CENWW-OD-WL SPURGEON (1130) 13 October, 2016

MEMORANDUM THRU:
Kimberley Oldham, Operations Project Manager, Lower Monumental Dam

FOR Chief, Operations Division
ATTN: John Bailey / Ann Setter

SUBJECT: Submission of 2016 Juvenile Fish Collection and Bypass Report, Lower Monumental Dam Juvenile Fish Facility.

1. Enclosed find the 2016 Juvenile Fish Collection and Bypass Report for Lower Monumental Dam as requested.

2. If you have any questions contact William Spurgeon at Lower Monumental Dam, (509) 282-7211.

WILLIAM F. SPURGEON
Supervisory Fisheries Biologist, Lower Monumental Dam

Enclosure

2016 Juvenile Fish Collection and Bypass Report
Lower Monumental Dam Juvenile Fish Facility

Prepared by

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U.S. Army Corps of Engineers

and

Jordan Korenkiewicz

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Anchor QEA

13 October, 2016

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Introduction

Juvenile fish transportation and bypass operations occurred for the twenty fourth year at Lower Monumental Dam Juvenile Fish Facility (JFF) in 2016. The bypass system was watered up at 1000 hours on March 23, and STSs were installed on March 30 through March 31. The JFF was watered up for testing on March 23. Primary bypass occurred March 24 through March 31. From April 1 through April 14, primary bypass was intermittently interrupted every third day for fish condition monitoring. From April 15 through 0700 on May 1, condition monitoring occurred every other day. Early season condition monitoring involved 24-hour sampling on target days. During this period, 11,294 fish were examined and returned to the river. These fish are included in the 2016 season spreadsheet (Appendix Tables 1-4). Pacific Northwest National Laboratory collected and tagged 713 juvenile salmonids at the Lower Monumental Dam juvenile fish facility for use in the Ice Harbor Dam survival pre-study.

Collection for transport began at 0700 hours on May 1 and ended at 0700 hours on September 30. On September 30, the facility was returned to primary bypass and continued in bypass mode through December 15. Smolt collection in the 2016 season was 5,028,464. This includes expanded numbers of those sampled during pre-transport. This is nearly five times the 1,167,619 fish collected in the 2015 season and at least double the 2,146,639 fish collected in the 2014 season. Of the 5,028,464 fish collected in the 2016 season, 669 were trucked, 2,751,127 were barged, and 2,275,829 were bypassed.

Pacific States Marine Fisheries Commission (PSMFC) technicians examined 1,368 fish for gas bubble trauma (GBT) in 2016. Examinations were conducted once a week from April 8 through July 13.

The passive integrated transponder (PIT) tag system detected 103,168 tagged fish coming through the JFF from April 1 to October 1. None of these PIT tagged fish are included in the bypass numbers.

This season's total collection by species group included: 2,887,590 clipped yearling Chinook, 619,657 unclipped yearling Chinook, 83,808 clipped subyearling Chinook, 100,029 unclipped subyearling Chinook, 1,009,016 clipped steelhead, 276,408 unclipped steelhead, 10,300 clipped sockeye, 1,070 unclipped sockeye, and 40,586 clipped/unclipped coho. Full powerhouse screening and bypass operations continued through December 15, 2016.

Juvenile hatchery Chinook salmon, hatchery coho salmon, and hatchery steelhead in the Snake River Basin are normally designated by fin clips, usually the adipose fin but occasionally one of the pectoral or ventral fins. Before 1998, Idaho Fish and Game (IDFG) was the only agency that released sizeable numbers of unclipped hatchery fish. Starting in 1998, increasing numbers of unclipped hatchery fish were released by state, federal, tribal, or other agencies (FPC), therefore, the reported clipped/unclipped fish collected, sampled, bypassed, and transported no longer represent hatchery/wild origins of these fish. As of the 2005 report, juvenile salmonids are

designated as clipped/unclipped not hatchery/wild. Coho were reintroduced by the tribes and if clipped or not, they are all hatchery progeny.

Corps of Engineers personnel included: supervisory biologist Bill Spurgeon, assistant biologist Raymond A. Addis, biological technicians: Shelly Montoya, Tasha Geiger, Jon Saylor, Dawn Kunkel, and Paul Bertschinger, and truck driver / maintenance personnel: Rick Blevins and Kenneth Fletcher. Quality control tasks were conducted by Anchor QEA biologists Jordan Korenkiewicz and Chris Albrecht. Smolt monitoring was conducted by Pacific States Marine Fisheries Commission PSMFC biologist Wm. Monty Price and Washington Department of Fish and Wildlife (WDF&W) biologist Sharon Lind. PSMFC technicians Carol Williams and Karen Gleason were involved in fish sampling and smolt monitoring quality control and data keeping tasks.

Facility Modifications

The following modifications were made to the JFF prior to or during the 2016 fish collection season:

No modifications were made to the Lower Monumental JFF and support equipment in 2016.

River Conditions

During the 2016 season, the average daily flow did not exceeded 120.0 kcfs. The highest daily average flow for the season was 119.6 kcfs on April 25. The lowest daily average flow for the season occurred on September 26 with a flow of 12.5 kcfs. The average flow for the season was 49.3 kcfs. Spill occurred for 152 days from April 3 through midnight on August 31, with a maximum daily average spill of 47.1 kcfs on May 27 and 29. The RSW (Removable Spillway Weir) was put into operation when BiOp spill began on April 3, and was taken out of service for the season on July 25.

River temperature averaged 61.7 °F for the season and ranged from 46.0 °F on April 1, to 69.8 °F on August 20. A comparison of daily powerhouse flow and spill is shown in Figure 1. Average monthly flow and spill for the 2012 to 2016 collection seasons are provided in Table 1.

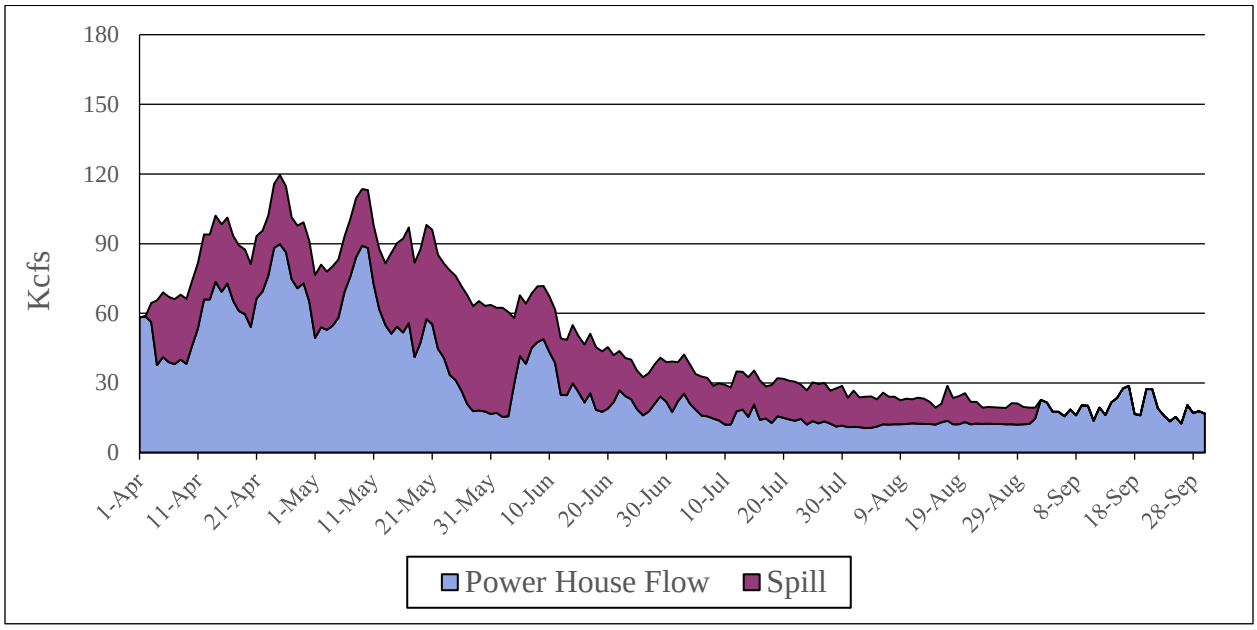
Fish Collection

Migration and Collection

Pre-transport primary bypass occurred from March 24 through May 1. Fish collection for transportation began at 0700 hours on May 1 and continued until 0700 hours on September 30. An estimated 5,028,464 juvenile salmonids were collected in 2016 (Table 2). Within each species group, the number collected and percent of the total collection was: 2,887,590 clipped yearling Chinook (57.4%), 619,657 unclipped yearling Chinook (12.3%), 83,808 clipped subyearling Chinook (1.7%), 100,029 unclipped subyearling Chinook (2.0%), 1,009,016 clipped

