VEAL EXHIBIT 13

ED MCCARTHY, P.E., PS
Hydrology ▪ Hydraulics ▪ Engineering

9957 171 Avenue SE
Renton, WA 98059

(425) 271-5734

August 11, 2015

Mr. Rory Veal
9859 Woodinville-Redmond Road NE
Redmond, WA 98052

Re: **Veal Residence – Hydrology Assessment**
9859 Woodinville-Redmond Road NE

Dear Mr. Veal;

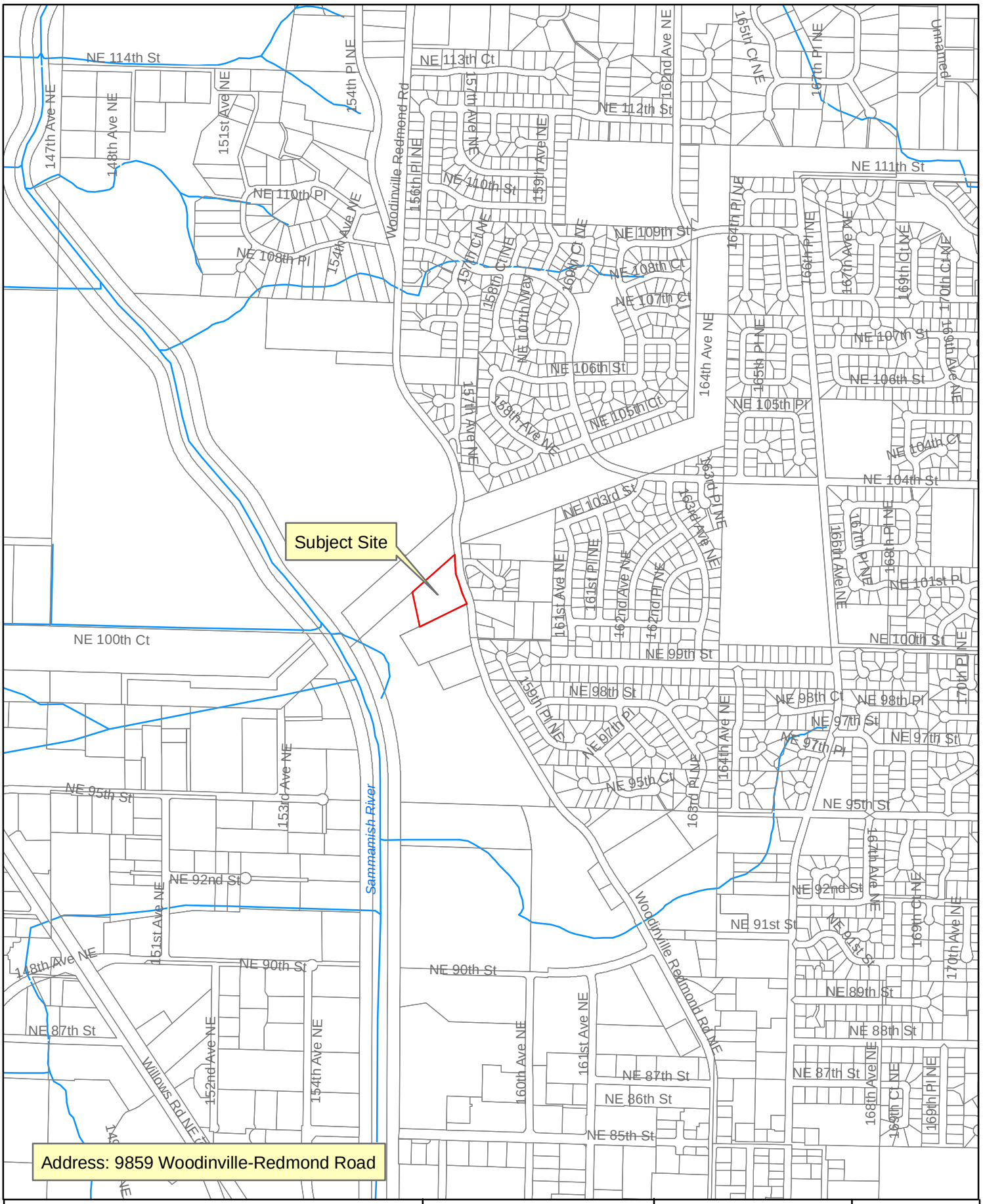
This letter documents my observations and conclusions resulting from a hydrology assessment I conducted for the property at 9859 Woodinville-Redmond Road NE in Redmond, Washington (Figure 1). The property has experienced increased stormwater runoff volumes and flow rates over the past several years resulting in wetter site conditions and an incised channel developing across the property. In addition to a site visit that I conducted on July 24, 2015, I also reviewed the following documents:

- Soil Survey of King County
- Aerial photographs
- Topographic contours for King County
- Revised Drainage Calculations – Redmond Manor (Litchfield, October 11, 1995)

Site Conditions

The subject property has an area of 3 acres and is located down gradient and west of Woodinville-Redmond Road NE. The parcel is in an area mapped as having Alderwood soils. The parcel slopes to the west, away from Woodinville-Redmond Road NE with gradients ranging from 12 to 20 percent. Site vegetation is primarily unmaintained pasture with vegetation including blackberries and alder becoming established over the last decade.

