



# TECHNICAL MEMO

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**TO:** Jackson Hydroelectric Project (FERC No. 2157) file

**FROM:** Keith Binkley, Natural Resources Manager

**DATE:** December 14, 2016

**RE:** License Article 404: Side Channel Enhancements, Maintenance 2016

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## Introduction

This memo was prepared to document specific maintenance actions taken during 2016 to ensure that the objectives of the Plan for Side Channel Enhancement and Large Woody Debris Placement (SCE/LWD Plan) continue to be met under License Article 404.

The SCE/LWD Plan has a number of objectives to advance the overall goal of enhancing adult and juvenile salmon habitats in the lower river. These objectives include:

1. *Provide for adult holding and spawning habitat in the main river channel over a range of hydrologic flow conditions.*
2. *Expand the range of hydrologic flow conditions over which side channels receive inflow from the main river by manipulating the hydraulic inlet controls to ensure inflows at a mainstem minimum flow of 300 cfs.*
3. *Use LWD structures to increase both adult and juvenile habitat availability in the mainstream and side channels.*
4. *Ensure that the overall design of LWD structures takes advantage of natural river geomorphic processes that promote their long-term effectiveness and sustainability.*
5. *Provide for maintenance of existing adult spawning habitat and expand potential off-channel refuge and summer rearing habitat in side channels for native salmon and trout species.*
6. *Develop and implement a long-term monitoring program to track overall performance of these enhancement measures.*

Potential maintenance actions are identified through routine monitoring, as described below:

*Structure Performance - Engineered log structures are routinely inspected for structural integrity and signs of degradation / changes in form, orientation, or function. Racking of additional woody debris is noted and in instances where it negatively impacts the functioning of the structure, it is removed. Observations are recorded and photo documented.*

To date, no maintenance actions have been taken at any of the eight engineered log structure installations in the lower river.

*Physical Habitat Measurements - Side channel habitats are monitored seasonally to qualitatively assess functionality over the full range of flow conditions with focused surveys conducted when mainstem flows drop below 400 cfs. This information defines flow connectivity and the relationship between mainstem and side channel flow.*

*Monitoring includes a pedestrian (walking) habitat survey along the length of each channel including photo documentation of observed changes, as appropriate.*

*Consistent with the Fisheries and Habitat Monitoring Plan, during Year 1 through Year 10, if there is a high flow event or other major event causing change, the District will perform a comprehensive quantitative habitat survey of the lower river including side channel habitats. Under the current license, comprehensive surveys have been conducted in 2014 and again in 2016 with baseline surveys conducted in 2007 and 2010.*

During the 2016 comprehensive survey (Stillwater 2016), dewatering of a portion of one side channel, under low flow conditions, was documented and quantified. This area was also identified during a ramping rate evaluation conducted at the same time. The documentation and subsequent resolution of this issue is the focus of this report.

Prior to 2016, maintenance actions have been minor and included:

- fence repair along conservation easement areas,
- contouring of pedestrian trails, near bridges, to maintain appropriate access as stipulated in the Americans with Disabilities Act,
- re-seeding of landowner properties, and
- placement of wood from Culmback Dam.

None of these minor actions warranted detailed reporting.

**Table 1. Habitat surveys conducted in the Sultan River since issuance of the current license in 2011.**

Date	Action
September 2012	Completion of Side Channel Construction Project
2013	Annual Pedestrian Surveys, Initial Side Channel Habitat Surveys for Evaluation of Downramping Rates
2014	Annual Pedestrian Surveys, Comprehensive Riverine Habitat Survey
2015	Annual Pedestrian Surveys, Revised Ramping Rate Evaluation
2016	Annual Pedestrian Surveys, continuation of Revised Ramping Rate Evaluation, Comprehensive Riverine Habitat Survey

## Identification of Maintenance Issue or Concern

The routing and distribution of flow within the Side Channel 1 (SC 1) complex has been closely monitored since the completion of the construction of side channel enhancements. The SC 1 complex has two inlets and two outlets (Figure 1). A second inlet, referred to as the “new” or “redundant” inlet, was created to ensure water delivery in the event that the original inlet became blocked or compromised. The original “old” inlet is adjacent to a large wetland where beaver have been observed. Historically, beaver activity has resulted in flow reductions within SC 1 under low flows. Since construction, no significant flow related problems have been identified at the inlets other than the occasional damming of the channel by people during the summer.

