APPENDIX A

Appendix A
Existing Conditions
SCS Lag Time Calculations

Watershed	Total Area (ac)	TLAG (Basins < 2000 acres)						TLAG (Basins >2000 acres)					
		L (ft)	CN	S	Slope (%)	Tlag (hr)	Tlag (min)	L (mi)	Lc (mi)	Kn	S (ft/mi)	Tlag (hr)	Tlag (min)
EWSTR01	74.1	3784.0	85.0	1.8	19.7	0.2	10.6	-	-	-	-	-	-
EWSTR02	16.4	2241.4	85.1	1.8	10.5	0.2	9.5	-	-	-	-	-	-
EWSTR03	58.2	3879.7	85.1	1.8	10.4	0.2	14.8	-	-	-	-	-	-
EWSTR04	35.3	2516.4	85.8	1.7	14.1	0.1	8.7	-	-	-	-	-	-
EWSTR05	9.5	1557.5	85.2	1.7	19.3	0.1	5.2	-	-	-	-	-	-
EWSTR06	15.7	2833.9	86.3	1.6	14.7	0.2	9.2	-	-	-	-	-	-
EWSTR07	46.9	3561.8	85.2	1.7	15.7	0.2	11.2	-	-	-	-	-	-
EWSTR08	72.2	3028.5	85.4	1.7	17.5	0.2	9.3	-	-	-	-	-	-
EWSTR09	4081.4	-	-	-	-	-	-	4.7	2.21	0.1	343.5	1.8	109.5
EWSTR10	27.2	2729.5	85.3	1.7	9.7	0.2	11.5	-	-	-	-	-	-
EWSTR11	13.3	1906.0	85.7	1.7	10.2	0.1	8.3	-	-	-	-	-	-
EWSTR12	73.7	4423.7	85.1	1.7	15.9	0.2	13.3	-	-	-	-	-	-
EWSTR13	300.6	7460.4	85.1	1.8	10.9	0.4	24.4	-	-	-	-	-	-
EWSTR14	10.6	2297.0	85.3	1.7	7.1	0.2	11.7	-	-	-	-	-	-
EWSTR15	39.9	4094.5	85.4	1.7	5.9	0.3	20.3	-	-	-	-	-	-
EWSTR16	5.8	2613.6	86.5	1.6	4.2	0.3	16.1	-	-	-	-	-	-
EWSTR17	195.5	6412.1	85.2	1.7	10.7	0.4	21.7	-	-	-	-	-	-
EWSTR18	1.2	563.2	86.0	1.6	4.2	0.1	4.8	-	-	-	-	-	-
EWSTR19	14.1	2698.6	86.3	1.6	3.7	0.3	17.9	-	-	-	-	-	-
EWSTR20	553.6	12345.4	85.0	1.8	6.8	0.8	46.3	-	-	-	-	-	-
EWSTR21	39.8	3984.1	85.7	1.7	4.3	0.4	23.0	-	-	-	-	-	-
EWSTR22	1.3	542.5	88.1	1.4	3.4	0.1	4.8	-	-	-	-	-	-
EWSTR23	79.5	6653.5	85.3	1.7	4.9	0.6	33.0	-	-	-	-	-	-
EWSTR24	724.5	19235.4	85.0	1.8	10.2	0.9	53.9	-	-	-	-	-	-
EWSTR25	4.4	1826.5	90.6	1.0	4.9	0.2	9.6	-	-	-	-	-	-
EWSTR26	9350.0	-	-	-	-	-	-	8.0	4.1	0.1	250.2	2.8	168.7
EWSTR27	174.0	6796.4	85.4	1.7	9.5	0.4	24.0	-	-	-	-	-	-
EWSTR28	164.2	5763.6	85.5	1.7	10.6	0.3	19.8	-	-	-	-	-	-
EWSLH01	33.0	3027.7	85.5	1.7	9.3	0.2	12.6	-	-	-	-	-	-
EWSLH02	1587.2	16488.1	85.0	1.8	5.2	1.1	66.6	-	-	-	-	-	-
EWSLH03	132.0	5507.7	85.3	1.7	9.4	0.3	20.5	-	-	-	-	-	-
EWSLH04	273.4	7544.6	85.1	1.8	8.9	0.5	27.3	-	-	-	-	-	-

Appendix A
Existing Conditions
SCS Lag Time Calculations

Watershed	Total Area (ac)	TLAG (Basins < 2000 acres)						TLAG (Basins >2000 acres)					
		L (ft)	CN	S	Slope (%)	Tlag (hr)	Tlag (min)	L (mi)	Lc (mi)	Kn	S (ft/mi)	Tlag (hr)	Tlag (min)
EWSLH05	69.4	2723.0	85.1	1.8	8.7	0.2	12.2	-	-	-	-	-	-
EWSLH06	247.8	4962.5	85.1	1.8	8.9	0.3	19.4	-	-	-	-	-	-
EWSLH07	27.2	4357.3	85.3	1.7	14.2	0.2	13.8	-	-	-	-	-	-
EWSLH08	232.0	5780.5	85.1	1.8	7.3	0.4	24.3	-	-	-	-	-	-
EWSLH09	174.7	5651.1	85.0	1.8	13.9	0.3	17.3	-	-	-	-	-	-
EWSLH10	54.8	3261.0	85.2	1.7	5.5	0.3	17.7	-	-	-	-	-	-
EWSLH11	2342.8	-	-	-	-	-	-	4.2	2.3	0.1	384.8	1.8	105.7
EWSLH12	3420.7	-	-	-	-	-	-	4.7	2.7	0.1	400.9	1.9	114.5
EWSLH13	398.3	8283.2	85.1	1.8	6.7	0.6	33.7	-	-	-	-	-	-
EWSLH14	208.0	6457.5	85.1	1.8	15.7	0.3	18.1	-	-	-	-	-	-
EWSLH15	1573.5	26001.2	84.6	1.8	7.4	1.4	81.6	-	-	-	-	-	-
EWSLH16	6211.8	-	-	-	-	-	-	8.6	4.0	0.1	197.8	3.0	178.3
EWSLH17	1832.7	27410.6	85.0	1.8	6.0	1.6	93.6	-	-	-	-	-	-
EWSLH18	14.6	1880.8	85.0	1.8	5.0	0.2	12.0	-	-	-	-	-	-
EWSLH19	394.6	12466	84.3	1.86	5.0	0.93	55.67	-	-	-	-	-	-

Notes:
For basins < 2000 acres:
$S = (1000/CN)-10$
$Tlag = (L^{0.8}(S+1)^{0.7})/(1900*Slope^{0.5})$
For basins > 2000 acres:
$Tlag = 22.1*Kn*(L*L_c/S^{0.5})^{0.33}$
Kn = 0.1 for shrub and brush

Routing Description	Length, ft	Elevation, from	Elevation, to	Δ Elev	Slope, ft/ft	Shape	Bottom Width (ft)	Side Slope (X:1)	Manning's
EWSTR01 to EWSTR02	1212	5639.5	5573.0	66.5	0.055	Triangular	0	3	0.030
EWSTR02 to EWSTR03	133	5572.0	5564.5	7.5	0.056	Triangular	0	3	0.030
EWSTR03 to EWSTR05	699	5564.5	5520.0	44.5	0.064	Triangular	0	3	0.030
EWSTR04 to EWSTR07	2516	5550.0	5399.0	151.0	0.060	Triangular	0	4	0.030
EWSTR05 to EWSTR06	1117	5520.0	5447.0	73.0	0.065	Triangular	0	3	0.030
EWSTR06 to EWSTR08	3087	5447.0	5303.0	144.0	0.047	Triangular	0	5	0.030
EWSTR07 to EWSTR09	265	5399.0	5388.0	11.0	0.042	Triangular	0	6	0.030
EWSTR08 to EWSTR12	1588	5303.0	5237.5	65.5	0.041	Trapezoidal	1.5	4	0.030
EWSTR09 to EWSTR10	1534	5388.0	5321.0	67.0	0.044	Triangular	0	2.5	0.030
EWSTR10 to EWSTR11	732	5321.0	5288.5	32.5	0.044	Triangular	0	5	0.030
EWSTR11 to EWSTR15	3576	5288.5	5169.5	119.0	0.033	Trapezoidal	5	4	0.030
EWSTR12 to EWSTR13	203	5237.5	5229.5	8.0	0.039	Trapezoidal	4	3	0.030
EWSTR13 to EWSTR14	1139	5229.5	5186.0	43.5	0.038	Trapezoidal	5	3	0.030
EWSTR14 to EWSTR16	2585	5186.0	5088.0	98.0	0.038	Triangular	0	5	0.030
EWSTR15 to EWSTR18	374	5169.5	5157.0	12.5	0.033	Triangular	0	8	0.030
EWSTR16 to EWSTR17	886	5088.0	5062.5	25.5	0.029	Triangular	0	4	0.030
EWSTR17 to EWSTR21	1437	5062.5	5020.0	42.5	0.030	Trapezoidal	3	9	0.030
EWSTR18 to EWSTR19	2662	5157.0	5060.0	97.0	0.036	Triangular	0	3	0.030
EWSTR19 to EWSTR20	1207	5060.0	5017.0	43.0	0.036	Trapezoidal	5	3	0.030
EWSTR20 to EWSTR23	1940	5017.0	4990.0	27.0	0.014	Triangular	0	3	0.030
EWSTR21 to EWSTR23	2178	5020.0	4990.0	30.0	0.014	Triangular	0	3	0.030
EWSTR22 to EWSTR26	4240	5014.0	4904.0	110.0	0.026	Trapezoidal	15	15	0.030
EWSTR23 to EWSTR24	1380	4990.0	4925.0	65.0	0.047	Triangular	0	3	0.030
EWSTR25 to EWSTR26	534	4928.0	4904.0	24.0	0.045	Trapezoidal	10	5	0.030
EWSTR27 to EWSTR26	249	4914.0	4904.0	10.0	0.040	Trapezoidal	10	5	0.030
EWSTR28 to EWSTR27	1854	4950.0	4914.0	36.0	0.019	Triangular	0	4	0.030
EWSLH01 to EWSLH02	3376	5560.0	5442.0	118.0	0.035	Trapezoidal	5	3	0.030
EWSLH03 to EWSLH04	346	5466.0	5448.0	18.0	0.052	Triangular	0	5	0.030
EWSLH04 to EWSLH06	3085	5448.0	5357.0	91.0	0.029	Trapezoidal	15	2	0.030
EWSLH02 to EWSLH05	186	5442.0	5435.0	7.0	0.038	Circular	2	-	0.024
EWSLH05 to EWSLH06	3050	5435.0	5357.0	78.0	0.026	Trapezoidal	15	2	0.030
EWSLH06 to EWSLH07	1287	5357.0	5324.0	33.0	0.026	Trapezoidal	10	5	0.030
EWSLH07 to EWSLH08	2235	5324.0	5268.0	56.0	0.025	Trapezoidal	10	5	0.030
EWSLH08 to EWSLH10	2586	5268.0	5201.5	66.5	0.026	Trapezoidal	10	6	0.030
EWSLH09 to EWSLH10	2509	5266.0	5201.5	64.5	0.026	Trapezoidal	10	6	0.030
EWSLH10 & 11 to EWSLH12	17310	5230.0	4760.0	470.0	0.027	Trapezoidal	8	10	0.030
EWSLH13 to EWSLH14	4026	5056.5	4875.0	181.5	0.045	Triangular	0	8	0.030
EWSLH14 to EWSLH15	5399	4875.0	4748.0	127.0	0.024	Triangular	0	8	0.030
EWSLH15 to EWSLH16	25782	4748.0	4282.0	466.0	0.018	Trapezoidal	7	15	0.030

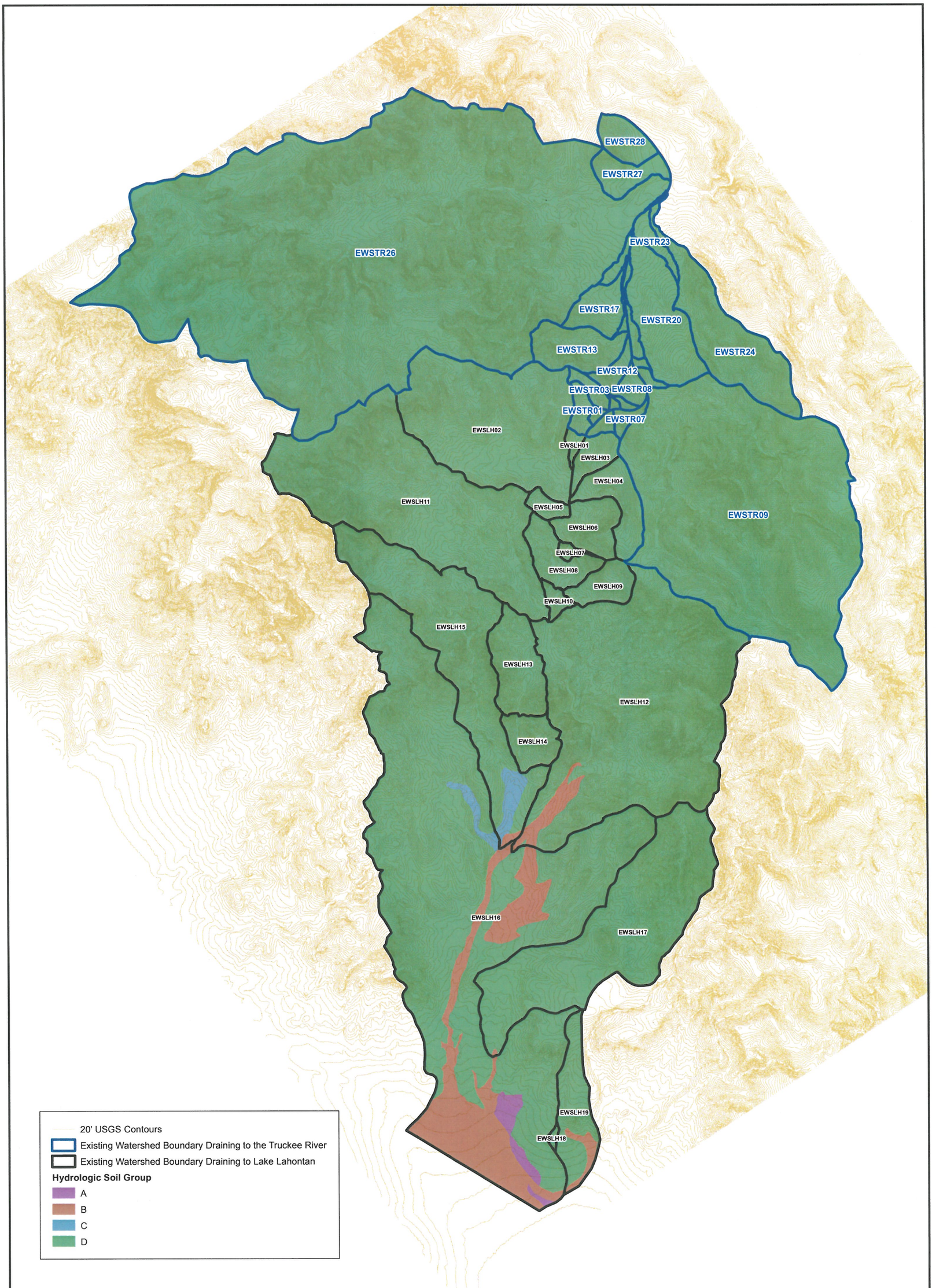
Routing Description	Length, ft	Elevation, from	Elevation, to	Δ Elev	Slope, ft/ft	Shape	Bottom Width (ft)	Side Slope (X:1)	Manning's
EWSLH12 to EWSLH16	26477	4760.0	4282.0	478.0	0.018	Trapezoidal	7	15	0.030
EWSLH17 to EWSLH16	10205	4473.0	4282.0	191.0	0.019	Trapezoidal	7	15	0.030
EWSLH18 to EWSLH16	3053	4380.0	4282.0	98.0	0.032	Trapezoidal	7	15	0.030

