Appendix A. Special Status Species Life History Information

Designated Critical Habitat

The designated critical habitat of Sacramento River winter-run Chinook salmon occurs at the origin of the SRSC adjacent to Kimball, Browns and Winter Islands near RM 4 of the San Joaquin River and is inclusive of the aquatic habitat below the ordinary high water mark surrounding these islands. The winter-run Chinook ESU has designated critical habitat in the SRSC beginning at the Chipps Island, the western margin of the Sacramento-San Joaquin Delta. Designated critical habitat for Central Valley spring-run Chinook salmon borders the northern edge of the San Joaquin River from the confluence of the Mokelumne River west to the boundaries of Suisun Bay and the Delta hydrologic sub units at approximately RM 4 of the San Joaquin River. This includes the waters of Three Mile Slough and New York Slough. Critical habitat for CV Chinook salmon includes the Sacramento River from Keswick Dam in Shasta County through the San Francisco Bay. Individuals of both Chinook salmon Evolutionarily Significant Units (ESUs) can occupy waters within the SSC and SRSC action area. Designated critical habitat for the Central Valley steelhead ESU occurs along the entire length of the SSC and SRSC below the ordinary high water mark. The recently listed Southern Distinct Population Segment DPS of green sturgeon's critical habitat designation is not yet proposed. Other key species of interest that are at least seasonally present in the action area include: delta smelt, Sacramento splittail, Pacific and river lamprey, and longfin smelt.

Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawyscha*)
ESA Status: Endangered- Critical Habitat designated. California Status: Endangered.
[Sources: CalFed 2005; Fry 1961, 1973; Hallock et al. 1970; Hallock and Fry 1967; Miller and Lea 1972; Moyle 1976; Sasaki 1966; Wang 1986.]

Use of project area waters by this ESU of Chinook salmon is primarily for adult spawning migrations, and juvenile rearing and outmigrations. Winter-run Chinook adults migrate upstream December-July with spawning in accessible upper reaches of the Sacramento River basin occurring April-July.

Chinook alevins have been collected from Suisun Bay in January and February. Larger parr-juveniles have been found from April to June. Juvenile life stages are commonly found inshore, in shallow water and throughout estuarine habitat. Some Chinook salmon delay their downstream migration until the early smolt stage. Juvenile outmigration peaks from May to June. Juvenile Chinook salmon feed primarily on various aquatic and terrestrial insects, crustaceans, chironomid larvae and pupae, and caddisflies when they are in fresh water. When found in saline waters, the Chinook smolt diet changes to mainly *Neomysis spp.*, *Gammarus spp.*, and *Crangon spp*. Juvenile salmon are prey for many animals, including other fish and birds.

Central Valley spring-run Chinook salmon (*O. tshawyscha*)
ESA Status: Threatened - Critical Habitat designated. California Status: Threatened.
[Sources: CalFed 2005; Fry 1961, 1973; Hallock et al. 1970; Hallock and Fry 1967; Miller and Lea 1972; Moyle 1976; Sasaki 1966; Skinner 1972. Wang 1986.]

Uses of the project areas by spring-run Chinook salmon are of the same types as described for the winter-run ESU. Spawning migration timing differs with spring-run Chinook moving upstream April-October, and spawning from August-October. Juvenile usage in the areas of concern is similar to that described for winter-run Chinook.

Central Valley steelhead (*O. mykiss*)
ESA Status: Threatened - Critical Habitat designated.
[Sources: CalFed 2005; Hallock et al. 1961; Hallock and Fry 1967; Moyle 1976; Wang 1986.]

After an ocean residence of 2-3 years, anadromous adults of the Central Valley steelhead ESU make their upstream migrations beginning in July (peaking in September and October), and spawn December through April. Steelhead primarily use the project areas as a migration corridor, with some juvenile rearing overlapping with their smoltification and outmigrations. Spawning and incubation, along with the majority of rearing, occurs farther upstream than for Chinook salmon. Juveniles feed on diverse aquatic and terrestrial insects and other small invertebrates, primarily occupying the water column and near surface when over deeper waters. Though juvenile Central Valley steelhead outmigrate to the ocean from December through August, most are found migrating through the project areas in spring.

