Prepared by:	Matt Paulsen and Cole Lindsey, Environmental Assessment Services, LLC
Report Period:	December 1 to December 15, 2021
Report No.:	2021 Willamette RST Bi-Weekly Report 12/1 – 12/15 by EAS
Re:	**WILLAMETTE VALLEY FISH PASSAGE MONITORING VIA ROTARY SCREW TRAPS**

Project Schedule

Table 1. Project Schedule

Site	Task	Start	End	Days
Hills Creek RO and PWR	Deployment	10/12/21	10/12/21	1
Hills Creek RO	Operation	10/21/21	3/15/22	146
Hills Creek PWR	Operation	10/23/21	3/15/22	144
Hills Creek	Trap Efficiency Release (1,200 fish, 600 per route)[a]	12/13/21	12/13/21	1
Cougar Dam RST	Operation	12/01/21	12/31/22	396
Big Cliff Dam RST	Operation	12/01/21	2/15/22	292
Big Cliff Dam RST	Operation	3/15/22	10/15/22	

[a] Tentative schedule of first trap release.

Summary of Rotary Screw Trap Data

Rotary screw traps (RSTs) were operated at three locations in the southern Willamette river watershed: on the Middle Fork Willamette River below Hills Creek Dam (Hills Creek), the South Fork McKenzie river below Cougar Dam (Cougar Dam), and on the North Santiam River below Big Cliff Dam (Big Cliff). The locations of the RST's are depicted in Figures 1, 2 and 3 respectively. Sampling sites generally monitor individual routes for fish passage at the dams, including powerhouse (PWR) and regulating outlets (RO). Sampling began at the Hills Creek site on October 21, 2021, and at the Cougar and Big Cliff sites on December 1, 2021. Sampling dates and catch summaries are provided in Tables 2 and 3, respectively.

Figure 1. Hills Creek Dam RST Locations

Figure 2. Cougar Dam RST Locations

Figure 3. Big Cliff RST Location

Table 2. Sampling Dates for Reporting Period

Site	Total Sampling Period Start	Current Reporting Period Start	Current Reporting Period End	Days Sampled This Period	Total Days Sampled
Hills Creek RO	10/21/21	12/1/21	12/15/21	15 days	56 days
Hills Creek PWR	10/21/21	12/1/21	12/15/21	15 days	56 days
Cougar RO	12/1/21	12/1/21	12/15/21	15 days	15 days
Cougar PWR	12/1/21	12/1/21	12/15/21	15 days	15 days
Big Cliff	12/1/21	12/1/21	12/15/21	15 days	15 days

Table 3. Willamette Valley Rotary Screw Trap Monitoring Catch Summary

Site	Species	Catch (Reporting Period)	Recaptures (Reporting Period)	Total Catch	Total Recaptures
Hills Creek	CHS	8	0	56	0
Cougar	CHS	18	0	18	0
Big Cliff	CHS	10	0	10	0

Middle Fork Willamette – Hills Creek Dam

Target Species

This reporting period began on December 1 and ended on December 15. A total of 8 Chinook salmon (CHS) were captured during the 15-day sampling period (Figure 4). Sampling durations were 100% for both RO RST and Powerhouse RST. Table 4 provides life stage, length, and weight data for all Chinook salmon that have been caught at the Hills Creek site to-date and Figure 5 shows length frequency data to-date.

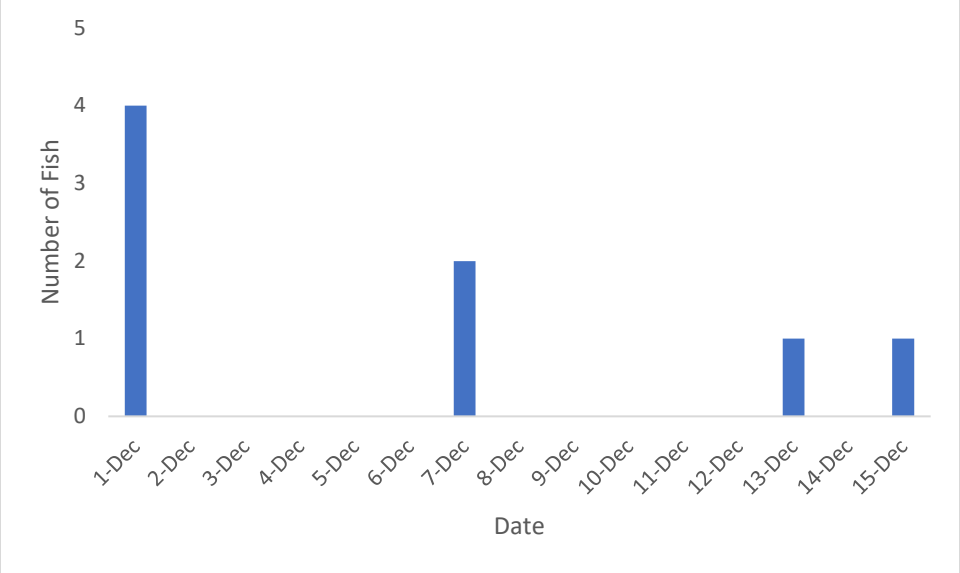

Figure 4. Chinook Captured Per Day 12/1/2021 to 12/15/2021 (Hills Creek)

Table 4. Descriptive Statistics of Target Species Captured at Hills Creek Dam Season To-Date and for the Reporting Period

To-Date											
Site	Route	Species	Life stage	Collected	Length (mm)*			Weight (g)*			
					Min	Max	Mean	Min	Max	Mean	
Hills Creek	RO	CHS	Smolt	21	143.0	260.0	239.3	107.8	191.5	161.9	
		CHS	Parr	--	--	--	--	--	--	--	
Hills Creek	PWR	CHS	Smolt	32	137.0	262.0	225.6	27.4	202.2	130.4	
		CHS	Parr	1	111.0	111.0	111	11.9	11.9	11.9	

December 1-15, 2021										
Site	Route	Species	Life stage	Collected	Length (mm)*			Weight (g)*		
					Min	Max	Mean	Min	Max	Mean
Hills Creek	RO	CHS	Smolt	3	223.0	242.0	231.7	116.0	146.7	128.8
		CHS	Parr	--	--	--	--	--	--	--
Hills Creek	PWR	CHS	Smolt	5	210.0	260.0	235.6	106.5	202.2	153.9
		CHS	Parr	--	--	--	--	--	--	--

*Fish that were missing heads are not included in length and weight calculations.