*Channel dimensions based on topographic data

Appandix A
Existing SCS Curve
Number Calculations

Watershed	Total Area (ac)	Total Area (sq. mi.)	$CN_{unimproved}$								$CN_{impervious}$			$CN_{combined}$
			Hydro Soil Group A	Hydro Soil Group A Area (ac)	Hydro Soil Group B	Hydro Soil Group B Area (ac)	Hydro Soil Group C	Hydro Soil Group C Area (ac)	Hydro Soil Group D	Hydro Soil Group D Area (ac)	Impervious	Impervious Area (ac)	Impervious Area (%)	
EWSTR01	74.1	0.116	63	0.00	67	0.00	80	0.00	85	74.10	98	0.04	0.1	85.0
EWSTR02	16.4	0.026	63	0.00	67	0.00	80	0.00	85	16.34	98	0.08	0.5	85.0
EWSTR03	58.2	0.091	63	0.00	67	0.00	80	0.00	85	58.21	98	0.03	0.1	85.1
EWSTR04	35.3	0.055	63	0.00	67	0.00	80	0.00	85	33.51	98	1.84	5.2	85.1
EWSTR05	9.5	0.015	63	0.00	67	0.00	80	0.00	85	9.36	98	0.14	1.4	85.0
EWSTR06	15.7	0.025	63	0.00	67	0.00	80	0.00	85	14.97	98	0.88	5.6	85.6
EWSTR07	46.9	0.073	63	0.00	67	0.00	80	0.00	85	46.34	98	0.55	1.2	85.0
EWSTR08	72.2	0.113	63	0.00	67	0.00	80	0.00	85	70.21	98	2.05	2.8	85.0
EWSTR09	4081.4	6.377	63	0.00	67	0.00	80	0.00	85	4081.37	98	0.00	0.0	85.0
EWSTR10	27.2	0.043	63	0.00	67	0.00	80	0.00	85	26.68	98	0.56	2.1	85.0
EWSTR11	13.3	0.021	63	0.00	67	0.00	80	0.00	85	12.59	98	0.69	5.2	85.0
EWSTR12	73.7	0.115	63	0.00	67	0.00	80	0.00	85	73.08	98	0.66	0.9	85.0
EWSTR13	300.6	0.470	63	0.00	67	0.00	80	0.00	85	300.17	98	0.55	0.2	85.0
EWSTR14	10.6	0.017	63	0.00	67	0.00	80	0.00	85	10.42	98	0.22	2.1	85.0
EWSTR15	39.9	0.062	63	0.00	67	0.00	80	0.00	85	38.51	98	1.35	3.4	85.0
EWSTR16	5.8	0.009	63	0.00	67	0.00	80	0.00	85	5.15	98	0.65	11.2	85.0
EWSTR17	195.5	0.305	63	0.00	67	0.00	80	0.00	85	193.64	98	1.87	1.0	85.0
EWSTR18	1.2	0.002	63	0.00	67	0.00	80	0.00	85	1.11	98	0.09	7.4	85.0
EWSTR19	14.1	0.022	63	0.00	67	0.00	80	0.00	85	12.77	98	1.35	9.5	85.0
EWSTR20	553.6	0.865	63	0.00	67	0.00	80	0.00	85	552.52	98	1.05	0.2	85.0
EWSTR21	39.8	0.062	63	0.00	67	0.00	80	0.00	85	37.91	98	1.90	4.8	85.0
EWSTR22	1.3	0.002	63	0.00	67	0.00	80	0.00	85	0.98	98	0.30	23.3	85.0
EWSTR23	79.5	0.124	63	0.00	67	0.00	80	0.00	85	77.55	98	1.96	2.5	85.0
EWSTR24	724.5	1.132	63	0.00	67	0.00	80	0.00	85	724.45	98	0.25	0.0	85.0
EWSTR25	4.4	0.007	63	0.00	67	0.00	80	0.00	85	2.49	98	1.89	43.2	85.0
EWSTR26	9350.0	14.609	63	0.00	67	0.00	80	0.00	85	9343.74	98	6.26	0.1	85.0
EWSTR27	174.0	0.272	63	0.00	67	0.00	80	0.00	85	169.44	98	4.61	2.6	85.0
EWSTR28	164.2	0.257	63	0.00	67	0.00	80	0.00	85	157.98	98	6.28	3.8	85.0
EWSLH01	33.0	2.480	63	0.00	67	0.00	80	0.00	85	31.89	98	1.11	3.4	85.0
EWSLH02	1587.2	0.205	63	0.00	67	0.00	80	0.00	85	1585.63	98	2.10	0.1	85.0
EWSLH03	132.0	0.427	63	0.00	67	0.00	80	0.00	85	129.78	98	2.28	1.7	85.0
EWSLH04	273.4	0.243	63	0.00	67	0.00	80	0.00	85	272.86	98	0.65	0.2	85.0
EWSLH05	69.4	0.109	63	0.00	67	0.00	80	0.00	85	69.14	98	0.32	0.5	85.0
EWSLH06	247.8	0.010	63	0.00	67	0.00	80	0.00	85	246.67	98	1.22	0.5	85.0
EWSLH07	27.2	0.038	63	0.00	67	0.00	80	0.00	85	26.62	98	0.61	2.2	85.0
EWSLH08	232.0	3.639	63	0.00	67	0.00	80	0.00	85	231.25	98	0.82	0.4	85.0
EWSLH09	174.7	0.014	63	0.00	67	0.00	80	0.00	85	174.70	98	0.01	0.0	85.0
EWSLH10	54.8	0.212	63	0.00	67	0.00	80	0.00	85	54.15	98	0.64	1.2	85.0
EWSLH11	2342.8	0.007	63	0.00	67	0.00	80	0.00	85	2339.85	98	3.78	0.2	85.0
EWSLH12	3420.7	0.105	63	0.00	67	116.89	80	0.00	85	3302.52	98	1.24	0.0	84.4
EWSLH13	398.3	0.027	63	0.00	67	0.00	80	0.00	85	397.04	98	1.33	0.3	85.0
EWSLH14	208.0	0.127	63	0.00	67	0.00	80	0.01	85	206.93	98	1.11	0.5	85.0
EWSLH15	1573.5	0.013	63	0.00	67	15.76	80	90.95	85	1465.38	98	1.87	0.1	84.6
EWSLH16	6211.8	0.034	63	115.77	67	1021.52	80	62.46	85	5009.19	98	2.81	0.0	80.4
EWSLH17	1832.7	0.273	63	0.00	67	2.78	80	0.00	85	1830.39	98	0.00	0.0	85.0
EWSLH18	14.6	0.023	63	0.00	67	0.00	80	0.00	85	14.60	98	0.00	0.0	85.0
EWSLH19	394.6	0.617	63	0.00	67	0.00	80	54.07	85	339.36	98	0.00	0.0	84.3

CN values based on Technical Release 55 Urban Hydrology for Small Watersheds manual.
Cover type of "Sagebrush with grass understory" was applied.
A Hydrologic Condition of "Poor - <30% ground cover" was applied.
See HMS Time of Concentration Table for all contributing watersheds for watersheds denoted above with a "+".
For areas with Hydrologic Soil Type of A, "Desert Shrub" with a hydrologic condition of "Poor < 30% ground cover" was applied



APPENDIX A
EXISTING OFFSITE WATERSHEDS HYDROLOGIC SOILS GROUP
30% PREFERRED ALTERNATIVE DRAINAGE REPORT
STOREY COUNTY AND LYON COUNTY, NEVADA
NOVEMBER, 2013

NORTH

0 0.5 1
MILES

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
5440 Reno Corporate Drive Tel: 775.823.4068
Reno, NV 89511 Fax: 775.823.4066

NOTES
SOILS: NRCS
WATERSHED BOUNDARY: WRI
TOPOGRAPHY: NDOT, JACOBS, USGS

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Appendix A
Proposed Conditions
SCS Lag Time Calculations

Watershed	Total Area (ac)	TLAG (Basins < 2000 acres)						TLAG (Basins >2000 acres)					
		L (ft)	CN	S	Slope (%)	Tlag (hr)	Tlag (min)	L (mi)	Lc (mi)	Kn	S (ft/mi)	Tlag (hr)	Tlag (min)
WSTR01	74.1	3784	85.0	1.76	19.7	0.18	10.55	-	-	-	-	-	-
WSTR02	15.7	2238	85.6	1.68	10.5	0.15	9.28	-	-	-	-	-	-
WSTR03	58.1	3846	85.0	1.76	10.5	0.24	14.65	-	-	-	-	-	-
WSTR04	36.3	2529	86.2	1.60	14.2	0.14	8.63	-	-	-	-	-	-
WSTR05	9.2	1560	85.2	1.74	19.0	0.09	5.25	-	-	-	-	-	-
WSTR06	17.1	2834	86.8	1.52	14.7	0.15	9.08	-	-	-	-	-	-
WSTR07	44.5	3569	85.6	1.68	13.1	0.20	12.11	-	-	-	-	-	-
WSTR08	75.3	3028	85.8	1.66	17.5	0.15	9.14	-	-	-	-	-	-
WSTR09	4077.8	-	-	-	-	-	-	4.67	2.21	0.10	344.95	1.82	109.29
WSTR10	29.0	2696	85.8	1.65	9.6	0.19	11.17	-	-	-	-	-	-
WSTR11	13.2	1866	86.2	1.60	10.4	0.13	7.89	-	-	-	-	-	-
WSTR12	73.9	4424	85.3	1.73	15.9	0.22	13.20	-	-	-	-	-	-
WSTR13	300.7	7460	85.3	1.72	10.9	0.40	24.17	-	-	-	-	-	-
WSTR14	11.1	2297	86.2	1.60	7.1	0.19	11.32	-	-	-	-	-	-
WSTR15	39.0	4085	86.0	1.62	5.8	0.33	19.89	-	-	-	-	-	-
WSTR16	6.4	2614	88.5	1.30	4.2	0.25	14.94	-	-	-	-	-	-
WSTR17	195.8	6412	85.2	1.74	10.7	0.36	21.69	-	-	-	-	-	-
WSTR18	1.1	556	89.6	1.16	4.0	0.07	4.23	-	-	-	-	-	-
WSTR19	13.5	2433	88.4	1.31	3.8	0.25	14.92	-	-	-	-	-	-
WSTR20	553.8	12278	85.1	1.75	6.8	0.77	45.97	-	-	-	-	-	-
WSTR21	39.8	3984	85.2	1.73	4.3	0.39	23.40	-	-	-	-	-	-
WSTR22	1.4	542	88.8	1.27	3.4	0.08	4.67	-	-	-	-	-	-
WSTR23	78.7	6531	85.5	1.70	4.9	0.53	32.08	-	-	-	-	-	-
WSTR24	724.8	19222	85.0	1.76	9.1	0.95	56.82	-	-	-	-	-	-

Appendix A
Proposed Conditions
SCS Lag Time Calculations

Watershed	Total Area (ac)	TLAG (Basins < 2000 acres)						TLAG (Basins >2000 acres)					
		L (ft)	CN	S	Slope (%)	Tlag (hr)	Tlag (min)	L (mi)	Lc (mi)	Kn	S (ft/mi)	Tlag (hr)	Tlag (min)
WSTR25	4.1	1736	91.4	0.94	4.6	0.15	9.14	-	-	-	-	-	-
WSTR26	9350.5	-	-	-	-	-	-	7.9	4.1	0.1	251.5	2.80	168.30
WSTR27	174.0	6796	85.4	1.71	9.5	0.40	23.94	-	-	-	-	-	-
WSTR28	164.2	5764	85.6	1.68	10.6	0.33	19.76	-	-	-	-	-	-
WSLH01	1587.2	16141	85.0	1.76	5.1	1.10	65.89	-	-	-	-	-	-
WSLH02	84.9	3218	85.2	1.73	16.3	0.17	10.11	-	-	-	-	-	-
WSLH02a	46.4	3865	85.6	1.68	13.6	0.21	12.66	-	-	-	-	-	-
WSLH03	273.5	7571	85.0	1.76	8.8	0.46	27.43	-	-	-	-	-	-
WSLH04	153.5	4962	85.2	1.74	8.9	0.32	19.37	-	-	-	-	-	-
WSLH05	69.7	2723	85.1	1.75	8.7	0.20	12.15	-	-	-	-	-	-
WSLH06	6.3	987	86.0	1.63	16.6	0.06	3.78	-	-	-	-	-	-
WSLH07	23.3	1772	85.4	1.70	13.7	0.11	6.79	-	-	-	-	-	-
WSLH08	2330.6	-	-	-	-	-	-	4.0	2.2	0.1	320.7	1.74	104.61
WSLH09	8.8	1068	85.5	1.69	18.2	0.07	3.92	-	-	-	-	-	-
WSLH10	132.8	4599	85.0	1.76	6.0	0.37	22.38	-	-	-	-	-	-
WSLH11	4.4	705	87.0	1.50	14.6	0.05	2.97	-	-	-	-	-	-
WSLH11a	3.7	1156	88.5	1.29	7.6	0.10	5.77	-	-	-	-	-	-
WSLH12	68.7	3850	85.1	1.75	18.1	0.19	11.11	-	-	-	-	-	-
WSLH13	17.2	2380	85.7	1.66	26.0	0.10	6.18	-	-	-	-	-	-
WSLH14	81.1	3741	85.3	1.73	22.4	0.16	9.72	-	-	-	-	-	-
WSLH15	8.4	1391	86.5	1.56	7.4	0.12	7.35	-	-	-	-	-	-
WSLH16	6.0	917	87.2	1.47	11.5	0.07	4.12	-	-	-	-	-	-
WSLH16a	5.8	956	85.3	1.72	19.1	0.06	3.53	-	-	-	-	-	-

Appendix A
Proposed Conditions
SCS Lag Time Calculations

Watershed	Total Area (ac)	TLAG (Basins < 2000 acres)						TLAG (Basins >2000 acres)					
		L (ft)	CN	S	Slope (%)	Tlag (hr)	Tlag (min)	L (mi)	Lc (mi)	Kn	S (ft/mi)	Tlag (hr)	Tlag (min)
WSLH16b	8.9	950	85.7	1.67	29.8	0.05	2.77	-	-	-	-	-	-
WSLH17	174.7	5651	85.0	1.76	13.3	0.30	17.71	-	-	-	-	-	-
WSLH18	45.2	3261	85.8	1.66	5.5	0.29	17.29	-	-	-	-	-	-
WSLH19	7.9	1243	85.3	1.73	15.6	0.08	4.82	-	-	-	-	-	-
WSLH19a	2.0	628	90.8	1.01	11.3	0.04	2.65	-	-	-	-	-	-
WSLH20	2.0	530	88.9	1.25	16.2	0.03	2.09	-	-	-	-	-	-
WSLH21	6.9	657	87.3	1.46	7.5	0.06	3.87	-	-	-	-	-	-
WSLH22	3396.9	-	-	-	-	-	-	4.7	2.7	0.1	400.9	1.91	114.53
WSLH23	9.0	648	86.4	1.57	18.1	0.04	2.56	-	-	-	-	-	-
WSLH24	7.0	812	86.6	1.55	7.7	0.08	4.66	-	-	-	-	-	-
WSLH25	8.3	1080	86.1	1.62	16.7	0.07	4.06	-	-	-	-	-	-
WSLH26	12.9	1580	85.3	1.72	28.6	0.07	4.31	-	-	-	-	-	-
WSLH27	7.8	1281	85.3	1.73	37.8	0.05	3.17	-	-	-	-	-	-
WSLH28	44.2	1917	85.5	1.69	29.8	0.08	4.89	-	-	-	-	-	-
WSLH29	79.4	2882	77.5	2.90	11.0	0.24	14.46	-	-	-	-	-	-
WSLH30	317.3	8283	85.2	1.74	6.7	0.56	33.54	-	-	-	-	-	-
WSLH31	50.4	2780	85.1	1.75	19.4	0.14	8.29	-	-	-	-	-	-
WSLH32	61.3	4457	86.0	1.63	11.3	0.26	15.34	-	-	-	-	-	-
WSLH33	36.6	1942	85.6	1.68	33.2	0.08	4.67	-	-	-	-	-	-
WSLH33a	58.5	3115	85.2	1.73	20.7	0.15	8.75						
WSLH34	1464.3	26001	84.7	1.81	7.4	1.35	81.26	-	-	-	-	-	-
WSLH35	126.3	5554	77.9	2.84	8.7	0.45	27.11	-	-	-	-	-	-
WSLH36	444.9	13795	84.8	1.80	7.5	0.81	48.58	-	-	-	-	-	-

Watershed	Total Area (ac)	TLAG (Basins < 2000 acres)						TLAG (Basins >2000 acres)					
		L (ft)	CN	S	Slope (%)	Tlag (hr)	Tlag (min)	L (mi)	Lc (mi)	Kn	S (ft/mi)	Tlag (hr)	Tlag (min)
WSLH36a	56.7	3121	69.2	4.45	33.1	0.19	11.23	-	-	-	-	-	-
WSLH36b	288.8	9368	83.2	2.01	11.0	0.52	30.94	-	-	-	-	-	-
WSLH37	1750.3	27407	85.0	1.77	6.0	1.56	93.57	-	-	-	-	-	-
WSLH37a	43.2	4686	86.3	1.59	34.9	0.15	9.00	-	-	-	-	-	-
WSLH38	4710.0	-	-	-	-	-	-	8.6	4.1	0.1	197.8	2.98	178.79
WSLH39	157.5	6790	85.0	1.76	6.5	0.49	29.35	-	-	-	-	-	-
WSLH40	12.3	1429	85.5	1.70	7.1	0.13	7.93	-	-	-	-	-	-
WSLH41	39.4	2268	85.5	1.70	9.1	0.17	10.15	-	-	-	-	-	-
WSLH42	163.7	6289	85.0	1.77	5.7	0.49	29.59	-	-	-	-	-	-
WSLH42a	3.4	845	85.9	1.64	42.3	0.04	2.11	-	-	-	-	-	-
WSLH42b	3.3	742	83.4	2.00	48.1	0.03	1.94	-	-	-	-	-	-
WSLH43	52.4	3372	85.3	1.72	6.8	0.27	16.24	-	-	-	-	-	-
WSLH43a	11.3	1755	85.5	1.69	13.0	0.12	6.91	-	-	-	-	-	-
WSLH44	15.2	1428	85.9	1.65	6.1	0.14	8.45	-	-	-	-	-	-
WSLH44a	6.1	1523	85.1	1.75	5.7	0.16	9.43	-	-	-	-	-	-
WSLH45	25.3	2301	85.0	1.76	4.9	0.24	14.21	-	-	-	-	-	-
WSLH46	69.7	4293	84.6	1.82	9.3	0.29	17.25	-	-	-	-	-	-
WSLH46a	25.8	2788	84.2	1.88	14.3	0.17	9.99	-	-	-	-	-	-
WSLH46b	13.0	1635	85.3	1.72	24.4	0.08	4.80	-	-	-	-	-	-
WSLH47	31.7	2516	85.7	1.67	11.7	0.16	9.66	-	-	-	-	-	-
WSLH47a	2.1	650	87.7	1.41	45.2	0.03	1.54	-	-	-	-	-	-
WSLH48	57.8	3624	86.2	1.60	4.9	0.33	19.70	-	-	-	-	-	-
WSLH49	20.9	1567	84.7	1.81	11.2	0.12	6.99	-	-	-	-	-	-

Appendix A
Proposed Conditions
SCS Lag Time Calculations

Watershed	Total Area (ac)	TLAG (Basins < 2000 acres)						TLAG (Basins >2000 acres)					
		L (ft)	CN	S	Slope (%)	Tlag (hr)	Tlag (min)	L (mi)	Lc (mi)	Kn	S (ft/mi)	Tlag (hr)	Tlag (min)
WSLH50	383.5	12622	84.3	1.86	5.0	0.94	56.57	-	-	-	-	-	-

Notes:
For basins < 2000 acres:
S= (1000/CN)-10
Tlag = $(L^{0.8}(S+1)^{0.7})/(1900*Slope^{0.5})$
For basins > 2000 acres:
Tlag = $22.1*Kn*(L*L_c/S^{0.5})^{0.33}$
Kn = 0.1 for shrub and brush

