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September 26, 2016

MEMORANDUM FOR: Christopher E. Yates

FROM: Richard W. Zabel *Richard W. Zabel*

SUBJECT: Estimation of Percentages for Listed Pacific Salmon and Steelhead Smolts Arriving at Various Locations in the Columbia River Basin in 2016

Each year your office requests a description of how the Fish Ecology Division calculates the percentages of listed wild and hatchery fish arriving at selected Columbia and Snake River projects. These estimates are necessary for evaluating the potential impacts of proposed research on listed species. Given new hatchery release estimates, we have computed percentages for 2016. The attached tables show our best estimates for the total numbers of protected juvenile Pacific salmon and steelhead arriving at Columbia River and Snake River dams during the 2016 outmigration, and the percentage of the total collection they will comprise at each dam. We have developed estimates based on transportation with spill river conditions that have existed in the past and on a full transportation scenario (with no spill). Tables 1-6 show the development of the estimates, Tables 7-10 summarize the estimates for each listed species at each project, and Table 11 presents our estimates of the total run size for each listed group of fish.

Several Snake River species will have unmarked hatchery fish released for the 2016 outmigration. Because we have encountered unmarked hatchery spring/summer Chinook salmon in the past, we have adopted a practice of labeling any unclipped spring/summer Chinook salmon that is greater than 124-mm in fork length as hatchery-origin fish. To derive this fork length, we analyzed data from wild spring/summer Chinook salmon PIT-tagged in their natal streams (from our wild parr marking project; Permit #1406,

Study 1) that were subsequently captured and re-measured at one of the lower Snake River dams during slide-gate evaluations (1989-1994 and 1999-2004).

For several groups of fish, we could find no new information; therefore, our estimates for these groups are the same as last year.

Please discuss and distribute this memorandum with all interested parties.

Attachments

cc: Hard
Dickhoff
Dey
Downing
Fresh
Pess
Sanderson
Turner
Rule
Bellerud
Graves
Griffin
Kratz
Tehan

YEARLING CHINOOK SALMON ESTIMATES

Snake River ESU

The estimate of wild spring/summer Chinook salmon arriving at Lower Granite Dam is based on Idaho Department of Fish and Game (IDFG) and Oregon Department of Fish and Wildlife (ODFW) redd counts for brood year 2014. Redd counts were grouped by drainages where fecundity rates were available: (Middle Fork of the Salmon River, South Fork of the Salmon River, Salmon River (excluding Middle and South Forks), Clearwater River, Imnaha River, and Grande Ronde River). The egg-to-smolt survival rate (to Lower Granite Dam) was set at 5%. We estimate that 1,542,451 wild/natural spring/summer Chinook salmon will reach Lower Granite Dam in 2016.

Under the 2005 listing guidelines, hatchery fish must now be tracked, not only by their listing status, but also by whether they have been adipose-fin clipped. We estimate that 16,281,169 hatchery spring/summer Chinook salmon smolts will be released from Idaho (14,852,977) and Oregon (1,428,192). Of these 16,281,169 hatchery spring/summer Chinook salmon smolts, 5,626,820 will be listed (5,028,532 with AD-clips and 598,288 without AD-clips) and 10,654,349 will be unlisted (10,267,065 with AD-clips and 387,284 without AD-clips).

In order to estimate how many hatchery smolts will reach Lower Granite Dam, we first estimated the percentage composition of Snake River spring/summer Chinook salmon arriving at the dam from listed hatcheries (Table 1). Using the mean survival estimates for the 2003-2015 outmigrations, we estimated the total number of hatchery fish that will arrive at Lower Granite Dam. The mean survival estimate for each hatchery from these years was applied to the 2016 projected release numbers for each hatchery. We estimate that 10,429,827 or 64.06068% of the 16,281,169 hatchery fish released will arrive at Lower Granite Dam. Of these 10,429,827 hatchery spring/summer Chinook salmon smolts, 3,001,989 will be listed (2,682,004 with AD-clips and 319,985 without AD-clips) and 7,427,838 will be unlisted (7,176,771 with AD-clips and 251,067 without AD-clips).

In June 2005, Snake River hatchery fall Chinook salmon were listed under the ESA. While most hatchery fall Chinook salmon

are released as subyearlings, the Nez Perce Tribe and Washington Department of Fish and Wildlife (WDFW) release yearling fall Chinook salmon above Lower Granite Dam. Because these fish may not be distinguishable from yearling spring/summer Chinook salmon, they have been included in the yearling estimates detailed below.

Holdover fall Chinook salmon (wild fish that do not outmigrate as subyearlings and hatchery fish released as subyearlings that did not outmigrate as subyearlings) show extreme year-to-year variability in the numbers collected at the various dams. Also, based on PIT-tag detections of holdover fall Chinook salmon, it is known that these fish can stop migrating anywhere along their migration route and holdover to the next spring. These two characteristics of fall Chinook life history make it extremely difficult to estimate how many holdover fish will outmigrate in any given year. Therefore, no estimates of holdover yearling fall Chinook salmon are included.

In 2016, 209,955 AD-clipped and 260,045 Non-AD-clipped yearling listed hatchery fall Chinook salmon will be released above Lower Granite Dam. Using an average survival rate of 0.868, we estimate that 407,960 (182,241 AD-clipped and 225,719 Non-AD-clipped) yearling listed hatchery fall Chinook salmon will arrive at Lower Granite Dam.

Knowing the total number of hatchery fish, the number of listed hatchery fish, and the number of wild fish arriving at Lower Granite Dam, we estimated the percentage composition of listed hatchery fish and wild fish arriving at the dam as follows:

$$\begin{aligned} \text{total yearling smolts} &= \text{total hatchery fish} + \text{wild fish} = \\ 12,380,238 &= (10,429,827 + 407,960) + 1,542,451 \end{aligned}$$

$$\begin{aligned} \% \text{ wild fish to dam} &= \text{wild fish} / \text{total smolts} = \\ 12.45897\% &= 1,542,451 / 12,380,238 \end{aligned}$$

$$\% \text{ listed hatchery fish} = \text{listed hatchery fish} / \text{total smolts} =$$

AD-clip spring/summer	21.66359%	=	2,682,004/12,380,238
Non-AD-clip spring/summer	2.58464%	=	319,985/12,380,238
AD-clip yearling fall	1.47203%	=	182,241/12,380,238
Non-AD-clip yearling fall	1.82322%	=	225,719/12,380,238

We set fish guidance efficiencies (FGE) at Lower Granite and Little Goose Dams to 0.292 and 0.327, respectively. Using an FGE of 0.292, the total collection at Lower Granite Dam will be 3,615,029 (12,380,238 x 0.292), based on 12,380,238 smolts arriving at the dam. The collection at Lower Granite Dam will be comprised of the following:

<u>Listed groups</u>	<u>Total</u>	<u>Percent</u>
Wild spring/summer	450,395	12.4
AD-clip hatchery spring/summer	783,145	21.7
Non-AD-clip hatchery spring/summer	93,436	2.6
AD-clip hatchery yearling fall	53,214	1.5
Non-AD-clip hatchery yearling fall	65,910	1.8
<u>Unlisted groups</u>		
AD-clip hatchery spring/summer	2,095,619	58.0
Non-AD-clip hatchery spring/summer	73,310	2.0

Tucannon River fish, both hatchery and wild, are within the Snake River spring/summer Chinook salmon Evolutionarily Significant Unit (ESU) and are considered listed fish. In spring 2016, 30,000 wild and 220,000 Non-AD-clipped hatchery spring/summer Chinook salmon are expected to outmigrate from the Tucannon River. The Tucannon River joins the Snake River between Little Goose and Lower Monumental Dams. Because of the short distance from the confluence to Lower Monumental Dam, we assumed no mortality of these fish prior to Lower Monumental Dam. The estimates shown in Table 2 and Tables 7-8 reflect the addition of these fish above Lower Monumental Dam.

Since 1995, some of the PIT-tagged fish bypassed at the collection dams (Lower Granite, Little Goose, and Lower Monumental Dams) have been returned to the river to continue migrating inriver. This return of fish to the river requires adjustment of our estimates of the number of listed fish that reach McNary Dam. We estimated the number of fish that will be PIT-tagged for 2016 and, as described in Appendix A, adjusted for fish diverted to transportation at each Snake River collector dam. If transportation occurs at McNary Dam, we also assumed that 100% of all PIT-tagged fish would be returned to the river. A detailed description of how we estimated the impact of returning PIT-tagged fish to the river is presented in Appendix A. We estimated that 32,081 PIT-tagged spring/summer Chinook salmon from the Snake River (including 10,591 wild and 3,662 listed hatchery fish) will be collected at McNary Dam because they were returned to the river at an upstream dam(s). These numbers represent collected fish. Dividing the collected number by the FGE at McNary Dam (0.251), we determined that 42,195 wild ($10,591/0.251$) and 14,590 listed hatchery ($3,662/0.251$) fish will arrive at McNary Dam and must be added to the number of fish that were estimated to reach McNary Dam as a result of not having been collected at an upstream dam (column "Listed fish to McNary", Table 2).

Upper Columbia River ESU

The Upper Columbia River ESU spring Chinook salmon is listed as endangered under the ESA. The ESU begins at the confluence of the Yakima and Columbia rivers and continues upstream to Chief Joseph Dam.

Adults that returned in 2014 produced the smolts that will outmigrate in 2016. We obtained 2014 redd counts for the major Columbia River tributaries in this ESU from WDFW and the Yakama Indian Nation. Fecundity estimates for this ESU range from 4,000 to 5,500 eggs per female. Estimates for egg-to-smolt survival generally range up to 19%. Using the median egg count, 4,750, and an egg-to-smolt survival estimate (to the first dam encountered) of 7.5%, we estimated the number of smolts that each stream will produce.

We also have hatchery release estimates for this ESU from WDFW and the U.S. Fish and Wildlife Service. There are no survival estimates for these hatcheries. So, based on the distance from

the hatchery to the first dam the fish will encounter, we assigned the same survival estimates for Snake River hatcheries, with similar distances to the first dam. Using this method, we assigned a survival rate of 0.786 (Dworshak Hatchery's survival estimate to Lower Granite Dam) to the fish from Winthrop, Methow, Entiat, and Leavenworth Hatcheries, a survival estimate of 0.749 (Rapid River Hatchery's estimate to Lower Granite Dam) to Cle Elum Hatchery, and a survival estimate of 100% to Eastbank and Ringold Hatcheries.

We used per-project survival estimates for spring Chinook salmon in the Columbia River above McNary Dam as summarized in the Mainstem Columbia River Hydropower Projects Recovery Plan Module dated 24 September 2008. These survival estimates were: 0.962 for Wells Dam, 0.921 for Rocky Reach Dam, 0.934 for Rock Island Dam, 0.905 for Wanapum Dam and 0.905 Priest Rapids Dam.

In 2016, a total of 3,683,000 AD-clipped and no Non-AD-clipped hatchery yearling summer Chinook salmon will be released in the Columbia River above McNary Dam. There are no listed summer Chinook salmon in the Columbia River. Because these fish may not be distinguishable from yearling spring Chinook salmon, they have been included in the yearling estimates detailed below. For the same reasons discussed under the Snake River section above, we were unable to estimate the number of holdover summer Chinook salmon outmigrating through the Columbia River.

Based on the assumptions stated above, we derived the estimates shown in Table 7a and 7b. Based on projected hatchery releases and the number of wild smolts we estimate will outmigrate from the various drainages along the Columbia River above McNary Dam, we estimate that 5,470,777 spring Chinook salmon will arrive at McNary Dam. The composition of fish arriving at McNary Dam will be as follows:

Listed wild spring	433,751
Listed AD-clip hatchery spring	202,097
Listed Non-AD-clip hatchery spring	225,691
Unlisted wild spring	545,775
Unlisted AD-clip hatchery spring	1,950,103
Unlisted Non-AD-clip hatchery spring	180,000
Unlisted AD-clip hatchery yearling summer	1,933,360
Unlisted Non-AD-clip hatchery yearling summer	-

Note that the numbers shown for Columbia River dams above McNary Dam are numbers arriving at the dam and not the numbers collected at the dam. The reason for this is that fish guidance efficiency (FGE) for these dams is either unknown or is currently being evaluated.

Estimate of Fish Arriving at McNary Dam

McNary Dam is the first dam on the Columbia River below the confluence of the Snake River. To obtain an estimate of the number of spring/summer Chinook salmon smolts arriving at McNary Dam, we added the estimated numbers from the Columbia River above McNary Dam (5,470,777) and the Snake River (3,674,844).

We estimate that 9,145,621 (5,470,777 + 3,674,844) spring/summer Chinook salmon smolts will arrive at McNary Dam in 2016, and that 2,295,551 fish will be collected (FGE = 0.251). The collection at McNary Dam will be comprised of the following:

	Snake R. ESU	Upper Col. R. ESU	Total	Percent
<u>Listed groups</u>				
Wild spring/summer	111,534	108,872	220,406	9.6
AD-clip hatchery spring/summer	170,761	50,726	221,487	9.7
Non-AD-clip hatchery spring/summer	55,450	56,648	112,098	4.9
AD-clip hatchery yearling fall	50,662	0	50,662	2.2
Non-AD-clip hatchery yearling fall	53,371	0	53,371	2.3
<u>Unlisted groups</u>				
Wild spring (from Mid-Columbia)	0	136,990	136,990	6.0
AD-clip hatchery spring/summer	464,966	489,476	954,442	41.6
Non-AD-clip hatchery spring/summer	15,642	45,180	60,822	2.6
AD-clip hatchery yearling Col. R. summer	0	485,273	485,273	21.1
Non-AD-clip hatchery Yearling Col. R. summer	0	0	0	0.0

The ratio of Upper Columbia River ESU wild spring Chinook salmon to Snake River ESU wild spring/summer Chinook salmon at McNary, John Day, and The Dalles Dams will be 0.494:0.506 (433,751:444,358). The proportion of Upper Columbia River ESU listed hatchery fish and Snake River ESU listed hatchery fish arriving at McNary, John Day, The Dalles, and Bonneville Dams will be as follows:

	Ad-clipped	Non-AD-clipped
Snake R spring/summers	0.628 (680,320)	0.335 (220,918)
Snake R yearling falls	0.186 (201,841)	0.323 (212,633)
Upper Columbia R springs	<u>0.186</u> (202,097)	<u>0.342</u> (225,691)
	1.000	1.000

We received some redd information from ODFW, (Streamnet) for the John Day River. Using the same redd to smolt calculation as described above (Upper Columbia River ESU, paragraph 2), we added 259,524 wild unlisted fish arriving between McNary and John Day Dams. Hatchery releases between McNary and John Day Dams will total 885,000 (720,000 AD-clipped and 165,000 Non-AD-clipped) unlisted spring and 910,000 (all AD-clipped) unlisted yearling fall Chinook salmon. We received 2014 redd count data for the Deschutes River from ODFW (Streamnet), which resulted in an estimated 34,200 wild unlisted fish being added between John Day and The Dalles Dams. Based on data from WDFW (Streamnet), we estimate that 324,900 wild unlisted spring Chinook salmon will be added (from the Klickitat River) between The Dalles and Bonneville Dams. Hatchery releases between John Day and The Dalles Dams will total 373,000 (all AD-clipped) unlisted spring Chinook salmon. Hatchery releases between The Dalles and Bonneville Dams will total 3,229,511 (all AD-clipped) unlisted spring Chinook salmon.

Lower Columbia River ESU

The Lower Columbia River ESU extends from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. This ESU includes wild and hatchery spring-run and fall-run Chinook salmon. The fall-run fish will be discussed below under the subyearling fall Chinook salmon section. We have received information that spawning is

occurring in the Wind River, however, these spring Chinook are not considered to be part of the ESU even though they are naturally produced. We estimate that 2,088 wild spring Chinook salmon will be produced above Bonneville Dam. Also, 3,229,511 unlisted AD-clipped hatchery spring Chinook salmon will be released above Bonneville Dam. This ESU will introduce 1,313,856 wild, 3,497,799 listed hatchery (2,724,529 AD-clipped and 773,270 Non-AD-clipped), and 2,496,444 (2,145,137 AD-clipped and 351,307 Non-AD-clipped) unlisted hatchery spring Chinook salmon to the Columbia River below Bonneville Dam.

Estimate of Fish Arriving at Bonneville Dam

At Bonneville Dam, the ratio of Upper Columbia River ESU, Snake River ESU, and Lower Columbia River ESU listed wild fish will be 0.492:0.505:0.003 (316,204:323,937:2,088).

Fish transported from Snake River dams are released below Bonneville Dam. The number of listed transport fish returned to the river will be 3,023,571. The composition of these fish will be as follows:

Snake River ESU (Total number = 3,023,571)	
Listed wild spring/summers	900,600
Listed AD-clip hatchery spring/summers	1,555,215
Listed Non-AD-clip hatchery spring/summers	230,871
Listed AD-clip hatchery yearling falls	155,836
Listed Non-AD-clip hatchery yearling falls	181,049

A total of 7,330,757 (3,023,571 listed + 4,307,186 unlisted fish) transported yearling Chinook salmon will be released below Bonneville Dam.

Upper Willamette River ESU

The Upper Willamette River ESU contains spring Chinook salmon populations above Willamette Falls. This ESU will introduce 635,996 listed wild, 6,349,103 listed hatchery (all AD-clipped), and no unlisted hatchery spring Chinook salmon to the Columbia River below Bonneville Dam.