The site's natural tributary drainage basin includes a 5-acre area upgradient from Woodinville-Redmond Road NE (Basins A and B in Figure 2). Prior to construction of Woodinville-Redmond Road NE, surface runoff from this upgradient basin area sheet flowed across the subject property. With construction of the road, a 12-inch diameter culvert was installed to convey drainage collected from the upgradient area onto the southeastern portion of the subject property. Additional changes to the basin flow paths and hydrology occurred with development of Redwood Manor and the residential parcel adjacent to and south of Redwood Manor.



Vicinity Map

Veal Residence Hydrology Assessment

Redmond, Washington

1,000 Feet

Ed McCarthy, PE, PS

9957 171st Avenue SE

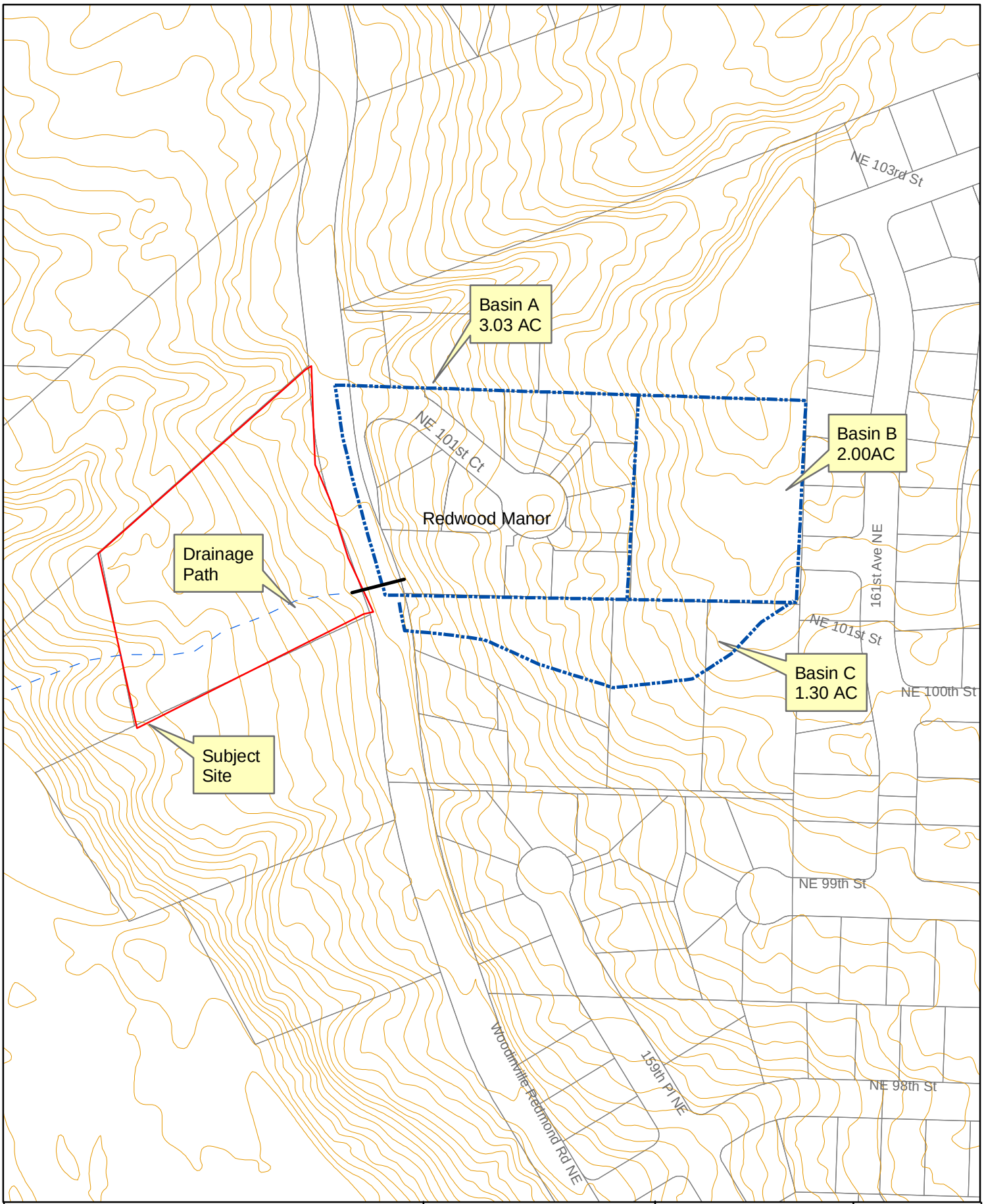
Renton, Washington 98059

Phone: (425) 271-5734

Proj. No.