Routing Description	Length, ft	Elevation, from	Elevation, to	Δ Elev	Slope, ft/ft	Shape	Bottom Width (ft)	Side Slope (X:1)	Manning's
WSTR01 to WSTR02	1225	5639.5	5573.0	66.5	0.054	Triangular	0	4	0.036
WSTR02 to WSTR03	137	5572.0	5565.0	7.0	0.051	Triangular	0	4	0.036
WSTR03 to WSTR05	703	5565.0	5524.0	41.0	0.058	Triangular	0	4	0.036
WSTR05 to WSTR06	1121	5524.0	5447.0	77.0	0.069	Triangular	0	3	0.036
WSTR06 to WSTR08	3087	5447.0	5303.0	144.0	0.047	Triangular	0	5	0.030
WSTR08 to WSTR12	1588	5303.0	5237.5	65.5	0.041	Trapezoidal	1.5	4	0.030
WSTR12 to WSTR13	203	5237.5	5229.5	8.0	0.039	Trapezoidal	4	3	0.030
WSTR13 to WSTR14	1139	5229.5	5186.0	43.5	0.038	Trapezoidal	5	3	0.030
WSTR14 to WSTR16	2585	5186.0	5088.0	98.0	0.038	Trapezoidal	5	4	0.036
WSTR16 to WSTR17	886	5088.0	5062.5	25.5	0.029	Trapezoidal	14	2	0.036
WSTR17 to WSTR21	1437	5062.5	5020.0	42.5	0.030	Trapezoidal	3	9	0.030
WSTR19 to WSTR20	1403	5070.5	5020.0	50.5	0.036	Trapezoidal	25	3	0.036
WSTR20 to WSTR23	1881	5020.0	4990.0	30.0	0.016	Trapezoidal	40	2	0.036
WSTR21 to WSTR23	2077	5020.0	4990.0	30.0	0.014	Trapezoidal	40	2	0.036
WSTR04 to WSTR07	2551	5546.0	5398.0	148.0	0.058	Trapezoidal	10	2	0.036
WSTR07 to WSTR09	198	5398.0	5389.0	9.0	0.045	Triangular	0	4	0.036
WSTR09 to WSTR10	1720	5389.0	5323.0	66.0	0.038	Trapezoidal	10	2	0.036
WSTR10 to WSTR11	726	5323.0	5288.5	34.5	0.048	Triangular	0	5	0.030
WSTR11 to WSTR15	3576	5288.5	5172.0	116.5	0.033	Trapezoidal	5	4	0.036
WSTR15 to WSTR18	369	5172.0	5157.0	15.0	0.041	Triangular	0	5	0.036
WSTR18 to WSTR19	2440	5157.0	5070.5	86.5	0.035	Trapezoidal	20	2	0.036
WSTR22 to WSTR26	4240	5014.0	4904.0	110.0	0.026	Trapezoidal	15	15	0.030
WSTR23 to WSTR24	1433	4990.0	4922.0	68.0	0.047	Trapezoidal	25	3	0.036
WSTR25 to WSTR26	534	4928.0	4904.0	24.0	0.045	Trapezoidal	10	5	0.030
WSTR28 to WSTR27	1854	4950.0	4914.0	36.0	0.019	Triangular	0	4	0.036
WSTR27 to WSTR26	249	4914.0	4904.0	10.0	0.040	Trapezoidal	10	5	0.030
WSLH02 to WSLH02a	2307	5588.0	5466.0	122.0	0.053	Triangular	0	3	0.030
WSLH47 to WSLH02a	2438	5596.0	5466.0	130.0	0.053	Triangular	0	3	0.03
WSLH02a to WSLH03	369	5466.0	5448.0	18.0	0.049	Triangular	0	3	0.036
WSLH47a to WSLH01	3375	5560.0	5433.0	127.0	0.038	Trapezoidal	5	3	0.03
WSLH01 to WSLH05	182	5433.0	5432.5	0.5	0.003	Triangular	0	3	0.036
WSLH03 to WSLH04	3011	5448.0	5358.0	90.0	0.030	Trapezoidal	15	2	0.03
WSLH05 to WSLH04	2976	5435.0	5358.0	77.0	0.026	Trapezoidal	15	2	0.03
WSLH06 to WSLH04	2058	5435.0	5358.0	77.0	0.037	Trapezoidal	15	2	0.03
WSLH07 to WSLH012	1173	5408.0	5346.0	62.0	0.053	Triangular	0	5	0.036
WSLH04 to WSLH12	585	5359.0	5346.0	13.0	0.022	Trapezoidal	10	5	0.03
WSLH11 to WSLH13	897	5396.0	5324.0	72.0	0.080	Trapezoidal	10	5	0.03
WSLH11a to WSLH10	160	5346.0	5314.0	32.0	0.200	Triangular	0	3	0.036
WSLH12 to WSLH13	777	5346.0	5324.0	22.0	0.028	Trapezoidal	10	5	0.03
WSLH15 to WSLH14	616	5289.5	5268.0	21.5	0.035	Trapezoidal	10	5	0.03
WSLH13 to WSLH14	2235	5324.0	5268.0	56.0	0.025	Trapezoidal	10	5	0.03

Routing Description	Length, ft	Elevation, from	Elevation, to	Δ Elev	Slope, ft/ft	Shape	Bottom Width (ft)	Side Slope (X:1)	Manning's
WSLH10 to WSLH14	1181	5314.0	5268.0	46.0	0.039	Trapezoidal	10	5	0.03
WSLH16a to WSLH14	707	5332.0	5268.0	64.0	0.091	Triangular	0	6	0.03
WSLH16b to WSLH18	2510	5310.0	5214.0	96.0	0.038	Trapezoidal	10	6	0.03
WSLH14 to WSLH18	2586	5268.0	5214.0	54.0	0.021	Trapezoidal	10	6	0.03
WSLH17 to WSLH18	2029	5266.0	5214.0	52.0	0.026	Trapezoidal	10	6	0.03
WSLH16 TO WSLH08	261	5255.0	5230.0	25.0	0.096	Triangular	0	3	0.036
WSLH08 to WSLH18	904	5230.0	5211.0	19.0	0.021	Trapezoidal	8	4	0.03
WSLH09 to WSLH18	586	5239.0	5201.0	38.0	0.065	Triangular	0	8	0.03
WSLH18 to WSLH22	17223	5201.0	4749.0	452.0	0.026	Trapezoidal	8	10	0.03
WSLH19 to WSLH22	17233	5237.0	4749.0	488.0	0.028	Triangular	0	12	0.03
WSLH23 to WSLH22	16847	5220.0	4749.0	471.0	0.028	Trapezoidal	8	10	0.03
WSLH21 to WSLH22	16366	5226.0	4749.0	477.0	0.029	Triangular	0	12	0.03
WSLH24 to WSLH30	3589	5225.0	5056.0	169.0	0.047	Trapezoidal	2	3	0.03
WSLH25 to WSLH30	3181	5205.0	5056.0	149.0	0.047	Trapezoidal	2	3	0.03
WSLH26 to WSLH30	2723	5195.0	5056.0	139.0	0.051	Trapezoidal	2	3	0.03
WSLH27 to WSLH30	2227	5206.0	5056.0	150.0	0.067	Trapezoidal	2	3	0.03
WSLH28 to WSLH30	289	5094.0	5056.0	38.0	0.132	Trapezoidal	2	3	0.03
WSLH30 to WSLH32	4026	5056.5	4875.0	181.5	0.045	Triangular	0	8	0.03
WSLH31 to WSLH32	3601	5060.0	4875.0	185.0	0.051	Triangular	0	8	0.030
WSLH33 to WSLH32	1665	5004.0	4875.0	129.0	0.077	Triangular	0	8	0.030
WSLH33a to WSLH32	675	4917.0	4875.0	42.0	0.062	Triangular	0	8	0.030
WSLH32 to WSLH34	5399	4875.0	4748.0	127.0	0.024	Triangular	0	8	0.030
WSLH46b to WSLH34	5570	4902.0	4748.0	154.0	0.028	Triangular	0	8	0.030
WSLH46 to WSLH34	2515	4796.0	4748.0	48.0	0.019	Triangular	0	8	0.030
WSLH46a to WSLH34	1274	4768.0	4748.0	20.0	0.016	Triangular	0	8	0.030
WSLH34 to WSLH38	25782	4748.0	4282.0	466.0	0.018	Trapezoidal	7	15	0.030
WSLH22 to WSLH38	26586	4749.0	4282.0	467.0	0.018	Trapezoidal	7	15	0.030
WSLH29 to WSLH38	24384	4721.0	4282.0	439.0	0.018	Trapezoidal	7	15	0.030
WSLH35 to WSLH38	22907	4683.0	4282.0	401.0	0.018	Trapezoidal	7	15	0.030
WSLH36a to WSLH38	22266	4669.0	4282.0	387.0	0.017	Trapezoidal	7	15	0.030
WSLH36b to WSLH38	21492	4665.0	4282.0	383.0	0.018	Trapezoidal	7	15	0.030
WSLH36 to WSLH38	21119	4660.0	4282.0	378.0	0.018	Trapezoidal	7	15	0.030
WSLH37a to WSLH48	2175	4585.0	4525.0	60.0	0.028	Triangular	0	12	0.036
WSLH48 TO WSLH37	2037	4526.0	4473.0	53.0	0.026	Trapezoidal	7	15	0.030
WSLH37 to WSLH38	10205	4473.0	4282.0	191.0	0.019	Trapezoidal	7	15	0.030
WSLH39 to WSLH38	9892	4469.0	4282.0	187.0	0.019	Trapezoidal	7	15	0.030
WSLH40 to WSLH38	9245	4468.0	4282.0	186.0	0.020	Triangular	0	10	0.030
WSLH41 to WSLH38	8732	4428.0	4282.0	146.0	0.017	Trapezoidal	7	15	0.030
WSLH42a to WSLH38	8269	4426.0	4282.0	144.0	0.017	Triangular	0	12	0.036
WSLH42b to WSLH38	8239	4424.0	4282.0	142.0	0.017	Triangular	0	12	0.036
WSLH42 to WSLH38	7714	4421.5	4282.0	139.5	0.018	Trapezoidal	7	15	0.030

Routing Description	Length, ft	Elevation, from	Elevation, to	Δ Elev	Slope, ft/ft	Shape	Bottom Width (ft)	Side Slope (X:1)	Manning's
WSLH49 to WSLH38	7315	4404.0	4282.0	122.0	0.017	Trapezoidal	7	15	0.030
WSLH43a to WSLH38	7292	4406.0	4282.0	124.0	0.017	Triangular	0	15	0.036
WSLH43 to WSLH38	7327	4409.0	4282.0	127.0	0.017	Triangular	0	15	0.036
WSLH44a to WSLH38	5489	4430.0	4282.0	148.0	0.027	Triangular	0	15	0.036
WSLH44 to WSLH38	4496	4416.0	4282.0	134.0	0.030	Triangular	0	15	0.036
WSLH45 to WSLH38	3271	4355.0	4282.0	73.0	0.022	Trapezoidal	7	15	0.030

*Channel dimensions based on topographic data

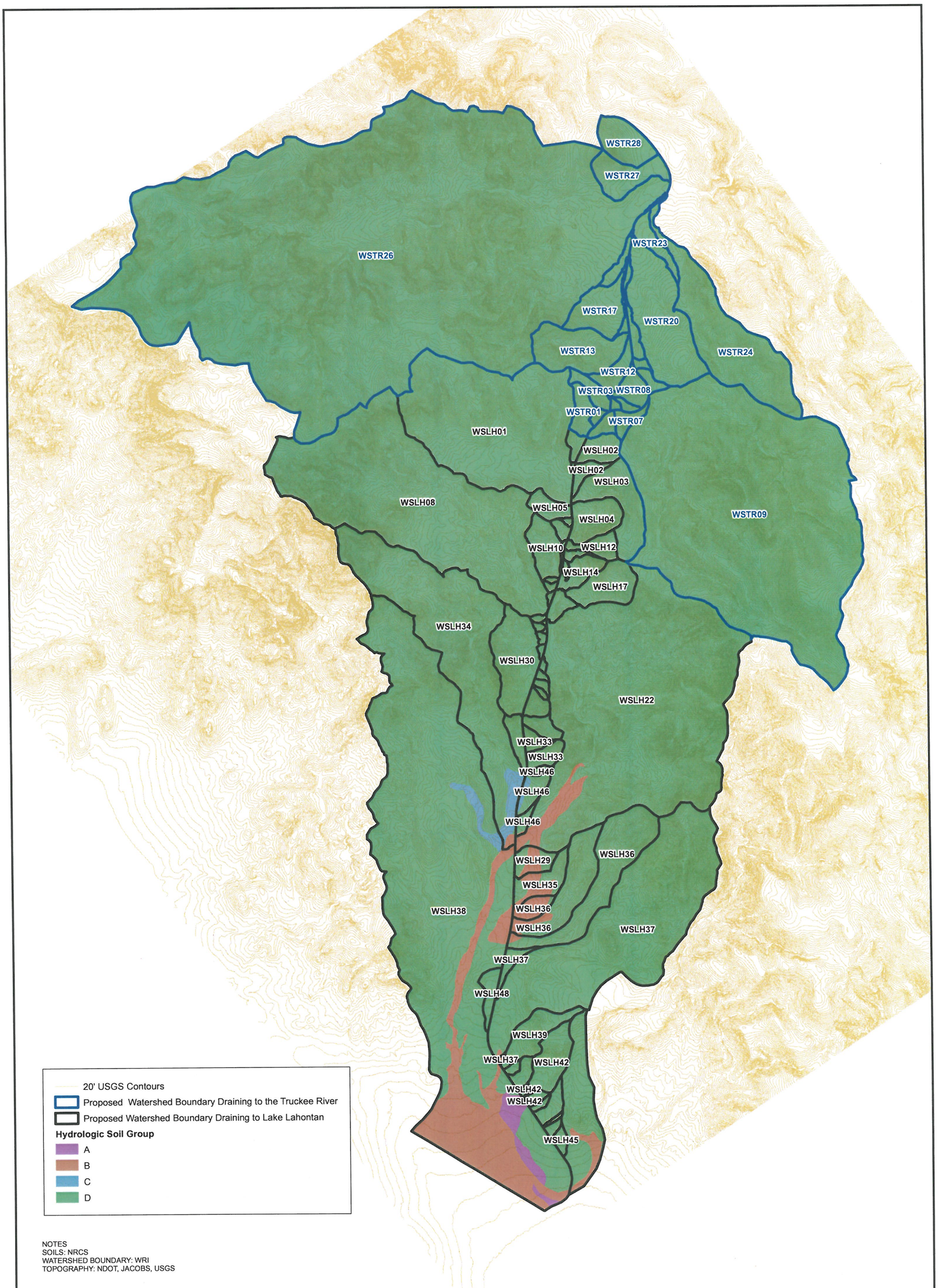
Appendix A
Proposed SCS Curve
Number Calculations

Watershed	Total Area (ac)	Total Area (sq. mi.)	$CN_{unimproved}$								$CN_{impervious}$			$CN_{combined}$
			Hydro Soil Group A	Hydro Soil Group A Area (ac)	Hydro Soil Group B	Hydro Soil Group B Area (ac)	Hydro Soil Group C	Hydro Soil Group C Area (ac)	Hydro Soil Group D	Hydro Soil Group D Area (ac)	Impervious	Impervious Area (ac)	Impervious Area (%)	
WSTR01	74.1	0.116	63	0.00	67	0.00	80	0.00	85	74.04	98	0.10	0.1	85.0
WSTR02	15.7	0.025	63	0.00	67	0.00	80	0.00	85	14.98	98	0.75	4.8	85.0
WSTR03	58.1	0.091	63	0.00	67	0.00	80	0.00	85	58.07	98	0.03	0.1	85.0
WSTR04	36.3	0.057	63	0.00	67	0.00	80	0.00	85	32.98	98	3.37	9.3	85.0
WSTR05	9.2	0.014	63	0.00	67	0.00	80	0.00	85	9.08	98	0.14	1.5	85.0
WSTR06	17.1	0.027	63	0.00	67	0.00	80	0.00	85	14.80	98	2.31	13.5	85.0
WSTR07	44.5	0.070	63	0.00	67	0.00	80	0.00	85	42.59	98	1.91	4.3	85.0
WSTR08	75.3	0.118	63	0.00	67	0.00	80	0.00	85	71.06	98	4.27	5.7	85.0
WSTR09	4078.9	6.372	63	0.00	67	0.00	80	0.00	85	4078.87	98	0.17	0.0	85.0
WSTR10	29.0	0.045	63	0.00	67	0.00	80	0.00	85	27.16	98	1.80	6.2	85.0
WSTR11	13.2	0.021	63	0.00	67	0.00	80	0.00	85	11.93	98	1.27	9.6	85.0
WSTR12	73.9	0.115	63	0.00	67	0.00	80	0.00	85	72.54	98	1.37	1.9	85.0
WSTR13	300.7	0.470	63	0.00	67	0.00	80	0.00	85	300.96	98	0.72	0.2	85.3
WSTR14	11.1	0.017	63	0.00	67	0.00	80	0.00	85	10.10	98	0.98	8.8	85.0
WSTR15	39.0	0.061	63	0.00	67	0.00	80	0.00	85	35.89	98	3.08	7.9	85.0
WSTR16	6.4	0.010	63	0.00	67	0.00	80	0.00	85	4.66	98	1.73	27.1	85.0
WSTR17	195.8	0.306	63	0.00	67	0.00	80	0.00	85	193.49	98	2.36	1.2	85.0
WSTR18	1.1	0.002	63	0.00	67	0.00	80	0.00	85	0.78	98	0.37	32.3	85.6
WSTR19	13.5	0.021	63	0.00	67	0.00	80	0.00	85	10.04	98	3.44	25.6	85.1
WSTR20	553.8	0.865	63	0.00	67	0.00	80	0.00	85	551.97	98	2.01	0.4	85.0
WSTR21	39.8	0.062	63	0.00	67	0.00	80	0.00	85	37.58	98	2.01	5.0	84.5
WSTR22	1.4	0.002	63	0.00	67	0.00	80	0.00	85	0.95	98	0.45	32.0	84.4
WSTR23	78.7	0.123	63	0.00	67	0.00	80	0.00	85	75.64	98	3.02	3.8	85.0
WSTR24	724.7	1.132	63	0.00	67	0.00	80	0.00	85	723.84	98	1.14	0.2	85.0
WSTR25	4.1	0.006	63	0.00	67	0.00	80	0.00	85	2.08	98	2.01	49.1	85.0
WSTR26	9350.5	14.610	63	0.00	67	0.00	80	0.00	85	9343.86	98	6.60	0.1	85.0
WSTR27	174.0	0.272	63	0.00	67	0.00	80	0.00	85	168.91	98	5.13	3.0	85.0
WSTR28	164.2	0.257	63	0.00	67	0.00	80	0.00	85	156.88	98	7.39	4.5	85.0
WSLH01	1587.2	2.480	63	0.00	67	0.00	80	0.00	85	1583.33	98	3.88	0.2	85.0
WSLH02	84.9	0.133	63	0.00	67	0.00	80	0.00	85	83.42	98	1.46	1.7	85.0
WSLH02a	46.4	0.072	63	0.00	67	0.00	80	0.00	85	44.27	98	2.11	4.6	85.0
WSLH03	273.5	0.427	63	0.00	67	0.00	80	0.00	85	272.72	98	0.79	0.3	85.0
WSLH04	153.5	0.240	63	0.00	67	0.00	80	0.00	85	151.18	98	2.36	1.5	85.0
WSLH05	69.7	0.109	63	0.00	67	0.00	80	0.00	85	68.90	98	0.76	1.1	85.0
WSLH06	6.3	0.010	63	0.00	67	0.00	80	0.00	85	5.81	98	0.49	7.8	85.0
WSLH07	23.3	0.036	63	0.00	67	0.00	80	0.00	85	22.47	98	0.78	3.3	85.0
WSLH08	2330.6	3.641	63	0.00	67	0.00	80	0.00	85	2326.61	98	3.95	0.2	85.0
WSLH09	8.8	0.014	63	0.00	67	0.00	80	0.00	85	8.48	98	0.36	4.0	85.0
WSLH10	132.8	0.208	63	0.00	67	0.00	80	0.00	85	132.52	98	0.31	0.2	85.0
WSLH11	4.4	0.007	63	0.00	67	0.00	80	0.00	85	3.72	98	0.67	15.3	85.0
WSLH11a	3.7	0.006	63	0.00	67	0.00	80	0.00	85	2.73	98	1.02	27.2	85.0
WSLH12	68.7	0.107	63	0.00	67	0.00	80	0.00	85	68.01	98	0.72	1.0	85.0
WSLH13	17.2	0.027	63	0.00	67	0.00	80	0.00	85	16.28	98	0.96	5.6	85.0
WSLH14	81.1	0.127	63	0.00	67	0.00	80	0.00	85	79.34	98	1.74	2.1	85.0
WSLH15	8.4	0.013	63	0.00	67	0.00	80	0.00	85	7.42	98	0.95	11.4	85.0
WSLH16	6.0	0.009	63	0.00	67	0.00	80	0.00	85	4.98	98	1.00	16.7	85.0
WSLH16a	5.8	0.009	63	0.00	67	0.00	80	0.00	85	5.66	98	0.13	2.3	85.0
WSLH16b	8.9	0.014	63	0.00	67	0.00	80	0.00	85	8.42	98	0.49	5.5	85.0

