

**OFFICIAL COORDINATION REQUEST FOR
NON-ROUTINE OPERATIONS AND MAINTENANCE**

COORDINATION TITLE- 19 LMN 01 MOC - Lower Monumental Dam Head Gate
Position Fish Guidance Efficiency Study

COORDINATION DATE- 1/18/19

PROJECT- Lower Monumental Dam

RESPONSE DATE- 2/1/19

Description of the problem

The purpose of this study is to estimate fish guidance efficiency (FGE) at Lower Monumental Dam with turbine unit head gates in the originally designed stored operating gate position (SOG), and the raised operating gate position (ROG). To properly test the FGE differences in SOG vs. ROG two units need to be of the same family, next to each other, similar output, and running at the same time. The study is anticipated to begin during the week of April 19 and is expected to end the week of July 12. This work was coordinated with SRWG, FFDRWG, LMN project staff, and included in Appendix A of the 2019 Fish Passage Plan. The study will occur at Units 2 and 3.

Unit outages will be required to have divers install and remove split beam transducers on the STS Screens and trash racks of Units 2 and 3. Installation dive work will occur in February, outside of fish passage season. Removal dive work will occur either during the outage for Doble testing or after fish passage season.

Unit outages of between 3-6 hours for Units 2 and 3 will be needed weekly for changing the head gate position (see Figure 10 for study schedule). Head gate position change will alternate weekly between Units 2 and 3.

To ensure Units 2 and 3 will be operating during the study, a Unit priority change will be needed during the study period (19 April-12 July) only. Note that Unit 1 will be offline from May 28 to July 12 for digital governor install.

Changes to 2019 FPP Table LMN-1 for turbine unit priority order for the study period are red text.

Season	Unit Priority Order
March 1 – April 18 and July 13-November 30 Fish Passage Season	<p>DEFAULT 1, 2, 3, 4, 5, 6</p> <p>MODIFIED ORDER for Fixed-Blade Units* Start-up (U1 available): 1, 3, 4, 5, 6, 2* Start-up (U1 not available): 2*, 3, 4, 5, 6 Shutdown: 6, 5, 4, 3, 2*, 1</p>
April 19 – July 12	<p>Start-up: 2*, 3, 1, 4, 5, 6 Shutdown: 6, 5, 4, 1, 3, 2*</p>
December 1 – End of February Winter Maintenance Period	Any Order

*Units that have hydraulically locked runner blades will be operated in a modified priority order to minimize starts/stops. As of Feb 2019, Unit 2 has hydraulically locked blades. When Unit 1 is unavailable, Unit 2 will be first priority for fish passage. When the blade seals are replaced, the unit will resume operating in its default order.

To ensure Units 2 and 3 will be operating similarly as much as possible during the study, a blade angle change will be needed for Unit 2. Unit 2 is currently fixed at the low end of the 1% range (11-13 kcfs). Average output (kcfs) for Units 2, 3, and 4 during May and June 2017 (when all units were Kaplan) averaged from 17-18 kcfs. For this study, we will be adjusting the blade angle on Unit 2 to 25° (~15-17kcfs) or right at peak operating efficiency (USACE 2004). Unit 3 which is a Kaplan unit will be adjusted to run with similar output as Unit 2 as much as possible. Blade angle adjustment will occur concurrently with the dive work in early February. HDC will index test Unit 2 Feb. 19-21.

Type of outage required

Turbine Outages - Once per week from 19 April-12 July, units 2 and 3 will be taken out of service for 3-6 hours to change the head gate position (see Figure 10 for study schedule).

Impact on facility operation – Units 2 and 3 will operate with headgates both in SOG and ROG position during the study.

Impact on unit priority – During the study from 19 April-12 July, Unit 2 will become the priority unit followed by 3,1,4,5, and 6. Before and after the study priority will be at the default 1,2,3,4,5,6.

Impact on forebay/tailwater operation - There will be no impact on forebay/tailwater operation

Impact on spill – There is no anticipated impact on spill operations.

Dates of impacts/repairs – Installation of split-beam transducers and Unit 2 blade angle change will occur early Feb. 2019. Removal of split-beam transducers will occur during either the outage for Doble testing or after fish passage season. HDC index testing for unit 2: Feb. 19-21. Unit priority change will occur from 19 April through 12 July. Head gate positions will vary between SOG and ROG position for units 2 and 3 during the study utilizing a random study design (Figs. 10 and 11).