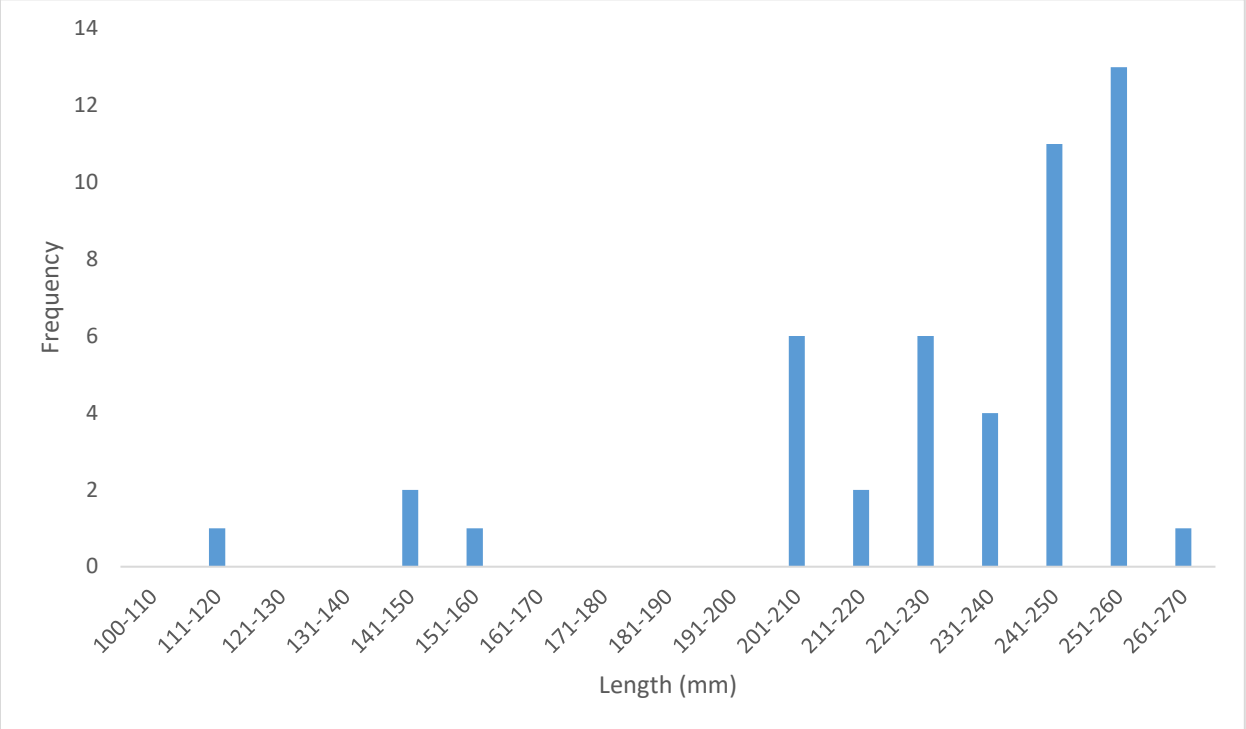

*Figure does not include fish without heads

Figure 5. Length Frequency of Juvenile Chinook Sampled Season To-Date (Hills Creek)

Injuries and Copepod Infection

Partial descaling <20% was observed on 2 of 3 Chinook collected at the RO RST (67%), and 5 of 5 Chinook collected at the PWR RST (100%). Descaling >20% was observed on 1 of 3 Chinook collected at the RO RST (33%), and 0 of 5 Chinook collected at the PWR RST (0%). All Chinook fish collected during this reporting period had copepods present. Of the 8 Chinook captured, 0 displayed body injuries and 0 had eye injuries present. There was 1 Chinook mortality collected in the RO RST, and 2 collected in the PWR RST (Table 5). A summary of injuries observed during the reporting period, and for the duration of the season are provided in Appendix A.

Table 5. Number of Descaled and Partially Descaled Chinook Salmon.

Site	# CHS Collected	# DSC* <20%	# DSC* >20%	# with Body Injuries	# with Eye Injuries	# with COP* In B.C.	# with COP* on Fins	Mortalities
Hills Creek RO	3	2	1	0	0	3	3	1
Hills Creek PWR	5	5	0	0	0	5	0	2

*DSC=Descaled, COP=Copepods, B.C.=Branchial Cavity

Non-Target Species

A total of 44 non-target fish were captured at Hills Creek during the reporting period; the data is summarized below in Table 6.

Table 6. Summary of Non-target Species (Hills Creek).

Species	RO Capture	RO Mortality	PWR Capture	PWR Mortality	Season Total	Season Total Mortality
Bluegill	3	1	10	4	24	6
Brook Lamprey	0	0	0	0	1	0
Bullhead	0	0	0	0	1	0
Crappie	0	0	2	0	52	38
Longnose Dace	0	0	0	0	2	0
Red-Sided Shiner	0	0	2	0	16	2
Sculpin	1	0	8	0	32	0
Spotted Bass	0	0	1	0	6	1
Sucker	0	0	0	0	2	1
Whitefish	1	1	0	0	1	1
O. mykiss	6	2	10	4	42	10
Totals	**11**	**4**	**33**	**8**	**179**	**59**

Stream Statistics

Basic stream statistics at the Hills Creek site were calculated from data downloaded from the U.S. Geological Survey stream gage number 14145110. Gage height (feet) is the only metric provided at this gage. During the reporting period, daily maximum values for instantaneous gage height ranged from 1,223.98 feet to 1,227.50 feet (mean: 1,224.87 feet). Figure 6 shows instantaneous gage height.

Stream temperatures were recorded every 2 hours for the both the RO RST and the PWR RST (Figures 7 and 8). Temperature probes operated normally throughout this reporting period.

Flows through the PWR and RO during the reporting period averaged 572.1 and 721.4 cubic feet per second (cfs) respectively (Figure 9). The average flow of the PWR while the PWR was generating was 725.2cfs and the RO was 721.4cfs. Catch per unit of effort (CPUE) data are summarized in Table 7.

Table 7. Summary of Chinook CPUE, Hills Creek.

	Chinook	
Description	RO (5ft)	PWR(8ft)
Catch	3	5
Effort (hrs)	359.1	359.2
CPUE (fish/hr)	0.008	0.014