The ratio of Upper Columbia River ESU, Snake River ESU, Lower Columbia River ESU, and Upper Willamette River ESU listed wild fish at Tongue Point will be 0.066:0.256:0.276:0.402 (316,204:1,224,537:1,315,944:1,917,063). The proportion of

Upper Columbia River ESU, Snake River ESU, Lower Columbia River ESU, and Upper Willamette River ESU listed hatchery fish at Tongue Point will be as follows:

	Ad-clipped	Non-AD-clipped
Upper Columbia R spring	0.013 (147,328)	0.099 (164,529)
Snake R spring/summer	0.177 (2,051,168)	0.235 (391,920)
Lower Columbia R spring	0.235 (2,724,529)	0.464 (773,270)
Upper Willamette R spring	0.549 (6,349,103)	0.000 (0)
Snake R yearling fall	<u>0.026</u> (302,978)	<u>0.202</u> (336,059)
	1.000	1.000

The per-project survival estimate remained the same (0.900) (Table 2).

Summary

Tables 7a, 7b, 8a, and 8b present a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2016. This information is derived from the data shown in Tables 1-2 and Appendix Table A1. Table 11 shows the estimated number of listed spring, spring/summer, and yearling fall Chinook salmon expected to outmigrate from each ESU.

COHO SALMON ESTIMATES

Lower Columbia River coho salmon were listed under the Endangered Species Act in June 2005. The Lower Columbia River ESU extends from the mouth of the Columbia River to the Big White Salmon River on the Washington State shore and the Hood River on the Oregon shore. It includes the Willamette River to Willamette Falls, Oregon. This ESU includes both wild and hatchery-origin coho salmon.

Hatchery coho salmon are released in the Snake River and the Columbia River above the Lower Columbia River ESU. At this time, we have no estimates of wild coho salmon from these areas; therefore, we have included no wild information in Table 7c. As with yearling and subyearling Chinook salmon, hatchery fish must be tracked based on whether they have an adipose-fin clip.

We assigned coho salmon the same survival rates as yearling Chinook salmon in all our calculations. Enough coho have been released over the past couple years that we are able to estimate FGE at Lower Granite Dam at 0.292. Also, as with the other species discussed here, all our calculations are based on the "Transportation with Spill" scenario.

Based on hatchery outplanting records, we estimate that 1,544,956 hatchery coho salmon (415,221 AD-clipped and 1,129,735 Non-AD-clipped) will be released into the Snake River drainage. We estimate that 6,269,443 hatchery coho salmon (3,904,900 AD-clipped and 2,364,543 Non-AD-clipped) will be released into the Columbia River drainage above the Lower Columbia River ESU. From these releases, we estimate that 6,410,623 hatchery coho salmon (4,037,830 AD-clipped and 2,372,793 Non-AD-clipped) will reach Tongue Point.

Lower Columbia River ESU

With the June 2005 change in ESU listing status, all hatchery coho in this ESU are now listed (except those released at Youngs Bay, Tongue Point, and Blind Slough in Oregon and Deep River in Washington). We obtained wild and hatchery coho salmon production estimates for 2016 from the various agencies involved in the lower Columbia River system. From the information provided, we estimate that 95,496 listed wild coho salmon will

arrive at Bonneville Dam. No listed hatchery fish are released above Bonneville Dam.

Listed wild coho salmon estimates from below Bonneville Dam to Tongue Point are 518,230, while listed hatchery releases in this area are 6,708,658 (6,550,158 AD-clipped and 158,500 Non-AD-clipped) and 3,150,000 unlisted (2,625,000 AD-clipped and 525,000 Non-AD-clipped).

In addition, another 5,850 listed wild and 825,000 hatchery (all unlisted AD-clipped) coho salmon will enter the Columbia River below Tongue Point.

Summary

Tables 7c, 8a, and 8b present a summary of the estimated number of fish that will be collected, or will be arriving, at various locations during 2016. Table 11 shows the estimated number of listed coho salmon expected to outmigrate from the Lower Columbia River ESU.

SUBYEARLING FALL CHINOOK SALMON ESTIMATES

To estimate the 2016 collection number at Lower Granite Dam, we used the 2015 collection number and the adult returns over the dam for 2014 and 2015. In 2015, a total of 200,000 unmarked hatchery subyearling fall Chinook salmon were released above Lower Granite Dam. Assuming a survival rate of 0.676 (the estimated survival rate of hatchery subyearling fall Chinook salmon released above Lower Granite Dam in 2015), a total of 135,267 (200,000 x 0.676) of these fish would have arrived at Lower Granite Dam. Assuming an FGE of 0.226 (derived from PIT-tagged hatchery subyearling fall Chinook salmon in 2015), a total of 30,570 (135,267 x 0.226) would have been collected at Lower Granite Dam. Through December 31, 2015 a total of 394,880 unclipped (and without a coded-wire tag) subyearling Chinook salmon had been collected at Lower Granite Dam. By removing the estimated 30,570 unmarked hatchery subyearling fall Chinook salmon, we estimate that 364,310 (394,880 - 30,570) wild subyearling fall Chinook salmon were collected at Lower Granite Dam in 2015. These wild subyearling fall Chinook salmon were from the 2014 adult return. The adult count over Lower Granite Dam in 2014 was 61,034. Of these, 3,910 were hatchery fish that were returned to either Lyons Ferry Hatchery or the Nez Perce Tribal Hatchery, leaving 57,124 adults that passed above Lower Granite Dam. The 2016 outmigration will be the result of the 2015 adults that passed over Lower Granite Dam. Through December 31, 2015, a total of 60,163 adults had been counted in the adult ladder. Of these, 3,088 fish were returned to either Lyons Ferry Hatchery or the Nez Perce Tribal Hatchery, leaving 57,075 adults that passed above Lower Granite Dam. The 2015 count of 57,075 adults represents 99.9% of the 2014 count (57,124). We applied this change (99.9%) to the 2015 subyearling collection number to arrive at the estimated 2016 collection number.

$$\left(\begin{array}{l} \text{total wild fall} \\ \text{Chinook} \\ \text{collected at} \\ \text{Granite} \end{array} \right) = \left(\begin{array}{l} \text{wild fall} \\ \text{Chinook} \\ \text{collected in} \\ \text{2015} \end{array} \right) \times \left(\begin{array}{l} \% \text{ change between adult} \\ \text{counts for 2015 and 2016} \\ \text{outmigrations} \end{array} \right) =$$

$$363,946 = 364,310 \times 0.999$$

We estimated the total number of wild subyearling fall Chinook salmon arriving at Lower Granite Dam by dividing the number of wild fish collected by the FGE at Lower Granite Dam. The

average estimated FGE for PIT-tagged hatchery subyearling fall Chinook salmon arriving at Lower Granite Dam from 2006-2015 (after onset of court ordered spill) is 0.226. Therefore, the total wild fall Chinook = total wild fall Chinook collected/FGE, or 1,610,381 fish (363,946/0.226).

The Nez Perce Tribe along with WDFW will release 2,600,000 listed subyearling fall Chinook salmon in the Clearwater and Snake Rivers in 2016. Of these fish, 1,700,000 will be AD-clipped and 900,000 will be Non-AD-clipped. Assuming a survival rate of 0.797 (the average estimated survival rate of PIT-tagged hatchery subyearling fall Chinook salmon released above Lower Granite Dam from 2009-2015), 2,072,200 (2,600,000 x 0.797) of the 2,600,000 hatchery fish will arrive at Lower Granite Dam. Of these fish, 1,354,900 will be AD-clipped and 717,300 will be Non-AD-clipped. By adding the Non-AD-clipped fish to the total number of wild fall Chinook salmon (1,610,381), we estimate that 2,327,681 Non-AD-clipped subyearling fall Chinook salmon will arrive at Lower Granite Dam. The percentage of Non-AD-clipped subyearling fall Chinook salmon that are wild will be 69.1839% (1,610,381/2,327,681). We added the total AD-clipped hatchery fish (1,354,900), the total Non-AD-clipped hatchery fish (717,300), and the total wild fish (1,610,381) to determine the total number of subyearling fall Chinook salmon arriving at Lower Granite Dam (3,682,581).

Knowing the total number of hatchery fish, the number of listed hatchery fish, and the number of wild fish arriving at Lower Granite Dam, we estimated the percentage composition of listed hatchery fish and wild fish arriving at the dam as follows:

$$\% \text{ listed fish} = \text{listed fish} / \text{total smolts} =$$

Wild subyearling fall	43.7297% = 1,610,381/3,682,581
AD-clip subyearling fall	36.7921% = 1,354,900/3,682,581
Non-AD-clip subyearling fall	19.4782% = 717,300/3,682,581

We set FGEs at Lower Granite and Little Goose Dams to 0.226 and 0.286, respectively. Using an FGE of 0.226, the total collection at Lower Granite Dam will be 832,263 (3,682,581 x 0.226), based on 3,682,581 smolts arriving at the dam. The collection at Lower Granite Dam will be comprised of the following:

Listed wild subyearling fall	363,946
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Listed AD-clip hatchery subyearling fall	306,207
Listed Non-AD-clip hatchery subyearling fall	162,110

NMFS has conducted subyearling fall Chinook salmon survival tests since 1995. As part of these tests, we estimated actual FGEs for McNary Dam (factoring in effects of spill). To more accurately estimate the collection number at McNary Dam, we averaged these actual FGEs for 2006-2015, since the onset of court ordered spill. We also averaged the number of fall Chinook salmon adults crossing McNary Dam for each of the brood years (2004-2015) and the number of juvenile subyearling fall Chinook salmon collected at McNary Dam (2004-2015). The 2015 count of 498,969 adults represents 233.9% of the average for 2004-2015 count (213,339). We applied this change (233.9%) to the average 2004-2015 subyearling collection number (2,464,692) to arrive at an estimated 2016 collection number of 5,764,915 (2,464,692 x 2.339).

Based on the NMFS subyearling fall Chinook salmon survival studies conducted from 2006-2015, per-project survival was set at 75%. We set the FGEs at Little Goose, Lower Monumental, and McNary Dams, based on 2011-2015 NMFS fall Chinook salmon survival study results, to 0.286, 0.131, and 0.164, respectively.

Lower Columbia River ESU

The Lower Columbia River ESU includes both wild and hatchery tule and late-run bright fall Chinook salmon, including fall Chinook salmon from the Clackamas River.

To determine the number of wild outmigrants from this ESU, we assumed that 50% of the adults counted in the spawning areas were female and that every female spawned successfully. We used average fecundity and set the egg-to-smolt survival rate at 15%, the same used for spring/summer Chinook salmon.

Based on these assumptions, we estimate that 806,032 tule fall Chinook salmon will outmigrate from above Bonneville Dam. No late-run bright fish will enter the Columbia River above Bonneville Dam. Additionally, we estimate that 5,867,671 tule fall Chinook salmon and 2,689,039 late-run bright fall Chinook salmon will enter the Columbia River below Bonneville Dam.

The ratio of Snake River ESU and Lower Columbia River ESU (tule fall Chinook salmon) listed wild fish at Bonneville Dam will be 0.100:0.900 (89,750:806,032).

With the June 2005 change in ESA listing status, most hatchery fish released in this ESU are now listed. In 2016, hatchery releases above Bonneville Dam will total 10,167,948 listed tule (9,969,991 AD-clipped and 197,957 Non-AD-clipped) and 7,600,000 unlisted (7,400,000 AD-clipped and 200,000 Non-AD-clipped) subyearling fall Chinook salmon. Below Bonneville Dam releases totaled 15,876,500 listed tule (all AD-clipped) and 5,425,000 unlisted (3,300,000 AD-clipped and 2,125,000 Non-AD-clipped) subyearling fall Chinook salmon.

The ratio of Snake River ESU and Lower Columbia River ESU (tule fall Chinook salmon) listed hatchery AD-clipped fish at Bonneville Dam will be 0.011:0.989 (107,090:9,969,991), while the ratio for hatchery Non-AD-clipped fish at Bonneville Dam will be 0.163:0.837 (38,441:197,957).

Fish transported from Snake River dams are released below Bonneville Dam. The number of listed transport fish returned to the river will be 741,238 wild, 662,323 AD-clipped, and 328,283 Non-AD-clipped fish, all from the Snake River ESU. A total of 7,387,354 transported subyearling fall Chinook salmon will be released below Bonneville Dam.

The ratio of Snake River ESU, Lower Columbia River ESU (tule fall Chinook salmon), and Lower Columbia River ESU (late-run bright fall Chinook salmon) listed wild fish at Tongue Point will be 0.081:0.655:0.264 (830,988:6,673,703:2,689,039). The proportion for hatchery fish at Tongue Point will be as follows:

	Ad-clipped		Non-AD-clipped	
Snake R. subyearling fall	0.029	(769,413)	0.649	(366,724)
Lower Columbia R. subyearling fall - Tule	0.971	(25,846,491)	0.351	(197,957)
Lower Columbia R. subyearling fall - Late run	<u>0.000</u>	(0)	<u>0.000</u>	(0)
	1.000		1.000	

Summary

Tables 7a, 7b, 8a, and 8b present a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2016. This information is derived from the data shown in Table 2. Table 11 shows the estimated number of subyearling fall Chinook salmon expected to outmigrate from each ESU.

SOCKEYE SALMON ESTIMATES

The sockeye salmon collection count at Lower Granite Dam is based on IDFG's estimate of wild and hatchery-reared sockeye salmon smolts exiting the upper Salmon River in 2016 and IDFG and NOAA Fisheries estimates of survival to Lower Granite Dam. We estimate that 20,832 wild fish and 219,542 hatchery fish will survive to Lower Granite Dam in spring 2016. All of these fish are listed as endangered.

$$\begin{aligned} \text{listed sockeye (wild and hatchery) to Lower Granite Dam} &= \\ \text{IDFG's estimated wild fish + estimated hatchery fish} &= \\ 240,374 &= 20,832 + 219,542 \end{aligned}$$

To determine the percentage of wild sockeye salmon collected at Lower Granite Dam, we estimated the number of kokanee arriving at Lower Granite Dam. In 2015, WDFW staff at Lower Granite Dam estimated that 147 kokanee were collected (Allan Martin, WDFW, Pers.commun., March 2016). With an FGE of 0.277 (the 2015 estimate), 531 (147/0.277) kokanee reached Lower Granite Dam. Assuming the same amount of spill from Dworshak Dam in 2016 with a release of the same number of kokanee, we estimated the total number of wild *O. nerka* arriving at Lower Granite Dam to be 21,363 (531 + 20,832). We then estimated the percentage of wild *O. nerka* arriving at Lower Granite Dam that will be listed Snake River sockeye salmon.

$$\begin{aligned} \% \text{ listed wild sockeye} &= \\ \text{listed wild sockeye/total wild } O. \text{ nerka to Lower Granite Dam} &= \\ 97.5\% &= 20,832/21,363 \end{aligned}$$

A total of 240,905 (240,374 listed sockeye + 531 kokanee) *O. nerka* will arrive at Lower Granite Dam.

$$\begin{aligned} \% \text{ total listed sockeye} &= \\ \text{total listed sockeye/total } O. \text{ nerka to Lower Granite Dam} &= \\ 99.8\% &= 240,374/240,905 \end{aligned}$$

An FGE of 0.277 (average for 2011-2015 (excluding 2001)) was used to estimate the number of *O. nerka* smolts reaching Lower Granite Dam that will be collected.

$$\begin{aligned} O. \text{ nerka salmon collected} &= \text{total } O. \text{ nerka salmon} \times \text{FGE} = \\ 66,731 &= 240,905 \times 0.277 \end{aligned}$$

Because of extreme year-to-year variability, the count used at McNary Dam for 2016 is based on the average of the counts at the dam from 1993 to 2015 (399,115). Project survival was set at the yearling Chinook salmon level (Table 2).

Summary

Table 7c presents a summary of the estimated number of fish that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the dams during 2016. This information is derived from the data shown in Table 2. Table 11 shows the estimated number of sockeye salmon expected to outmigrate from the Snake River ESU.

STEELHEAD ESTIMATES

Introduction

Because of the time of year that steelhead spawn, it is very difficult to obtain redd count information. All of our steelhead estimates, not otherwise explained, are based on adult counts in the spawning areas. We assumed that 65% of the adults were females and that every female spawned successfully. To estimate the number of outmigrants, we used average fecundity estimates, and assigned an egg-to-smolt survival rate of 0.6%. This survival rate is within the range of rates we calculated or found in the literature, which were from 0.5% to 0.75%.

Snake River Steelhead ESU

Prior to the 2001 outmigration, nearly all hatchery steelhead were fin-clipped, allowing us to use the juvenile collection numbers at Lower Granite Dam without making any adjustments for unclipped hatchery fish. Because it was known that a large number of unclipped steelhead were to be released for the 2015 outmigration, WDFW not only recorded the number of unclipped steelhead collected but also the number of unclipped steelhead that had fin erosion, a strong indicator that a fish is of hatchery origin. Based on the information provided by WDFW (Allan Martin, WDFW, Pers. commun., March 2016), we determined that 80,083 wild steelhead were collected at Lower Granite Dam in 2015 (0.474, or 72,300, of the 152,383 unclipped steelhead collected at Lower Granite Dam in 2015 had fin erosion). We applied the 2015 estimated FGE (0.114) to the collection number to determine that 702,482 ($80,083/0.114$) wild steelhead arrived at Lower Granite Dam in 2015.

