4 Take Analysis

4.1 Take of Delta Smelt

4.2 Take of Longfin Smelt

4.2.1 Construction Effects

The proposed timing of in-water construction activities within the potential range of longfin smelt (north Delta intakes and barge landings: June 1-October 31; Clifton Court Forebay and associated facilities: June 1-November 30) will avoid the longfin smelt migration and spawning season, and the potential occurrence of adults, eggs, and larvae in these areas.

The potential for take of longfin smelt will occur due to permanent losses of potential spawning habitat, if such habitat occurs within the footprints of the water conveyance facilities. The extent of impacts of in-water habitat is presented in [table to be developed for Delta smelt and referred to here]. Compensation for impacts on potential spawning habitat of longfin smelt will be achieved in conjunction with compensation measures for delta smelt by restoring shallow water habitat[1] at a 3:1 ratio at an approved restoration site, or purchasing equivalent conservation credits at an approved conservation bank.

4.2.2 Operations Effects

4.2.2.1 Delta Outflow Effects

Freshwater flow influences the physical, chemical, and biological characteristics of estuarine environments (Kimmerer 2002). In the upper San Francisco Estuary, ecosystem services that have been found to vary with flow include primary production (Jassby et al. 2008), secondary production (Kimmerer et al. 2009), and habitat for pelagic fishes (Feyrer et al. 2007). Additionally, flow has been found to affect survival, growth, and population levels of many key estuarine species, including Chinook salmon (Newman and Brandes 2001), longfin smelt (Rosenfield and Baxter 2007), and delta smelt (Feyrer et al. 2007; Feyrer et al. 2011).

For longfin smelt, focus on estuarine inflow has centered on the positive relationship found between winter/spring outflow (January to June) and juvenile abundance during the fall (Rosenfield and Baxter 2007; Kimmerer et al. 2009). Specifically, as X2 (the position of the 2-ppt near-bottom salinity isohaline from the Golden Gate Bridge; see Jassby et al. [1995]) shifts downstream during the spring, the abundance index of longfin smelt in the Fall Midwater Trawl (FMWT) survey increases (Kimmerer 2002; Kimmerer et al. 2009). The mechanisms underlying this relationship are poorly understood; however, the positive abundance-flow relationship suggests that higher outflow produces conditions that enhance recruitment to juvenile life stages. Hypotheses about underlying mechanisms to this abundance-flow relationship include transport of larval longfin smelt out of the Delta to downstream rearing habitats (Moyle 2002; Rosenfield

[1] The U.S. Fish and Wildlife Service defines shallow water habitat as all waters between mean high water and 3 meters below mean lower low water.

and Baxter 2007); increased extent of rearing habitat as X2 moves seaward (Kimmerer et al. 2009); retention of larvae in suitable rearing habitats (Kimmerer et al. 2009); increased food abundance under higher flows (California Department of Fish and Game 2009a); and reduced clam grazing effects on primary and secondary production (California Department of Fish and Game 2009a). It has also been recognized that abundance of adults (spawners) is an important factor driving longfin smelt population dynamics (Baxter et al. 2010), with recent studies examining this link in detail (Maunder et al. 2015; Nobriga and Rosenfield 2016); this factor is discussed further following the analysis of potential outflow effects.

Changes in outflow associated with the proposed project (PP) could affect longfin smelt in accordance with the flow-abundance relationship of Kimmerer et al. (2009). Specifically, the log abundance values represent a relative survival index for each of these relationships, which, when reverse log-transformed, indicate how the PP might influence numbers of longfin smelt surviving until the following fall (expressed as a relative abundance index). The methods and detailed results of that analysis are presented in Appendix 4.A[2]. Overall, the analysis finds that relative abundance indices do not differ greatly between the baseline condition (NAA) and PP scenarios for regressions based on any of the available time series: the Fall Midwater Trawl (Appendix 4.A: Figure 4.A-1, Figure 4.A-2, and Table 4.A-2), the Bay Midwater Trawl (Appendix 4.A: Figure 4.A-3, Figure 4.A-4, and Table 4.A-2), and the Bay Otter Trawl (Appendix 4.A: Figure 4.A-5, Figure 4.A-6, and Table 4.A-2). The mean relative abundance indices in wet, above normal, and below normal years were very similar (within 0-1%), whereas there were slightly greater differences in mean relative abundance in critical years (2-3% less under PP) and dry years (4-5% less under PP). These results reflect similar or slightly higher mean X2 (slightly less Delta outflow) under the PP during the January-June period (see Table 5.A.6-29 and Figures 5.A.6.29-1 to 5.A.6.29-19 in Attachment 4.A.1.1, *CalSim II Modeling and Result*s, of Appendix 4.A). Note that the differences in relative abundance index between NAA and PP in all years were small compared to the range in predicted abundance indices derived from the 95% confidence intervals of the Kimmerer et al. (2009) regression equations; the 95% confidence intervals in the relative abundance indices overlapped in all years (Appendix 4.A: Figure 4.A-7, Figure 4.A-8, and Figure 4.A-9). This suggests that the small magnitude of difference in relative abundance index between NAA and PP scenarios would be challenging to detect statistically.