Appendix A
Proposed SCS Curve
Number Calculations

Watershed	Total Area (ac)	Total Area (sq. mi.)	$CN_{unimproved}$								$CN_{impervious}$			$CN_{combined}$
			Hydro Soil Group A	Hydro Soil Group A Area (ac)	Hydro Soil Group B	Hydro Soil Group B Area (ac)	Hydro Soil Group C	Hydro Soil Group C Area (ac)	Hydro Soil Group D	Hydro Soil Group D Area (ac)	Impervious	Impervious Area (ac)	Impervious Area (%)	
WSLH17	174.7	0.273	63	0.00	67	0.00	80	0.00	85	174.64	98	0.01	0.0	85.0
WSLH18	45.2	0.071	63	0.00	67	0.00	80	0.00	85	42.44	98	2.75	6.1	85.0
WSLH19	7.9	0.012	63	0.00	67	0.00	80	0.00	85	7.82	98	0.09	1.2	85.1
WSLH19a	2.0	0.003	63	0.00	67	0.00	80	0.00	85	1.34	98	0.69	34.7	87.0
WSLH20	2.0	0.003	63	0.00	67	0.00	80	0.00	85	1.44	98	0.56	28.1	85.3
WSLH21	6.9	0.011	63	0.00	67	0.00	80	0.00	85	5.69	98	1.21	17.5	85.0
WSLH22	3396.9	5.308	63	0.00	67	119.72	80	0.00	85	3273.68	98	3.55	0.1	84.4
WSLH23	9.0	0.014	63	0.00	67	0.00	80	0.00	85	8.06	98	0.98	10.8	85.0
WSLH24	7.0	0.011	63	0.00	67	0.00	80	0.00	85	6.12	98	0.84	12.1	85.0
WSLH25	8.3	0.013	63	0.00	67	0.00	80	0.00	85	7.67	98	0.67	8.1	85.0
WSLH26	12.9	0.020	63	0.00	67	0.00	80	0.00	85	12.54	98	0.34	2.7	85.0
WSLH27	7.8	0.012	63	0.00	67	0.00	80	0.00	85	7.60	98	0.16	2.1	85.0
WSLH28	44.2	0.069	63	0.00	67	0.00	80	0.00	85	42.44	98	1.76	4.0	85.0
WSLH29	79.4	0.124	63	0.00	67	34.34	80	0.00	85	43.18	98	1.84	2.3	77.0
WSLH30	317.3	0.496	63	0.00	67	0.00	80	0.00	85	312.54	98	4.81	1.5	85.0
WSLH31	50.4	0.079	63	0.00	67	0.00	80	0.00	85	49.92	98	0.51	1.0	85.0
WSLH32	61.3	0.096	63	0.00	67	0.00	80	0.09	85	56.62	98	4.61	7.5	85.0
WSLH33	36.6	0.057	63	0.00	67	0.00	80	0.00	85	35.00	98	1.64	4.5	85.0
WSLH33a	58.5	0.091	63	0.00	67	0.00	80	0.00	85	57.52	98	0.99	1.7	85.0
WSLH34	1464.3	2.288	63	0.00	67	10.18	80	73.64	85	1373.86	98	6.57	0.4	84.6
WSLH35	126.3	0.197	63	0.00	67	51.42	80	0.00	85	72.58	98	2.30	1.8	77.5
WSLH36	444.9	0.695	63	0.00	67	6.72	80	0.00	85	436.88	98	1.26	0.3	84.7
WSLH36a	56.7	0.089	63	0.00	67	50.45	80	0.00	85	5.32	98	0.90	1.6	68.7
WSLH36b	288.8	0.451	63	0.00	67	29.03	80	0.00	85	258.47	98	1.31	0.5	83.2
WSLH37	1750.3	2.735	63	0.00	67	4.30	80	0.00	85	1740.89	98	5.11	0.3	85.0
WSLH37a	43.2	0.067	63	0.00	67	0.00	80	0.00	85	38.94	98	4.25	9.8	85.0
WSLH38	4710.0	7.359	63	111.70	67	837.17	80	62.44	85	3670.03	98	28.63	0.6	79.7
WSLH39	157.5	0.246	63	0.00	67	0.00	80	0.00	85	156.99	98	0.48	0.3	85.0
WSLH40	12.3	0.019	63	0.00	67	0.00	80	0.00	85	11.91	98	0.43	3.5	85.0
WSLH41	39.4	0.062	63	0.00	67	0.00	80	0.00	85	37.91	98	1.50	3.8	85.0
WSLH42	163.7	0.256	63	0.44	67	0.00	80	0.00	85	163.10	98	0.13	0.1	84.8
WSLH42a	3.4	0.005	63	0.00	67	0.00	80	0.00	85	3.15	98	0.23	6.8	85.0
WSLH42b	3.3	0.005	63	0.44	67	0.00	80	0.00	85	2.55	98	0.32	9.7	72.6
WSLH43	52.4	0.082	63	0.00	67	0.00	80	0.00	85	51.01	98	1.39	2.6	85.0
WSLH43a	11.3	0.018	63	0.00	67	0.00	80	0.00	85	10.88	98	0.45	4.0	85.0
WSLH44	15.2	0.024	63	0.00	67	0.00	80	0.00	85	14.18	98	0.99	6.6	85.0
WSLH44a	6.1	0.010	63	0.00	67	0.00	80	0.00	85	6.09	98	0.05	0.7	85.0
WSLH45	25.3	0.040	63	0.00	67	0.00	80	0.00	85	23.64	98	1.65	6.5	85.0
WSLH46	69.7	0.109	63	0.00	67	0.00	80	11.77	85	55.47	98	2.44	3.5	84.1
WSLH46a	25.8	0.040	63	0.00	67	2.41	80	0.00	85	21.64	98	1.71	6.7	83.2
WSLH46b	13.0	0.020	63	0.00	67	0.00	80	0.00	85	12.68	98	0.32	2.4	85.0
WSLH47	31.7	0.050	63	0.00	67	0.00	80	0.00	85	30.04	98	1.65	5.2	85.0
WSLH47a	2.1	0.003	63	0.00	67	0.00	80	0.00	85	1.66	98	0.43	20.6	85.0
WSLH48	57.8	0.090	63	0.00	67	0.00	80	0.00	85	52.57	98	5.23	9.0	85.0
WSLH49	20.9	0.033	63	0.83	67	0.00	80	0.00	85	19.19	98	0.85	4.1	81.5
WSLH50	383.5	0.599	63	0.00	67	54.07	80	0.00	85	328.27	98	1.14	0.7	82.5

CN values based on Technical Release 55 Urban Hydrology for Small Watersheds manual.
Cover type of "Sagebrush with grass understory" was applied.
A Hydrologic Condition of "Poor - <30% ground cover" was applied.
For areas with Hydrologic Soil Type of A, "Desert Shrub" with a hydrologic condition of "Poor < 30% ground cover" was applied



NOTES
SOILS: NRCS
WATERSHED BOUNDARY: WRI
TOPOGRAPHY: NDOT, JACOBS, USGS

APPENDIX A
PROPOSED OFFSITE WATERSHEDS HYDROLOGIC SOILS GROUP

30% PREFERRED ALTERNATIVE DRAINAGE REPORT
STOREY COUNTY AND LYON COUNTY, NEVADA
NOVEMBER, 2013

NORTH

0 0.5 1
MILES

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
5440 Reno Corporate Drive
Reno, NV 89511
Tel: 775.823.4068
Fax: 775.823.4066

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Appendix A
Proposed Conditions
Onsite Watershed Peak Flow Calculations

Concentration Point	Contributing Onsite Watersheds	Contributing Onsite Watershed Area (ac)	Channel Length	Channel Width	Total Channel Area (ac)	Total Area (ac)	Time of Concentration														Precipitation		Runoff			
							Initial Sheet Flow					Shallow Conc. Flow				Channel Flow				Total	Intensity (in/hr)		C		Q (cfs)	
							L_i (ft)	n	P_2 (in)	S (ft/ft)	T_i (min)	L_s(ft)	S (ft/ft)	V(ft/s)	T_{t1} (min)	L_t (ft)	S (ft/ft)	V (ft/s)	T_{t2} (min)	T_c(min)	10-yr	25-yr	10yr	25-yr	10-yr	25-yr
36+35	ONL01	1.17	-	-	1.17	1.17	22	0.011	1.49	0.02	0.06	0	0.000	0.0	0.00	1394	0.04	3.4	6.85	6.91	2.42	3.15	0.98	0.98	2.77	3.61
50+50	-	0	2200	40	2.02	2.02	99	0.030	1.49	0.03	0.11	0	0.000	0.0	0.00	2101	0.03	2.6	13.68	13.79	1.76	2.29	0.98	0.98	3.48	4.53
85+95	-	0	1250	40	1.15	1.15	99	0.030	1.49	0.01	0.18	0	0.000	0.0	0.00	1151	0.01	2.0	9.84	10.02	2.03	2.64	0.98	0.98	2.28	2.97
86+05	-	0	1650	40	1.52	1.52	99	0.030	1.49	0.02	0.15	0	0.000	0.0	0.00	1551	0.02	2.6	9.87	10.02	2.03	2.64	0.98	0.98	3.01	3.92
91+30 Rt.	ONL04	0.32	-	-	0.00	0.32	89	0.011	1.49	0.02	0.06	326	0.018	2.2	2.48	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.84	1.10
93+10 Lt.	ONL05	0.29	-	-	0.00	0.29	71	0.011	1.49	0.02	0.06	352	0.016	2.0	2.91	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.76	0.99
100+00 Rt.	ONL06	0.29	-	-	0.00	0.29	76	0.011	1.49	0.05	0.04	331	0.033	2.9	1.88	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.76	0.99
102+50	-	0	1300	40	1.19	1.19	99	0.030	1.49	0.02	0.14	0	0.000	0.0	0.00	1201	0.02	2.6	7.64	7.78	2.07	2.69	0.98	0.98	2.42	3.15
109+90 Rt.	ONL07	0.23	-	-	0.00	0.23	68	0.011	1.49	0.01	0.10	261	0.010	1.6	2.75	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.59	0.78
111+20 Lt.	ONL08	0.23	-	-	0.00	0.23	50	0.011	1.49	0.01	0.08	265	0.006	1.2	3.64	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.60	0.78
115+50	-	0	1300	40	1.19	1.19	99	0.030	1.49	0.01	0.24	0	0.000	0.0	0.00	1201	0.03	3.4	5.85	6.09	2.34	3.05	0.98	0.98	2.74	3.57
115+90 Rt.	ONL09	0.70	-	-	0.00	0.70	86	0.011	1.49	0.03	0.05	768	0.017	2.1	6.10	0	0.00	0.0	0.00	6.15	2.52	3.28	0.98	0.98	1.73	2.25
117+10 Lt.	ONL10	0.46	-	-	0.00	0.46	63	0.011	1.49	0.03	0.05	600	0.015	2.0	5.06	0	0.00	0.0	0.00	5.11	2.65	3.45	0.98	0.98	1.20	1.57
124+80	ONL11	1.21	1400	40	1.29	2.50	95	0.011	1.49	0.07	0.04	0	0.000	0.0	0.00	1300	0.03	3.7	5.79	5.83	2.56	3.33	0.98	0.98	6.26	8.14
139+50	ONL12	0.36	1950	40	1.79	2.15	99	0.030	1.49	0.03	0.12	0	0.000	0.0	0.00	1851	0.03	3.2	9.67	9.79	2.06	2.67	0.98	0.98	4.34	5.63
159+00	-	0	2100	40	1.93	1.93	99	0.030	1.49	0.02	0.14	0	0.000	0.0	0.00	2001	0.03	2.8	11.87	12.00	1.76	2.46	0.98	0.98	3.33	4.65
180+00	-	0	2200	40	2.02	2.02	99	0.030	1.49	0.01	0.18	0	0.000	0.0	0.00	2101	0.01	2.8	12.51	12.69	1.84	2.39	0.98	0.98	3.64	4.73
202+00	ONL13	1.50	1800	40	1.65	3.15	99	0.030	1.49	0.04	0.10	0	0.000	0.0	0.00	1760	0.01	2.1	13.97	14.07	1.75	2.27	0.98	0.98	5.41	7.02
220+00	-	0	1650	40	1.52	1.52	99	0.011	1.49	0.02	0.06	0	0.000	0.0	0.00	1551	0.02	2.3	11.39	11.45	1.93	2.51	0.98	0.98	2.87	3.73
220+40 Rt.	ONL14	0.13	-	-	0.00	0.13	70	0.011	1.49	0.03	0.05	110	0.018	2.2	0.84	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.34	0.44
236+50	-	0	1690	40	1.55	1.55	99	0.011	1.49	0.03	0.06	0	0.000	0.0	0.00	1591	0.02	2.8	9.44	9.49	2.08	2.7	0.98	0.98	3.16	4.11
251+00 Rt.	ONL15	0.85	-	-	0.00	0.85	76	0.011	1.49	0.03	0.05	962	0.022	2.4	6.73	0	0.00	0.0	0.00	6.78	2.81	3.67	0.98	0.98	2.34	3.06
252+00 Lt.	ONL16	0.32	-	-	0.00	0.32	66	0.011	1.49	0.03	0.05	358	0.022	2.4	2.47	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.83	1.09
253+80	-	0	1980	40	1.82	1.82	99	0.030	1.49	0.02	0.14	0	0.000	0.0	0.00	1881	0.02	3.0	10.52	10.66	1.98	2.57	0.98	0.98	3.53	4.58
273+50	ONL17	0.83	1500	40	1.38	2.21	99	0.011	1.49	0.04	0.05	0	0.000	0.0	0.00	1401	0.03	3.6	6.52	6.57	2.46	3.21	0.98	0.98	5.32	6.94
276+30 Rt.	ONL18	1.86	-	-	0.00	1.86	82	0.011	1.49	0.05	0.04	2060	0.038	3.1	10.94	0	0.00	0.0	0.00	10.98	1.96	2.55	0.98	0.98	3.57	4.65
288+50	ONL19	0.57	1450	15	0.50	1.07	99	0.011	1.49	0.07	0.04	0	0.000	0.0	0.00	1410	0.05	3.5	6.68	6.71	2.44	3.19	0.98	0.98	2.56	3.34
303+00	ONL20	0.63	1610	15	0.55	1.18	99	0.030	1.49	0.06	0.09	0	0.000	0.0	0.00	1511	0.11	3.5	7.17	7.26	2.66	3.47	0.98	0.98	3.09	4.03
307+20 Lt.	ONL21	1.76	-	-	0.00	1.76	99	0.011	1.49	0.06	0.04	1990	0.055	3.8	8.78	0	0.00	0.0	0.00	8.82	2.18	2.84	0.98	0.98	3.76	4.90
309+70 Rt.	ONL22a	0.50	-	-	0.00	0.50	50	0.011	1.49	0.04	0.05	530	0.049	3.6	2.47	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.30	1.70
315+00 Rt.	ONL22c	0.47	-	-	0.00	0.47	45	0.011	1.49	0.04	0.04	500	0.052	3.7	2.26	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.23	1.60
319+10	ONL23	0.24	1090	15	0.38	0.62	98	0.011	1.49	0.05	0.04	0	0.000	0.0	0.00	1050	0.05	2.8	6.23	6.27	2.02	2.62	0.98	0.98	1.22	1.58
320+00 Rt.	ONL22b	0.94	-	-	0.00	0.94	94	0.011	1.49	0.06	0.04	1005	0.025	2.6	6.56	0	0.00	0.0	0.00	6.60	2.30	3.5	0.98	0.98	2.12	3.22
329+80	ONL24	1.24	1100	15	0.38	1.62	99	0.030	1.49	0.06	0.09	0	0.000	0.0	0.00	1001	0.06	3.2	5.15	5.24	2.63	3.43	0.98	0.98	4.17	5.44
330+10 Rt.	ONL25a	0.79	-	-	0.00	0.79	53	0.011	1.49	0.08	0.04	740	0.054	3.8	3.29	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	2.06	2.69
337+50 Rt.	ONL25b	0.69	-	-	0.00	0.69	84	0.011	1.49	0.07	0.04	732	0.055	3.8	3.23	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.80	2.35
342+60 Lt.	ONL26c	0.50	-	-	0.00	0.50	54	0.011	1.49	0.04	0.05	540	0.052	3.7	2.45	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.30	1.70
345+20 Rt.	ONL27a	0.77	-	-	0.00	0.77	65	0.011	1.49	0.05	0.04	830	0.053	3.7	3.72	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	2.01	2.62
348+00 Lt.	ONL26a	0.51	-	-	0.00	0.51	54	0.011	1.49	0.04	0.05	550	0.053	3.7	2.47	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.33	1.73
353+50 Lt.	ONL26b	1.03	-	-	0.00	1.03	80	0.011	1.49	0.05	0.04	1100	0.044	3.4	5.44	0	0.00	0.0	0.00	5.48	2.60	3.39	0.98	0.98	2.62	3.42
354+50 Rt.	ONL27b	1.06	-	-	0.00	1.06	76	0.011	1.49	0.03	0.05	965	0.050	3.6	4.47	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	2.76	3.60
366+90 Lt.	ONL28	0.61	-	-	0.00	0.61	79	0.011	1.49	0.03	0.05	660	0.011	1.7	6.62	0	0.00	0.0	0.00	6.67	2.45	3.19	0.98	0.98	1.46	1.91
366+80 Rt.	ONL29	0.49	-	-	0.00	0.49	99	0.011	1.49	0.02	0.07	470	0.019	2.2	3.51	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.28	1.67
372+00	ONL30	0.12	-	-	0.00	0.12	40	0.011	1.49	0.03	0.05	150	0.003	0.9	2.68	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.31	0.41
382+90 Lt.	ONL31	0.87	-	-	0.00	0.87	40	0.011	1.49	0.04	0.05	930	0.009	1.5	10.36	0	0.00	0.0	0.00	10.41	2.00	2.6	0.98	0.98	1.70	2.20
388+80	ONL32	1.42	-	-	0.00	1.42	40	0.011	1.49	0.04	0.05	1520	0.339	9.4	2.70	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	3.70	4.83
392+10 Lt.	ONL34	0.98	-	-	0.00	0.98	82	0.011	1.49	0.03	0.05	1105	0.008	1.4	12.83	0	0.00	0.0	0.00	12.88	1.83	2.38	0.98	0.98	1.76	2.29
394+10 Rt.	ONL35	0.75	-	-	0.00	0.75	99	0.011	1.49	0.02	0.06	510	0.008	1.4	5.95	0	0.00	0.0	0.00	6.01	2.53	3.3	0.98	0.98	1.86	2.43
394+10	ONL36	0.36	-	-	0.00	0.36	97	0.030	1.49	0.02	0.14	0	0.000	0.0	0.00	152	0.01	2.7	0.93	5.00	2.66	3.47	0.98	0.98	0.94	1.22
396+10	ONL37	0.83	590	20	0.27	1.10	99	0.011	1.49	0.03	0.05	180	0.033	2.9	1.02	590	0.02	2.6	3.84	5.00	2.66	3.47	0.98	0.98	2.87	3.74
401+80 Rt.	ONL38	0.88	-	-	0.00	0.88	99	0.011	1.49	0.06	0.04	850	0.041	3.3	4.33	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	2.29	2.99
404+70 Lt.	ONL39a	0.49	-	-	0.00	0.49	61	0.011	1.49	0.05	0.04	530	0.020	2.3	3.83	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.28	1.67
410+00 Lt.	ONL39b	0.41	-	-	0.00	0.41	69	0.011	1.49	0.05	0.04	430	0.047	3.5	2.06	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.07	1.39
410+10	ONL40	0.75	-	-	0.00	0.75	55	0.011	1.49	0.03	0.05	740	0.043	3.4	3.68	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.96	2.55
414+50 Lt.	ONL41a	0.51	-	-	0.00	0.51	50	0.011	1.49	0.04	0.05	550	87.211	150.7	0.06	0	0.00	0.0	0.00	5.00	2.63	3.43	0.98	0.98	1.31	1.71
418+10 Rt.	ONL42	0.64	-	-	0.00	0.64	99	0.011	1.49	0.05	0.04	760	0.033	2.9	4.33	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.67	2.18
420+00 Lt.	ONL41b	0.56	-	-	0.00	0.56	64	0.011	1.49	0.05	0.04	570	0.039	3.2	3.00	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.46	1.90
424+60	ONL43	0.25	-	-	0.00	0.25	86	0.030	1.49	0.07	0.08	196	0.041	3.3	1.00	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.65	0.85
425+50 Rt.	ONL60	0.23	-	-	0.00	0.23	99	0.030	1.49	0.04	0.10	0	0.000	0.0	1.00	245	0.05	2.6	1.57	5.00	2.66	3.47	0.30	0.35	0.18	0.28
427+00	ONL44, ONL47	0.69	1100	20	0.51	1.20	85	0.011	1.49	0.06	0.04	0	0.000	0.0	0.00	1085	0.04	3.3	5.45	5.49	2.60	3.39	0.98	0.98	3.04	3.97
429+80 Lt.	ONL45	0.57	-	-	0.00	0.57	99	0.011	1.49	0.05	0.04	620	0.045	3.4	3.01	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.47	1.92
431+20 Rt.	ONL59	0.57	-	-	0.00	0.57	99	0.030	1.49	0.04	0.10	0	0.000	0.0	0.00	460	0.04	2.4	3.19	5.00	2.66	3.47	0.30	0.35	0.45	0.69
438+00	ONL48	0.66	850	15	0.29	0.95	99	0.030	1.49	0.04	0.10	0	0.000	0.0	0.00	850	0.04	2.4	5.83	5.93	2.54	3.32	0.98	0.98	2.36	3.09