Monitoring by District staff has indicated that the distribution of flow between the two outlets to SC 1 has evolved since construction. This was not unexpected because the confluence of the

two outlets is a dynamic area. In addition, a small log jam is present at this location. The distribution of flow is also variable over the range of river flows leading further to the evolution of the area. During initial project construction, an intentional “plug” was created (installed) in the newly constructed outlet, near cross section (XS) 8 and XS-9 (Figure 1), as a measure to protect against the complete routing of all flow down the new channel. Over time, sedimentation and changes at the log jam lead to the routing of a proportionately lesser amount of flow down the new outlet. This situation was not problematic at mainstem flows above 400 cfs but was concerning at flows below 400 cfs, especially during the summer when groundwater levels tend to be lower.



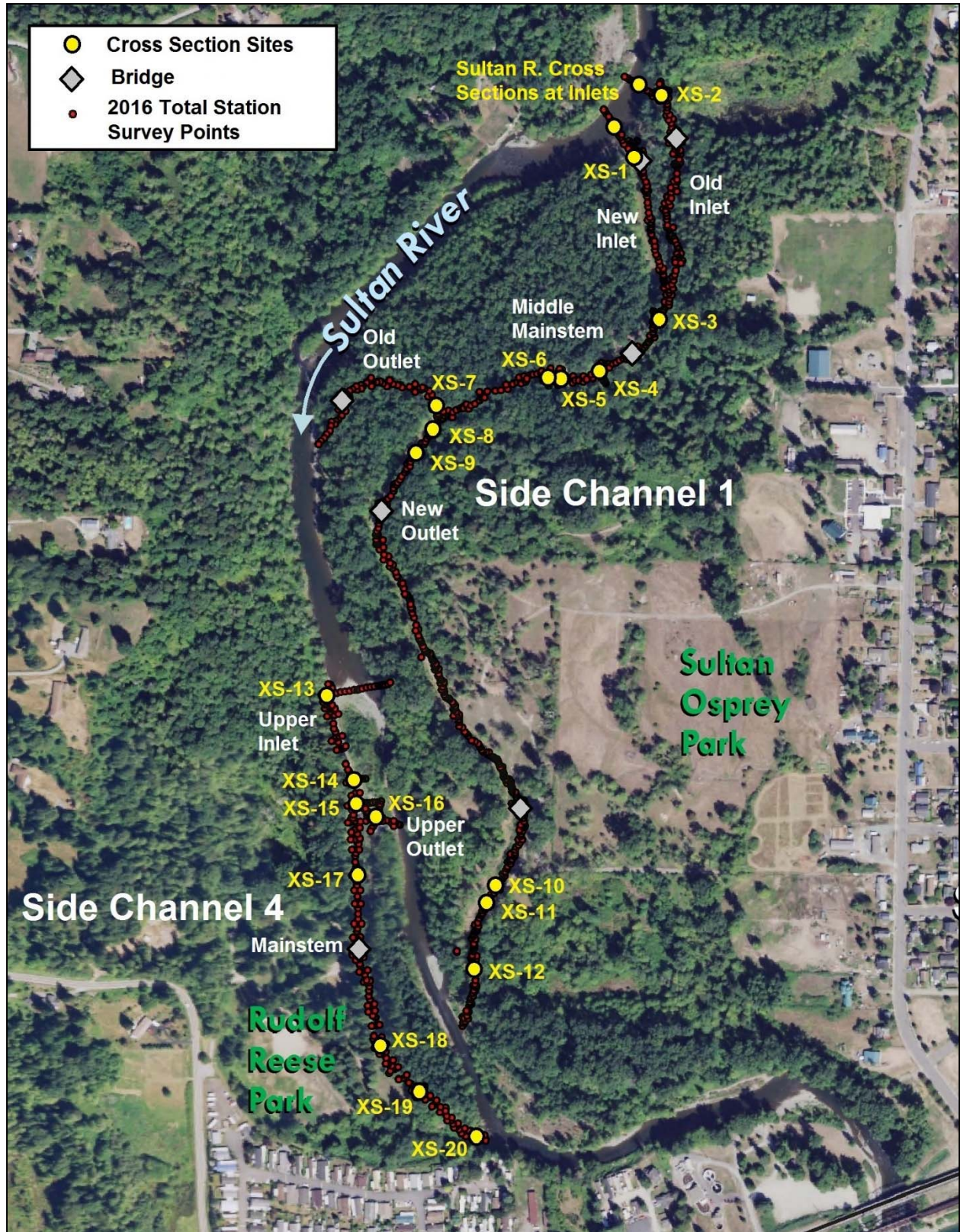


Figure 1. Map of the lower Sultan River, including the old and new outlets to Side Channel 1.