Analysis of potential impacts to fish

1. 10-year average passage by run during the period of impact for adults and juvenile listed species, as appropriate for the proposed action and time of year;
 - a. The hatchery production is expected to be average. Wild production is expected to be less than the 10 year average because adult returns were lower than the 10 year average.
 - b. 10-year passage timings and numbers are shown in Figs. 1-7.
2. Statement about the current year's run (e.g., higher or lower than 10-year average);
 - a. Adult returns for 2019 are expected to be below the 10-year average because ocean conditions have been poor for the last several years.
 - b. Outmigration is expected to be at or below the 10-year average based on the lower adult returns but average hatchery production.
3. Estimated exposure to impact by species and age class (i.e., number or percentage of run exposed to an impact by the action);
 - a. From 19 April to 12 July the estimated percentage of the run covered by the study period for juveniles is as follows:
 - i. ~95% of the yearling Chinook salmon run (Fig. 1)
 - ii. ~75% of the subyearling Chinook salmon run (Fig. 2)
 - iii. ~95% of the juvenile Steelhead run (Fig. 3)
 - iv. 99% of the Sockeye salmon smolt run (Fig. 4)
 - b. From 19 April to 12 July the estimated percentage of the run covered by the study period for adults is as follows:
 - i. ~95% of the spring/summer Chinook salmon run (Fig.5)
 - ii. <50% of the adult Steelhead salmon run (Fig. 6)
 - iii. <50% of the adult Sockeye salmon run (Fig. 7)
4. Type of impact by species and age class (increased delay, exposure to predation, exposure to a route of higher injury/mortality rate, exposure to higher TDG, etc.).
 - a. FGE of juvenile salmonids will likely not significantly change with SOG vs ROG based on similar past studies at Little Goose and McNary dams. However, the screens at those dams are longer (i.e. extended length bar

screens) whereas the screens at Lower Monumental are shorter (i.e. standard length traveling screens) thus FGE differences may occur thus the purpose of this study. SOG will reduce gate well turbulences resulting in lower fish injuries. Juvenile salmonids will not be affected by the split-beam systems and will not be affected by operations as they will be within the 1% operating range.

- b. Adult passage should not be affected by the change in unit priority. Analysis of PTAGIS data at a time when Unit 3 was priority (Sept. 14-25, 2017) shows adult Steelhead and Chinook salmon were not delayed versus years when Unit 2 was priority (Figs. 8 and 9).
- c. Unit 2 at Lower Monumental Dam has been the priority unit in the FPP since at least 2014 due to various issues with Unit 1. During the last 5-years while unit 1 was out of service and units 2 or 3 were the priority units no adult passage issues were observed. Travel times cannot be calculated for previous years when Unit 1 was in priority because pit tag detectors Lower Monumental Dam in the adult ladder came online in 2014

Summary Statement - expected impact on:

Downstream migrants

The change in priority is expected to have very little impact on juvenile salmonids, as the turbines will remain operating within 1% peak efficiency. FGE and gatewell turbulence associated with head gate position are not anticipated to effect juvenile fish passage.

Upstream migrants (including Bull Trout)

The change in unit priority is not expected to impact adult passage.

Lamprey

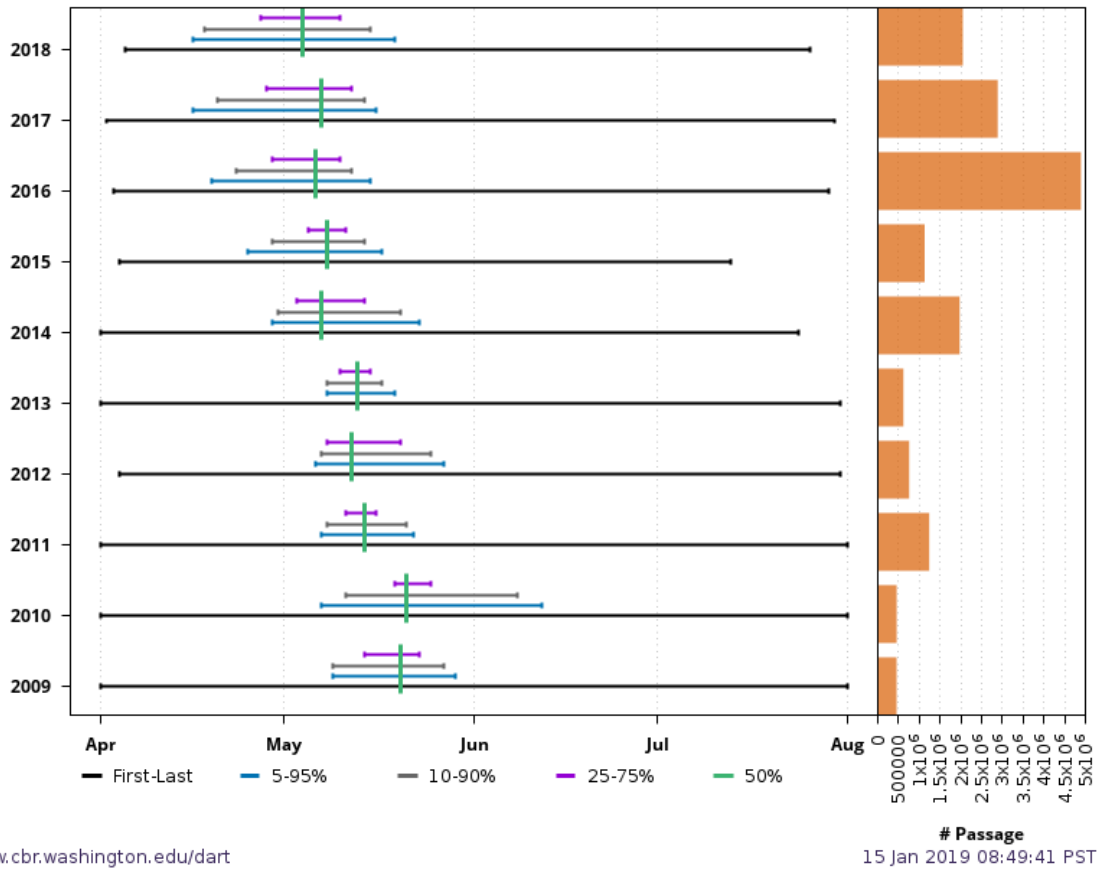
This change should have little impact on lamprey passage.