Delta smelt (*Hypomesus transpacificus*)
ESA Status: Threatened - Critical Habitat designated. California status: Threatened
[Sources: Bennett 2005; CalFed 2005; Ganssle 1966; Herald 1961; McAllister 1963; Messersmith 1966; Moyle 1976; Radtke 1966; Wang 1986.]

The endemic delta smelt is a euryhaline fish that ranges from the lower reaches of the Sacramento and San Joaquin rivers, through the Delta, and into Suisun Bay. They have been found in the SRSC and SSC in low abundance. The abundance of this fish is closely associated with salinities between 0-7 practical salinity units (psu), with an upper tolerance of 19 psu and a significant preference centered near or upstream of the 2 psu zone. The delta smelt is not present in waters over 25 ˚C, and is rarely found in water temperatures above 22 ˚C.

Delta smelt spawn in deadened sloughs, near-inshore areas of the Delta, and shallow fresh water channels of the Delta and Suisun Bay. In the fall, prior to spawning, delta smelt congregate in upper Suisun Bay and the lower reaches of the Delta. The spawning period is estimated to be from February to June. Eggs are adhesive. The delta smelt may prefer spawning over vegetation, if present, but often deposit their eggs over submerged tree branches and stems, or in open water over sandy and rocky substrate, and may even use the shallower areas of Delta levees. Newly hatched larvae float near the surface of the water column in both inshore and channel areas. Larval movements are variable and follow tides and discharge. Data from trawl and trap net catches show larger juveniles and adults abundant during spring and summer in Suisun Bay and the Delta. The

smelt swim in large schools. Seasonal migrations occur within a short section of the upper estuary. Juvenile smelt move downstream to San Pablo Bay and Carquinez Strait before turning back to Suisun Bay for spawning. Juvenile delta smelt primarily eat planktonic crustaceans, small insect larvae, and mysid shrimp. Delta smelt mature quickly after their first year, with most adults dying after spawning.

Green sturgeon (*Acipencer medirostrus*)
ESA Status: Threatened (June 6, 2006), Southern DPS. California Status: Threatened.
[Sources: Adams *et al*. 2002; CalFed 2005; Fry 1973; Radtke 1966; Wang 1986.]

The little-studied green sturgeon occurs in the Sacramento-San Joaquin Rivers and the Delta. The Southern DPS is comprised of fish in the San Francisco Bay and Delta that spawn in the Sacramento River basin. A number of presumed spawning populations of green sturgeon have been lost since the 1960s and 1970s - from the Eel River, South Fork Trinity River, and San Joaquin River.

Green sturgeon inhabit near shore oceanic waters, bays, and estuaries. Early life-history stages (< 4 years old) reside in fresh water, with adults returning to freshwater to spawn when they are more than 15 years of age and more than 130 cm in size. Spawning occurs in spring and summer in reported locations of the upper Sacramento River and tributaries to the Sacramento River such as the Feather, Yuba, and American Rivers. Developmental biology of this species is essentially unstudied. Little is known about the age and growth of the green sturgeon but juveniles of two apparent size groups (20 to 58 cm FL, range) have been collected in the Sacramento-San Joaquin Rivers and Suisun Bay. The diet of juvenile sturgeon consists mostly of amphipods and mysid shrimps in the Delta.

> *The following fishes, though not listed under ESA, are included here as they are part of the Estuarine Composite species with Essential Fish Habitat (EFH) protections under the Magnuson-Stevens Fishery Conservation and Management Act (MSA); and are the most likely of their composite to utilize the upper portions of the Delta affected by the project. These species have also been included in the EFH assessment for the Stockton SSC Maintenance Dredging and Levee Stabilization Project (NMFS 2006a).*

Starry Flounder (*Platichthys stellatus*)
ESA Status: None, MSA species - Estuarine Composite EFH
[Sources: CalFed 2005; Fry 1973; PFMC 1998; McCain *et al*. 2005; NMFS 2006; Radtke 1966; Wang 1986; Wydoski and Whitney, 2005.]

