10251200	Spring Creek at Furnace Creek Inn, Nev.	10	15	0.21		75.1
10251220	Amargosa River near Beatty, Nev.	10	19	70	5,070	59.5

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10251270	Amargosa River Tributary near Mercury, Nev.	10	22	110	4,060	75.2
10251271	Amargosa River Tributary No. 1 near Johnnie, Nev.	10	18	2.21	3,460	75.4
10251272	Amargosa River Tributary No. 2 near Johnnie, Nev.	10	17	2.49	4,640	75
10251350	Horse Thief Creek near Tecopa, Nev.	10	10	3.06		75.8
10251400	Ibex Creek near Tecopa, Nev	10	15	0.2	2,150	80.2
10251500	Yucca Creek near Yucca Grove, Calif.	10	15	0.03		75
10251600	Salsberry Creek near Shoshone, Calif.	10	15	0.01		80.1
10251980	Lovell Wash near Blue Diamond, Nev.	10	17	52.8	6,390	64.8
10252300	China Spring Creek near Mountain Pass, Calif.	10	15	0.94		74.9
10252550	Caruthers Creek near Ivanpah, Nev.	10	23	1.13	6,200	75
10253000	Gourd Creek near Ludlow, Calif.	10	22	0.3	1,800	80
10253250	Granite Wash near Rice, Calif.	10	14	0.01		100
10253255	Granite Wash No. 2 near Rice, Calif.	10	14	0.01		100
10253350	Fortynine Palms Creek near Twentynine Palms, Calif.	10	18	8.55	4,200	79.7

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10253700	Palen Dry Lake Tributary near Desert Center, Calif.	10	14	0.04		90.8
10253750	Monument Wash near Desert Center, Calif.	10	14	4.29		93.8
10253800	Coxcomb Wash near Desert Center, Calif.	10	14	0.03		92.6
10254020	Betz Wash near Salton Beach, Calif.	10	14	5.95		73.6
10254475	Glamis Wash at Glamis, Calif	10	15	0.6	400	80
10255200	Myer Creek Tributary near Jacumba, Calif.	10	14	0.11	2,000	61.8
10255230	Myer Creek Tributary No.2 near Coyote Wells, Calif.	10	14	0.08	1,160	68.6
10255650	Chariot Creek near Julian, Calif.	10	12	7.95	4,000	60.9
10255700	San Felipe Creek near Julian, Calif.	10	25	89.2	3,400	59.8
10255730	Pinyon Wash near Borrego Springs Calif.	10	14	19.6	2,750	59.7
10255800	Coyote Creek near Borrego Springs, Calif.	10	36	144	4,300	59.9
10255820	Yaqui Pass Wash near Borrego, Calif.	10	14	0.03		60
10255825	Yaqui Pass Wash No.2 near Borrego, Calif.	10	14	0.04		60
10255850	Vallecito Creek near Julian, Calif.	10	20	39.7		70.3
10255885	San Felipe Creek near Westmorland, Calif.	10	26	1693		65.4
10256000	Whitewater River at Whitewater, Calif.	10	30	57.5	5,600	60.6

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10256400	San Gornonio River near Whitewater, Calif.	10	14	154		51.3
10256500	Snow Creek near Whitewater, Calif.	10	26	10.8	6,150	58.2
10257600	Mission Creek near Desert Hot Springs, Calif.	10	18	35.6		61.1
10258000	Tahquitz Creek near Palm Springs, Calif.	10	38	16.9	6,800	61.4
10258100	Palm Canyon Creek Tributary near Anza, Calif.	10	12	0.47	5,200	70.8
10258500	Palm Canyon Creek near Palm Springs, Calif.	10	52	93.1	4,500	65.2
10259000	Andreas Creek near Palm Springs, Calif.	10	37	8.65	4,500	63.9
10259200	Deep Creek near Palm Desert, Calif.	10	24	30.6	4,000	70
10259300	Whitewater River at Indio, Calif.	10	20	1,073.00		70
10259500	Thermal Canyon Tributary near Mecca, Calif.	10	14	0.18	1,700	80.5
10259600	Cottonwood Wash near Cottonwood Spring, Calif.	10	14	0.71		80.8
10260200	Pipes Creek near Yucca Valley, Calif.	10	21	15.1		79.8
10260400	Cushenbury Creek near Lucerne Valley, Calif.	10	20	6.36		69.6
10261000	West Fork Mohave River near Hesperia, Calif.	10	49	70.3	4,120	69.3

