


AIPCP Programmatic Environmental Impact Report FINAL

January 24, 2018

Aquatic Invasive Plant Control Program

A program to manage aquatic invasive plants in the Sacramento-San Joaquin Delta and its tributaries.

F I N A L

Programmatic Environmental Impact Report

January 24, 2018

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Acronyms and Abbreviations

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1. **2,4-D** – 2,4-dichlorophenoxyacetic acid
2. **2,4,5-T** – 2,4,5-trichlorophenoxyacetic acid
3. **ADI** – Acceptable Daily Intake
4. **a.i.** – Active Ingredient
5. **AGR** – Agricultural Supply (Basin Plan beneficial use)
6. **AHS** – Agricultural Health Study
7. **AIP** – Aquatic Invasive Plant
8. **AIPCP** – Aquatic Invasive Plant Control Program
9. **ALS** – Amyotrophic Lateral Sclerosis or Acetolactate Synthase
10. **AMPA** – Aminomethylphosphonic Acid
11. **APAP** – Aquatic Pesticide Application Plan
12. **APHIS** – Agriculture, Animal and Plant Health Inspection Service
13. **APMP** – Aquatic Pesticide Monitoring Program
14. **Bay-Delta Estuary** – San Francisco Bay and Sacramento-San Joaquin Delta
15. **BA** – Biological Assessment
16. **BAAQMD** – Bay Area Air Quality Management District
17. **BCF** – Bioconcentration Factor
18. **BDCP** – Bay Delta Conservation Plan
19. **BMP** – Best Management Practices
20. **BO or BiOp** – Biological Opinion
21. **BSMT** – Bay Study Midwater Trawl
22. **BSOT** – Bay Study Otter Trawl
23. **C** – Centigrade/Celsius
24. **CAC** – County Agricultural Commissioner
25. **CALFED** – California-Federal Bay Delta Program
26. **CCF** – Clifton Court Forebay
27. **CCWD** – Contra Costa Water District
28. **CDFA** – California Department of Food and Agriculture
29. **CDFG** – California Department of Fish and Game
30. **CDFW** – California Department of Fish and Wildlife (formerly CDFG)
31. **CE** – California Endangered
32. **CEC** – Contaminants of Emerging Concern
33. **CEDEN** – California Environmental Data Exchange Network
34. **CEQA** – California Environmental Quality Act
35. **CESA** – California Endangered Species Act
36. **cfs** – Cubic Feet Per Second
37. **CI** – Confidence Interval
38. **COA** – Coordinated Operations Agreement
39. **COMM** – Commercial Sport Fishing (Basin Plan beneficial use)

40. **COLD** – Cold Freshwater Habitat (Basin Plan beneficial use)
41. **CNDDB** – California Natural Diversity Database
42. **CNPS** – California Native Plant Society
43. **CR** – California Rare
44. **CRR** – Cohort Replacement Rate
45. **CSC** – California Species of Special Concern
46. **CT** – California Threatened
47. **CVP** – Central Valley Project
48. **CVRWQB** – Central Valley Regional Water Quality Control Board
49. **CVTRT** – Central Valley Technical Review Team
50. **CWA** – Clean Water Act
51. **CWT** – Coded-Wire Tag
52. **dBA** – Decibels
53. **DBW** – Division of Boating and Waterways (formerly Department of Boating and Waterways)
54. **DCC** – Delta Cross Channel
55. **Delta** – Sacramento-San Joaquin Delta
56. **DMA** – Dimethylamine Salt
57. **DO** – Dissolved Oxygen (measured in mg/L or ppm)
58. **DOC** – California Department of Conservation
59. **DPR** – California Department of Pesticide Regulation (also CDPR)
60. **DPS** – Distinct Population Segment
61. **DRERIP** – Delta Regional Ecosystem Restoration Implementation Plan
62. **DWSP** – Delta Water Supply Project
63. **DWR** – California Department of Water Resources
64. **E:I** – Export to Import
65. **EA** – Environmental Assessment
66. **EC** – Effective Concentration
67. **EC50** – Effective Concentration for 50 Percent of Target
68. **EDCP** – *Egeria densa* Control Program
69. **EDSM** – Early Delta Smelt Monitoring
70. **EEC** – Exposure Estimate Concentration
71. **EFH** – Essential Fish Habitat
72. **EIR** – Environmental Impact Report
73. **EIS** – Environmental Impact Statement
74. **ERP** – Ecosystem Restoration Program
75. **ESA** – Endangered Species Act (federal)
76. **EST** – Estuarine habitat (Basin Plan beneficial use)
77. **ESU** – Evolutionary Significant Unit
78. **EWA** – Environmental Water Account
79. **FC** – Federal Candidate (for consideration of endangered or threatened status)

80. **FCH** – Federal Critical Habitat
81. **FCHP** – Federal Critical Habitat for this Species Proposed
82. **FE** – Federal Endangered
83. **FETAX** – Frog Embryo Teratogenesis Assay – *Xenopus*
84. **FIFRA** – Federal Insecticide, Fungicide, and Rodenticide Act
85. **FMWT** – Fall Midwater Trawl
86. **FONSI** – Finding of No Significant Impact
87. **FRH** – Feather River Hatchery
88. **FT** – Federal Threatened
89. **GCID** – Glenn Colusa Irrigation District
90. **GGS** – Giant Garter Snake
91. **GI** – Gastrointestinal
92. **GWR** – Groundwater Recharge (Basin Plan beneficial use)
93. **HAPC** – Habitat Areas of Particular Concern
94. **HCP** – Habitat Conservation Plan
95. **HQ** – Hazard Quotient
96. **IARC** – International Agency for Registration of Carcinogens
97. **IEP** – Interagency Ecology Program
98. **IND** – Industrial Service Supply (Basin Plan beneficial use)
99. **IPM** – Integrated Pest Management
100. **JPE** – Juvenile Production Estimate
101. **JPI** – Juvenile Production Index
102. **K_{OC}** – Soil Adsorption Coefficient (normalized by organic matter)
103. **LC5** – Lethal Concentration for 5 Percent of Subjects
104. **LC10** – Lethal Concentration for 10 Percent of Subjects
105. **LC50** – Lethal Concentration for 50 Percent of Subjects
106. **LD50** – Lethal Dose or Lethal Dietary Dose for 50 Percent of Subjects
107. **LH** – Luteinizing hormone
108. **LOC** – Level of Concern
109. **LOD** – Limit of Detection
110. **LOAEC** – Lowest Observable Adverse Effect Concentration
111. **LOEC** – Lowest Observable Effect Concentration
112. **LOEL** – Lowest Observable Effect Level
113. **LSNFH** – Livingston Stone National Fish Hatchery
114. **LSZ** – Low Salinity Zone
115. **MAF** – Million Acre Feet
116. **MATC** – Maximum Acceptable Toxicant Concentration
117. **MCL** – Maximum Contaminant Level
118. **MCP** – Maintenance Control Practices
119. **MCPA** – 4-chloro-2-methylphenoxyacetic acid

120. **MIGR** – Migration of Aquatic Organisms (Basin Plan beneficial use)
121. **mM** – Millimolar (a concentration of one thousandth of a mole per liter)
122. **MOE** – Margin of Error or Margin of Safety
123. **MOU** – Memorandum of Understanding
124. **MRDL** – Maximum Residual Disinfectant Level
125. **MRA** – Montane Riverine Aquatic
126. **MRDL** – Maximum Residual Disinfectant Level
127. **MSA** – Magnuson-Stevens Fishery Conservation and Management Act
128. **MSDS** – Material Safety Data Sheet
129. **MTCO2E** – Metric Tons Carbon Dioxide Equivalents
130. **MUN** – Municipal and Domestic Supply
131. **NAV** – Navigation (Basin Plan beneficial use)
132. **NBA** – North Bay Aqueduct
133. **NCCP** – Natural Community Conservation Plan
134. **ND** – Non-detectable
135. **NFPE** – Nontidal Freshwater Permanent Emergent
136. **NHL** – Non-Hodgkin Lymphoma
137. **NIH** – National Institute of Health
138. **NMFS** – National Marine Fisheries Service
139. **NOAA-Fisheries** – National Oceanic and Atmospheric Administration-Fisheries (also referred to as NMFS, National Marine Fisheries Service)
140. **NOAEC** – Non-observable Adverse Effect Concentration
141. **NOEC** – Non-observable Effect Concentration
142. **NOEL** – Non-observable Effect Level
143. **NOI** – Notice of Intent
144. **NOP** – Notice of Preparation
145. **NPDES** – National Pollution Discharge Elimination System
146. **NPE** – Nonylphenol Ethoxylates
147. **NRDC** – Natural Resources Defense Council
148. **NTU** – Nephelometric Turbidity Units
149. **OCAP** – Operations Criteria and Plan
150. **OMP** – Operations Management Plan
151. **OMR** – Old and Middle River
152. **OR** – Odds Ratio
153. **OSHA** – Occupational Safety and Health Administration
154. **PAHs** – Poly aromatic Hydrocarbons
155. **PCA** – Pest Control Advisor
156. **PCE** – Primary Constituent Elements (of critical habitat)
157. **PEIR** – Program Environmental Impact Report
158. **PFMC** – Pacific Fisheries Management Council

159. **PG&E** – Pacific Gas and Electric
160. **POD** – Pelagic Organism Decline
161. **POEA** – Polyethoxylated tallowamine
162. **ppb** – Parts per Billion (µg/L or µg/kg)
163. **ppm** – Parts per Million (mg/L or mg/kg)
164. **ppt** – Parts per Thousand (g/L)
165. **PPE** – Personal Protective Equipment
166. **PRO** – Industrial Process Supply (Basin Plan beneficial use)
167. **psu** – Practical Salinity Units
168. **PUR** – Pesticide Use Report
169. **PVA** – Population Viability Analysis
170. **QAC** – Qualified Applicator Certificate
171. **QAPP** – Quality Assurance Project Plan
172. **RARE** – Rare, Threatened, or Endangered Species (Basin Plan beneficial use)
173. **RBDD** – Red Bluff Diversion Dam
174. **RCRA** – Resource Conservation and Recovery Act
175. **REC-1** – Water Contact Recreation (Basin Plan beneficial use)
176. **REC-2** – Non-water Contact Recreation (Basin Plan beneficial use)
177. **RfD** – Reference Dose
178. **RGP** – Regional General Permit (U.S. Army Corps of Engineers)
179. **RM** – River Mile
180. **ROD** – Record of Decision
181. **RPA** – Reasonable and Prudent Alternative
182. **RQ** – Risk Quotient
183. **RR** – Risk Ratio
184. **RTS** – Rotary Screw Traps
185. **RUP** – Restricted Use Permit
186. **SCP** – Spongeplant Control Program
187. **SDIP** – South Delta Improvement Program
188. **SF** – San Francisco
189. **SFA** – Seasonally Flooded Agricultural
190. **SFEI** – San Francisco Estuary Institute
191. **SHELL** – Shellfish harvesting (Basin Plan beneficial use)
192. **SJ** – San Joaquin
193. **SJRRP** – San Joaquin River Restoration Program
194. **SL** – Standard Length
195. **SMR** – Standard Mortality Ratio
196. **SMUD** – Sacramento Municipal Utility District
197. **SOD** – Superoxide dismutase
198. **SPWN** – Spawning, Reproduction, and/or Early Development (Basin Plan beneficial use)

199. **STS** – Soft Tissue Sarcoma
200. **SVWMA** – Sacramento Valley Water Management Agreement
201. **SWB** – State Water Board (Water Resources Control Board)
202. **SWP** – State Water Project
203. **SWRCB** – State Water Resources Control Board
204. **TDF** – Through-Delta Facility
205. **TFE** – Tidal Freshwater Emergent
206. **THM** – Trihalomethane
207. **TL** – Total Body Length
208. **TNS** – Townet Survey
209. **TPA** – Tidal Perennial Aquatic
210. **UC** – Upland Cropland
211. **USACE** – United States Army Corps of Engineers
212. **USBR** – United States Bureau of Reclamation
213. **USCG** – United States Coast Guard
214. **USDA-ARS** – United States Department of Agriculture – Agricultural Research Service
215. **USFS** – United States Forest Service
216. **USFWS** – United States Fish and Wildlife Service
217. **VAMP** – Vernalis Adaptive Management Plan
218. **VFR** – Valley Foothill Riparian
219. **VRA** – Valley Riverine Aquatic
220. **WARM** – Warm Freshwater Habitat (Basin Plan beneficial use)
221. **WHCP** – Water Hyacinth Control Program
222. **WHO** – World Health Organization
223. **WILD** – Wildlife Habitat (Basin Plan beneficial use)
224. **WOE** – Weight-of-evidence
225. **WY** – Water Year
226. **X2** – The Line at which 2ppt (parts per thousand) Saline Occurs
227. **YOY** – Young of the Year.