Comments from agencies

Final coordination results

After Action update

**Historical Run Timing, 2009 - 2018
Smolt Index Yearling Chinook
Lower Monumental Dam, 3/1 - 8/1**

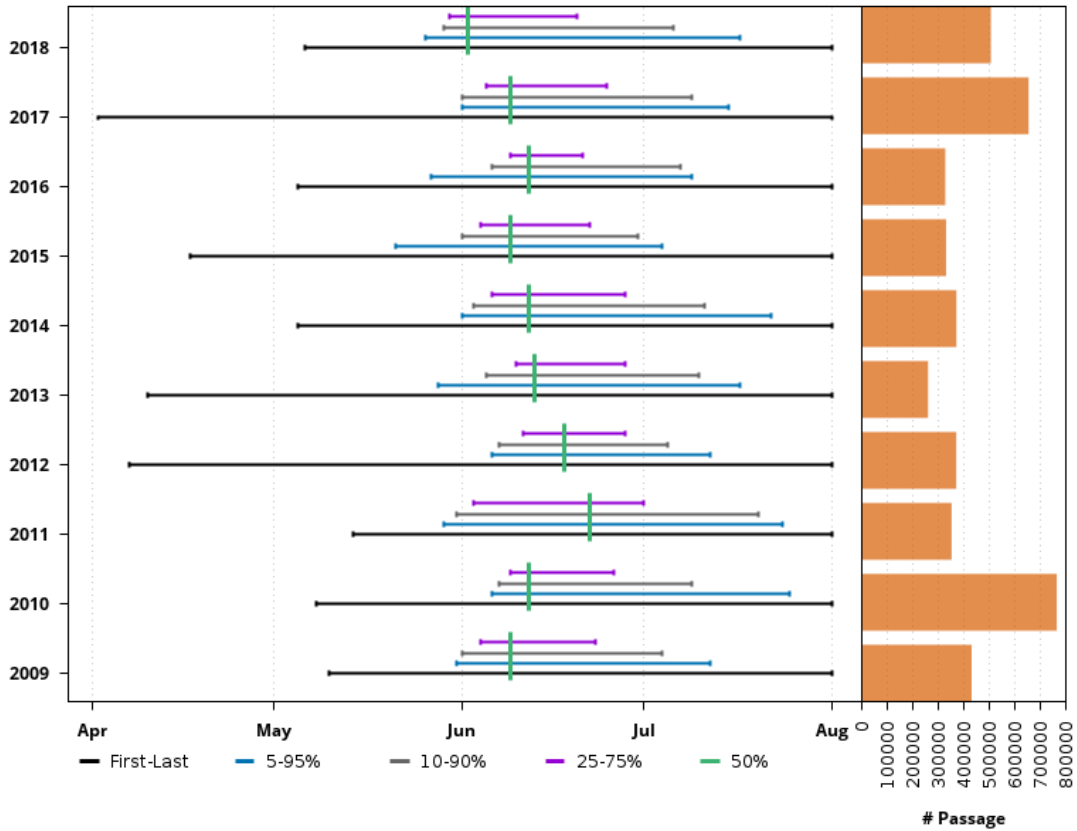


www.cbr.washington.edu/dart

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Figure 1. 10-year (2009-2018) run timing of yearling Chinook salmon at Lower Monumental Dam. Source: www.cbr.washington.edu/dart