As described further in Section 4.A.1.3, *Methods: Outflow-Relative Abundance General Linear Models*, of Appendix 4.A, DFW expressed concern that the method of calculation of the 95% confidence intervals around the mean relative abundance estimates from the Kimmerer et al (2009) X2-relative abundance regressions was not appropriate. In order to address this concern, the analysis of Kimmerer et al. (2009) was essentially updated to include more recent years of data, and was based on Delta outflow rather than X2, in addition to step changes reflecting the invasion of *Corbula amurensis* and the onset of the Pelagic Organism Decline. As described in more detail within Section 4.A.1.3, *Methods: Outflow-Relative Abundance General Linear Models*, of Appendix 4.A, two Delta outflow averaging periods were investigated (January–June and March–June), consistent with the analysis undertaken by Mount et al. (2013); both were

[2] CalSim modeling methods and results for the NAA and PP are presented in Attachment 4.A.1.1 *CalSim II Modeling and Results* of Appendix 4.A. The attachment provides summaries of modeled Delta outflow, X2, and other outputs of interest.

equally supported and so both were used to provide further comparison of potential differences in longfin smelt abundance (as indexed by the Fall Midwater Trawl) between NAA and PA. As described in in Section 4.A.1.4, *Results: Outflow-Relative Abundance General Linear Models*, of Appendix 4.A, the results of these additional analyses were similar to those found with the Kimmerer et al. (2009) regression, in that there was very little difference in terms of predicted longfin smelt relative abundance between NAA and PP (Appendix 4.A: Table 4.A-4, Figure 4.A-12, Figure 4.A-13, Figure 4.A-14, and Figure 4.A-15). In particular, the overall predictions based on March–June Delta outflow were essentially identical (Figure 4.A-15[3]), as would be expected based on the overall similarity between NAA and PP in Delta outflow during most of this portion of the year, whereas slightly lower Delta outflow in January–March (1–2%, over the 82-year simulation) contributed to slightly lower predicted abundance based on the the January–June averaging period (see Table 5.A.6-26 in Attachment 4.A.1.1, *CalSim II Modeling and Results*, of Appendix 4.A). Consistent with the analysis based on the Kimmerer et al. (2009) regressions, the 95% confidence intervals for annual estimates of fall midwater trawl relative abundance index overlapped in every year between NAA and PA (Figures 4.A-16 and 4.A-17). This again suggests that the small magnitude of difference in relative abundance index between NAA and PP scenarios would be challenging to detect statistically.

Although the differences in mean relative abundance predicted from applying the X2-abundance regression relationships from Kimmerer et al. (2009) and general linear modeling based on Delta outflow suggested at most small negative effects of the PP relative to NAA, DFW is concerned that small differences could accumulate over time: as previously noted, in addition to the importance of outflow, adult abundance affects subsequent juvenile abundance (stock-recruitment relationships; Nobriga and Rosenfield 2016), so an effect of outflow on juvenile and subsequent adult abundance could then affect the number of recruits derived from those adults. Ideally, population dynamics (life cycle) models would be applied to investigate the potential for this type of effect. Two recent published works have investigated such models. Maunder et al.'s (2015) state-space modeling found that multiple factors (flow, ammonium concentration, and water temperature) and density dependence influenced the survival of longfin smelt (represented by Bay Study abundance indices during 1980–2009). However, the flow terms included in their best models are not affected by the PP: Sacramento River October-July unimpaired runoff and Napa River runoff. A quantitative forward stepwise selection procedure found that the longfin smelt response data better supported these flow terms over others that were initially considered, including mean Old and Middle River flows (January–March), mean X2 (April–June), mean Delta outflow (January–March), and Delta outflow threshold indicators (March–May mean >34,500 cfs and >44,500 cfs) (Maunder and Deriso 2013). Therefore, the state-space modeling of Maunder et al. (2015) would not be useful for investigating year-over-year effects of the PP because the best supported models suggested general hydrological conditions, as opposed to specific Delta conditions, better supported the pattern of longfin smelt survival in 1980–2009.

