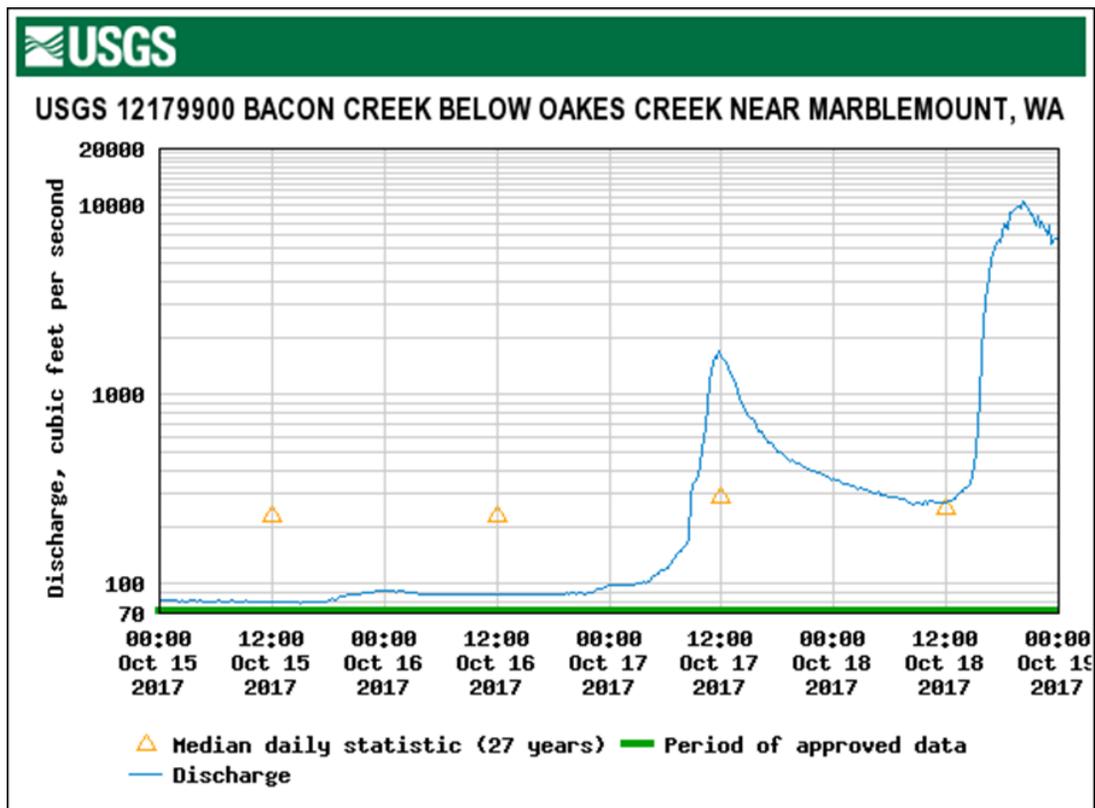


# Bull Trout Population Monitoring Field Study In The Skagit River Basin In 2017



## Report to Seattle City Light

Memorandum of Understanding WDFW#16-07206  
Amendment One

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*Cover graphic: USGS flow graph for Bacon Creek 03.1774 in mid-October when summer low flows spiked 5 feet in less than 48 hours.  
Graph courtesy United States Geological Survey.*

## Introduction

Washington Department of Fish and Wildlife (WDFW) used funding provided by Seattle City Light (SCL) to hire surveyors to monitor bull trout (*Salvelinus confluentus*) spawning in index streams in the Skagit River Basin in 2017. With the financial support of SCL, surveys of historical bull trout spawning indexes were completed throughout the entire bull trout spawning period.

## Methods

Ten historical bull trout indexes in the Skagit River Basin in Washington State were scheduled for monitoring bull trout spawning in 2017 (Table 1). Surveys were to be conducted on foot with a survey interval goal of every 10 – 14 days. Depending on the method of access and topography, some sections would be surveyed working downstream and others would be surveyed working upstream. Vehicles were able to transport surveyors to the general location of some indexes but five indexes also required hiking or biking up to seven miles to get to the start point of the index.