Date 8/11/15

Figure 1



Basin Map

Veal Residence Hydrology Assessment

Redmond, Washington

200 Feet

Ed McCarthy, PE, PS

9957 171st Avenue SE

Renton, Washington 98059

Phone: (425) 271-5734

Proj. No.

Date 8/11/15

Figure 2

Redwood Manor was developed into a 12-lot plat in 1998, along with the widening of Woodinville-Redmond Road NE. A stormwater network, including an extensive interceptor drain, collects both surface and groundwater from the Redwood Manor site and the 2-acre parcel located to the east of Redwood Manor. A stormwater detention pipe, designed using the Y&W method, provides nominal flow control for stormwater being discharged from the plat. Stormwater collected on the developed site is conveyed to the stormwater detention pipe and subsequently discharged to the culvert that crosses under Woodinville-Redmond Road NE and then onto the subject site.

The property located east of Redwood Manor (Basin C) is not within the natural tributary basin draining to the subject site. However, when this site was developed, runoff from the site's access driveway was routed to a catch basin that connects to the culvert crossing under Woodinville-Redmond Road NE. The driveway and upgradient basin intercepted by the driveway represents approximately 1.3 acres of area diverted onto the subject property.

Hydrologic Assessment

I conducted a hydrologic assessment of basins contributing to the subject site to assess the effects of development on the site's hydrology. The upstream tributary area was divided into 3 basins (Figure 2). Delineations of basin boundaries were based on a topographic map with 5-foot contour intervals developed from aerial topographic data.

The area of each basin was broken down into categories of land cover type, hydrologic soil group, and slope. Categories of land cover types included forest, pasture, landscape, and impervious. These areas were delineated using a color aerial photograph from King County's GIS online database. Hydrologic soil groups included C/D, which is characterized as being poorly drained soil with a relatively high amount of surface runoff. The hydrologic soil groups were based on those pre-designated to mapped soils series (U.S. Department of Agriculture, 1973).

Data for each basin were input to the Western Washington Hydrologic Model (WWHM2012). WWHM2012 is a continuous hydrologic model that develops runoff time series for a 51-year period of rainfall record. A rainfall correction factor of 1.00 was applied to calibrate the rainfall data for the SeaTac area rain gage to Redmond.

The WWHM2012 program generates statistical reports for several hydrologic parameters including peak flow rates for estimated return periods, flow durations, and annual runoff volumes. These data are useful in evaluating changes to the subject site's hydrology resulting from upgradient development.

The hydrology from upgradient areas contributing to the subject site was evaluated for pre-1998 basin conditions as well as for existing basin conditions. A summary of tributary basin areas for each scenario is summarized in Table 1 below.

Table 1. Basin area cover types

Pre-1998 Conditions

Basin	Forest (AC)	Pasture (AC)	Landscape (AC)	Impervious (AC)	Total (AC)
Basin A	1.45	1.00 0.28	0.30 3.03		
Basin B	2.00				2.00
Total	3.45	1.00 0.28	0.30 5.03		

Existing Conditions

Basin	Forest (AC)	Pasture (AC)	Landscape (AC)	Impervious (AC)	Total (AC)
Basin A			1.24	1.79	3.03
Basin B	2.00				2.00
Basin C	0.90	0.30		0.10	1.30
Total	2.90	1.54		1.89	6.33

Development in the upslope basin resulted in more than a six-fold increase in impervious area with 0.30 acres prior to the development and 1.89 acres after development. In addition, diversion of Basin C onto the subject site increased the overall tributary basin area by 26 percent.

