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## Summary and Conclusion

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### 7.1 OVERVIEW

This section integrates current conditions described in the status of species and environmental baseline sections of this BA with anticipated effects of the 2-Gates Project and expected cumulative effects of future non-Federal actions. Its purpose is to develop a better understanding of the likely effects to listed species and designated critical habitat of the 5-year 2-Gates Project. The Action Area for the 2-Gates Project includes the area where gate operations control hydrodynamic and water quality conditions within the Delta in order to influence delta smelt movement and other Delta channels where flows may be affected but not directly controlled. The geographic extent of the action area was determined by hydrodynamic~~caulie~~ modeling, as described in Section 2.~~34.2-~~

### 7.2 SUMMARY OF SPECIES STATUS AND ENVIRONMENTAL BASELINE

As described in the status of species and environmental baseline sections of this BA, past and present activities have caused significant habitat loss, fragmentation, and degradation of aquatic habitats within the Delta. In addition, past and present operations of the Central Valley Pumps (CVP) and State Water Pump (SWP) pumping facilities within the south Delta, along with other unscreened diversions, have resulted in significant entrainment and loss of Endangered Species Act (ESA) listed aquatic species.

The functionality of aquatic, riparian, and floodplain habitat within the Action Area have all been substantially degraded due to anthropogenic activities, such as alterations in Delta channel geometry, removal of riparian vegetation and shallow water habitat, construction of armored levees, changes in Delta hydrodynamics due to upstream water storage reservoirs, water export demands and in-Delta water diversions, and the influx of contaminants from stormwater, treated municipal discharges and agricultural returnsdischarges. Introduction and spread of non-native invasive species of plants and animals has significantly altered the habitat structure, community composition and food web dynamics in the Delta. Past and present effects described in the environmental baseline are expected to continue through the duration of the 5-year operation planned for the 2-Gates Project and into the future.

### 7.3 SUMMARY OF EFFECTS OF THE 2-GATES PROJECT

The proposed 2-Gates Project, along with the interrelated and interdependent activities associated with it are expected to affect aquatic and terrestrial species and the value of their habitat for the 5-years covering Project installation and operation. For aquatic species, these effects are anticipated to extend throughout the Action Area. For terrestrial species, these effects are expected to be more localized primarily occurring only within the actual physical foot print of the gates and associated structures (i.e. adjacent levees, boat ramps, access roads, staging areas).

#### 7.3.1 Aquatic Species

Listed aquatic species that could be affected by the 2-Gates Project include delta smelt, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and the

Southern distinct population segment (DPS) of North American green sturgeon. Project effects would result from in-channel installation during October and November, 2009, the annual operation of the gate structures during the months of December through June, 2009 to 2014, and removal of the gates at the Project's conclusion in July 2014 (Table 7-1).

**Table 7-1. Aquatic Species - Summary of Potential Effects**

<u>Construction Effects (Oct – Nov)</u>							
<u>Life Stage/Species</u>	<u>Direct Injury/mortality</u>	<u>Noise/Disturbance</u>	<u>Contaminants</u>	<u>Turbidity/Sediment Resuspension</u>	<u>Habitat loss/alteration</u>	<u>Increased Predation</u>	<u>Entrainment at CVP/SWP</u>
<b><u>Adult</u></b>							
<u>Delta smelt</u>			±	±	±		±
<u>Chinook salmon</u>							
<u>Winter-run</u>							
<u>Spring-run</u>							
<u>Fall-run</u>		±	±				
<u>Late Fall-run</u>		±	±				
<u>Steelhead</u>							
<u>Green sturgeon</u>	±	±	±	±	±		
<b><u>Larvae/juveniles</u></b>							
<u>Delta smelt</u>							
<u>Chinook salmon</u>							
<u>Winter-run</u>		±	±	±			±
<u>Spring-run</u>							
<u>Fall-run</u>							
<u>Late Fall-run</u>							
<u>Steelhead</u>							
<u>Green sturgeon</u>	±	±	±	±	±		
<u>Operational Effects (Dec – Jun)</u>							
<u>Life Stage/Species</u>	<u>Direct Injury/mortality</u>	<u>Noise/Disturbance</u>	<u>Contaminants</u>	<u>Sediment Resuspension</u>	<u>Habitat loss/alteration</u>	<u>Increased Predation</u>	<u>Entrainment at CVP/SWP</u>
<b><u>Adult</u></b>							
<u>Delta smelt</u>							
<u>Chinook salmon</u>							
<u>Winter-run</u>							
<u>Spring-run</u>							
<u>Fall-run</u>							
<u>Late Fall-run</u>							
<u>Steelhead</u>							
<u>Green sturgeon</u>					±		
<b><u>Larvae/juveniles</u></b>							
<u>Delta smelt</u>					±	±	±
<u>Chinook salmon</u>							
<u>Winter-run</u>						±	±
<u>Spring-run</u>						±	±
<u>Fall-run</u>						±	