Table 1. 2017 Skagit River Basin bull trout spawning ground indexes surveyed with funding support from Seattle City Light.

Stream	WRIA* <sup>1</sup>	Index					
		River mile		Lower		Upper	
		Low	Up	Latitude	Longitude	Latitude	Longitude
West Fork Bacon Creek	04.1774	6.1	8.1	48.66057	121.43329	48.675317	121.4536
South Fork Cascade River	04.1411	20.0	21.8	48.453688	121.143798	48.420143	121.124329
South Fork Cascade River	04.1411	18.6	19.3	48.462583	121.164305	48.461116	121.151704
Cascade River	04.1411	15.8	18.6	48.4666818	121.2165845	48.462583	121.164305
Illabot Creek	04.1346	9.9	10.7	48.42044	121.3752	48.41221	121.36302
Illabot Creek	04.1346	10.7	11.7	48.41221	121.36302	48.40301	121.35013
Downey Creek	04.0919	0.0	2.1	48.28397	121.20732	48.30655	121.18424
Downey Creek	04.0919	3.0	6.3	48.3008255	121.1915679	48.3242549	121.1576495
South Fork Sauk River	04.1204	4.5	5.0	48.05524	121.42942	48.03224	121.43636
South Fork Sauk River	04.1204	6.1	9.3	48.03224	121.43636	47.99567	121.41489

\*<sup>1</sup> WRIA references for the Upper Skagit River Basin begins with a "03." within WDFW's spawning database.

Weather conditions were carefully evaluated prior to starting a survey and regularly monitored during the survey itself. Because of the remoteness of several of the indexes and the inability to communicate from the indexes via cellular phones surveyors were instructed to use caution and abandon a survey prior to the onset of darkness or looming severe weather. Field and office personnel established a daily plan regarding the specific surveys that would be done and what time surveyors would discontinue a survey if the survey took longer than expected. At the end of each field day, the surveyors would convey they were out of the field by phone or text message.

Polarized sunglasses were worn regardless of conditions to better view redds and fish. All redds were counted and recorded and individually marked with brightly colored and labeled PVC survey flagging. Date observed, species, and location of redd in relation to the flag was written on each flag with permanent marker. Flagging was then tied a highly visible location on nearby vegetation. On the rare occasion no vegetation was available to hang flagging, redds were “pit flagged” by tying flagging around a stone and placing it in the pit of the redd. Any observed bull trout or other salmonids were counted and recorded with the exception of fry and parr. Surveyors also documented concurrent spawning by any other fish species observed. Redds from other species were marked with labeled flagging if they were a risk to being counted as bull trout redds on subsequent surveys. At the end of each survey the surveyors recorded conditions encountered throughout each index. Documented conditions included water level (low, medium, high), water clarity (clear, medium, muddy), estimated percent of spawning seen (averaged over the entire index as a reference to how environmental variables affected viewing conditions during the survey), weather observations, and any other comments about the survey. Survey results were compiled throughout the survey season and summed for each index.

## **Results**

Bull trout spawning ground surveys began 14 September 2017 and concluded 15 November 2017 (Table 2).

Each reach for each population was successfully surveyed at least three times in 2017 and both temporal and spatial coverage were adequate (Table 2). Peak bull trout redd counts occurred during week 41, 8-Oct through 14-Oct. The greatest number of redds during 2017 spawning were observed in the Cascade population reaches (Table 2). Redd density for the combined Cascade reaches was 24.3 redds per mile. Redd density in the Downey Creek reaches was 27.1 redds per mile, and was the highest density of all monitored Skagit populations in 2017. The West Fork Bacon Creek population reach had the fewest redds in 2017 with just four redds observed.

Total redd counts in 2017 were less than observed in 2016 for the West Fork Bacon, Illabot, and Downey spawning populations (Table 3). The 2017 to 2016 comparison could not be made for the Cascade or South Fork Sauk spawning populations because survey coverage was considered incomplete in 2016. The next year with complete coverage was 2015. There were 52.2% fewer redds in the South Fork Sauk spawning population in 2017 than in 2015 but the redd count in the Cascade population was one redd greater in 2017 than in 2015. (Table 3).