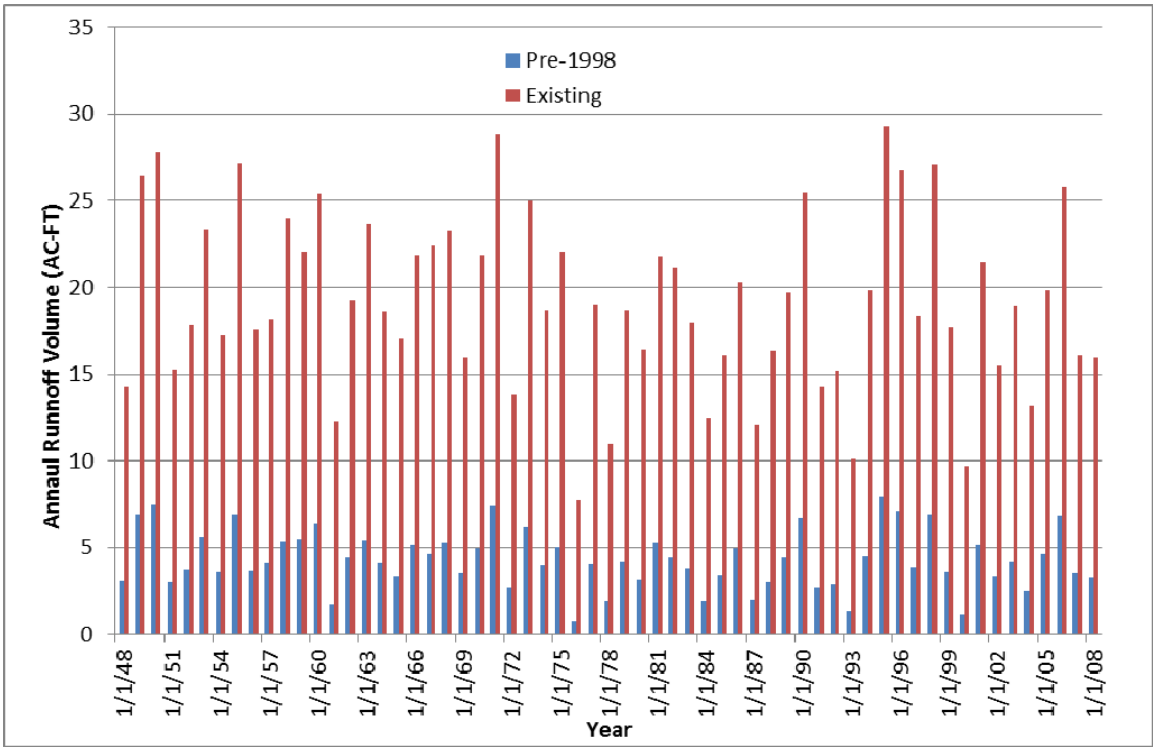
The WWHM2012 model simulated the resulting hydrology for each of these basin conditions. The stormwater detention pipe installed with development of Redwood Manor is included in the model for existing basin conditions (Attachment A). The interceptor trenches installed with development of Redwood Manor collect groundwater that otherwise would travel laterally down the slope within the soil profile at a much lower rate. While this component of the hydrology is small in terms of peak flow rate, it does extend the duration of flow onto the subject site. During my site visit on July 24, 2015, water was noted to be discharging from the culvert onto the project site even after an extended period with no rainfall.

Predicted peak runoff rates from the upstream tributary to the subject site are compared in Table 2 for pre-1998 and existing basin conditions. The 2-year flow to the subject site was predicted to increase from 0.26 cubic foot per second under pre-1998 conditions to 1.51 cubic feet per second under existing conditions. Similar increases were predicted for the 10-year and 100-year storms. In addition, the average annual runoff volume to the subject site was predicted to increase from an average of 4.3 acre-feet per year under pre-1998 conditions to 19.2 acre-feet per year under existing conditions. Runoff volumes for each of the years simulated are presented in Figure 3, showing the large increase in flow volumes to the site resulting from upstream development.

Table 2. Comparison of Site Hydrology

Basin Condition	2-Year Flow Rate (CFS)	10-Year Flow Rate CFS)	100-Year Flow Rate (CFS)	Average Annual Runoff Volume (AC-FT)
Pre-1998 Conditions	0.26	0.49 0.89		4.3
Existing Conditions	1.51	2.44 4.01		19.2
Change (%)	581%	498%	451%	447%

Figure 3. Annual Runoff Volumes



Conclusions:

Development that has occurred upgradient from the subject site has concentrated and increased runoff rates and volumes onto the subject property. The stormwater flow control system at Redwood Manor is designed to older standards that are now known to be ineffective in providing adequate flow rate control and channel erosion protection, particularly for larger storms.

Both surface water and groundwater in the upstream basin has been collected and diverted from their natural flow paths and inappropriately discharged to the subject site. This has resulted in adverse impacts to the site including formation of an incised channel and increased hydrology that has saturated the ground for longer durations and now supports wetland vegetation. Groundwater collected by interceptor trenches at Redwood Manor, as well as excess irrigation contributions from the plat, have apparently extended flow durations onto the subject site during times that would ordinarily be dry.

The slopes of the subject site downstream from the culvert range from 15 to 20 percent. The ordinary standard of care for stormwater engineering calls for protection of slopes of this magnitude from increased and concentrated runoff. Adequate mitigation to protect the slope was not provided at any stage of the development of the upstream tributary areas to the subject site.

The lack of proper mitigation for upstream development has created an artificial channel on the subject site that is currently susceptible to erosion. In this sense, the channel on the subject site is man-made, resulting from poorly executed surface water management. Increased runoff rates and volumes to the subject site flood the slope. This has resulted in saturated soil conditions and the formation of wetlands that were not likely present prior to the upgradient development.