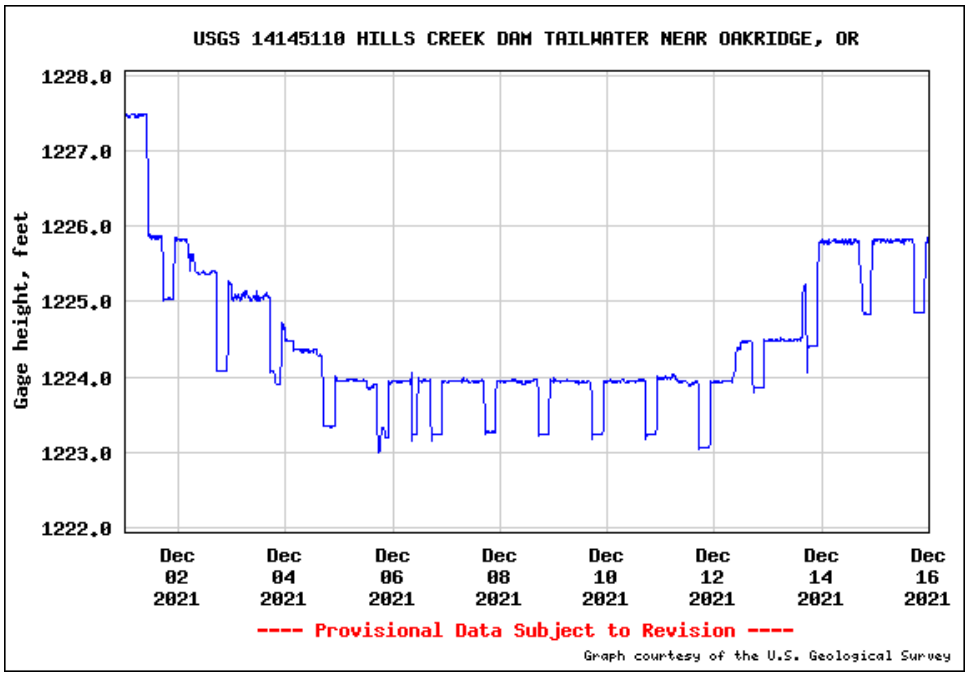

Figure 6. Gage Height (feet); below Hills Creek Dam, Middle Fork Willamette River

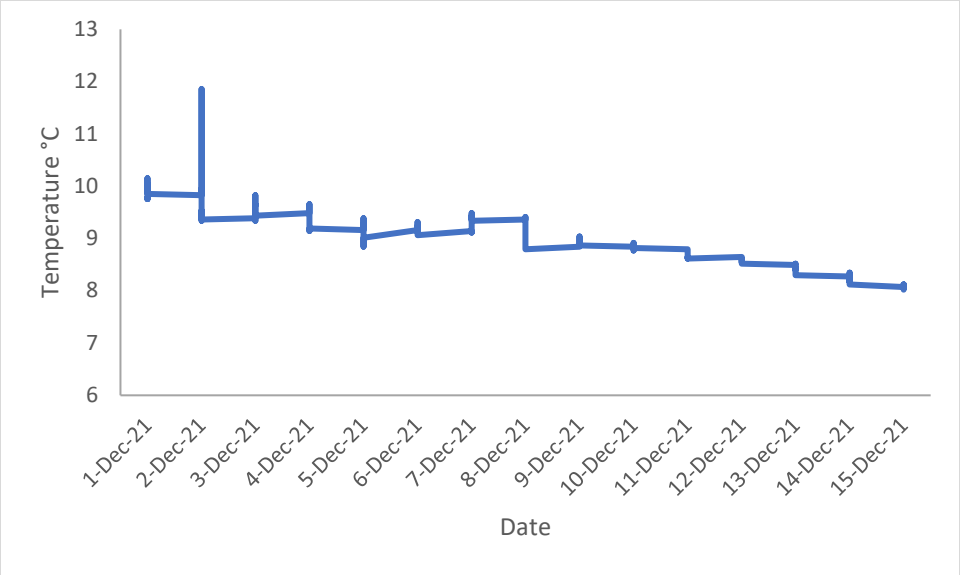

Figure 7. Temperature at RO RST (Hills Creek)

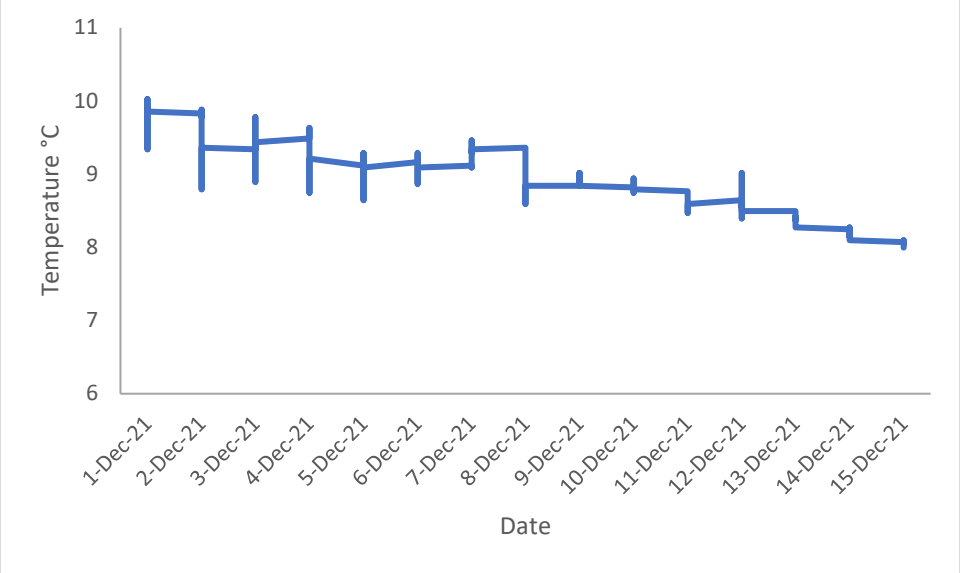

Figure 8. Temperature at Powerhouse RST (Hills Creek)