Executive Summary

Executive Summary

A. Introduction to the PEIR

This document presents a final programmatic environmental impact report (PEIR) analyzing the potential environmental effects of the California Department of Parks and Recreation, Division of Boating and Waterways (DBW), Aquatic Invasive Plant Control Program (AIPCP). This document was prepared in compliance with the California Environmental Quality Act of 1970 (CEQA) (Public Resource Code 21000 *et seq*.).

The basic purpose of CEQA is to: (1) inform governmental decision-makers and the public about the potential, significant environmental effects of proposed activities; (2) identify ways that environmental damages can be avoided or significantly reduced; (3) prevent significant avoidable damages through alternatives and mitigation measures; and (4) disclose why a project is approved if significant environmental effects are involved. The Environmental Impact Report (EIR) is a State of California public document used by governmental agencies to analyze significant environmental effects of a proposed project, to identify project alternatives, and to disclose possible ways to reduce, or avoid, possible environmental damages.

A programmatic EIR is an EIR which may be prepared on a series of actions that can be characterized as one large project, such as this AIPCP. DBW is the Lead Agency for purposes of this PEIR.

Exhibit ES-1 illustrates the AIPCP project area, defined as follows: “the delta, its tributaries, and the marsh” (Harbors and Navigation Code Section 64). The State of California legal definition of the Sacramento-San Joaquin Delta (Delta) includes six counties (San Joaquin, Yolo, Sacramento, Solano, Contra Costa, and Alameda).

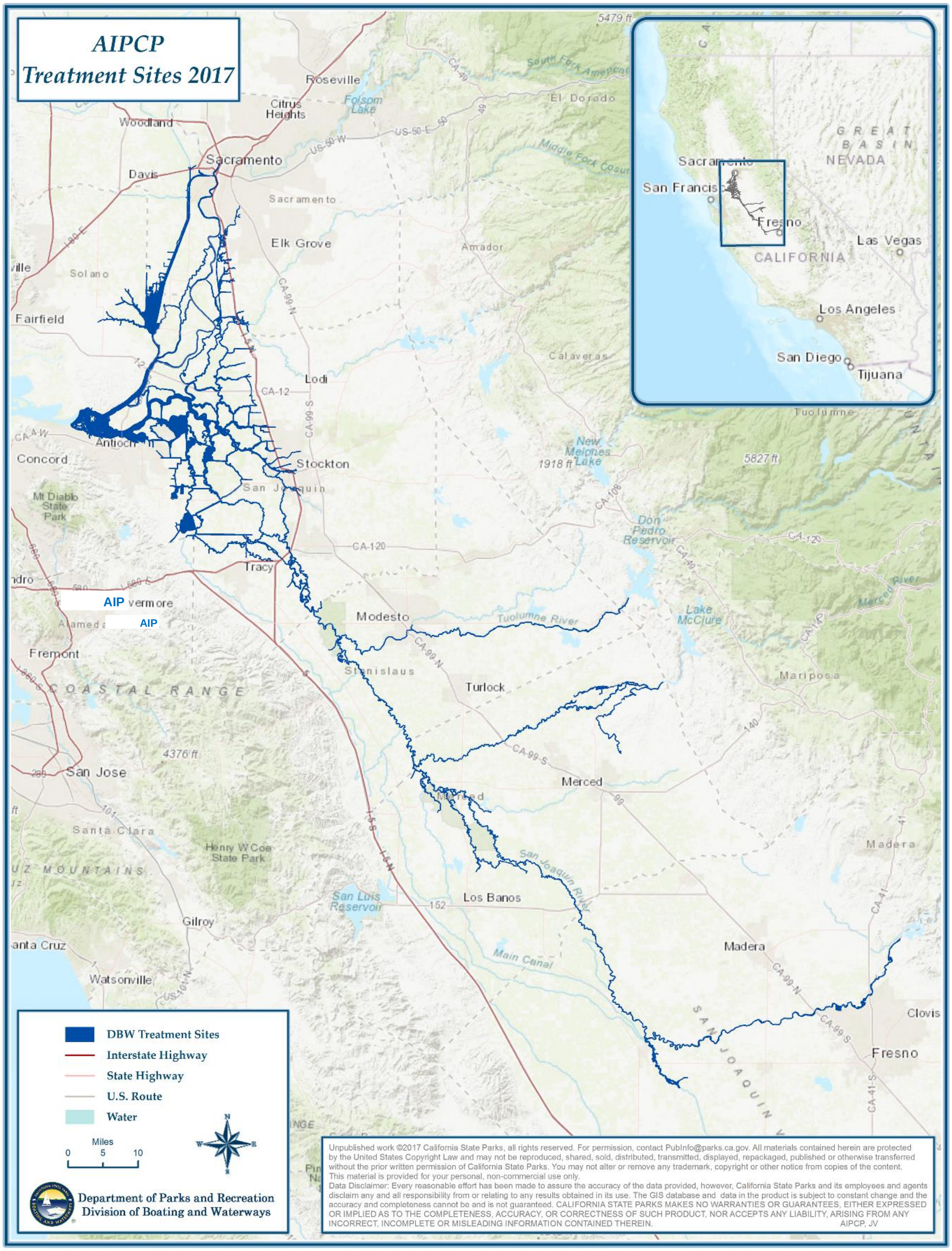
The AIPCP includes eleven (11) counties (including the six “Delta” counties) that encompass much of the Sacramento-San Joaquin Delta and its upland tributaries. The eleven counties are: (1) Alameda, (2) Contra Costa, (3) Fresno, (4) Madera, (5) Merced, (6) Sacramento, (7) San Joaquin, (8) Solano, (9) Stanislaus, (10) Tuolumne, and (11) Yolo.

The general boundaries for the treatment area in the Delta and its tributaries are as follows:

- West up to, and including, Sherman Island, at the confluence of the Sacramento and San Joaquin Rivers;
- West up to the Sacramento Northern Railroad, to include water bodies north of the southern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel;
- North to the northern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel, plus waters within Lake Natoma;
- South along the San Joaquin River to Mendota, just east of Fresno;
- East along the San Joaquin River to Friant Dam on Millerton Lake;
- East along the Tuolumne River to LaGrange Reservoir below Don Pedro Reservoir; and
- East along the Merced River to Merced Falls, below Lake McClure.

The objective of the AIPCP is to keep waterways safe and navigable by controlling the growth and spread of aquatic invasive plants in the Sacramento-San Joaquin Delta (Delta), its surrounding tributaries, and Suisun Marsh. There are currently eight species in the AIPCP: water hyacinth *(Eichhornia crassipes)*, spongeplant *(Limnobium laevigatum)*, water primrose *(Ludwigia spp)*, Brazilian waterweed *(Egeria densa)*, Curlyleaf pondweed *(Potomogeton crispus)*, Eurasian watermilfoil *(Myriophyllum spicatum)*, Carolina fanwort *(Cabomba caroliniana)*, and Coontail *(Ceratophyllum demersum)*. The AIPCP balances potential impacts of aquatic invasive plant management while (1) minimizing non-target species impacts and (2) preventing environmental degradation in Delta waterways and tributaries.

Exhibit ES-1
AIPCP Project Area Map



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B. Purpose of this PEIR

With preparation of this AIPCP Final PEIR, DBW is seeking to complete environmental documentation for the AIPCP for purposes of compliance with the California Environmental Quality Act (CEQA), and the California Endangered Species Act (CESA). This PEIR will supersede previously prepared EIRs/PEIRs for individual DBW aquatic invasive plant control programs (Water Hyacinth Control Program (WHCP), *Egeria densa* Control Program (EDCP), and Spongeplant Control Program (SCP)).

This programmatic Final EIR for the AIPCP will provide DBW with the opportunity to carefully evaluate the program within the current context of the Delta environment and its current treatment practices.

C. Project Alternatives Considered in this PEIR

CEQA requires that an EIR discuss a reasonable range of alternatives that could avoid, or substantially lessen, the significant environmental impacts of the proposed program, even if the alternatives might impede to some degree attainment of program objectives, or the alternatives would be costlier. An EIR must also evaluate the impacts of the "No Program Alternative" to allow decision makers to compare impacts of approving the proposed program with impacts of not approving the proposed program.

DBW considered five program alternatives: (1) Integrated Management (the selected alternative); (2) Herbicide Control Only; (3) Physical Control Only; (4) Biological Control Only; and (5) No Program Alternative. In over thirty years of operating the WHCP and 15 years of operating the EDCP, DBW has examined and tested a broad range of potential control methods. Based on an adaptive management approach, the AIPCP will continuously evolve to incorporate new information and experience. The selected AIPCP alternative reflects DBW's aquatic weed control program experience. The selected alternative provides flexibility to continue to adapt the AIPCP over time, shifting between treatment methods, as DBW gains more experience with the existing and new aquatic invasive species occurring in the project area.

D. AIPCP Overview

The purpose of the DBW Aquatic Invasive Plant Control Program (AIPCP) is to support a comprehensive, flexible, practical, inclusive, efficient, and effective approach to managing aquatic invasive plants (AIPs) in the Delta while minimizing environmental and ecosystem impacts, and supporting public health and the economy. The proposed program consists of an integrated and adaptive approach, consisting of herbicide treatment, physical treatment methods, and biological control agents, adjusting over time, as treatment methods, technology, and environmental factors change. The AIPCP is a comprehensive, programmatic approach to aquatic invasive plants control in the Delta that balances the needs of the environment, public health, and the economy. All previous aquatic invasive plant programs in the Sacramento-San Joaquin Delta (Delta) are incorporated into the AIPCP (including the Water Hyacinth Control Program, Spongeplant Control Program, and *Egeria densa* Control Program). The Harbors and Navigation Code, Section 64, authorizes DBW AIS control programs. The legislature has provided authority through the following:

- Senate Bill (SB) 1344 (Garamendi, Chapter 263, Statutes of 1982) designated the then Department of Boating Waterways as the lead agency for controlling water hyacinth *(Eichhornia crassipes)* in the Delta, its tributaries, and Suisun Marsh.
- AB 2193 (Rainey, Chapter 728, Statutes of 1996) authorized DBW to develop a control program for *Egeria densa* (Brazilian waterweed) in the Delta, its tributaries, and Suisun Marsh.
- AB 1540 (Buchanan, Chapter 188, Statutes of 2012) authorized DBW to control South American spongeplant *(Limnobium laevigatum)* in the Delta, its tributaries, and Suisun Marsh.
- AB 763 (Buchanan, Chapter 330, Statutes of 2013) created a new process within Section 64.5 of the Harbors and Navigation Code for authorizing new AIS control programs in the Delta, its tributaries, and Suisun Marsh. The bill authorizes DBW, in consultation with appropriate state, local, and federal agencies, and upon concurrence from the California Department of Fish and Wildlife (CDFW), following the completion of a specified assessment described in the bill, to take such action it determines is necessary to implement control and, when feasible, eradication measures for those invasive aquatic plants.