Appendix A
Proposed Conditions
Onsite Watershed Peak Flow Calculations

Concentration Point	Contributing Onsite Watersheds	Contributing Onsite Watershed Area (ac)	Channel Length	Channel Width	Total Channel Area (ac)	Total Area (ac)	Time of Concentration														Precipitation		Runoff			
							Initial Sheet Flow					Shallow Conc. Flow				Channel Flow				Total	Intensity (in/hr)		C		Q (cfs)	
							L_i (ft)	n	P_2 (in)	S (ft/ft)	T_i (min)	L_s(ft)	S (ft/ft)	V(ft/s)	T_{t1} (min)	L_t (ft)	S (ft/ft)	V (ft/s)	T_{t2} (min)	T_c(min)	10-yr	25-yr	10yr	25-yr	10-yr	25-yr
433+00 Rt.	ONL46	0.55	-	-	0.00	0.55	80	0.011	1.49	0.06	0.04	590	0.038	3.2	3.12	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.42	1.86
441+00 Rt.	ONL03, ONL49	1.19	-	-	0.00	1.19	99	0.011	1.49	0.04	0.05	1401	0.017	2.1	11.17	225	0.04	2.4	1.56	12.79	1.83	2.38	0.63	0.66	1.37	1.87
443+00 Rt.	ONL49	0.58	-	-	0.00	0.58	99	0.011	1.49	0.04	0.05	1401	0.017	2.1	11.17	0	0.00	0.0	0.00	11.22	1.94	2.53	0.98	0.98	1.11	1.45
445+70 Lt.	ONL50	0.57	-	-	0.00	0.57	60	0.011	1.49	0.05	0.04	650	0.027	2.6	4.09	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.50	1.96
446+50	ONL51, ONL52	1.06	1210	20	0.56	1.61	40	0.011	1.49	0.01	0.07	230	0.013	1.8	2.08	1210	0.02	2.7	7.36	9.51	2.09	2.72	0.98	0.98	3.30	4.30
458+60	ONL52	0.26	-	-	0.00	0.26	40	0.011	1.49	0.01	0.07	230	0.013	1.8	2.08	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.68	0.88
448+60 Rt.	ONL02	0.41	-	-	0.00	0.41	99	0.030	1.49	0.04	0.10	0	0.000	0.0	0.00	273	0.04	2.4	1.90	5.00	2.66	3.47	0.30	0.35	0.33	0.50
458+40 Lt.	ONL53	0.53	-	-	0.00	0.53	99	0.011	1.49	0.02	0.06	461	0.023	2.4	3.16	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.38	1.80
461+20 Rt.	ONL54	0.92	-	-	0.00	0.92	58	0.011	1.49	0.03	0.05	940	0.012	1.8	8.78	0	0.00	0.0	0.00	8.83	2.18	2.83	0.98	0.98	1.97	2.55
463+70	ONL55a	0.51	-	-	0.00	0.51	54	0.011	1.49	0.04	0.05	530	0.015	2.0	4.46	0	0.00	0.0	0.00	5.00	2.37	3.09	0.98	0.98	1.18	1.54
469+00	ON55b	0.55	-	-	0.00	0.55	99	0.011	1.49	0.03	0.05	510	0.014	1.9	4.50	0	0.00	0.0	0.00	5.00	2.66	2.76	0.98	0.98	1.43	1.49
472+80 Rt.	ONL56	1.99	-	-	0.00	1.99	53	0.011	1.49	0.08	0.03	2080	0.054	3.7	9.26	0	0.00	0.0	0.00	9.29	2.12	2.76	0.98	0.98	4.13	5.38
475+00 Lt.	ONL57a	0.59	-	-	0.00	0.59	87	0.011	1.49	0.07	0.04	600	0.052	3.7	2.73	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.54	2.01
481+00 Lt.	ONL57b	0.70	-	-	0.00	0.70	99	0.011	1.49	0.07	0.04	800	0.054	3.7	3.56	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	1.82	2.38
488+50	ONL58	0.23	-	-	0.00	0.23	84	0.011	1.49	0.08	0.03	184	0.060	3.9	0.78	0	0.00	0.0	0.00	5.00	2.66	3.47	0.98	0.98	0.60	0.78
491+00	ONL59	0.77	1900	20	0.87	1.64	99	0.030	1.49	0.01	0.17	0	0.000	0.0	0.00	1801	0.05	2.6	11.59	11.76	1.91	2.48	0.98	0.98	3.07	3.99
493+60 Rt.	ONL60	1.57	-	-	0.00	1.57	47	0.011	1.49	0.04	0.05	1650	0.044	3.4	8.10	0	0.00	0.0	0.00	8.15	2.26	2.95	0.98	0.98	3.47	4.53
510+50 (HIGH PT)																										
511+90 Rt.	ONT01	0.07	-	-	0.00	0.07	40	0.011	1.67	0.01	0.08	30	0.067	4.2	0.12	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	0.19	0.24
524+50	ONT02	0.58	1300	10	0.30	0.88	99	0.011	1.67	0.02	0.07	0	0.000	0.0	0.00	1200	0.04	2.5	8.13	8.20	2.32	3.01	0.98	0.98	2.00	2.59
524+30 Lt.	ONT04	0.52	-	-	0.00	0.52	99	0.011	1.67	0.05	0.04	531	0.055	3.8	2.35	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	1.38	1.81
526+80 Rt.	ONT03	0.92	-	-	0.00	0.92	44	0.011	1.67	0.07	0.04	1050	0.055	3.8	4.63	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	2.44	3.20
540+00	ONT05	1.40	1550	20	0.71	2.11	67	0.011	1.67	0.04	0.05	0	0.000	0.0	0.00	1500	0.06	4.3	5.81	5.86	2.63	3.41	0.98	0.98	5.44	7.06
540+30 Rt.	ONT07	0.29	-	-	0.00	0.29	53	0.011	1.67	0.08	0.04	330	0.048	3.6	1.55	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	0.77	1.01
542+50 Lt.	ONT06	0.26	-	-	0.00	0.26	99	0.011	1.67	0.06	0.04	251	0.072	4.3	0.97	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	0.69	0.90
555+00	ONT08	1.34	1500	10	0.34	1.68	99	0.030	1.67	0.06	0.09	0	0.000	0.0	0.00	1401	0.06	4.3	5.42	5.51	2.67	3.46	0.98	0.98	4.41	5.71
570+00	ONT09	1.34	1500	15	0.52	1.86	52	0.011	1.67	0.04	0.05	0	0.000	0.0	0.00	1500	0.05	4.1	6.08	6.13	2.59	3.36	0.98	0.98	4.71	6.11
575+90 Rt.	ONT10	0.57	-	-	0.00	0.57	68	0.011	1.67	0.04	0.05	690	0.036	3.1	3.74	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	1.51	1.98
573+50 Lt.	ONT11	0.11	-	-	0.00	0.11	58	0.011	1.67	0.03	0.05	140	0.043	3.3	0.70	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	0.29	0.38
586+00	ONT12	0.84	1290	5	0.15	0.99	99	0.030	1.67	0.04	0.11	0	0.000	0.0	0.00	1290	0.04	3.8	5.69	5.79	2.46	3.19	0.98	0.98	2.38	3.09
604+50 Lt.	ONT15	1.75	-	-	0.00	1.75	99	0.011	1.67	0.04	0.05	1950	0.036	3.1	10.63	0	0.00	0.0	0.00	10.68	2.03	2.63	0.98	0.98	3.48	4.51
585+00	ONT13	0.22	-	-	0.00	0.22	58	0.011	1.67	0.05	0.04	233	0.039	3.2	1.22	0	0.00	0.0	0.00	5.00	2.71	3.55	0.98	0.98	0.58	0.77
620+50 Rt.	ONT16	1.59	-	-	0.00	1.59	49	0.011	1.67	0.04	0.05	1600	0.038	3.1	8.53	0	0.00	0.0	0.00	8.58	2.27	2.95	0.98	0.98	3.54	4.60
620+50 Lt.	ONT17	1.46	-	-	0.00	1.46	52	0.011	1.67	0.04	0.05	1600	0.038	3.1	8.53	0	0.00	0.0	0.00	8.58	2.27	2.98	0.98	0.98	3.25	4.26
638+00	ONT18	0.74	1650	25	0.95	1.69	62	0.011	1.67	0.03	0.05	0	0.000	0.0	0.00	1650	0.05	3.8	7.29	7.35	2.43	3.16	0.98	0.98	4.02	5.22
658+50	-	0.00	2050	25	1.18	1.18	99	0.030	1.67	0.04	0.11	0	0.000	0.0	0.00	2000	0.03	2.9	11.66	11.76	1.96	2.54	0.98	0.98	2.26	2.93
679+50	ONT19	1.90	2150	25	1.23	3.13	99	0.030	1.67	0.04	0.11	0	0.000	0.0	0.00	2051	0.02	3.1	11.03	11.13	2.01	2.6	0.98	0.98	6.16	7.97
692+60	ONT20	0.65	1310	20	0.60	1.25	99	0.030	1.67	0.05	0.10	0	0.000	0.0	0.00	1211	0.05	3.8	5.38	5.48	2.68	3.47	0.98	0.98	3.29	4.26

P_2 equals the 2-yr, 24 hr rainfall depth.

Channel velocities were calculated using Manning's Formula in FlowMaster, under the following assumptions: Small Roadside channels - n=0.035, 3:1 side slopes, 1' depth; with iteration

$$T_i = (0.42*L_i*n)^{0.8}/P_2^{0.5}/S^{0.4}$$

$$T_{t1} = L_s/V/60$$

$$T_{t2} = L_t/(60*V)$$

Manning's values for sheet flow: 0.011 for paved/smooth surfaces; 0.03 for riprap.

Appendix A
Proposed Conditions
Onsite C Values

Onsite Watershed	Total Area (ac)	$C_{unimproved}$			$C_{impervious}$		$C_{combined}$	
		$C_{10\text{-}yr}$	$C_{25\text{-}yr}$	Unimproved Area (ac)	$C_{10,25\text{-}yr}$	Impervious Area (ac)	10-yr	25-yr
ONL01	1.17	0.30	0.35	0.00	0.98	1.17	0.98	0.98
ONL02	0.41	0.30	0.35	0.00	0.98	0.41	0.98	0.98
ONL03	0.61	0.30	0.35	0.61	0.98	0.00	0.30	0.35
ONL04	0.32	0.30	0.35	0.00	0.98	0.32	0.98	0.98
ONL05	0.29	0.30	0.35	0.00	0.98	0.29	0.98	0.98
ONL06	0.29	0.30	0.35	0.00	0.98	0.29	0.98	0.98
ONL07	0.23	0.30	0.35	0.00	0.98	0.23	0.98	0.98
ONL08	0.23	0.30	0.35	0.00	0.98	0.23	0.98	0.98
ONL09	0.70	0.30	0.35	0.00	0.98	0.70	0.98	0.98
ONL10	0.46	0.30	0.35	0.00	0.98	0.46	0.98	0.98
ONL11	1.21	0.30	0.35	0.00	0.98	1.21	0.98	0.98
ONL12	0.36	0.30	0.35	0.00	0.98	0.36	0.98	0.98
ONL13	1.50	0.30	0.35	0.00	0.98	1.50	0.98	0.98
ONL14	0.13	0.30	0.35	0.00	0.98	0.13	0.98	0.98
ONL15	0.85	0.30	0.35	0.00	0.98	0.85	0.98	0.98
ONL16	0.32	0.30	0.35	0.00	0.98	0.32	0.98	0.98
ONL17	0.83	0.30	0.35	0.00	0.98	0.83	0.98	0.98
ONL18	1.86	0.30	0.35	0.00	0.98	1.86	0.98	0.98
ONL19	0.57	0.30	0.35	0.00	0.98	0.57	0.98	0.98
ONL20	0.63	0.30	0.35	0.00	0.98	0.63	0.98	0.98
ONL21	1.76	0.30	0.35	0.00	0.98	1.76	0.98	0.98
ONL22a	0.50	0.30	0.35	0.00	0.98	0.50	0.98	0.98
ONL22b	0.94	0.30	0.35	0.00	0.98	0.94	0.98	0.98
ONL22c	0.47	0.30	0.35	0.00	0.98	0.47	0.98	0.98
ONL23	0.24	0.30	0.35	0.00	0.98	0.24	0.98	0.98
ONL24	1.24	0.30	0.35	0.00	0.98	1.24	0.98	0.98
ONL25a	0.69	0.30	0.35	0.00	0.98	0.69	0.98	0.98
ONL25b	0.79	0.30	0.35	0.00	0.98	0.79	0.98	0.98
ONL26a	0.51	0.30	0.35	0.00	0.98	0.51	0.98	0.98
ONL26b	1.03	0.30	0.35	0.00	0.98	1.03	0.98	0.98
ONL26c	0.50	0.30	0.35	0.00	0.98	0.50	0.98	0.98
ONL27a	0.77	0.30	0.35	0.00	0.98	0.77	0.98	0.98
ONL27b	1.06	0.30	0.35	0.00	0.98	1.06	0.98	0.98
ONL28	0.61	0.30	0.35	0.00	0.98	0.61	0.98	0.98
ONL29	0.49	0.30	0.35	0.00	0.98	0.49	0.98	0.98
ONL30	0.12	0.30	0.35	0.00	0.98	0.12	0.98	0.98
ONL31	0.87	0.30	0.35	0.00	0.98	0.87	0.98	0.98
ONL32	1.42	0.30	0.35	0.00	0.98	1.42	0.98	0.98
ONL34	0.98	0.30	0.35	0.00	0.98	0.98	0.98	0.98
ONL35	0.77	0.30	0.35	0.00	0.98	0.77	0.98	0.98