<u>Late Fall-run</u>						±		
<u>Steelhead</u>						±		±
<u>Green sturgeon</u>					±	±		

In-water site preparation and gate installation (dredging, foundation prep, sheet pile and king pile installation, barge placement, etc.) is anticipated to occur during established in-water work windows to avoid negative adverse effects to listed species. Southern DPS green sturgeon and CV steelhead adults may be present in the Action Area and at the Project sites during installation. Construction effects include increased construction vessel activity with potential oil and gas contamination from spills; the installation of the sheet pile walls; dredging of peat sediments and installation of a rock base for the barge, and installation of the gate and placement of rock to lock in the barge. Construction activities would generate noise from construction vessels, sheet pile installation, dredging activity and rock placement that would disturb species in the immediate vicinity of the Project sites. Dredging would remove between 11,500 and 42,800 cubic yards of channel bed material in Old River and between 7,500 and 11,300 cubic yards of bed material in Connection Slough and replace that with a small volume imilar amount of rock. This activity would increase local turbidity during the dredging and would replace approximately 2.1 acres of soft bottom habitat with hard bottom substrate and the two barges. Green sturgeon are bottom-oriented fish and could be injured or killed by dredging, rock or barge placement, however, green sturgeon in the Delta are relatively large and would be able to quickly move away from any threat.

The gates will be operated to modulate flows in Old and Middle Rivers and thus manage distribution of higher turbidity conditions that cue adult pre-spawning migration from extending into the south Delta. Adult smelt begin moving inland from the western Delta when first flush flows increase turbidity (greater than or equal to 12 NTUs) and decrease salinity. During this period, typically December to February/March, gates will be operated to reduce movement of fresher, more turbid water in the central Delta from extending into the south Delta via Old and Middle Rivers. The Old River gate will be closed periodically depending on turbidity distributions. Typically, Old River gate closure occurs for period of 0.5 to 2.5 hours during a tidal cycle, depending on the strength of the tide. of up to about an hour within a 25 hour tidal cycle will be sufficient to achieve desired conditions. The Connection Slough gate will generally be closed.

Delta smelt spawning typically commences once Delta-wide average water temperatures reach 12 °C, approximately February or March. Once this occurs, gates will be operated to protect larval and juvenile delta smelt from entrainment into the south Delta, as informed by 20-mm surveys of larval distribution. The Old River gate will be operated tidally: open on ebb tides and closed on two flood tides, both lasting approximately 5-7 hours each within a 25 hour tidal cycle. The Connection Slough gate will be closed during ebb and flood tides, may be opened on slack tides (approximately one hour each opening), and will be opened to allow boat navigation on weekends and as needed. Gate operations will be coordinated with OCAP restrictions on OMR flows and San Joaquin River flow requirements established by NMFS (NMFS 2009, RPA Action IV.2.1). Gates will also be open continuously between April 1 and May 31 and on weekends from Memorial Day through June. Gates will remain open from July into December.

All listed fish species would be present in the Action Area during gate operations between December and June each year. The gate structures and their operations would affect habitat conditions by affecting hydrodynamics and turbidty in areas of the central and south Deltaregion-of-influence. These altered hydrodynamics and water quality conditons may affect delta smelt, winter-run and spring-run Chinook, steelhead, and green sturgeon. During the prespawning adult operations (December to March, tThe Project will balance net-flows between in Old and Middle Rivers but have no effect on the net OMR flows and little effect on flows in connecting channels. between the San Joaquin River and Woodward Cut, but will increase