The proposed program reflects changes in the Delta ecosystem as well as legislative authority. Previously, aquatic invasive species have been handled on a species-by-species basis. As new plants emerged, they were added to existing programs through new legislation. However, changes in the aquatic invasive species landscape, including the increasing emergence of new species, prompted a new approach to control of these plants, which was authorized in 2013 by Assembly Bill 763. The bill eliminates the need for separate legislation to establish each new AIP control program. AB 763 requires DBW to regularly consult with United States Department of Agriculture – Agricultural Research Service (USDA-ARS), United States Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), the University of California, other members of the scientific and research communities, and other state agencies with authority over the control of invasive aquatic plants.

The AIPCP operates under federal, state, and local regulatory authorities, including:

- **USFWS Biological Opinion (BO)** – DBW and its federal nexus USDA-ARS are seeking a new Biological Opinion for compliance under Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)). Delta AIP control programs are currently operating under three USFWS BOs: 91410-2013-F-0005 for the WHCP, 08FBDT00-2013-F-0015 for the EDCP, as well as the newer Submersed Aquatic Vegetation (SAV) species, and 08FBDT00-2014-0029 for the SCP and water primrose. DBW and USDA-ARS submitted an AIPCP Programmatic Biological Assessment (BA) to USFWS on October 16, 2017. The BA is incorporated by reference. A PDF is provided as an Appendix to this PEIR.
- **NMFS BO or Letter of Concurrence (LoC)** – DBW and USDA-ARS are seeking a Biological Opinion for compliance under Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)) and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Delta AIP control programs are currently operating under three NMFS LoCs: 2013/9443 for the WHCP, 2013/9391 for the EDCP, as well as the newer SAV species, and 2014-394 for the SCP and water primrose. DBW and USDA-ARS submitted an AIPCP Programmatic Biological Assessment (BA) to USFWS on October 16, 2017.
- **CDFW Incidental Take permit under the California Endangered Species Act (CESA)** – With this PEIR DBW is currently in the process of obtaining an incidental take permit under CESA for the AIPCP.
- **CDFW Streambed Alteration and Routine Maintenance Agreement (RMA)** – DBW operates under a RMA for activities that could affect Delta channels, specifically mechanical harvesting operations.
- **Section 10 Permit under the Rivers and Harbors Act** –DBW is currently seeking a Section 10 River and Harbors Act permit from the Army Corps of Engineers (USACE) for use of floating booms and other physical treatment methods. DBW submitted a Regional General Permit application and Environmental Assessment (EA) of six of AIPCP physical control methods that fall within the jurisdiction of the Army Corps of Engineers. Because of their permitting authority, USACE is the Responsible Agency for these six methods. The six physical control methods evaluated in the EA consist of a subset of the AIPCP physical control methods with independent utility from the AIPCP. The AIPCP can be implemented without inclusion of these control methods. Consistent with this PEIR, the EA evaluation determined that these control methods have less than significant impacts. If USACE concurs with this finding, they will prepare a Finding of No Significant Impact (FONSI) as part of the Regional General Permit process.
- **National Pollution Discharge Elimination System (NPDES) Statewide General Permit CAG990005** –the NPDES permit guides DBW water quality monitoring for the AIPCP The State Water Resources Control Board (SWB) issued the current NPDES General Permit on March 5, 2013. This permit went into effect on December 1, 2013, with the most recent amendments approved in July 2016.
- **California Department of Pesticide Regulation and County Agricultural Commissioner requirements –** the AIPCP must comply with State and County requirements and restrictions related to herbicide application.

As part of its programmatic approach to controlling floating aquatic vegetation (FAV) and submersed aquatic vegetation (SAV), DBW is analyzing a diverse set of treatment tools that may ultimately minimize the amount of herbicide applied to Delta waterways, reduce potential for species resistance, minimize environmental and ecosystem impacts, and enable earlier treatment in areas where there are current restrictions. The AIPCP strives for the widest range of flexibility possible in terms of available tools. The tools proposed include treatment options that are not currently in use, but may become desirable in the future if new species emerge. For instance, the addition of new herbicides to the program does not automatically indicate that DBW will use them. Including as diverse a set of tools as possible in the current program supports the program's proactive (as opposed to reactive) philosophy.

The tools proposed fall into three categories:

1. Herbicide
2. Physical (mechanical harvesting, booms/barriers, hand-picking, etc.)
3. Biological (biocontrol).

Within this PEIR and the Programmatic BA, DBW is conducting a rigorous analysis of all proposed tools and respects the need to control aquatic invasive species while minimizing resulting environmental and ecosystem impacts to Delta waterways and its surrounding tributaries and Suisun Marsh. When selecting AIPCP herbicides, DBW is considering efficacy, legal and regulatory compliance, and ecosystem impacts. DBW has rejected several herbicides due to toxicity concerns and is further analyzing only those not expected to adversely harm sensitive species at the concentrations used. By including new herbicides in a more flexible and strategic program, DBW may ultimately minimize the amount of herbicide applied to Delta waterways, reduce potential for adverse health effects, increase efficacy, or reduce environmental impact. To treat various FAV and SAV the AIPCP proposes that five herbicides be added to the six that have been previously approved for use in prior programs.

Exhibit ES-2 outlines the control methods — herbicide, physical, and biological — that will be considered for incorporation into the AIPCP for treatment of FAV and SAV invasive plant species.

The AIPCP will conduct extensive incremental monitoring as a critical component of the program. The AIPCP is responsible for collecting water quality monitoring data, as well as collecting water samples for herbicide residue testing. AIPCP monitoring will include the four general areas listed below. Overall AIPCP monitoring will be integrated, and inform and support regulatory compliance, program planning, and program performance. AIPCP monitoring will include the following:

- NPDES and Immunoassay Monitoring
- SAV Hydroacoustic Monitoring
- FAV Monitoring and SAV Point Intercept Assessment
- Program Performance Metrics

Based on NPDES permit requirements, the AIPCP includes an Annual Environmental Monitoring Protocol specified in the Aquatic Pesticide Application Plan (APAP). DBW has monitoring protocols and APAPs specific to FAVs and SAVs. These protocols fulfill the monitoring requirements of the Regional Water Quality Control Board, NMFS, and USFWS. At each monitoring site, water samples are taken immediately pre-application (adjacent to the AIP). DBW also takes follow-up water samples at least two times following treatment.

Exhibit ES-2
Summary of Proposed AIPCP Control Methods

	FAV	SAV
Herbicides (X indicates the types of plants proposed for each method)		
2,4-D	X	
Glyphosate	X	
Penoxsulam	X	X
Imazamox	X	X
Diquat	X	X
Fluridone		X
Imazapyr	X	
Carfentrazone-ethyl	X	X
Endothall (Aquathol)		X
Flumioxazin	X	X
Florpyrauxifen-benzyl	X (label pending)	X (label pending)
Tank Mixes	X	X
Physical and Mechanical Methods		
Benthic mats		X
Hand/nets	X	
Diver handpicking, pulling		X
Diver suction harvesting		X
Booms and floating barriers	X	X
Curtains, screens	X	X
Surface excavators	X	
Harvesters	X	X
Cutters and shredders	X	
Herding	X	
Adjuvants and Dyes		
Agri-Dex	X	
Competitor	X	
Cygnet Plus	X	
Break-Thru SP 133	X (label pending)	
ColorFast	X	
Rhodamine WT		X
Bright Dyes		X
Biological Controls *(Water hyacinth only)*		
Neochetina weevil	X	
Plant hopper (*Megamelus scutellaris*)	X	

E. AIPCP Environmental Impacts and Mitigation Measures

Exhibit ES-3 provides the AIPCP Environmental Checklist for the 18 (I to XVIII) broad EIR impact categories. This table follows the general format provided in CEQA Guidelines, Appendix G. There are five (5) resource areas with avoidable, potentially avoidable, or unavoidable significant impacts. Exhibit ES-3 identifies Mandatory Findings of Significance. In two areas, the AIPCP has potentially unavoidable significant impacts: (1) potential to degrade the environment, and (2) cumulative impacts.

Within this PEIR, the DBW has identified 19 mitigation measures to reduce environmental impacts of the AIPCP. Many of these mitigation measures apply to more than one impact. CA State Parks – DBW is a stewardship agency. Projects and programs are designed and implemented to minimize impacts to the environment. The 19 mitigation measures have been incorporated in the AIPCP's daily operations. **Exhibit ES-4** provides each mitigation measure, and identifies the associated AIPCP potential impact areas the measures seek to reduce.

Exhibit ES-5 provides a summary of proposed AIPCP impacts, significance levels before mitigation, associated mitigation measures, and significance levels after mitigation. Exhibit ES-5 identifies two specific agriculture and forestry resource impacts; eight specific biological resource impacts; three specific hazards and hazardous materials impacts; six specific hydrology and water quality impacts; and one specific utilities and service systems impact.

The CEQA Guidelines, Section 15142, state that EIRs shall focus on the significant effects on the environment. Section 15128 states that the EIR shall briefly indicate reasons that various possible effects of a project were determined not to be significant.

Furthermore, Section 15150 discusses incorporation by reference from another public document in cases where descriptions and/or analyses are duplicative. The AIPCP Final PEIR makes use of these guidelines to address twelve environmental factor categories. Eleven of these twelve resource categories are addressed in detail in the *Egeria densa* Control Program Final EIR (2001), Water Hyacinth Control Program Final PEIR (2009), and Spongeplant Control Program Final PEIR (2014). Exhibit ES-4 also summarizes the reasons for DBW's determination that greenhouse gas emission impacts will be less than significant, or have no impact, and DBW's tribal consultation process under Public Resources Code section 21080.3.

Exhibit ES-3 summarizes 18 environmental factor areas, plus mandatory findings of significance. Exhibit ES-5 summarizes potential impacts in the five environmental factor areas with any potential for significant impacts. **Exhibit ES-6** summarizes 13 environmental factor areas that DBW determined will not be significantly affected by the AIPCP. Exhibit ES-6 also describes that the AIPCP will not result in growth inducing impacts.

Exhibit ES-3
AIPCP Environmental Checklist

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED BY THE AIPCP

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Significant Impact" (either "unavoidable", "potentially unavoidable", or "avoidable") as indicated by the checklist on the following pages.

[ ] Aesthetics I
[**X**] Agriculture and Forestry Resources II
[ ] Air Quality III
[**X**] Biological Resources IV
[ ] Cultural Resources V
[ ] Geology/Soils VI
[ ] Greenhouse Gas Emissions VII
[ ] Hazards & Hazardous Materials VIII
[**X**] Hydrology/Water Quality IX
[ ] Land Use/Planning X
[ ] Mineral Resources XI
[ ] Noise XII
[ ] Population/Housing XIII
[ ] Public Services XIV
[ ] Recreation XV
[ ] Transportation/Traffic XVI
[ ] Tribal Cultural Resources XVII
[**X**] Utilities/Service Systems XVIII
[**X**] Mandatory Findings of Significance XVIIII

Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
I. AESTHETICS — Would the project:					
a) Have a substantial adverse effect on a scenic vista?		[ ]	[ ]	[ ]	[X]
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?		[ ]	[ ]	[ ]	[X]
c) Substantially degrade the existing visual character or quality of the site and its surroundings?		[ ]	[ ]	[ ]	[X]
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?		[ ]	[ ]	[ ]	[X]
II. AGRICULTURE AND FORESTRY RESOURCES — In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:					
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?		[ ]	[ ]	[ ]	[X]
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?		[ ]	[ ]	[ ]	[X]
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?		[]	[]	[]	[X]
d) Result in the loss of forest land or conversion of forest land to non-forest use?		[]	[]	[]	[X]
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?		[ ]	[ ]	[ ]	[X]
f) Adversely impact agricultural crops or agricultural operations, such as irrigation?					
Impact A1: Agricultural crops	3, 16, 18	[ ]	[X]	[ ]	[ ]
Impact A2: Irrigation pumps	11, 16, 18	[ ]	[X]	[ ]	[ ]