steelhead (20.1%), 276,408 unclipped steelhead (5.5%), 10,300 clipped sockeye/kokanee (0.2%), 1,070 unclipped sockeye/kokanee (0.0%), and 40,586 clipped/unclipped coho (0.8%). Post-season bypass occurred from October 1 through December 15. Daily collection and bypass numbers are provided in Appendix Table 1.

Figure 1. Comparisons of daily powerhouse flow and spill at Lower Monumental Dam, 2016.



By the end of May, 96.3% of the total yearly collection had arrived. The percent of the total collection arriving by the end of June and the end of July was 99.4% and 99.98%, respectively. The months of August and September contributed 0.02% of the total collection, and were responsible for the collection of 0.8% of the year's unclipped subyearling Chinook.

The peak daily collection total and date for each species group were: clipped yearling Chinook 339,800 (May 9), unclipped yearling Chinook 70,000 (April 26), clipped subyearling Chinook 13,550 (June 10), unclipped subyearling Chinook 10,300 (June 10), clipped steelhead 140,200 (April 26), unclipped steelhead 18,200 (May 9), clipped sockeye 2,900 (May 22), unclipped sockeye 200 (May 5, 8, and 11), and clipped/unclipped coho 7,000 (May 9). Total daily collection in 2016 peaked at 431,000 (April 26). Peak collection date and daily collection total by species group are listed in Table 3. Daily collection of all species combined versus total flow is shown graphically in Figure 2.

Adult Fallbacks

A total of 915 adult salmonids fell back through the juvenile bypass system and were bypassed from the separator between April 1 and September 30, 2016 (Table 4). The total includes: 113 adult Chinook salmon, 26 jack Chinook salmon, 339 clipped steelhead, 432 unclipped steelhead,

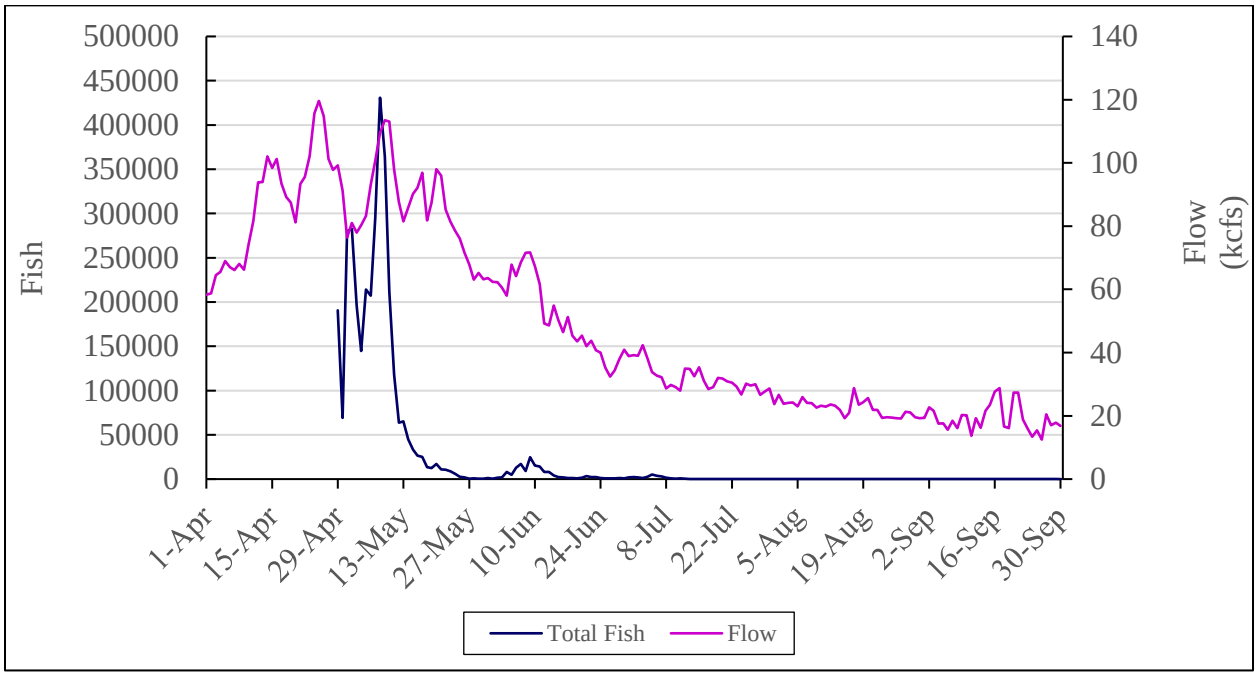
0 clipped sockeye, 2 unclipped sockeye, and 3 coho. The total number of fallbacks in 2016 was the second lowest in the last 5 years with the 2015 operating year being the lowest. The daily number of adult fallbacks and fallback mortalities at Lower Monumental Dam can be found in Appendix Table 4.

As has been the case in previous years, most adult fallbacks in 2016 were steelhead. The months of May and June accounted for 48.4% and August and September 5.7% of the steelhead fallback in 2016 (Table 5). Spring/summer Chinook accounted for 56.8% and fall Chinook accounted for 43.2% of Chinook fallbacks. Monthly adult salmonid fallback peaked in April through May, with a second (much smaller) increase in September.

Table 1. Comparisons of average monthly flow and spill at Lower Monumental Dam, 2012-2016.

Month	2012	2013	2014	2015	2016	Average
Flow						
April	121.5	59.7	75.2	50.0	87.0	78.8
May	105.5	82.2	100.9	60.3	85.2	86.8
June	88.7	56.4	84.5	41.0	51.3	64.4
July	45.9	34.0	45.5	27.0	31.5	36.8
August	27.6	23.4	26.8	21.0	22.5	24.3
Sept.	21.6	19.4	20.2	18.2	18.8	19.6
Spill						
April	37.5	27.4	26.4	25.7	25.2	28.4
May	29.5	26.3	29.3	24.2	35.3	28.9
June	28.3	21.7	25.9	19.3	24.5	23.9
July	18.2	16.0	17.1	14.1	16.2	16.3
August	14.0	11.0	13.1	8.5	10.4	11.4
Sept.	0.4	0.2	0.3	0.2	0.2	0.3

Figure 2. Daily juvenile salmonid collection, all species combined, versus daily average river flow at Lower Monumental Dam, 2016.



The condition of adult salmonids was evaluated as they were released from the separator. Their condition was predominantly good to fair with 91.7% of the fallbacks rated in these categories (Table 6). Condition ratings of the 910 adults examined (excluding sockeye and coho) were as follows: 695 good (76.4%), 139 fair (15.3%), 60 poor (6.6%), and 16 were dead (1.8%). The number of dead in each species group of adult salmonids was: 1 clipped jack chinook, 9 clipped steelhead, and 6 unclipped steelhead. Adult Chinook had a higher percentage of good/fair fish (97.3%) than adult steelhead (90.7%).