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
10261500	Mohave River at Lower Narrows, near Victorville, Calif.	10	39	513	4,500	80.3
10261800	Beacon Creek at Helendale, Calif.	10	17	0.72	2,700	80.3
10262600	Boom Creek near Barstow, Calif.	10	23	0.24	2,350	75.2
10263100	ZZYZX Creek near Baker, Calif	10	11	0.23	1,800	80.7
10263500	Big Rock Creek near Valyermo, Calif.	10	64	22.9	6,000	81
10263900	Buckhorn Creek near Valyermo, Calif.	10	20	0.48	7,600	79.5
10264000	Little Rock Creek near Little Rock, Calif.	10	47	49	5,600	84
10264520	Amargosa Creek Tributary near Palmdale, Calif.	10	15	0.05	3,440	84.6
10264530	Pine Creek near Palmdale, Calif.	10	24	1.37		85.2
10264560	Spencer Canyon Creek near Fairmont, Calif.	10	21	3.6	3,300	59.3
10264605	Joshua Creek near Mohave, Calif.	10	15	3.83	4,300	54.7
10264680	Mescal Creek Tributary at Big Pines, Calif.	10	12	0.05	7,400	77.6
10264700	Peewee Creek near Randsburg, Calif.	10	15	0.14		80.5
10264750	Pine Tree Creek near Mohave, Calif.	10	20	33.5		71.2
10264840	Sand Creek near Inyokern, Calif.	10	15	1.02	3,400	75
10264878	Ninemile Creek near Brown, Calif.	10	15	10.4	5,000	71.8

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID	Gage Location	Flood Region	Record Length, yrs	Drainage Area, sm	Gage Elev.	Mean Annual Evap, in
(1)	(2)	(3)	(4)	(5)	(6)	(7)
10264900	Salt Wells Creek near Westend, Calif.	10	15	61.6		75
10264915	Crust Creek near Westend, Calf.	10	14	0.13	1,700	75
09383500	Nutrioso Creek above Nelson Reservoir near Springerville, Ariz.	11	17	83.4	8,550	44.4
09384000	Little Colorado River above Lyman Lake near St. Johns, Ariz.	11	46	747	7,760	51.8
09384200	Lyman Reservation Tributary near St. Johns, Ariz.	11	14	0.24	6,100	52.1
09385800	Little Colorado River Tributary near St. Johns, Ariz.	11	14	0.35	6,350	52.3
09386100	Largo Creek near Quemado, N. Mex.	11	32	151	8,270	48.7
09387050	Galestena Canyon Tributary near Black Rock, N. Mex.	11	30	19	7,100	50.4
09390500	Show Low Creek near Lakeside, Ariz.	11	33	68.6	7,320	49
09392800	Long Lake Tributary near Show Low, Ariz.	11	12	5.18	6,700	51.3
09393500	Silver Creek near Snowflake, Ariz.	11	56	886	6,400	55.7
09395100	Carr Lake Tributary near Holbrook, Ariz.	11	13	1.19	5,420	55.3
09395400	Milk Rock Canyon near Ft Wingate, N. Mex.	11	35	14	8,300	49.7
09395500	Puerco River at Gallup, N. Mex.	11	34	558	7,900	50
09395600	Wagon Trail Wash near Gamerco, N. Mex.	11	24	0.38	6,500	50