We based our age-class distribution of migrating juvenile steelhead in the Snake River on a two-year average of data from the Wild juvenile steelhead and Chinook salmon abundance and composition at Lower Granite Dam, migratory years 2010 and 2011; Idaho Department of Fish and Game Report 13-17 (available on IDFG website). For this memo the age-class percentage estimates are: 3.5% age-1, 50.4% age-2, 39.1% age-3, and 6.8% age-4 smolts. The age-class of the remainder of smolts was made up by fish either less than one year or greater than age-4. Because of this age-class breakdown, we decided to base our estimates on age-classes 1 to 4. Because steelhead spawn in the spring, our annual counts were from July 1 to June 30, rather than by

calendar year. Using the adult counts at Lower Granite Dam of the 4 years that comprised the 2015 wild smolt outmigration (2010-2014 brood years, July 1, 2009-June 30, 2014), and applying the smolt age-class percentages to the adult counts for each of these 4 years, we estimated that 143,494 of the adults passing Lower Granite Dam produced the 2015 steelhead outmigration. We performed the same calculation to estimate the number of adults from the 4 years (2011-2015 brood years) producing the 2016 wild outmigration. We calculated that the 2016 wild outmigration will be based on 115,284 adults, or 80.3% of the number of fish producing the 2015 outmigration. We applied the change in the number of adults to the number of wild steelhead that arrived at Lower Granite Dam in 2015 (702,482) to determine the estimated 2016 arrival number.

$$\left(\begin{array}{c} \text{total wild} \\ \text{steelhead} \\ \text{arriving at Lower} \\ \text{Granite} \end{array} \right) = \left(\begin{array}{c} \text{wild} \\ \text{steelhead} \\ \text{arriving in} \\ \text{2015} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult counts for} \\ \text{2015 and 2016 outmigrations} \end{array} \right) =$$

$$564,093 = 702,482 \times 0.803$$

For the steelhead hatchery release numbers, we used IDFG's, ODFW's, WDFW's, and Nez Perce Tribe's estimates of hatchery releases in Idaho, Oregon, and Washington. We estimate that 9,296,732 hatchery smolts (Table 4) will be released from Idaho (8,131,732), Oregon (965,000), and Washington (200,000) above Lower Granite Dam.

In order to estimate how many hatchery smolts will reach Lower Granite Dam, we used the survival estimates for the 2008-2015 outmigrations (from the NMFS survival study, Research Action #1212). Using the 2016 projected release number and survival estimate for each hatchery, we estimated how many total hatchery fish will arrive at Lower Granite Dam. We estimate that 7,097,372 or 76.3427% of the 9,296,732 hatchery fish released will arrive at the dam (Table 4).

Knowing the numbers of hatchery and wild fish arriving at Lower Granite Dam, we estimated the percentage composition of listed wild fish arriving at the dam as follows:

$$\begin{aligned} \text{total smolts} &= \text{total hatchery fish} + \text{wild fish} = \\ 7,661,465 &= 7,097,372 + 564,093 \end{aligned}$$

% wild fish to Lower Granite Dam = wild fish/total smolts =
 7.36273% = 564,093/7,661,465

% listed hatchery fish = listed hatchery fish/total smolts =

AD-clip summer 37.03719% = 2,837,591/7,661,465
 Non-AD-clip summer 4.16950% = 319,445/7,661,465

We set FGEs at Lower Granite and Little Goose Dams at 0.279 and 0.337, respectively. Using an FGE of 0.279, the total collection at Lower Granite Dam will be 2,137,549 (7,661,465 x 0.279), based on 7,661,465 smolts arriving at the dam. The collection at Lower Granite Dam will be comprised of the following:

	<u>Number</u>	<u>Percent</u>
Listed wild	157,382	7.4
Listed hatchery AD-clip	791,688	37.0
Listed hatchery Non-AD-clip	89,125	4.2
Unlisted hatchery AD-clip	947,210	44.3
Unlisted hatchery Non-AD-clip	152,144	7.1

Wild/natural Tucannon River drainage fish are listed within the Snake River ESU. In spring 2016, 25,000 wild fish are expected to outmigrate from the Tucannon River (Michael Gallinat, WDFW, Pers. commun., March 2016). In addition, 94,500 (44,500 AD-clipped and 50,000 Non-AD-clipped) listed hatchery fish and 108,000 (all AD-clipped) unlisted hatchery fish will be released into the Tucannon River or released directly from Lyons Ferry Hatchery. The Tucannon River joins the Snake River between Little Goose and Lower Monumental Dams. Because of the short distance from the confluence to Lower Monumental Dam, we assumed no mortality of these fish prior to Lower Monumental Dam. The estimates shown in Table 5 and Tables 9-10 reflect the addition of these fish above Lower Monumental Dam.

Except when research studies require an alternate disposition, all PIT-tagged fish bypassed at the collection dams (Lower Granite, Little Goose, and Lower Monumental Dams) are returned to the river to continue migrating inriver. This return of fish to the river requires adjustment of our estimates of the number of listed fish that reach McNary Dam. We estimated the number of fish that will be PIT tagged for 2016 and, as described in Appendix B, adjusted for fish diverted to transportation at each

Snake River collector dam. A detailed description of how we estimated the impact of returning PIT-tagged fish to the river is presented in Appendix B. We estimated that 9,259 PIT-tagged steelhead from the Snake River (including 1,561 wild fish) will be collected at McNary Dam because they were returned to the river at an upstream dam(s). These numbers represent collected fish. Dividing the collected number by the FGE at McNary Dam (0.135), we determined that 11,563 wild Snake River steelhead ($1,561/0.135$) will arrive at McNary Dam and must be added to the number of fish that were estimated to reach McNary Dam as a result of not having been collected at an upstream dam (column "Listed fish to McNary", Table 5).

Upper-Columbia River ESU Steelhead

Very little is known regarding wild steelhead in the Columbia River above the confluence with the Yakima River. Also, little is known regarding dam passage of smolts at the dams above McNary Dam. Because of this lack of information, the estimates of wild steelhead from the listed Upper Columbia River ESU are based on what little information is available and on broad generalizations based on this information. No FGE's have been established for the dams in this reach, so the numbers presented in this section of the memorandum (and in Tables 9 and 10) are the number of fish arriving at the dam, not collection numbers (unless otherwise noted in the text).

Pevan et al. (1994) showed that migrating steelhead were 0.7% age-1, 43.2% age-2, 46.4% age-3, and 8.6% age-4 smolts. The age-class of the remainder of smolts (1.1%) was greater than age-4, up to age-7. Because of this age-class breakdown, we decided to base our estimates on age-classes 1 to 4.

We based our estimates of wild fish on counts collected at Rock Island Dam by the Fish Passage Center. During the 2015 outmigration, 5,315 wild steelhead smolts were counted in the Smolt Monitoring Program's sample. It is estimated that the sample represents 3-5% of the fish passing the dam. Using a 4% sample rate, we estimated that 132,875 wild steelhead passed Rock Island Dam in 2015.

We then examined the adult counts at Rock Island Dam. Because steelhead spawn in the spring, our annual counts were from July 1 to June 30, rather than by calendar year. Using the adult counts of the 4 years that comprised the 2015 wild smolt

outmigration (2011-2014 brood years, July 1, 2010-June 30, 2014), and applying the smolt age-class percentages to the adult counts for each of these 4 years, we estimated that 17,531 of the adults passing Rock Island Dam produced the 2015 steelhead outmigration. We performed the same calculation to estimate the number of adults from the 4 years (2012-2015 brood years) producing the 2016 wild outmigration. We calculated that the 2016 wild outmigration will be based on 13,933 adults, or 0.795 of the number of fish producing the 2015 outmigration. We applied the change in the number of adults to the 2015 Rock Island Dam collection to arrive at the estimated 2016 collection number.

$$\left(\begin{array}{c} \text{total wild} \\ \text{steelhead} \\ \text{collected at Rock} \\ \text{Island} \end{array} \right) = \left(\begin{array}{c} \text{wild} \\ \text{steelhead} \\ \text{collected} \\ \text{in 2015} \end{array} \right) \times \left(\begin{array}{c} \% \text{ change between adult} \\ \text{counts} \\ \text{for 2015 and 2016} \\ \text{outmigrations} \end{array} \right) =$$

$$4,225 = 5,315 \times 0.795$$

Since this represents 4% of the fish passing the dam, we estimate that 105,625 wild steelhead smolts will pass the dam in 2016. Using the smolt age-class percentages, we estimate that 739 smolts will be age-1, 45,630 will be age-2, 49,010 will be age-3, and 9,084 will be age-4, and 1,162 will be age-5 and older.

To determine the number of wild smolts passing the two dams above Rock Island Dam (Rocky Reach and Wells Dams), we used the estimate of wild smolts passing Rock Island Dam (105,625) and the adult counts at all three dams.

By comparing the adult counts at each of the three dams for the 4 years that will produce the 2016 outmigration (2011-2015), we calculated the number of adults "lost" between each dam. We assigned this "loss" to adults migrating up rivers between the dams. The difference in adult counts between dams varied between years, so we applied the age-class percentages to each year's differences between dams to determine the number of wild smolts added from the rivers between the dams.

From Rock Island Dam to McNary Dam, the only adjustment made to the wild steelhead smolt count was for per-project survival.

To determine the number of hatchery smolts arriving at each dam in 2016, we used the outplanting data for the 3 years comprising the 2016 outmigration (2014-2016). Because hatchery fish are larger than equivalent age-class wild fish, we assigned age-2 status to hatchery fish released in 2016, age-3 to those released in 2015, and age-4 to those released in 2014. All of the hatchery outplants will be of listed hatchery stocks.

Because there are no survival data for the various hatcheries releasing fish in this section of the Columbia River, we assumed that all fish released survived to the first dam. We again applied the age-class percentages to the number of fish released each of the 3 years to determine the number of hatchery fish that would outmigrate in 2016. Beginning at Wells Dam and assuming 90% per-project survival, we determined both the number of listed hatchery and the total number of hatchery fish reaching each dam through McNary Dam (Tables 5 and 9).

Mid-Columbia River ESU Steelhead

The Mid-Columbia River wild summer-run and winter-run steelhead are listed protected species. With the January 2006 listings, some hatchery steelhead in this ESU are now listed. Only summer steelhead from the Yakima and Walla Walla Rivers enter the Columbia River above McNary Dam.

Based on our assumptions described in the steelhead introduction, 107,642 wild summer steelhead will enter above McNary Dam in 2016.

WDFW will release 132,000 (85,000 AD-clipped and 47,000 Non-AD-clipped) listed (from Mid-Columbia River ESU stock) and no unlisted hatchery steelhead into the Touchet River, a tributary of the Walla Walla River, and 100,000 (all AD-clipped) Non-listed hatchery steelhead (from Mid-Columbia River ESU stock) into the Walla Walla River. The Walla Walla River enters the Columbia River above McNary Dam. For these fish, survival to McNary Dam was set at 100%.

An additional 131,207 wild steelhead from this ESU will be added between McNary and John Day Dams. Hatchery summer steelhead will be released between McNary and John Day Dams. Release numbers will be as follows:

Summer Steelhead

Listed hatchery AD-clip	150,000
-------------------------	---------

Between John Day and The Dalles Dams, 125,941 wild and 233,000 listed hatchery (162,000 AD-clipped and 71,000 Non-AD-clipped) summer steelhead will be added. Between The Dalles and Bonneville Dams, 60,353 wild winter, 90,000 (all AD-clipped) unlisted hatchery summer, and no unlisted hatchery winter steelhead will be added.

Estimate of Fish Arriving at McNary Dam

McNary Dam is the first dam on the Columbia River below the confluence of the Snake River. To obtain an estimate of the number of steelhead smolts arriving at McNary Dam, we added the estimated numbers from the Upper Columbia River (1,037,706), Mid-Columbia (107,642) and the Snake River (2,060,860) ESUs.

We estimate that 3,206,208 (1,037,706 + 107,642 + 2,060,860) steelhead smolts will arrive at McNary Dam in 2016, and that 432,838 fish will be collected. Of the 432,838 smolts collected at McNary Dam, 46,830 (0.108) will be wild (10,188 Upper Columbia River ESU, 22,110 Snake River ESU, and 14,532 Mid-Columbia River ESU), 171,396 (0.396) will be listed hatchery AD-clipped (59,859 Upper Columbia River ESU, 100,062 Snake River ESU, and 11,475 Mid-Columbia River ESU), 44,451 (0.103) will be listed hatchery non-AD-clipped (23,444 Upper Columbia River ESU, 14,662 Snake River ESU, and 6,345 Mid-Columbia River ESU), and 201,481 (0.465) will be unlisted hatchery fish (173,840 AD-clipped and 27,641 non-AD-clipped). The ratio of Upper Columbia River ESU wild fish, Snake River ESU wild fish and Mid-Columbia River ESU wild fish at McNary, John Day, and The Dalles Dams will be as follows:

	McNary Dam	John Day	The Dalles
Upper Columbia	0.218 (75,468)	0.158 (67,921)	0.122 (61,129)
Snake River	0.472 (163,776)	0.342 (147,398)	0.265 (132,658)
Mid-Columbia			
Summer	0.310 (107,642)	0.500 (214,964)	0.613 (306,815)
Winter	—	—	—
	<u>1.000</u>	<u>1.000</u>	<u>1.000</u>

The proportion of Upper Columbia River ESU, Snake River ESU, and Mid-Columbia River ESU hatchery fish at McNary, John Day, and The Dalles Dams will be as follows:

	McNary Dam	John Day	The Dalles
Upper Columbia			
AD-clipped	0.349 (443,398)	0.309 (399,058)	0.271 (359,152)
Non-AD-clipped	0.527 (173,660)	0.527 (156,294)	0.417 (140,665)
Snake River			
AD-clipped	0.584 (741,199)	0.516 (667,079)	0.453 (600,371)
Non-AD-clipped	0.330 (108,611)	0.330 (97,750)	0.260 (87,975)
Mid-Columbia			
Summer			
AD-clipped	0.067 (85,000)	0.175 (226,500)	0.276 (365,850)
Non-AD-clipped	0.143 (47,000)	0.143 (42,300)	0.323 (109,070)
Winter			
AD-clipped	0.000 (0)	0.000 (0)	0.000 (0)
Non-AD-clipped	0.000 (0)	0.000 (0)	0.000 (0)

Lower Columbia River ESU Steelhead

We estimate that 35,076 (20,463 summer and 14,613 winter) wild steelhead from this ESU will arrive at Bonneville Dam. With the January 2006 listings, some hatchery steelhead in this ESU are now listed. Because the hatchery steelhead are denoted as of summer or winter stock, we have decided to track each run individually. At Bonneville Dam, the proportion of wild fish in the various ESUs will be as follows:

Upper Columbia	0.101 (55,016)
Snake River	0.219 (119,392)
Mid-Columbia	
summer	0.506 (276,134)
winter	0.110 (60,353)

Lower Columbia		
summer	0.037	(20,463)
winter	<u>0.027</u>	(14,613)
	1.000	

No unlisted hatchery summer steelhead will be added. There will be 50,000 AD-clipped winter steelhead released above Bonneville Dam from this ESU. At Bonneville Dam, the proportion of hatchery fish in the various ESUs will be as follows:

	Bonneville Dam	
Upper Columbia		
AD-clipped	0.260	(323,237)
Non-AD-clipped	0.417	(126,599)
Snake River		
AD-clipped	0.435	(540,334)
Non-AD-clipped	0.260	(79,178)
Mid-Columbia		
Summer		
AD-clipped	0.265	(329,265)
Non-AD-clipped	0.323	(98,163)
Winter		
AD-clipped	0.000	(0)
Non-AD-clipped	0.000	(0)
Lower Columbia		
Summer		
AD-clipped	0.000	(0)
Non-AD-clipped	0.000	(0)
Winter		
AD-clipped	0.040	(50,000)
Non-AD-clipped	0.000	(0)

Another 274,121 (33,788 summer and 240,333 winter) wild steelhead are expected to enter the Columbia River from Washington and Oregon downstream from Bonneville Dam.

Fish transported from Snake River dams are released below Bonneville Dam. The number of listed transport fish returned to the river will be 2,335,257 (356,786 wild, 1,769,371 AD-clipped hatchery, and 209,100 Non-AD-clipped hatchery), all from the Snake River ESU. A total of 4,541,187 transported steelhead will be released below Bonneville Dam.

Upper Willamette River ESU

The Upper Willamette River wild winter-run steelhead are listed protected species. With the January 2006 listings, some hatchery steelhead in this ESU are now listed. Because the hatchery steelhead are denoted as of summer or winter stock, we have decided to track each run individually.

Based on our assumptions described in the steelhead introduction, 183,635 winter steelhead will enter the Columbia River in 2016, 143,898 of which will be from listed stocks.

At Tongue Point the proportions of wild fish from the various ESUs will be as follows:

	Tongue Point	
Upper Columbia	0.042	(55,016)
Snake River	0.360	(476,178)
Mid-Columbia		
summer	0.209	(276,134)
winter	0.046	(60,353)
Lower Columbia		
summer	0.041	(54,251)
winter	0.193	(254,946)
Upper Willamette		
summer	0	(0)
winter	<u>0.109</u>	(143,898)
	1.000	

Listed hatchery releases from this ESU will total 169,724 (all AD-clipped) summer and no winter steelhead. At Tongue Point the ratios of listed hatchery fish from the various ESUs will be as follows:

	Tongue Point	
Upper Columbia		
AD-clipped	0.076	(323,237)
Non-AD-clipped	0.221	(126,599)
Snake River		
AD-clipped	0.544	(2,309,705)
Non-AD-clipped	0.503	(288,278)
Mid-Columbia		
Summer		
AD-clipped	0.078	(329,265)
Non-AD-clipped	0.171	(98,163)
Winter		
AD-clipped	0.000	(0)
Non-AD-clipped	0.000	(0)
Lower Columbia		
Summer		
AD-clipped	0.014	(60,000)
Non-AD-clipped	0.000	(0)
Winter		
AD-clipped	0.248	(1,050,000)
Non-AD-clipped	0.105	(60,000)
Upper Willamette		
Summer		
AD-clipped	0.040	(169,724)
Non-AD-clipped	0.000	(0)
Winter		
AD-clipped	0.000	(0)
Non-AD-clipped	0.000	(0)

Summary

Tables 9 and 10 summarize the estimated number of steelhead that will be collected, or will be arriving (Columbia River dams above McNary Dam), at each of the collection dams during 2016. This information is derived from the data shown in Tables 4-5 and Appendix Table B1. Table 11 shows the estimated number of steelhead expected to outmigrate from each ESU.