Table 2. Annual collection, bypass, and transport at Lower Monumental Dam, 2012-2016.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Year	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clip/Un.	Total
Collection										
2012	394,107	143,211	106,551	145,438	293,773	140,551	320	13,069	14,368	1,251,388
2013	351,719	118,229	61,709	108,369	334,849	123,933	4,388	3,674	7,999	1,114,869
2014	868,447	271,339	104,635	152,371	536,410	150,324	13,550	31,858	17,705	2,146,639
2015	514,612	127,462	66,316	108,154	252,560	69,705	5,840	850	22,120	1,167,619
2016	2,887,590	619,657	83,808	100,029	1,009,016	276,408	10,300	1,070	40,586	5,028,464
Bypass										
2012	4,235	1,286	5,954	6,979	4,253	1,564	0	0	0	24,271
2013	79	50	5,784	7,646	237	97	0	0	0	13,893
2014	175	67	236	380	237	112	0	0	0	1,207
2015	34,051	26,431	201	417	31,786	5,011	0	30	300	98,227
2016	1,195,352	417,149	307	1,663	550,091	105,023	0	0	6244	2,275,829
Truck										
2012	2	6	87	1,932	0	0	0	6	2	2,035
2013	0	2	201	3,192	4	13	0	0	0	3,412
2014	0	5	150	1,617	11	2	0	2	0	1,787
2015	0	0	8	760	14	1	0	0	0	783
2016	1	0	103	551	12	2	0	0	0	669
Barge										
2012	389,454	141,830	100,150	135,840	289,404	138,923	320	13,052	14,356	1,223,329
2013	351,214	118,070	55,493	96,942	334,411	123,768	4,388	3,670	7,998	1,095,954
2014	867,541	271,038	103,940	149,906	536,007	150,172	13,544	31,566	17,705	2,141,419
2015	480,257	100,972	65,845	106,548	220,464	64,610	5,821	819	21,816	1,067,152
2016	1,691,793	202,472	83,276	97,727	458,818	171,354	10,280	1,066	34,341	2,751,127
Total Transported										
2012	389,456	141,836	100,237	137,772	289,404	138,923	320	13,058	14,358	1,225,364
2013	351,214	118,072	55,694	100,134	334,415	123,781	4,388	3,670	7,998	1,099,366
2014	867,541	271,043	104,090	151,523	536,018	150,174	13,544	31,568	17,705	2,143,206
2015	480,257	100,972	65,853	107,308	220,478	64,611	5,821	819	21,816	1,067,935
2016	1,691,794	202,472	83,379	98,278	458,830	171,356	10,280	1,066	34,341	2,751,796

Table 3. Annual peak collection dates at Lower Monumental Dam, 2012-2016.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clip/Un	
2012	May 6	May 6	June 6	June 28	May 7	May 21	May 15	May 21	May 19	May 6
	56,755	15,480	7,034	8,453	23,900	11,220	100	1,390	1,200	97,045
2013	May 15	May 14	June 11	June 10	May 14	May 14	May 18	May 20	May 14	May 14
	50,035	15,400	7,766	12,347	52,900	18,700	1,600	1,000	2,200	138,800
2014	May 7	May 2	June 6	June 6	May 2	May 2	May 20	May 2	May 19	May 7
	90,000	31,400	9,750	9,400	50,800	10,000	6,200	3,400	2,000	156,800
2015	May 6	May 6	June 5	June 5	May 2	May 9	May 18	May 7**	May 17	May 9
	74,226	13,411	7,400	7,150	21,800	5,200	1,300	200	2,800	109,200
2016	May 9	April 26	June 10	June 10	April 26	May 9	May 22	May 5*	May 9	April 26
	339,800	70,000	13,550	10,300	140,200	18,200	2,900	200	7,000	431,000

* May 5, 8, and 11, same number collected each day

** May 7, 8, 9, and 18, same number collected each day

Table 4. Annual totals of adult salmonids released from the juvenile fish separator at Lower Monumental Dam, 2012-2016.

Year[1]	Adult Chinook	Jack Chinook	Clipped Steelhead	Unclipped Steelhead	Total
2012	152	116	403	812	1,484[3]
2013	135	89	556	505	1,294[3]
2014	163	58	321	992	1,561[3,2]
2015	178	34	224	312	761[3,2]
2016	113	26	339	432	915[3,2]

[1] Seasons varied in length.

[2] Coho are included in the total.

[3] Clipped and/or unclipped sockeye are included in the total.

Table 5. Monthly totals of adult salmonids[1] released from the juvenile fish separator at Lower Monumental Dam, 2016.

Month	Adult Chinook	Jack Chinook	Clipped Steelhead	Unclipped Steelhead	Total
April	0	1	126	218	345
May	45	2	180	161	388
June	13	0	10	22	45
July	12	1	5	5	23
August	10	5	3	15	33
September	33	17	15	11	76
October	0	0	0	0	0
Total	113	26	339	432	910

[1]Neither Coho or Sockeye are included in this table.

Table 6. Condition of adult salmonids[1] released from the juvenile fish separator at Lower Monumental Dam, 2016.

Condition	Adult Chinook	Jack Chinook	Clipped Steelhead	Unclipped Steelhead	Total
Good	97	23	260	315	695
Fair	13	2	42	82	139
Poor	3	0	28	29	60
Dead	0	1	9	6	16
Total	113	26	339	432	910

[1]Neither Coho or Sockeye are included in this table.

Separator Efficiency

The separator is designed with bar spacing to allow only smaller smolts, subyearling Chinook and sockeye, to divert to the A side of the collection facility. Larger smolts, steelhead and yearling Chinook, divert to the B side through wider spaced bars. Separator efficiency for 2016 by species group was: clipped yearling Chinook 85.1%, unclipped yearling Chinook 80.2%, subyearling Chinook 75.0%, clipped steelhead 76.6%, unclipped steelhead 47.9%, clipped sockeye/kokanee 63.1%, and unclipped sockeye/kokanee 4.7% (Table 7).

Table 7. Annual separator efficiency in percent at Lower Monumental Dam, 2012-2016.

Year	Clipped Yearling Chinook A-side	Unclipped[1] Yearling Chinook A-side	Subyearling Chinook A-side	Clipped Steelhead B-side	Unclipped[1] Steelhead B-side	Clipped Sockeye/ Kokanee A-side	Unclipped Sockeye/ Kokanee A-side
2012	70.5	65.7	49.4	84.2	61.8	31.3	51.8
2013	62.8	67.6	21.6	88.1	68.3	45.7	59.5
2014	70.6	68.0	59.1	78.8	32.5	38.0	44.3
2015	87.1	79.6	60.8	83.2	74.9	41.4	60.7
2016	85.1	80.2	75.0	76.6	47.9	63.1	4.7

[1] This category includes unclipped hatchery fish.

Sampling

From 2014 FCRPS BiOp:
Data on fish survival, adult returns, current year inriver conditions, and water supply forecast will be reviewed with RIOG each year to determine the best operation for the fish Transport Start Date. TMT will review the results of transport studies annually and provide an annual recommendation on how to operate the juvenile transport program to achieve the goal of transporting about 50% of juvenile steelhead. Planning dates to initiate juvenile transport at Lower Granite Dam will be April 21 to April 25, unless the Corps adopts a recommendation by TMT that proposes a later start date (No Later Than May 1) and accompanying alternative operation in their annual recommendation to achieve the goal of transporting about 50% of juvenile steelhead. Transport will begin up to 4 days and up to 7 days after the Lower Granite start date at Little Goose and Lower Monumental dams, respectively. Transport will continue until approximately September 30 at Lower Monumental and through October 31 at Lower Granite and Little Goose dams.