The starry flounder is a marine flatfish with both eyes on the same side of its head. Starry flounder are white on the ventral side and have conspicuous ventral black bands on their dorsal and anal fins. They have a tolerance for a variety of salinities and are found along the coast and in estuaries and lower rivers. Juveniles and adults are demersal and prefer sandy to muddy substrates. Starry flounder have been recorded at a depth of 900 feet. Some move a considerable distance (440 nautical miles). Juveniles and sub-adult life stages extend the upstream freshwater use to the Bay

or lower reaches of the Delta. Adults may reach a length of 3 feet and a weight of 20 pounds. Females grow faster than males and are heavier at a given length. Males mature at two years and females at three years. They spawn in winter with water temperatures averaging 11 °C (51.8 °F). Eggs and larvae are epipelagic and occur near the surface over water 20-70 m (65-230 feet) deep. They feed on copepods, amphipods and annelid worms and, as adults, include crabs, mollusks and echinoderms. Feeding slows in winter as temperatures drop. Starry flounder provide both a recreational and commercial fishery. Juveniles may occur on the bottom in the lower portion of the SSC and SRSC.

English Sole (*Pleuronectes vetulus*)
ESA Status: None, MSA species - Estuarine Composite EFH
[Sources: McCain *et al*. 2005; NMFS 2006; PFMC 1998; Wang 1986; Wydoski and Whitney 2005]

English sole are an inner shelf-mesobenthal flatfish species that ranges from Mexico to Alaska and is abundant in the San Francisco Bay estuary system. Adults generally spawn during late fall to early spring in inshore waters over soft mud bottoms to 70 m (230 feet). Epipelagic larvae are carried by wind and near surface tidal currents into bays and estuaries where they metamorphose to demersal juveniles. Juveniles rear in the inshore areas and in the bays and estuaries moving offshore as they age. Juvenile English sole seek food and shelter in shallow near-shore, inter-tidal, and estuarine waters. Prey items include small crustaceans (i.e. copepods and amphipods) and polychaete worms. English sole provide commercial and recreational fisheries. Bottom-oriented juveniles may occur in the lower portion of the SSC and SRSC.

The following fishes, though not listed under ESA, nor protected under the MSA, have been listed or petitioned for listing in the recent past, and are presently considered species of special concern by the state of California. Information on these species is being sought by the Services. This background information is provided since these fish were encountered by the fish community and or entrainment monitoring conducted in 2006

Lamprey, Pacific and river (*Lampetra tridentata* and *L. ayersii*, respectively).
ESA Status: Not Warranted (decision 2005). California Status: Watch List – river lamprey.
[Sources: Moyle 2002, Kostow 2002, Wydoski and Whitney 2005]

Anadromous Pacific and river lamprey co-occur in SSC and SRSC. Little is known about population trends for the river lamprey at the southern end of its distribution. Most records of this species in California are from the lower Sacramento-San Joaquin system. Both species are lumped together here due to the difficulty in discriminating between the two species at the life stage encountered during the 2006 monitoring effort. Adult lamprey of both species spawn during spring in gravel substrates upstream of the Delta and lower Sacramento-San Joaquin river system. The filter-feeding ammocoetes develop for years burrowed into soft substrates in freshwater. Lamprey encountered during the 2006 sampling were at lengths and displayed characteristics of the macropthalmic life-history stage. Macropthalmic lamprey are transforming or newly transformed adults that undergo physiological and morphological changes that allow them to shift from a freshwater to saltwater environment. River lamprey begin their transformation from ammocoete to

adult form at about 120 mm total length, Pacific lamprey at approximately 140 to 160 mm. Metamorphosis lasts 9 – 10 months in river lamprey, the longest known in this family of fishes. During this time, both lamprey species congregate close to the saltwater-freshwater interface in estuaries.

Macropthalmia have large, well-developed eyes and the body coloration that is silvery on the lateral and ventral aspects with blue to dark gray coloration along the dorsal aspect. During this stage, mouth dentition forms adult teeth used to prey/parasitize other fishes. It is noted in Pacific lamprey that full development of the middle tooth of the supraoral lamina does not develop until late in the transforming adult stage, complicating field identification at this stage. Following complete transformation, macropthalmia migrate downstream to the ocean, likely in the winter and spring, when outflow is high. River lamprey may spend their entire life history in freshwater and are more parasitic in freshwater than Pacific lamprey. Adult river lamprey spend less time in the ocean, migrating back to freshwater in the fall and winter. Adult Pacific lamprey generally migrate stream to spawning areas in winter and spring.