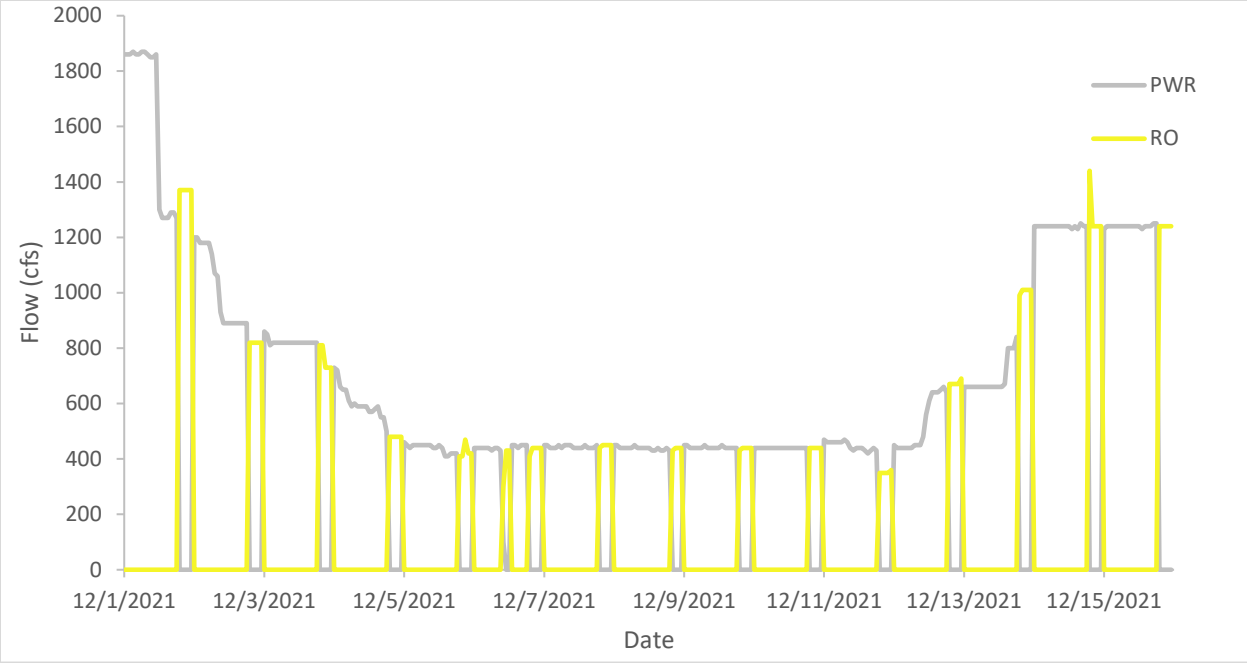

Figure 9. Hourly Flows PWR vs. RO (Hills Creek)

South Fork McKenzie – Cougar Dam

Target Species

This reporting period began on December 1 and ended on December 15. There was a total of 18 Chinook salmon (CHS) during the 15-day sampling period (Figure 10). Sampling durations were 100% for the RO RST and 0% for the Powerhouse RST. There was no flow through the powerhouse during the reporting period, so the RST cones were lifted out of the sampling position for the PWR traps to avoid damage. Table 8 provides life stage, length, and weight data for all Chinook salmon that have been caught at the Cougar Dam site to-date and Figure 11 shows length frequency data to-date.

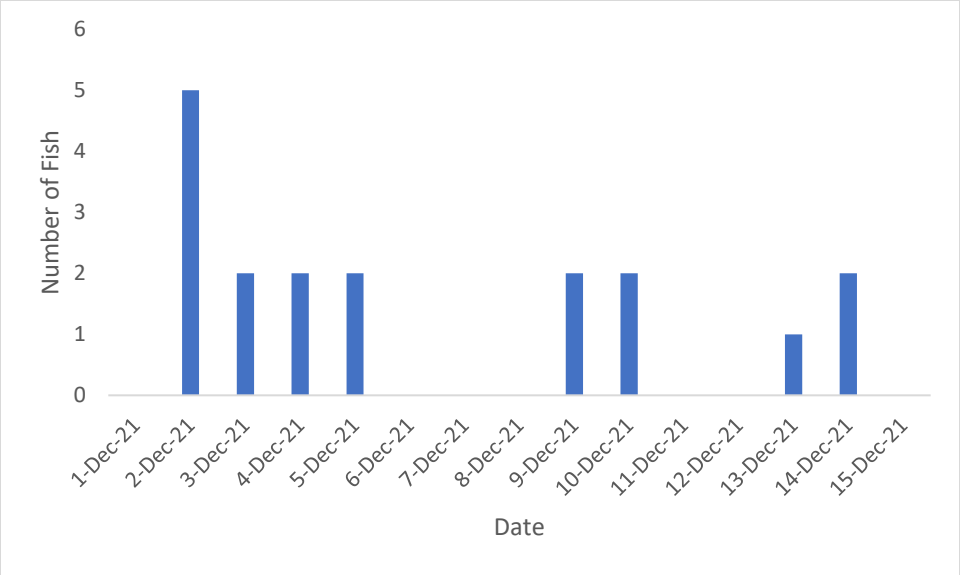

Figure 10. Chinook Captured Per Day 12/1/2021 to 12/15/2021 (Cougar Dam)

Table 8. Descriptive Statistics of Target Species Captured at the Cougar Dam Season To-Date

					Length (mm)*			Weight (g)*		
Site	**Route**	**Species**	**Life stage**	**Collected**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Cougar Dam	RO	CHS	Smolt	1	127	127	127	22.43	22.43	22.43
Cougar Dam		CHS	Parr	17	90	145	116.1	7.34	30.66	17.23
Cougar Dam	PWR	CHS	Smolt	--	--	--	--	--	--	--
Cougar Dam		CHS	Parr	--	--	--	--	--	--	--

*Fish that were missing heads are not included in length and weight calculations.

24-Hour Post Collection Holding Trial

A total of 17 Chinook captured in the RSTs were held for ~24 hours in holding tanks and then evaluated for survival rates. All 17 fish were captured in the RO trap. All 17 fish (100%) held during this period were released alive.

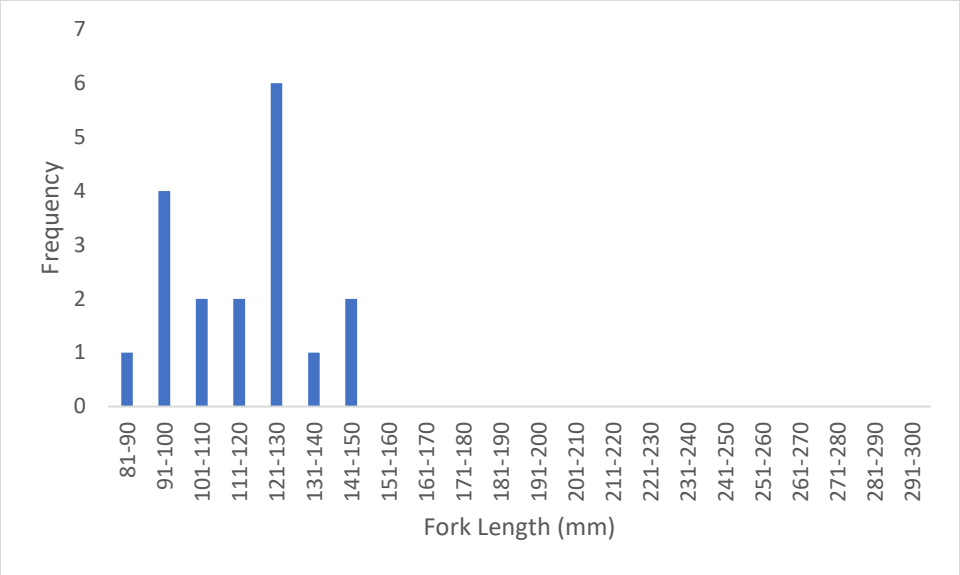

*Figure does not include fish without heads

Figure 11. Length Frequency of Juvenile Chinook Sampled Season To-Date (Cougar Dam)

Injuries and Copepod Infection

Partial descaling <20% was observed on 7 of 18 Chinook collected at the RO RST (39%), and descaling >20% was observed on 0 of 18 Chinook collected at the RO RST (0%). The PWR RST was not in operation for this reporting period due to low water levels. Fourteen of 18 Chinook fish collected during this reporting period had copepods present. Of the 18 Chinook captured, 1 displayed body injuries and 0 had eye injuries present. There were 0 Chinook mortalities collected in the RO RST, and 0 collected in the PWR RST (Table 5). A summary of injuries observed during the reporting period, and for the duration of the season are provided in Appendix A.