Appendix A
Proposed Conditions
Onsite C Values

Onsite Watershed	Total Area (ac)	$C_{unimproved}$			$C_{impervious}$		$C_{combined}$	
		$C_{10\text{-}yr}$	$C_{25\text{-}yr}$	Unimproved Area (ac)	$C_{10,25\text{-}yr}$	Impervious Area (ac)	10-yr	25-yr
ONL36	0.36	0.30	0.35	0.00	0.98	0.36	0.98	0.98
ONL37	0.83	0.30	0.35	0.00	0.98	0.83	0.98	0.98
ONL38	0.88	0.30	0.35	0.00	0.98	0.88	0.98	0.98
ONL39a	0.49	0.30	0.35	0.00	0.98	0.49	0.98	0.98
ONL39b	0.41	0.30	0.35	0.00	0.98	0.41	0.98	0.98
ONL40	0.75	0.30	0.35	0.00	0.98	0.75	0.98	0.98
ONL41a	0.51	0.30	0.35	0.00	0.98	0.51	0.98	0.98
ONL41b	0.56	0.30	0.35	0.00	0.98	0.56	0.98	0.98
ONL42	0.64	0.30	0.35	0.00	0.98	0.64	0.98	0.98
ONL43	0.25	0.30	0.35	0.00	0.98	0.25	0.98	0.98
ONL44	0.55	0.30	0.35	0.00	0.98	0.55	0.98	0.98
ONL45	0.57	0.30	0.35	0.00	0.98	0.57	0.98	0.98
ONL46	0.55	0.30	0.35	0.00	0.98	0.55	0.98	0.98
ONL47	0.13	0.30	0.35	0.00	0.98	0.13	0.98	0.98
ONL48	0.67	0.30	0.35	0.00	0.98	0.67	0.98	0.98
ONL49	0.58	0.30	0.35	0.00	0.98	0.58	0.98	0.98
ONL50	0.57	0.30	0.35	0.00	0.98	0.57	0.98	0.98
ONL51	0.80	0.30	0.35	0.00	0.98	0.80	0.98	0.98
ONL52	0.26	0.30	0.35	0.00	0.98	0.26	0.98	0.98
ONL53	0.53	0.30	0.35	0.00	0.98	0.53	0.98	0.98
ONL54	0.92	0.30	0.35	0.00	0.98	0.92	0.98	0.98
ONL55a	0.51	0.30	0.35	0.00	0.98	0.51	0.98	0.98
ONL55b	0.55	0.30	0.35	0.00	0.98	0.55	0.98	0.98
ONL56	1.99	0.30	0.35	0.00	0.98	1.99	0.98	0.98
ONL57a	0.59	0.30	0.35	0.00	0.98	0.59	0.98	0.98
ONL57b	0.70	0.30	0.35	0.00	0.98	0.70	0.98	0.98
ONL58	0.23	0.30	0.35	0.00	0.98	0.23	0.98	0.98
ONL59	0.77	0.30	0.35	0.00	0.98	0.77	0.98	0.98
ONL60	1.57	0.30	0.35	0.00	0.98	1.57	0.98	0.98
ONL61	0.57	0.30	0.35	0.00	0.98	0.57	0.98	0.98
ONL62	0.23	0.30	0.35	0.23	0.98	0.00	0.30	0.35
ONL49, ONL03	1.19	0.30	0.35	0.61	0.98	0.58	0.63	0.66
ONT01	0.07	0.30	0.35	0.00	0.98	0.07	0.98	0.98
ONT02	0.58	0.30	0.35	0.00	0.98	0.58	0.98	0.98
ONT03	0.92	0.30	0.35	0.00	0.98	0.92	0.98	0.98
ONT04	0.52	0.30	0.35	0.00	0.98	0.52	0.98	0.98
ONT05	1.40	0.30	0.35	0.00	0.98	1.40	0.98	0.98
ONT06	0.26	0.30	0.35	0.00	0.98	0.26	0.98	0.98
ONT07	0.29	0.30	0.35	0.00	0.98	0.29	0.98	0.98
ONT08	1.34	0.30	0.35	0.00	0.98	1.34	0.98	0.98
ONT09	1.34	0.30	0.35	0.00	0.98	1.34	0.98	0.98

Appendix A
Proposed Conditions
Onsite C Values

Onsite Watershed	Total Area (ac)	$C_{unimproved}$			$C_{impervious}$		$C_{combined}$	
		$C_{10\text{-}yr}$	$C_{25\text{-}yr}$	Unimproved Area (ac)	$C_{10,25\text{-}yr}$	Impervious Area (ac)	10-yr	25-yr
ONT10	0.57	0.30	0.35	0.00	0.98	0.57	0.98	0.98
ONT11	0.11	0.30	0.35	0.00	0.98	0.11	0.98	0.98
ONT12	0.84	0.30	0.35	0.00	0.98	0.84	0.98	0.98
ONT13	0.22	0.30	0.35	0.00	0.98	0.22	0.98	0.98
ONT14	1.59	0.30	0.35	0.00	0.98	1.59	0.98	0.98
ONT15	1.75	0.30	0.35	0.00	0.98	1.75	0.98	0.98
ONT16	1.55	0.30	0.35	0.00	0.98	1.55	0.98	0.98
ONT17	1.46	0.30	0.35	0.00	0.98	1.46	0.98	0.98
ONT18	0.84	0.30	0.35	0.00	0.98	0.84	0.98	0.98
ONT19	1.90	0.30	0.35	0.00	0.98	1.90	0.98	0.98
ONT20	0.65	0.30	0.35	0.00	0.98	0.65	0.98	0.98

Appendix A
Proposed USGS Regression Calculations

WSLH22*

Area (sq. mi.)	13.4
Mean Basin Elevation (ft.)	5480
Latitude (Dec. Degrees)	39.46

Q2 =	51.0	cfs
Q5 =	200.1	cfs
Q10=	430.2	cfs
Q25=	971.5	cfs
Q50=	1603.2	cfs
Q100=	2449.8	cfs

WSLH37

Area (sq. mi.)	2.7
Mean Basin Elevation (ft.)	5080
Latitude (Dec. Degrees)	39.44

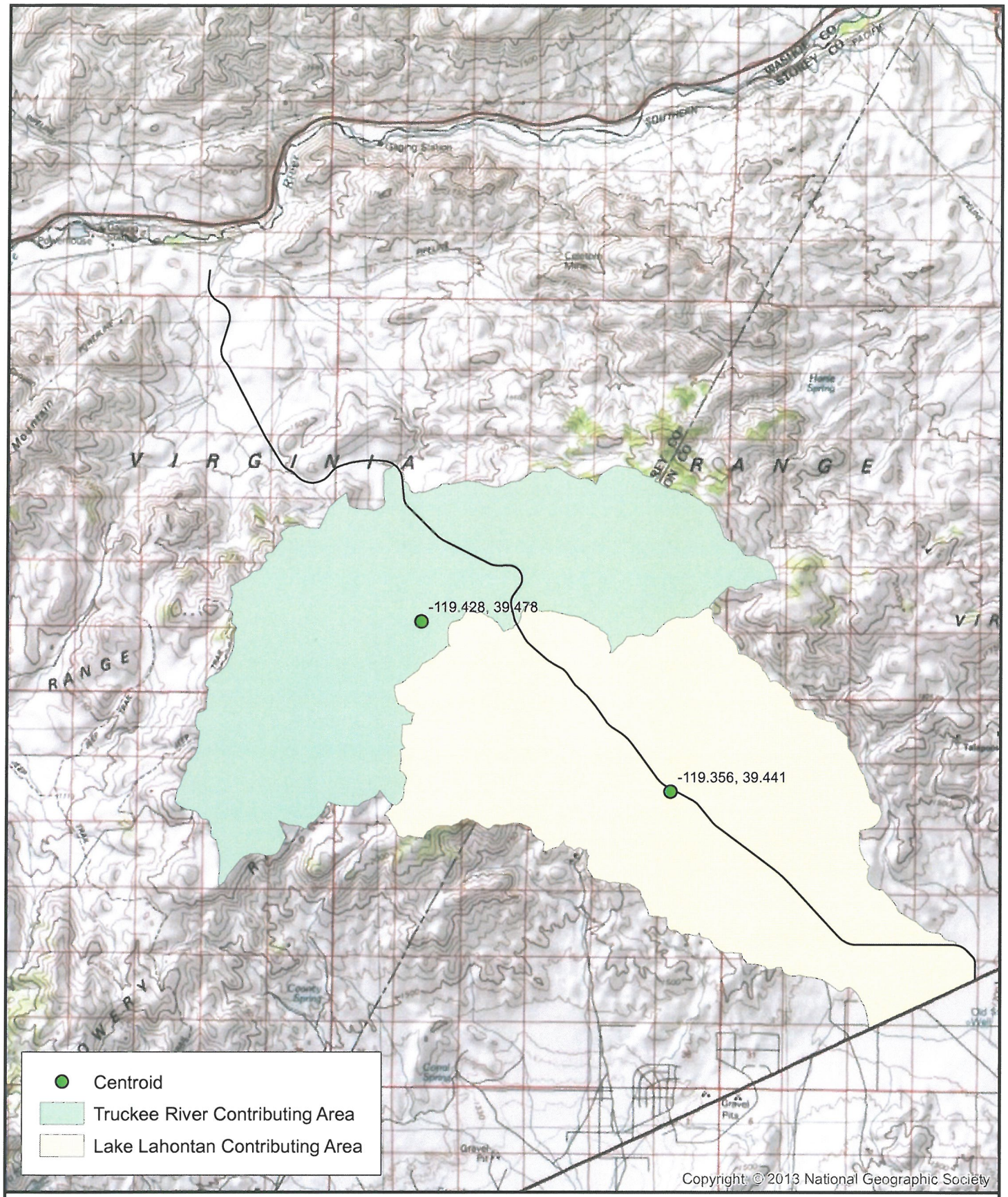
Q2 =	10.6	cfs
Q5 =	49.6	cfs
Q10=	114.5	cfs
Q25=	287.3	cfs
Q50=	507.7	cfs
Q100=	824.4	cfs

WSLH38**

Area (sq. mi.)	29.4
Mean Basin Elevation (ft.)	5000
Latitude (Dec. Degrees)	39.44

Q2 =	77.2	cfs
Q5 =	345.0	cfs
Q10=	815.2	cfs
Q25=	2014.1	cfs
Q50=	3475.9	cfs
Q100=	5474.6	cfs

Notes:
Analysis based on USGS Fact Sheet 123-98, September, 1999
Region 5 Equations were applied.
The mean basin elevation for allwatersheds is located below the minimum limit of 5770' (see applicable ranges in USGS Fact Sheet).
However, a physically lower mean elevation was considered to yield conservative peak flows.
*Includes basin 1-23, 47 and 47a



APPENDIX A

LOCATIONS FOR NOAA PRECIPITATION ESTIMATES

30% PREFERRED ALTERNATIVE DESIGN REPORT

STOREY AND LYON COUNTY, NEVADA

NOVEMBER, 2013

NOTES

NORTH

0 1 2

MILES

WOOD RODGERS
DEVELOPING INNOVATIVE DESIGN SOLUTIONS
5440 Reno Corporate Drive Tel: 775.823.4068
Reno, NV 89511 Fax: 775.823.4066

Watersheds Draining to Lake Lahontan

NOAA Atlas 14, Volume 1, Version 5
Location name: Silver Springs, Nevada, US*
Coordinates: 39.4413, -119.3562
Elevation: 4989ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphics | Maps & aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.28 (1.09-1.54)	1.62 (1.37-1.94)	2.17 (1.84-2.60)	2.66 (2.23-3.20)	3.47 (2.83-4.20)	4.20 (3.34-5.14)	5.06 (3.90-6.25)	6.08 (4.52-7.67)	7.73 (5.44-10.1)	9.24 (6.20-12.3)
10-min	0.984 (0.828-1.17)	1.24 (1.04-1.48)	1.65 (1.39-1.99)	2.03 (1.70-2.44)	2.64 (2.15-3.20)	3.20 (2.54-3.91)	3.86 (2.97-4.76)	4.63 (3.44-5.84)	5.88 (4.14-7.66)	7.03 (4.72-9.35)
15-min	0.812 (0.684-0.968)	1.02 (0.864-1.22)	1.36 (1.15-1.64)	1.68 (1.41-2.02)	2.18 (1.78-2.64)	2.64 (2.10-3.23)	3.18 (2.46-3.93)	3.83 (2.84-4.82)	4.86 (3.42-6.33)	5.81 (3.90-7.73)
30-min	0.546 (0.462-0.652)	0.686 (0.582-0.822)	0.920 (0.776-1.11)	1.13 (0.948-1.36)	1.47 (1.20-1.78)	1.78 (1.41-2.17)	2.14 (1.65-2.65)	2.58 (1.91-3.25)	3.27 (2.30-4.26)	3.91 (2.62-5.21)
60-min	0.338 (0.286-0.404)	0.425 (0.360-0.508)	0.569 (0.480-0.684)	0.699 (0.586-0.840)	0.910 (0.742-1.10)	1.10 (0.874-1.35)	1.33 (1.02-1.64)	1.60 (1.19-2.01)	2.03 (1.43-2.64)	2.42 (1.62-3.22)
2-hr	0.219 (0.190-0.260)	0.274 (0.238-0.324)	0.354 (0.302-0.418)	0.421 (0.356-0.498)	0.524 (0.432-0.622)	0.612 (0.494-0.736)	0.717 (0.565-0.871)	0.846 (0.648-1.04)	1.06 (0.780-1.34)	1.27 (0.897-1.63)
3-hr	0.173 (0.151-0.201)	0.217 (0.190-0.254)	0.274 (0.237-0.320)	0.320 (0.275-0.375)	0.386 (0.326-0.453)	0.444 (0.368-0.525)	0.511 (0.417-0.611)	0.585 (0.476-0.722)	0.736 (0.571-0.909)	0.865 (0.655-1.09)
6-hr	0.120 (0.105-0.138)	0.150 (0.131-0.174)	0.187 (0.162-0.217)	0.216 (0.187-0.251)	0.256 (0.218-0.298)	0.287 (0.241-0.336)	0.318 (0.264-0.376)	0.359 (0.292-0.429)	0.421 (0.335-0.512)	0.479 (0.373-0.591)
12-hr	0.078 (0.068-0.090)	0.099 (0.086-0.114)	0.126 (0.109-0.145)	0.147 (0.127-0.169)	0.175 (0.150-0.203)	0.197 (0.167-0.230)	0.219 (0.183-0.259)	0.242 (0.199-0.289)	0.273 (0.218-0.331)	0.300 (0.235-0.369)
24-hr	0.049 (0.044-0.055)	0.062 (0.055-0.070)	0.081 (0.072-0.091)	0.096 (0.085-0.108)	0.117 (0.102-0.132)	0.133 (0.116-0.151)	0.151 (0.130-0.171)	0.169 (0.144-0.193)	0.195 (0.163-0.223)	0.215 (0.178-0.249)
2-day	0.029 (0.025-0.033)	0.037 (0.032-0.042)	0.049 (0.043-0.056)	0.058 (0.051-0.066)	0.072 (0.062-0.082)	0.083 (0.071-0.095)	0.095 (0.081-0.109)	0.107 (0.090-0.124)	0.125 (0.103-0.146)	0.140 (0.113-0.165)
3-day	0.021 (0.019-0.024)	0.027 (0.024-0.031)	0.036 (0.032-0.041)	0.043 (0.038-0.050)	0.054 (0.046-0.061)	0.062 (0.053-0.071)	0.071 (0.060-0.082)	0.081 (0.066-0.093)	0.094 (0.076-0.110)	0.106 (0.086-0.124)
4-day	0.017 (0.015-0.020)	0.022 (0.020-0.025)	0.030 (0.026-0.034)	0.036 (0.031-0.041)	0.045 (0.039-0.051)	0.052 (0.044-0.059)	0.059 (0.050-0.068)	0.067 (0.057-0.077)	0.079 (0.065-0.092)	0.088 (0.072-0.103)
7-day	0.012 (0.010-0.013)	0.015 (0.013-0.017)	0.020 (0.017-0.023)	0.024 (0.021-0.028)	0.030 (0.026-0.035)	0.035 (0.030-0.040)	0.040 (0.034-0.047)	0.046 (0.038-0.053)	0.054 (0.044-0.063)	0.060 (0.049-0.071)
10-day	0.009 (0.008-0.011)	0.012 (0.010-0.014)	0.016 (0.014-0.018)	0.019 (0.017-0.022)	0.024 (0.020-0.027)	0.027 (0.023-0.031)	0.031 (0.026-0.036)	0.035 (0.029-0.041)	0.041 (0.034-0.048)	0.045 (0.037-0.054)
20-day	0.006 (0.005-0.007)	0.008 (0.007-0.009)	0.010 (0.009-0.012)	0.012 (0.010-0.014)	0.015 (0.013-0.017)	0.017 (0.014-0.019)	0.019 (0.016-0.022)	0.021 (0.018-0.024)	0.024 (0.020-0.028)	0.027 (0.022-0.031)
30-day	0.005 (0.004-0.005)	0.006 (0.005-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.012 (0.010-0.013)	0.013 (0.011-0.015)	0.015 (0.013-0.017)	0.017 (0.014-0.019)	0.019 (0.016-0.022)	0.021 (0.017-0.025)
45-day	0.004 (0.003-0.004)	0.005 (0.004-0.005)	0.006 (0.005-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.012)	0.012 (0.010-0.014)	0.013 (0.011-0.015)	0.015 (0.013-0.018)	0.017 (0.014-0.020)
60-day	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.007-0.010)	0.010 (0.008-0.011)	0.011 (0.009-0.012)	0.012 (0.010-0.014)	0.013 (0.011-0.016)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Watersheds Draining to Lake Lahontan