A vouchered and preserved lamprey specimen was sent to D. F. Markle, PhD. at Oregon State University's, Fish and Wildlife Department, (104 Nash Hall, Corvallis, Oregon) for species identification. Based on morphological features of this one specimen, species identification could not be determined. However, the vouchered specimen was identified as a macropthalmic phase (transformed or newly transforming adult) of either the river lamprey (*L. ayresi*) or Pacific lamprey (*L. tridentata*).

Sacramento splittail (*Pogonichthys macrolepidotus*)
ESA Status: species of concern (2003), formerly listed as threatened (1999).
[Sources: Moyle 2002, USFWS 2003, Wang 1986]

The Sacramento splittail is found only in California's Sacramento-San Joaquin Delta, streams of the Central Valley, and the Napa and Petaluma rivers. This native minnow (family Cyprinidae) received protection as a threatened species in February 1999 (64 FR 5963). The USFWS delisted the splittail on September 22, 2003 (68 FR 55140). The relatively long-lived splittail (to 9 years) can grow up to 400 mm long. The upper part of the tail is enlarged and appears to be split, hence its common name. Historically, the splittail occurred in the Sacramento River as far north as Redding, as far south in the San Joaquin River as Friant Dam near Fresno, and as far west as the Petaluma River. They are adapted to living in estuarine systems and are tolerant of salinities from 10 – 18 ppt. Young-of-year and yearling splittail are most abundant in shallow water and are able to swim in strong current. Adults exhibit slow upstream movement during winter and spring to forage and spawn in flooded areas. Their small, subterminal mouth with barbells and pharyngeal teeth, along with the large upper tail lobe, reflect their preference for feeding on bottom invertebrates in low to moderate current strength. Splittail reach adulthood at approximately 170 mm in their second year. Splittail populations have declined as dams and diversions prevented fish from access to upstream areas of large rivers. Reclamation and modification of flood basins also have reduced the species' spawning grounds.

Longfin smelt *(Spirinchus thaleichthys)*
ESA status: none, petitioned for listing. California Status: Endangered
[Sources Moyle 1995, 2002, CDFG 2000, CFDG 2007]

Longfin smelt are a euryhaline and anadromous fish that was historically one of the most abundant fish in the San Francisco estuary and delta, but have since declined precipitously there and elsewhere in its range. Longfin smelt can be distinguished from other California smelts by their long pectoral fins which reach or nearly reach the base of their pelvic fins. These fish reach a maximum size of about 150 mm TL, and mature near the end of their second year. As they mature in the fall, adults found throughout San Francisco Bay migrate to brackish or freshwater in Suisun Bay, Montezuma Slough, and the lower reaches of the Sacramento and San Joaquin Rivers. They congregate for spawning at the upper end of Suisun Bay and in the lower and middle Delta, especially in the Sacramento River channel and adjacent sloughs. In April and May, juveniles are believed to migrate downstream to San Pablo Bay; juvenile longfin smelt are collected throughout the Bay during the late spring, summer and fall, and occasionally venture into the Gulf of the Farallons. Juveniles tend to inhabit the middle and lower portions of the water column. Their decline is likely due to multiple factors including: reduction in outflows, Entrainment losses to water diversions, climactic variation, toxic substances, predation and introduced species. The U.S. Fish and Wildlife Service was petitioned to list longfin smelt as endangered in 1992. The petition was denied in 1993. Longfin smelt were again petitioned for federal listing on August 8, 2007 and outcome of the current listing process is in process.