Sampling for condition and outmigration indexing at Lower Monumental Dam began April 1. Sampling for transport began at 0700 hours on May 1 and ended at 0700 hours on September 30.

Sampling is diverting and segregating groups of fish in a consistent fashion so that data collected from those segregated groups will accurately represent the sum total of the fish being collected in real time. Sampling is not the act of evaluating those groups.

Fish were sampled every third day (24 hour sampling) from April 1 through April 15 and every other day from April 15 through May 1 to monitor fish condition, ensure the system was operating correctly, and to train personnel on facility operation and sampling protocols. This type of sampling is termed “sampling for condition”. The total number of fish sampled during the April 1 through May 1 period was 11,294. The number sampled within each species group was: 4,712 clipped yearling Chinook, 2,950 unclipped yearling Chinook, 0 clipped subyearling Chinook, 0 unclipped subyearling Chinook, 3,013 clipped steelhead, 602 unclipped steelhead, 0 clipped sockeye, 0 unclipped sockeye, and 17 hatchery Coho.

Total sampling includes both "sampling for condition" as well as "sampling for transport" which was conducted during the 2016 operating year. Sampling for transport was conducted daily from May 1 through September 30. A total of 40,154 fish (0.8% of the collection) was sampled in 2016. Within each species group, the number and percent sampled of those collected in that group was: 15,957 clipped yearling Chinook (0.6%), 4,579 unclipped yearling Chinook (0.7%), 4,079 clipped subyearling Chinook (4.9%), 6,993 unclipped subyearling Chinook (7.0%), 6,040 clipped steelhead (0.6%), 1,905 unclipped steelhead (0.7%), 276 clipped sockeye/kokanee (2.7%), 14 unclipped sockeye/kokanee (1.3%), and 311 clipped/unclipped coho (0.8%) (Table 8).

Average weekly sample rates can be found in Table 9 and ranged from 0.5% to 100%.

Table 8. Annual percentage sampled of each juvenile salmonid species group at Lower Monumental Dam, 2012-2016.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Year	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clip/Un.	Total
2012	2.2	2.8	8.9	12.2	3.4	3.2	2.8	3.7	3.2	4.4
2013	1.1	1.9	16.5	22.3	1.4	1.7	1.7	2.2	2.6	4.3
2014	0.6	0.7	4.9	7.8	0.7	0.8	0.6	0.8	0.7	1.4
2015	0.7	0.9	3.5	5.4	1.0	1.1	1.1	1.1	1.5	1.4
2016	0.6	0.7	4.9	7.0	0.6	0.7	2.7	1.3	0.8	0.8

Transportation

An estimated 2,751,796 juvenile salmonids (54.7% of the collection) were transported from Lower Monumental Dam in 2016. Of these, 669 were transported by truck and approximately 2,751,127 by barge. Within each species group, the number transported and percent of those collected in that group was: 1,691,794 clipped yearling Chinook (58.6%), 202,472 unclipped yearling Chinook (32.7%), 83,379 clipped subyearling Chinook (99.5%), 98,278 unclipped subyearling Chinook (98.3%), 458,830 clipped steelhead (45.5%), 171,356 unclipped steelhead (62.0%), 10,280 clipped sockeye/kokanee (99.8%), 1,066 unclipped sockeye/kokanee (99.6%), and 34,341 clipped/unclipped coho (84.6%). Daily truck and barge transportation numbers are provided in Appendix Table 3.

There was no early season trucking from this site this year. Juvenile fish were trucked by midi-tanker from August 15 at 1700 hours through September 30 at 0700 hours. A salt solution of 2.5 grams per liter (g/l) (6 pounds per 300 gallons of water) is used routinely in the mini and midi-tankers to treat or ease the *Columnaris* symptoms common at this time of year. A total of 669 fish (0.0% of the collection) were transported by truck in 2016 (Table 2). Within each species group, the number trucked and percent of those collected in that group was: 1 clipped yearling Chinook (0.0%), 0 unclipped yearling Chinook (0.0%), 103 clipped subyearling Chinook (0.1%),

551 unclipped subyearling Chinook (0.6%), 12 clipped steelhead (0.0%), 2 unclipped steelhead (0.0%), 0 clipped sockeye/kokanee, 0 unclipped sockeye/kokanee (0.0%), and 0 clipped/unclipped coho (0.0%).

Juvenile fish collected at Lower Monumental Dam from May 1 through August 15 at 1700 hours were transported by barge. An estimated 2,751,127 (54.7% of the collection) were transported by barge in 2016 (Table 2). Within each species group, the number barged and percent of those collected in that group was: 1,691,793 clipped yearling Chinook (58.6%), 202,472 unclipped yearling Chinook (32.7%), 83,276 clipped subyearling Chinook (99.4%), 97,727 unclipped subyearling Chinook (97.7%), 458,818 clipped steelhead (45.5%), 171,354 unclipped steelhead (62.0%), 10,280 clipped sockeye/kokanee (99.8%), 1,066 unclipped sockeye/kokanee (99.6%), and 34,341 clipped/unclipped coho (84.6%).

Bypass

During the 2016 season (April 1 to September 30) a total of 2,275,829 fish were bypassed, 45.3% of the collection (Table 2). Within each species group, the number bypassed and percent of those collected in that group was: 1,195,352 clipped yearling Chinook (41.4%), 417,149 unclipped yearling Chinook (67.3%), 307 clipped subyearling Chinook (0.4%), 1,663 unclipped subyearling Chinook (1.7%), 550,091 clipped steelhead (54.5%), 105,023 unclipped steelhead (38.0%), 0 clipped sockeye/kokanee (0.0%), 0 unclipped sockeye/kokanee (0.0%), and 6,244 clipped/unclipped coho (15.4%). These numbers include fish examined for GBT during the transport season after June 16. This does not include fish bypassed by the PIT tag diversion system.

Juvenile salmonids were bypassed rather than transported for the following purposes this season.

1. Condition sampling and secondary bypass occurred from 0700 hours on April 1 through 0700 hours May 1 (see condition sampling frequency in sampling section); a total of 1,686,742 fish were bypassed at these times during this period. Within each species group, the number bypassed was: 726,173 clipped yearling Chinook, 359,991 unclipped yearling Chinook, 0 clipped subyearling Chinook, 0 unclipped subyearling Chinook, 511,712 clipped steelhead, 85,847 unclipped steelhead, 0 clipped sockeye/kokanee, 0 unclipped sockeye/kokanee, and 3,019 clipped/unclipped coho. These numbers include fish examined for GBT during this primary bypass period.
2. GBT inspections during the transport period of May 1 through October 1 accounted for a total of 1,368 fish bypassed. Within each species group the number bypassed was: 187 clipped yearling Chinook, 186 unclipped yearling Chinook, 169 clipped subyearling Chinook, 283 unclipped subyearling Chinook, 387 clipped steelhead, and 156 unclipped steelhead.
3. The PTAGIS3 database revealed that 103,168 PIT-tagged fish of different species groups were bypassed through the PIT tag system. These fish are not included in the facility bypass total.

PIT-tag diversion gates are set to bypass PIT-tagged fish when sample rates are 20% or higher, and during sampling intervals when fish were being collected for research (this prevents anesthetizing study fish a second time).