NOAA Atlas 14, Volume 1, Version 5
Location name: Silver Springs, Nevada, US*
Coordinates: 39.4413, -119.3562
Elevation: 4989ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.107 (0.091-0.128)	0.136 (0.114-0.162)	0.181 (0.153-0.217)	0.222 (0.186-0.267)	0.289 (0.236-0.350)	0.350 (0.278-0.426)	0.422 (0.325-0.521)	0.507 (0.377-0.639)	0.644 (0.453-0.839)	0.770 (0.517-1.02)
10-min	0.164 (0.138-0.195)	0.206 (0.174-0.246)	0.275 (0.232-0.331)	0.338 (0.284-0.406)	0.440 (0.359-0.533)	0.533 (0.423-0.651)	0.642 (0.495-0.793)	0.772 (0.573-0.973)	0.980 (0.690-1.28)	1.17 (0.786-1.56)
15-min	0.203 (0.171-0.242)	0.255 (0.216-0.305)	0.341 (0.288-0.410)	0.420 (0.352-0.504)	0.546 (0.445-0.661)	0.661 (0.525-0.807)	0.796 (0.614-0.983)	0.957 (0.711-1.21)	1.22 (0.855-1.58)	1.45 (0.974-1.93)
30-min	0.273 (0.231-0.326)	0.343 (0.291-0.411)	0.460 (0.388-0.553)	0.565 (0.474-0.679)	0.735 (0.600-0.890)	0.890 (0.706-1.08)	1.07 (0.827-1.32)	1.29 (0.957-1.63)	1.64 (1.15-2.13)	1.96 (1.31-2.60)
60-min	0.338 (0.286-0.404)	0.425 (0.360-0.508)	0.569 (0.480-0.684)	0.699 (0.586-0.840)	0.910 (0.742-1.10)	1.10 (0.874-1.35)	1.33 (1.02-1.64)	1.60 (1.19-2.01)	2.03 (1.43-2.64)	2.42 (1.62-3.22)
2-hr	0.438 (0.379-0.519)	0.549 (0.475-0.649)	0.707 (0.604-0.837)	0.842 (0.712-0.996)	1.05 (0.863-1.25)	1.22 (0.988-1.47)	1.43 (1.13-1.74)	1.69 (1.30-2.08)	2.13 (1.56-2.69)	2.53 (1.79-3.27)
3-hr	0.521 (0.453-0.605)	0.651 (0.571-0.762)	0.822 (0.711-0.961)	0.962 (0.825-1.13)	1.16 (0.979-1.36)	1.33 (1.11-1.58)	1.54 (1.25-1.84)	1.79 (1.43-2.17)	2.21 (1.72-2.73)	2.60 (1.97-3.29)
6-hr	0.717 (0.626-0.825)	0.898 (0.784-1.04)	1.12 (0.972-1.30)	1.30 (1.12-1.50)	1.53 (1.31-1.79)	1.72 (1.44-2.01)	1.91 (1.58-2.25)	2.15 (1.75-2.57)	2.52 (2.01-3.06)	2.87 (2.24-3.54)
12-hr	0.943 (0.824-1.08)	1.19 (1.04-1.37)	1.51 (1.32-1.74)	1.77 (1.53-2.03)	2.11 (1.80-2.44)	2.37 (2.01-2.77)	2.64 (2.21-3.12)	2.92 (2.40-3.48)	3.29 (2.63-3.98)	3.61 (2.83-4.44)
24-hr	1.18 (1.05-1.32)	1.49 (1.33-1.69)	1.94 (1.72-2.19)	2.29 (2.03-2.59)	2.80 (2.45-3.16)	3.20 (2.78-3.62)	3.62 (3.12-4.11)	4.06 (3.46-4.63)	4.67 (3.92-5.36)	5.17 (4.26-5.98)
2-day	1.39 (1.22-1.59)	1.77 (1.56-2.02)	2.34 (2.06-2.67)	2.80 (2.44-3.19)	3.46 (2.98-3.94)	3.99 (3.42-4.56)	4.55 (3.87-5.23)	5.16 (4.33-5.96)	6.02 (4.95-7.02)	6.72 (5.44-7.91)
3-day	1.52 (1.34-1.74)	1.95 (1.72-2.23)	2.60 (2.28-2.97)	3.12 (2.72-3.57)	3.87 (3.35-4.42)	4.47 (3.84-5.12)	5.12 (4.35-5.88)	5.81 (4.88-6.70)	6.80 (5.60-7.90)	7.60 (6.17-8.91)
4-day	1.66 (1.46-1.90)	2.14 (1.88-2.44)	2.86 (2.51-3.28)	3.44 (3.01-3.94)	4.28 (3.71-4.89)	4.96 (4.26-5.68)	5.69 (4.84-6.53)	6.46 (5.44-7.44)	7.57 (6.26-8.76)	8.48 (6.90-9.91)
7-day	1.96 (1.70-2.25)	2.51 (2.19-2.90)	3.37 (2.93-3.90)	4.07 (3.53-4.70)	5.07 (4.35-5.86)	5.88 (5.01-6.80)	6.75 (5.70-7.83)	7.68 (6.42-8.94)	9.02 (7.40-10.6)	10.1 (8.19-11.9)
10-day	2.20 (1.91-2.54)	2.84 (2.48-3.28)	3.81 (3.31-4.41)	4.58 (3.96-5.30)	5.66 (4.85-6.55)	6.52 (5.56-7.56)	7.44 (6.29-8.64)	8.41 (7.04-9.80)	9.78 (8.06-11.5)	10.9 (8.85-12.9)
20-day	2.83 (2.48-3.24)	3.66 (3.21-4.20)	4.85 (4.24-5.56)	5.77 (5.03-6.62)	7.02 (6.08-8.06)	8.00 (6.88-9.21)	9.03 (7.70-10.4)	10.1 (8.53-11.7)	11.6 (9.62-13.5)	12.7 (10.5-14.9)
30-day	3.33 (2.91-3.84)	4.32 (3.78-4.97)	5.74 (5.00-6.61)	6.84 (5.93-7.88)	8.34 (7.18-9.61)	9.53 (8.15-11.0)	10.8 (9.14-12.4)	12.0 (10.1-14.0)	13.8 (11.5-16.1)	15.2 (12.5-17.8)
45-day	3.95 (3.44-4.50)	5.13 (4.48-5.83)	6.80 (5.92-7.76)	8.11 (7.02-9.26)	9.86 (8.50-11.3)	11.3 (9.64-13.0)	12.8 (10.8-14.7)	14.3 (12.0-16.5)	16.5 (13.6-19.2)	18.2 (14.9-21.3)
60-day	4.52 (3.93-5.16)	5.89 (5.14-6.71)	7.84 (6.81-8.94)	9.26 (8.02-10.6)	11.1 (9.58-12.7)	12.5 (10.8-14.4)	14.0 (11.9-16.1)	15.5 (13.1-17.9)	17.5 (14.6-20.3)	19.2 (15.8-22.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Watersheds Draining to Truckee River

NOAA Atlas 14, Volume 1, Version 5
Location name: Silver Springs, Nevada, US*
Coordinates: 39.4783, -119.4281
Elevation: 5638ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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NOAA, National Weather Service, Silver Spring, Maryland

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PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.33 (1.13-1.58)	1.67 (1.42-1.99)	2.23 (1.88-2.68)	2.74 (2.29-3.28)	3.55 (2.90-4.30)	4.30 (3.42-5.26)	5.17 (4.00-6.40)	6.20 (4.62-7.85)	7.88 (5.56-10.3)	9.43 (6.34-12.6)
10-min	1.01 (0.858-1.20)	1.27 (1.08-1.52)	1.70 (1.43-2.03)	2.09 (1.75-2.50)	2.71 (2.21-3.27)	3.27 (2.60-4.00)	3.93 (3.04-4.87)	4.72 (3.52-5.98)	5.99 (4.22-7.86)	7.18 (4.82-9.63)
15-min	0.836 (0.708-0.996)	1.05 (0.888-1.25)	1.40 (1.18-1.68)	1.72 (1.44-2.06)	2.24 (1.82-2.70)	2.70 (2.15-3.30)	3.25 (2.51-4.02)	3.90 (2.91-4.94)	4.96 (3.49-6.50)	5.93 (3.98-7.96)
30-min	0.564 (0.476-0.670)	0.706 (0.600-0.844)	0.946 (0.796-1.13)	1.16 (0.972-1.39)	1.50 (1.23-1.82)	1.82 (1.45-2.22)	2.19 (1.69-2.71)	2.63 (1.96-3.33)	3.34 (2.35-4.37)	3.99 (2.68-5.36)
60-min	0.349 (0.294-0.415)	0.437 (0.371-0.522)	0.585 (0.493-0.700)	0.718 (0.602-0.860)	0.931 (0.761-1.13)	1.13 (0.895-1.38)	1.35 (1.05-1.68)	1.63 (1.21-2.06)	2.07 (1.46-2.71)	2.47 (1.66-3.32)
2-hr	0.228 (0.198-0.270)	0.285 (0.248-0.336)	0.366 (0.314-0.433)	0.436 (0.369-0.515)	0.540 (0.446-0.642)	0.631 (0.511-0.758)	0.738 (0.583-0.898)	0.871 (0.668-1.07)	1.10 (0.806-1.38)	1.31 (0.928-1.69)
3-hr	0.182 (0.159-0.211)	0.228 (0.200-0.265)	0.286 (0.248-0.333)	0.334 (0.287-0.390)	0.402 (0.340-0.470)	0.460 (0.383-0.543)	0.529 (0.433-0.632)	0.617 (0.494-0.747)	0.764 (0.594-0.942)	0.899 (0.683-1.13)
6-hr	0.128 (0.112-0.147)	0.161 (0.141-0.186)	0.199 (0.174-0.231)	0.230 (0.199-0.267)	0.271 (0.232-0.316)	0.303 (0.255-0.354)	0.335 (0.278-0.395)	0.376 (0.307-0.450)	0.440 (0.352-0.535)	0.501 (0.393-0.618)
12-hr	0.086 (0.075-0.098)	0.108 (0.095-0.124)	0.137 (0.119-0.157)	0.160 (0.138-0.184)	0.190 (0.163-0.220)	0.214 (0.181-0.250)	0.238 (0.199-0.281)	0.263 (0.215-0.313)	0.295 (0.236-0.358)	0.323 (0.253-0.398)
24-hr	0.055 (0.049-0.062)	0.070 (0.062-0.079)	0.090 (0.080-0.102)	0.107 (0.094-0.121)	0.130 (0.114-0.147)	0.149 (0.129-0.169)	0.168 (0.145-0.192)	0.189 (0.161-0.216)	0.218 (0.182-0.251)	0.241 (0.199-0.280)
2-day	0.033 (0.029-0.038)	0.042 (0.037-0.049)	0.056 (0.049-0.064)	0.067 (0.058-0.077)	0.083 (0.071-0.095)	0.096 (0.082-0.110)	0.109 (0.093-0.126)	0.124 (0.104-0.144)	0.145 (0.119-0.170)	0.162 (0.131-0.192)
3-day	0.024 (0.021-0.028)	0.031 (0.027-0.036)	0.042 (0.036-0.048)	0.050 (0.044-0.058)	0.062 (0.054-0.071)	0.072 (0.062-0.083)	0.083 (0.070-0.096)	0.094 (0.079-0.109)	0.111 (0.091-0.129)	0.124 (0.100-0.146)
4-day	0.020 (0.018-0.023)	0.026 (0.023-0.030)	0.035 (0.030-0.040)	0.042 (0.036-0.048)	0.052 (0.045-0.060)	0.061 (0.052-0.070)	0.070 (0.059-0.080)	0.080 (0.066-0.092)	0.094 (0.077-0.109)	0.105 (0.085-0.123)
7-day	0.014 (0.012-0.016)	0.018 (0.015-0.020)	0.024 (0.020-0.027)	0.029 (0.025-0.033)	0.036 (0.031-0.042)	0.042 (0.035-0.049)	0.048 (0.040-0.056)	0.055 (0.046-0.064)	0.065 (0.053-0.076)	0.073 (0.059-0.087)
10-day	0.011 (0.009-0.013)	0.014 (0.012-0.016)	0.019 (0.016-0.022)	0.023 (0.020-0.026)	0.028 (0.024-0.033)	0.033 (0.028-0.038)	0.037 (0.031-0.043)	0.042 (0.035-0.049)	0.049 (0.040-0.058)	0.055 (0.044-0.065)
20-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.012 (0.011-0.014)	0.014 (0.013-0.017)	0.018 (0.015-0.020)	0.020 (0.017-0.023)	0.023 (0.019-0.026)	0.026 (0.022-0.030)	0.029 (0.024-0.035)	0.033 (0.027-0.038)
30-day	0.006 (0.005-0.006)	0.007 (0.006-0.008)	0.010 (0.009-0.011)	0.012 (0.010-0.013)	0.014 (0.012-0.016)	0.016 (0.014-0.019)	0.018 (0.016-0.021)	0.021 (0.017-0.024)	0.024 (0.020-0.028)	0.026 (0.021-0.031)
45-day	0.004 (0.004-0.005)	0.006 (0.005-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.015)	0.015 (0.012-0.017)	0.017 (0.014-0.019)	0.019 (0.016-0.022)	0.021 (0.017-0.025)
60-day	0.004 (0.003-0.004)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.010 (0.008-0.011)	0.011 (0.009-0.013)	0.012 (0.010-0.014)	0.014 (0.011-0.016)	0.015 (0.013-0.018)	0.017 (0.014-0.020)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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Watersheds Draining to the Truckee River

NOAA Atlas 14, Volume 1, Version 5
Location name: Silver Springs, Nevada, US*
Coordinates: 39.4783, -119.4281
Elevation: 5638ft*
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POINT PRECIPITATION FREQUENCY ESTIMATES

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PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.111 (0.094-0.132)	0.139 (0.118-0.166)	0.186 (0.157-0.223)	0.228 (0.191-0.273)	0.296 (0.242-0.358)	0.358 (0.285-0.438)	0.431 (0.333-0.533)	0.517 (0.385-0.654)	0.657 (0.483-0.861)	0.786 (0.528-1.05)
10-min	0.169 (0.143-0.200)	0.212 (0.180-0.253)	0.283 (0.238-0.338)	0.348 (0.291-0.416)	0.451 (0.368-0.545)	0.545 (0.433-0.666)	0.655 (0.506-0.811)	0.787 (0.586-0.997)	0.999 (0.704-1.31)	1.20 (0.803-1.61)
15-min	0.209 (0.177-0.249)	0.263 (0.222-0.313)	0.351 (0.295-0.420)	0.431 (0.361-0.516)	0.559 (0.456-0.676)	0.676 (0.537-0.828)	0.812 (0.628-1.01)	0.976 (0.727-1.24)	1.24 (0.873-1.62)	1.48 (0.996-1.99)
30-min	0.282 (0.238-0.335)	0.353 (0.300-0.422)	0.473 (0.398-0.565)	0.580 (0.486-0.695)	0.752 (0.615-0.910)	0.909 (0.723-1.11)	1.09 (0.846-1.35)	1.31 (0.978-1.66)	1.67 (1.18-2.19)	2.00 (1.34-2.68)
60-min	0.349 (0.294-0.415)	0.437 (0.371-0.522)	0.585 (0.493-0.700)	0.718 (0.602-0.860)	0.931 (0.761-1.13)	1.13 (0.895-1.38)	1.35 (1.05-1.68)	1.63 (1.21-2.06)	2.07 (1.46-2.71)	2.47 (1.66-3.32)
2-hr	0.456 (0.395-0.539)	0.570 (0.495-0.672)	0.732 (0.628-0.866)	0.872 (0.738-1.03)	1.08 (0.893-1.28)	1.26 (1.02-1.52)	1.48 (1.17-1.80)	1.74 (1.34-2.15)	2.19 (1.61-2.76)	2.62 (1.86-3.38)
3-hr	0.547 (0.476-0.633)	0.684 (0.601-0.797)	0.860 (0.746-1.00)	1.00 (0.863-1.17)	1.21 (1.02-1.41)	1.38 (1.15-1.63)	1.59 (1.30-1.90)	1.85 (1.48-2.24)	2.29 (1.79-2.83)	2.70 (2.05-3.40)
6-hr	0.769 (0.673-0.883)	0.963 (0.842-1.11)	1.19 (1.04-1.38)	1.38 (1.19-1.60)	1.62 (1.39-1.89)	1.81 (1.53-2.12)	2.00 (1.67-2.37)	2.25 (1.84-2.69)	2.64 (2.11-3.20)	3.00 (2.35-3.70)
12-hr	1.03 (0.903-1.18)	1.30 (1.14-1.50)	1.65 (1.44-1.90)	1.93 (1.67-2.21)	2.29 (1.96-2.65)	2.56 (2.16-3.01)	2.87 (2.40-3.38)	3.17 (2.60-3.77)	3.55 (2.84-4.31)	3.89 (3.05-4.80)
24-hr	1.32 (1.17-1.49)	1.67 (1.49-1.89)	2.17 (1.92-2.45)	2.56 (2.26-2.90)	3.12 (2.73-3.53)	3.57 (3.10-4.05)	4.04 (3.48-4.60)	4.54 (3.86-5.18)	5.23 (4.38-6.01)	5.79 (4.78-6.71)
2-day	1.60 (1.40-1.83)	2.04 (1.79-2.33)	2.69 (2.35-3.08)	3.22 (2.80-3.68)	3.98 (3.42-4.55)	4.59 (3.93-5.27)	5.25 (4.45-6.06)	5.96 (4.98-6.91)	6.97 (5.71-8.16)	7.79 (6.28-9.21)
3-day	1.76 (1.54-2.02)	2.26 (1.98-2.58)	3.00 (2.63-3.45)	3.61 (3.14-4.14)	4.49 (3.87-5.15)	5.20 (4.45-5.98)	5.97 (5.05-6.89)	6.80 (5.68-7.87)	7.98 (6.54-9.31)	8.94 (7.21-10.5)
4-day	1.92 (1.68-2.21)	2.47 (2.17-2.84)	3.32 (2.90-3.82)	4.01 (3.48-4.61)	5.00 (4.31-5.74)	5.82 (4.96-6.68)	6.70 (5.66-7.71)	7.63 (6.38-8.82)	8.98 (7.36-10.5)	10.1 (8.14-11.8)
7-day	2.28 (1.99-2.65)	2.95 (2.56-3.41)	3.98 (3.44-4.62)	4.82 (4.16-5.59)	6.03 (5.16-7.00)	7.03 (5.95-8.16)	8.10 (6.80-9.43)	9.26 (7.68-10.8)	10.9 (8.89-12.9)	12.3 (9.87-14.8)
10-day	2.59 (2.25-3.01)	3.36 (2.92-3.89)	4.52 (3.91-5.24)	5.45 (4.70-6.33)	6.76 (5.77-7.85)	7.82 (6.63-9.08)	8.95 (7.52-10.4)	10.1 (8.44-11.9)	11.6 (9.70-14.0)	13.2 (10.7-15.7)
20-day	3.38 (2.95-3.89)	4.38 (3.82-5.04)	5.81 (5.06-6.70)	6.94 (6.02-8.00)	8.48 (7.30-9.78)	9.69 (8.29-11.2)	11.0 (9.29-12.7)	12.3 (10.3-14.3)	14.1 (11.7-16.6)	15.6 (12.8-18.5)
30-day	4.03 (3.51-4.66)	5.23 (4.55-6.04)	6.98 (6.04-8.07)	8.34 (7.19-9.64)	10.2 (8.74-11.8)	11.7 (9.94-13.6)	13.2 (11.2-15.4)	14.9 (12.4-17.3)	17.1 (14.1-20.1)	18.9 (15.4-22.3)
45-day	4.84 (4.21-5.55)	6.29 (5.47-7.19)	8.38 (7.25-9.60)	10.0 (8.62-11.5)	12.2 (10.5-14.1)	14.0 (11.9-16.2)	15.9 (13.4-18.4)	17.8 (14.9-20.7)	20.6 (16.9-24.1)	22.9 (18.6-27.0)
60-day	5.61 (4.86-6.44)	7.34 (6.36-8.41)	9.79 (8.45-11.2)	11.6 (9.98-13.3)	13.9 (11.9-16.0)	15.8 (13.4-18.2)	17.6 (14.9-20.4)	19.5 (16.4-22.7)	22.2 (18.4-25.9)	24.3 (19.9-28.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

Thick mulches in forests are associated with low retardance factors and reflect high degrees of retardance, as well as high infiltration rates. Hay meadows have relatively low retardance factors. Like thick mulches in forests, stem densities in meadows provide a high degree of retardance to overland flow in small watersheds. Conversely, bare surfaces with little retardance to overland flows are represented by high retardance factors.

The retardance factor is approximately the same as the curve number (CN) as defined in NEH630.09, Hydrologic Soil-Cover Complexes. In practical usage, CN is used as a surrogate for cn', and the CN tables in NEH 630.09 may be used to approximate cn' in equations 15–4a and 15–4b. A CN of less than 60, or greater than 95 should not be used in the solution of equations 15–4a and 15–4b (Mockus 1961).

Applications and limitations—The watershed lag equation was developed using data from 24 watersheds ranging in size from 1.3 acres to 8.2 square miles, with the majority of the watersheds being less than 2,000 acres in size (Mockus 1961). Folmar and Miller (2000) revisited the development of this equation using additional watershed data and found that a reasonable upper limit may be as much as 19 square miles.