Exhibit ES-3
AIPCP Environmental Checklist *(continued)*

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Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
III. AIR QUALITY — Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:					
a) Conflict with or obstruct implementation of the applicable air quality plan?		[ ]	[ ]	[ ]	[X]
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?		[ ]	[ ]	[ ]	[X]
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?		[ ]	[ ]	[ ]	[X]
d) Expose sensitive receptors to substantial pollutant concentrations?		[ ]	[ ]	[X]	[ ]
e) Create objectionable odors affecting a substantial number of people?		[ ]	[ ]	[X]	[ ]
IV. BIOLOGICAL RESOURCES — Would the project:					
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the CDFW or USFWS?					
Impact B1: Herbicide overspray	1, 2, 3, 4, 5, 19	[X]			
Impact B2: Herbicide toxicity	1, 3, 4, 6, 7, 8, 9, 13	[X]			
Impact B3: Herbicide bioaccumulation				[X]	
Impact B4: Food web effects	1, 3, 4, 7, 8	[X]			
Impact B5: Dissolved oxygen levels	10		[X]		
Impact B6: Treatment disturbances	1, 5, 6, 17	[X]			
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the CDFW or USFWS?					
Impact B1: Herbicide overspray	1, 2, 3, 4, 5, 19	[X]			
Impact B5: Dissolved oxygen levels	10		[X]		
Impact B6: Treatment disturbances	1, 5, 6, 17	[X]			
Impact B7: Plant fragmentation	11, 17		[X]		
Impact B8: Spoiling of harvested plants				[X]	
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?					
Impact B1: Herbicide toxicity	1, 3, 4, 6, 7, 8, 9, 13	[X]			
Impact B5: Dissolved oxygen levels	10		[X]		
Impact B6: Treatment disturbances	1, 5, 6, 17	[X]			
Impact B7: Plant fragmentation	11, 17		[X]		
Impact B8: Spoiling of harvested plants				[X]	

Exhibit ES-3
AIPCP Environmental Checklist *(continued)*

Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
IV. BIOLOGICAL RESOURCES *(continued)* — Would the project:					
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?					
Impact B2: Herbicide toxicity	1, 3, 4, 6, 7, 8, 9, 13	[X]			
Impact B4: Food web effects	1, 3, 4, 7, 8	[X]			
Impact B5: Dissolved oxygen levels	10		[X]		
Impact B6: Treatment disturbances	1, 5, 6, 17	[X]			
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?		[ ]	[ ]	[ ]	[X]
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?		[ ]	[ ]	[ ]	[X]
V. CULTURAL RESOURCES — Would the project:					
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?		[ ]	[ ]	[ ]	[X]
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?		[ ]	[ ]	[ ]	[X]
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?		[ ]	[ ]	[ ]	[X]
d) Disturb any human remains, including those interred outside of formal cemeteries?		[ ]	[ ]	[ ]	[X]
VI. GEOLOGY AND SOILS — Would the project:					
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:					
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.		[ ]	[ ]	[ ]	[X]
ii) Strong seismic ground shaking?		[ ]	[ ]	[ ]	[X]
iii) Seismic-related ground failure, including liquefaction?		[ ]	[ ]	[ ]	[X]
iv) Landslides?		[ ]	[ ]	[ ]	[X]
b) Result in substantial soil erosion or the loss of topsoil?		[ ]	[ ]	[ ]	[X]
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?		[ ]	[ ]	[ ]	[X]
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?		[ ]	[ ]	[ ]	[X]
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?		[ ]	[ ]	[ ]	[X]

Exhibit ES-3
AIPCP Environmental Checklist *(continued)*

Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
VII. GREENHOUSE GAS EMISSIONS — Would the project:					
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?				[X]	
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?					[X]
VIII. HAZARDS AND HAZARDOUS MATERIALS — Would the project:					
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?					
Impact H1: General public exposure				[X]	
Impact H2: Treatment crew exposure	3, 8, 12, 13, 14		[X]		
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?					
Impact H3: Accidental spills	13		[X]		
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?		[ ]	[ ]	[ ]	[X]
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?		[ ]	[ ]	[ ]	[X]
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?		[ ]	[ ]	[ ]	[X]
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?		[ ]	[ ]	[ ]	[X]
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?		[ ]	[ ]	[ ]	[X]
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?		[ ]	[ ]	[ ]	[X]
IX. HYDROLOGY AND WATER QUALITY — Would the project:					
a) Violate any water quality standards or waste discharge requirements?					
Impact W1: Chemical constituents	3, 4, 7, 8, 15	[X]			
Impact W2: Pesticides	1, 3, 4, 5, 6, 7, 8, 15	[X]			
Impact W3: Toxicity	1, 3, 4, 5, 6, 7, 8, 15	[X]			
Impact W4: Dissolved oxygen levels	10	[X]			
Impact W5: Floating material	11, 15, 16		[X]		
Impact W6: Turbidity				[X]	

Exhibit ES-3
AIPCP Environmental Checklist *(continued)*

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Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
IX. HYDROLOGY AND WATER QUALITY *(continued)* — Would the project:					
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?		[ ]	[ ]	[ ]	[X]
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?		[ ]	[ ]	[ ]	[X]
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?		[ ]	[ ]	[ ]	[X]
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?		[ ]	[ ]	[ ]	[X]
f) Otherwise substantially degrade water quality?					
Impact W1: Chemical constituents	3, 4, 7, 8, 15	[X]			
Impact W2: Pesticides	1, 3, 4, 5, 6, 7, 8, 15	[X]			
Impact W3: Toxicity	1, 3, 4, 5, 6, 7, 8, 15	[X]			
Impact W4: Dissolved oxygen levels	10	[X]			
Impact W5: Floating material	11, 15, 16		[X]		
Impact W6: Turbidity				[X]	
g) Otherwise substantially degrade drinking water quality?					
Impact W1: Chemical constituents	3, 4, 7, 8, 15	[X]			
Impact W2: Pesticides	1, 3, 4, 5, 6, 7, 8, 15	[X]			
Impact W3: Toxicity	1, 3, 4, 5, 6, 7, 8, 15	[X]			
h) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?		[ ]	[ ]	[ ]	[X]
i) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?		[ ]	[ ]	[ ]	[X]
j) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?		[ ]	[ ]	[ ]	[X]
k) Inundation by seiche, tsunami, or mudflow?		[ ]	[ ]	[ ]	[X]

Exhibit ES-3
AIPCP Environmental Checklist *(continued)*

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Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
X. LAND USE AND PLANNING — Would the project:					
a) Physically divide an established community?		[ ]	[ ]	[ ]	[X]
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?		[ ]	[ ]	[ ]	[X]
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?		[ ]	[ ]	[ ]	[X]
XI. MINERAL RESOURCES — Would the project:					
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?		[ ]	[ ]	[ ]	[X]
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?		[ ]	[ ]	[ ]	[X]
XII. NOISE — Would the project result in:					
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?		[ ]	[ ]	[ ]	[X]
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?		[ ]	[ ]	[ ]	[X]
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?		[ ]	[ ]	[ ]	[X]
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?		[ ]	[ ]	[X]	[ ]
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?		[ ]	[ ]	[ ]	[X]
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?		[ ]	[ ]	[ ]	[X]
XIII. POPULATION AND HOUSING — Would the project:					
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?		[ ]	[ ]	[ ]	[X]
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?		[ ]	[ ]	[ ]	[X]
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?		[ ]	[ ]	[ ]	[X]

Exhibit ES-3
AIPCP Environmental Checklist *(continued)*

Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
XIV. PUBLIC SERVICES — Would the project:					
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:					
Fire protection?		[ ]	[ ]	[ ]	[X]
Police protection?		[ ]	[ ]	[ ]	[X]
Schools?		[ ]	[ ]	[ ]	[X]
Parks?		[ ]	[ ]	[ ]	[X]
Other public facilities?		[ ]	[ ]	[ ]	[X]
XV. RECREATION — Would the project:					
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?		[ ]	[ ]	[ ]	[X]
b) Include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?		[ ]	[ ]	[ ]	[X]
c) Would the project adversely impact existing recreational opportunities?		[ ]	[ ]	[X]	[ ]
XVI. TRANSPORTATION/TRAFFIC — Would the project:					
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?		[ ]	[ ]	[ ]	[X]
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?		[ ]	[ ]	[ ]	[X]
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?		[ ]	[ ]	[ ]	[X]
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?		[ ]	[ ]	[ ]	[X]
e) Result in inadequate emergency access?		[ ]	[ ]	[ ]	[X]
f) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?		[ ]	[ ]	[ ]	[X]

Exhibit ES-3
AIPCP Environmental Checklist *(continued)* *Page 8 of 8*

Environmental Factors	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
XVII. TRIBAL CULTURAL RESOURCES —Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:					
a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)?		[ ]	[ ]	[ ]	[X]
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.		[ ]	[ ]	[ ]	[X]
XVIII. UTILITIES AND SERVICE SYSTEMS — Would the project:					
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?		[ ]	[ ]	[ ]	[X]
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?		[ ]	[ ]	[ ]	[X]
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?		[ ]	[ ]	[ ]	[X]
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?		[ ]	[ ]	[ ]	[X]
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?		[ ]	[ ]	[ ]	[X]
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?		[ ]	[ ]	[ ]	[X]
g) Comply with federal, state, and local statutes and regulations related to solid waste?		[ ]	[ ]	[ ]	[X]
h) Result in problems for local or regional water utility intake pumps?					
Impact U1: Water utility intake pumps	11, 16	[ ]	[X]	[ ]	[ ]
XIX. MANDATORY FINDINGS OF SIGNIFICANCE — Does the project:					
a) Have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	1 to 11, 13	[ ]	[X]	[ ]	[ ]
b) Have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	1 to 19	[X]	[ ]	[ ]	[ ]
c) Have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	3, 7, 8, 12, 13, 14, 19	[ ]	[X]	[ ]	[ ]

Exhibit ES-4
AIPCP Mitigation Measures

Mitigation Measures	Mitigated Impact Areas
1. Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources Each year, prior to the start of the treatment season, AIPCP will conduct field crew environmental awareness training. Under this training, crews will be informed about the presence and life histories of special status species; habitats associated with species; sensitive habitats and wetlands; the terms and conditions of the program's biological opinions; incidental take procedures; and that unlawful take of an animal or destruction of its habitat is a violation of the Endangered Species Act and/or California Endangered Species Act. AIPCP also will provide crews with a special status species field guide for easy identification of special status species on-site. Prior to treating a site, crews will conduct a visual survey to determine whether special status plants, animals, or sensitive habitats are present. Crews will complete an Environmental Observations Checklist for each site to document the presence or absence of special status species. If any special status species or sensitive habits are present at the site, the field crew will not perform any treatment. DBW Environmental Scientists will classify treatment sites as high, medium, or low potential for nesting birds. DBW also will examine CNDDB records to determine if special status bird species have been sited within AIPCP treatment locations, and prepare a map for field crews identifying such sites. For those treatment sites that have habitat characteristics that might support special status bird species, Environmental Scientists will survey the specific site. DBW will delay treatments at locations where nesting Swainson's hawks are present until after June 10th, the start of the post-fledging stage. At all treatment locations, crews will conduct a visual survey, following an established protocol, to determine whether special status plants, animals, or sensitive habitats are present, including bird nesting sites. DBW will follow a Swainson's hawk survey protocol consistent with the requirements in the 2015 CDFW-DBW Final Streambed agreement, including surveys focused on active Swainson's hawk nests during their nesting season (February 15 – July 31) within ¼ mile of the project work site. Crews will complete an Environmental Observations Checklist for each site to document the presence or absence of bird nesting sites. If nesting yellow-headed blackbird, Swainson's hawk, or tricolored blackbird are known to be present at the site, the field crew will not perform any treatment within one-quarter mile of the nesting site until the post-fledging stage. For mechanical harvesting operations, DBW Environmental Scientists will observe plant materials during harvesting, and to the extent possible, remove special status species such as Western Pond Turtle, from bycatch. Turtles and other special status species will be placed back in the water in a location away from the harvesting operation.	Biological Resources, Hydrology and Water Quality