**Historical Run Timing, 2009 - 2018
Smolt Index Subyearling Chinook
Lower Monumental Dam, 3/1 - 8/1**

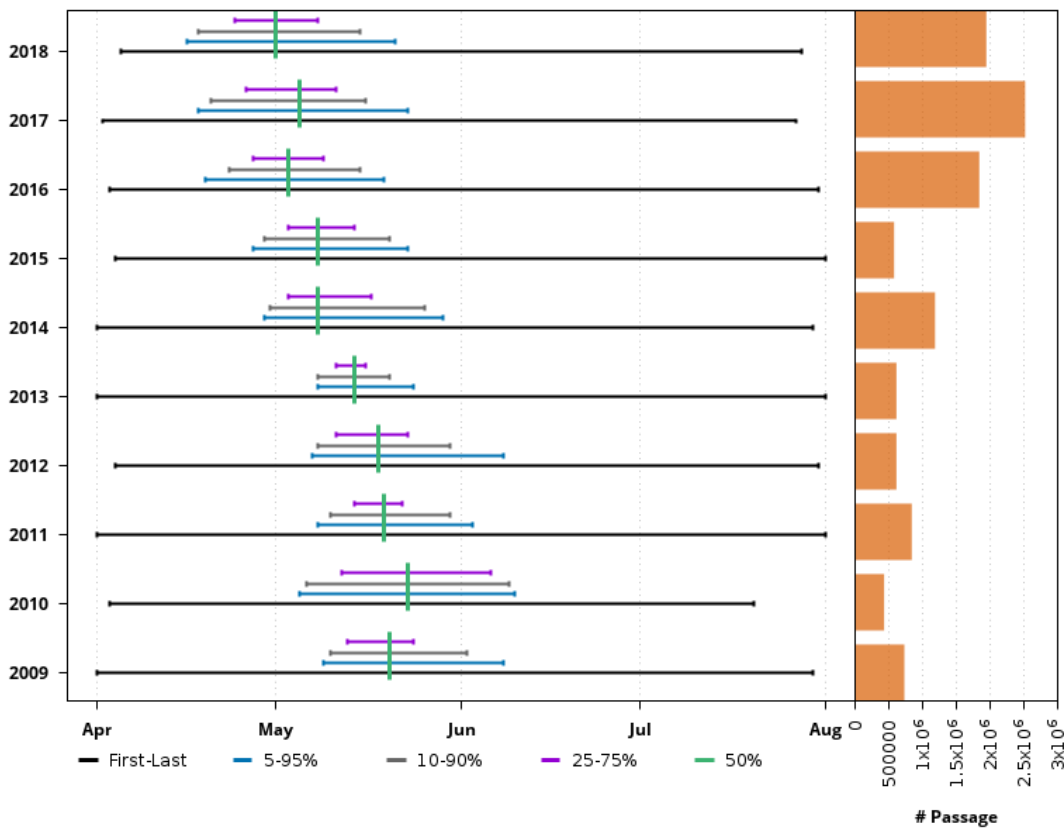


www.cbr.washington.edu/dart

15 Jan 2019 08:51:12 PST

Figure 2. 10-year (2009-2018) run timing of subyearling Chinook salmon at Lower Monumental Dam. Source: www.cbr.washington.edu/dart

**Historical Run Timing, 2009 - 2018
Smolt Index Steelhead
Lower Monumental Dam, 4/1 - 8/1**

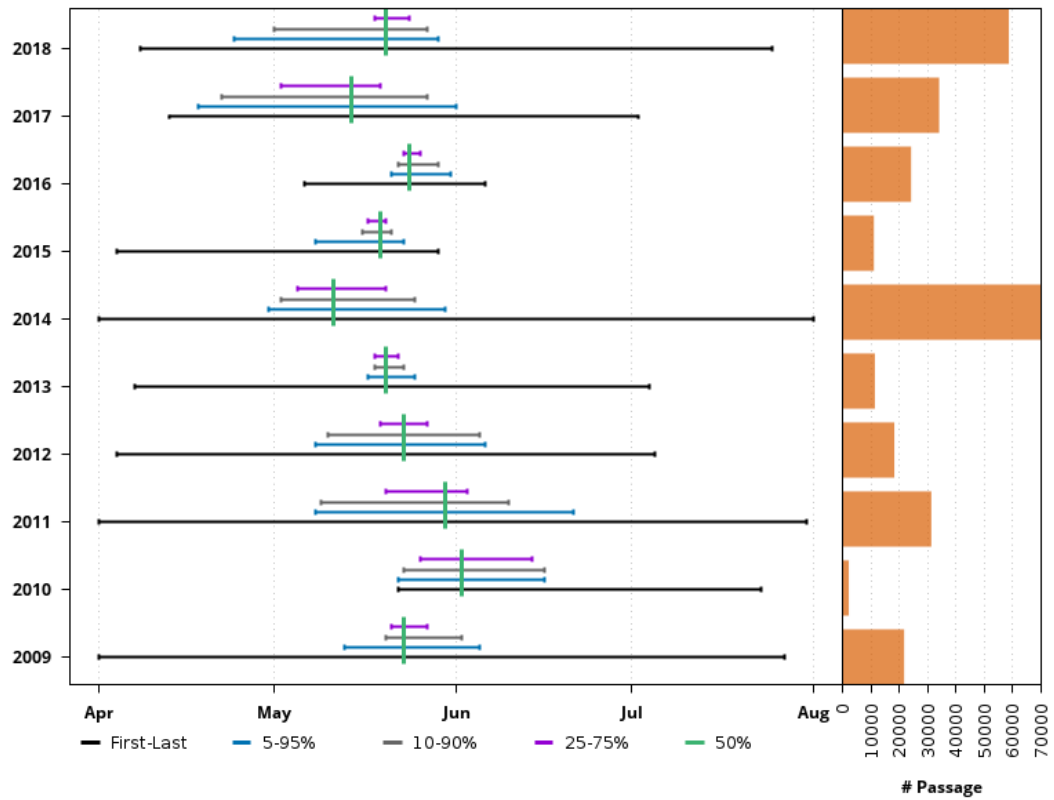


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Passage
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Figure 3. 10-year (2009-2018) run timing of juvenile Steelhead at Lower Monumental Dam. Source: www.cbr.washington.edu/dart