(b) Velocity method

Another method for determining time of concentration normally used within the NRCS is called the velocity method. The velocity method assumes that time of concentration is the sum of travel times for segments along the hydraulically most distant flow path.

$$T_c = T_{t1} + T_{t2} + T_{t3} + \ldots T_{tn} \qquad \text{(eq. 15–7)}$$

where:

T_c = time of concentration, h

T_{tn} = travel time of a segment n, h

n = number of segments comprising the total hydraulic length

The segments used in the velocity method may be of three types: sheet flow, shallow concentrated flow, and open channel flow.

Sheet flow—Sheet flow is defined as flow over plane surfaces. Sheet flow usually occurs in the headwaters of a stream near the ridgeline that defines the watershed boundary. Typically, sheet flow occurs for no more than 100 feet before transitioning to shallow concentrated flow (Merkel 2001).

A simplified version of the Manning's kinematic solution may be used to compute travel time for sheet flow. This simplified form of the kinematic equation was developed by Wells and Woodward (1986) after studying the impact of various parameters on the estimates.

$$T_t = \frac{0.007(nl)^{0.8}}{(P_2)^{0.5}\, S^{0.4}} \qquad \text{(eq. 15–8)}$$

where:

T_t = travel time, h

n = Manning's roughness coefficient (table 15–1)

l = sheet flow length, ft

P_2 = 2-year, 24-hour rainfall, in

S = slope of land surface, ft/ft

Table 15–1 Manning's roughness coefficients for sheet flow (flow depth generally ≤ 0.1 ft)

Surface description	n [2]
Smooth surface (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤ 20%	0.06
Residue cover > 20%	0.17
Grass:	
Short-grass prairie	0.15
Dense grasses [3]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:	
Light underbrush	0.40
Dense underbrush	0.80

1 The Manning's n values are a composite of information compiled by Engman (1986).

2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

3 When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

This simplification is based on the following assumptions:

- shallow steady uniform flow
- constant rainfall excess intensity (that part of a rain available for runoff) both temporally and spatially
- 2-year, 24-hour rainfall assuming standard NRCS rainfall intensity-duration relations apply (Types I, II, and III)
- minor effect of infiltration on travel time

For sheet flow, the roughness coefficient includes the effects of roughness and the effects of raindrop impact including drag over the surface; obstacles such as litter, crop ridges, and rocks; and erosion and transport of sediment. These *n* values are only applicable for flow depths of approximately 0.1 foot or less, where sheet flow occurs. Table 15–1 gives roughness coefficient values for sheet flow for various surface conditions.

Kibler and Aron (1982) and others indicated the maximum sheet flow length is less than 100 feet. To support the sheet flow limit of 100 feet, Merkel (2001) reviewed a number of technical papers on sheet flow. McCuen and Spiess (1995) indicated that use of flow length as the limiting variable in the equation 15–8 could lead to less accurate designs, and proposed that the limitation should instead be based on:

$$\ell = \frac{100\sqrt{S}}{n} \qquad \text{(eq. 15–9)}$$

where:

n = Manning's roughness coefficient
ℓ = limiting length of flow, ft
S = slope, ft/ft

Table 15–2 provides maximum sheet flow lengths based on the McCuen-Spiess limiting criteria for various cover type—*n* value—slope combinations.

Table 15–2 Maximum sheet flow lengths using the McCuen-Spiess limitation criterion

Cover type	*n* values	Slope (ft/ft)	Length (ft)
Range	0.13	0.01	77
Grass	0.41	0.01	24
Woods	0.80	0.01	12.5
Range	0.13	0.05	172
Grass	0.41	0.05	55
Woods	0.80	0.05	28

Shallow concentrated flow—After approximately 100 feet, sheet flow usually becomes shallow concentrated flow collecting in swales, small rills, and gullies. Shallow concentrated flow is assumed not to have a well-defined channel and has flow depths of 0.1 to 0.5 feet. It is assumed that shallow concentrated flow can be represented by one of seven flow types. The curves in figure 15–4 were used to develop the information in table 15–3.

To estimate shallow concentrated flow travel time, velocities are developed using figure 15–4, in which average velocity is a function of watercourse slope and type of channel (Kent 1964). For slopes less than 0.005 foot per foot, the equations in table 15–3 may be used.

After estimating average velocity using figure 15–4, use equation 15–1 to estimate travel time for the shallow concentrated flow segment.

Open channel flow—Shallow concentrated flow is assumed to occur after sheet flow ends at shallow depths of 0.1 to 0.5 feet. Beyond that channel flow is assumed to occur. Open channels are assumed to begin where surveyed cross-sectional information has been obtained, where channels are visible on aerial photographs, or where bluelines (indicating streams) appear on U.S. Geological Survey (USGS) quadrangle sheets.

Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for the bankfull elevation.

Manning's equation is:

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \qquad \text{(eq. 15–16)}$$

Figure 15–4 Velocity versus slope for shallow concentrated flow

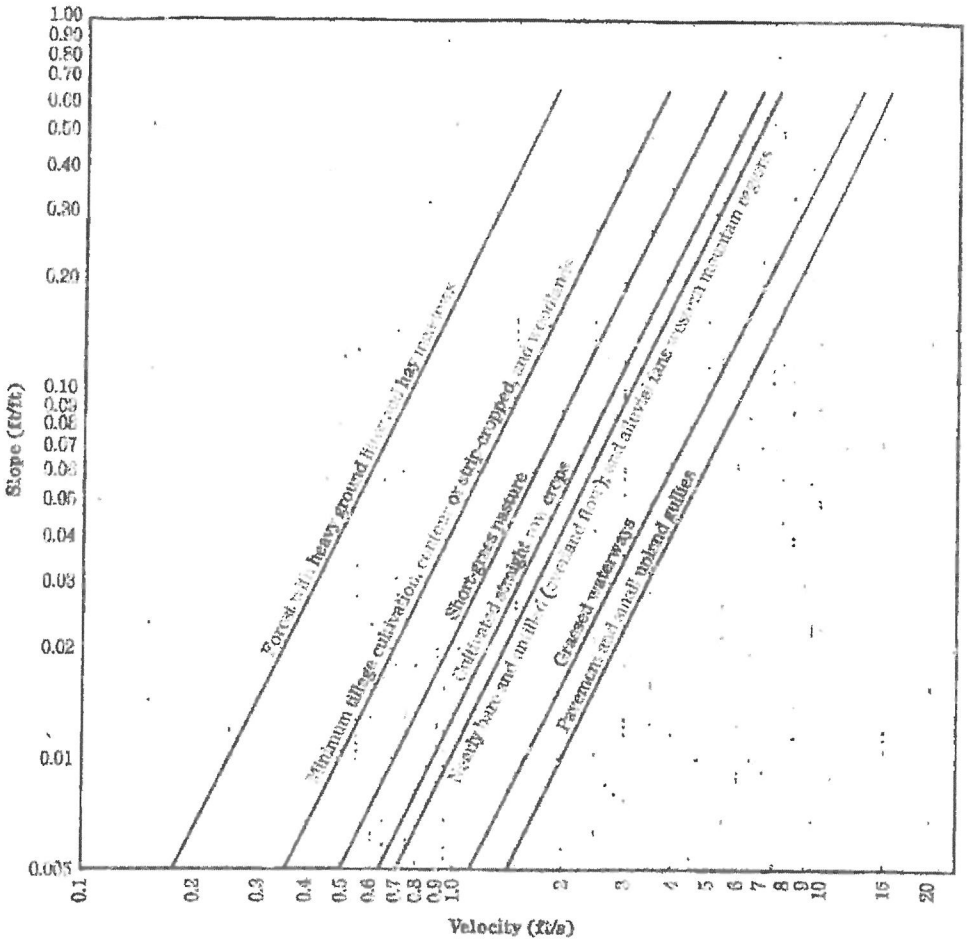

Table 15–3 Equations and assumptions developed from figure 15–4

Flow type	Depth (ft)	Manning's n	Velocity equation (ft/s)
Paved areas and small upland gullies	0.2	0.025	$V=20.328(s)^{0.5}$
Grassed waterways	0.4	0.050	$V=16.135(s)^{0.5}$
Nearly bare and untilled (overland flow); and alluvial fans in western mountain regions	0.2	0.051	$V=9.965(s)^{0.5}$
Cultivated straight row crops	0.2	0.058	$V=9.702(s)^{0.5}$
Short-grass pasture	0.2	0.073	$V=6.962(s)^{0.5}$
Minimum tillage cultivation, contour or strip-cropped, and woodlands	0.2	0.101	$V=4.918(s)^{0.5}$
Forest with heavy ground litter and hay meadows	0.2	0.262	$V=2.516(s)^{0.5}$

where:

V = average velocity, ft/s

r = hydraulic radius, ft

$= \frac{a}{P_w}$

a = cross-sectional flow area, ft^2

P_w = wetted perimeter, ft

s = slope of the hydraulic grade line (channel slope), ft/ft

n = Manning's n value for open channel flow

Manning's n values for open channel flow can be obtained from standard hydraulics textbooks, such as Chow (1959), and Linsley, Kohler, and Paulhus (1982). Publications dealing specifically with Manning's n values are Barnes (1967); Arcement and Schneider (1989); Phillips and Ingersoll (1986); and Cowan (1956). For guidance on calculating Manning's n values, see NEH630.14, Stage Discharge Relations.

Applications and limitations—The velocity method of computing time of concentration is hydraulically sound and provides the opportunity to incorporate changes in individual flow segments if needed. The velocity method is the best method for calculating time of concentration for an urbanizing watershed or if hydraulic changes to the watercourse are being considered.

Often, the average velocity and valley length of a reach are used to compute travel time through the reach using equation 15-1. If the stream is quite sinuous, the channel length and valley length may be significantly different and it is up to the modeler to determine which is the appropriate length to use for the depth of flow of the event under consideration.

The role of channel and valley storage is important in the development and translation of a flood wave and the estimation of lag. Both the hydraulics and storage may change from storm to storm and the velocity distribution may vary considerably both horizontally and vertically. As a result, actual lag for a watershed may have a large variation. In practice, calculations are typically based on the 2-year frequency discharge event since it is normally assumed that the time of concentration computed using these characteristics is representative of travel time conditions for a wide range of storm events. Wells and Woodward's simplification of Manning's kinematic equation was developed assuming the 2-year, 24-hour precipitation value.

630.1503 Other considerations

(a) Field observations

At the time field surveys to obtain channel data are made, there is a need to observe the channel system and note items that may affect channel efficiency. Observations such as the type of soil materials in the banks and bottoms of the channel; an estimate of Manning's roughness coefficients; the apparent stability or lack of stability of channel; indications of debris flows as evidenced by deposition of coarse sediments adjacent to channels, size of deposited materials, etc., may be significant.

(b) Multiple subarea watersheds

For multiple subarea watersheds, the time of concentration must be computed for each subarea individually, and consideration must be given to the travel time through downstream subareas from upstream subareas. Travel time and attenuation of hydrographs in valley reaches and reservoirs are accounted for using channel and reservoir routing procedures addressed in NEH630.17.

(c) Surface flow

Both of the standard methods for estimating time of concentration, as well as most other methods, assume that flow reaching the channel as surface flow or quick return flow adds directly to the peak of the subarea hydrograph. Locally derived procedures might be developed from data where a major portion of the contributing flow is other than surface flow. This is normally determined by making a site visit to the watershed.

(d) Travel time through bodies of water

The potential for detention is the factor that most strongly influences travel time through a body of water. It is best to divide the watershed such that any potential storage area is modeled as storage.

The regression equations, the average standard errors of prediction, and the equivalent years of record for regions 1, 2, 3, and 5 are given in table 1. The average standard errors of prediction are an average measure of the accuracy of the regression equations when estimating peak-discharge values for ungaged watersheds similar to those that were used to derive the regression equations. The equivalent years of record is the number of years of streamflow record needed to achieve the same accuracy as the regression equation.

Table 1. Flood-peak discharge regression equations and associated statistics for regions 1, 2, 3, and 5 in Nevada (modified from Thomas and others, 1997)

[QT, peak discharge for recurrence interval T, 2 to 100 years, in cubic feet per second; AREA, drainage area, in square miles; PREC, mean annual precipitation, in inches; ELEV, mean basin elevation, in feet above sea level (NGVD of 1929); LAT, latitude in decimal degrees]

Regression equation	Average standard error of prediction, in percent	Equivalent years of record
Region 1 - 165 stations (For sites located at elevations greater than elevation threshold from figure 2)		
$Q_2 = 0.124AREA^{0.845}PREC^{1.44}$	59	0.16
$Q_5 = 0.629AREA^{0.807}PREC^{1.12}$	52	.62
$Q_{10} = 1.43AREA^{0.785}PREC^{0.958}$	48	1.34
$Q_{25} = 3.08AREA^{0.768}PREC^{0.811}$	46	2.50
$Q_{50} = 4.75AREA^{0.758}PREC^{0.732}$	46	3.37
$Q_{100} = 6.78AREA^{0.750}PREC^{0.668}$	46	4.19
Region 2 - 108 stations		
$Q_2 = 13.1AREA^{0.719}$	72	0.96
$Q_5 = 22.4AREA^{0.723}$	66	1.80
$Q_{10} = 55.7AREA^{0.727}(ELEV/1,000)^{-0.757}$	61	3.07
$Q_{25} = 84.7AREA^{0.737}(ELEV/1,000)^{-0.436}$	61	4.64
$Q_{50} = 113AREA^{0.745}(ELEV/1,000)^{-0.511}$	64	5.47
$Q_{100} = 148AREA^{0.753}(ELEV/1,000)^{-0.584}$	68	6.05
Region 3 - 35 stations		
$Q_2 = 0.444AREA^{0.649}PREC^{1.15}$	86	0.29
$Q_5 = 1.21AREA^{0.639}PREC^{0.995}$	83	.49
$Q_{10} = 1.99AREA^{0.633}PREC^{0.924}$	80	.77
$Q_{25} = 3.37AREA^{0.627}PREC^{0.849}$	78	1.23
$Q_{50} = 4.70AREA^{0.625}PREC^{0.802}$	77	1.57
$Q_{100} = 6.42AREA^{0.624}PREC^{0.757}$	78	1.92
Region 5 - 37 stations		

$Q_2 = 0.0333AREA^{0.652}(ELEV/1,000)^{2.68}[(LAT - 28)/10]^{4.1}$	135	0.21
$Q_5 = 2.42AREA^{0.623}(ELEV/1,000)^{1.51}[(LAT - 28)/10]^{4.1}$	101	.73
$Q_{10} = 28.0AREA^{0.629}[(LAT - 26)/10]^{4.3}$	84	1.69
$Q_{25} = 426AREA^{0.612}(ELEV/1,000)^{-1.56}[(LAT - 28)/10]^{4.3}$	87	2.62
$Q_{50} = 2,030AREA^{0.796}(ELEV/1,000)^{-1.71}[(LAT - 28)/10]^{4.4}$	91	3.26
$Q_{100} = 7,000AREA^{0.782}(ELEV/1,000)^{-2.18}[(LAT - 28)/10]^{4.6}$	95	3.80

The regression equations for regions 6 and 10 were developed using an iterative regression method (Hjalmarson and Thomas, 1992) and a modified form of the station year statistical analysis method (Fuller, 1914). The regression equations, the estimated average standard errors of regression, and the equivalent years of record for regions 6 and 10 are given in table 2. The average standard error of regression is an estimate of the predictive accuracy of these regression equations and is determined by a direct sampling method.

Table 2. Flood-peak discharge equations and associated statistics for regions 6 and 10 in Nevada (modified from Thomas and others, 1994)

[Q, peak discharge for recurrence interval T, 2 to 100 years, in cubic feet per second; AREA, drainage area, in square miles; ELEV, mean basin elevation, in feet above sea level (NGVD of 1929)]

Estimated average standard error of regression for these equations includes much of the within-station residual variance and therefore is not comparable to standard error of estimate from an ordinary-least-squares regression.

Regression equation	Estimated average standard error of regression, in log units	Equivalent years of record
Region 6 - 80 stations		
$Q_2 = 0$	--	--
$Q_5 = 32AREA^{0.80}(ELEV/1,000)^{-0.66}$	1.47	0.233
$Q_{10} = 590AREA^{0.62}(ELEV/1,000)^{-1.6}$	1.12	.748
$Q_{25} = 3,200AREA^{0.62}(ELEV/1,000)^{-2.1}$	.796	2.52
$Q_{50} = 5,300AREA^{0.64}(ELEV/1,000)^{-2.1}$	1.10	1.75
$Q_{100} = 20,000AREA^{0.51}(ELEV/1,000)^{-2.3}$	1.84	.794
Region 10 - 104 stations		
$Q_2 = 12\ AREA^{0.58}$	1.14	0.618
$Q_5 = 85\ AREA^{0.59}$	.602	3.13
$Q_{10} = 200\ AREA^{0.62}$	.675	3.45
$Q_{25} = 400\ AREA^{0.65}$	.949	2.49
$Q_{50} = 590\ AREA^{0.67}$	.928	3.22
$Q_{100} = 850\ AREA^{0.69}$	1.23	2.22

The approximate ranges of the explanatory watershed variables over which the equations are applicable are shown in table 3. Thomas and others (1997) presented the actual ranges of applicability as two-dimensional clusters of

explanatory variables plotted against one another. The ranges shown in table 3 define a rectangular space that brackets the clusters and, therefore, include pairs of values of the explanatory variables near the corners of the rectangle that are outside of the clusters. Application of the equations for values of the variables near the extremes of a range should be done cautiously. The standard errors increase appreciably when any explanatory watershed variable is near or outside the quoted range.

Table 3. Range of explanatory variables for which regression equations are applicable

[--, not applicable.]

Hydrologic study region	Drainage area, in square miles[1]	Mean basin elevation, in feet above sea level[2]	Mean annual precipitation, in inches	Latitude in decimal degrees
Region 1	0.6-1,060	--	11-43	--
Region 2	0.8--1,680	3,540-7,950	--	--
Region 3	2.2-1,450	--	10-41	--
Region 5	4.1-360	5,770-10,500	--	36.44-39.50
Region 6	0.2-210	4,770-9,960	--	--
Region 10	0.1-1,000	--	--	--

[1]For best results, applications should be limited to basins of less than 200 square miles.

[2]NGVD of 1929.

Improving Estimates With Gaged Data

The U.S. Water Resources Council (1981, appendix 8) described weighting techniques to improve estimates of peak discharge at gaged locations by combining the estimates derived from analysis of gage records with estimates derived by other means, including regression equations.

The weights for these two estimates are based on the length of the stream gage record (in years) and the equivalent years of record of the applicable regression equation. The weighted estimate of peak discharge is computed as:

$$\log Q_T(W) = \frac{N \cdot \log Q_T(G) + EQ \cdot \log Q_T(R)}{N + EQ}$$

where

$Q_T(W)$ is the weighted estimate for recurrence interval T at the gaged site,

$Q_T(G)$ is the estimate of Q_T derived from analysis of the gage records,

$Q_T(R)$ is the estimate of Q_T derived from application of the regression equation,