The other recently published longfin smelt population dynamics modeling study is that of Nobriga and Rosenfield (2016), who examined various formulations of a Ricker (1954) stock-

[3] Small differences between water-year annual means (Table 4.A-4) were not apparent when the data were sorted into exceedances, which do not consider water-year type.

recruitment model to simulate fall midwater trawl indices through time. They found that Delta outflow had a positive association with recruits per spawner and that juvenile survival was density-dependent (lower survival with greater numbers of juveniles), possibly as a result of processes occurring in the mesohaline or marine environments where juveniles predominantly rear. Nobriga and Rosenfield (2016: 54) suggested that the density-dependent term in their models was too strong, and the propagated prediction error in the models was large. In the context of potential use in the present take analysis of the PP, this latter issue would be likely to generate largely overlapping estimates of longfin smelt indices between the NAA and PP. Nobriga and Rosenfield (2016: 56) discussed their findings in relation to density dependence as follows:

> The results suggest that the general life cycle model for Longfin Smelt is very similar to Striped Bass *Morone saxatilis* (Kimmerer et al. 2000). For each of these species, freshwater flow variation has been linked to productivity early in the life cycle—an effect that is subsequently tempered by density-dependent survival during the juvenile life stage. Density-dependent survival may seem paradoxical in a declining fish species like the Longfin Smelt, but fisheries recruitment theory has demonstrated how a spawner–recruit relationship that appears to reflect density dependence can arise from food-web-related mechanisms that are unrelated to a population's limitation of its own resource base (Walters and Juanes 1993).

The "tempering" of the Delta outflow effect referred to by Nobriga and Rosenfield (2016) suggests that the small differences in longfin smelt abundance indices (i.e., recruitment) between NAA and PP that were estimated in the present take analysis may not accumulate over time; rather, the differences would be lessened by density-dependent effects during the juvenile life stage.

4.2.2.2 Entrainment and South Delta Entry

There is potential for the PP to take longfin smelt through entrainment by water diversions in the Delta, including the south Delta export facilities and the proposed NDD, and to alter Delta channel hydrodynamics such that there is a changed likelihood of entry into the south Delta, where survival may be lower. Of particular concern is the potential for take of longfin smelt larvae during winter (January-March). With respect to the NDD, survey data suggest that the frequency of occurrence of longfin smelt near the NDD is very low (Table 4.1-1, Table 4.1-2, Table 4.1-3, and Table 4.1-4), and there are no suitable recent data to provide an estimate of the relative density of longfin smelt larvae near the NDD compared to other areas of the Delta. An analysis was undertaken based on Smelt Larval Survey (SLS) data from 2009-2014, combined with DSM2-PTM (particle tracking modeling) results, in order to compare potential longfin smelt potential entrainment loss for the NAA and PP scenarios. The method and detailed results are provided in Appendix 4.A[4]. Note that the estimates of entrainment from the analysis are not predictions of actual percentages of the larval longfin smelt population that would be entrained,

[4] In addition, DSM2 modeling methods and results for the NAA and PP are presented in Attachment 4.A.1.2 *DSM2 Modeling and Results* of Appendix 4.A.

but instead are a comparison of potential relative differences between two operational scenarios, which is assumed to be a surrogate for risk of take. It is important to recognize that operational adjustments could be further evaluated once more information is gathered about the relative proportions of larvae entrained. Based on methods applied in Appendix 4.A, where distribution of newly hatched larvae from the Smelt Larval Survey were analyzed, the relative proportion of larval longfin smelt hatching and rearing in the south and north Delta is smaller than previously was the assumed in the SWP Incidental Take Permit effects analysis (California Department of Fish and Game 2009b); the latter analysis focused on distribution only in the Delta (based on 1991-1994 and 2005 California Department of Fish and Game larval sampling), whereas the present analysis includes consideration of more locations based on SLS data. Operational adjustments would be made in order to minimize the potential for take of longfin smelt and other fishes, based on real-time biological and physical monitoring; such adjustments cannot be readily simulated in this analysis.