In addition to the observed changes in flow distribution, evolution of the channel also resulted in changes in habitat. Since 2014, SC 1 has evolved from a channel that contained 18 units (primarily main channel pools, low gradient riffles, and glides) to one that is now made up of 93 units including 35 pools, stretches of dry channels and isolated pools, as well as a marsh, islands, and glides and low gradient riffles.

Though more complex in terms of number of distinct units that constitute the channel, the ability for SC 1 to maintain channel connectivity has been compromised due to the decreasing depths and channel widths, and the observed stretches of dry channels and intermittent pools. The following photo was taken in the new outlet to SC 1 in July 2016 when mainstem flow of the Sultan River was approximately 320 cfs. (Figure 2).



**Figure 2. Photo taken in July, 2016 depicting dry reach in new outlet to Side Channel 1.**

Upon documentation of the severity of the dewatering issue under low-flow conditions, the District implemented a timely resolution of the situation prior to closing of the typical annual in-water work window. The sequence of events leading up to channel modification and those conducted afterward are outlined in Table 2. The cooperation of the Washington Department of Fish and Wildlife (WDFW) was critical to the immediate resolution of this issue.

**Table 2. Chronological sequence of events during 2016**

Date	Action
July 10	Reduction in plant output (generation) to decrease river flows and replicate flow conditions present during prior survey conducted in 2014
July 11-15	Dewatering documented during surveys <sup>1</sup>
July 22	WDFW notified of issue and intent to remediate
July 28	On-site meeting with WDFW Habitat Biologist
August 8	Formal submission of plans to modify channel, under Hydraulic Project Approval (HPA) 122550
August 25	HPA issued by WDFW. In-water work window during 2016 through September 30
September 21	Pre-project survey
September 26-28	Construction - excavation/removal of "plug" (1,150 cubic yards of material)
October 3	Post construction measurements of flow distribution
October 16	Notification to ARC of immediate actions taken and intent to document by survey
October 19	Post construction site visit with WDFW
November 9	Post project topographic / bathymetric survey of project area

## Methods

### Pre Measurements

The approach to resolving the identified dewatering issue was to remove or modify the intentional "plug" installed during initial construction. A review of as-built set with the Project Engineer indicated that this could be accomplished through removal of approximately 8 inches of material within the upper 300 feet of the new channel. The channel was surveyed and staked prior to excavation and monitored continually through the process to ensure that the area was not over excavated.

### Implementation of Best Management Practices / Erosion Control Measures

Construction was scheduled to coincide with a period of reduced generation and discharge so as to provide favorable flow conditions within the side channel work area and to minimize potential issues with turbidity. Ironically, while mainstem flows were identical to those during the summer survey, no dewatering of the channel was evident at the time of construction. This is likely attributable to recharge of the groundwater aquifer since the summer survey. With the increased amount of water present at the site, temporary actions were taken to reduce the volume and route a greater portion of the flow down the old channel. At this time, in order to control erosion, straw bales were placed in the channel at the downstream end of the work area.

### Excavation

As stated previously, surveying during the excavation process assured that final target channel elevations were achieved. In order to avoid the presence of a homogenous channel, additional excavation was done in select areas, primarily near existing large wood installations, to increase hydraulic diversity and complexity and to make the channel more fish friendly. The primary

<sup>1</sup> Two separate "low flow" habitat surveys were conducted this week. One of the surveys was for the purpose of evaluating ramping rates and the other was a post significant high flow assessment. Issue of dewatering in the new SC 1 outlet was documented and quantified during both surveys.

purpose of this short 300-foot section of channel is to convey water further downstream consistent with desired flow split although utilization of this area by spawning adults and rearing juveniles has been readily evident since construction.

### Post Measurements

A detailed topographic / bathymetric survey of the entire modified area was completed after construction was complete. This survey provided the basis for documenting finished channel elevations, updating of the longitudinal profile, updating of cross sections at two survey locations, and the calculation of volume of material removed during excavation. Several flows greater than 2,000 cfs in the main channel of the river had occurred between the time construction was completed on September 28 and the date of this survey on November 9. (Figure 3).