Concurrent coho spawning occurred in the Cascade River, in the river miles 15.8 – 18.6 reach. Redd superimposition and redds with undetermined species origin were observed. Surveyors used professional judgement to assign redds to a species. Bull trout redds were enumerated, and coho redds were marked to avoid confusion. In the infrequent event redd characteristics were not adequate to make a clear species distinction, the redd was classified as a coho redd.

Table 2. Redd counts from 2017 Skagit Basin bull trout spawning ground surveys.

Spawning population	Stream	Stream code	Survey week:		37	38	39	39	40	40	41	41	41	41	42	42	43	43	43	43	44	44	45	45	45	46	Total		
			River mile		Survey date																								
			Upper	Lower	9/14	9/21	9/26	9/28	10/3	10/4	10/9	10/10	10/11	10/12	10/16	10/17	10/24	10/25	10/26	10/27	10/30	10/31	11/6	11/7	11/8	11/15			
WF Bacon	West Fork Bacon Creek	03.1774	8.1	6.1							2							0							2	4			
Cascade	Middle Fork Cascade River	03.1670	0.1	0.0					1						0					0						1			
Cascade	South Fork Cascade River	03.1411	21.8	20.0					8						14						12					34			
Cascade	South Fork Cascade River	03.1411	19.3	18.6						1					21								0			22			
Cascade	Cascade River	03.1411	18.6	15.8	0	2					7				71									4		84			
Illabot	Illabot Creek	03.1346	11.7	10.7			0					0							1					3		4			
Illabot	Illabot Creek	03.1346	10.7	9.9			0					0							0					3		3			
SF Sauk	South Fork Sauk River	03.1204	9.3	6.1				0					25						3					0		28			
SF Sauk	South Fork Sauk River	03.1204	5.0	4.5			0						3						0					1		4			
Downey	Downey Creek	03.0919	6.3	3.5					17						32				1							50			
Downey	Downey Creek	03.0919	2.1	0.0				16							63									0		83			

Cumulative total from all indexes: 317

\*1 WRIA references for the Upper Skagit River Basin begin with a "04." within WDFW's spawning ground database.

Table 3. Yearly bull trout redd counts from 2017 through 2002. Counts were cumulative counts from all indexes within each stream. The Cascade River redd counts also included the counts from the Middle Fork and South Fork Cascade River reaches. If no redd count is listed then no surveys were conducted in that index that year. Redd counts are shown from prior to 2005 but note in years prior to 2005 some spawning areas were still being located and explored so survey coverage was not necessarily consistent year to year.

Stream	Comparisons						Skagit River basin bull trout spawning population redd counts by spawn year															
	Years compared			Redds			2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002
	N reaches	Last	First	N	Mean	Median																
WF Bacon Creek	1	2017	2002	16	68	71	4	23	58	87	59	91	48	67	21	84	86	59	101	91	75	127
Cascade River	4	2017	2006	12	267	270	141	115	140	412	376	437	178	207	91	333	344	434				
Illabot Creek	2	2017	2002	11	84	51	7	13	40	124						33	51	26	57	156	211	201
SF Sauk River	2	2017	2002	16	157	138	32	30	67	124	156	151	133	152	77	208	110	143	104	433	279	318
Downey Creek	2	2017	2005	13	173	172	133	186	143	263	208	260	141	95	103	197	172	193	158		32	
Total redds:							317	367	448	1,010	799	939	500	521	292	855	763	855	420	680	597	646

Counts in red font mean monitoring was considered incomplete for that spawning population in that year.

## Discussion

Weather and stream conditions during 2017 bull trout spawning allowed for a successful season of monitoring with at least three surveys through each reach during the normal bull trout spawning period. However lower than average summer flows in August and September were immediately followed by an intense flow increase during the second week of October with a minimal period of transition (Figure 1, Figure 2, and Figure 3). The ferocity of the flow increase may have negatively affected spawning and locating and enumerating redds. Surveyors noted spawning streams were all impacted, but the severity of effects on spawning habitat was not equal between streams.