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Appendix B. Water Quality Data Collected During 2006 Fish Community Sampling in the Sacramento and San Joaquin Deepwater Ship Channels

Appendix B. Water Quality Data Collected During 2006 Fish Community Sampling in the Sacramento and San Joaquin Deepwater Ship Channels

	Surface Water Quality										Bottom Water Quality										
Date	Time	Depth (ft)	Temp. [C]	DO [ppm]	DO %	pH	TDS	ORP	Cond. (uS)	Salinity	Time	Depth [ft]	Temp [C]	DO [ppm]	DO %	pH	TDS	ORP	Cond	Sal	Comments
02-Oct-06	14:08	1	18.6							0.12											1*
02-Oct-06	16:32	1	19.8							0.14											1*
04-Oct-06	12:16	1	19.5							0.14											1*
04-Oct-06	10:27	1	18.5							0.12											1*
02-Nov-06	15:38	1	14.52	9.2	91	7.35	0.236	-33.6	290	0.17	15:33	40	14.16	9.24	90.1	7.2	0.239	20	292	0.18	2*
02-Nov-06	12:33	1	14.4	9.35	91.8	6.57	0.246	42.3	302	0.18	12:36	36	14.2	9.01	87.8	6.81	0.247	28	301	0.18	2*
04-Nov-06	16:10	1	14.63	9.03	88.9	7.29	0.246	-185	302	0.18	16:13	40	14.58	8.74	86	7.23	0.246	-179.5	305	0.18	
04-Nov-06	13:30	1	14.75	8.85	87.6	7.16	0.271	-151.2	336	0.2	13:31	21	14.66	8.72	85.9	7.28	0.272	-184	336	0.20	
06-Nov-06	14:26	1	15.65	8.47	85	7.39	0.335	-122.8	425	0.25	14:29	38	15.2	8.38	83.6	7.32	0.343	-121	428	0.26	
06-Nov-06	17:20	1	15.44	9.11	91.4	7.54	0.261	-27.1	328	0.19	17:25	40.5	15.14	8.23	82.9	7.32			312	0.23	
08-Nov-06	18:25	1	15.17	8.73	88.3	7.26	0.325	-58.7	411	0.24	18:29	35	15.72	8.05	81.1	7.12	0.346	48.2	346	0.26	
08-Nov-06	13:24	1	16.15	8.25	83.9	7.49			451	0.26	13:27	35	15.75	8.2	82.4	7.28	0.343	-191.8	432	0.26	
10-Nov-06	13:01	1	16.05	8.15	82.7	8.31	0.376	-200.4	479	0.28	13:04	36	15.31	7.99	79.8	8.03	0.389	-191.4	487	0.29	
17-Oct-06	15:36	1	16.8							0.1											1*
17-Oct-06	17:43	1	16.8							0.1											1*
19-Oct-06	14:34	1	16.9							0.1											1*
19-Oct-06	16:24	1	16.8							0.1											1*
21-Oct-06	11:17	1	16.9							0.1											1*
21-Oct-06	14:00	1	17.1							0.1											1*
23-Oct-06	10:40	1	17.1							0.1											1*
23-Nov-06	12:54	1	18							0.1											1*
14-Nov-06	14:46	1	14.98	8.65	86.4	9.45	1.519	-232.8	1936	1.21	14:53	29	14.72	8.3	83.2	8.25	3.234	-231.6	3989	2.68	
15-Nov-06	14:25	1	14.7	8.78	87.1	7.78	1.776	-86	2271	1.46	14:28	32	14.5	8.67	86.5	7.71	2.832	-121.3	3482	2.33	
15-Nov-06	17:22	1	14.26	8.64	84.5	6.75	0.69		843	0.53	17:25	-29	14.3	8.56	83.7	6.88	0.762	-103.7	927	0.58	
16-Nov-06	18:22	1	14.2	8.25	80.5	7.66	0.281	-157	349	0.21	18:24	31	14.23	8.23	80.5	7.52	0.433	-120	530	0.33	
16-Nov-06	15:28	1	14.63	8.46	84.1	8.09	1.835	-179	2374	1.9	15:30	28	14.52	8.36	83.4	8.14	3.06	-176	3773	2.54	
18-Nov-06	16:46	1	14.57	8.47	83.7	7.9	1.688	-254.3	2043	1.29	16:49	29	14.62	8.32	82.6	7.89	1.948	-252.8	2403	1.56	