CHUM ESTIMATES

Columbia River ESU

Wild and all hatchery chum salmon in the Columbia River are listed protected species.

To estimate wild chum salmon outmigration, we used a five-year average of available adult data (Streamnet) for the Grays and lower Columbia river systems. We assumed 50% of the adults were females and that every female spawned successfully. To estimate the number of outmigrants, we used an average fecundity estimate of 3000, and assigned an egg-to-smolt rate of 0.30%. We estimate a total of 4,608,900 (3,030,300 Grays River and 562,500 Columbia River) wild chum salmon outmigrating in 2016.

We expect the hatchery (all Non-AD-clipped) chum salmon outmigration to be 900,000 (500,000 from the Columbia River, 200,000 from Chinook River, and 200,000 from Grays River). This provides an overall estimate of 5,508,900 (4,608,900 + 900,000) listed chum salmon outmigrating in 2016.

Full Transportation Scenario

The estimates shown in Tables 3 and 6 were derived using the same methodology utilized under the Transportation with Spill Scenario, with one major difference. The number of fish removed at each dam under the Transportation with Spill Scenario was based on an FGE value that was adjusted for spill. For our estimates under the Full Transportation Scenario, we used the FGE values developed during developmental testing of the diversion screens installed in each of the turbine intakes. Using the results from these tests, the FGEs for spring/summer Chinook salmon and sockeye salmon were changed from the values in Table 2 to 60.0, 65.0, 50.0, and 80.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Subyearling fall Chinook salmon FGEs were changed from the values in Table 2 to 55.0, 60.0, 40.0, and 65.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Steelhead FGEs (in Table 6) were changed from the values in Table 5 to 80.0, 90.0, 65.0, and 90.0% at Lower Granite, Little Goose, Lower Monumental, and McNary Dams, respectively. Using the same formulas as under the Transportation with Spill Scenario, we derived the values found in Tables 3 and 6-10.

Because the adjusted FGE at Lower Granite Dam was changed from 29.2 to 60.0% for yearling spring/summer Chinook and sockeye salmon, the total number of fish collected at Lower Granite Dam will be 7,428,143 (12,380,238 x 0.600) spring/summer Chinook salmon and 144,543 (240,905 x 0.600) *O. nerka* salmon.

Because more PIT-tagged fish will be collected at the upstream dams, the number of PIT-tagged fish that are returned to the river and subsequently collected at McNary Dam will be different under this scenario. The effects of this are shown in Appendices A and B.

As under the Transportation with Spill Scenario, to estimate the number of spring/summer Chinook salmon smolts arriving at McNary Dam, we added the estimated numbers from the Columbia River above McNary (5,470,777) and the Snake River (1,060,140).

$$5,470,777 + 1,060,140 = 6,530,917$$

Tables 7-10 show the changes in percentages of listed fish at each dam.

Table 1. Estimated percentage composition of Snake River spring/summer Chinook salmon arriving at Lower Granite Dam from listed hatcheries compared with total hatchery releases projected for spring 2016.

Hatchery	2016 Total hatchery releases ^a		Survival to <u>Lower Granite Dam</u>	Fish to Lower Granite Dam	
	AD-clipped	Non-AD-clipped	Mean ^b	AD-clipped	Non-AD-clipped
Dworshak ^c	1,454,208	0	0.786	1,143,007	0
Kooskia ^c	605,115	54,919	0.656	396,955	36,027
Lookingglass					
Imnaha ^d	657,937	0	0.660	434,238	0
Grande Ronde ^d	660,128	110,127	0.447	295,077	49,227
Clearwater ^c	1,762,000	0	0.647	1,140,014	0
Rapid River ^c	3,200,000	0	0.749	2,396,800	0
Sawtooth ^d	1,652,136	150,771	0.507	837,633	76,441
McCall ^d	875,460	154,869	0.544	476,250	84,249
Pahsimeroi ^d	1,054,263	66,859	0.527	555,597	35,235
Nez Perce ^{c,d}	3,374,350	448,027	0.647	2,183,204	289,873
Totals					
All stocks	15,295,597	985,572		9,858,775	571,052
Listed stocks	5,028,532	598,288		2,682,004	319,985
Percent of listed stocks	34.56029%			28.78273%	

- a Data from USEWS, NPT, IDFG and ODFW.
- b Mean survival estimate made from PIT-tag detections of marked hatchery fish releases as part of the NMFS survival studies (Research Action #1212) for 2003-2015.
- c Non-listed stocks in 2016.
- d Listed stocks in 2016.

Table 2. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2016 under past transportation and spill conditions.

Yearling spring/summer Chinook salmon

Snake River ESU

Rearing type	Total Collection*		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	FGE ¹			Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary				Goose	Low Mon**	McNary			Listed Fish	% Listed Fish
Wild	3,615,029	2,295,551	12.459	1,542,451	0.292	0.327	0.206	0.251	0.900	444,358	111,534	4.86
Listed Hatchery***												
AD-clipped	3,615,029	2,295,551	21.664	2,682,004	0.292	0.327	0.206	0.251	0.900	680,320	170,760	7.44
Non-AD-clipped	3,615,029	2,295,551	2.585	319,985	0.292	0.327	0.206	0.251	0.900	220,918	55,450	2.42

Upper Columbia River ESU

Rearing type	Number of listed fish passing dam			Of dam total, % listed fish			FGE McNary	Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild****	262,556	302,377	588,439	8.9	7.4	10.4	0.251	0.900	433,751	108,872	4.74
Listed Hatchery											
AD-clipped	318,723	293,544	274,170	10.9	7.2	4.8	0.251	0.900	202,097	50,726	2.21
Non-AD-clipped	355,934	327,815	306,179	12.1	8.0	5.4	0.251	0.900	225,691	56,648	2.47

Fall Chinook salmon

Rearing type	Total Collection*		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	FGE ¹			Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary				Goose	Low Mon	McNary			Listed Fish	% Listed Fish
Wild****	832,263	5,764,915	43.730	1,610,379	0.226	0.286	0.131	0.164	0.75	254,475	41,734	0.72
Listed Subyearling Hatchery												
AD-clipped	832,263	5,764,915	36.792	1,354,900	0.226	0.286	0.131	0.164	0.75	303,641	49,797	0.86
Non-AD-clipped	832,263	5,764,915	19.478	717,300	0.226	0.286	0.131	0.164	0.75	108,995	17,875	0.31
Listed Yearling Hatchery												
AD-clipped	3,615,029	2,295,551	1.47203	182,241	0.292	0.327	0.206	0.251	0.900	201,841	50,662	2.21
Non-AD-clipped	3,615,029	2,295,551	1.82322	225,719	0.292	0.327	0.206	0.251	0.900	212,633	53,371	2.32

Sockeye salmon

Rearing type	Total Collection*		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	FGE ¹			Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary				Goose	Low Mon	McNary			Listed Fish	% Listed Fish
Wild and listed hatchery*****	66,731	399,115	99.8	240,374	0.277	0.233	0.236	0.118	0.9	66,817	7,884	1.98

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Listed wild and hatchery spring Chinook salmon enter the Snake River above Lower Monumental Dam. WDFW predicts that 30,000 wild and 220,000 listed hatchery (all Non-AD-clipped) fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2016 (Michael Gallinat, WDFW, Pers. commun., March 2016)

***Note: Based on 2016 hatchery releases, it was estimated that 27.20423% and 56.0343% of the AD-clipped and Non-AD-clipped, respectively, hatchery fish arriving at Lower Granite Dam are products of a listed hatchery (Table 1). Because Table 2 is based on the total collection at Lower Granite Dam, which includes both wild and hatchery (listed and unlisted) fish, these estimates of 27.20423% and 56.0343% of all hatchery fish were adjusted to 21.66359% and 2.58464% of the total collection at Lower Granite Dam.

****Note: Estimated values based on the average redd counts 2009-2014 (Streamnet) and the 2015 adult returns (FPC Weekly Reports).

*****Note: The Lower Granite Dam estimate is based on IDFG's estimate of 20,832 wild sockeye salmon smolts and 219,542 hatchery fish that overwintered in the lakes arriving at Lower Granite Dam in 2016 (Eric Johnson, IDFG, Pers. commun., March 2016). The McNary Dam estimate is the average collection count at McNary Dam from 1993-2014 (Annual Fish Passage Reports, and WDFW's 2015 fish counts).

The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted from 2011-2015 (Steven G. Smith, NMFS, Pers. commun., April 2016).

Formulas:

a) Listed fish to Granite = $((\text{Collection}_{\text{Granite}})/(\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total \% Listed Fish})$

b) Listed Fish to McNary = $(\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Goose}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$

where: listed Tucannon fish = 30,000 wild and 220,000 hatchery (all Non-AD-clipped) PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table A1.

Table 3. Estimate of listed threatened and endangered species arriving at various locations during outmigration year 2016 under full transportation conditions (no spill).

Yearling spring/summer Chinook salmon

Snake River ESU

Rearing type	Total Collection*		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	FGE			Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary				Goose	Low	Mon**			McNary	Listed Fish
Wild	7,428,143	5,224,734	12.459	1,542,451	0.60	0.65	0.50	0.80	0.900	147,984	118,387	2.27
Listed Hatchery***												
AD-clipped	7,428,143	5,224,734	21.664	2,682,004	0.60	0.65	0.50	0.80	0.900	145,001	116,001	2.22
Non-AD-clipped	7,428,143	5,224,734	2.585	319,985	0.60	0.65	0.50	0.80	0.900	103,796	83,037	1.59

Upper Columbia River ESU

Rearing type	Number of listed fish passing dam			Of dam total, % listed fish			FGE McNary	Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild****	262,556	302,377	588,439	8.9	7.4	10.4	0.80	0.900	433,751	347,001	6.64
Listed Hatchery											
AD-clipped	318,723	293,544	274,170	10.9	7.2	4.8	0.80	0.900	202,097	161,678	3.09
Non-AD-clipped	355,934	327,815	306,179	12.1	8.0	5.4	0.80	0.900	225,691	180,553	3.46

Subyearling fall Chinook salmon

Rearing type	Total Collection*		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	FGE			Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary				Goose	Low	Mon			McNary	Listed Fish
Wild****	2,025,418	22,843,962	43.730	1,610,379	0.55	0.60	0.40	0.65	0.75	61,780	40,157	0.18
Listed Subyearling Hatchery												
AD-clipped	2,025,418	22,843,962	36.792	1,354,900	0.55	0.60	0.40	0.65	0.75	113,799	73,969	0.32
Non-AD-clipped	2,025,418	22,843,962	19.478	717,300	0.55	0.60	0.40	0.65	0.75	24,511	15,932	0.07
Listed Yearling Hatchery												
AD-clipped	7,428,143	5,224,734	1.47203	182,241	0.60	0.65	0.50	0.80	0.900	106,987	85,590	1.64
Non-AD-clipped	7,428,143	5,224,734	1.82322	225,719	0.60	0.65	0.50	0.80	0.900	108,984	87,187	1.67

Sockeye salmon

Rearing type	Total Collection*		Of Granite % Listed Fish	Total Listed Fish to Granite ^a	Granite	FGE			Project Survival	Listed fish to McNary ^b	Of Fish Collected at McNary	
	Granite	McNary				Goose	Low	Mon			McNary	Listed Fish
Wild and listed hatchery*****	144,543	399,115	99.8	240,374	0.60	0.65	0.50	0.80	0.900	11,040	8,832	2.21

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Listed wild and hatchery spring Chinook salmon enter the Snake River above Lower Monumental Dam. WDFW predicts that 30,000 wild and 220,000 listed hatchery (all Non-AD-clipped) fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2016 (Michael Gallinat, WDFW, Pers. commun., March 2016)

***Note: Based on 2016 hatchery releases, it was estimated that 27.20423% and 56.0343% of the AD-clipped and Non-AD-clipped, respectively, hatchery fish arriving at Lower Granite Dam are products of a listed hatchery (Table 1). Because Table 2 is based on the total collection at Lower Granite Dam, which includes both wild and hatchery (listed and unlisted) fish, these estimates of 27.20423% and 56.0343% of all hatchery fish were adjusted to 21.66359% and 2.58464% of the total collection at Lower Granite Dam.

****Note: Estimated values based on the average redd counts from 2009-2014 (Streamnet) and the 2015 adult returns (FPC Weekly Reports).

*****Note: The Lower Granite Dam estimate is based on IDFG's estimate of 20,832 wild sockeye salmon smolts and 219,542 hatchery fish that overwintered in the lakes arriving at Lower Granite Dam in 2016 (Eric Johnson, IDFG, Pers. commun., March 2016). The McNary Dam estimate is the average collection count at McNary Dam from 1993 (Annual Fish Passage Reports, and WDFW's 2015 fish counts).

The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted from 2011-2015 (Steven G. Smith, NMFS, Pers. commun., April 2016).

Formulas:

$$a) \text{ Listed fish to Granite} = ((\text{Collection}_{\text{Granite}})/(\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total \% Listed Fish})$$

$$b) \text{ Listed Fish to McNary} = (\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Goose}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$$

where: listed Tucannon fish = 30,000 wild and 220,000 hatchery (all Non-AD-clipped) PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table A1.

Table 4. Estimated percentage composition of Snake River steelhead arriving at Lower Granite Dam from total hatchery releases projected for spring 2016.

Hatchery	2016 Total hatchery releases ^a		Survival to <u>Lower Granite Dam</u>	Fish to Lower Granite Dam	
	AD-clipped	Non-AD-clipped	Mean ^b	AD-clipped	Non-AD-clipped
Dworshak ^d	2,059,736	241,140	0.759	1,563,340	183,025
Clearwater ^d	574,937	334,300	0.767	440,977	256,408
Hagerman ^{c,d}	1,533,000	84,500	0.746	1,143,618	63,037
Magic Valley ^{c,d}	1,033,990	458,600	0.79	816,852	362,294
Niagara Springs ^c	1,811,529	0	0.746	1,351,401	0
Irrigon (released above Lower Granite Dam) ^{c,d}	965,000	0	0.788	760,420	0
Lyons Ferry (released into Grande Ronde) ^c	200,000	0	0.78	156,000	0
Totals					
All stocks	8,178,192	1,118,540		6,232,608	864,764
Listed stocks	3,746,950	418,800		2,837,591	319,445
Percent of listed stocks	44.80876%			44.48176%	

- a Data from USEWS, IDFG, ODFW, and WDFW.
- b Mean survival estimate made from PIT-tag detections of marked hatchery fish releases as part of the NMFS survival studies (Research Action #1212) for 2011-2015.
- c Non-listed stocks in 2016.
- d Listed stocks in 2016.

Table 5. Estimates of listed threatened and endangered steelhead arriving at various locations during outmigration year 2016 under past transportation and spill conditions.

Snake River ESU

Rearing type	<u>Total Collection*</u>		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	Granite	<u>FGE¹</u>			Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary				Goose	Low	Mon**			McNary	Listed Fish
Wild	2,137,549	416,864	7.3627	564,093	0.279	0.337	0.228	0.135	0.9	163,776	22,110	5.30
Listed Hatchery***												
AD-clipped	2,137,549	416,864	37.0372	2,837,591	0.279	0.337	0.228	0.135	0.9	741,199	100,062	24.00
Non-AD-clipped	2,137,549	416,864	4.1695	319,445	0.279	0.337	0.228	0.135	0.9	108,611	14,662	3.52

Upper Columbia River ESU

Rearing type	<u>Number of listed fish passing dam</u>			<u>Of dam total, % listed fish</u>			<u>FGE¹</u> McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild***	71,250	89,556	105,625	13.7	17.2	17.0	0.135	0.9	75,468	10,188	2.44
Listed Hatchery***											
AD-clipped	448,540	429,701	513,984	75.4	72.7	64.4	0.135	0.9	443,398	59,859	14.36
Non-AD-clipped	75,095	71,941	178,336	12.6	12.2	22.3	0.135	0.9	173,660	23,444	5.62

Mid-Columbia River ESU

Rearing type	<u>Total Collection*</u>		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	Granite	<u>FGE¹</u>			Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>		
	Granite	McNary				Goose	Low	Mon**			McNary	Listed Fish	% Listed Fish
Summer-run (First dam reached is McNary Dam)													
Wild									0.135	0.9	107,642	14,532	3.49
Listed Hatchery***													
AD-clipped									0.135	0.9	85,000	11,475	2.75
Non-AD-clipped									0.135	0.9	47,000	6,345	1.52
Winter-run (First dam reached is Bonneville Dam)													
Wild									0.135	0.9	0	0	0.00
Listed Hatchery***													
AD-clipped									0.135	0.9	0	0	0.00
Non-AD-clipped									0.135	0.9	0	0	0.00

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Hatchery steelhead and listed wild steelhead enter the Snake River above Lower Monumental Dam. WDFW predicts that 25,000 wild fish and 50,000 (all non-AD-clipped) listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2016. An additional 132,000 (85,000 AD-clipped and 47,000 non-AD-clipped) listed Mid-Columbia hatchery summer steelhead will outmigrate from the Touchet and Walla Walla Rivers above McNary Dam Michael Gillanet, WDFW, Pers. commun., March 2016).

***Note: Estimated values based on 2015 collection numbers and on the number of adult returns from 2011-2015 (Fish Passage Center Weekly Reports).

The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted from 2011-2015 (Steven G. Smith, NMFS, Pers. commun., April 2016).

Formulas:

a) Listed fish to Granite = $((\text{Collection}_{\text{Granite}}) / (\text{FGE}_{\text{Granite}})) \times (\text{Of Granite Total \% Listed Fish})$

b) Listed Fish to McNary = $(\text{Listed Fish to Granite}) \times (1 - \text{FGE}_{\text{Granite}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Goose}}) \times (\text{Project Survival}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{listed Tucannon fish}) \times (1 - \text{FGE}_{\text{Low Mon}}) \times (\text{Project Survival})^2 + (\text{Rock Island listed fish}) \times (\text{Project Survival})^2 + (\text{PIT-tagged fish})$

where: listed Tucannon fish = 25,000 wild and 50,000 (all non-AD-clipped) hatchery fish PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table B1.