Historical Run Timing, 2009 - 2018
 Smolt Index Sockeye
 Lower Monumental Dam, 4/1 - 8/1

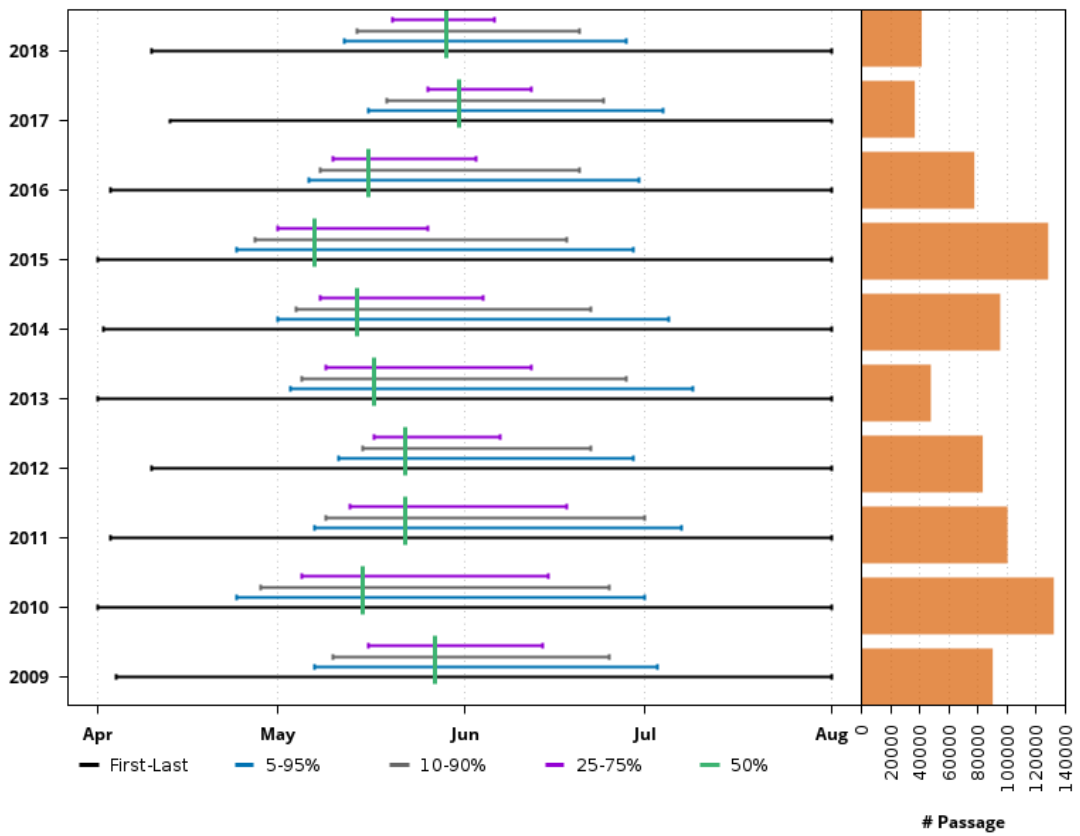


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15 Jan 2019 08:52:26 PST

Figure 4. 10-year (2009-2018) run timing of Sockeye salmon smolts at Lower Monumental Dam. Source: www.cbr.washington.edu/dart

Historical Run Timing, 2009 - 2018
 Adult Visual Counts Chinook
 Lower Monumental Dam, 3/1 - 8/1