Recommendations

Over time, erosion in the channel that has developed on the site can be anticipated to increase in severity if the situation is not mitigated. In retrospect, a tightline should have been installed down the slope, across the property, to convey drainage that was concentrated by construction of Woodinville-Redmond Road NE. A second chance to provide appropriate protection to the slope was skirted with construction of Redwood Manor and the adjacent residential property, which substantially increased erosion risk and dumped additional water on the subject site.

Installation of a tightline at this point in time would provide slope protection, eliminate erosion potential and would also prevent the slope from becoming saturated during the wet season. This would entail extending a 12-inch pipe from the culvert outfall at Woodinville-Redmond Road NE down the slope to a suitable discharge location.

If you have questions regarding my assessment or recommendations, call me at (425) 271-5734.

Edward J. McCarthy, Ph.D., PE
Water Resource Engineer

References

Clear Creek Solutions, 2012. Western Washington Hydrology Model 2012 (WWHM2012) Version 2015/5/28. Olympia, Wash.

Litchfield, Keith, October 11, 199.5 Revised Drainage Calculations – Redmond Manor – NE 101st Place – Redmond Wash. File No. PPL90-06. Redmond, Wash.

U.S. Department of Agriculture, Soil Conservation Service, 1973. *Soil Survey of King County Area, Washington.* Seattle.

Attachment A. WWHM2012 Input and Results

WWHM2012
PROJECT REPORT

Project Name: Veal Hydrology
Site Name: Veal Residence
Site Address: 9859 W-R Rd NE
City : Redmond
Report Date: 8/11/2015
Gage : Seatac
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version : 2014/05/28

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin A
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	1.45
C, Pasture, Mod	1
C, Lawn, Mod	.28
Pervious Total	2.73

Impervious Land Use	Acres
ROADS MOD	0.3
Impervious Total	0.3
Basin Total	3.03

Element Flows To:
Surface **Interflow** **Groundwater**

Name : Basin B
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	2
Pervious Total	**2**

Impervious Land Use	Acres
Impervious Total	**0**
Basin Total	**2**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Basin A
Bypass: Yes

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	1.24
Pervious Total	**1.24**

Impervious Land Use	Acres
ROADS MOD	1.79
Impervious Total	**1.79**
Basin Total	**3.03**

Element Flows To:

Surface	Interflow	Groundwater
Tank 1	Tank 1	

Name : Basin B
Bypass: Yes

GroundWater: No

Pervious Land Use	Acres

C, Forest, Mod	**2**
Pervious Total	**2**

Impervious Land Use	**Acres**
Impervious Total	**0**
Basin Total	**2**

Element Flows To:
Surface **Interflow** **Groundwater**

Name : Tank 1
Tank Name: Tank 1

Dimensions
Depth: 4.5 ft.
Tank Type : Circular
Diameter : 4.5 ft.
Length : 98 ft.
Discharge Structure
Riser Height: 4 ft.
Riser Diameter: 24 in.
Orifice 1 Diameter: 3.6 in. **Elevation:** 0.25 ft.
Orifice 2 Diameter: 1 in. **Elevation:** 1.25 ft.
Orifice 3 Diameter: 0.82 in. **Elevation:** 2.25 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Tank Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000	0.000	0.000	0.000
0.0500	0.002	0.000	0.000	0.000
0.1000	0.003	0.000	0.000	0.000
0.1500	0.003	0.000	0.000	0.000
0.2000	0.004	0.000	0.000	0.000
0.2500	0.004	0.000	0.000	0.000
0.3000	0.005	0.001	0.076	0.000
0.3500	0.005	0.001	0.107	0.000
0.4000	0.005	0.001	0.131	0.000
0.4500	0.006	0.001	0.152	0.000
0.5000	0.006	0.002	0.170	0.000
0.5500	0.006	0.002	0.186	0.000
0.6000	0.006	0.002	0.201	0.000
0.6500	0.007	0.003	0.215	0.000