Exhibit ES-4
AIPCP Mitigation Measures *(continued)*

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Mitigation Measures	Mitigated Impact Areas
2. Provide a 100 foot buffer between treatment sites and shoreline elderberry shrubs (*Sambucus* ssp.), host plant for the valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)* in most sites; in selected sites, utilize backpack style sprayers to direct spray on FAV adjacent to elderberry shrubs AIPCP will conduct a survey of treatment sites to prepare a map that identifies locations of elderberry shrubs, and provide this map to field crews. In most locations, AIPCP crews will ensure at least 100 feet of buffer between elderberry shrubs and herbicide treatments. Crews will also conduct treatments downwind of elderberry shrubs. For selected treatment sites where Priority 1 and Priority 2 treatment occurs adjacent to elderberry shrubs, DBW crews will utilize backpack style spray wands to target herbicide directly onto FAV species. DBW will photograph and monitor elderberry shrubs near these treatment sites. In addition, AIPCP environmental scientists will survey a sample of elderberry shrubs which could be potentially impacted by application activities at the beginning of the treatment season, and at the end of the treatment season. The environmental scientists will compare the health of elderberry shrubs at control sites (i.e. not adjacent to treatments) with elderberry shrubs located adjacent to treated sites. If elderberry shrubs located near treated sites show signs of adverse effects from treatment, AIPCP will develop additional mitigation measures to protect elderberry shrubs (for example, increasing the size of the buffer zone).	Biological Resources
3. Minimize potential for drift when applying herbicides In addition to complying with the label application requirements, DBW will, to the degree possible, schedule herbicide applications to occur at high tide, or at a point in the tidal cycle determined by the field supervisor to provide the least non-target impact at a particular site. In general, treatment at high tide will allow for better spray accuracy and access, and will provide for greater dilution volume of herbicides. DBW crews will change nozzle type and spray pressures whenever conditions warrant, limiting the amount of herbicide which may inadvertently contact non-target species or enter the water.	Biological Resources, Agriculture and Forestry Resources, Hydrology and Water Quality
4. Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total To minimize the potential for negative impacts to covered species from exposure to diquat dibromide, DBW will only utilize diquat for unforeseen infestations. Diquat will only be utilized from August 1st through November 30th of each year, unless utilized in a controlled DIZ location where listed fish species will not be present. Diquat treatments will be limited to a total of 1 percent of AIPCP treatment acres in the Delta per year. Unforeseen infestations include situations in which aquatic invasive plant growth completely impedes navigation of Delta waters, such as a completely blocked slough that would impair the movement of emergency response vessels, or infestations that block water intake facilities and require immediate treatment. DBW will consult with USFWS and NMFS prior to utilizing diquat to help ensure that covered fish species are not likely to be present at the time of treatment.	Biological Resources, Hydrology and Water Quality
5. Minimize boat wakes and propeller noise to avoid disturbance to the habitat Operational procedures for AIPCP vessels will minimize boat wakes and propeller noise. These procedures will be particularly important in shallow water, or other sensitive habitats.	Biological Resources, Hydrology and Water Quality

Exhibit ES-4
AIPCP Mitigation Measures *(continued)*

Mitigation Measures	Mitigated Impact Areas
6. Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed species are likely to be present The AIPCP will implement a historical mapping and survey-based approach to conducting treatments that allows for treatments in areas with invasive plant infestations when listed fish species are not likely to be present. AIPCP will use the historical wet and drought year monthly mapping results, in combination with current CDFW and USFWS fish survey results to identify locations were species are not likely to be present. These site-specific treatment time restrictions minimize potential exposure of migratory salmonids and sensitive juvenile fish to AIPCP herbicides or mechanical harvesting. Some SAV herbicide treatments using low herbicide concentrations may take place in sites where listed fish have been found historically, depending on water flow and herbicide efficacy requirements. See the exhibits in Chapter 3 that summarize treatment timing. Appendix 3-A provides historical maps of fish species location by month. Species-specific maps are provided in the AIPCP Biological Assessment Supplemental Materials.	Biological Resources
7. Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters AIPCP will conduct comprehensive monitoring. This monitoring is in compliance with the general NPDES permit, and prior NOAA-Fisheries and USFWS Biological Opinions/Letters of Concurrence. AIPCP will collect a pre-treatment sample no more than 24-hours prior the start of treatment, and collect post-treatment samples, continuing until the sampling location shows non-detectable herbicide levels. AIPCP will conduct water quality monitoring as required by the NPDES General Permit for each herbicide, and water body type. Water samples will be submitted to a certified analytical laboratory to measure herbicide and adjuvant concentrations, as appropriate. Should these levels exceed allowable limits, AIPCP will take immediate measures to reduce herbicide levels at future treatment sites. AIPCP will conduct additional immunoassay monitoring for selected SAV herbicide applications to more closely track herbicide levels. In the event that herbicide or adjuvant concentrations exceed allowable limits, DBW will take reasonable measures to document the extent of the associated.impacts and affected areas including photographic documentation of affected areas and any injured fish and wildlife. If dead fish or wildlife are found in the affected area, DBW will collect carcasses and deliver them to CDFW. DBW will meet with CDFW within ten days of the incident in order to develop a resolution including: site clean-up, site remediation and compensatory mitigation for the harm caused to fish, wildlife and the habitats on which they depend as a result of the incident. DBW will be responsible for all clean-up, site remediation and compensatory mitigation costs. DBW will take all reasonable measures to ensure that a resolution be achieved within a specified timeframe, generally six months from the date of the incident.	Biological Resources, Hydrology and Water Quality

Exhibit ES-4
AIPCP Mitigation Measures *(continued)*

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Mitigation Measures	Mitigated Impact Areas
8. Implement an adaptive management approach to minimize the use of herbicides in the long-term [Note: in order to reduce recent infestation levels to maintenance status, DBW may need to increase the amount of herbicide utilized over the next few years; once a maintenance level has been established, the goal would be to reduce annual herbicide applications] Under an adaptive management approach, AIPCP will seek to improve efficacy and reduce environmental impacts over time as new and better information is available. Specifically, AIPCP will evaluate the need for control measures on a site by site, month-to-month, basis; select appropriate indicators for pre-treatment monitoring; monitor indicators following treatment and evaluate data to determine program efficacy and environmental impacts; support ongoing research to explore impacts of the AIPCP and alternative control methodologies; report findings to regulatory agencies; and adjust program actions, as necessary, in response to recommendations and evaluations by USDA-ARS, DBW staff, regulatory agencies and stakeholders. In addition to this adaptive management approach, AIPCP will follow maintenance control practices that from a program standpoint seek to reduce the number of acres of invasive plants to be treated each year, until treatment acreage reaches a minimal level. This will reduce the volume of herbicide utilized by the AIPCP.	Biological Resources, Hydrology and Water Quality
9. Provide treatment crews with electronic mapping that identifies previously surveyed areas for giant garter snake habitat, valley elderberry shrub locations (see hard copy example in Chapter 3), and nesting special status birds. Application crews will use these maps as tools for performing pre-application visual inspections for the presence of giant garter snakes, valley elderberry longhorn beetle, or nesting special status birds. If giant garter snakes are present, treatment crews will not treat at that location. If valley elderberry shrubs are within 100 feet of the potential spray area, crews will generally not treat at that location (see Mitigation Measure 2 for exceptions). If nesting special status birds are present, treatment crews will not perform any treatment within 200 yards of the nesting site until the post-fledging stage.	Biological Resources
10. Monitor dissolved oxygen levels pre- and post-treatment for all AIPCP treatments, and at selected locations in the Delta over time Based on the pre-treatment DO levels, the AIPCP application crew will determine whether to conduct treatment at that site. No treatment will be performed when dissolved oxygen levels are between 3 ppm (the level below which DO is considered to be detrimental to fish species) and the basin plan limits established by the Central Valley Regional Water Quality Control Board (CVRWQB). The basin plan limits depend on location and time of year, and range from 5 ppm to 8 ppm. DBW will maintain written and map summaries of specific DO numeric limits. When pre-treatment levels are below 3 ppm, fish species are not likely to be present due to the extremely low oxygen levels. When pre-treatment levels are above the basin plan limit, AIPCP treatments, following label guidelines and mitigation measures, are not expected to adversely affect special status fish, resident native or migratory fish, or sensitive riparian or wetland habitats.	Biological Resources, Hydrology and Water Quality
11. Collect plant fragments during and immediately following treatment To maximize containment of plant fragments, AIPCP crews will collect plant fragments that are released from physical/mechanical treatments. Crews will also be trained on the importance of minimizing fragment escape.	Biological Resources, Agriculture and Forestry Resources, Hydrology and Water Quality

Exhibit ES-4
AIPCP Mitigation Measures *(continued)*

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Mitigation Measures	Mitigated Impact Areas
12. Require treatment crews to participate in training on herbicide and heat hazards, as well as continuing education units required under California Department of Pesticide Regulation law AIPCP will provide training to ensure that treatment crews have the knowledge and tools necessary to conduct the program in a safe manner. Training will include reading, understanding, and following herbicide label requirements; purpose and proper use of Personal Protective Equipment; symptoms of herbicide poisoning and minimization of exposure; avoidance, symptoms, and treatment of heat exposure; and emergency medical procedures.	Hazards and Hazardous Materials
13. Follow best management practices to minimize the risk of spill and to minimize the impact of a spill, should one occur The AIPCP best management practices are listed in the WHCP/SCP Operations Management Plan and in the EDCP Operations Management Plan, which are incorporated into this PEIR by reference. These include several provisions to reduce the potential for spill, such as: fastening herbicide containers securely in boats in original, watertight containers; carrying a marker buoy and anchor line to mark any spills in water; reporting spills immediately to appropriate State and local agencies; stopping movement of land spills as soon as possible using absorbing materials; marking and monitoring spills in water for herbicide residues and environmental impacts, if appropriate. Treatment crews will include at least one person with a Qualified Applicators Certificate (QAC), and all crew members will participate in annual training on herbicide handling procedures. In the event of an accidental spill of materials deleterious to aquatic life, AIPCP shall take all reasonable measures to document the extent of the associated impacts and affected areas including photographic documentation of affected areas and any injured fish and wildlife. If dead fish or wildlife are found in the affected area then DBW shall collect carcasses, preserve them, and immediately deliver them to the California Department of Fish and Wildlife (CDFW). DBW shall meet and confer with CDFW within 10 days of the incident in order to develop a resolution including: site clean-up, site remediation and compensatory mitigation for the harm caused to fish, wildlife and all the habitats which they depend as a result of the incident. DBW shall take all reasonable measures to ensure that a resolution be achieved within a specified timeframe, generally six months from the date of the incident.	Biological Resources, Hazards and Hazardous Materials
14. Implement safety precautions on hot days to prevent heat illness In addition to annual training on heat illness prevention, and compliance with CalOSHA's California Heat Illness Prevention Standard, AIPCP field supervisors will conduct special training sessions on days when weather is expected to be hot. This training will cover the symptoms of heat illness, and immediate actions to take should any symptoms occur. Field supervisors will cancel treatments if the weather is exceptionally hot. AIPCP may also provide bimini tops (shade covers) for AIPCP treatment boats.	Hazards and Hazardous Materials