Table 6. Estimates of listed threatened and endangered steelhead arriving at various locations during outmigration year 2016 under full transportation conditions (no spill).

Snake River ESU

Rearing type	<u>Total Collection*</u>		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	Granite	<u>FGE</u>			Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Granite	McNary				Goose	Low	Mon**			McNary	Listed Fish
Wild	6,129,172	1,112,149	7.3627	564,093	0.80	0.90	0.65	0.90	0.90	29,781	26,803	2.41
Listed Hatchery***												
AD-clipped	6,129,172	1,112,149	37.0372	2,837,591	0.80	0.90	0.65	0.90	0.90	71,782	64,604	5.81
Non-AD-clipped	6,129,172	1,112,149	4.1695	319,445	0.80	0.90	0.65	0.90	0.90	15,642	14,078	1.27

Upper Columbia River ESU

Rearing type	<u>Number of listed fish passing dam</u>			<u>Of dam total, % listed fish</u>			FGE ¹ McNary	Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>	
	Wells	Rocky Reach	Rock Island	Wells	Rocky Reach	Rock Island				Listed Fish	% Listed Fish
Wild***	71,250	89,556	105,625	13.7	17.2	17.0	0.90	0.90	75,468	67,921	6.11
Listed Hatchery***											
AD-clipped	448,540	429,701	513,984	75.4	72.7	64.4	0.90	0.90	443,398	399,058	35.88
Non-AD-clipped	75,095	71,941	178,336	12.6	12.2	22.3	0.90	0.90	173,660	156,294	14.05

Mid-Columbia River ESU

Rearing type	<u>Total Collection*</u>		Of Granite Total % Listed Fish	Listed Fish to Granite ^a	Granite	<u>FGE¹</u>			Project Survival	Listed fish to McNary ^b	<u>Of Fish Collected at McNary</u>		
	Granite	McNary				Goose	Low	Mon**			McNary	Listed Fish	% Listed Fish
Summer-run (First dam reached is McNary Dam)													
Wild									0.90	0.90	107,642	96,878	8.71
Listed Hatchery***													
AD-clipped									0.90	0.90	85,000	76,500	6.88
Non-AD-clipped									0.90	0.90	47,000	42,300	3.80
Winter-run (First dam reached is Bonneville Dam)													
Wild									0.90	0.90	0	0	0.00
Listed Hatchery***													
AD-clipped									0.90	0.90	0	0	0.00
Non-AD-clipped									0.90	0.90	0	0	0.00

*Note: Total Collection is the total number of fish collected of that species or run, regardless of rearing type.

**Note: Hatchery steelhead and listed wild steelhead enter the Snake River above Lower Monumental Dam. WDFW predicts that 25,000 wild fish and 50,000 (all non-AD-clipped) listed hatchery fish will outmigrate from the Tucannon River and Lyons Ferry Fish Hatchery in 2016. An additional 132,000 (85,000 AD-clipped and 47,000 non-AD-clipped) listed Mid-Columbia hatchery summer steelhead will outmigrate from the Touchet and Walla Walla Rivers above McNary Dam Michael Gillanet, WDFW, Pers. commun., March 2016).

***Note: Estimated values based on 2015 collection numbers and on the number of adult returns from 2011-2015 (Fish Passage Center Weekly Reports).

The FGE used in this table is adjusted for spill conditions, and PIT-tag detection efficiency at a dam. This estimate was obtained from the NMFS survival studies conducted from 2011- 2015 (Steven G. Smith, NMFS, Pers. commun., April 2016).

Formulas:

a) Listed fish to Granite = ((Collection_{Granite})/(FGE_{Granite}))x(Of Granite Total % Listed Fish)

b) Listed Fish to McNary = (Listed Fish to Granite)x(1-FGE_{Granite})x(Project Survival)x(1-FGE_{Goose})x(Project Survival)x(1-FGE_{Low Mon})x(Project Survival)² + (listed Tucannon fish)x(1-FGE_{Low Mon})x(Project Survival)² +(Rock Island listed fish)x(Project Survival)² + (PIT-tagged fish)

where: listed Tucannon fish = 25,000 wild and 50,000 (all Non-AD-clipped) hatchery fish PIT-tagged fish = fish collected at Snake River dams, returned to the river, and subsequently arrived at McNary Dam; See Appendix Table B1.

Table 7a. Estimated juvenile Chinook salmon collection at each of eight mainstem collection facilities in 2016 under a full transportation scenario.

	Full Transportation Scenario								
	Chinook salmon								
	Yearlings			Subyearlings					
Total fish collected at:*									
Lower Granite	7,428,143			2,025,418					
Little Goose	3,001,141			745,722					
Lower Monumental	1,179,654			237,144					
Ice Harbor**	706,760			120,054					
<u>Columbia River</u>									
Wells***	2,937,177			NA					
Rocky Reach***	4,098,588			NA					
Rock Island***	5,671,598			NA					
Wanapum***	5,132,796			NA					
Priest Rapids***	4,645,180			NA					
McNary****	5,224,734			22,843,962					
John Day** ****	4,759,410			3,438,906					
The Dalles** ****	3,038,526			1,842,271					
Bonneville (I & II combined)** *****	4,027,313			7,230,238					
---To the tailrace of Bonneville	10,068,283			24,100,793					
---To Tongue Point*****	37,038,127			79,811,249					
	Spring/Summer Chinook			Fall Chinook - Yearlings			Fall Chinook - Subyearlings		
	Hatchery			Hatchery			Hatchery		
	Wild	Ad-clip	No Ad-clip	Ad-clip	No Ad-clip	Wild	Ad-clip	No Ad-clip	
Total listed fish at:									
Lower Granite	925,470	1,609,202	191,991	109,344	135,431	885,710	745,195	394,515	
Little Goose	391,424	640,144	74,876	42,644	52,818	326,102	274,367	145,253	
Lower Monumental	138,544	164,528	128,143	132,083	134,548	73,220	134,873	29,051	
Ice Harbor**	98,656	96,668	69,197	71,325	72,656	37,068	68,279	14,707	
<u>Columbia River</u>									
Wells***	262,556	318,723	355,934	0	0	NA	NA	NA	
Rocky Reach***	302,377	293,544	327,815	0	0	NA	NA	NA	
Rock Island***	588,439	274,170	306,179	0	0	NA	NA	NA	
Wanapum***	532,537	248,124	277,092	0	0	NA	NA	NA	
Priest Rapids***	481,946	224,552	250,768	0	0	NA	NA	NA	
McNary****	465,388	277,679	263,589	193,060	196,663	40,157	73,969	15,932	
John Day** ****	314,137	187,433	177,923	130,316	132,748	5,676	10,455	2,252	
The Dalles** ****	188,482	112,460	126,754	78,190	79,649	3,041	5,601	1,206	
Bonneville (I & II combined)** *****	170,469	101,214	114,079	70,371	71,684	244,547	2,996,038	60,473	
---To the tailrace of Bonneville	426,173	253,035	285,198	175,928	179,210	815,157	9,986,793	201,577	
---To Tongue Point*****	5,045,952	11,715,528	1,453,478	459,999	502,007	10,697,056	27,091,697	786,328	
Percent listed fish at:									
Lower Granite	12.46%	21.66%	2.58%	1.47%	1.82%	43.73%	36.79%	19.48%	
Little Goose	13.04%	21.33%	2.49%	1.42%	1.76%	43.73%	36.79%	19.48%	
Lower Monumental	11.74%	13.95%	10.86%	11.20%	11.41%	30.88%	56.87%	12.25%	
Ice Harbor**	13.96%	13.68%	9.79%	10.09%	10.28%	30.88%	56.87%	12.25%	
<u>Columbia River</u>									
Wells***	8.94%	10.85%	12.12%	0.00%	0.00%	NA	NA	NA	
Rocky Reach***	7.38%	7.16%	8.00%	0.00%	0.00%	NA	NA	NA	
Rock Island***	10.38%	4.83%	5.40%	0.00%	0.00%	NA	NA	NA	
Wanapum***	10.38%	4.83%	5.40%	0.00%	0.00%	NA	NA	NA	
Priest Rapids***	10.38%	4.83%	5.40%	0.00%	0.00%	NA	NA	NA	
McNary****	8.91%	5.31%	5.05%	3.70%	3.76%	0.18%	0.32%	0.07%	
John Day** ****	6.60%	3.94%	3.74%	2.74%	2.79%	0.17%	0.30%	0.07%	
The Dalles** ****	6.20%	3.70%	4.17%	2.57%	2.62%	0.17%	0.30%	0.07%	
Bonneville (I & II combined)** *****	4.23%	2.51%	2.83%	1.75%	1.78%	3.38%	41.44%	0.84%	
---To the tailrace of Bonneville	4.23%	2.51%	2.83%	1.75%	1.78%	3.38%	41.44%	0.84%	
---To Tongue Point*****	13.62%	31.63%	3.92%	1.24%	1.36%	13.40%	33.94%	0.99%	

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

***** Note: (See next page)

**** Note: The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at McNary, John Day, and The Dalles Dams are:
For example, if you handle 1,000 yearling Chinook salmon at Tongue Point, under the Full Transportation scenario (above),
 13.62% of them will be listed wild fish, or 136 fish. To these 136 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU (SR, $136 \times 0.2966 = 40$; UCR, $136 \times 0.0627 = 10$; etc).

Yearling Chinook salmon	Full Transportation		
	Wild	Ad-clip	No Ad-clip
SR - Spr/Sum	25.44	31.93	23.67
SR - Fall (Yrlg)	0.00	23.56	24.86
UCR	74.56	44.51	51.47
LCR - Spring	0.00	0.00	0.00
UWR	0.00	0.00	0.00
Subyearling Chinook salmon			
SR - Fall (Subyrlg)	100.00	100.00	100.00
LCR - Tule fall	0.00	0.00	0.00
LCR - Late run fall	0.00	0.00	0.00

***** Note: Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.
 The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam Yearling Chinook salmon	Full Transportation		
	Wild	Ad-clip	No Ad-clip
SR - Spr/Sum	25.31	31.93	23.67
SR - Fall (Yrlg)	0.00	23.56	24.86
UCR	74.20	44.51	51.47
LCR - Spring	0.49	0.00	0.00
UWR	0.00	0.00	0.00
Subyearling Chinook salmon			
SR - Fall (Subyrlg)	1.12	0.17	1.80
LCR - Tule fall	98.88	99.83	98.20
LCR - Late run fall	0.00	0.00	0.00

Tongue Point Yearling Chinook salmon	Full Transportation		
	Wild	Ad-clip	No Ad-clip
SR - Spr/Sum	29.66	20.65	25.99
SR - Fall (Yrlg)	0.00	3.00	22.21
UCR	6.27	1.22	9.09
LCR - Spring	26.08	22.56	42.71
UWR	37.99	52.57	0.00
Subyearling Chinook salmon			
SR - Fall (Subyrlg)	12.47	4.60	74.83
LCR - Tule fall	62.39	95.40	25.17
LCR - Late run fall	25.14	0.00	0.00

SR - Spr/Sum = Snake River ESU - Spring/Summer Chinook salmon
 SR - Fall (Yrlg) = Snake River ESU - Yearling Fall Chinook salmon
 SR - Fall (Subyrlg) = Snake River ESU - Subyearling Fall Chinook salmon
 UCR = Upper Columbia River ESU
 LCR - Spring = Lower Columbia River ESU - Spring Chinook salmon
 UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall Chinook salmon
 LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall Chinook salmon

Table 7b. Estimated juvenile Chinook salmon collection at each of eight mainstem collection facilities in 2016 under a transportation with spill scenario.

	Transportation with Spill Scenario								
	Chinook salmon								
	Yearlings			Subyearlings					
Total fish collected at:*									
Lower Granite	3,615,029			832,263					
Little Goose	2,605,101			611,393					
Lower Monumental	1,163,258			178,783					
Ice Harbor**	1,086,120			185,901					
<u>Columbia River</u>									
Wells***	2,937,177			NA					
Rocky Reach***	4,098,588			NA					
Rock Island***	5,671,598			NA					
Wanapum***	5,132,796			NA					
Priest Rapids***	4,645,180			NA					
McNary****	2,295,551			5,764,915					
John Day** ****	1,419,411			2,399,867					
The Dalles** ****	3,885,691			4,245,048					
Bonneville (I & II combined)** *****	2,251,188			532,255					
---To the tailrace of Bonneville	11,974,404			31,309,118					
---To Tongue Point*****	34,879,426			68,554,682					
	Spring/Summer		Fall Chinook - Yearlings			Fall Chinook - Subyearlings			
	Wild	Hatchery	Hatchery		Wild	Hatchery			
		Ad-clip	No Ad-clip	Ad-clip	No Ad-clip	Ad-clip	No Ad-clip		
Total listed fish at:									
Lower Granite	450,395	783,145	93,436	53,214	65,910	363,946	306,207	162,110	
Little Goose	328,855	561,907	66,674	37,972	47,032	267,360	224,944	119,088	
Lower Monumental	137,610	216,360	70,761	64,650	68,107	68,198	81,375	29,210	
Ice Harbor**	131,332	201,073	65,294	59,655	62,845	70,913	84,615	30,373	
<u>Columbia River</u>									
Wells***	262,556	318,723	355,934	0	0	NA	NA	NA	
Rocky Reach***	302,377	293,544	327,815	0	0	NA	NA	NA	
Rock Island***	588,439	274,170	306,179	0	0	NA	NA	NA	
Wanapum***	532,537	248,124	277,092	0	0	NA	NA	NA	
Priest Rapids***	481,946	224,552	250,768	0	0	NA	NA	NA	
McNary****	220,406	221,486	112,098	50,662	53,371	41,734	49,797	17,875	
John Day** ****	109,061	109,596	55,468	25,069	26,409	16,913	20,181	7,244	
The Dalles** ****	284,507	285,903	164,699	65,397	68,893	29,917	35,698	12,814	
Bonneville (I & II combined)** *****	120,739	120,937	69,668	27,663	29,142	15,228	171,310	4,019	
---To the tailrace of Bonneville	642,229	643,282	370,574	147,144	155,011	895,765	10,077,059	236,412	
---To Tongue Point*****	4,773,748	11,272,129	1,374,715	302,980	336,060	10,193,713	26,615,882	564,695	
Percent listed fish at:									
Lower Granite	12.46%	21.66%	2.58%	1.47%	1.82%	43.73%	36.79%	19.48%	
Little Goose	12.62%	21.57%	2.56%	1.46%	1.81%	43.73%	36.79%	19.48%	
Lower Monumental	11.83%	18.60%	6.08%	5.56%	5.85%	38.15%	45.52%	16.34%	
Ice Harbor**	12.09%	18.51%	6.01%	5.49%	5.79%	38.15%	45.52%	16.34%	
<u>Columbia River</u>									
Wells***	8.94%	10.85%	12.12%	0.00%	0.00%	NA	NA	NA	
Rocky Reach***	7.38%	7.16%	8.00%	0.00%	0.00%	NA	NA	NA	
Rock Island***	10.38%	4.83%	5.40%	0.00%	0.00%	NA	NA	NA	
Wanapum***	10.38%	4.83%	5.40%	0.00%	0.00%	NA	NA	NA	
Priest Rapids***	10.38%	4.83%	5.40%	0.00%	0.00%	NA	NA	NA	
McNary****	9.60%	9.65%	4.88%	2.21%	2.32%	0.72%	0.86%	0.31%	
John Day** ****	7.68%	7.72%	3.91%	1.77%	1.86%	0.70%	0.84%	0.30%	
The Dalles** ****	7.32%	7.36%	4.24%	1.68%	1.77%	0.70%	0.84%	0.30%	
Bonneville (I & II combined)** *****	5.36%	5.37%	3.09%	1.23%	1.29%	2.86%	32.19%	0.76%	
---To the tailrace of Bonneville	5.36%	5.37%	3.09%	1.23%	1.29%	2.86%	32.19%	0.76%	
---To Tongue Point*****	13.69%	32.32%	3.94%	0.87%	0.96%	14.87%	38.82%	0.82%	

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

***** Note: (See next page)

**** Note: The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at McNary, John Day, and The Dalles Dams are:
For example, If you handle 1,000 yearling Chinook salmon at Tongue Point, under the Transportation with spill scenario (above),
 13.69% of them will be listed wild fish, or 137 fish. To these 137 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU (SR, $137 \times 0.2265 = 31$; UCR, $137 \times 0.0662 = 9$; etc).

Yearling Chinook salmon	Transportation with spill		
	Wild	Ad-clip	No Ad-clip
SR - Spr/Sum	50.60	62.74	33.51
SR - Fall (Yrlg)	0.00	18.62	32.25
UCR	49.40	18.64	34.24
LCR - Spring	0.00	0.00	0.00
UWR	0.00	0.00	0.00

Subyearling Chinook salmon	Hatchery		
	Wild	Ad-clip	No Ad-clip
SR - Fall (Subyrlg)	100.00	100.00	100.00
LCR - Tule fall	0.00	0.00	0.00
LCR - Late run fall	0.00	0.00	0.00

***** Note: Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.
 The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam Yearling Chinook salmon	Transportation with spill		
	Wild	Ad-clip	No Ad-clip
SR - Spr/Sum	50.44	62.74	33.51
SR - Fall (Yrlg)	0.00	18.62	32.25
UCR	49.24	18.64	34.24
LCR - Spring	0.32	0.00	0.00
UWR	0.00	0.00	0.00

Subyearling Chinook salmon	Hatchery		
	Wild	Ad-clip	No Ad-clip
SR - Fall (Subyrlg)	10.02	1.06	16.26
LCR - Tule fall	89.98	98.94	83.74
LCR - Late run fall	0.00	0.00	0.00

Tongue Point Yearling Chinook salmon	Transportation with spill		
	Wild	Ad-clip	No Ad-clip
SR - Spr/Sum	25.65	17.72	23.53
SR - Fall (Yrlg)	0.00	2.62	20.17
UCR	6.62	1.27	9.88
LCR - Spring	27.57	23.54	46.42
UWR	40.16	54.85	0.00

Subyearling Chinook salmon	Hatchery		
	Wild	Ad-clip	No Ad-clip
SR - Fall (Subyrlg)	8.15	2.89	64.94
LCR - Tule fall	65.47	97.11	35.06
LCR - Late run fall	26.38	0.00	0.00

SR - Spr/Sum = Snake River ESU - Spring/Summer Chinook salmon
 SR - Fall (Yrlg) = Snake River ESU - Yearling Fall Chinook salmon
 SR - Fall (Subyrlg) = Snake River ESU - Subyearling Fall Chinook salmon
 UCR = Upper Columbia River ESU
 LCR - Spring = Lower Columbia River ESU - Spring Chinook
 UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall Chinook salmon
 LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall Chinook salmon

Table 7c. Estimated juvenile sockeye, coho, and chum salmon collection at each of eight mainstem collection facilities in 2016.