The fish rearing designation used by PTAGIS is hatchery/wild not clipped/unclipped; therefore you will find said designation used to report the PIT tag numbers in the following section rather than the clipped/unclipped designation used throughout the rest of this report. According to the PTAGIS3 database the composition of bypassed PIT-tagged fish totaled 99,119. The total by unit group was: 42,080 hatchery spring/summer Chinook, 7,216 hatchery fall Chinook, 806 hatchery Chinook of unknown run, 5,821 wild spring/summer Chinook, 167 wild fall Chinook, 6,090 wild Chinook of unknown run, 3 Chinook of unknown run or rearing disposition, 33,889 hatchery steelhead, 1,955 wild steelhead, 6 steelhead of unknown rearing, 362 hatchery sockeye, 372 wild sockeye, 352 hatchery coho. An unknown number of other fish were bypassed incidentally with the PIT-tagged fish as the PIT-tag diversion gates opened and closed to divert the PIT tagged fish

Incidental Species

Non-target fish species that were too large to pass through the separator bars were recorded and bypassed through the adult release pipe at the separator. Those that were small enough to pass through the separator bars were either sampled and bypassed, or held in the raceways and transported with the juvenile salmonids. Fortunately, most incidentals generally arrive late in the season while we are sampling at 100% of the collection. At that time they are easily removed while working up the sample, therefore avoiding transport. Sample fish from each incidental species were counted and their total numbers were calculated using the sample rate. These numbers were then added with separator counts of the same group to estimate the total collection for each species. The most common incidental species groups for 2016 included: juvenile shad (38,051), juvenile Pacific lamprey (17,907), Siberian prawn (10,527), sunfish (2,236), crappie (1,978), yellow perch (1,782), large/smallmouth bass (848), sucker (677) and walleye (608).

The number of juvenile shad (38,051) in 2016 is far greater than the 19,015 collection of the 2015 operating year. Other incidental fish species numbers collected at the facility have increased as well. Historically juvenile crappie was one of the most encountered incidental species. Their numbers this year have increased from 988 in 2015 to 1,978 in 2016. Estimated numbers of some groups may also become exaggerated high or low, due to the low sample rates at the time of their collection. This season we found an increase in the number of walleye collected from 377 in 2015 to 608 in 2016.

Some variability in past years is explained by facility problems which have been found and corrected, however, many incidental species show mild to strong decline. Juvenile lamprey numbers came back in 2016. In 2010 the collection of the juvenile (silver/macrothalmia) lamprey was 218,102; by 2015 they dropped to 2,121 and in 2016 they reached 17,907. The estimated collection of brown lamprey (ammocoete) in 2015 was 0 while the 2016 collection was 74. A summary of incidental fish collection is provided in Table 10.

Fish Condition

Descaling

Descaling data was collected from all live sample fish (full sample) rather than just a portion (subsample). Full sample data collection provides a larger sample size and therefore a better representation of fish condition.

The descaling rate for all fish sampled in 2016 was 1.7%. The annual descaling rate by species group was: clipped yearling Chinook (1.4%), unclipped yearling Chinook (1.4%), clipped subyearling Chinook (1.2%), unclipped subyearling Chinook (1.6%), clipped steelhead (2.6%), unclipped steelhead (2.7%), clipped sockeye/kokanee (6.9%), unclipped sockeye/kokanee (0.0%), and clipped/unclipped coho (1.0%), (Table 11). The highest rate ever recorded at the JFF was 6.7 in 1993. Rates of the last five years have ranged from a low of 1.9% in 2013 and 2014 to a high of 2.6% in 2015.

The highest weekly descaling rate for all species combined was 4.6% for the week ending June 2 (with fewer than 440 fish sampled in a week of condition sampling), while the lowest rate (0.0%) occurred in the weeks ending July 14, 28 and September 1, 29 (Table 12). Daily descaling rates are provided in Appendix Table 2.

Other Injuries and Disease

Injury data was gathered from a subsample of 100 of the dominant species and not more than 100 each of the non-dominant species. There were 17,932 fish examined for injury and disease in 2016. The most common symptom observed in 2016 was fin injury. A vast majority of fin injuries were observed to be split caudal fins, however other fin injuries were included in this category also. Split caudal fins have been defined as a split in the caudal fin membrane that extends the full length of the fin to the caudal peduncle. Split fin injuries are primarily observed in the lower lobe of the caudal fin within each species rearing and run type, aside from subyearling Chinook, where most fin injuries were located at the center of the caudal fin. Fin injuries were found on 3.1% of all fish examined. The incidence of fin injury was: clipped yearling Chinook 4.1%, unclipped yearling Chinook 2.9%, clipped subyearling Chinook 5.1%, unclipped subyearling Chinook 6.0%, clipped steelhead 2.0%, unclipped steelhead 3.7%, clipped sockeye/kokanee 36.4%, unclipped sockeye/kokanee 30.0%, and clipped/unclipped coho 7.8%. The high incidence of fin injury in clipped sockeye was not split fin, but highly frayed caudal fins. Fin hemorrhaging occasionally coincided with split fin injuries.

Fin hemorrhaging is the discharge of blood outside the fin tissue. Fin hemorrhaging is a sign of trauma and was found on 0.8% of all fish examined for injuries in 2016. The incidence of fin hemorrhaging by species group was: clipped yearling Chinook 1.1%, unclipped yearling Chinook 1.4%, clipped subyearling Chinook 2.0 %, unclipped subyearling Chinook 2.1%, clipped steelhead 0.2%, unclipped steelhead 0.1%, clipped sockeye/kokanee 2.0%, unclipped sockeye/kokanee 0.0%, and clipped/unclipped coho 0.4%.

Table 9. Weekly sample rates in percent and sample totals at Lower Monumental Dam, 2016.

Week	Weekly Rate	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Ending	(%)	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clip/Un.	Totals*
7-Apr	10	29	84	0	0	47	46	0	0	2	208
14-Apr	5.3	859	865	0	0	168	56	0	0	0	1,948
21-Apr	0.8	840	859	0	0	632	220	0	0	0	2,551
28-Apr	0.5	2,462	1,043	0	0	1,901	217	0	0	11	5,634
5-May	0.5	3,580	585	0	3	1,308	304	0	1	32	5,813
12-May	0.5	6,924	641	0	32	1,043	452	0	2	102	9,196
19-May	0.6	810	145	1	12	332	207	0	1	43	1,551
26-May	0.7	402	104	1	39	346	239	195	6	73	1,405
2-Jun	9.3	26	27	43	74	101	67	78	2	21	439
9-Jun	4.9	15	55	1,206	623	96	71	3	2	21	2,092
16-Jun	3.1	3	26	784	860	13	14	0	0	1	1,701
23-Jun	1.4	1	28	508	1,220	15	4	0	0	1	1,777
30-Jun	14.3	5	38	320	714	10	3	0	0	2	1,092
7-Jul	16.4	0	58	818	1,789	8	1	0	0	2	2,676
14-Jul	14.3	0	14	216	688	1	0	0	0	0	919
21-Jul	50	0	4	37	145	0	0	0	0	0	186
28-Jul	7.1	0	3	11	67	4	0	0	0	0	85
4-Aug	50	0	0	9	69	3	2	0	0	0	83
11-Aug	50	0	0	10	55	0	0	0	0	0	65
18-Aug	7.1	0	0	18	77	1	0	0	0	0	96
25-Aug	100	0	0	15	70	7	1	0	0	0	93
1-Sep	100	0	0	11	47	3	0	0	0	0	61
8-Sep	100	1	0	50	248	0	0	0	0	0	299
15-Sep	100	0	0	12	94	1	1	0	0	0	108
22-Sep	100	0	0	5	50	0	0	0	0	0	55
29-Sep	100	0	0	3	15	0	0	0	0	0	18
1-Oct	100	0	0	1	2	0	0	0	0	0	3
Total Sampled		15,957	4,579	4,079	6,993	6,040	1,905	276	14	311	40,154
% of Sample		39.7	11.4	10.2	17.4	15.0	4.7	0.7	0.0	0.8	100
% of Collection		0.6	0.7	4.9	7.0	0.6	0.7	2.7	1.3	0.8	0.8

* Daily 24 hour sampling at Lower Monumental Dam began this year on May 1.