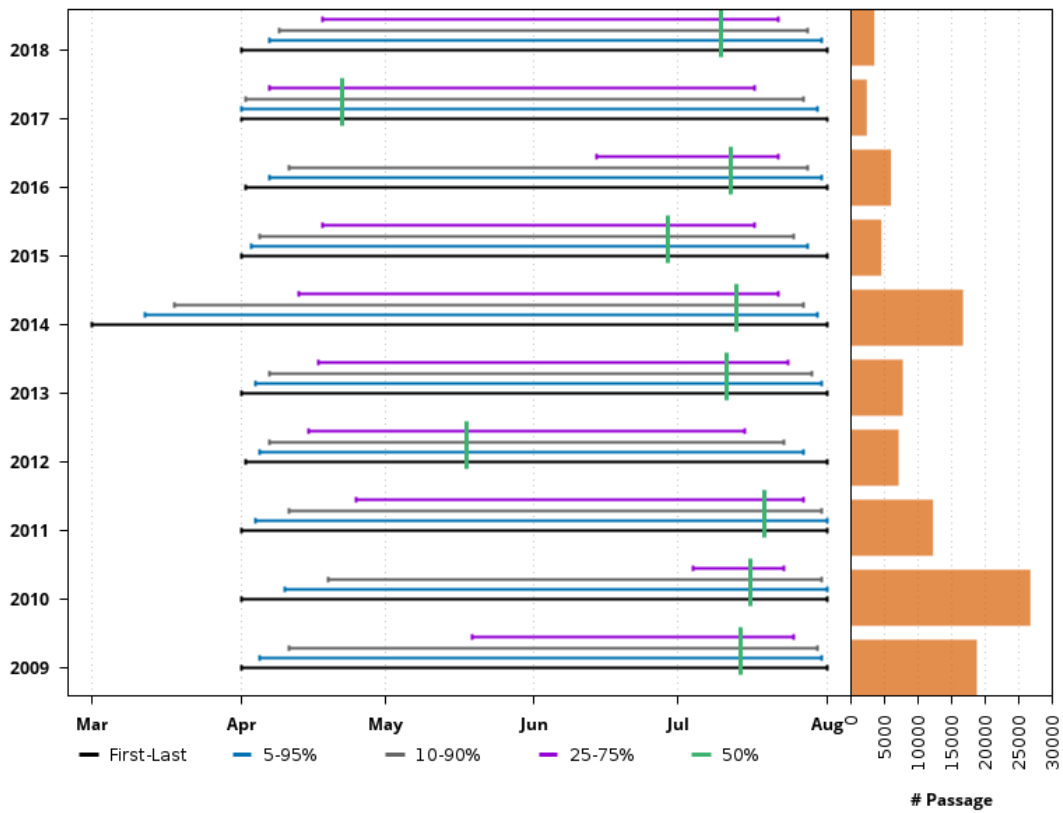


www.cbr.washington.edu/dart

Passage
 15 Jan 2019 14:45:01 PST

Figure 5. 10-year (2009-2018) run timing of adults spring/summer Chinook salmon at Lower Monumental Dam. Source: www.cbr.washington.edu/dart

**Historical Run Timing, 2009 - 2018
Adult Visual Counts Steelhead
Lower Monumental Dam, 3/1 - 8/1**

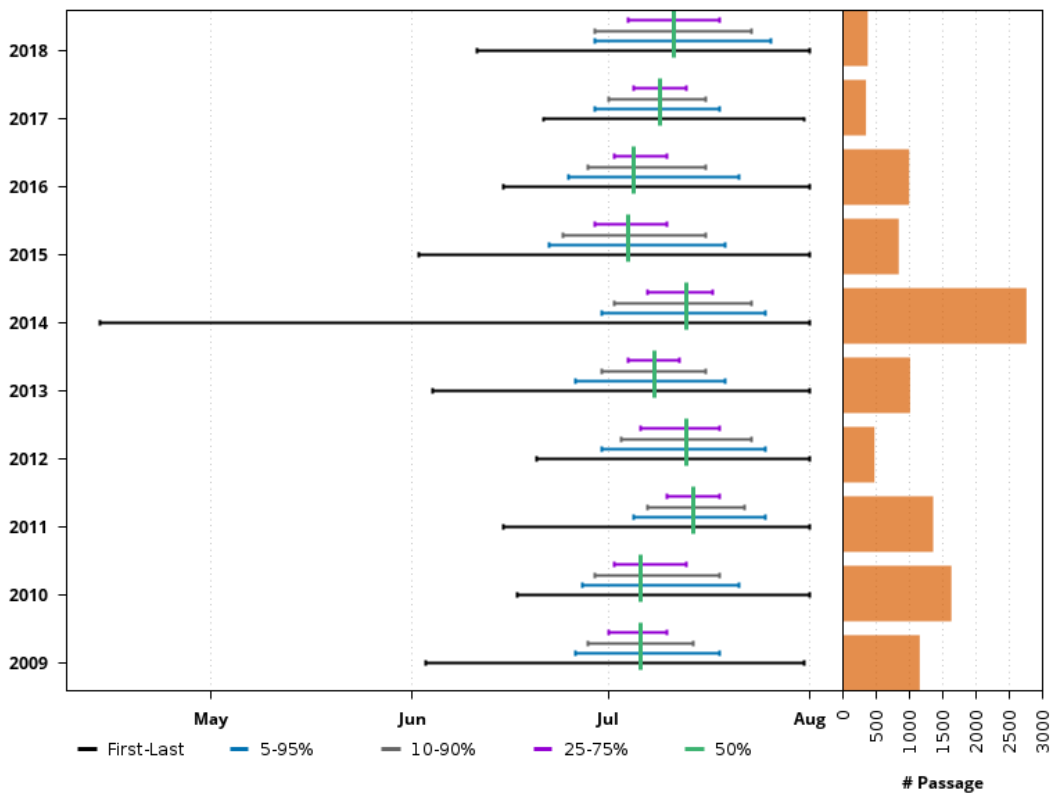


www.cbr.washington.edu/dart

15 Jan 2019 14:53:14 PST

Figure 6. 10-year (2009-2018) run timing of adult Steelhead salmon at Lower Monumental Dam. Source: www.cbr.washington.edu/dart