The results of the analysis indicate that larval longfin smelt entrainment under PP would be less than under NAA, particularly in wetter years when the NDD would be less constrained in terms of operations (Appendix 4.A: Figure 4.A-20 and Figure 4.A-21; Figure 4.A-22 and Figure 4.A-23; Figure 4.A-24 and Figure 4.A-25). Predicted mean annual total entrainment under PP ranges from 1% less than NAA in February of dry years and March of critical years to 35% less than NAA in January of below normal years (Appendix 4.A: Table 4.A-9). As described in Appendix 4.A, most entrainment is estimated to occur at the NBA because of the larval distribution assumed in the analysis, whereas the relative differences in entrainment by the south Delta export facilities between NAA and PP are considerably greater than the relative differences in total entrainment.

The analysis of the potential for longfin smelt larvae to enter the south Delta, where survival is expected to be low, suggests that there would be appreciably less entry into the south Delta under PP than under NAA (Appendix 4.A: Figure 4.A-26, Figure 4.A-27, and Table 4.A-10; Figure 4.A-28 and Figure 4.A-29; Figure 4.A-30 and Figure 4.A-31). Thus the PP is expected to provide improved hydrodynamic conditions for longfin smelt larvae occurring in the Delta.

As discussed in Section 4.A.2.1.3, *Note on Proportion of Larval Population Outside the Delta and Suisun Bay/Marsh*, in Appendix 4.A, the SLS survey likely samples a narrow window of the actual longfin smelt hatching distribution, especially during wetter years. Thus, the effects of entrainment are likely smaller than previously expected, but not non-existent. Because there is little difference in X2 between NAA and the PP, the PP is not likely to affect spawning habitat distribution during most years.

With increasing sea level, adult longfin smelt could be distributed farther upstream in response to increasing X2. However, Grimaldo et al. (2009) found that adult longfin smelt salvage at the south Delta export facilities was significantly negatively related to mean December–February Old and Middle River flows, but not to X2 (or other variables that were examined). Given that Old and Middle River flows during December–February would be less negative/more positive under the PP than under NAA (see Attachment 4.A.4.1, *CalSim Modeling and Results* of Appendix 4.A, *Longfin Smelt Quantitative Analyses*, specifically Table 5.A.6-25 and Figures

5.A.6-25-1 to 5.A.6-25-7), any take of longfin smelt adults during this time period would be expected to be less under the PP than NAA. In addition, and as previously noted, both NAA and PP would, as now, include real-time management of south Delta exports and Old and Middle River flows in order to limit the potential for entrainment of longfin smelt and other listed fishes; such adjustments cannot be readily simulated.

As shown in Section 4.A.2.2.3, *Particles Remaining in the Modeling Domain*, of Appendix 4.A, the percentage of particles (representing longfin smelt) remaining in the DSM2-PTM modeling domain after the 45-day simulation period can range from around 2 to 20% or more, reflecting particles that were not entrained or did not leave the model domain. These particles are representative of juvenile longfin that may still be susceptible to entrainment. Grimaldo et al. (2009) found that juvenile longfin smelt salvage principally occurred in April–May, and was significantly negatively related to mean April–May Old and Middle River flow (and was not related to other factors such as X2). Old and Middle River flows during April–May generally would be similar between PP and NAA (see Attachment 4.A.4.1, *CalSim Modeling and Results* of Appendix 4.A, *Longfin Smelt Quantitative Analyses*, specifically Table 5.A.6-25 and Figures 5.A.6-25-1 to 5.A.6-25-7), so take of juvenile longfin smelt during this time period would be expected to be similar under the NAA and PA. In addition, and as previously noted in the discussion of larval and adult longfin smelt entrainment, both NAA and PP would include real-time management of south Delta exports and Old and Middle River flows in order to limit the potential for entrainment of longfin smelt and other listed fishes.