	Full Transportation Scenario				Transportation with Spill Scenario					
	Sockeye salmon	Coho salmon			Chum salmon	Sockeye salmon	Coho salmon			Chum salmon
Total fish collected at:*										
Lower Granite	144,543	599,752			0	66,731	291,879			0
Little Goose	56,372	233,903			0	36,525	208,278			0
Lower Monumental	13,659	56,676			0	25,538	79,473			0
Ice Harbor**	7,376	30,605			0	17,486	73,333			0
<u>Columbia River</u>										
Wells***	NA	267,597			0	NA	267,597			0
Rocky Reach***	NA	240,837			0	NA	240,837			0
Rock Island***	NA	920,014			0	NA	920,014			0
Wanapum***	NA	828,013			0	NA	828,013			0
Priest Rapids***	NA	745,212			0	NA	745,212			0
McNary****	399,115	1,190,068			0	399,115	424,139			0
John Day** ****	1,826,458	1,103,296			0	97,411	278,873			0
The Dalles** ****	1,095,875	661,978			0	1,095,874	727,495			0
Bonneville (I & II combined)** *****	986,288	2,251,939			12,000	463,555	1,086,125			12,000
---To the tailrace of Bonneville	2,465,720	5,629,848			30,000	2,465,718	5,777,261			30,000
---To Tongue Point*****	2,680,294	16,213,567			1,892,982	2,594,512	13,974,437			1,892,982
		Coho salmon					Coho salmon			
	Sockeye salmon	Wild	Ad-clip	Hatchery No Ad-clip	Chum salmon	Sockeye salmon	Wild	Ad-clip	Hatchery No Ad-clip	Chum salmon
Total listed fish at:										
Lower Granite	144,224	0	0	0	0	66,584	0	0	0	0
Little Goose	56,247	0	0	0	0	36,444	0	0	0	0
Lower Monumental	13,629	0	0	0	0	25,481	0	0	0	0
Ice Harbor**	7,360	0	0	0	0	17,446	0	0	0	0
<u>Columbia River</u>										
Wells***	NA	0	0	0	0	NA	0	0	0	0
Rocky Reach***	NA	0	0	0	0	NA	0	0	0	0
Rock Island***	NA	0	0	0	0	NA	0	0	0	0
Wanapum***	NA	0	0	0	0	NA	0	0	0	0
Priest Rapids***	NA	0	0	0	0	NA	0	0	0	0
McNary****	8,832	0	0	0	0	7,884	0	0	0	0
John Day** ****	5,962	0	0	0	0	1,924	0	0	0	0
The Dalles** ****	3,577	0	0	0	0	21,645	0	0	0	0
Bonneville (I & II combined)** *****	3,219	38,198	0	0	12,000	9,156	17,953	0	0	12,000
---To the tailrace of Bonneville	8,048	95,495	0	0	30,000	48,702	95,495	0	0	30,000
---To Tongue Point*****	230,980	1,162,883	6,550,158	158,500	1,892,982	177,211	1,162,883	6,550,158	158,500	1,892,982
Percent listed fish at:										
Lower Granite	99.78%	0.00%	0.00%	0.00%	---	99.78%	0.00%	0.00%	0.00%	---
Little Goose	99.78%	0.00%	0.00%	0.00%	---	99.78%	0.00%	0.00%	0.00%	---
Lower Monumental	99.78%	0.00%	0.00%	0.00%	---	99.78%	0.00%	0.00%	0.00%	---
Ice Harbor**	99.78%	0.00%	0.00%	0.00%	---	99.77%	0.00%	0.00%	0.00%	---
<u>Columbia River</u>										
Wells***	NA	0.00%	0.00%	0.00%	---	NA	0.00%	0.00%	0.00%	---
Rocky Reach***	NA	0.00%	0.00%	0.00%	---	NA	0.00%	0.00%	0.00%	---
Rock Island***	NA	0.00%	0.00%	0.00%	---	NA	0.00%	0.00%	0.00%	---
Wanapum***	NA	0.00%	0.00%	0.00%	---	NA	0.00%	0.00%	0.00%	---
Priest Rapids***	NA	0.00%	0.00%	0.00%	---	NA	0.00%	0.00%	0.00%	---
McNary****	2.21%	0.00%	0.00%	0.00%	---	1.98%	0.00%	0.00%	0.00%	---
John Day** ****	0.33%	0.00%	0.00%	0.00%	---	1.98%	0.00%	0.00%	0.00%	---
The Dalles** ****	0.33%	0.00%	0.00%	0.00%	---	1.98%	0.00%	0.00%	0.00%	---
Bonneville (I & II combined)** *****	0.33%	1.70%	0.00%	0.00%	---	1.98%	1.65%	0.00%	0.00%	---
---To the tailrace of Bonneville	0.33%	1.70%	0.00%	0.00%	100.00%	1.98%	1.65%	0.00%	0.00%	100.00%
---To Tongue Point*****	8.62%	7.17%	40.40%	0.98%	100.00%	6.83%	8.32%	46.87%	1.13%	100.00%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.

Table 8a. Estimated juvenile salmon collection at each of the mainstem collection facilities in 2016 under a full transportation scenario. Percentage of listed fish at each facility.

****Use this table only if the reartype and/or clip/no-clip status of all handled fish is known****

	Full Transportation Scenario											
	Yearling Chinook salmon			Coho salmon			Subyearling Chinook salmon					
	Unclipped		Clipped	Unclipped		Clipped	Unclipped		Clipped			
Total fish collected at:*												
Lower Granite	1,403,533		6,024,610	438,563	161,189	1,280,223	745,195					
Little Goose	577,869		2,423,272	142,533	52,386	471,355	274,367					
Lower Monumental	415,471		764,183	28,781	10,578	102,271	134,873					
Ice Harbor**	248,196		458,564	12,951	4,760	51,775	68,279					
<u>Columbia River</u>												
Wells***	618,490		2,318,687	267,597	0	NA	NA					
Rocky Reach***	630,192		3,468,396	240,837	0	NA	NA					
Rock Island***	894,618		4,776,980	920,015	0	NA	NA					
Wanapum***	805,156		4,299,282	828,013	0	NA	NA					
Priest Rapids***	724,640		3,869,354	745,212	0	NA	NA					
McNary****	1,400,196		3,787,684	1,162,667	3,427	15,400,097	7,443,865					
John Day** *****	1,199,847		3,534,687	844,800	242,313	2,176,744	1,262,162					
The Dalles** *****	753,588		2,270,012	506,880	145,388	1,166,113	676,158					
Bonneville (I & II combined)** *****	679,065		3,334,815	710,390	1,532,809	1,410,698	5,819,540					
---To the tailrace of Bonneville	1,697,663		8,337,038	1,775,975	3,832,023	4,702,327	19,398,467					
---To Tongue Point*****	7,814,592		32,306,315	4,750,249	13,234,761	32,637,983	47,173,267					
	Spring/Summer Chinook		Fall Chinook	Spring/Summer Chinook		Fall Chinook	Coho salmon		Coho salmon		Fall Chinook	Fall Chinook
	Wild	Hatchery	Hatchery	Hatchery	Hatchery	Wild	Hatchery	Hatchery	Wild	Hatchery	Wild	Hatchery
	No Ad-clip	No Ad-clip	Ad-clip	Ad-clip	Ad-clip	No Ad-clip	Ad-clip	Ad-clip	No Ad-clip	No Ad-clip	Ad-clip	Ad-clip
Total listed fish at:												
Lower Granite	925,470	191,991	135,431	1,609,202	109,344	0	0	0	885,710	394,515	745,195	
Little Goose	391,424	74,876	52,818	640,144	42,644	0	0	0	326,102	145,253	274,367	
Lower Monumental	138,544	128,143	134,548	164,528	132,083	0	0	0	73,220	29,051	134,873	
Ice Harbor**	98,656	69,197	72,656	96,668	71,325	0	0	0	37,068	14,707	68,279	
<u>Columbia River</u>												
Wells***	262,556	355,934	0	318,723	0	0	0	0	NA	NA	NA	
Rocky Reach***	302,377	327,815	0	293,544	0	0	0	0	NA	NA	NA	
Rock Island***	588,439	306,179	0	274,170	0	0	0	0	NA	NA	NA	
Wanapum***	532,537	277,092	0	248,124	0	0	0	0	NA	NA	NA	
Priest Rapids***	481,946	250,768	0	224,552	0	0	0	0	NA	NA	NA	
McNary****	465,388	263,589	196,663	277,679	193,060	0	0	0	40,157	15,932	73,969	
John Day** *****	314,137	177,923	132,748	187,433	130,316	0	0	0	5,676	2,252	10,455	
The Dalles** *****	188,482	126,754	79,649	112,460	78,190	0	0	0	3,041	1,206	5,601	
Bonneville (I & II combined)** *****	170,469	114,079	71,684	101,214	70,371	38,198	0	0	244,547	60,473	2,996,038	
---To the tailrace of Bonneville	426,173	285,198	179,210	253,035	175,928	95,495	0	0	815,157	201,577	9,986,793	
---To Tongue Point*****	5,045,952	1,453,478	502,007	11,715,528	459,999	1,162,883	158,500	6,550,158	10,697,056	786,328	27,091,697	
Percent listed fish at:												
Lower Granite	65.94%	13.68%	9.65%	26.710%	1.815%	0.00%	0.00%	0.00%	69.18%	30.82%	100.00%	
Little Goose	67.74%	12.96%	9.14%	26.417%	1.760%	0.00%	0.00%	0.00%	69.18%	30.82%	100.00%	
Lower Monumental	33.35%	30.84%	32.38%	21.530%	17.284%	0.00%	0.00%	0.00%	71.59%	28.41%	100.00%	
Ice Harbor**	39.75%	27.88%	29.27%	21.081%	15.554%	0.00%	0.00%	0.00%	71.59%	28.41%	100.00%	
<u>Columbia River</u>												
Wells***	42.45%	57.55%	0.00%	13.75%	0.00%	NA	NA	NA	NA	NA	NA	
Rocky Reach***	47.98%	52.02%	0.00%	8.46%	0.00%	NA	NA	NA	NA	NA	NA	
Rock Island***	65.78%	34.22%	0.00%	5.74%	0.00%	NA	NA	NA	NA	NA	NA	
Wanapum***	66.14%	34.41%	0.00%	5.77%	0.00%	NA	NA	NA	NA	NA	NA	
Priest Rapids***	66.51%	34.61%	0.00%	5.80%	0.00%	NA	NA	NA	NA	NA	NA	
McNary****	33.24%	18.83%	14.05%	7.33%	5.10%	0.00%	0.00%	0.00%	0.26%	0.10%	0.99%	
John Day** *****	26.18%	14.83%	11.06%	5.30%	3.69%	0.00%	0.00%	0.00%	0.26%	0.10%	0.83%	
The Dalles** *****	25.01%	16.82%	10.57%	4.95%	3.44%	0.00%	0.00%	0.00%	0.26%	0.10%	0.83%	
Bonneville (I & II combined)** *****	25.10%	16.80%	10.56%	3.04%	2.11%	5.38%	0.00%	0.00%	17.34%	4.29%	51.48%	
---To the tailrace of Bonneville	25.10%	16.80%	10.56%	3.04%	2.11%	5.38%	0.00%	0.00%	17.34%	4.29%	51.48%	
---To Tongue Point*****	64.57%	18.60%	6.42%	36.26%	1.42%	24.48%	3.34%	49.49%	32.77%	2.41%	57.43%	

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.
 ** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.
 *** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established. Also, there is no transportation from these dams.
 **** Note: (See next page)
 ***** Note: (See next page)

**** Note: The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at McNary, John Day, and The Dalles Dams are: **For example, if you handle 1,000 yearling Chinook salmon at Tongue Point, under the Full Transportation scenario (above),** 64.57% of them will be listed wild fish, or 646 fish. To these 646 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU (SR, 646 x 0.2966 = 192; UCR, 646 x 0.0627 = 41; etc).

Spring/Summer Chinook salmon	Full Transportation Hatchery		
	Wild	Ad-clip	No Ad-clip
SR	25.44	31.93	23.67
SR - Fall (Yrlg)	0.00	23.56	24.86
UCR	74.56	44.51	51.47
LCR - Spring	0.00	0.00	0.00
UWR	0.00	0.00	0.00

Fall Chinook salmon			
SR	100.00	100.00	100.00
LCR - Tule fall	0.00	0.00	0.00
LCR - Late run fall	0.00	0.00	0.00

***** Note:

Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.
The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam Spring/Summer Chinook salmon	Full Transportation Hatchery		
	Wild	Ad-clip	No Ad-clip
SR	25.31	31.93	23.67
SR - Fall (Yrlg)	0.00	23.56	24.86
UCR	74.20	44.51	51.47
LCR - Spring	0.49	0.00	0.00
UWR	0.00	0.00	0.00

Fall Chinook salmon			
SR	1.12	0.17	1.80
LCR - Tule fall	98.88	99.83	98.20
LCR - Late run fall	0.00	0.00	0.00

Tongue Point Spring/Summer Chinook salmon	Full Transportation Hatchery		
	Wild	Ad-clip	No Ad-clip
SR	29.66	20.65	25.99
SR - Fall (Yrlg)	0.00	3.00	22.21
UCR	6.27	1.22	9.09
LCR - Spring	26.08	22.56	42.71
UWR	37.99	52.57	0.00

Fall Chinook salmon			
SR	12.47	4.60	74.83
LCR - Tule fall	62.39	95.40	25.17
LCR - Late run fall	25.14	0.00	0.00

SR = Snake River ESU
UCR = Upper Columbia River ESU
LCR - Spring = Lower Columbia River ESU - Spring Chinook
UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall Chinook salmon
LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall Chinook salmon

Table 8b. Estimated juvenile salmon collection at each of the mainstem collection facilities in 2016 under a transportation with spill scenario. Percentage of listed fish at each facility.