Table 9. Number of Descaled and Partially Descaled Chinook Salmon (Cougar Dam).

Site	# CHS Collected	# DSC* <20%	# DSC* >20%	# with Body Injuries	# with Eye Injuries	# with COP* In B.C.	# with COP* on Fins	Mortalities
Cougar RO	18	7	0	1	0	14	5	0
Cougar PWR	0	--	--	--	--	--	--	--

*DSC=Descaled, COP=Copepods, B.C.=Branchial Cavity

Non-Target Species

A total of 3 non-target species fish were captured during the reporting period; the data is summarized below in Table 6.

Table 10. Summary of Non-target Species (Cougar Dam).

Species	RO Capture	RO Mortality	PWR Capture	PWR Mortality	Season Total Live	Season Total Mortality
Bluegill	0	0	0	0	0	0
Brook Lamprey	0	0	0	0	0	0
Bullhead	0	0	0	0	0	0
Crappie	0	0	0	0	0	0
Longnose Dace	0	0	0	0	0	0
Kokanee	1	0	0	0	1	0
Red-Sided Shiner	0	0	0	0	0	0
Sculpin	0	0	0	0	0	0
Spotted Bass	0	0	0	0	0	0
Sucker	0	0	0	0	0	0
Whitefish	0	0	0	0	0	0
O. mykiss	2	0	0	0	2	0
Totals	**3**	**0**	**0**	**0**	**3**	**0**

Stream Statistics

Basic stream statistics at the Hills Creek site were calculated from data downloaded from the U.S. Geological Survey stream gage number 14159410. Gage height (feet) is the only metric provided at this gage. During the reporting period, daily maximum values for instantaneous gage height ranged from 1,251.09 feet to 1,251.44 feet (mean: 1,251.2 feet). Figure 12 shows instantaneous gage height.

Stream temperatures were recorded every 2 hours for the RO RST, and were not collected for the Powerhouse RST, due to low water levels (Figure 13). Temperature probes for the RO RST operated normally throughout this reporting period.

Flows through the Powerhouse and RO during the reporting period averaged 0 and 488.7 cubic feet per second (cfs) respectively (Figure 14). The Powerhouse was not in operation during this reporting period. Catch per unit of effort (CPUE) data are summarized in Table 11.

Table 11. Summary of salmonid CPUE, Cougar Dam.

	Chinook	
Description	RO (5ft)	PWR(8ft)
Catch	18	0
Effort (hrs)	358.1	--
CPUE (fish/hr)	0.050	--

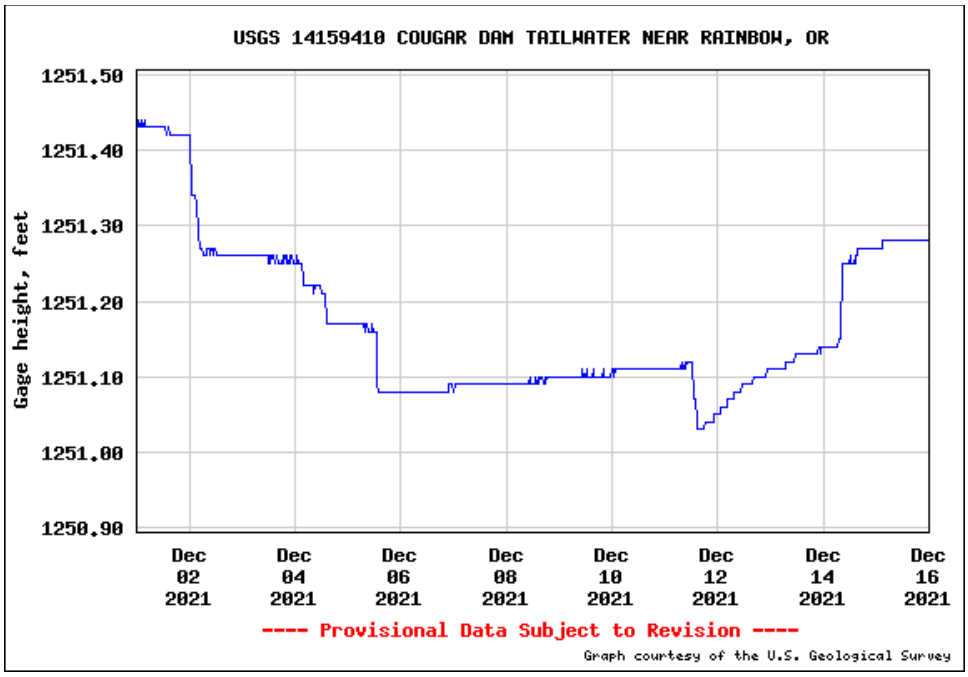

Figure 12. Gage Height (feet); below Cougar Dam, South Fork McKenzie River

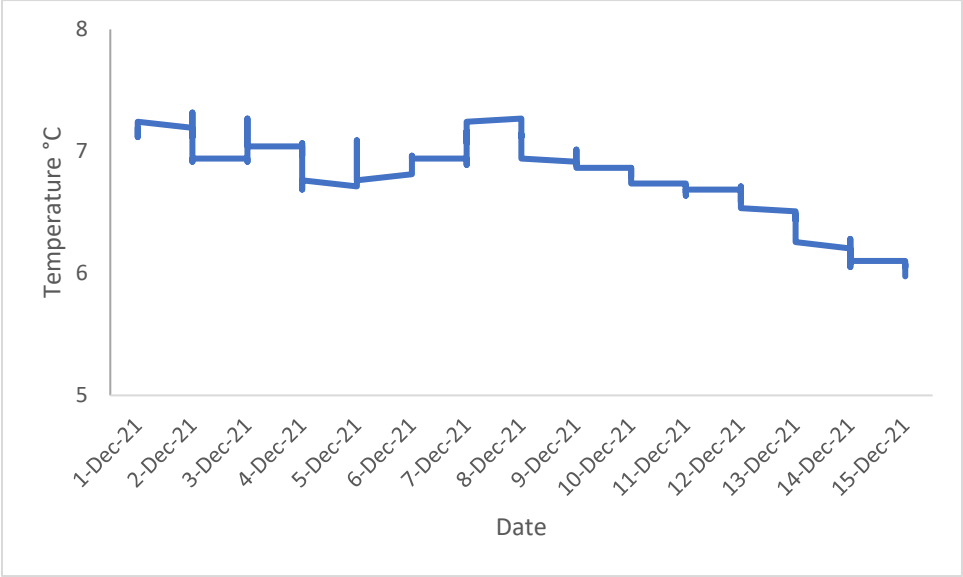

Figure 13. Temperature at RO RST (Cougar Dam)