Table 4.1-1. Number of Longfin Smelt Collected and Catch per Trawl during the Fall Midwater Trawl Survey (September–December)

Year	Number of Samples		Total Caught		Proportion (Intake Area/Total)	Mean Catch Per Trawl	
	Intake Area	Downstream Area	Intake Area	Downstream Area		Intake Area	Downstream Area
1991	9	590	0	223	0.00	0.00	0.38
1992	21	685	0	74	0.00	0.00	0.11
1993	18	875	0	668	0.00	0.00	0.76
1994	24	805	0	1006	0.00	0.00	1.25
1995	21	713	0	2799	0.00	0.00	3.93
1996	22	719	0	1943	0.00	0.00	2.70
1997	18	626	0	604	0.00	0.00	0.96
1998	6	509	0	4958	0.00	0.00	9.74
1999	12	532	0	2644	0.00	0.00	4.97
2000	13	581	0	2472	0.00	0.00	4.25
2001	21	628	0	1122	0.00	0.00	1.79
2002	9	356	0	473	0.00	0.00	1.33
2003	12	359	0	322	0.00	0.00	0.90
2004	12	357	0	115	0.00	0.00	0.32
2005	12	359	0	46	0.00	0.00	0.13
2006	8	351	0	275	0.00	0.00	0.78
2007	12	360	0	9	0.00	0.00	0.03
2008	12	356	0	78	0.00	0.00	0.22
2009	12	382	0	49	0.00	0.00	0.13
2010	12	384	0	50	0.00	0.00	0.13

Source: California Department of Fish and Game unpublished data. Note: Intake Area includes all stations on the Sacramento River upstream of the Delta Cross Channel. Downstream Area includes all other stations.

Table 4.1-2. Number of Longfin Smelt (<60 mm Fork Length) Collected and Catch per Seine during USFWS Seine Sampling in the Plan Area (January–December)

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Seine (Intake Area)	Catch per Seine (Downstream)
	Intake Area	Down-stream					
1976	29	126	0	0	–	0.00	0.00
1977	118	190	0	0	–	0.00	0.00
1978	72	147	0	0	–	0.00	0.00
1979	95	363	0	0	–	0.00	0.00
1980	104	440	0	31	0.00	0.00	0.07
1981	93	308	0	0	–	0.00	0.00
1982	101	321	0	0	–	0.00	0.00
1983	66	267	0	0	–	0.00	0.00
1984	66	256	0	0	–	0.00	0.00
1985	59	230	0	0	–	0.00	0.00
1986	33	168	0	0	–	0.00	0.00
1987	44	172	0	0	–	0.00	0.00
1988	43	164	0	0	–	0.00	0.00
1989	49	202	0	0	–	0.00	0.00
1990	19	52	0	0	–	0.00	0.00
1991	44	152	0	0	–	0.00	0.00
1992	103	338	0	0	–	0.00	0.00
1993	149	413	0	9	0.00	0.00	0.02
1994	215	731	1	1	0.50	0.00	0.00
1995	497	645	0	7	0.00	0.00	0.01
1996	646	782	0	0	–	0.00	0.00
1997	444	693	0	0	–	0.00	0.00
1998	360	782	0	2	0.00	0.00	0.00
1999	323	854	0	0	–	0.00	0.00
2000	372	826	0	1	0.00	0.00	0.00
2001	364	924	0	0	–	0.00	0.00
2002	331	1070	1	3	0.25	0.00	0.00
2003	332	1014	0	1	0.00	0.00	0.00
2004	359	1015	0	0	–	0.00	0.00
2005	386	1006	0	3	0.00	0.00	0.00
2006	324	928	0	0	–	0.00	0.00
2007	360	994	0	1	0.00	0.00	0.00
2008	341	950	0	0	–	0.00	0.00
2009	358	970	0	0	–	0.00	0.00
2010	359	850	0	0	–	0.00	0.00
2011	347	852	0	0	–	0.00	0.00
Mean	222	561	0	2	0.08	0.00	0.00
5th percentile	32	142	0	0	0.00	0.00	0.00
25th percentile	66	223	0	0	0.00	0.00	0.00
Median	182	543	0	0	0.00	0.00	0.00
75th percentile	359	872	0	1	0.00	0.00	0.00

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Seine (Intake Area)	Catch per Seine (Downstream)
	Intake Area	Down-stream					
95th percentile	457	1014	0	8	0.39	0.00	0.01

Source: U.S. Fish and Wildlife Service Delta Juvenile Fish Monitoring Program (Speegle pers. comm.). Note: Intake Area includes all stations on the Sacramento River upstream of the Delta Cross Channel. Downstream Area includes all other stations.