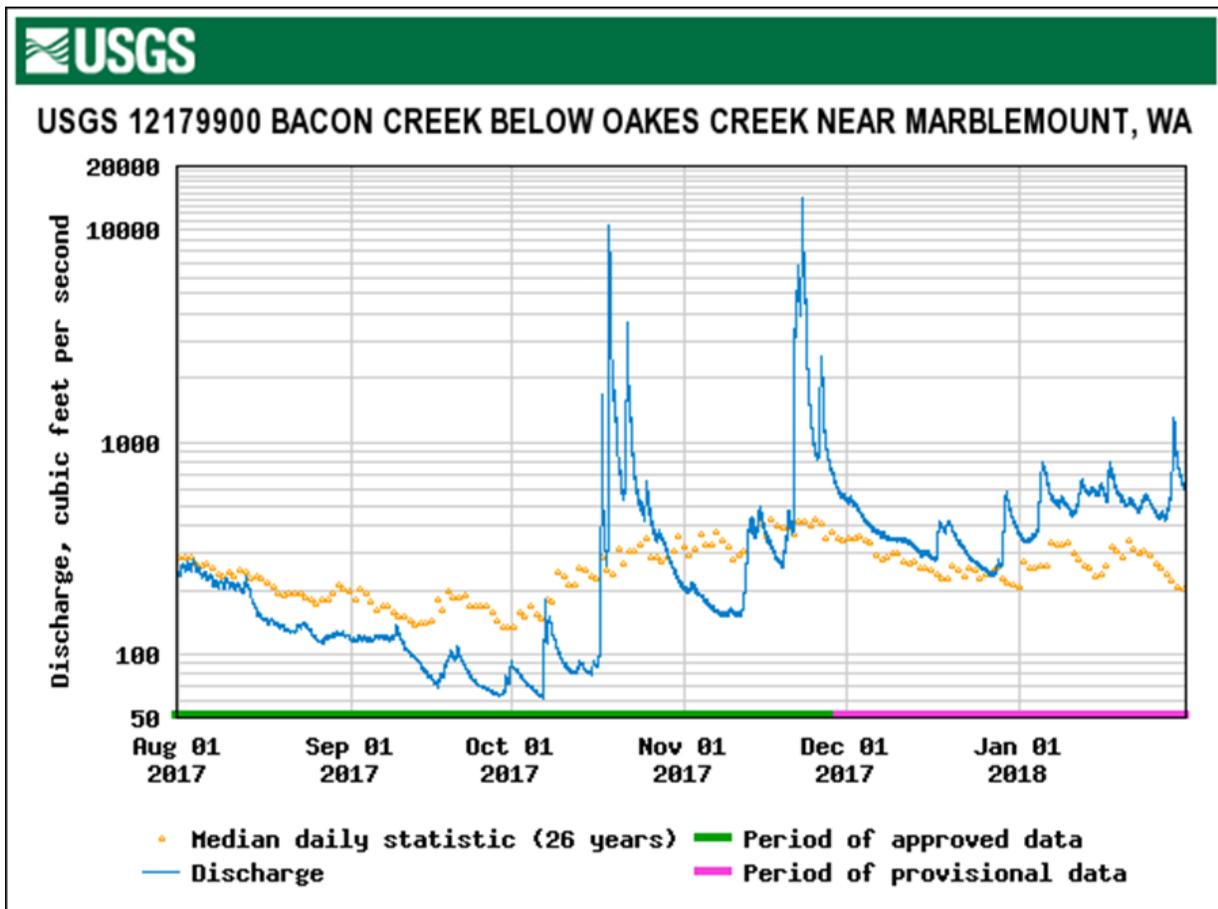


Figure 1. Bacon Creek stream flow from 1-Aug-2017 through 31-Jan-2018. Stream flows were lower than average into October until a damaging storm spiked flows in mid-October.