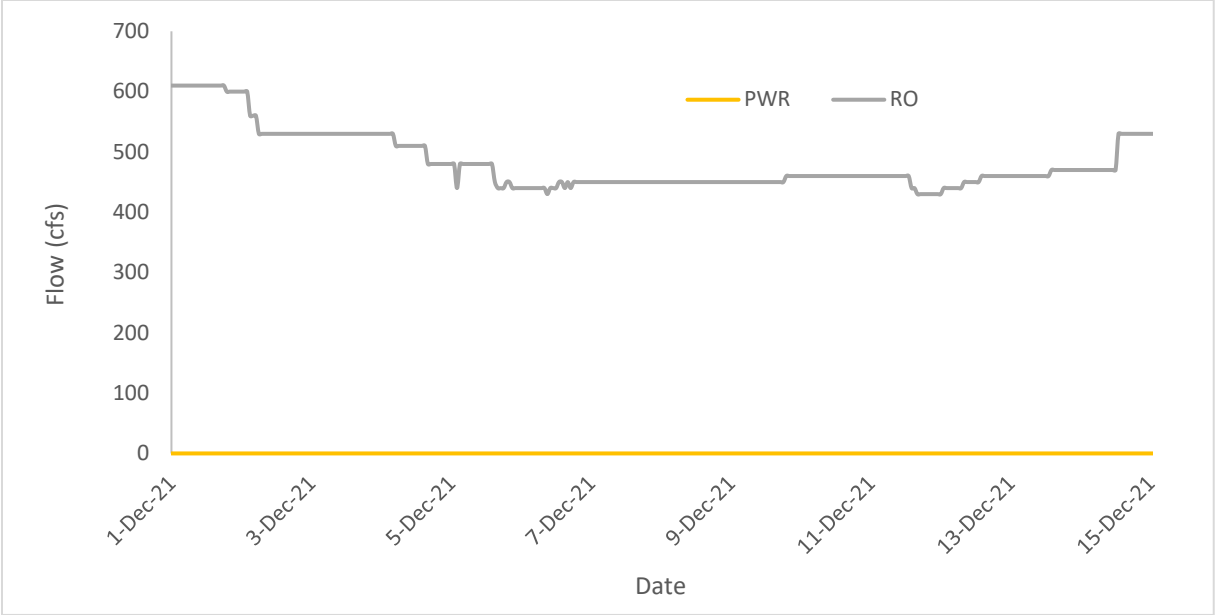

Figure 14. Hourly Flows PWR vs. RO (Cougar Dam)

North Santiam – Big Cliff Dam

Target Species

The reporting period began on December 1 and ended on December 15. Ten Chinook salmon (CHS) were collected during the 15-day sampling period (Figure 15). Sampling duration was 100% for the Big Cliff Powerhouse RST. Table 12 provides life stage, length, and weight data for all Chinook salmon that have been caught at the Big Cliff site to-date and Figure 16 shows length frequency data to-date.

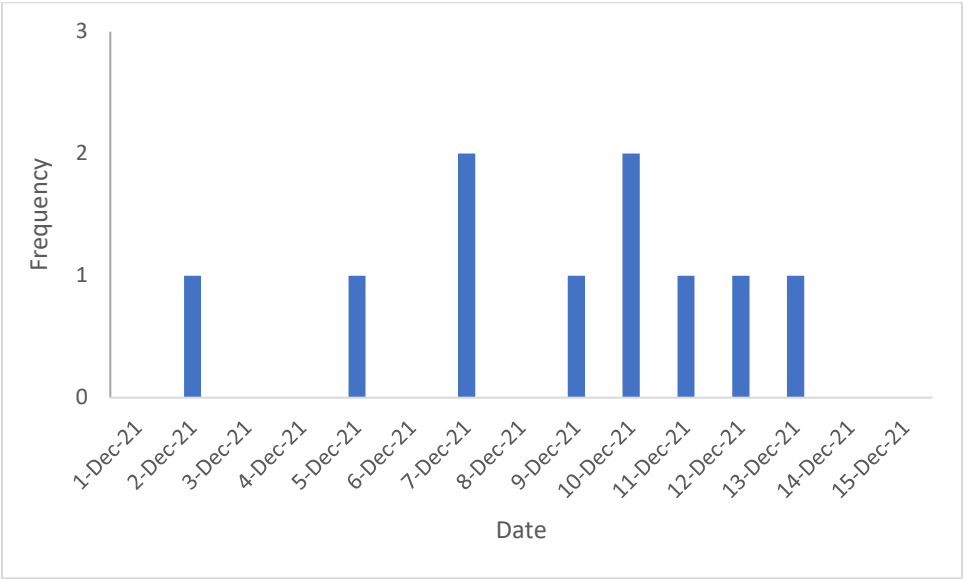

Figure 15. Chinook Captured Per Day 12/1/2021 to 12/15/2021 (Big Cliff)

Table 12. Descriptive Statistics of Target Species Captured at Big Cliff Dam Season To-Date

					Length (mm)*			Weight (g)*		
Site	**Route**	**Species**	**Life stage**	**Collected**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Big Cliff Dam	PWR	CHS	Smolt	10	151	195	169	35.65	90.76	49.30
		CHS	Parr	--	--	--	--	--	--	--

*Fish that were missing heads are not included in length and weight calculations.

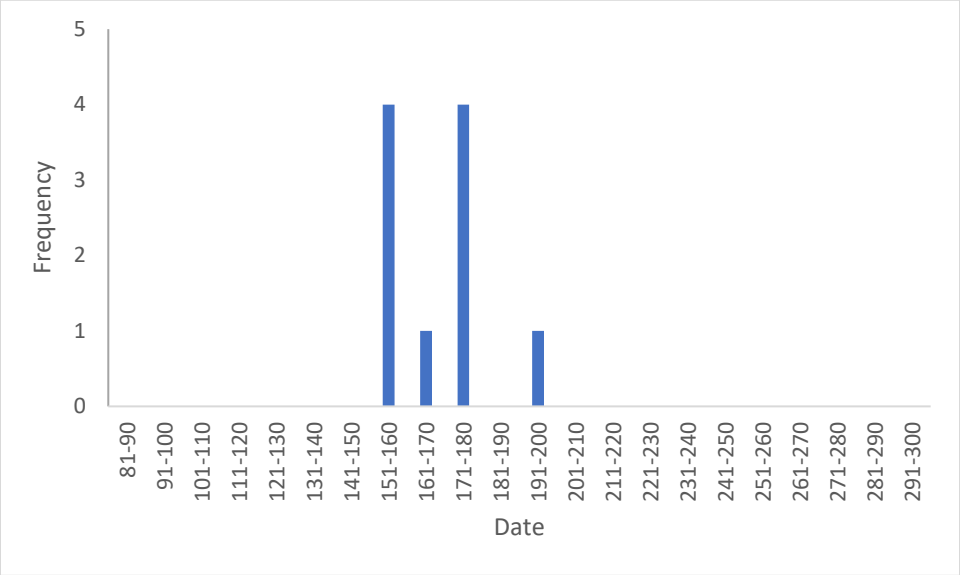

*Figure does not include fish without heads

Figure 16. Length Frequency of Juvenile Chinook Sampled Season To-Date (Big Cliff)