~~reverse flows in Turner and Columbia cuts. These altered hydrodynamics may affect delta smelt, winter run and spring run Chinook, steelhead, and green sturgeon. All listed fish species would be present in the Action Area during gate operations between December and June each year. Results of the modeling studies indicate that there would be a reduced risk of entrainment for delta smelt and other species from the reduced turbidity levels that occur in the south Old and Middle river channels near the intakes to the pumping facilities. within the Action Area during operations. This relative change would be good for Delta smelt since would not continue to move upstream moving pre-spawning adults would n and et move into close proximity to the conveyance channels that lead to the pumping facilities. These changes would be unlikely to substantially change the conditions affecting also provide an advantage to juvenile salmonids that are emigrating from the Sacramento River (winter-run and spring-run Chinook salmon and CV steelhead) and the Mokelumne River salmon and CV steelhead since net flows are not changed. Project operations during this time are not expected to increase the risk of entrainment to juvenile green sturgeon over baseline conditions.~~

During the juvenile operations period (March to April and June) the gates will operated tidally, with the Old River gate open on ebb and closed on flood tides, and the Connection Slough gate mostly closed, but open during slack water. Again, the operation doesn't change the net flows in OMR, but the operation shifts negative flows into Middle River during the time the gates are closed and then results in net seaward flows in Old River since there is little negative flow during closure and strong positive flow during the ebb. The operation creates a dispersive mixing area between Middle and Old Rivers into Franks Tract and False River based on modeling. The dispersive mixing would aid transport and dispersal of larval and juvenile delta smelt downstream and away from the pumps. Dispersive mixing could also disperse salinity and nutrients from the San Joaquin River to the west where it could add to the productivity in eastern Suisun Bay. Effects on delta smelt would be positive since it transports larvae fish away from the pumps. Effects on salmon and steelhead is likely positive since under OMR flows alone, flows in both the Old and Middle rivers are net negative, compare to the dispersive mixing operations where Middle River has stronger negative flows, but Old River has positive flow. Negative effects could occur for delta smelt, salmon or steelhead entering the central Delta from the east through Turner or Columbia cuts, or entering the San Joaquin River via the Mokelumne River or Georgiana Slough may face stronger negative flows in Middle River and be drawn toward the pumps. Fish so entrained could still be exposed to positive flows down Old River and continue their movement westward, but others may (CV steelhead) by providing positive (downstream) flows through Old River anbe at d reducing their risk of entrainment at the CVP and SWP pumping facilities. During the main migration period of April through May, the gates will remain open.

Gate closure may affect migration corridors for salmon and steelhead juveniles emigrating from the San Joaquin River by impeding movement during flood tides or diverting individuals to other routes through the Delta. The consequence would be periodic and short-term delays in migration to the ocean and/or increased exposure to predators in the Delta. The magnitude of potential adverse effects on CV steelhead from the San Joaquin River would depend on the number of juveniles using the Old River route. Factors expected to minimize potential adverse effects of the Project on San Joaquin River steelhead include: 1)gate closures occur during flood tides, downstream movement by juveniles tends to occur during ebb tides, and the gates will remain open during peak smolt outmigration through the Delta (April 1 through May 31). Gate operations may help juvenile Chinook salmon and CV steelhead emigrating from the Sacramento River by reducing opportunities for diversion down Old River toward the south Delta and the export facilities. Outmigrating salmon and steelhead that move through Georgiana Slough could experience an increase in local flow cues that would direct them down Middle River.

~~Project operations are not expected to increase the risk of entrainment to juvenile green sturgeon over baseline conditions.~~

Gate operations will not change ~~local~~ water quality conditions in ~~close proximity the vicinity~~ of the gates beyond the range of natural variation experienced in the Delta. In Old River, changes in DO or turbidity are unlikely because of the short periods of gate closure. In Connection Slough, where the gate will be closed for

longer durations, there may be reduced DO levels in the slough west of the gate. However, these reductions are not likely to reach deleterious levels during the winter and early spring when Delta water temperatures are cool and algae blooms are not occurring. -Also, there will be some water exchange through the leaky gate structures. The gate structure in Connection Slough is situated close to the confluence of Middle River and local mixing with Middle River water is expected to reduce the effect of gate closure on waters east of the gate.