### USGS 12182500 CASCADE RIVER AT MARBLEMOUNT, WA

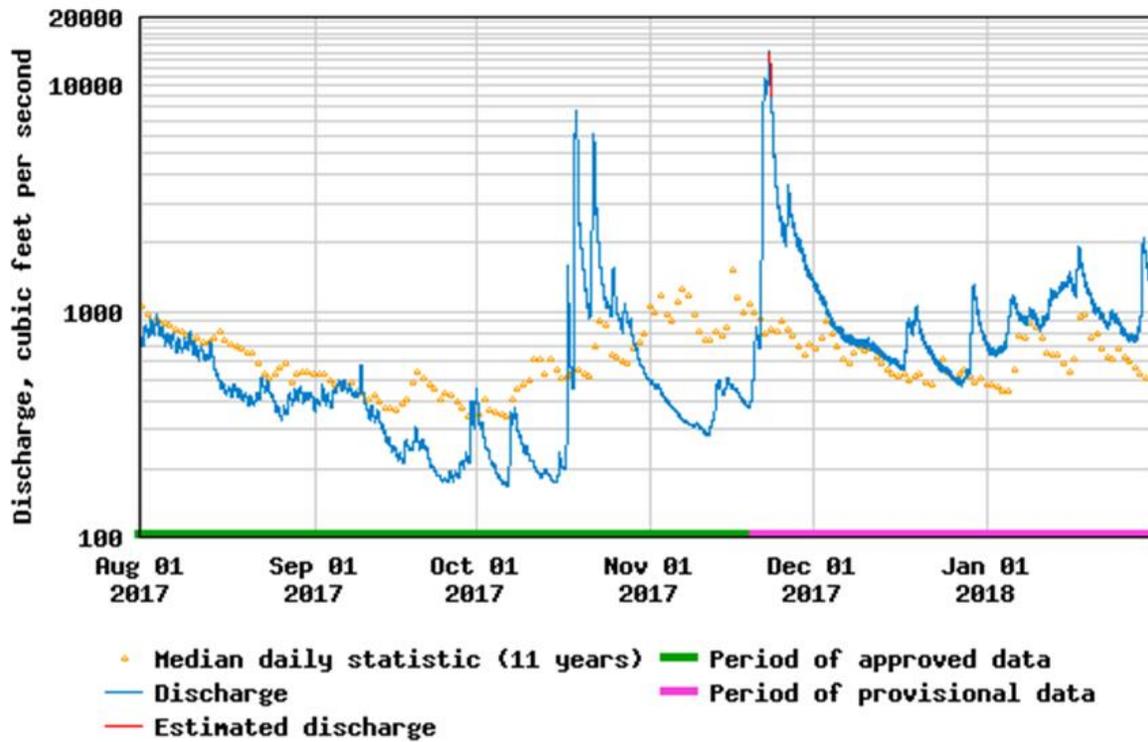


Figure 2. Cascade River stream flow from 1-Aug-2017 through 31-Jan-2018. Bull trout spawning in the Cascade population reaches experienced a substantial flow event in mid-October in the middle of their normal spawning period.