Injuries and Copepod Infection

Partial descaling <20% was observed on 5 of 10 target Chinook collected (50%), and descaling >20% was observed on 1 of 10 Chinook collected (10%). Ten of 10 Chinook collected during this reporting period had copepods present (100%). Of the 10 Chinook captured, 1 displayed body injuries and 2 had eye injuries present. There were 3 Chinook mortalities (Table 5). A summary of injuries observed during the reporting period, and for the duration of the season are provided in Appendix A.

Table 13. Number of Descaled and Partially Descaled Chinook Salmon.

Site	# CHS Collected	# DSC* <20%	# DSC* >20%	# with Body Injuries	# with Eye Injuries	# with COP* In B.C.	# with COP* on Fins	Mortalities
Big Cliff	10	5	1	1	2	10	2	3

*DSC=Descaled, COP=Copepods, B.C.=Branchial Cavity

Non-Target Species

A total of 17 non-target fish were captured at Big Cliff during the reporting period; the data is summarized below in Table 14.

Table 14. Summary of Non-target Species (Big Cliff Dam).

Species	RO Capture	RO Mortality	PWR Capture	PWR Mortality	Season Total	Season Total Mortality
Bluegill	3	2	0	0	3	2
Brook Lamprey	0	0	0	0	0	0
Bullhead	0	0	0	0	0	0
Crappie	0	0	0	0	0	0
Longnose Dace	0	0	0	0	0	0
Kokanee	14	7	0	0	14	7
Red-Sided Shiner	0	0	0	0	0	0
Sculpin	0	0	0	0	0	0
Spotted Bass	0	0	0	0	0	0
Sucker	0	0	0	0	0	0
Whitefish	0	0	0	0	0	0
O. mykiss	0	0	0	0	0	0
Totals	**17**	**9**	**0**	**0**	**17**	**9**

Stream Statistics

Basic stream statistics at the Big Cliff site were calculated from data downloaded from the U.S. Geological Survey stream gage number 14181410. Gage height (feet) is the only metric provided at this gage. During the reporting period, daily maximum values for instantaneous gage height ranged from 1,109.4 feet to 1,112.02 feet (mean: 1,110.71 feet). Figure 17 shows instantaneous gage height.

Stream temperatures were recorded every 2 hours for the Big Cliff RST (Figure 18). Temperature probes for the Big Cliff RST operated normally throughout this reporting period.

Flows through the Powerhouse and spill during the reporting period averaged 2,123.3 and 33.1 cubic feet per second (cfs) respectively (Figure 19). Catch per unit of effort (CPUE) data are summarized in Table 15.

Table 15. Summary of salmonid CPUE, Big Cliff Dam.

	Chinook
Description	**PWR(8ft)**
Catch	10
Effort (hrs)	334.77
CPUE (fish/hr)	.0299

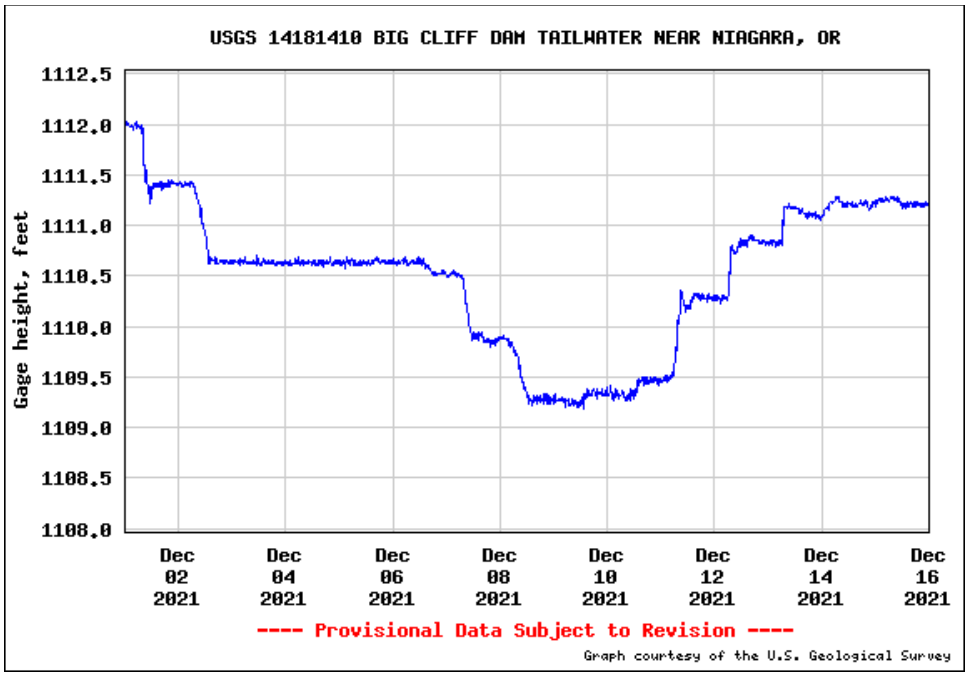

Figure 17. Gage Height (feet); below Big Cliff Dam, North Santiam River

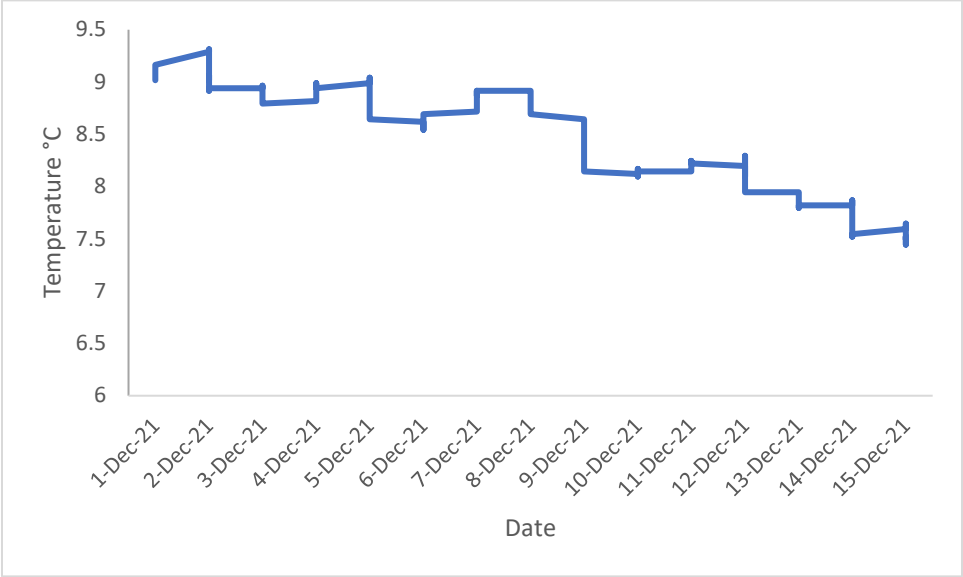

Figure 18. Temperature at RST (Big Cliff)