Exhibit ES-4
AIPCP Mitigation Measures *(continued)*

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Mitigation Measures	Mitigated Impact Areas
15. Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities. The MOU is an agreement between CCWD and DBW. No applications shall occur within Rock Slough, or within one mile of the confluence of Rock Slough and Old River, or within one mile of CCWD's Old River or Mallard Slough intake pumps without consensual agreement between CCWD and DBW. Herbicide applications within one mile of CCWD's water intakes may only occur with prior consent of CCWD. In order to treat within one mile of an intake, AIPCP must notify CCWD at least two weeks in advance, and make every reasonable attempt to schedule applications during periods when CCWD's intakes are shut down for environmental or maintenance reasons, allowing at least two complete tidal cycles between application and restart. This measure is primarily aimed at reducing the potential for drinking water contamination from the AIPCP.	Hydrology and Water Quality, Utilities/Service Systems
16. Notify County Agricultural Commissioners about AIPCP activities Before an application may occur, AIPCP shall file Pesticide Use Recommendations (PUR) and a Notice of Intent (NOI) with the appropriate County Agricultural Commissioner (CAC) office, when required for restricted material or as requested by each county. Each NOI will include the site number, spray dates, locations, and herbicides and adjuvants to be used. NOIs will be submitted before the upcoming treatment week. Based on information in the NOIs, CAC's could inform land owners of particular periods of time during which irrigation should not occur. If necessary, AIPCP shall also obtain a Restricted Use Permit (RUP) from all appropriate CACs.	Agriculture and Forestry Resources, Hydrology and Water Quality
17. Follow environmental compliance measures for species avoidance, equipment operation, and spoiling when conducting mechanical harvesting operations. The AIPCP will implement a protocol similar to that for herbicide treatment prior to conducting mechanical removal. Environmental scientists will check fish survey data to verify that listed fish species are not likely to be present at the removal site. The equipment operator will utilize the Environmental Checklist to evaluate presence of listed species or sensitive habitat prior to removal. If listed species or sensitive habitats are present, the operator will not conduct mechanical removal at that site. DBW will conduct mechanical removal of AIPs in sensitive giant garter snake habitat or areas where giant garter snakes have been sighted in the past, only between October 1st and May 1st. The mechanical harvester will maintain a speed of 2 to 2.5 knots in areas outside of sensitive giant garter snake habitat, areas where giant garter snake has been sighted in the past, during the active season, and areas where Western pond turtles are likely to be present, so that if these species were in the area, they could move out of the way and/or be readily removed from bycatch. The operator will stop and reverse the mechanical harvester if a snake is seen within AIPs during removal. DBW will spoil all AIPs collected by mechanical removal outside of the May 1st to October 1st giant garter snake active season at an approved spoil location to ensure no hibernating giant garter snakes are buried under piles of collected spoils.	Biological Resources

Exhibit ES-4
AIPCP Mitigation Measures *(continued)*

Mitigation Measures	Mitigated Impact Areas
18. Follow the Memorandum of Understanding (MOU) protocol for herbicide applications in Discovery Bay and Indian Slough. The AIPCP will follow herbicide label requirements. This includes requirements and The MOU is an agreement between the East Contra Costa Irrigation District (ECCID) and DBW. The MOU includes the items described in the following text. Provision of date, location and concentration levels for all treatments in the Discovery Bay and Indian Slough area will be shared with ECCID. Notification by DBW to ECCID of any changes made to the treatment schedule. DBW will provide the ECCID with maps of the treatment areas within Discovery Bay in addition to sonar hydro-acoustic map. Adjust application rates depending on Fluridone residue test results. Any changes in the treatment schedule will be sent to the ECCID contact person prior to the following week's treatment. Provide Fluridone herbicide residue test results to ECCID on a weekly basis. Test results include ECCID canal sampling locations E1 through E7. The test results will be emailed to the ECCID contact person by DBW staff. Application rates may be adjusted depending on Fluridone residue test results. Any changes in the treatment schedule will be sent to the ECCID contact person prior to the following week's treatment. During the treatment period, provide DBW with approximate pumping information pertaining to Station 1 at Bixler on a weekly basis. ECCID will provide DBW with crop information from growers/farmers utilizing water from ECCID (WURF data base) prior to the treatment season or whenever there is a change of crop planting. When available, the ECCID will provide DBW with the planting schedule and maps for farms that plant any crops/vegetables belonging to Solanaceae family. Provide DBW with a set of keys (Waiver agreement or Entry Permit) with access to Bixler headwall for testing purposes.	Agriculture and Forestry Resources
19. Visually inspect riparian habitat to document impacts from treatment AIPCP trained and approved staff will visually monitor and document the health of riparian vegetation adjacent to treatment sites that could be potentially impacted by application activities at the beginning and end of the treatment season. DBW Designated Biologists will conduct annual training for AIPCP staff on healthy riparian habitat characteristics, identification of damage to habitats, evaluation of extent of damage, survey methodology, and reporting. In addition to regular surveys by AIPCP trained and approved staff, Designated Biologists will perform visual inspections of randomly selected riparian locations during the treatment season. If any mortality of riparian vegetation occurs as a result of herbicide overspray within the treatment season, DBW will meet and confer with CDFW in order to develop a resolution and/or riparian enhancement plan.	Biological Resources

Exhibit ES-5
Summary of Proposed AIPCP Impacts, Mitigation Measures, and Significance Levels Before and After Mitigation

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Resource Areas	Potential Impacts	Significance Level Before Mitigation: Unavoidable or Potentially Unavoidable Significant Impact	Significance Level Before Mitigation: Avoidable Significant Impact	Significance Level Before Mitigation: Less than Significant Impact	Mitigation	Significance Level After Mitigation: Reduced, but still Potentially Unavoidable Significant Impact	Significance Level After Mitigation: Less than Significant Impact
II. Agriculture and Forestry Resources	**A1 – Agricultural crops:** effects of AIPCP herbicide treatments on agricultural crops		[X]		**3** – Minimize potential for drift when applying herbicides **16** – Notify County Agricultural Commissioners about AIPCP activities **18** – Follow the MOU protocol for herbicide applications in Discovery Bay and Indian Slough		[X]
	A2 – Irrigation pumps: effects of AIPCP treatments on agricultural irrigation		[X]		**11** – Collect plant fragments during and immediately following treatment **16** – Notify County Agricultural Commissioners about AIPCP activities **18** – Follow the MOU protocol for herbicide applications in Discovery Bay and Indian Slough		[X]
IV. Biological Resources	**B1 – Herbicide overspray:** effects of herbicide overspray on special status species, riparian or other sensitive habitats, and wetlands	[X]			**1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **2** – Provide a 100 foot buffer between treatment sites and shoreline elderberry shrubs, host plant for the valley elderberry longhorn beetle in most sites; in selected sites, utilize backpack sprayers to direct spray on FAV adjacent to elderberry shrubs **3** – Minimize potential for drift when applying herbicides **4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total **5** – Minimize boat wake and propeller noise to avoid disturbance to habitat 19 – Visually inspect riparian habitat to document impacts from treatment	[X]	

Exhibit ES-5
Summary of Proposed AIPCP Impacts, Mitigation Measures, and Significance Levels Before and After Mitigation *(continued)*

Resource Areas	Potential Impacts	Significance Level Before Mitigation: Unavoidable or Potentially Unavoidable Significant Impact	Significance Level Before Mitigation: Avoidable Significant Impact	Significance Level Before Mitigation: Less than Significant Impact	Mitigation	Significance Level After Mitigation: Reduced, but still Potentially Unavoidable Significant Impact	Significance Level After Mitigation: Less than Significant Impact
IV. Biological Resources *(continued)*	**B2 – Herbicide toxicity:** toxic effects of herbicides on special status species, native resident fish, and migratory fish	[X]			**1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **3** – Minimize potential for drift when applying herbicides **4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total **6** – Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed fish are likely to be present **7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters **8** – Implement an adaptive management approach to minimize the use of herbicides in the long-term **9** – Provide treatment crews with electronic mapping that identifies previously surveyed areas for giant garter snake habitat, valley elderberry shrubs, and nesting special status birds 13 – Follow best management practices to minimize the risk of spill and to minimize the impact of a spill, should one occur	[X]	
	B3 – Herbicide bioaccumulation: effects of herbicide bioaccumulation on special status species			[X]	NA		NA
	B4 – Food web effects: effect of treatment on food webs, and resulting impact on special status species, sensitive habitats, and migration of species	[X]			**1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **3** – Minimize potential for drift when applying herbicides **4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total **7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters **8** – Implement an adaptive management approach to minimize the use of herbicides in the long-term	[X]	

Exhibit ES-5
Summary of Proposed AIPCP Impacts, Mitigation Measures, and Significance Levels Before and After Mitigation *(continued)*

Resource Areas	Potential Impacts	Significance Level Before Mitigation: Unavoidable or Potentially Unavoidable Significant Impact	Significance Level Before Mitigation: Avoidable Significant Impact	Significance Level Before Mitigation: Less than Significant Impact	Mitigation	Significance Level After Mitigation: Reduced, but still Potentially Unavoidable Significant Impact	Significance Level After Mitigation: Less than Significant Impact
IV. Biological Resources *(continued)*	**B5 – Dissolved oxygen levels:** effects of treatment on local dissolved oxygen (DO) levels, and resulting impact on special status species, resident native or migratory fish, sensitive habitat, and wetlands		[X]		**10** – Monitor dissolved oxygen levels pre- and post-treatment for all AIPCP treatments, and at selected locations in the Delta over time		[X]
	B6 – Treatment disturbances: effects of treatment disturbances on special status species, resident native or migratory fish, sensitive habitat, and wetlands	[X]			**1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **5** – Operate program vessels in a manner that causes the least amount of disturbance to the habitat **6** – Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed fish are likely to be present **17** – Follow environmental compliance measures for species avoidance, equipment operation, and spoiling when conducting mechanical harvesting operations	[X]	
	B7 – Plant fragmentation: effects of plant fragmentation on sensitive habitat and wetlands		[X]		**1** – Avoid herbicide application near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **6** – Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed fish are likely to be present **11** – Collect plant fragments during and immediately following treatment **17** – Follow environmental compliance measures for species avoidance, equipment operation, and spoiling when conducting mechanical harvesting operations		[X]
	B8 – Spoiling of harvested aquatic plants: effects of spoiling following physical removal or mechanical harvesting on sensitive habitat and wetlands			[X]			[X]

Exhibit ES-5
Summary of Proposed AIPCP Impacts, Mitigation Measures, and Significance Levels Before and After Mitigation *(continued)*

Resource Areas	Potential Impacts	Significance Level Before Mitigation: Unavoidable or Potentially Unavoidable Significant Impact	Significance Level Before Mitigation: Avoidable Significant Impact	Significance Level Before Mitigation: Less than Significant Impact	Mitigation	Significance Level After Mitigation: Reduced, but still Potentially Unavoidable Significant Impact	Significance Level After Mitigation: Less than Significant Impact
VIII. Hazards and Hazardous Materials	**H1 – General public exposure:** there is potential for the AIPCP to create a significant hazard to the public through the routine transport, use, or disposal of AIPCP herbicides			[X]			[X]
	H2 – Treatment crew exposure: there is potential for the AIPCP to create a significant hazard to treatment crews through the routine transport, use, or disposal of AIPCP herbicides; and/or through heat exposure		[X]		**3** – Minimize potential for drift when applying herbicides **8** – Implement an adaptive management approach to minimize the use of herbicides in the long-term **12** – Require treatment crews to participate in training on herbicide and heat hazards, as well as continuing education units required under California Department of Pesticide Regulation **13** – Follow best management practices to minimize the risk of spill, and to minimize the impact of spill, should one occur **14** – Implement safety precautions on hot days to prevent heat illness		[X]
	H3 – Accidental spill: there is potential for the AIPCP to create a significant hazard to the public or the environment through reasonably foreseeable upset and accidental conditions involving the release of hazardous materials into the environment		[X]		**13** – Follow best management practices to minimize the risk of spill, and to minimize the impact of spill, should one occur		[X]
IX. Hydrology and Water Quality	**W1 – Chemical constituents:** following AIPCP herbicide treatment, waters may potentially contain chemical constituents that adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water quality or drinking water quality	[X]			**3** – Minimize potential for drift when applying herbicides **4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total **7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters **8** – Implement an adaptive management approach to minimize the use of herbicides in the long-term **15** – Follow the MOU protocol for herbicide applications within one mile of Contra Cos Water District drinking water intake facilities	[X]	

Exhibit ES-5
Summary of Proposed AIPCP Impacts, Mitigation Measures, and Significance Levels Before and After Mitigation *(continued)*