Table 4.1-3. Number of Longfin Smelt (≥60 mm Fork Length) Collected and Catch per Seine during USFWS Seine Sampling in the Plan Area (January–December)

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Seine (Intake Area)	Catch per Seine (Downstream)
	Intake Area	Down-stream					
1976	29	126	0	0	–	0.00	0.00
1977	118	190	0	0	–	0.00	0.00
1978	72	147	0	0	–	0.00	0.00
1979	95	363	0	15	0.00	0.00	0.04
1980	104	440	0	1	0.00	0.00	0.00
1981	93	308	0	0	–	0.00	0.00
1982	101	321	0	1	0.00	0.00	0.00
1983	66	267	0	0	–	0.00	0.00
1984	66	256	0	0	–	0.00	0.00
1985	59	230	0	0	–	0.00	0.00
1986	33	168	0	0	–	0.00	0.00
1987	44	172	0	0	–	0.00	0.00
1988	43	164	0	0	–	0.00	0.00
1989	49	202	0	0	–	0.00	0.00
1990	19	52	0	0	–	0.00	0.00
1991	44	152	0	0	–	0.00	0.00
1992	103	338	0	0	–	0.00	0.00
1993	149	413	0	0	–	0.00	0.00
1994	215	731	1	0	1.00	0.00	0.00
1995	497	645	0	0	–	0.00	0.00
1996	646	782	0	8	0.00	0.00	0.01
1997	444	693	0	0	–	0.00	0.00
1998	360	782	1	0	1.00	0.00	0.00
1999	323	854	0	0	–	0.00	0.00
2000	372	826	0	0	–	0.00	0.00
2001	364	924	0	0	–	0.00	0.00
2002	331	1070	0	0	–	0.00	0.00
2003	332	1014	0	0	–	0.00	0.00
2004	359	1015	0	0	–	0.00	0.00
2005	386	1006	0	0	–	0.00	0.00
2006	324	928	0	0	–	0.00	0.00
2007	360	994	0	0	–	0.00	0.00
2008	341	950	0	0	–	0.00	0.00
2009	358	970	0	0	–	0.00	0.00

Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Seine (Intake Area)	Catch per Seine (Downstream)
	Intake Area	Down-stream					
2010	359	850	0	0	–	0.00	0.00
2011	347	852	0	0	–	0.00	0.00
Mean	222	561	0	1	0.33	0.00	0.00
5th percentile	32	142	0	0	0.00	0.00	0.00
25th percentile	66	223	0	0	0.00	0.00	0.00
Median	182	543	0	0	0.00	0.00	0.00
75th percentile	359	872	0	0	0.75	0.00	0.00
95th percentile	457	1014	0	3	1.00	0.00	0.00

Source: U.S. Fish and Wildlife Service Delta Juvenile Fish Monitoring Program (Speegle pers. comm.). Note: Intake Area includes all stations on the Sacramento River upstream of the Delta Cross Channel. Downstream Area includes all other stations.

Table 4.1-4. Number of Longfin Smelt Larvae Collected and Catch per Cubic Meter during the Striped Bass Egg and Larval Survey (February–July)

Water Year	Number of Samples		Total Caught (Intake Area)	Total Caught (Downstream Area)	Proportion Caught (Intake Area/Total)	Catch per Cubic Meter (Intake Area)	Catch per Cubic Meter (Downstream)
	Intake Area	Downstream					
1991	217	1371	38	2333	0.02	0.17	9.65
1992	355	2064	2	2497	0.00	0.01	10.18
1993	261	2160	3	2632	0.00	0.01	12.30
1994	312	2348	2	22233	0.00	0.01	97.17
Mean	286	1986	11	7424	0.00	0.05	32.32

Source: California Department of Fish and Game unpublished data. Note: Intake Area includes all stations on the Sacramento River upstream of the Delta Cross Channel. Downstream Area includes all other stations.

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