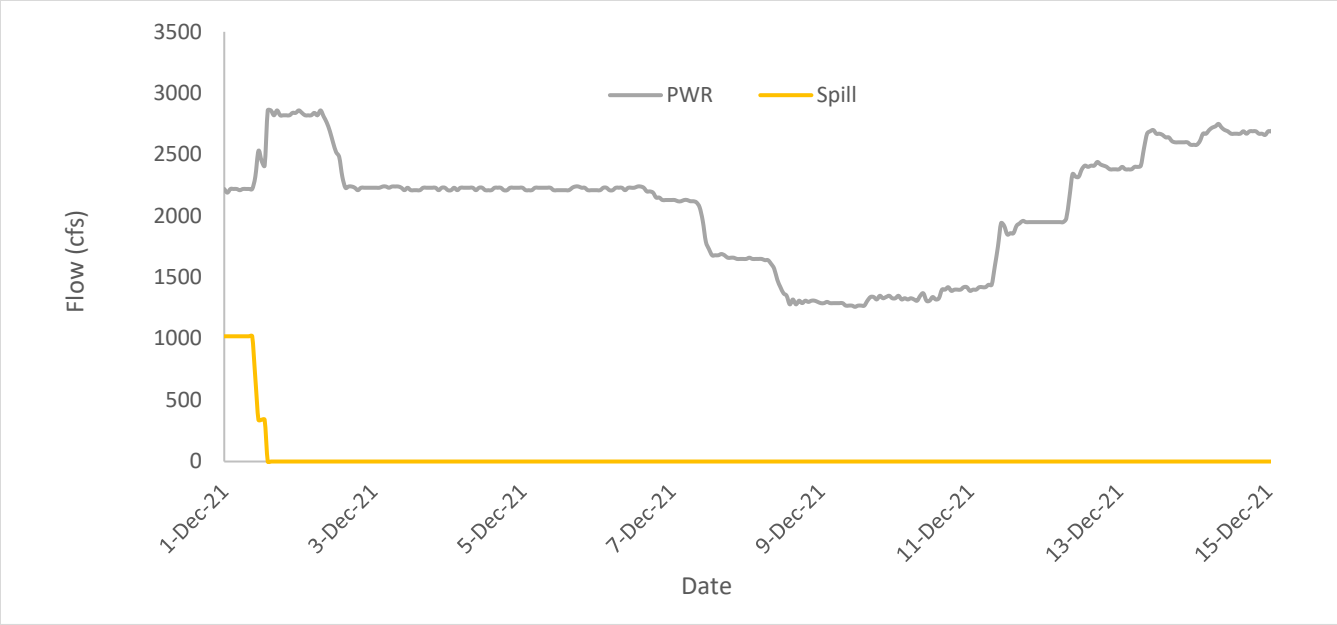

Figure 19. Hourly Flows PWR vs. Spill (Big Cliff)

Issues Encountered

None during this reporting period.

Upcoming USACE Support Services

None.

Appendix A

Injuries During Reporting Period (12-1-21 to 12-15-21)

Site/Trap/Life Stage	Total Fish	MUNK	DS<2	BLO	EYB	FUN	BKD	COP	DS>2	PRD	FID	HBO	BO	HO	BVT	HBP	BRU	TEA	OPD	HIN	FVB	POP	GBD
Big Cliff	10		5		2			10	1		1	1			1			1	3				
8 ft (PH)	10		5		2			10	1		1	1			1			1	3				
Smolt	10		5		2			10	1		1	1			1			1	3				
Cougar	18		7			1		14			4							1	3				
5 ft (RO)	18		7			1		14			4							1	3				
Parr	17		6			1		13			4							1	3				
Smolt	1		1					1															
Hills Creek	8		7					8	1						3		1						
5 ft (RO)	3		2					3	1														
Smolt	3		2					3	1														
8 ft (PH)	5		5					5							3		1						
Smolt	5		5					5							3		1						

Injuries Since Project Initiation (10-21-21 to 12-15-21)

Site/Trap/Life Stage	Total Fish	MUNK	DS<2	BLO	EYB	FUN	BKD	COP	DS>2	PRD	FID	HBO	BO	HO	BVT	HBP	BRU	TEA	OPD	HIN	FVB	POP	GBD
Big Cliff	10		5		2			10	1		1	1			1			1	3				
8 ft (PH)	10		5		2			10	1		1	1			1			1	3				
Smolt	10		5		2			10	1		1	1			1			1	3				
Cougar	18		7			1		14			4							1	3				
5 ft (RO)	18		7			1		14			4							1	3				
Parr	17		6			1		13			4							1	3				
Smolt	1		1					1															
Hills Creek	54		34		4			45	17		8		5		19	6	2	2	4	1	1		
5 ft (RO)	21		15		2			19	6		5		1		8	3			2	1			
Smolt	21		15		2			19	6		5		1		8	3			2	1			
8 ft (PH)	33		19		2			26	11		3		4		11	3	2	2	2		1		
Parr	1																						
Smolt	32		19		2			26	11		3		4		11	3	2	2	2		1		

Injury Code	Description of Injury/Condition
NXI	Live fish with no external injuries
MUNK	Mortality with no external injuries
DS<2	Descaling <20%
BLO	Bloated
EYB	Bloody Eye (hemorrhage)
BVT	Bleeding from Vent
FVB	Fin Blood Vessels Broken
GBD	Gas Bubble Disease (fin ray/eye inclusions)
POP	Pop Eye (eye popping out of head)
HIN	Head Injury
OPD	Opercle Damage
TEA	Body Injury (tears, scrapes, mechanical damage)
BRU	Bruising (any part of the body)
HBP	Hole Behind Pectoral Fin
DS>2	Descaling > 20%
HO	Head Only
BO	Body Only
HBO	Head Barely Connected
FID	Fin Damage
PRD	Predation Marks (vert. claw or teeth marks)
COP	Copepods (on gills or fins)
BKD	BKD (distended abdomen)
FUN	Fungus