APPENDIX E

Hydrologic Analysis Information

Table E-1. Description of and references for the flows used for modeling.

Recurrence Interval/ Event (year)	Flow (cfs)	Reference/Description	Skagit River Boundary Condition Flow (cfs)	Skagit Reference/Description
Low Flow	**250**	Baseflow used for assessing accessibility of year-round aquatic habitat to support steelhead and coho rearing. 250 cfs is within a low-flow range (monthly average flows are lowest in February/March and August/September, and within a 200-300cfs range, based on a basin area relationship to Bacon Creek (49.7mi^2), and reviewing the Bacon Creek Gauge - USGS 12179900 - records, also reviewed Newhalem Creek (26.9 mi^2) gauge - USGS 12178100 - data too); flow can also serve as a model calibration flow - close to the estimated Goodell Creek (39.19 mi^2) flow during the fan site visit on 4-3-14.	**10,000**	1-year peak event in Skagit: Ross Dam passes through flows below a 2-year event; USGS gauge results indicates 10,000 cfs was exceeded 6 times in the last 7 years.
2	**2,935**	Peak flow used for assessing aquatic habitat accessibility during a semi-frequent storm event. USGS Regression Equations (Sumioka et al. 1998), Drainage Area = 39.19 square miles, Average Annual Rainfall = 115.79 inches, with snow equivalent	**10,000**	1-year peak event in Skagit: Ross Dam passes through flows below a 2-year event; USGS gauge results indicates 10,000 cfs was exceeded 6 times in the last 7 years.
10	***5,413***	USGS Regression Equations (Sumioka et al. 1998), Drainage Area = 39.19 square miles, Average Annual Rainfall = 115.79 inches, with snow equivalent	***30,000***	Extreme Peak equalled or exceeded about 5-6 times since 1953 (Ross Dam Completed); Page 46-47 of the 2013 Final Skagit River Flood Risk Management Feasibility Study
10	**5,413**	USGS Regression Equations (Sumioka et al. 1998), Drainage Area = 39.19 square miles, Average Annual Rainfall = 115.79 inches, with snow equivalent	**10,000**	1-year peak event in Skagit: Ross Dam passes through flows below a 2-year event; USGS gauge results indicates 10,000 cfs was exceeded 6 times in the last 7 years.
100	**9,024**	USGS Regression Equations (Sumioka et al. 1998), Drainage Area = 39.19 square miles, Average Annual Rainfall = 115.79 inches, with snow equivalent	**10,000**	1-year peak event in Skagit: Ross Dam passes through flows below a 2-year event; USGS gauge results indicates 10,000 cfs was exceeded 6 times in the last 7 years.
10-year Bulked Extreme/ Sediment Transporting Event	**11,281**	=1.25*100-Year event from the USGS equations; Based on a review of the field evidence and other historic documentation, running a debris flood or flood wave was dropped from the analysis. Instead given the need to evaluate an extreme event due to the infrastructure present in the project area (WSDOT highway, SCL towers), because of the likelihood of a large sediment-transporting event (not a debris flow or debris flood, but a flood with significant capacity to convey sediment), and due to the inherent hydrologic uncertainty in using a regression equation to derive our regulatory 100-year flow, the selected extreme event is essentially a bulked 100-year event, equivalent to 1.25*USGS 100-year flow. The 1.25 factor can be supported by a max %volume (20%) of sediment that can be transported in these types of events (without the sediment hyperconcentration of a debris flow/mudflow) and also is within the range of a typical factor for estimating the 500-year clear flow from the 100-year clear flow for PNW basins	**10,000**	1-year peak event in Skagit: Ross Dam passes through flows below a 2-year event; USGS gauge results indicates 10,000 cfs was exceeded 6 times in the last 7 years.