0.7000	0.007	0.003	0.228	0.000
0.7500	0.007	0.003	0.240	0.000
0.8000	0.007	0.004	0.252	0.000
0.8500	0.007	0.004	0.263	0.000
0.9000	0.008	0.005	0.274	0.000
0.9500	0.008	0.005	0.284	0.000
1.0000	0.008	0.005	0.294	0.000
1.0500	0.008	0.006	0.304	0.000
1.1000	0.008	0.006	0.313	0.000
1.1500	0.008	0.007	0.322	0.000
1.2000	0.009	0.007	0.331	0.000
1.2500	0.009	0.008	0.340	0.000
1.3000	0.009	0.008	0.354	0.000
1.3500	0.009	0.009	0.365	0.000
1.4000	0.009	0.009	0.375	0.000
1.4500	0.009	0.010	0.384	0.000
1.5000	0.009	0.010	0.393	0.000
1.5500	0.009	0.010	0.402	0.000
1.6000	0.009	0.011	0.411	0.000
1.6500	0.009	0.011	0.419	0.000
1.7000	0.009	0.012	0.427	0.000
1.7500	0.009	0.012	0.435	0.000
1.8000	0.009	0.013	0.443	0.000
1.8500	0.010	0.013	0.450	0.000
1.9000	0.010	0.014	0.458	0.000
1.9500	0.010	0.014	0.465	0.000
2.0000	0.010	0.015	0.473	0.000
2.0500	0.010	0.015	0.480	0.000
2.1000	0.010	0.016	0.487	0.000
2.1500	0.010	0.016	0.494	0.000
2.2000	0.010	0.017	0.500	0.000
2.2500	0.010	0.017	0.507	0.000
2.3000	0.010	0.018	0.518	0.000
2.3500	0.010	0.018	0.526	0.000
2.4000	0.010	0.019	0.534	0.000
2.4500	0.010	0.019	0.541	0.000
2.5000	0.010	0.020	0.548	0.000
2.5500	0.010	0.020	0.555	0.000
2.6000	0.010	0.021	0.562	0.000
2.6500	0.010	0.021	0.569	0.000
2.7000	0.009	0.022	0.576	0.000
2.7500	0.009	0.022	0.582	0.000
2.8000	0.009	0.023	0.589	0.000
2.8500	0.009	0.023	0.595	0.000
2.9000	0.009	0.024	0.602	0.000
2.9500	0.009	0.024	0.608	0.000
3.0000	0.009	0.025	0.614	0.000
3.0500	0.009	0.025	0.620	0.000
3.1000	0.009	0.026	0.626	0.000
3.1500	0.009	0.026	0.632	0.000
3.2000	0.009	0.027	0.638	0.000
3.2500	0.009	0.027	0.644	0.000
3.3000	0.009	0.028	0.650	0.000
3.3500	0.008	0.028	0.655	0.000
3.4000	0.008	0.029	0.661	0.000
3.4500	0.008	0.029	0.667	0.000
3.5000	0.008	0.029	0.672	0.000

3.5500	0.008	0.030	0.678	0.000
3.6000	0.008	0.030	0.683	0.000
3.6500	0.007	0.031	0.689	0.000
3.7000	0.007	0.031	0.694	0.000
3.7500	0.007	0.031	0.699	0.000
3.8000	0.007	0.032	0.705	0.000
3.8500	0.007	0.032	0.710	0.000
3.9000	0.006	0.032	0.715	0.000
3.9500	0.006	0.033	0.720	0.000
4.0000	0.006	0.033	0.726	0.000
4.0500	0.006	0.033	0.948	0.000
4.1000	0.005	0.034	1.352	0.000
4.1500	0.005	0.034	1.872	0.000
4.2000	0.005	0.034	2.488	0.000
4.2500	0.004	0.035	3.186	0.000
4.3000	0.004	0.035	3.956	0.000
4.3500	0.003	0.035	4.794	0.000
4.4000	0.003	0.035	5.693	0.000
4.4500	0.002	0.035	6.650	0.000
4.5000	0.000	0.035	7.662	0.000
4.5500	0.000	0.000	8.725	0.000

Name : Basin C
Bypass: Yes

GroundWater: No

Pervious Land Use	**Acres**
C, Lawn, Mod	**.3**
C, Forest, Mod	**.9**
Pervious Total	**1.2**

Impervious Land Use	**Acres**
ROADS MOD	**0.1**
Impervious Total	**0.1**
Basin Total	**1.3**

Element Flows To:

Surface	**Interflow**	**Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:4.73
Total Impervious Area:0.3