Historical Run Timing, 2009 - 2018
 Adult Visual Counts Sockeye
 Lower Monumental Dam, 3/1 - 8/1



www.cbr.washington.edu/dart

15 Jan 2019 14:53:54 PST

Figure 7. 10-year (2009-2018) run timing of adult Sockeye salmon at Lower Monumental Dam. Source: www.cbr.washington.edu/dart

Steelhead	2014	2015	2016	2017	2018
Percentile	hrs	hrs	hrs	hrs	hrs
0.95	94	91	83	69	88
0.9	75	75	72	57	73
0.8	66	67	60	47	62
0.7	55	54	51	43	53
0.6	50	50	47	40	48
0.5	47	47	44	35	45
0.4	43	44	39	30	43
0.3	40	41	34	28	40
0.2	35	36	30	25	34
0.1	30	30	27	24	30
0.05	27	27	24	22	27
Average	51 hrs	52 hrs	47 hrs	39 hrs	50 hrs
Units	2,[3 or 4]	2,3	2,3	3,4	2,5
Unit kcfs	13, 7 or 6	14,6	14, 8	18, 8	13,8
Flow Out	20 kcfs ave	19 kcfs ave	19 kcfs ave	26 kcfs ave	22 kcfs ave
Number	902	707	565	288	228
Date	Sept. 14-25	Sept. 14-25	Sept. 14-25	Sept. 14-25	Sept. 14-25

Figure 8. Adult Steelhead PTAGIS Travel times from Ice Harbor (last detection) to Lower Monumental Dam (first detection) from Sept. 14-25 time frame from 2014-2018. Number of fish, total outflow from project, units running, per unit average kcfs, average travel times, and percentile of travel times are included. Unit and flow data were gathered from GDACS.

Chinook	2014	2015	2016	2017	2018
Percentile	hrs	hrs	hrs	hrs	hrs
0.95	73	54	52	49	55
0.9	66	49	48	45	50
0.8	49	45	45	43	47
0.7	46	42	41	33	45
0.6	44	40	34	27	43
0.5	41	31	28	26	39
0.4	32	28	27	25	29
0.3	28	26	25	24	27
0.2	26	25	24	23	25
0.1	24	23	23	21	23
0.05	23	22	22	21	22
Average	42 hrs	35 hrs	34 hrs	31 hrs	37 hrs
Units	2,[3 or 4]	2,3	2,3	3,4	2,5
Unit kcfs	13, 7 or 6	14,6	14, 8	18, 8	13,8
Flow Out	20 kcfs ave	19 kcfs ave	19 kcfs ave	26 kcfs ave	22 kcfs ave
Number	1252	660	323	290	125
Date	Sept. 14-25	Sept. 14-25	Sept. 14-25	Sept. 14-25	Sept. 14-25

Figure 9. Adult Chinook PTAGIS Travel times from Ice Harbor (last detection) to Lower Monumental Dam (first detection) from Sept. 14-25 time frame from 2014-2018. Number of fish, total outflow from project, units running, per unit average kcfs, average travel times, and percentile of travel times are included. Unit and flow data were gathered from GDACS.