~~Gate closure may affect migration corridors for salmon and steelhead juveniles emigrating from the San Joaquin River by impeding movement during flood tides or diverting individuals to other routes through the Delta. The consequence would be periodic and short term delays in migration to the ocean and increased exposure to predators in the Delta. The magnitude of potential adverse effects on CV steelhead from the San Joaquin River would depend on the number of juveniles which utilize the Old River route. Factors expected to minimizing potential adverse effects of the Project on San Joaquin River steelhead include: 1) gate closures occur for a relative short time during flood tides, downstream movement by juveniles tends to occur during ebb tides, and the gates will remain open during peak outmigration through the Delta (April 1 through May 31). Gate operations may help juvenile Chinook and CV steelhead emigrating from the Sacramento River by reducing opportunities for diversion down Old River toward the south Delta and the export facilities.~~

The gate structures would attract predatory fish, such as striped bass, largemouth bass and catfish, which exploit situations where food is abundant or where features exist that enhance feeding opportunities, such as turbulent flows, structural habitat. Adult and juvenile delta smelt and juvenile salmon and steelhead would be potentially at risk. This effect would be localized, ~~however,~~ and predation studies conducted as part of the 2- Gates Project Monitoring program will provide insight into the distribution and density of predators around and near the gate structures along, ~~with needed data to quantify potential effects to delta smelt and juvenile salmonids.~~

### 7.3.2 Effects on Designated Critical Habitat for Aquatic Species

Critical Habitat in the Action Area has been designated for delta smelt and Central Valley steelhead, and proposed for Southern DPS Green sturgeon. The Action Area supports a variety of Primary Constituent Elements (PCEs) of Critical Habitat for each species. For delta smelt, these include physical habitat (suitable spawning substrate and depth), water (suitable water quality, low entrainment risk), flow (cues for spawning migrations and larval transport flows), and salinity (low salinity rearing habitat). For CV steelhead in the Delta, these include migration corridors for adults and juveniles that are free of barriers (unobstructed passage) and entrainment risk. For green sturgeon in the Delta, these include migration corridors for adults and juveniles, sediments free of contaminants, and rearing habitat for juveniles. Current conditions of aquatic habitat in the Delta overall are considered degraded.

The Project would negatively adversely modify critical habitat at the sites of the gates structures, and is expected to have minor effects on critical habitat within the Action Area as a whole. ~~Overall, The Project would change improve~~ critical habitat for pre-spawning adult delta smelt within the larger Delta region by reducing through control of turbidity in the southern Old and Middle river channels in close proximity to the pumping facilities. This change is designed to discourage use of the channel segments with a high entrainment risk, and hence is a trade-off of sorts; by reducing habitat quality in an area that with high entrainment risk, pre-spawning adult delta smelt will not venture into the zone of influence of the pumps and will spawn outside this area. Consequently, fewer adult delta smelt will be taken in salvage and potentially more of their offspring will be transported to the western Delta instead of entrained and removed from the system. This habitat reduction would occur following storm events from December into March and typically occurs once or twice per year following large run-off events. important habitat constituents, turbidity, and salinity. The Project is designed to improve conditions for delta smelt by reducing entrainment risk.



Installation of the gates will disturb approximately 2.1 acres of soft-bottom channel habitat and replace it with two barges and rock substrate. This would affect a relatively small area compared to the habitat that is available in Old River and Connection Slough and the Delta as a whole. Delta smelt are pelagic fish and Central Valley steelhead are surface-oriented, so alteration of the channel bottom would not be considered an adverse effect on critical habitat for these species. Green sturgeon are bottom-oriented, but the relatively small amount of habitat that is altered would not be considered to be an adverse modification of proposed critical habitat for foraging. Gate installation will create structural features in otherwise open channel habitat. The gates and barges will create some habitat features, such as underwater structure, shear zones, eddies, and other changes in local hydrodynamic conditions that may be attractive to predators such as striped bass, largemouth bass or catfish and expose smaller fish to concentrations of predators at the gate sites, perhaps altering background predation..

The structures may also provide passage impediment to some species. Gate structures restrict the open width in both channels and affect the amount of conveyance volume during tidal flows. The Old River site has the largest effect because of the volume of tidal flows in this channel. The barge deck in Old River is set close to the bed elevation, so bottom dwelling species would not have difficulty in passing the site. The Connection Slough site has limited tidal flows, but the barge deck is set about 12-15 feet above the bed of channel and this structure may present some impediments to passage for bottom dwelling sturgeon.