20-Nov-06	17:17	1	14.6	0.75	87.1	7.57	2.644	-219.4	3260	2.17	17:22	-24	14.7	8.27	82.9	7.48	3.396	-210.4	4197	2.83	
20-Nov-06	14:38	1	14.6	8.16	81.2	7.81	2.447	-232.5	3017	2	14:50	27	14.7	8.01	80.4	7.78	3.582	-238.5	4427	3.00	
22-Nov-06	13:27	1	14.4	8.24	81.2		1.357	-306.7	1664	1.07	13:34	31	14.47	8.24	81.2		2.853	-300.9	3514	2.36	
22-Nov-06	10:05	1	13.88	8.65	83.8	7.43	0.463	-268.2	561	0.35	10:09	28	13.94	8.25	80.3	7.34	0.829	-268.8	1003	0.64	
28-Nov-06	16:48	1	12.21	9.05	84.5		0.157	-275	182	0.12	16:51	28	12.22	8.89	82.9		0.164	-273	191	0.12	
28-Nov-06	14:37	1	12.32	8.94	83.8	6.98	0.511	-263	584	0.38	14:41	27	12.33	8.93	83.7		0.569	-263.8	682	0.43	
30-Nov-06		1	11.64	9.8	90.5	7.55	0.828	-213	956	0.65		28	11.51	9.56	88.4	7.28	1.5989	-202.8	1817	1.27	
01-Dec-06	10:47	1	11.33	9.15	84.1		1.143	-214.4	1300	0.9	10:50	31	11.33	9.13	83.9		1.194	-223.9	1356	0.94	
01-Dec-06	7:59	1	10.8	9.06	81.9		0.154	-194	166	0.11	8:01	30	10.83	8.97	81.1		0.167	-168	168	0.11	
02-Dec-06	15:36	1	11.36	9.42	86.7		1659	1.18	2	-239.1	15:40	30	11.33	9.24	85		1.7	-236.5	1936	1.36	
02-Dec-06	12:41	1	11.46	9.15	85		2.222	-202.9	2698	1.81	12:45	32	11.39	9.16	84.9		2.489	-196.7	2832	2.03	
04-Dec-06	11:46	1	10.57	9.32	83.4		0.494	-210.9	589	0.4	11:50	34	10.55	9.21	82.9		0.766	-210.2	852	0.59	
04-Dec-06	14:00	1	11.33	9.42	87.1		2.146	-201.1	2322	1.68	14:06	34	11.18	9.31	85.9		2.542	-196.8	2880	2.08	
07-Dec-06	13:48	1	9.88	15.43	136.4	7.15	0.299	118.3	328	0.22	13:51	27	9.86	14.98	132.5	7.33	0.3	112.7	328	0.22	
07-Dec-06	11:20	1	9.69	14.89	131.2	7.38			289	0.19	11:23	28	9.69	15.42	138.1	7.39			291	0.20	
09-Dec-06	14:28	1	9.61	12.37	108.6	7.56	0.129	106.8	140	0.09	14:32	29	9.56	12.69	111.4	7.6	0.127	102.8	138	0.09	
09-Dec-06	12:35	1	9.7	11.27	99.3	6.98	0.227	130.3	260	0.17	12:39	30	9.68	11.24	98.8	7.2	0.226	122.3	246	0.47	
11-Dec-06	14:13	1	9.78	11.94	105.4	7.58	0.139	40.7	150	0.1	14:17	30	9.77	11.97	105.7	7.63	0.132	41.2	145	0.10	
14-Dec-06	16:47	1	10.64	20.71	96.4	7.67	0.117	17.2	131	0.09	16:49	29	10.64	11.01	99.1	7.67	0.117	16.9	131	0.09	
14-Dec-06	14:12	1	10.41	11.33	101.3	7.54	0.116	10.1	129	0.08	14:16	32	10	11.37	102.1	7.55	0.116	10.3	129	0.09	
15-Dec-06	12:47	1	10.6	11.49	103.5	7.39	0.154	14.3	172	0.11	12:50	28	10.56	11.46	103	7.48	0.158	15	172	0.12	
15-Dec-06	16:39	1	10.85	10.94	98.9	7.68	0.115	4.8	131	0.08	16:42	34	10.86	11.32	102.6	7.63	0.116	9.4	131	0.09	
17-Dec-06	11:36	1	10.9	11.49	104.2	7.44			122	0.08	11:41	34	10.96	11.51		7.54			122	0.08	

ılity meter not in use - Temperature collected with vessel thermometer; Salinity collected with handheld refractometer.
ɜ for water quality measures from this date forward.