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09395900	Black Creek near Lupton, Ariz.	11	19	500	7,500	49.9
09396400	Dead Wash Tributary near Holbrook, Ariz.	11	13	1	5,740	54
09397200	Penzance Wash near Joseph City, Ariz.	11	14	0.17	5,150	55
09397500	Chevelon Creek below Wildcat Canyon, near Winslow, Ariz.	11	28	275	7,030	54.3
09397800	Brookbank Canyon near Heber, Ariz.	11	13	27.6	6,950	52.3
09398000	Chevelon Creek near Winslow, Ariz.	11	48	794	6,440	55.6
09398500	Clear Creek below Willow Creek, near Winslow, Ariz.	11	39	321	7,100	52.3
09399000	Clear Creek near Winslow, Ariz.	11	52	607	6,500	55.6
09399250	Jacks Canyon Tributary No. 2 near Winslow, Ariz.	11	14	31.8	6,530	53.8
09400100	Ganado Wash Tributary near Ganado, Ariz.	11	14	11.1	6,770	51.4
09400200	Steamboat Wash Tributary near Ganado, Ariz.	11	12	0.32	6,750	53.8
09400290	Teshbito Wash Tributary near Holbrook, Ariz.	11	14	16.4	6,420	54
09400300	Teshbito Wash near Holbrook, Ariz.	11	14	57.4	6,280	53.7
09400530	Cow Canyon near Winslow, Ariz.	11	15	3.53		55.5

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09400560	Oraibi Wash Tributary near Oraibi, Ariz.	11	14	1.78	6,020	54.9
09400565	Polacca Wash Tributary near Chinle, Ariz.	11	13	6.17	6,890	55
09400580	Castle Butte Wash near Winslow, Ariz.	11	13	5.53	5,820	55
09400590	Rio de Flag at Hidden Hollow Road at Flagstaff, Ariz.	11	13	31.5	8,130	44.2
09400595	Schultz Canyon at Flagstaff, Ariz.	11	11	6.09	8,060	44.1
09400600	Rio de Flag at Flagstaff, Ariz.	11	18	51	8,050	44.1
09400650	Sinclair Wash at Flagstaff, Ariz.	11	11	8.16	7,200	44.2
09400655	Rio de Flag at 140 at Flagstaff, Ariz.	11	13	82.4	7,840	44.1
09400680	Switzer Canyon at Flagstaff, Ariz.	11	12	1.87	7,130	44.1
09400730	Lockett Fanning Diversion at Flagstaff, Ariz.	11	12	1.05	8,020	44.1
09400910	Fay Canyon near Flagstaff, Ariz.	11	16	2.76	7,000	44.2
09401210	Slate Mountain Wash near Flagstaff, Ariz.	11	14	5.43	7,350	51
09401220	Cedar Wash near Cameron, Ariz.	11	10	556	6,430	55.3
09401245	Klethla Valley Tributary near Kayenta, Ariz.	11	15	0.77	6,730	54.4
09401300	Hamblin Wash Tributary near Cedar Ridge, Ariz.	11	14	0.1	5,860	55

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID	Gage Location	Flood Region	Record Length, yrs	Drainage Area, sm	Gage Elev.	Mean Annual Evap, in
(1)	(2)	(3)	(4)	(5)	(6)	(7)
09401370	Hamblin Wash Tributary No. 2 near Tuba City, Ariz.	11	13	2.16	4,670	55
09402100	Forest Boundary Wash near Cameron, Ariz.	11	14	0.72	6,810	55.3
09403930	West Cataract Creek near Williams, Ariz.	11	13	3.18	7,190	49.6
09404050	Spring Valley Wash Tributary, near Williams, Ariz.	11	14	3.93	6,750	52.2
09424200	Cottonwood Wash No.1 near Kingman, Ariz.	12	15	143	5,350	53.9
09424407	McGarrys Wash near Kingman, Ariz.	12	12	13.5	4,610	60.5
09424410	Big Sandy River Tributary near Kingman, Ariz.	12	16	1.99	3,700	61
09424430	Kaiser Spring Canyon Tributary near Wikieup, Ariz.	12	16	1.7	3,520	60.9
09424470	Kirkland Creek near Kirkland, Ariz.	12	10	109		54.6
09424480	Ash Creek near Kirkland, Ariz.	12	16	6.95	4,680	54.7
09424700	Iron Spring Wash Tributary near Bagdad, Ariz.	12	15	0.64	3,470	54.8
09424900	Santa Maria River near Bagdad, Ariz.	12	19	1,210.00	4,010	62.6
09425500	Santa Maria River near Alamo, Ariz.	12	28	1,520.00	3,650	63.3
09468300	Sevenmile Wash Tributary near Globe, Ariz.	12	16	0.83	4,410	53.1