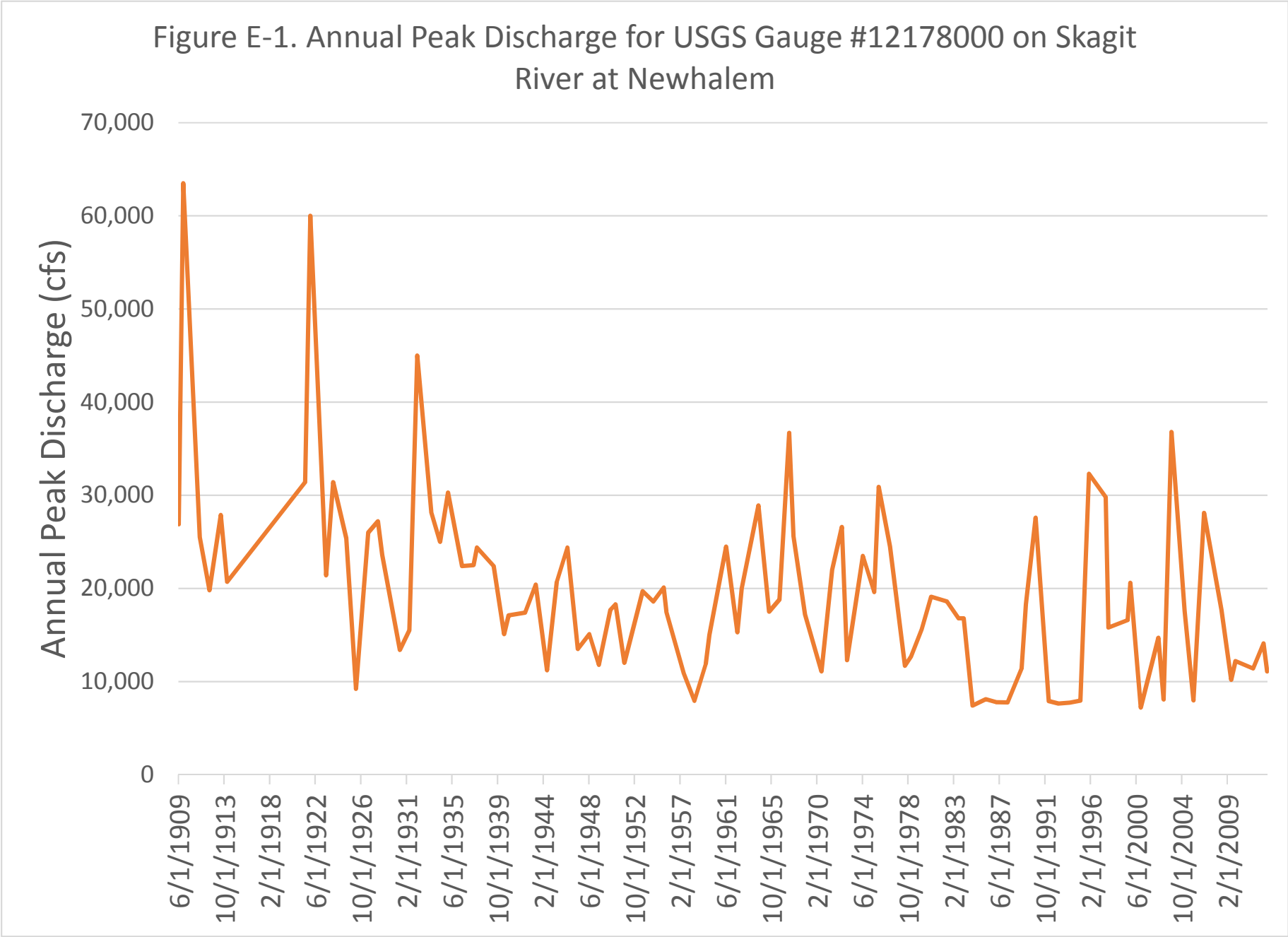
Figure E-1. Annual Peak Discharge for USGS Gauge #12178000 on Skagit River at Newhalem
Annual Peak Discharge (cfs)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
6/1/1909
10/1/1913
2/1/1918
6/1/1922
10/1/1926
2/1/1931
6/1/1935
10/1/1939
2/1/1944
6/1/1948
10/1/1952
2/1/1957
6/1/1961
10/1/1965
2/1/1970
6/1/1974
10/1/1978
2/1/1983
6/1/1987
10/1/1991
2/1/1996
6/1/2000
10/1/2004
2/1/2009