Other common injuries included: blood pooling, bird marks, fish marks, fungus and *Columnaris*.

Blood pooling is defined as the vasodilatation of the capillaries in fins (also referred to as fin pinkness). It seems to be a symptom of anesthetic use during higher water temperatures and is mostly found on subyearling Chinook. Evidence of blood pooling was found on 0.4% of all fish examined. The incidence of blood pooling by species group was: clipped yearling Chinook 0.6%, unclipped yearling Chinook 0.2%, clipped subyearling Chinook 1.5 %, unclipped subyearling Chinook 1.7%, clipped steelhead 0.2%, unclipped steelhead 0.1%, clipped sockeye/kokanee 0.0%, unclipped sockeye/kokanee 0.0%, and clipped/unclipped coho 0.4%.

Bird marks were observed on 2.2% of all fish examined. The incidence of bird marks by species group was: clipped yearling Chinook 2.2%, unclipped yearling Chinook 1.9%, clipped subyearling Chinook 1.0 %, unclipped subyearling Chinook 0.9%, clipped steelhead 5.4%, unclipped steelhead 4.9 %, clipped sockeye/kokanee 4.4 %, unclipped sockeye/kokanee 0.0%, and clipped/unclipped coho 1.3%.

Fish marks were found on 1.2% of all fish examined. Fish marks were found on all species and rearing types with the exception of unclipped sockeye.

Fungus was found on 0.2% of all fish examined. Fungus was found on all species and rearing types with the exception of clipped subyearling Chinook and unclipped sockeye. The occurrence of fungus is generally seen early in the season while the water is still relatively cold.

Columnaris was seen again this year. It occurs most frequently in subyearling Chinook but has been seen on coho and steelhead as well. Typically it is found on the fish during the warmer water conditions of July, August, and September. Peamouth also appear to be susceptible to this disease. *Columnaris* can be recognized by the presence of yellowish lesions on the belly, as well as some damage to the gills, pelvic fins, snout, and caudal fins. It has also been found in the dorsal region. This year both clipped and unclipped subyearling Chinook showed signs with rates of 0.8% and 1.3%, respectively. In contrast to previous years and despite high water temperatures, we did not see an increase in the incidence of *Columnaris* this season.

The maximum daily *Columnaris* rate in 2016 for subyearling Chinook was 45.5% (only 11 fish examined). In 2015, it reached a high of 30.8% (only 14 fish sampled). Increased mortality in the summer months is frequently attributed to *Columnaris*.

Mortality

Annual facility mortality for all groups combined was 0.0% in 2016 (Table 13) and totaled 839 fish. Within each species group, the number of facility mortalities and percent of those collected in that group was: 444 clipped yearling Chinook (0.0%), 36 unclipped yearling Chinook (0.0%), 122 clipped subyearling Chinook (0.1%), 88 unclipped subyearling Chinook (0.1%), 95 clipped steelhead (0.0%), 29 unclipped steelhead (0.0%), 20 clipped sockeye/kokanee (0.2%), 4 unclipped sockeye/kokanee (0.4%), and 1 clipped/unclipped coho (0.0%). Total annual facility mortality was 0.1% in all 4 years prior to 2016 (0.0%). Weekly mortality rates had a high of 4.0% for the week ending September 8 and a low of 0.0% for multiple weeks (Table 14). Daily mortality rates are provided in Appendix Table 2.

Annual sample mortality for all groups combined was 0.5% in 2016 (Table 15) and totaled 208 fish. The number of sample mortalities and mortality rate by species group was: 106 clipped yearling Chinook (0.7%), 10 unclipped yearling Chinook (0.2%), 33 clipped subyearling Chinook (0.8%), 34 unclipped subyearling Chinook (0.5%), 13 clipped steelhead (0.2%), 7 unclipped steelhead (0.4%), 5 clipped sockeye/kokanee (1.8%), 0 unclipped sockeye/kokanee (0.0%), and 0 clipped/unclipped coho (0.0%). Sample mortality for all groups combined has

ranged from a high of 2.0% in 2011 to a low of 0.3% in 2008 and 2010.

Annual post-sample mortality for all groups combined was 0.1% in 2016 and totaled 21 fish. The number of post-sample mortalities and mortality rate by species group was: 13 clipped yearling Chinook (0.1%), 7 clipped subyearling Chinook (0.2%), and 1 unclipped subyearling Chinook (0.0%). The highest post-sample mortality rate (0.7%) occurred in 2004 and the lowest (0.0%) in 1999.

Annual truck mortality in 2016 was 0.45% (3 of 669 fish). The number of truck mortalities and mortality rate by species group was: 2 clipped subyearling Chinook (1.9%) and 1 unclipped subyearling Chinook (0.2%). The annual truck mortality rate in 2015 was 0.0%.

Research

Gas Bubble Trauma Monitoring (PSMFC)

Juvenile Chinook and steelhead were sampled once a week for GBT from April 8 through July 13 in 2016. The GBT inspections were stopped early due to small numbers of available fish. Typically it would have ended when spill stopped on August 31. This season 1,368 fish were sampled for GBT. PSMFC personnel examined up to100 individuals of each of the following groups: yearling Chinook, subyearling Chinook, and juvenile steelhead. The fish were searched for evidence of bubbles in paired and unpaired fins, and in the eye, as per Fish Passage Center GBT protocols. Prior to collection for transport the GBT fish were bypassed to the river after examination. Weekly GBT sampling continued for up to eight hours or until 100 fish had been sampled per species group. The number of fish sampled for GBT, by species group was: 187 clipped yearling Chinook, 186 unclipped yearling Chinook, 169 clipped subyearling Chinook, 283 unclipped subyearling Chinook, 387 clipped steelhead, and 156 unclipped steelhead. In the 2016 season, 0 fish showed signs of GBT in the fins.

Ice Harbor Dam Survival Study (PNNL)

Juvenile yearling Chinook, subyearling Chinook and steelhead were collected for use in an Ice Harbor Dam survival preparatory study conducted by Pacific Northwest National Laboratory. The study was conducted over a two month period with staggered collection dates to collect both yearling and subyearling Chinook. A total of 713 fish were collected by PNNL and are accounted for in this report as bypassed. The number of fish collected and bypassed for the Ice Harbor Dam study by species group was: 179 clipped yearling Chinook, 43 unclipped yearling Chinook, 138 clipped subyearling Chinook, 148 unclipped subyearling Chinook, 135 clipped steelhead and 70 unclipped steelhead.

Table 10. Estimated collection of incidental species at Lower Monumental Dam, 2015.

Common Name	Scientific Name	Exp. Sample	Separator	Total Collection[1]
American shad (Adult)	*Alosa sapidissima*	30	221	251
American shad (Juvenile)	*A. sapidissima*	37,983	68	38,051
Banded Killifish	*Fundulus diaphanus*	0	0	0
Bullhead (misc.)	*Amierus* spp.	11	11	22
Bull Trout	*Salvelinus confluentus*	0	3	3
Brown Trout	*Salmo trutta*	0	0	0
Channel catfish	*Ictalurus punctatus*	42	31	73
Chiselmouth	*Acrocheilus alutaceus*	1	0	1
Common carp	*Cyprinus carpio*	13	21	34
Crappie	*Pomoxis* spp.	1,858	120	1,978
Kokanee	*Oncorhynchus nerka*	0	0	0
Mosquitofish	*Gambusia affinis*	0	0	0
Northern Pikeminnow	*Ptychocheilus oregonensis*	10	3	13
Pacific lamprey (Adult)	*Lampetra tridentatus*	238	4	242
Pacific lamprey (Juvenile)	*L. tridentatus*	17,899	8	17,907
Pacific lamprey (Ammocoete)	*L. tridentatus*	74	0	74
Peamouth	*Mylocheilus caurinus*	64	0	64
Rainbow Trout[2]	*Oncorhynchus mykiss*	1	24	25
Redside Shiner	*Richardsonius balteatus*	0	0	0
Sandroller	*Percopsis transmontana*	0	0	0
Sculpin	*Cottus* spp.	273	12	285
Siberian Shrimp/Prawn	*Exopalaemon modestus*	10,481	46	10,527
Largemouth/Smallmouth bass	*Micropterus dolomieu/salmoides*	845	3	848
Sucker (misc.)	*Catostomus* spp.	558	119	677
Sunfish (misc.)	*Lepomis* spp.	2,225	11	2,236
Tadpole Madtom	*Nosturus gyrinus*	0	0	0
Whitefish	*Prosopium* spp.	0	0	0
White Sturgeon	*Acipenser transmontanus*	0	3	3
Walleye	*Stizostedion vitreum*	529	79	608
Warmouth	*Lepomis gulosus*	0	0	0
Yellow perch	*Perca flavescens*	1,754	28	1,782
Others	----------	201	6	207
Total		75,090	821	75,911