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09468500	San Carlos River near Peridot, Ariz.	12	57	1,027.00	4,480	58.2
09489100	Black River near Maverick, Ariz.	12	20	315	8,700	40.4
09489499	Black River above Willow Creek Diversion near Point of Pines, Ariz.	12	33	560	8,000	44.1
09489700	Big Bonito Creek near Fort Apache, Ariz.	12	24	119	7,920	44.4
09490500	Black River near Fort Apache, Ariz.	12	30	1,232.00	7,200	47.9
09492400	East Fork White River near Fort Apache, Ariz .	12	28	38.8	8,580	40.7
09494000	White River near Fort Apache, Ariz.	12	29	632	7,400	47.3
09494300	Carrizo Creek above Corduroy Creek near Show Low, Ariz.	12	14	225	6,370	44.7
09496000	Corduroy Creek near mouth near Show Low, Ariz.	12	24	203	6,370	44
09496500	Carrizo Creek near Show Low, Ariz	12	36	439	6,320	44.7
09496600	Cibecue 1 Tributary to Carrizo Creek near Show Low, Ariz.	12	14	0.1	5,390	44.6
09496700	Cibecue 2 Tributary to Carrizo Creek near Show Low, Ariz.	12	14	0.06	5,240	44.7
09496800	Carrizo Creek Tributary near Show Low, Ariz.	12	14	2.55	5,810	44.6
09497800	Cibecue Creek near Chrysotile, Ariz	12	28	295	5,700	45.7

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID	Gage Location	Flood Region	Record Length, yrs	Drainage Area, sm	Gage Elev.	Mean Annual Evap, in
(1)	(2)	(3)	(4)	(5)	(6)	(7)
09497900	Cherry Creek near Young, Ariz.	12	16	62.1	6,030	44.5
09497980	Cherry Creek near Globe, Ariz.	12	21	200	5,600	47.5
09498600	Cristopher Creek Tributary near Kohl's Ranch, Ariz.	12	11	0.66	6,080	45
09498800	Tonto Creek near Gisela, Ariz.	12	11	430	5,810	46.2
09498870	Rye Creek near Gisela, Ariz.	12	20	122	4,390	54.5
09498900	Gold Creek near Payson, Ariz.	12	15	6.44	4,590	57.1
09499000	Tonto Creek above Gun Creek, near Roosevelt, Ariz.	12	46	675	5,020	57.3
09501300	Tortilla Creek at Tortilla Flat, Ariz.	12	18	24.3	2,690	65
09502700	Crookton Wash near Seligman, Ariz.	12	17	6	5,970	52.7
09502800	Williamson Valley Wash near Paulden, Ariz.	12	21	255	5,120	52.2
09503000	Granite Creek near Prescott, Ariz.	12	16	39.6	5,900	54
09503720	Hell Canyon near Williams, Ariz.	12	13	14.9	7,110	46.9
09503740	Hell Canyon Tributary near Ash Fork, Ariz.	12	10	0.75	5,180	50.4
09503750	Limestone Canyon near Paulden, Ariz.	12	11	14.5	5,310	50.6
09503800	Volunteer Wash near Bellemont, Ariz.	12	14	131	7,620	44
09504100	Hull Canyon near Jerome, Ariz.	12	18	0.91	7,050	52.4