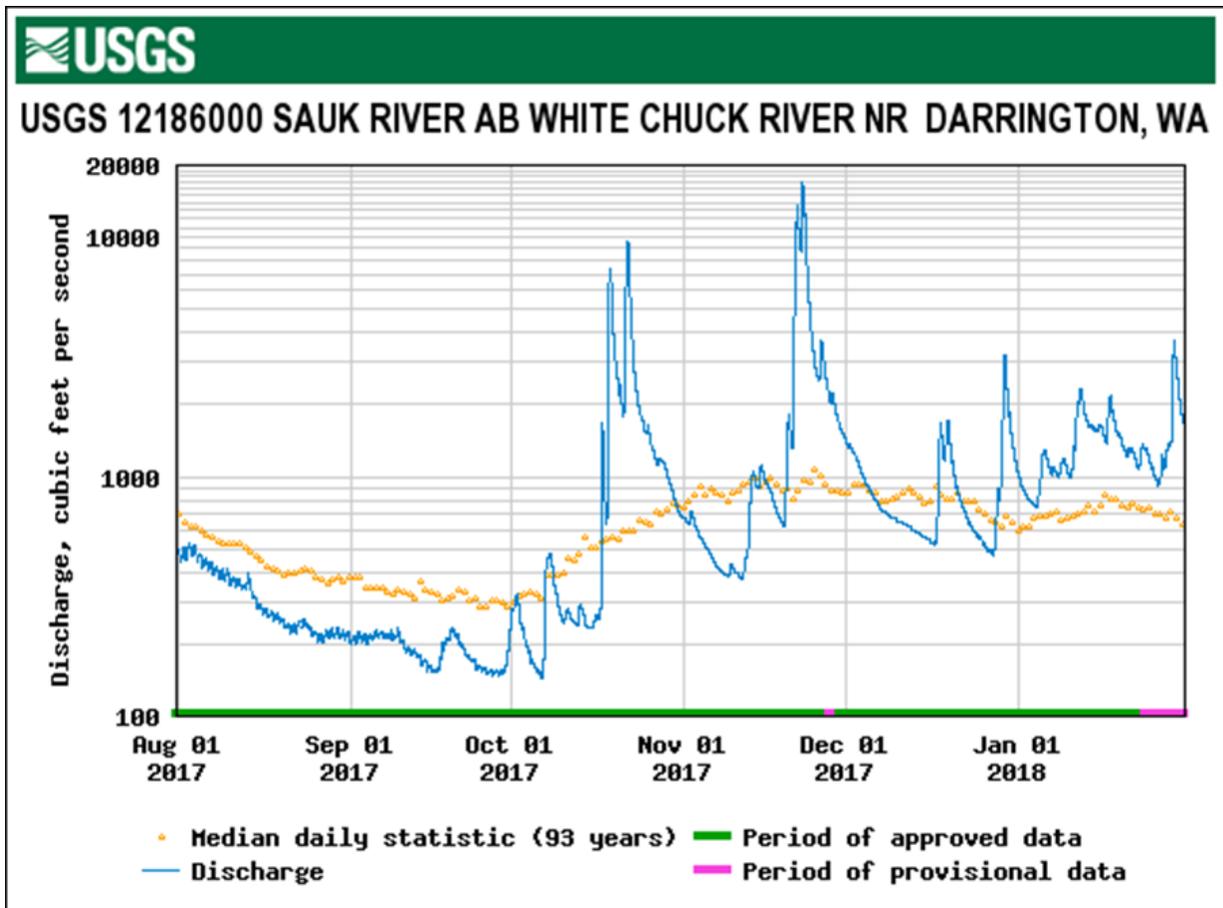


Figure 3. Sauk River stream flows measured upstream of the White Chuck River 1-Aug-2017 through 31-Jan-2018. Bull trout spawning in the South Fork Sauk River population reaches experienced a substantial flow event in mid-October in the middle of their normal spawning period.

Bacon Creek was subjectively assessed as the most negatively affected. Flows in Bacon Creek climbed to a peak of just over 10,000 cfs. The flow increase went from summer low flows of less than 100 cfs to over 10,000 cfs in less than 48 hours (Figure 4). In terms of gauge height, flows went from under 4 ft. to over 11 ft. in that 48-hour period. The greatest rate of change occurred on 18 October when flows went from 4.7 feet at 15:00 to 9.7 feet by 17:30, a five-foot increase in stream height in just 2.5 hours (Figure 4). On the survey following the major flow event surveyors described the WF Bacon Creek reach as totally destroyed with substantial scour, channel abandonment, and channel avulsion. The destruction was also observed in side channels and hyporheic fed spawning areas in abandoned stream channels normally protected during high water events.