[1] Incidental species collection estimates are based on (sampled number of group expanded by the sample rate) plus separator count. All incidental fish in the sample and the separator are removed and bypassed.
[2] Rainbow trout are classified by morphological characteristics, but this may include misidentified juvenile steelhead.

Table 11. Annual descaling rates in percent for fish sampled at Lower Monumental Dam, 2012-2016.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Year	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clip/Un.	Total
2012	2.7	1.5	1.1	1.0	3.2	3.0	0.0	4.1	2.7	2.0
2013	2.7	2.9	1.5	1.2	4.2	3.5	0.0	4.9	2.0	1.9
2014	2.4	1.8	1.2	1.3	3.5	1.8	5.3	3.8	2.3	1.9
2015	3.0	3.0	1.3	1.6	4.6	4.7	3.2	22.2	2.7	2.6
2016	1.4	1.4	1.2	1.6	2.6	2.7	6.9	0.0	1.0	1.7

Table 12. Weekly descaling rates in percent for fish sampled at Lower Monumental Dam, 2016.

Week Ending	Yearling Chinook Clipped	Yearling Chinook Unclip.	Subyearling Chinook Clipped	Subyearling Chinook Unclip.	Steelhead Clipped	Steelhead Unclip.	Sockeye/Kokanee Clipped	Sockeye/Kokanee Unclip.	Coho Clip/Un.	Total
7-Apr	0.0*	1.2*	---	---	6.4*	2.2*	---	---	0.0*	2.4
14-Apr	0.3	0.6	---	---	2.4	1.8*	---	---	---	0.7
21-Apr	1.1	2.0	---	---	2.1	2.3	---	---	---	1.7
28-Apr	1.3	1.2	---	---	1.3	2.3	---	---	14.3	1.3
5-May	1.4	1.5	---	0.0*	2.8	1.6	---	0.0	4.0	1.8
12-May	1.4	1.7	---	0.0*	3.5	2.7	---	0.0	10.6	1.8
19-May	1.6	1.4	0.0*	0.0*	6.3	1.9	---	0.0	0.0	2.6
26-May	2.0	0.0	0.0*	0.0*	2.4	3.6	5.7	0.0	0.0	2.6
2-Jun	3.8*	3.8*	4.7*	0.0*	4.0	4.5	10.7	0.0*	11.1	4.6
9-Jun	0.0*	0.0*	0.4	0.8	3.3	5.7	0.0*	0.0*	0.0	0.9
16-Jun	0.0*	0.0*	0.8	2.4	6.7	0.0	---	---	0.0*	1.6
23-Jun	100.0*	0.0*	2.0	1.6	0.0	20.0*	---	---	0.0*	1.8
30-Jun	0.0*	2.6*	2.8	2.1	0.0*	0.0*	---	---	0.0*	2.3
7-Jul	---	6.9*	1.2	2.0	0.0*	0.0*	---	---	0.0*	1.8
14-Jul	---	0.0*	1.4	2.0	0.0*	---	---	---	---	0.0
21-Jul	---	0.0*	5.0*	3.4	---	---	---	---	---	3.7
28-Jul	---	0.0*	0.0*	0.0*	0.0*	---	---	---	---	0.0
4-Aug	---	---	0.0*	1.5*	0.0*	50.0*	---	---	---	2.5
11-Aug	---	0.0*	0.0*	2.0*	---	---	---	---	---	1.5
18-Aug	---	---	5.9*	0.0*	0.0*	---	---	---	---	1.1
25-Aug	---	---	6.7*	0.0*	0.0*	0.0*	---	---	---	1.1*
1-Sep	---	---	0.0*	0.0*	0.0*	---	---	---	---	0.0*
8-Sep	100.0*	---	4.1*	2.1	---	---	---	---	---	2.8
15-Sep	---	---	0.0*	3.2*	0.0*	0.0*	---	---	---	2.8
22-Sep	---	---	0.0*	2.0*	---	---	---	---	---	1.8*
29-Sep	---	---	0.0*	0.0*	---	---	---	---	---	0.0*
1-Oct	---	---	0.0*	0.0*	---	---	---	---	---	0.0*
Total Descaled	218	63	50	113	157	52	19	0	3	675
Total Examined	15,957	4,579	4,079	6,993	6,040	1905	276	14	311	40,154
Percent Descaled	1.4%	1.4%	1.2%	1.6%	2.6%	2.7%	6.9%	0.0%	1.0%	1.7%

--- No fish sampled during the week.
* Fewer than 100 fish sampled during the week.

Table 13. Annual facility mortality in percent at Lower Monumental Dam, 2012-2016.

Year	Yearling Chinook Clipped	Yearling Chinook Unclip.	Subyearling Chinook Clipped	Subyearling Chinook Unclip.	Steelhead Clipped	Steelhead Unclip.	Sockeye/Kokanee Clipped	Sockeye/Kokanee Unclip.	Coho Clip/Un.	Total
2012	0.1	0.1	0.3	0.5	0.0	0.1	0.0	0.1	0.1	0.1
2013	0.1	0.1	0.3	0.5	0.0	0.0	0.0	0.1	0.0	0.1
2014	0.1	0.1	0.3	0.3	0.0	0.0	0.0	0.9	0.0	0.1
2015	0.1	0.0	0.4	0.4	0.1	0.1	0.3	0.1	0.0	0.1
2016	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.4	0.0	0.0

Table 14. Weekly facility mortality rates in percent at Lower Monumental Dam, 2016.