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Resource Areas	Potential Impacts	Significance Level Before Mitigation: Unavoidable or Potentially Unavoidable Significant Impact	Significance Level Before Mitigation: Avoidable Significant Impact	Significance Level Before Mitigation: Less than Significant Impact	Mitigation	Significance Level After Mitigation: Reduced, but still Potentially Unavoidable Significant Impact	Significance Level After Mitigation: Less than Significant Impact
IX. Hydrology and Water Quality *(continued)*	**W2 – Pesticides:** following AIPCP herbicide treatment pesticides may potentially be present in concentrations that adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water or drinking water quality	[X]			**1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **3** – Minimize potential for drift when applying herbicides **4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total **5** – Minimize boat wake and propeller noise to avoid disturbance to habitat **7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters **8**– Implement an adaptive management approach to minimize the use of herbicides in the long-term **15** – Follow the MOU protocol for herbicide applications within one mile of Contra Cost Water District drinking water intake facilities	[X]	
	W3 – Toxicity: following AIPCP herbicide treatment toxic substances may potentially be found in waters in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life, violating water quality standards or otherwise substantially degrading water or drinking water quality	[X]			**1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **3** – Minimize potential for drift when applying herbicides **4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total **5** – Minimize boat wake and propeller noise to avoid disturbance to habitat **6** – Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed fish are likely to be present **7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters **8** – Implement an adaptive management approach to minimize the use of herbicides in the long-term **15** – Follow the MOU protocol for herbicide applications within one mile of Contra Cost Water District drinking water intake facilities	[X]	

Exhibit ES-5
Summary of Proposed AIPCP Impacts, Mitigation Measures, and Significance Levels Before and After Mitigation *(continued)*

Resource Areas	Potential Impacts	Significance Level Before Mitigation: Unavoidable or Potentially Unavoidable Significant Impact	Significance Level Before Mitigation: Avoidable Significant Impact	Significance Level Before Mitigation: Less than Significant Impact	Mitigation	Significance Level After Mitigation: Reduced, but still Potentially Unavoidable Significant Impact	Significance Level After Mitigation: Less than Significant Impact
IX. Hydrology and Water Quality *(continued)*	**W4 – Dissolved oxygen:** following AIPCP herbicide treatment, dissolved oxygen may potentially be reduced below Basin Plan and Bay-Delta Plan objectives, violating water quality standards or otherwise substantially degrading water quality	[X]			**10** – Monitor dissolved oxygen levels pre- and post-treatment for all AIPCP treatments, and at selected locations in the Delta over time	[X]	
	W5 – Floating material: following AIPCP treatments, waters may potentially contain floating aquatic invasive plant fragments in amounts that cause nuisance or adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water quality		[X]		**1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources **6** – Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed fish are likely to be present **11** – Collect plant fragments during and immediately following treatment **15** – Follow the MOU protocol for herbicide applications within one mile of Contra Cost Water District drinking water intake facilities **16** – Notify County Agricultural Commissioners about AIPCP activities		[X]
	W6 – Turbidity: AIPCP treatment may potentially result in changes to turbidity that cause nuisance or adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water quality			[X]			[X]
XVIII. Utilities and Service Systems	**U1 – Water utility intake pumps:** effects of AIPCP treatments on water utility intake pumps		[X]		**11** – Collect plant fragments during and immediately following treatment **15** – Follow the MOU protocol for herbicide applications within one mile of Contra Cost Water District drinking water intake facilities		[X]

Exhibit ES-6
AIPCP Environmental Factors with "Less Than Significant Impact" or "No Impact"

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Environmental Factors	Impact Level		Discussion	Incorporation by Reference
	Less Than Significant	No Impact	*The AIPCP will not:*	
I. AESTHETICS — Would the project:				
a) Have a substantial adverse effect on a scenic vista?	[ ]	[X]	Impact scenic vistas. The AIPCP will improve scenic vistas by controlling large monoculture expanses of spongeplant.	*EDCP Final EIR* (2001), DBW, Pages 2-48 to 2-49; 3-99
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	[ ]	[X]	Damage scenic resources. The AIPCP will improve scenic resources by controlling large monoculture expanses of spongeplant.	
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	[ ]	[X]	Degrade the existing visual character or quality of the Delta. The AIPCP will improve the visual character of the Delta by controlling large monoculture expanses of spongeplant.	
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	[ ]	[X]	Create a new source of light or glare.	
III. AIR QUALITY — Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	[ ]	[X]	Conflict with or obstruct implementation of the applicable air quality plan.	*EDCP Final EIR* (2001), DBW, Pages 2-42; 3-84 to 3-85
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	[ ]	[X]	Violate any air quality standard or contribute to an existing or projected air quality violation.	
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	[ ]	[X]	Result in net increases of any criteria pollutants for which the project region is under an applicable federal or state ambient air quality standard.	
d) Expose sensitive receptors to substantial pollutant concentrations?	[X]	[ ]	Result in significant exposure of sensitive receptors to substantial pollutant concentrations. There may be short-term less than significant impacts on sensitive receptors due to drift of AIPCP herbicides during spraying operations.	
e) Create objectionable odors affecting a substantial number of people?	[X]	[ ]	Result in significant objectionable odors. There may be short-term, less than significant, objectionable odors in the immediate vicinity of treatments due to drift of AIPCP herbicides during spraying operations.	
V. CULTURAL RESOURCES — Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	[ ]	[X]	Cause a substantial adverse change in a historical resource.	*EDCP Final EIR* (2001), DBW, Pages 2-47; 3-98
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	[ ]	[X]	Cause a substantial adverse change in an archeological resource.	
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	[ ]	[X]	Destroy a unique paleontological resource or site or a geologic feature.	
d) Disturb any human remains, including those interred outside of formal cemeteries?	[ ]	[X]	Disturb any human remains.	

Exhibit ES-6
AIPCP Environmental Factors with
"Less Than Significant Impact" or "No Impact" *(continued)*

Page 2 of 5

Environmental Factors	Impact Level: Less Than Significant	Impact Level: No Impact	Discussion *The AIPCP will not:*	Incorporation by Reference
VI. GEOLOGY AND SOILS — Would the project:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				*EDCP Final EIR* (2001), DBW, Pages 2-44; EC-4
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	[ ]	[X]	Expose people or structures to adverse effects due to a known earthquake fault.	
ii) Strong seismic ground shaking?	[ ]	[X]	Expose people or structures to adverse effects due to seismic ground shaking.	
iii) Seismic-related ground failure, including liquefaction?	[ ]	[X]	Expose people or structures to adverse effects due to seismic related ground failure, including liquefaction.	
iv) Landslides?	[ ]	[X]	Expose people or structures to adverse effects due to landslides.	
b) Result in substantial soil erosion or the loss of topsoil?	[ ]	[X]	Result in substantial erosion or loss of topsoil.	
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	[ ]	[X]	Be located on a geological unit or soil that is or could become unstable and result in landslide, lateral spreading, subsidence, liquefaction, or collapse.	
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	[ ]	[X]	Be located on expansive soil	
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	[ ]	[X]	Have soils incapable of supporting septic tanks or alternative waste disposal systems.	
VII. GREENHOUSE GAS EMISSIONS — Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	[X]	[ ]	The AIPCP will result in minimal additional greenhouse gas emissions, as compared to existing other state and federal activities in the Delta, recreation in the Delta, and commercial boating operations. The AIPCP will operate motorized boats in the Delta. The potential greenhouse gas emission impact of DBW's treatment boats, monitoring boats, and mechanical harvesting activities during treatment is less than significant. In 2016, DBW utilized 22,303 gallons of fuel in conducting the WHCP, EDCP, and SCP, equivalent to 198 Metric Tons of CO2 equivalent (MTCO2E) (USEPA 2017). Assuming a 50% increase in fuel use, the AIPCP would generate approximately 300 MTCO2E. This is well below the Bay Area Air Quality Management District (BAAQMD) significance threshold of 1,100 MTCO2E (BAAQMD 2017).	
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	[ ]	[X]	The AIPCP will not conflict with existing plans, policies, or regulations adopted for the purpose of reducing emissions of greenhouse gases.	

Exhibit ES-6
AIPCP Environmental Factors with “Less Than Significant Impact” or “No Impact” *(continued)*

Page 3 of 5

Environmental Factors	Impact Level: Less Than Significant	Impact Level: No Impact	Discussion *The AIPCP will not:*	Incorporation by Reference
X. LAND USE AND PLANNING — Would the project:				
a) Physically divide an established community?	[ ]	[X]	Physically divide a community.	*EDCP Final EIR* (2001), DBW, Pages 2-45 to 2-46; 3-95
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	[ ]	[X]	Conflict with applicable land use plans, policies, or regulations.	
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	[ ]	[X]	Conflict with any applicable habitat conservation plan or natural community conservation plan. AIPCP has no known conflicts with various conservation plans, programs, or other initiatives in the Delta (see Chapter 7). AIPCP's control of aquatic weeds is consistent with, and supportive of, conservation planning efforts to reduce invasive species in the Delta.	
XI. MINERAL RESOURCES — Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	[ ]	[X]	Result in loss of availability of a known mineral resource.	*EDCP Final EIR* (2001), DBW, Pages 2-43; EC-7
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	[ ]	[X]	Result in loss of availability of a locally-important mineral resource recovery site.	
XII. NOISE — Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	[ ]	[X]	Result in exposure to, or generation of, noise levels in excess of standards.	*EDCP Final EIR* (2001), DBW, Pages 2-43; EC-7; 3-91
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	[ ]	[X]	Result in exposure of persons, or generation of, excessive groundborne vibration or groundborne noise levels.	
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	[ ]	[X]	Result in a permanent increase in ambient noise levels.	
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	[X]	[ ]	Result in a substantial temporary or period increase in ambient noise levels. There may be a less than significant increase in localized ambient noise levels due to operation of AIPCP boats during treatment.	
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	[ ]	[X]	Be located within an airport land use plan, or within two miles of a public airport, or expose people within the area to excessive noise levels.	
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	[ ]	[X]	Be located within the vicinity of a private airstrip, or expose people within the area to excessive noise levels.	

Exhibit ES-6
AIPCP Environmental Factors with
"Less Than Significant Impact" or "No Impact" *(continued)*

Page 4 of 5

Environmental Factors	Impact Level: Less Than Significant	Impact Level: No Impact	Discussion *The AIPCP will not:*	Incorporation by Reference
XIII. POPULATION AND HOUSING — Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	[ ]	[X]	Induce population growth in the area.	*EDCP Final EIR* (2001), DBW, Pages 2-47; 3-97
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	[ ]	[X]	Displace existing housing.	
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	[ ]	[X]	Displace people.	
XIV. PUBLIC SERVICES — Would the project:				
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				*EDCP Final EIR* (2001), DBW, Pages 2-47; 3-96
Fire protection?	[ ]	[X]	Impact fire protection.	
Police protection?	[ ]	[X]	Impact police protection.	
Schools?	[ ]	[X]	Impact schools.	
Parks?	[ ]	[X]	Impact parks.	
Other public facilities?	[ ]	[X]	Impact other public facilities.	
XV. RECREATION — Would the project:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	[ ]	[X]	Result in substantial physical deterioration of neighborhood or regional parks due to increased use.	*EDCP Final EIR* (2001), DBW, Pages 2-40 to 2-41; 3-82 to 3-83
b) Include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	[ ]	[X]	Include or require expansion of recreational facilities that would have an adverse physical effect on the environment.	
c) Would the project adversely impact existing recreational opportunities?	[X]	[ ]	Adversely impact existing recreational opportunities. The AIPCP would temporarily impact recreational boating and navigation at treatment sites, during treatment (including use of booms and curtains), however this impact would be less than significant.	