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID	Gage Location	Flood Region	Record Length, yrs	Drainage Area, sm	Gage Elev.	Mean Annual Evap, in
(1)	(2)	(3)	(4)	(5)	(6)	(7)
09504400	Munds Canyon Tributary near Sedona, Ariz.	12	16	1.19	6,880	44.2
09504500	Oak Creek near Cornville, Ariz.	12	45	357	6,200	51.9
09504800	Oak Creek Tributary near Cornville-, Ariz.	12	15	0.04	3,570	52.8
09505200	Wet Beaver Creek near Rimrock, Ariz.	12	25	111	6,410	50.4
09505220	Rocky Gulch near Stoneman Lake, Ariz. (USFS)	12	24	1.4	7,190	44.3
09505250	Red Tank Draw near Rimrock, Ariz.	12	21	49.4	5,910	50.6
09505300	Rattlesnake Canyon near Rimrock, Ariz.	12	23	24.6	6,560	46.6
09505350	Dry Beaver Creek near Rimrock, Ariz.	12	26	142	6,220	51.3
09505600	Dirty Neck Canyon near Clints Well,	12	12	3.42	7,140	44
09505800	West Clear Creek near Camp Verde, Ariz.	12	21	241	6,680	51.8
09505900	Cottonwood Wash near Camp Verde, Ariz.	12	14	0.64	3,540	53.1
09507600	East Verde River near Pine, Ariz.	12	13	6.65	6,430	44.6
09507700	Webber Creek above West Fork Webber Creek, near Pine, Ariz.	12	16	4.92	6,980	44
09507980	East Verde River near Childs, Ariz.	12	25	328	5,140	54.5
09508300	Wet Bottom Creek near Childs, Ariz.	12	19	36.4	4,810	57.8

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID	Gage Location	Flood Region	Record Length, yrs	Drainage Area, sm	Gage Elev.	Mean Annual Evap, in
(1)	(2)	(3)	(4)	(5)	(6)	(7)
09510070	West Fork Sycamore Creek above McFarland Creek, near Sunflower, Ariz.	12	14	4.58	5,430	58
09510080	West Fork Sycamore Creek near Sunflower, Ariz.	12	15	9.8	5,260	58.3
09510100	East Fork Sycamore Creek near Sunflower, Ariz.	12	23	4.49	5,760	58.2
09510150	Sycamore Creek near Sunflower, Ariz.	12	15	52.3	4,260	60
09510170	Camp Creek near Sunflower, Ariz.	12	17	2.6	3,520	63.1
09510180	Rock Creek near Sunflower, Ariz.	12	10	15.2	3,680	64.1
09510200	Sycamore Creek near Fort McDowell, Ariz.	12	27	164	3,820	65
09512100	Indian Bend Wash near Scottsdale, Ariz.	12	10	139	1,780	65.6
09512200	Salt River Tributary in South Mt. Park, at Phoenix, Ariz.	12	26	1.75	1,730	65.6
09512300	Cave Creek near Cave Creek, Ariz.	12	28	121	3,470	62.2
09512420	Lynx Creek Tributary near Prescott, Ariz.	12	10	0.95	5,900	54.2
09512500	Agua Fria River near Mayer, Ariz.	12	47	588	5,000	60.9
09512700	Agua Fria River Tributary No 2 near Rock Springs, Ariz.	12	18	1.11	2,140	60.2
09512800	Agua Fria River near Rock Springs, Ariz.	12	17	1,130.00	4,770	60.5

Table F.2 USGS data for stream gages used for regional regression equations

(Source: Blakemore, Hjalmarson, and Waltemeyer, 1997)

Gage ID (1)	Gage Location (2)	Flood Region (3)	Record Length, yrs (4)	Drainage Area, sm (5)	Gage Elev. (6)	Mean Annual Evap, in (7)
09513780	New River near Rock Springs, Ariz.	12	25	67.3	3,970	60.4
09513800	New River at New River, Ariz.	12	22	83.3	3,600	60.7
09513820	Deadman Wash near New River, Ariz.	12	20	11.1	1,980	62.3
09513835	New River at Bell Road, near Peoria, Ariz.	12	21	187	2,700	65.2
09513860	Skunk Creek near Phoenix, Ariz.	12	26	64.6	2,180	65.2
09513890	New River at Peoria, Ariz.	12	12	317	2,320	65.2
09513910	New River near Glendale, Ariz.	12	21	323	2,130	65.3
09513970	Agua Fria River at Avondale, Ariz.	12	23	633		65.3
09515500	Hassayampa River at Box Damsite near Wickenburg, Ariz.	12	38	417	4,750	58.6
09515800	Hartman Wash near Wickenburg, Ariz.	12	16	5.57	2,690	60.5
09516500	Hassayampa River near Morristown, Ariz.	12	30	774	3,190	60.8
09516600	Ox Wash near Morristown, Ariz.	12	17	6.31	2,290	60.7
09516800	Jack Rabbit Wash near Tonopah, Ariz.	12	16	137	2,260	61.4