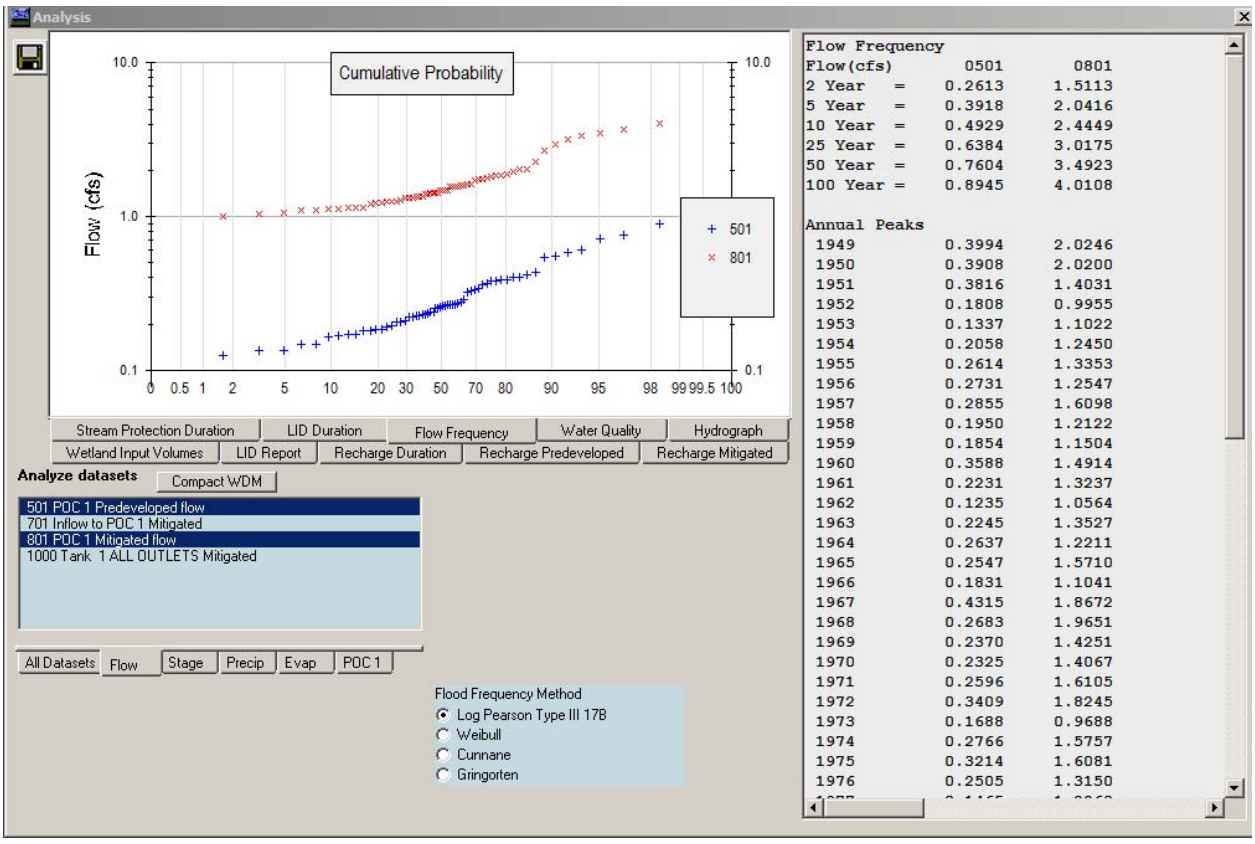
Mitigated Landuse Totals for POC #1
Total Pervious Area:4.44
Total Impervious Area:1.89

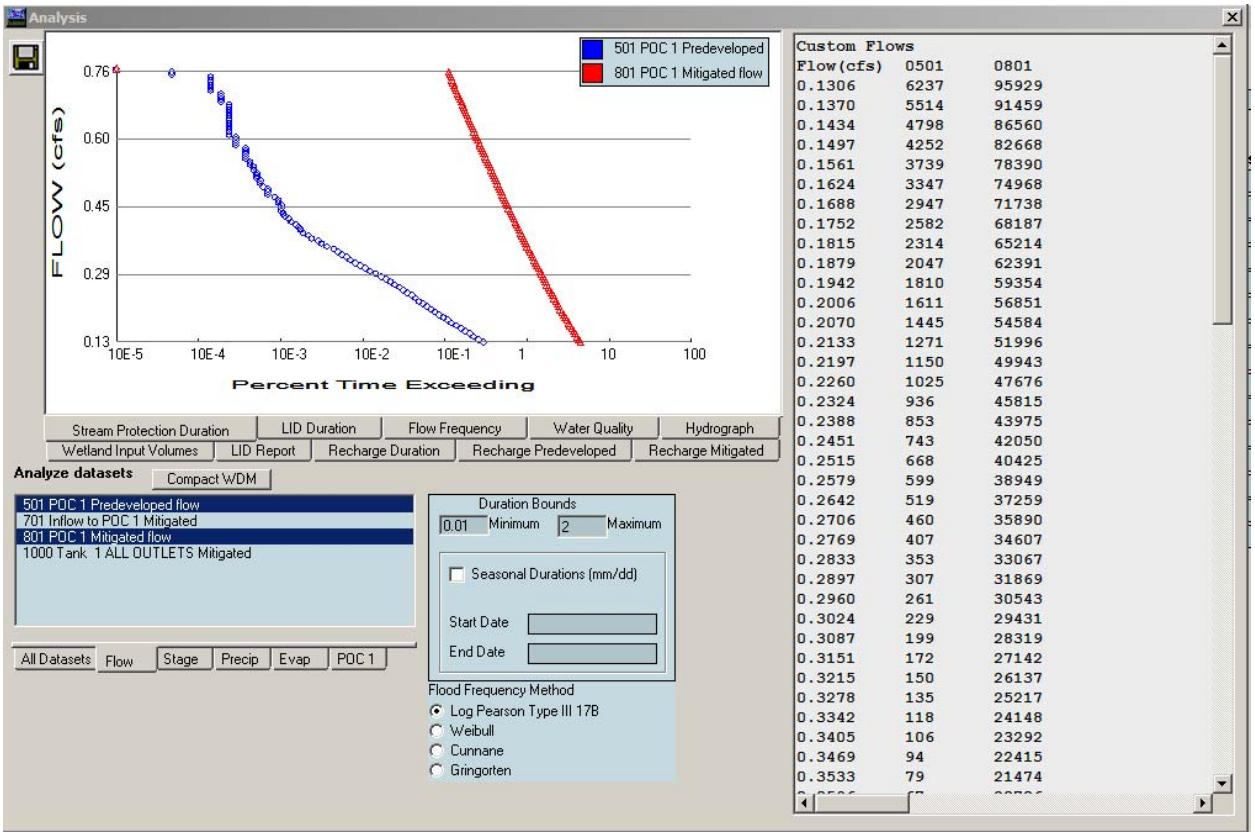
Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.261266
5 year	0.391783
10 year	0.492905
25 year	0.638421
50 year	0.760378
100 year	0.89453