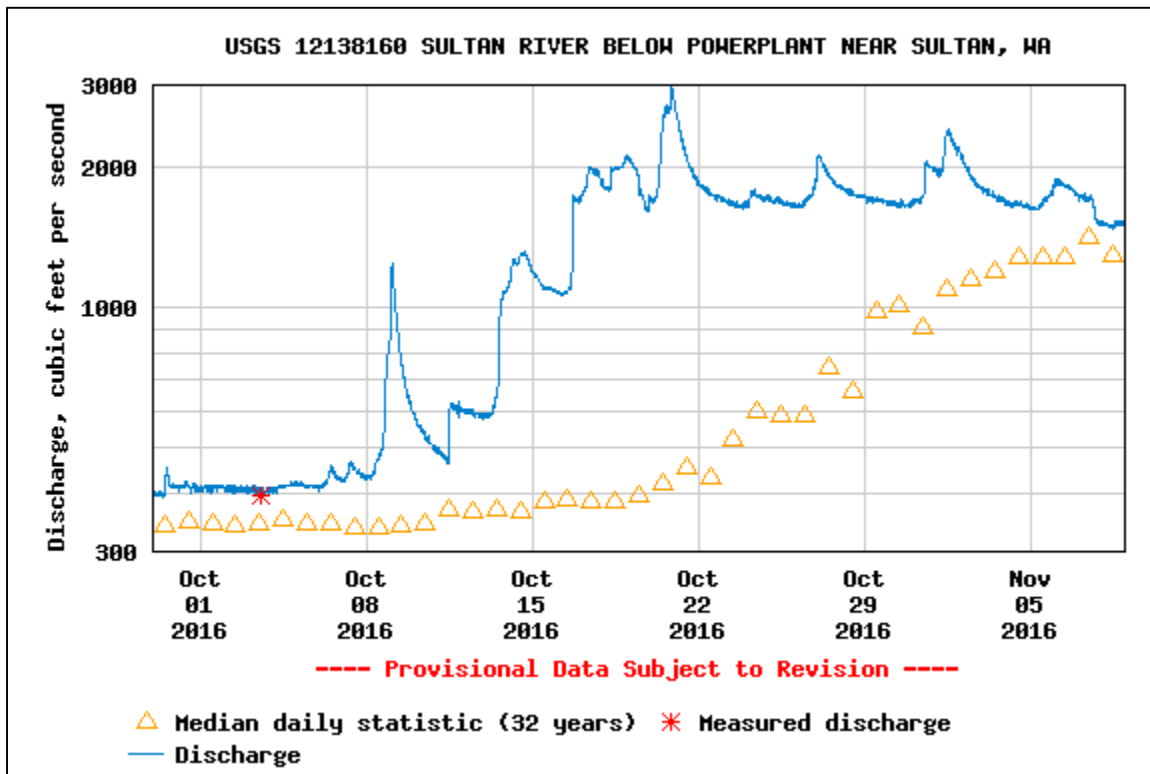


Figure 3. Hydrograph of the lower Sultan River depicting flows experienced prior to post construction topographic survey.