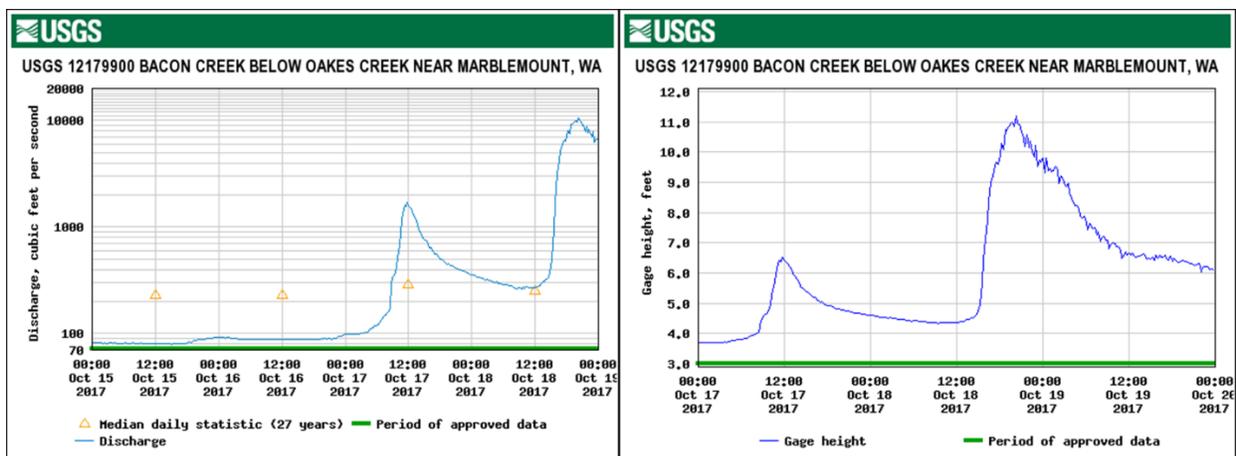


Figure 4. Stream flow (cfs) and Gauge height (feet) of Bacon Creek from 17-October through 20-October. On 18-October, stream height increased 6.8 vertical feet in the span of 8 hours.

Total Skagit basin bull trout spawning in the index reaches was again less than the prior year in 2017 (Table 3, Figure 5). Due to incomplete surveys in some reaches in 2016, little weight should be given to comparison between the two years. However, surveys were complete in 2015 and there were fewer redds in 2017 than in 2015. There were also 55.6% fewer redds in 2015 than observed in 2014 (Table 3, Figure 5). With the limited amount of Skagit basin bull trout monitoring performed each year, and with no components for other life history stages and expressions, the short term declining spawning abundance trend cannot yet be explained by any particular variable.

There are two noteworthy patterns developing in the historical spawning data. From the period between 2015 and 2006 annual spawning abundances appear to be tracking an odd-even cycle, with greater spawning abundances on even years than odd (Figure 5). The cycle continued through the period from 2013 and 2009 when the Illabot reaches were inaccessible and persisted with the addition of the Illabot reaches in 2014 and 2015. There also appears to be a three-year abundance cycle developing; three years of greater abundances are followed by three years of lower abundance and then repeated (Figure 5). Like the odd-even cycle, the three-year cycle trend persisted through years with and without the Illabot Creek reaches. Future years of monitoring will be needed to determine if the patterns are part of a biological or ecological process, from an undetermined survey bias, or purely coincidental.