Week Ending	Yearling Chinook Clipped	Yearling Chinook Unclip.	Subyearling Chinook Clipped	Subyearling Chinook Unclip.	Steelhead Clipped	Steelhead Unclip.	Sockeye/Kokanee Clipped	Sockeye/Kokanee Unclip.	Coho Clip/Un.	Total
7-Apr	0.0	0.0	---	---	0.0	0.4	---	---	0.0	0.1
14-Apr	0.0	0.0	---	---	0.0	0.0	---	---	---	0.0
21-Apr	0.0	0.0	---	---	0.0	0.0	---	---	---	0.0
28-Apr	0.0	0.0	---	---	0.0	0.0	---	---	0.0	0.0
5-May	0.0	0.0	---	0.0	0.0	0.0	---	1.0	0.0	0.0
12-May	0.0	0.0	---	0.0	0.0	0.0	---	0.3	0.0	0.0
19-May	0.0	0.0	0.0	0.0	0.0	0.0	---	0.0	0.0	0.0
26-May	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0
2-Jun	1.9	0.0	0.4	0.0	0.1	0.0	1.0	0.0	0.0	0.4
9-Jun	2.0	0.0	0.0	0.0	0.3	0.1	6.7	0.0	0.0	0.1
16-Jun	0.0	0.0	0.2	0.0	0.5	0.1	---	---	0.0	0.1
23-Jun	0.0	0.0	0.2	0.0	0.9	0.0	---	---	0.0	0.1
30-Jun	0.0	0.0	0.4	0.1	1.3	3.3	---	---	0.0	0.2
7-Jul	---	0.3	0.4	0.2	0.0	0.0	---	---	0.0	0.3
14-Jul	---	0.0	0.3	0.2	10.0	---	---	---	---	0.2
21-Jul	---	0.0	0.0	0.3	---	---	---	---	---	0.3
28-Jul	---	0.0	8.3	0.7	12.5	---	---	---	---	2.3
4-Aug	---	---	5.6	0.7	0.0	0.0	---	---	---	1.2
11-Aug	---	---	0.0	0.0	---	---	---	---	---	0.0
18-Aug	---	---	3.6	2.5	0.0	---	---	---	---	2.7
25-Aug	---	---	0.0	1.4	0.0	0.0	---	---	---	1.1
1-Sep	---	---	0.0	0.0	0.0	---	---	---	---	0.0
8-Sep	0.0	---	2.0	4.4	---	---	---	---	---	4.0
15-Sep	---	---	0.0	1.1	0.0	0.0	---	---	---	0.9
22-Sep	---	---	0.0	0.0	---	---	---	---	---	0.0
29-Sep	---	---	0.0	0.0	---	---	---	---	---	0.0

--- No fish collected during the week.

Table 15. Annual sample mortality in percent at Lower Monumental Dam, 2012-2016.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	
Year	Clipped	Unclip	Clipped	Unclip.	Clipped	Unclip.	Clipped	Unclip.	Clip/Un.	Total
2012	0.3	0.1	0.7	2.5	0.2	0.3	0.0	0.6	0.0	1.0
2013	0.2	0.3	0.8	1.5	0.3	0.2	0.0	0.0	0.0	1.0
2014	0.2	0.2	0.9	1.6	0.1	0.2	0.0	0.4	0.0	0.9
2015	0.8	1.4	0.9	0.8	1.2	1.3	0.0	0.0	0.6	0.9
2016	0.7	0.2	0.8	0.5	0.2	0.4	1.8	0.0	0.0	0.5

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA.

Below is a summary of unit outages and cause from March 1 through October 26.

Unit	Dates out of service	Reason out of service
All Units	March 15-17	Trash rack raking
All Units	March 29-31	STS installation
All Units	Monthly(2-3 days)	STS/VBS inspection
All Units	July 29- Aug. 5	Line Outage for Doble Testing
Unit 1	All Year	Awaiting overhaul
Unit 2	March 31	Startup failure
	July 7-8	Thrust bearing pressure switch change
	Aug. 23	Change out head cover pump
Unit 3	June 18-20	Linkage broken in Gov. cabinet
	June 27 - July 22	Annual Maintenance
Unit 4	August 8 – Sept. 8	Annual Maintenance
Unit 5	Sept. 19 – Oct. 27	Annual Maintenance

Debris/Trash Racks

Trash rack raking occurred on March 15, 16, and 17. A total of 66 cubic yards of debris was removed in this operation. With low flows throughout the year debris was exceptionally light this season.

Submersible Screens

The submersible traveling screens (STSs) were inspected and tested on March 17 and were installed from March 29 through March 31. After installation, inspection was done monthly by underwater video camera through November. No STS problems required repair during the 2016 season.

STSs were operated in "cycle" mode while the average fork length of subyearling Chinook and/or sockeye/kokanee were greater than 120 mm (March 23 through May 5, and, from July 11 through December 15), and in continuous "run" mode when either was less than 120 mm (May 6 through July 11).

Vertical Barrier Screens

The vertical barrier screens (VBSs) were inspected by underwater video camera on July 5 and 6. Additionally, they were spot-checked monthly during STS inspections. No problems were found.

Gatewells

Dipping the bulkhead slots (gatewells) yielded 26 cubic yards of debris this season. Gatewells were normally less than 10% covered. Gatewells did not exceed the 50% debris criterion in 2016. Occasional oil sheens were dealt with by floating oil absorbent pads in the affected gatewells.

Orifices/Collection Channel

During the 2016 season, the number of open orifices varied from 18 to 21 according to forebay level. With the Lower Monumental reservoir at minimum operating pool, water discharge through an orifice is reduced. During this period, extra orifices were opened to supply additional water to the adult fishway. Orifices were cycled and backflushed with air daily to remove debris. Orifice fouling was not a problem this season with low flows and a minimal debris load typifying the season. Orifice lights were checked daily. If a light was not working, the operating orifice was switched to the other orifice in the slot until repairs could be made.

Primary Dewaterer

A major problem occurred regarding the primary dewaterer during the 2012 season. Two weir stem drive gear assemblies failed. Weirs that were no longer useable were set to an acceptable elevation and an adjustment nut was used to hold them in place. A new automatic weir drive system is being researched and should be installed during the winter maintenance period of 2018.

The compressed air screen cleaner functioned well. The mechanical screen cleaner cable drive was upgraded to a belt drive during the winter maintenance season. No breakdowns occurred during the transport season but occasional adjustment of the mechanical screen cleaner was required. As usual, the system as a whole functioned very well keeping debris from plugging the inclined screen.

Wet Separator/Distribution and Sampling Systems

Sudden water level drops at the separator were not a problem this year. Water level remained fairly consistent at the separator with the automated weirs of the primary dewaterer in manual. As has been the case for the last few years, the separator was run at a higher water level to assure no problem with exposed separator bars would occur.

PIT-tag diversion gate position sensors were installed ten years ago. These sensors act to prevent the over-travel problem we once had, and by so doing, they eliminated gate failure problems caused by metal fatigue.

Barge Loading Operations

Fish were transported by barge from May 1 through August 15. Barge loading went very smoothly this season. No problems occurred during barge loading operations.

The guide for the downstream mooring bit, having been deformed in a collision by a barge years ago, has caused the downstream floating mooring bit to stick low in the guides. Additionally, it has occasionally taken on water. Plans are being made to refurbish all the mooring bits and repair/replace the damaged downstream mooring bit guide.

Truck Loading Operations

Juvenile fish were transported by truck from August 15 at 1700 hours to September 30 at 0700 hours. Throughout the late season the midi-tanker was used because of low fish numbers. A 2.5 mg/l salt solution was used to treat and/or ease outbreaks of *columnaris*.

Recommendations

1. Install a shear boom across the forebay to direct debris to the spillway during the high flow/high debris period to reduce orifice fouling and associated fish injury.
2. Research converting the porosity unit upstream of the separator to a third stage of the separator designed for the removal and bypassing of fry and juvenile lamprey. The concept has been discussed with COE's engineer Ryan Laughery and he is optimistic regarding its feasibility and functionality. (in AMRIP)
3. Research converting the pipe system between the PIT facility counter tanks and the PIT facility holding tank exits with an open system that eliminates the need to hold fish in the PIT system holding tanks. This also has been discussed with Laughery and he believes it can be accomplished.

APPENDIX TABLES

Appendix Table 1. Daily collection and bypass numbers and river conditions at Lower Monumental Dam, 2016.

See Excel Spreadsheet “2016 Fish Numbers LoMo.xls”.

Appendix Table 2. Daily number of fish trucked and barged from Lower Monumental Dam, 2016.

See Excel Spreadsheet “2016 Fish Numbers LoMo.xls”.

Appendix Table 3. Percent descaling and daily facility mortality numbers at Lower Monumental Dam, 2016.

See Excel Spreadsheet “2016 Fish Numbers LoMo.xls”.

Appendix Table 4. Daily number of adult fallbacks and fallback mortality at Lower Monumental Dam, 2016.

See Excel Spreadsheet “2016 Fish Numbers LoMo.xls”.