****Use this table only if the reartype and/or clip/no-clip status of all handled fish is known****

	Transportation with Spill Scenario										
	Yearling Chinook salmon			Coho salmon				Subyearling Chinook salmon			
	Unclipped	Clipped		Unclipped	Clipped		Unclipped	Clipped			
Total fish collected at:*											
Lower Granite	683,053	2,931,977		213,434	78,445		526,055	306,207			
Little Goose	494,875	2,110,227		126,918	46,647		386,448	224,944			
Lower Monumental	296,440	866,819		40,357	14,833		97,409	81,375			
Ice Harbor**	277,890	808,231		31,032	11,406		101,287	84,615			
<u>Columbia River</u>											
Wells***	618,490	2,318,687		267,597	0		NA	NA			
Rocky Reach***	630,192	3,468,396		240,837	0		NA	NA			
Rock Island***	894,618	4,776,980		920,015	0		NA	NA			
Wanapum***	805,156	4,299,282		828,013	0		NA	NA			
Priest Rapids***	724,640	3,869,354		745,212	0		NA	NA			
McNary****	581,863	1,702,126		368,871	2,577		3,886,377	1,878,538			
John Day** *****	346,502	1,067,187		196,325	56,475		1,574,978	824,889			
The Dalles** *****	937,598	2,933,166		512,152	147,326		2,785,928	1,459,120			
Bonneville (I & II combined)** *****	396,997	1,847,877		336,114	721,240		162,550	369,705			
---To the tailrace of Bonneville	2,111,686	9,829,133		1,787,840	3,836,383		9,561,765	21,747,353			
---To Tongue Point*****	6,579,499	28,601,190		3,739,150	13,154,043		25,139,764	43,414,917			
Total listed fish at:											
	Spring/Summer Chinook Wild	Hatchery No Ad-clip	Fall Chinook Hatchery No Ad-clip	Spring/Summer Chinook Hatchery Ad-clip	Fall Chinook Hatchery Ad-clip	Coho salmon Wild No Ad-clip	Coho salmon Hatchery No Ad-clip	Coho salmon Hatchery Ad-clip	Fall Chinook Wild No Ad-clip	Fall Chinook Hatchery No Ad-clip	Fall Chinook Hatchery Ad-clip
Lower Granite	450,395	93,436	65,910	783,145	53,214	0	0	0	363,946	162,110	306,207
Little Goose	328,855	66,674	47,032	561,907	37,972	0	0	0	267,360	119,088	224,944
Lower Monumental	137,610	70,761	68,107	216,360	64,650	0	0	0	68,198	29,210	81,375
Ice Harbor**	131,332	65,294	62,845	201,073	59,655	0	0	0	70,913	30,373	84,615
<u>Columbia River</u>											
Wells***	262,556	355,934	0	318,723	0	0	0	0	NA	NA	NA
Rocky Reach***	302,377	327,815	0	293,544	0	0	0	0	NA	NA	NA
Rock Island***	588,439	306,179	0	274,170	0	0	0	0	NA	NA	NA
Wanapum***	532,537	277,092	0	248,124	0	0	0	0	NA	NA	NA
Priest Rapids***	481,946	250,768	0	224,552	0	0	0	0	NA	NA	NA
McNary****	220,406	112,098	53,371	221,486	50,662	0	0	0	41,734	17,875	49,797
John Day** *****	109,061	55,468	26,409	109,596	25,069	0	0	0	16,913	7,244	20,181
The Dalles** *****	284,507	164,699	68,893	285,903	65,397	0	0	0	29,917	12,814	35,698
Bonneville (I & II combined)** *****	120,739	69,668	29,142	120,937	27,663	17,953	0	0	15,228	4,019	171,310
---To the tailrace of Bonneville	642,229	370,574	155,011	643,282	147,144	95,495	0	0	895,765	236,412	10,077,059
---To Tongue Point*****	4,773,748	1,374,715	336,060	11,272,129	302,980	1,162,883	158,500	6,550,158	10,193,713	564,695	26,615,882
Percent listed fish at:											
Lower Granite	65.94%	13.68%	9.65%	26.71%	1.82%	0.00%	0.00%	0.00%	69.18%	30.82%	100.00%
Little Goose	66.45%	13.47%	9.50%	26.63%	1.80%	0.00%	0.00%	0.00%	69.18%	30.82%	100.00%
Lower Monumental	46.42%	23.87%	22.97%	24.96%	7.46%	0.00%	0.00%	0.00%	70.01%	29.99%	100.00%
Ice Harbor**	47.26%	23.50%	22.62%	24.88%	7.38%	0.00%	0.00%	0.00%	70.01%	29.99%	100.00%
<u>Columbia River</u>											
Wells***	42.45%	57.55%	0.00%	13.75%	0.00%	NA	NA	NA	NA	NA	NA
Rocky Reach***	47.98%	52.02%	0.00%	8.46%	0.00%	NA	NA	NA	NA	NA	NA
Rock Island***	65.78%	34.22%	0.00%	5.74%	0.00%	NA	NA	NA	NA	NA	NA
Wanapum***	66.14%	34.41%	0.00%	5.77%	0.00%	NA	NA	NA	NA	NA	NA
Priest Rapids***	66.51%	34.61%	0.00%	5.80%	0.00%	NA	NA	NA	NA	NA	NA
McNary****	37.88%	19.27%	9.17%	13.01%	2.98%	0.00%	0.00%	0.00%	1.07%	0.46%	2.65%
John Day** *****	31.47%	16.01%	7.62%	10.27%	2.35%	0.00%	0.00%	0.00%	1.07%	0.46%	2.45%
The Dalles** *****	30.34%	17.57%	7.35%	9.75%	2.23%	0.00%	0.00%	0.00%	1.07%	0.46%	2.45%
Bonneville (I & II combined)** *****	30.41%	17.55%	7.34%	6.54%	1.50%	5.34%	0.00%	0.00%	9.37%	2.47%	46.34%
---To the tailrace of Bonneville	30.41%	17.55%	7.34%	6.54%	1.50%	5.34%	0.00%	0.00%	9.37%	2.47%	46.34%
---To Tongue Point*****	72.55%	20.89%	5.11%	39.41%	1.06%	31.10%	4.24%	49.80%	40.55%	2.25%	61.31%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected;

FGE's at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

***** Note: (See next page)

**** Note: The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at McNary, John Day, and The Dalles Dams are:
For example, if you handle 1,000 yearling Chinook salmon at Tongue Point, under the Transportation with spill scenario (above),
 72.55% of them will be listed wild fish, or 726 fish. To these 726 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU (SR, $726 \times 0.2565 = 186$; UCR, $726 \times 0.0662 = 48$; etc).

Spring/Summer Chinook salmon	Transportation with spill		
	Wild	Ad-clip	No Ad-clip
SR	50.60	62.74	33.51
SR - Fall (Yrlg)	0.00	18.62	32.25
UCR	49.40	18.64	34.24
LCR - Spring	0.00	0.00	0.00
UWR	0.00	0.00	0.00

Fall Chinook salmon	Hatchery		
	Wild	Ad-clip	No Ad-clip
SR	100.00	100.00	100.00
LCR - Tule fall	0.00	0.00	0.00
LCR - Late run fall	0.00	0.00	0.00

***** Note:

Because the Columbia River is a free flowing river below Bonneville Dam and there are no survival estimates available, survival was set at 100% to Tongue Point.
 The percentage of listed wild and hatchery spring/summer and fall Chinook salmon at and downstream of Bonneville Dam are:

Bonneville Dam Spring/Summer Chinook salmon	Transportation with spill		
	Wild	Ad-clip	No Ad-clip
SR	50.44	62.74	33.51
SR - Fall (Yrlg)	0.00	18.62	32.25
UCR	49.24	18.64	34.24
LCR - Spring	0.32	0.00	0.00
UWR	0.00	0.00	0.00

Fall Chinook salmon	Hatchery		
	Wild	Ad-clip	No Ad-clip
SR	10.02	1.06	16.26
LCR - Tule fall	89.98	98.94	83.74
LCR - Late run fall	0.00	0.00	0.00

Tongue Point Spring/Summer Chinook salmon	Transportation with spill		
	Wild	Ad-clip	No Ad-clip
SR	25.65	17.72	23.53
SR - Fall (Yrlg)	0.00	2.62	20.17
UCR	6.62	1.27	9.88
LCR - Spring	27.57	23.54	46.42
UWR	40.16	54.85	0.00

Fall Chinook salmon	Hatchery		
	Wild	Ad-clip	No Ad-clip
SR	8.15	2.89	64.94
LCR - Tule fall	65.47	97.11	35.06
LCR - Late run fall	26.38	0.00	0.00

SR = Snake River ESU
 UCR = Upper Columbia River ESU
 LCR - Spring = Lower Columbia River ESU - Spring Chinook
 UWR = Upper Willamette River ESU

LCR - Tule fall = Lower Columbia River ESU - Tule fall Chinook salmon
 LCR - Late run fall = Lower Columbia River ESU - Late-run bright fall Chinook salmon

Table 9. Estimated juvenile steelhead trout collection at each of the mainstem collection facilities in 2016 under full transportation and transportation with spill scenarios.

	Full Transportation Scenario			Transportation with Spill Scenario		
	Steelhead trout			Steelhead trout		
Total fish collected at:						
<u>Snake River</u>						
Lower Granite	6,129,172			2,137,549		
Little Goose	1,314,020			1,686,601		
Lower Monumental	311,768			743,026		
Ice Harbor**	179,490			649,598		
<u>Columbia River</u>						
Wells***	594,885			594,885		
Rocky Reach***	591,198			591,198		
Rock Island***	797,945			797,945		
Wanapum***	718,151			718,151		
Priest Rapids***	646,336			646,336		
McNary****	1,442,461			464,834		
John Day** ****	1,206,568			858,545		
The Dalles** ****	955,121			1,700,515		
Bonneville (I & II combined)** *****	1,075,056			626,308		
---To the tailrace of Bonneville	1,954,647			3,296,358		
---To Tongue Point****	13,429,608			11,713,627		
Total listed fish at:						
<u>Snake River</u>						
	Steelhead trout			Steelhead trout		
	Wild	Hatchery		Wild	Hatchery	
		Ad-clip	No Ad-clip		Ad-clip	No Ad-clip
Lower Granite	451,274	2,270,073	255,556	157,382	791,688	89,125
Little Goose	102,075	492,035	51,750	124,752	624,747	69,856
Lower Monumental	37,704	88,839	35,864	58,008	266,026	39,601
Ice Harbor**	24,818	59,819	13,035	51,497	233,066	34,152
<u>Columbia River</u>						
Wells***	71,250	448,540	75,095	71,250	448,540	75,095
Rocky Reach***	89,556	429,701	71,941	89,556	429,701	71,941
Rock Island***	105,625	513,984	178,336	105,625	513,984	178,336
Wanapum***	94,112	457,960	158,897	94,112	457,960	158,897
Priest Rapids***	83,854	408,042	141,577	83,854	408,042	141,577
McNary****	191,602	540,161	212,672	46,830	171,396	44,451
John Day** ****	225,966	483,113	148,870	112,625	328,331	75,270
The Dalles** ****	208,234	391,573	131,202	262,503	662,689	168,852
Bonneville (I & II combined)** *****	258,638	387,657	129,890	107,908	226,640	57,747
---To the tailrace of Bonneville	470,251	704,831	236,164	567,937	1,192,842	303,932
---To Tongue Point****	1,309,219	4,723,123	639,334	1,178,295	4,095,429	562,514
Percent listed fish at:						
<u>Snake River</u>						
Lower Granite	7.36%	37.04%	4.17%	7.36%	37.04%	4.17%
Little Goose	7.77%	37.45%	3.94%	7.40%	37.04%	4.14%
Lower Monumental	12.09%	28.50%	11.50%	7.81%	35.80%	5.33%
Ice Harbor**	13.83%	33.33%	7.26%	7.93%	35.88%	5.26%
<u>Columbia River</u>						
Wells***	11.98%	75.40%	12.62%	11.98%	75.40%	12.62%
Rocky Reach***	15.15%	72.68%	12.17%	15.15%	72.68%	12.17%
Rock Island***	13.24%	64.41%	22.35%	13.24%	64.41%	22.35%
Wanapum***	13.11%	63.77%	22.13%	13.11%	63.77%	22.13%
Priest Rapids***	12.97%	63.13%	21.91%	12.97%	63.13%	21.91%
McNary****	13.28%	37.45%	14.74%	10.08%	36.87%	9.56%
John Day** ****	18.73%	40.04%	12.34%	13.12%	38.24%	8.77%
The Dalles** ****	21.80%	41.00%	13.74%	15.44%	38.97%	9.93%
Bonneville (I & II combined)** *****	24.06%	36.06%	12.08%	17.23%	36.19%	9.22%
---To the tailrace of Bonneville	24.06%	36.06%	12.08%	17.23%	36.19%	9.22%
---To Tongue Point****	9.75%	35.17%	4.76%	10.06%	34.96%	4.80%

* Note: "Total fish collected at:" is the total number of fish collected of that species or run, regardless of rearing type.
 ** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.
 *** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGE's at these dams are not currently established at this time. Also, there is no transportation from these dams.
 **** Note: (See next page)

**** Note: The percentage of listed wild and hatchery fish from each ESU at each Columbia River dam from McNary Dam to Bonneville Dam and at Tongue Point.

For example If you handle 1,000 steelhead at Tongue Point, under the Full Transportation with spill scenario (above), 9.75% of them will be listed wild fish, or 98 fish. To these 98 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU (SR, 98 x 0.4134 = 41; UCR, 98 x 0.0382 = 4; etc).

McNary Dam	Full Transportation Hatchery			Transportation with spill Hatchery		
	Wild	AD-clipped	No AD-clip	Wild	AD-clipped	No AD-clip
SR	13.99	11.96	6.62	47.21	58.38	32.99
UCR	35.45	73.88	73.49	21.76	34.92	52.74
MCR - Summer	50.56	14.16	19.89	31.03	0.00	14.27
MCR - Winter	---	---	---	---	---	---
LCR - Summer	---	---	---	---	---	---
LCR - Winter	---	---	---	---	---	---
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
John Day Dam						
SR	8.66	9.36	6.62	34.26	51.61	32.99
UCR	21.93	57.82	73.49	15.78	30.87	52.74
MCR - Summer	69.41	32.82	19.89	49.96	17.52	14.27
MCR - Winter	---	0.00	0.00	---	0.00	0.00
LCR - Summer	---	---	---	---	---	---
LCR - Winter	---	---	---	---	---	---
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
The Dalles Dam						
SR	6.15	7.42	4.83	26.50	45.30	26.05
UCR	15.59	45.86	53.61	12.21	27.10	41.65
MCR - Summer	78.26	46.72	41.56	61.29	27.60	32.30
MCR - Winter	---	0.00	0.00	---	0.00	0.00
LCR - Summer	---	---	---	---	---	---
LCR - Winter	---	---	---	---	---	---
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
Bonneville Dam						
SR	4.84	6.93	4.83	21.87	43.48	26.05
UCR	12.27	42.82	53.61	10.08	26.01	41.65
MCR - Summer	61.60	43.62	41.56	50.58	26.49	32.30
MCR - Winter	13.46	0.00	0.00	11.05	0.00	0.00
LCR - Summer	4.57	0.00	0.00	3.75	0.00	0.00
LCR - Winter	3.26	6.63	0.00	2.67	4.02	0.00
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
Tongue Point						
SR	41.34	58.02	56.42	36.05	54.45	50.31
UCR	3.82	6.45	19.38	4.17	7.62	22.09
MCR - Summer	19.18	6.58	15.02	20.91	7.76	17.13
MCR - Winter	4.19	0.00	0.00	4.57	0.00	0.00
LCR - Summer	3.77	4.59	0.00	4.11	1.42	0.00
LCR - Winter	17.71	20.97	9.18	19.30	24.75	10.47
UWR - Summer	---	3.39	0.00	---	4.00	0.00
UWR - Winter	9.99	0.00	0.00	10.89	0.00	0.00

SR = Snake River ESU
 UCR = Upper Columbia River ESU
 MCR - Summer = Mid Columbia River ESU summer steelhead
 MCR - Winter = Mid Columbia River ESU winter steelhead
 LCR - Summer = Lower Columbia River ESU summer steelhead
 LCR - Winter = Lower Columbia River ESU winter steelhead
 UWR - Summer = Upper Willamette River ESU summer steelhead
 UWR - Winter = Upper Willamette River ESU winter steelhead

Table 10. Estimated juvenile steelhead trout collection at each of the mainstem collection facilities in 2016 under full transportation and transportation with spill scenarios. Percentage of listed fish by rearing type (wild or hatchery) at each facility.

****Use this table only if the reartype and/or clip/no-clip status of all handled fish is known****

	Full Transportation Scenario Steelhead trout			Transportation with Spill Scenario Steelhead trout		
	Unclipped	Clipped		Unclipped	Clipped	
Total fish collected at:						
<u>Snake River</u>						
Lower Granite	1,143,086	4,986,086		398,651	1,738,898	
Little Goose	242,167	1,042,027		313,857	1,367,167	
Lower Monumental	79,310	194,788		145,750	590,367	
Ice Harbor**	39,940	98,328		127,166	512,779	
<u>Columbia River</u>						
Wells***	146,345	448,540		146,345	448,540	
Rocky Reach***	161,497	429,701		161,497	429,701	
Rock Island***	283,961	513,984		283,961	513,984	
Wanapum***	255,565	462,586		255,565	462,586	
Priest Rapids***	230,009	416,327		230,009	416,327	
McNary****	471,970	916,972		118,922	341,767	
John Day** ****	422,224	746,880		234,701	616,825	
The Dalles** ****	369,900	561,137		514,279	1,173,800	
Bonneville (I & II combined)** ****	418,687	632,526		194,015	428,040	
---To the tailrace of Bonneville	761,249	1,150,047		1,021,132	2,252,842	
---To Tongue Point*****	2,717,362	10,812,793		2,393,241	9,441,900	
Total listed fish at:						
<u>Snake River</u>						
	Wild	Hatchery No Ad-clip	Hatchery Ad-clip	Wild	Hatchery No Ad-clip	Hatchery Ad-clip
Lower Granite	451,274	255,556	2,270,073	157,382	89,125	791,688
Little Goose	102,075	51,750	492,035	124,752	69,856	624,747
Lower Monumental	37,704	35,864	88,839	58,008	39,601	266,026
Ice Harbor**	24,818	13,035	59,819	51,497	34,152	233,066
<u>Columbia River</u>						
Wells***	71,250	75,095	448,540	71,250	75,095	448,540
Rocky Reach***	89,556	71,941	429,701	89,556	71,941	429,701
Rock Island***	105,625	178,336	513,984	105,625	178,336	513,984
Wanapum***	94,112	158,897	457,960	94,112	158,897	457,960
Priest Rapids***	83,854	141,577	408,042	83,854	141,577	408,042
McNary****	191,602	212,672	540,161	46,830	44,451	171,396
John Day** ****	225,966	148,870	483,113	112,625	75,270	328,331
The Dalles** ****	208,234	131,202	391,573	262,503	168,852	662,689
Bonneville (I & II combined)** ****	258,638	129,890	387,657	107,908	57,747	226,640
---To the tailrace of Bonneville	470,251	236,164	704,831	567,937	303,932	1,192,842
---To Tongue Point*****	1,309,219	639,334	4,723,123	1,178,295	562,514	4,095,429
Percent listed fish at:						
<u>Snake River</u>						
Lower Granite	39.48%	22.36%	45.53%	39.48%	22.36%	45.53%
Little Goose	42.15%	21.37%	47.22%	39.75%	22.26%	45.70%
Lower Monumental	47.54%	45.22%	45.61%	39.80%	27.17%	45.06%
Ice Harbor**	62.14%	32.64%	60.84%	40.50%	26.86%	45.45%
<u>Columbia River</u>						
Wells***	48.69%	51.31%	100.00%	48.69%	51.31%	100.00%
Rocky Reach***	55.45%	44.55%	100.00%	55.45%	44.55%	100.00%
Rock Island***	37.20%	62.80%	100.00%	37.20%	62.80%	100.00%
Wanapum***	36.83%	62.18%	99.00%	36.83%	62.18%	99.00%
Priest Rapids***	36.46%	61.55%	98.01%	36.46%	61.55%	98.01%
McNary****	40.60%	45.06%	58.91%	39.38%	37.38%	50.15%
John Day** ****	53.52%	35.26%	64.68%	47.99%	32.07%	53.23%
The Dalles** ****	56.29%	35.47%	69.78%	51.04%	32.83%	56.46%
Bonneville (I & II combined)** ****	61.77%	31.02%	61.29%	55.62%	29.76%	52.95%
---To the tailrace of Bonneville	61.77%	31.02%	61.29%	55.62%	29.76%	52.95%
---To Tongue Point*****	48.18%	23.53%	43.68%	49.23%	23.50%	43.38%

* Note: "Total fish collected at:" is the total number of fish collected of that species, run and rearing type.