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.511253
5 year	2.041571
10 year	2.444894
25 year	3.017459
50 year	3.49228
100 year	4.010787


Analysis
Cumulative Probability
Flow (cfs)
10.0
1.0
0.1
0 0.5 1 2 5 10 20 30 50 70 80 90 95 98 99 99.5 100
501
801
Stream Protection Duration
LID Duration
Flow Frequency
Water Quality
Hydrograph
Wetland Input Volumes
LID Report
Recharge Duration
Recharge Predeveloped
Recharge Mitigated
Analyze datasets
Compact WDM
501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Tank 1 ALL OUTLETS Mitigated
All Datasets
Flow
Stage
Precip
Evap
POC 1
Flood Frequency Method
Log Pearson Type III 17B
Weibull
Cunnane
Gringorten
Flow Frequency
Flow(cfs) 0501 0801
2 Year = 0.2613 1.5113
5 Year = 0.3918 2.0416
10 Year = 0.4929 2.4449
25 Year = 0.6384 3.0175
50 Year = 0.7604 3.4923
100 Year = 0.8945 4.0108
Annual Peaks
1949 0.3994 2.0246
1950 0.3908 2.0200
1951 0.3816 1.4031
1952 0.1808 0.9955
1953 0.1337 1.1022
1954 0.2058 1.2450
1955 0.2614 1.3353
1956 0.2731 1.2547
1957 0.2855 1.6098
1958 0.1950 1.2122
1959 0.1854 1.1504
1960 0.3588 1.4914
1961 0.2231 1.3237
1962 0.1235 1.0564
1963 0.2245 1.3527
1964 0.2637 1.2211
1965 0.2547 1.5710
1966 0.1831 1.1041
1967 0.4315 1.8672
1968 0.2683 1.9651
1969 0.2370 1.4251
1970 0.2325 1.4067
1971 0.2596 1.6105
1972 0.3409 1.8245
1973 0.1688 0.9688
1974 0.2766 1.5757
1975 0.3214 1.6081
1976 0.2505 1.3150


Analysis
501 POC 1 Predeveloped
801 POC 1 Mitigated flow
FLOW (cfs)
0.76
0.60
0.45
0.29
0.13
10E-5 10E-4 10E-3 10E-2 10E-1 1 10 100
Percent Time Exceeding
Stream Protection Duration
LID Duration
Flow Frequency
Water Quality
Hydrograph
Wetland Input Volumes
LID Report
Recharge Duration
Recharge Predeveloped
Recharge Mitigated
Analyze datasets
Compact WDM
501 POC 1 Predeveloped flow
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow
1000 Tank 1 ALL OUTLETS Mitigated
All Datasets
Flow
Stage
Precip
Evap
POC 1
Duration Bounds
0.01 Minimum
2 Maximum
Seasonal Durations (mm/dd)
Start Date
End Date
Flood Frequency Method
Log Pearson Type III 17B
Weibull
Cunnane
Gringorten
Custom Flows
Flow(cfs) 0501 0801
0.1306 6237 95929
0.1370 5514 91459
0.1434 4798 86560
0.1497 4252 82668
0.1561 3739 78390
0.1624 3347 74968
0.1688 2947 71738
0.1752 2582 68187
0.1815 2314 65214
0.1879 2047 62391
0.1942 1810 59354
0.2006 1611 56851
0.2070 1445 54584
0.2133 1271 51996
0.2197 1150 49943
0.2260 1025 47676
0.2324 936 45815
0.2388 853 43975
0.2451 743 42050
0.2515 668 40425
0.2579 599 38949
0.2642 519 37259
0.2706 460 35890
0.2769 407 34607
0.2833 353 33067
0.2897 307 31869
0.2960 261 30543
0.3024 229 29431
0.3087 199 28319
0.3151 172 27142
0.3215 150 26137
0.3278 135 25217
0.3342 118 24148
0.3405 106 23292
0.3469 94 22415
0.3533 79 21474