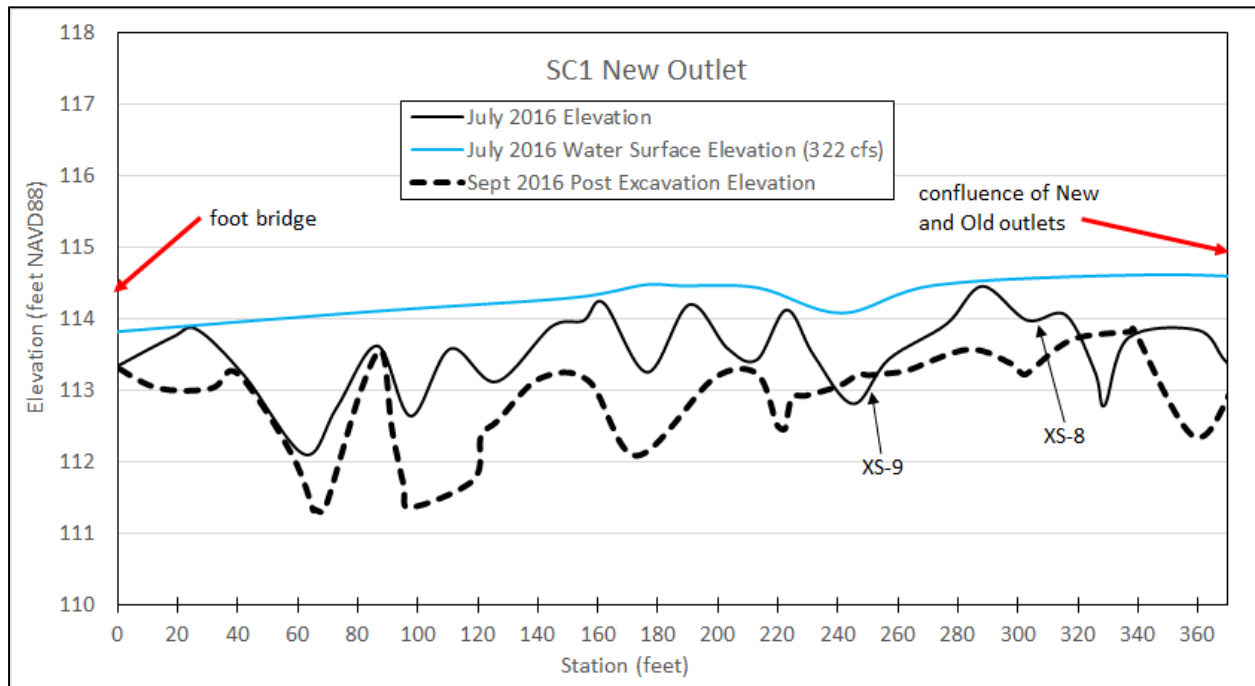
### Results

Dewatering of sections of the new SC 1 outlet was directly related to diminished connectivity with upper portions of the side channel and the distribution of flow at the confluence of the new and old channels. The potential for this issue was noted at the time of initial construction and identified for monitoring. Flow measurements within both channels have been obtained since 2013 (Table 3). The measurements indicate a general pattern of a reduced percentage of flow being routed down the new SC 1 outlet (Table 3). The observed variability in the trend was most likely attributed to the racking of wood at the jam present at the confluence of the two channels. Aggradation of the channel within the new SC 1 outlet was also likely a contributing factor to the observed dewatering.

**Table 3. Flow measurements at the confluence of the new and old outlets (pre-modification vs. current\*)**

Date	Mainstem Flow (cfs)	Side Channel 1 Total Flow (cfs), at confluence	Flow (cfs) and (percentage of total) routed down Old Outlet	Flow and (percentage of total) routed down New Outlet
6/25/13	342	12.3	8.5 (69)	3.7 (31)
10/1/13	447	9.8	6.1 (62)	3.8 (38)
11/14/13	1370	63.2	27.3 (43)	35.9 (57)
7/11/14	376	11.5	9.2 (80)	2.3 (20)
4/30/15	380	10.8	9.4 (87)	1.4 (13)
5/12/15	421	14.0	9.5 (68)	4.5 (32)
5/26/15	324	7.7	6.5 (85)	1.2 (15)
7/21/16	340	6.9	6.7 (96)	0.3 (4)
10/3/16*	404	6.6	1.9 (28)	4.7 (72)

The distribution of flow observed at the confluence on 10/3/16 (Table 3) is reflective of the channel modifications made within the upper portion of the new outlet and demonstrates the initial success at resolution of the dewatering issue. Figure 4 quantifies changes in channel elevation and updates the longitudinal profile for habitat related purposes. Similarly, modified changes at Cross Sections 8 and 9 are documented in Figures 5 and 6, respectively.