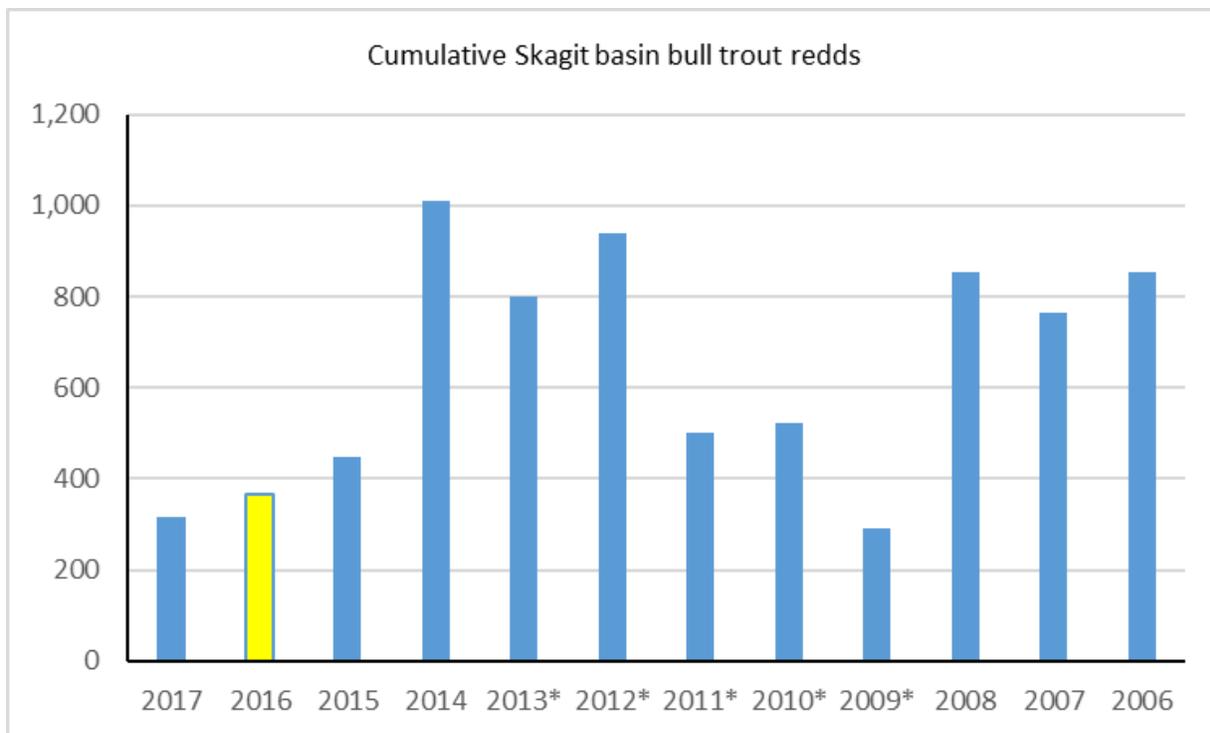


Figure 5. Chart of summed annual Skagit basin bull trout redds from all monitored Skagit spawning populations. In years with an asterisk, the Illabot Creek spawning population was not monitored due to road washout. Monitoring was incomplete in 2016 due to weather and stream flows.

Bull trout spawning often takes place in side channels and braids that are densely overgrown and far from easy or pleasant to navigate. Adding an additional layer of complication occurs with concurrent coho spawning. Coho spawning is generally only an issue in the mainstem Cascade River reach and in West Fork Bacon Creek. There were no issues in WF Bacon in 2017 but there were in the Cascade. Successful species assignment to a redd is dependent on surveyor experience. The senior member of the WDFW bull trout crew has been performing surveys in these reaches for over a decade. From years of observations of bull trout and coho working redds in various states of completion, it has been noted there are some physical characteristics that often distinguish one from the other. Size of redd is not a distinguishing characteristic but redd shape is. In general bull trout redds tend to be somewhat oval and fairly uniform with clean edges around the pit. Coho on the other hand in general create “messy” redds that are more circular and do not have as crisp of an outline as the char redds. Additionally Skagit bull trout frequently build the redd around or along woody debris as is common with the species throughout their range. Coho have not been regularly observed incorporating wood in their redds. It is likely some redds are misidentified using this necessary subjective species assignment. However, at present we have no way of assessing the accuracy and precision of the determinations.

The spawning information collected in 2017 and in prior years was not, has not, and should not be used to estimate the population size of bull trout in the surveyed basins. Bull trout exhibit many life history patterns and the only true measure of population size would have to measure the populations throughout the range of habitats they occupy and life history expressions they

demonstrate. The expression of anadromy in Puget Sound bull trout adds an additional complicating layer to the task of a full population assessment.

The purpose of the 2017 bull trout spawning ground surveys was to attempt to maintain a long-term dataset that may reflect spawning trends and general abundance of the spawning populations in the absence of more extensive monitoring. There are other spawning locations and populations that have been identified but have not been regularly monitored. Goodell Creek is an example of a known population that is not monitored. Bull trout have also been documented spawning in tributaries to the White Chuck River but increased numbers of staff and funding would be necessary to monitor the logistically challenging White Chuck, and any other spawning areas.

Washington Department of Fish and Wildlife continues to be grateful and appreciative of Seattle City Light for the funding support SCL provided to continue to maintain an increasingly long-term dataset on a fascinating and often under-appreciated species. This additional year of monitoring would not have been possible without their support.

It should be noted that anadromous bull trout also spawn in the Baker Lake system. Monitoring is coordinated and performed by Puget Sound Energy. The results of those spawning ground surveys are not provided in this report.