** Note: These dams have no transportation facilities, therefore, no fish are removed from the river at these dams.

*** Note: The numbers shown for these dams represent the number of fish arriving at the dam, not the number collected; FGEs at these dams are not currently established. Also, there is no transportation from these dams.

**** Note: (See next page)

**** Note: The percentage of listed wild and hatchery fish from each ESU at each Columbia River dam from McNary Dam to Bonneville Dam and at Tongue Point.

For example ,If you handle 1,000 steelhead at Tongue Point, under the Full Transportation with spill scenario (above), 48.18% of them will be listed wild fish, or 482 fish. To these 482 fish, apply the percentages listed below under the Tongue Point section to determine how many are from each ESU (SR, 482 x 0.4134 = 199; UCR, 482 x 0.0382 = 18; etc).

McNary Dam	Full Transportation Hatchery			Transportation with spill Hatchery		
	Wild	AD-clipped	No AD-clip	Wild	AD-clipped	No AD-clip
SR	13.99	11.96	6.62	47.21	58.38	32.99
UCR	35.45	73.88	73.49	21.76	34.92	52.74
MCR - Summer	50.56	14.16	19.89	31.03	6.70	14.27
MCR - Winter	---	---	---	---	---	---
LCR - Summer	---	---	---	---	---	---
LCR - Winter	---	---	---	---	---	---
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
John Day Dam						
SR	8.66	9.36	6.62	34.26	51.61	32.99
UCR	21.93	57.82	73.49	15.78	30.87	52.74
MCR - Summer	69.41	32.82	19.89	49.96	17.52	14.27
MCR - Winter	---	0.00	0.00	---	0.00	0.00
LCR - Summer	---	---	---	---	---	---
LCR - Winter	---	---	---	---	---	---
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
The Dalles Dam						
SR	6.15	7.42	4.83	26.50	45.30	26.05
UCR	15.59	45.86	53.61	12.21	27.10	41.65
MCR - Summer	78.26	46.72	41.56	61.29	27.60	32.30
MCR - Winter	---	0.00	0.00	---	0.00	0.00
LCR - Summer	---	---	---	---	---	---
LCR - Winter	---	---	---	---	---	---
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
Bonneville Dam						
SR	4.84	6.93	4.83	21.87	43.48	26.05
UCR	12.27	42.82	53.61	10.08	26.01	41.65
MCR - Summer	61.60	43.62	41.56	50.58	26.49	32.30
MCR - Winter	13.46	0.00	0.00	11.05	0.00	0.00
LCR - Summer	4.57	0.00	0.00	3.75	0.00	0.00
LCR - Winter	3.26	6.63	0.00	2.67	4.02	0.00
UWR - Summer	---	---	---	---	---	---
UWR - Winter	---	---	---	---	---	---
Tongue Point						
SR	41.34	58.02	56.42	36.05	54.45	50.31
UCR	3.82	6.45	19.38	4.17	7.62	22.09
MCR - Summer	19.18	6.58	15.02	20.91	7.76	17.13
MCR - Winter	4.19	0.00	0.00	4.57	0.00	0.00
LCR - Summer	3.77	4.59	0.00	4.11	1.42	0.00
LCR - Winter	17.71	20.97	9.18	19.30	24.75	10.47
UWR - Summer	---	3.39	0.00	---	4.00	0.00
UWR - Winter	9.99	0.00	0.00	10.89	0.00	0.00

SR = Snake River ESU
 UCR = Upper Columbia River ESU
 MCR - Summer = Mid Columbia River ESU summer steelhead
 MCR - Winter = Mid Columbia River ESU winter steelhead
 LCR - Summer = Lower Columbia River ESU summer steelhead
 LCR - Winter = Lower Columbia River ESU winter steelhead
 UWR - Summer = Upper Willamette River ESU summer steelhead
 UWR - Winter = Upper Willamette River ESU winter steelhead

Table 11. Estimated number of listed fish outmigrating from each ESU, 2016.

ESU	Run	Number of listed fish		
		Wild	AD-clipped	Hatchery ^e Non-AD-clipped
<u>Snake River</u>				
Chinook	Spring/summer	1,542,451	5,028,532	818,288
	Fall			
	- subyearlings	1,610,379	1,900,000	900,000
	- yearlings		453,455	503,545
Steelhead	Summer	589,093	3,791,450	468,800
Sockeye		20,832	219,542	0
<u>Upper Columbia</u>				
Chinook	Spring	629,138	405,500	397,300
Steelhead	Summer	112,094	570,010	187,590
<u>Mid-Columbia</u>				
Steelhead	Summer	364,790	397,000	118,000
	Winter	60,353	0	0
<u>Lower Columbia</u>				
Chinook	Spring	1,315,944	2,724,529	773,270
	Fall (tule)	6,673,703	25,846,491	197,957
	Fall (late run)	2,689,039	0	0
Steelhead	Summer	54,251	60,000	0
	Winter	254,946	1,050,000	60,000
Coho		619,576	6,550,158	158,500
<u>Upper Willamette</u>				
Chinook	Spring	1,275,681	6,349,103	0
Steelhead	Summer		169,724	0
	Winter	143,898	0	0
<u>Columbia River</u>				
Chum		4,608,900	0	900,000

^e Listed hatchery numbers are release numbers.

Appendix A.

Determination of the effects of returning all PIT-tagged spring/summer Chinook salmon to the river at each collection dam on the number of fish that arrive at each subsequent dam

A total of 209,895 hatchery spring/summer Chinook salmon (PIT tagged at hatcheries and traps) will arrive at Lower Granite Dam. Of the 209,895 hatchery fish reaching Lower Granite Dam, 35,767 will be listed hatchery fish. It is unknown whether the PIT-tagged hatchery fish will be ad-clipped or not, so, because ad-clipped hatchery fish constitute the vast majority of hatchery fish, all PIT-tagged fish are assumed to be ad-clipped for the following calculations.

Because tagging for the 2016 outmigration year began in July 2015 and continues throughout the outmigration year, we cannot accurately estimate survival from tagging of natural and migrating fish to the head of the Lower Granite Reservoir. We assumed that all of these fish would survive to the head of the reservoir, realizing that this is an overestimation. We chose the head of the reservoir because that is where the last of the tagging occurs, and because we have survival estimates from the head of the reservoir to the tailrace of Lower Granite Dam. It is expected that 96,520 wild spring/summer Chinook salmon will be PIT tagged above Lower Granite Dam. Using 90% survival from tagging location through the Lower Granite Dam pool, 86,868 ($96,520 \times 0.90$) will arrive at Lower Granite Dam.

National Marine Fisheries Service will be PIT-tagging fish at Lower Granite Dam during the 2016 outmigration. As part of this marking, 22,145 PIT-tagged wild spring/summer Chinook salmon will be released into the Lower Granite Dam tailrace. As these fish move downstream, all of those collected at Little Goose and Lower Monumental Dams will be diverted back to the river.

We performed two calculations to determine the expected number of PIT-tagged fish collected at each collector dam. The first calculation made use of the same formulas used under the "Transportation with Spill" and "Full Transportation" scenarios which assume that every fish collected is transported (except the CSS fish). This calculation provided the number of fish collected at each dam if no PIT-tagged fish were returned to the river. In other words, this calculation is based solely on the number of fish that are not collected and transported at upstream dam(s).

In the second calculation we assumed that the only fish transported at each Snake River collector dam are the CSS fish. This calculation provided the number of fish collected at each dam if the remaining PIT-tagged fish were returned to the river. This calculation includes both the fish that were returned to the river at upstream dam(s) and the fish that were not

collected at upstream dam(s). Because the number derived from the second calculation includes the number from the first calculation, the difference between the numbers from these two calculations is the number of PIT-tagged fish that were collected at each dam that were not accounted for because they were returned to the river at each dam (the number for each dam was added to the appropriate "... fish collected ..." columns in Tables 7-8). This difference in the number of fish collected was then expanded to the number of fish that arrived at the dam by dividing by the FGE of that dam, and was added to the number of fish that arrived at McNary Dam because they had not been collected and transported at upstream dams under both the "Transportation with Spill" and "Full Transportation" scenarios (column "Listed fish to McNary" in Tables 2 and 3, respectively).

Calculation 1 (Transportation)

Transportation with Spill Scenario--The numbers presented below assume that 70.8% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 29.2%), and that 30% of the CSS fish are returned to the river. In addition, 22,145 wild fish will be released into the tailrace of Lower Granite Dam from marking at the dam.

Using the FGEs in Table 2, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2016 will be

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	24,618	7,453	36,282	68,353
Lower Monumental	9,394	2,844	13,844	26,082
McNary	7,361	2,228	10,848	20,437

Full Transportation Scenario--The numbers presented below assume that 40.0% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 60.0%), and that 30% of the CSS fish are returned to the river. In addition, 22,145 wild fish will be released into the tailrace of Lower Granite Dam from marking at the dam.

Using the FGEs in Table 3, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2016 will be

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	33,282	8,369	40,746	82,397
Lower Monumental	8,064	2,028	9,873	19,965
McNary	5,226	1,314	6,397	12,937

Calculation 2 (Only CSS fish transported)

This calculation assumes that all collected PIT-tagged fish (except the CSS fish) are returned to the river at each Snake River collector dam.

For the PIT-tagged fish returned to the river at each collection dam, the only loss of fish as they migrate downstream is the mortality through each reservoir and dam. Based on the NMFS survival studies, survival through each reservoir and dam was estimated to be 90%. The estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2016 will be

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	32,082	10,526	51,245	93,853
Lower Monumental	18,190	5,968	29,055	53,213
McNary	17,952	5,890	28,676	52,518

Full Transportation Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Little Goose	63,773	20,924	101,865	186,562
Lower Monumental	44,151	14,486	70,522	129,159
McNary	57,221	18,774	91,397	167,392

Subtracting collection numbers estimated by Calculation 1 from Calculation 2 provides the number of unaccounted for PIT-tagged fish that were collected at each dam (Appendix Table A1).

Appendix Table A1. Estimates of the number of unaccounted for PIT-tagged spring/summer Chinook salmon that will be collected at each of the collection dams, and estimates of how many of these fish will arrive at McNary Dam, 2016.

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	7,464	3,073	14,963	25,500
Lower Monumental	8,796	3,124	15,211	27,131
McNary	10,591	3,662	17,828	32,081
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.251):				
McNary	42,195	14,590	71,028	127,813

Full Transportation Scenario (No Spill)

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	30,491	12,555	61,119	104,165
Lower Monumental	36,087	12,458	60,649	109,194
McNary	51,995	17,460	85,000	154,455
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.800):				
McNary	64,994	21,825	106,250	193,069

Appendix B.

Determination of the effects of returning all PIT-tagged steelhead to the river at each collection dam on the number of fish that arrive at each subsequent dam

We surveyed researchers regarding the number of outmigrating PIT-tagged steelhead in the Snake River we could expect in 2016. We found that 139,231 (65,042 of which will be listed) hatchery fish will be PIT tagged prior to release above Lower Granite Dam. Based on the survival rates of the various hatcheries releasing fish, we estimate that 106,816 (49,916 of which will be listed) will arrive at Lower Granite Dam. Another 9,000 unlisted hatchery steelhead (PIT tagged at traps) will arrive at Lower Granite Dam, bringing the total to 115,816 hatchery fish (which includes 49,916 listed fish) arriving at Lower Granite Dam. In addition, 16,500 wild steelhead PIT tagged at traps will arrive at Lower Granite Dam.

National Marine Fisheries Service will be PIT-tagging steelhead at Lower Granite Dam during the 2016 outmigration. As part of this marking, 32,747 PIT-tagged fish will be released into the Lower Granite Dam tailrace. Of these, approximately 14,774 will be wild fish, 9,030 will be listed hatchery fish, and 8,943 will be unlisted hatchery fish. All of the fish collected at Little Goose and Lower Monumental Dams will be diverted back to the river. WDFW plans to release 18,000 PIT-tagged fish into the Tucannon River. Of these, 15,000 will be listed, and 3,000 will be unlisted hatchery fish.

We performed two calculations to determine the expected number of PIT-tagged fish collected at each collector dam. The first calculation made use of the same formulas used under the "Transportation with Spill" and "Full Transportation" scenarios which assume that every fish collected is transported. This calculation provided the number of fish collected at each dam if no PIT-tagged fish were returned to the river. In other words, this calculation is based solely on the number of fish that are not collected and transported at upstream dam(s).

In the second calculation we assumed that no fish are transported. This calculation provided the number of fish collected at each dam if all PIT-tagged fish were returned to the river. This calculation includes both the fish that were returned to the river at upstream dam(s) and the fish that were not collected at upstream dam(s). Because the number derived from the second calculation includes the number from the first calculation, the difference between the numbers from these two calculations is the number of PIT-tagged fish that were collected at each dam that were not accounted for because they were returned to the river at each dam (the number for each dam was added to the appropriate "... fish collected ..." columns in Tables 9-10). This difference in the number of fish collected

was then expanded to the number of fish that arrived at the dam by dividing by the FGE of that dam, and was added to the number of fish that arrived at McNary Dam because they had not been collected and transported at upstream dams under both the "Transportation with Spill" and "Full Transportation" scenarios (column "Listed fish to McNary" in Tables 5 and 6, respectively).

Calculation 1 (Transportation)

Transportation with Spill Scenario--Assuming that 72.1% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 27.9%), 11,896 (16,500 x 0.721) wild, 35,989 (49,916 x 0.721) listed hatchery, and 47,514 (65,900 x 0.721) unlisted hatchery fish will reach the Lower Granite Dam tailrace. In addition, 14,774 wild, 9,030 listed hatchery, and 8,943 unlisted hatchery fish will be released into the tailrace from marking at the dam. Therefore, the total numbers of PIT-tagged fish in the Lower Granite Dam tailrace will be 26,670 (11,896 + 14,774) wild, 45,019 (35,989 + 9,030) listed hatchery, and 56,457 (47,514 + 8,943) unlisted hatchery fish.

Using the FGEs in Table 5, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2016 will be

Dam	Wild	Listed hatchery	Un-listed hatchery	Total
Little Goose	8,089	13,654	17,123	38,866
Lower Monumental	3,266	8,932	7,597	19,795
McNary	1,209	5,062	3,218	9,489

Full Transportation Scenario--Assuming that 20.0% of the PIT-tagged fish arriving at Lower Granite Dam will not be collected (FGE = 80.0%), 3,300 (16,500 x 0.20) wild, 9,983 (49,916 x 0.20) listed hatchery, and 13,180 (65,900 x 0.20) unlisted hatchery fish will reach the Lower Granite Dam tailrace. In addition, 14,774 wild, 9,030 listed hatchery, and 8,943 unlisted hatchery fish will be released into the tailrace from marking at the dam. Therefore, the total numbers of PIT-tagged fish in the Lower Granite Dam tailrace will be 18,074 (3,300 + 14,774) wild, 19,013 (9,983 + 9,030) listed hatchery, and 22,123 (13,180 + 8,943) unlisted hatchery fish.

Using the FGEs in Table 6, the estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2016 will be

Dam	Wild	Listed hatchery	Un-listed hatchery	Total
Little Goose	14,640	15,401	17,920	47,961
Lower Monumental	952	10,751	3,115	14,818
McNary	374	15,921	3,923	20,218

Calculation 2 (No Transportation)

Assuming that 100% of the collected PIT-tagged fish are returned to the river at Lower Granite Dam, 31,274 (16,500 + 14,774) wild, 58,946 (49,916 + 9,030) listed hatchery, and 74,843 (65,900 + 8,943) unlisted hatchery fish will reach the tailrace.

Because 100% of the PIT-tagged fish were assumed to be returned to the river at each collection dam, the only loss of fish as they migrate downstream is the mortality through each reservoir and dam. Based on the NMFS survival studies, survival through each reservoir and dam was estimated to be 90%. The estimated number of PIT-tagged fish collected at each dam below Lower Granite Dam in 2016 will be

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Un-listed hatchery	Total
Little Goose	9,485	17,878	22,700	50,063
Lower Monumental	5,775	14,306	14,506	34,587
McNary	2,770	8,616	7,362	18,748

Full Transportation Scenario

Dam	Wild	Listed hatchery	Un-listed hatchery	Total
Little Goose	25,332	47,746	60,623	133,701
Lower Monumental	16,466	40,785	41,355	98,606
McNary	18,467	57,442	49,082	124,991

Subtracting collection numbers estimated by Calculation 1 from Calculation 2 provides the number of unaccounted for PIT-tagged fish that were collected at each dam (Appendix Table B1).

Appendix Table B1. Estimates of the number of unaccounted for PIT-tagged steelhead that will be collected at each of the collection dams, and estimates of how many of these fish will arrive at McNary Dam, 2016.

Transportation with Spill Scenario

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	1,396	4,224	5,577	11,197
Lower Monumental	2,509	5,374	6,909	14,792
McNary	1,561	3,554	4,144	9,259
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.135):				
McNary	11,563	26,326	30,696	68,585

Full Transportation Scenario (No Spill)

Dam	Wild	Listed hatchery	Unlisted hatchery	Total
Number of unaccounted for PIT-tagged fish collected:				
Little Goose	10,692	32,345	29,826	72,863
Lower Monumental	15,514	30,034	37,670	83,218
McNary	18,093	41,521	53,519	113,133
Number of unaccounted for PIT-tagged fish that arrived at McNary Dam (FGE = 0.90):				
McNary	20,103	46,134	59,466	125,703