**Figure 4. SC 1 New Outlet profile from confluence with Old Outlet to foot-bridge downstream.**



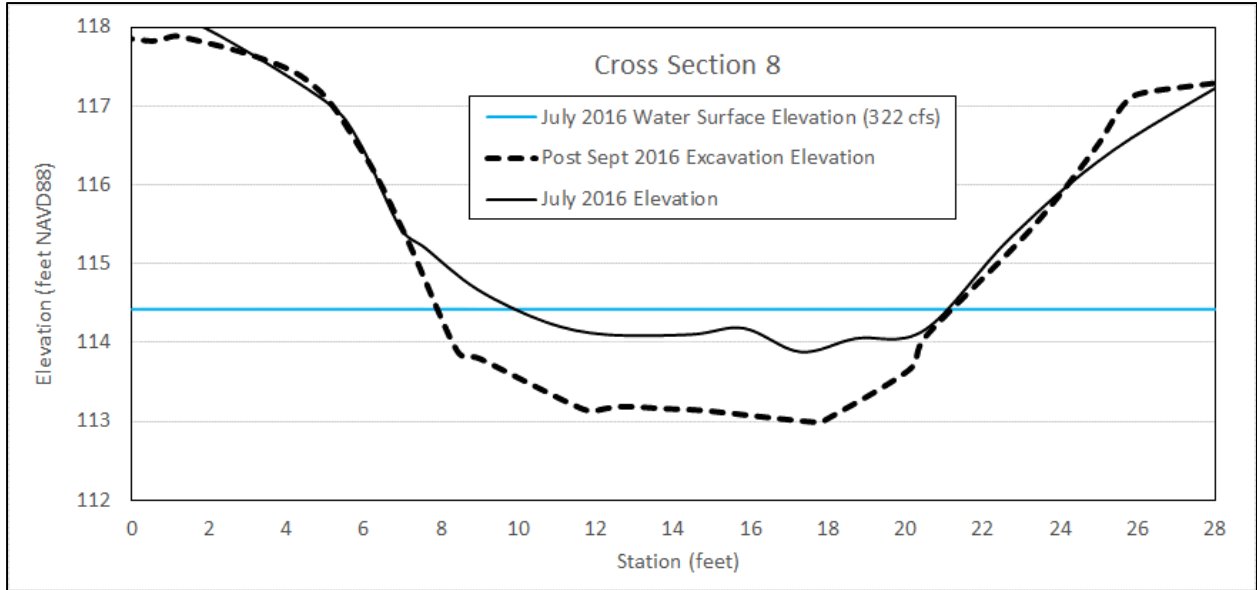


Figure 5. SC 1 Ramping Rate Study Cross Section 8 near the upstream end of the New Outlet.

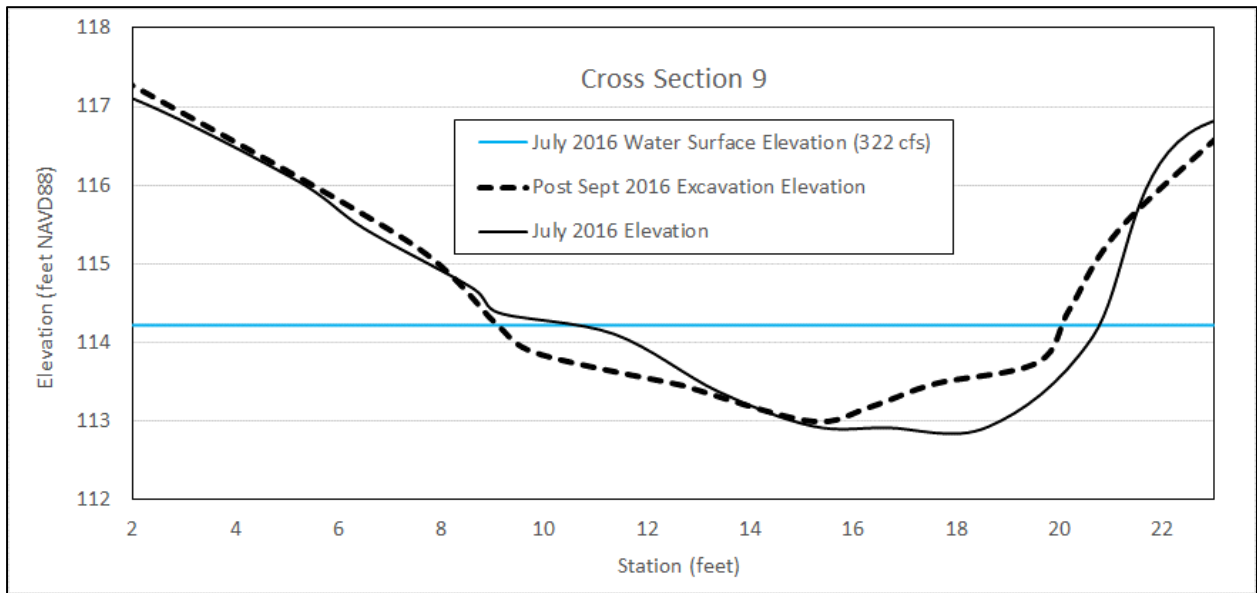


Figure 6. SC 1 Ramping Rate Study Cross Section 9 near the upstream end of the New Outlet.