Date	Day	Number	Unit_1_OR_2_Gates	Unit_3_Gates	Day_Of_wk	Season
Spring Study Begins						
19-Apr	1	Set Gates	Change	Change	Friday	Spring
20-Apr	2	1	Raised	Stored	Saturday	Spring
21-Apr	3	1	Raised	Stored	Sunday	Spring
22-Apr	4	1	Raised	Stored	Monday	Spring
23-Apr	5	1	Raised	Stored	Tuesday	Spring
24-Apr	6	1	Raised	Stored	Wednesday	Spring
25-Apr	7	1	Raised	Stored	Thursday	Spring
26-Apr	8	Gate change	Change	Change	Friday	Spring
27-Apr	9	2	Stored	Raised	Saturday	Spring
28-Apr	10	2	Stored	Raised	Sunday	Spring
29-Apr	11	2	Stored	Raised	Monday	Spring
30-Apr	12	2	Stored	Raised	Tuesday	Spring
1-May	13	2	Stored	Raised	Wednesday	Spring
2-May	14	2	Stored	Raised	Thursday	Spring
3-May	15	Gate change	Change	Change	Friday	Spring
4-May	16	3	Raised	Stored	Saturday	Spring
5-May	17	3	Raised	Stored	Sunday	Spring
6-May	18	3	Raised	Stored	Monday	Spring
7-May	19	3	Raised	Stored	Tuesday	Spring
8-May	20	3	Raised	Stored	Wednesday	Spring
9-May	21	3	Raised	Stored	Thursday	Spring
10-May	22	Gate change	Change	Change	Friday	Spring
11-May	23	4	Stored	Raised	Saturday	Spring
12-May	24	4	Stored	Raised	Sunday	Spring
13-May	25	4	Stored	Raised	Monday	Spring
14-May	26	4	Stored	Raised	Tuesday	Spring
15-May	27	4	Stored	Raised	Wednesday	Spring
16-May	28	4	Stored	Raised	Thursday	Spring
17-May	29	Gate change	Change	Change	Friday	Spring
18-May	30	5	Raised	Stored	Saturday	Spring
19-May	31	5	Raised	Stored	Sunday	Spring
20-May	32	5	Raised	Stored	Monday	Spring
21-May	33	5	Raised	Stored	Tuesday	Spring
22-May	34	5	Raised	Stored	Wednesday	Spring
23-May	35	5	Raised	Stored	Thursday	Spring
24-May	36	Gate change	Change	Change	Friday	Spring
25-May	37	6	Stored	Raised	Saturday	Spring
26-May	38	6	Stored	Raised	Sunday	Spring
27-May	39	6	Stored	Raised	Monday	Spring
28-May	40	6	Stored	Raised	Tuesday	Spring
29-May	41	6	Stored	Raised	Wednesday	Spring
30-May	42	6	Stored	Raised	Thursday	Spring

Figure 10. Tentative schedule for operating gate changes during from 19 April to 30 May.

Summer Study Begins						
31-May	43	no change	Stored	Raised	Friday	Spring
1-Jun	44	1	Stored	Raised	Saturday	Summer
2-Jun	45	1	Stored	Raised	Sunday	Summer
3-Jun	46	1	Stored	Raised	Monday	Summer
4-Jun	47	1	Stored	Raised	Tuesday	Summer
5-Jun	48	1	Stored	Raised	Wednesday	Summer
6-Jun	49	1	Stored	Raised	Thursday	Summer
7-Jun	50	Gate change	Change	Change	Friday	Summer
8-Jun	51	2	Raised	Stored	Saturday	Summer
9-Jun	52	2	Raised	Stored	Sunday	Summer
10-Jun	53	2	Raised	Stored	Monday	Summer
11-Jun	54	2	Raised	Stored	Tuesday	Summer
12-Jun	55	2	Raised	Stored	Wednesday	Summer
13-Jun	56	2	Raised	Stored	Thursday	Summer
14-Jun	57	Gate change	Change	Change	Friday	Summer
15-Jun	58	3	Stored	Raised	Saturday	Summer
16-Jun	59	3	Stored	Raised	Sunday	Summer
17-Jun	60	3	Stored	Raised	Monday	Summer
18-Jun	61	3	Stored	Raised	Tuesday	Summer
19-Jun	62	3	Stored	Raised	Wednesday	Summer
20-Jun	63	3	Stored	Raised	Thursday	Summer
21-Jun	64	Gate change	Change	Change	Friday	Summer
22-Jun	65	4	Raised	Stored	Saturday	Summer
23-Jun	66	4	Raised	Stored	Sunday	Summer
24-Jun	67	4	Raised	Stored	Monday	Summer
25-Jun	68	4	Raised	Stored	Tuesday	Summer
26-Jun	69	4	Raised	Stored	Wednesday	Summer
27-Jun	70	4	Raised	Stored	Thursday	Summer
28-Jun	71	Gate change	Change	Change	Friday	Summer
29-Jun	72	5	Stored	Raised	Saturday	Summer
30-Jun	73	5	Stored	Raised	Sunday	Summer
1-Jul	74	5	Stored	Raised	Monday	Summer
2-Jul	75	5	Stored	Raised	Tuesday	Summer
3-Jul	76	5	Stored	Raised	Wednesday	Summer
4-Jul	77	5	Stored	Raised	Thursday	Summer
5-Jul	78	Gate change	Change	Change	Friday	Summer
6-Jul	79	6	Raised	Stored	Saturday	Summer
7-Jul	80	6	Raised	Stored	Sunday	Summer
8-Jul	81	6	Raised	Stored	Monday	Summer
9-Jul	82	6	Raised	Stored	Tuesday	Summer
10-Jul	83	6	Raised	Stored	Wednesday	Summer
11-Jul	84	6	Raised	Stored	Thursday	Summer
12-Jul	85	End	Raised	Stored	Friday	Summer

Figure 11. Tentative schedule for operating gate changes during from 31 May to 12 July.

References:

USACE (U.S. Army Corps of Engineers). 2004. Turbine Survival Program (TSP) Phase I Report 1997-2003. Columbia River Basin, Oregon-Washington. Portland and Walla Walla Districts, Hydroelectric Design Center, and Engineer Research and Development Center, Waterways Experiment Station.

Please email or call with questions or concerns.

Thank you,

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