Overall, the Project ~~will~~ could reduce entrainment risk to delta smelt and ~~will~~ could not substantially degrade the functionality of critical habitat migration or rearing of juvenile salmon or for CV steelhead. The project may affect passage conditions in Connecticut Slough for and green sturgeon ~~within the Action Area.~~

### 7.3.3 Terrestrial Species

No Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp, or Conservancy Fairy Shrimp were detected during wet- and dry-season surveys and the wetland basin near the construction site was determined to be unsuitable for federally-listed large branchiopods. Therefore, the Project will have no effect on these species. Giant Garter Snake (GGS) is the only listed terrestrial species that could be affected by the Project. Effects to GGS would be due to construction activities, principally site disturbance during construction (October-November 2009), and to a lesser degree, gate installation (December 2009) and removal in 2014. Construction activities could affect GGS by trampling or crushing individuals if they are present within the terrestrial Action Area. Burrowing owls and western pond turtles could be killed or injured during construction. Gate operations would not adversely affect GGS.

### 7.3.4 Effects on Designated Critical Habitat of Terrestrial Species

The Project will not affect critical habitat for any terrestrial species, because none has been designated within the Action Area for the Project.

## 7.4 SUMMARY OF CUMULATIVE EFFECTS

The anticipated effects described in the cumulative effects section of this BA are expected to occur with or without the Project. Adverse effects resulting from non-Federal actions to both aquatic and terrestrial species are anticipated and may further diminish the functional value of critical habitat within the Action Area. Planning efforts such as the BDCP and the Governor's Delta Vision process are anticipated to have both adverse and beneficial effects to listed species as a result of planned actions in the long-term but not likely within the 5-year time frame of the 2-Gates Project. In addition, these efforts are expected to have a federal nexus and will be the subject of future State and Federal ESA consultations.



## 7.5 CONCLUSION

In conclusion, the 2-Gates Project, when combined with past and present effects and those anticipated as a result of future non-Federal actions within the Action Area, would benefit delta smelt. The Project would not jeopardize and may benefit other listed aquatic species as well. The Project would have minimal or no effect on listed terrestrial species within the Action Area, and would not jeopardize the existence of these species.

The presence and operations of the gates is intended to complement actions by fishery managers to protect threatened delta smelt. The intent is to operate the gates in concert with the protective requirements already established in the OCAP BOs from USFWS (USFWS 2008) and NMFS (NMFS 2009). These measures would affect hydrodynamic and water quality (turbidity and salinity) conditions, which would result in decreased entrainment of delta smelt at the CVP and SWP Delta export pumping facilities in the south Delta. The proposed installation and operation of the 2-Gates Project is not expected to appreciably reduce the functionality of the PCEs of designated critical habitat for delta smelt within the Delta as a whole. While there may be some adverse effects in the immediate vicinity of the gate structures themselves, these effects would be transitory and localized and would be more than offset by the benefits of reduced entrainment at the CVP and SWP pumping facilities. The result is an expected increase in the overall survival and recovery of delta smelt. Irreversible effects to delta smelt will be avoided by the short-term nature of the Project (5-years) and the ability to quickly remove the structures if deemed necessary.

Migrating adult and juvenile (smolt) life stages of winter-run and spring-run Chinook salmon and steelhead could be affected by the Project during both installation and operation of the gate structures and associated components. Reduced reverse flows in both Connection Slough and Old River between the gate locations and areas to the north and west are generally expected to improve flow conditions for outmigrating juvenile salmonids. In addition, since the 2-Gates Project will be operated in accordance with, and in coordination with, current OCAP operating requirements (USFWS 2008, NMFS 2009), it is anticipated that entrainment at the CVP and SWP pumping facilities will be further reduced.

Migration delays to both adult and juvenile salmon and steelhead are anticipated but expected to be minimal since gate operations would result in Old River gate closures on flood tides only. Juveniles may experience increased predation at the gate structures, although it is expected that these effects would be localized. Predation studies conducted as part of the 2-Gates Project Monitoring program will provide insight into the distribution and density of predators around and near the Project sites along with needed data to quantify potential effects to listed species.

Green sturgeon are expected to be exposed to the effects of the 2-Gates Project during both construction and operations periods. However, because there are no reliable estimates of the number of individual green sturgeon occupying the Delta, or the Action Area, population level effects are uncertain. Any green sturgeon individuals present in the area may experience temporary and localized disturbance and possibly even injury or mortality from construction and installation activities. Gate structures and, as with salmonids, gate closures would temporarily impede movement and/or passage of any green sturgeon in the vicinity of the gates during flood tides.