Exhibit ES-6
AIPCP Environmental Factors with “Less Than Significant Impact” or “No Impact” *(continued)*

Page 5 of 5

Environmental Factors	Impact Level: Less Than Significant	Impact Level: No Impact	Discussion *The AIPCP will not:*	Incorporation by Reference
XVI. TRANSPORTATION/TRAFFIC — Would the project:				
a) Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?	[ ]	[X]	Conflict with an applicable plan, ordinance, or policy establishing measures for effectiveness for the performance of the circulation system.	*EDCP Final EIR* (2001), DBW, Pages 2-38 to 2-39; EC-9
b) Conflict with an applicable congestion management program, including, but not limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?	[ ]	[X]	Conflict with an existing congestion management program.	
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	[ ]	[X]	Result in a change in air traffic patterns.	
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	[ ]	[X]	Substantially increase hazards due to a design feature or incompatible uses.	
e) Result in inadequate emergency access?	[ ]	[X]	Result in inadequate emergency access.	
f) Result in inadequate parking capacity?	[ ]	[X]	Result in inadequate parking capacity.	
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	[ ]	[X]	Conflict with adopted policies, plans, or programs supporting alternative transportation.	
XVI. GROWTH-INDUCING IMPACTS[a] — Would the project:				
a) Foster economic or population growth?	[ ]	[X]	Foster economic or population growth.	*EDCP Final EIR* (2001), DBW, Page 7-1
b) Foster construction of additional housing, either directly or indirectly, in the surrounding environment? (Including removing obstacles to population growth).	[ ]	[X]	Foster construction of housing, either directly or indirectly.	
c) Encourage or facilitate other activities that could significantly affect the environment, either individually or cumulatively?	[ ]	[X]	Encourage or facilitate other activities that could affect the environment.	
[a] Growth-inducing impacts are not included within the environmental factors checklist, however, CEQA Guidelines, Section 15126.2(d) require a discussion of the growth-inducing impacts of the proposed project or program. Because the AIPCP will not result in growth-inducing impacts, the topic is included in this table of “Less Than Significant Impact” and “No Impact” factors.				
XVII. TRIBAL CULTURAL RESOURCES —Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k)?	[ ]	[X]	DBW coordinated with California State Parks, Cultural Resource Program to complete the Section 21074 tribal consultation. DBW sent notification letters and a copy of the NOP to the Native American Heritage Commission (NAHC), United Auburn Indian (UAI) Community of the Auburn Rancheria, and Buena Vista Rancheria of Me-Wuk Indians (BVR) on August 18, 2017. All three entities received the communication, and responded within thirty days. The NAHC provided a summary of the CEQA process; the UAI sent standard mitigation measures for projects that disturb ground; the BVR submitted an emailing stating interest in the biological information for the project (Cultural Resources). The AIPCP will not result in impacts to cultural resources; however, DBW will provide biological information to BVR. After discussion with the Cultural Resources Program, the consultation requirements appear completed.	
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	[ ]	[X]		

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Section 1

Introduction

1. Introduction

The objective of the Aquatic Invasive Plant Control Program (AIPCP) is control the growth and spread of aquatic invasive plants (AIP) in the Sacramento-San Joaquin Delta (Delta), its surrounding tributaries, and Suisun Marsh to in support of the environment, economy, and public health. Because of the potential for spread, the long-term presence, and the persistence of invasive aquatic plants in the Delta, the AIPCP legislative mandates are for control, rather than eradication of aquatic invasive plants. The AIPCP is part of the California State Parks Division of Boating and Waterways (DBW) Aquatic Invasive Species Program. The mission of the Aquatic Invasive Species Program addresses both aquatic invasive plants and Dreissenid mussels. However, the program described in this document addresses only control of aquatic invasive plants.

The AIPCP provides a comprehensive approach to aquatic invasive plant control in the Delta, and incorporates all previous Delta programs conducted by the Division of Boating and Waterways, including the Water Hyacinth Control Program (WHCP), Spongeplant Control Program (SCP) and *Egeria densa* Control Program (EDCP), and new invasive plant species incorporated through the process defined by Assembly Bill (AB) 763. The AIPCP is supported by the Collaboration Guidelines for Delta AIS Control (Guidelines). The Guidelines identify actions, goals, and metrics to support a comprehensive, adaptive, collaborative, flexible, practical, efficient, effective, and sustainable approach to managing AIS species in the Delta. A draft of the Collaboration Guidelines for Delta AIS Controls provided as an appendix to this Final Programmatic Environmental Impact Report (PEIR). In addition, the AIPCP Biological Assessment (BA) provides a detailed analysis of the potential effects of the project on threatened and endangered species. The BA supports, and expands on, the analyses provided in the Biological Resources Impacts Assessment in this PEIR.

The AIPCP adheres to an adaptive management strategy with annual evaluation. This adaptive strategy allows the program to respond to changing conditions in the Delta. It also facilities adaptability to changes in other elements, such as regulatory environment, public health, and the economy. The AIPCP's adaptive management approach to AIP control reflects the changing nature of the Delta ecosystem and the authorization granted by AB 763. It is based on the use of a comprehensive set of treatment tools and approaches to optimize efficacy and environmental protection and is defined by increased use of monitoring, performance metrics, and treatment triggers to guide program actions and reduce risks. A comprehensive, diverse, and integrated set of tools will more effectively target treatments, with the aim to control infestations before they spread. For example, implementing management actions earlier should result in fewer acres of AIP that require multiple herbicide applications, thus lowering seasonal herbicide use overall. The AIPCP aims for efficacious management actions and the potential impacts of aquatic invasive plant management while at the same time strives to minimize non-target species impacts and to prevent environmental degradation in Delta waterways and tributaries.

The project area for AIPCP is specified in statute, as follows: "the delta, its tributaries, and the marsh" (Harbors and Navigation Code Section 64). The State of California legal definition of the Sacramento-San Joaquin Delta (Delta) includes six counties (San Joaquin, Yolo, Sacramento, Solano, Contra Costa, and Alameda). The AIPCP includes eleven (11) counties (including the six "Delta" counties) that encompass much of the Sacramento-San Joaquin Delta and its upland tributaries. The eleven counties are: (1) Alameda, (2) Contra Costa, (3) Fresno, (4) Madera, (5) Merced, (6) Sacramento, (7) San Joaquin, (8) Solano, (9) Stanislaus, (10) Tuolumne, and (11) Yolo.

The general boundaries for the treatment area in the Delta and its tributaries are as follows:

- West up to, and including, Sherman Island, at the confluence of the Sacramento and San Joaquin Rivers;
- West up to the Sacramento Northern Railroad, to include water bodies north of the southern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel;
- North to the northern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel, plus waters within Lake Natoma;
- South along the San Joaquin River to Mendota, just east of Fresno;

- East along the San Joaquin River to Friant Dam on Millerton Lake;
- East along the Tuolumne River to LaGrange Reservoir below Don Pedro Reservoir; and
- East along the Merced River to Merced Falls, below Lake McClure.

The project area is contained within the following fifty-one (51) United States Geological Service (USGS) quadrants: (1) Antioch North, (2) Rio Vista, (3) Jersey Island, (4) Isleton, (5) Bouldin Island, (6) Clifton Court Forebay, (7) Thornton, (8) Terminous, (9) Holt, (10) Union Island, (11) Lodi North, (12) Lodi South,(13) Stockton West, (14) Lathrop, (15) Woodward Island, (16) Courtland, (17) Gravelly Ford, (18)Mendota Dam, (19) Folsom, (20) Yosemite Lake, (21) Gustine, (22) Stevinson, (23) San Luis Ranch, (24) Turner Ranch, (25) Santa Rita Bridge, (26) Poso Farm, (27) Friant, (28) Lanes Bridge, (29) Vernalis, (30) Ripon, (31) Riverbank, (32) Waterford, (33) Paulsell, (34) Cooperstown, (35) La Grange, (36) Westley, (37) Brush Lake, (38) Ceres, (39) Denair, (40) Turlock Lake, (41) Snelling, (42) Merced Falls, (43) Crows Landing, (44) Hatch, (45) Turlock, (46) Cressey, (47) Winton, (48) Biola, (49) Herndon, (50) Firebaugh, and (51) Fresno North.

Exhibit 1-1 provides an illustration of the northern project area, including the legal boundaries of the Sacramento-San Joaquin Delta, as defined by Section 12220 of the California Water Code.[i] **Exhibit 1-2** provides an illustration of the southern project area.

This chapter of the Final PEIR describes the approach, describes the purpose, and provides background on aquatic invasive plants in the project area. This chapter is organized as follows:

A. Organization of the AIPCP Final PEIR

B. Purpose of the AIPCP Final PEIR

C. Biology and Invasion of Aquatic Invasive Plants.

Exhibit 1-1
Northern AIPCP Sites by Treatment Zone

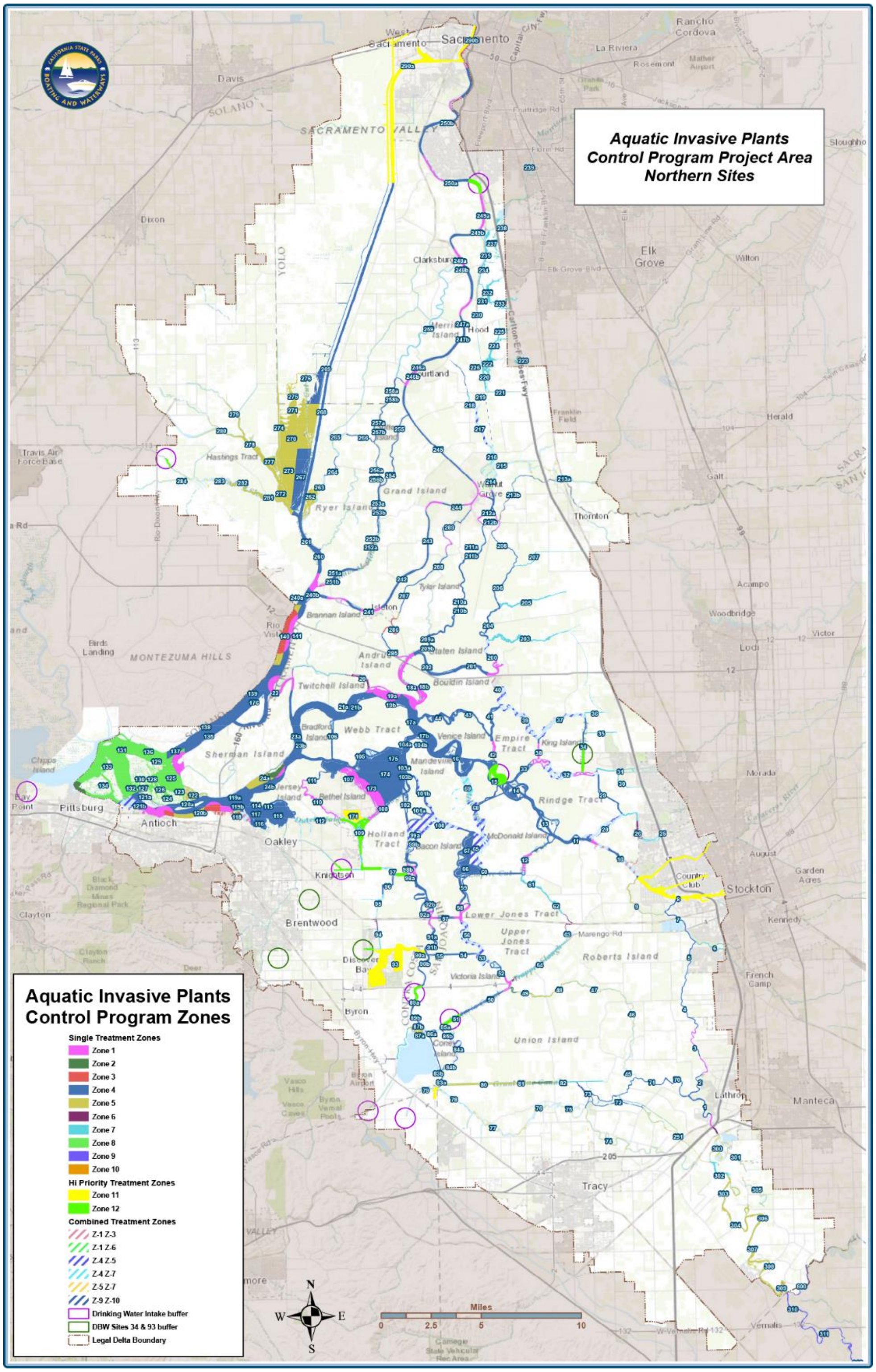


Exhibit 1-2a
Southern AIPCP Sites by Treatment Zone

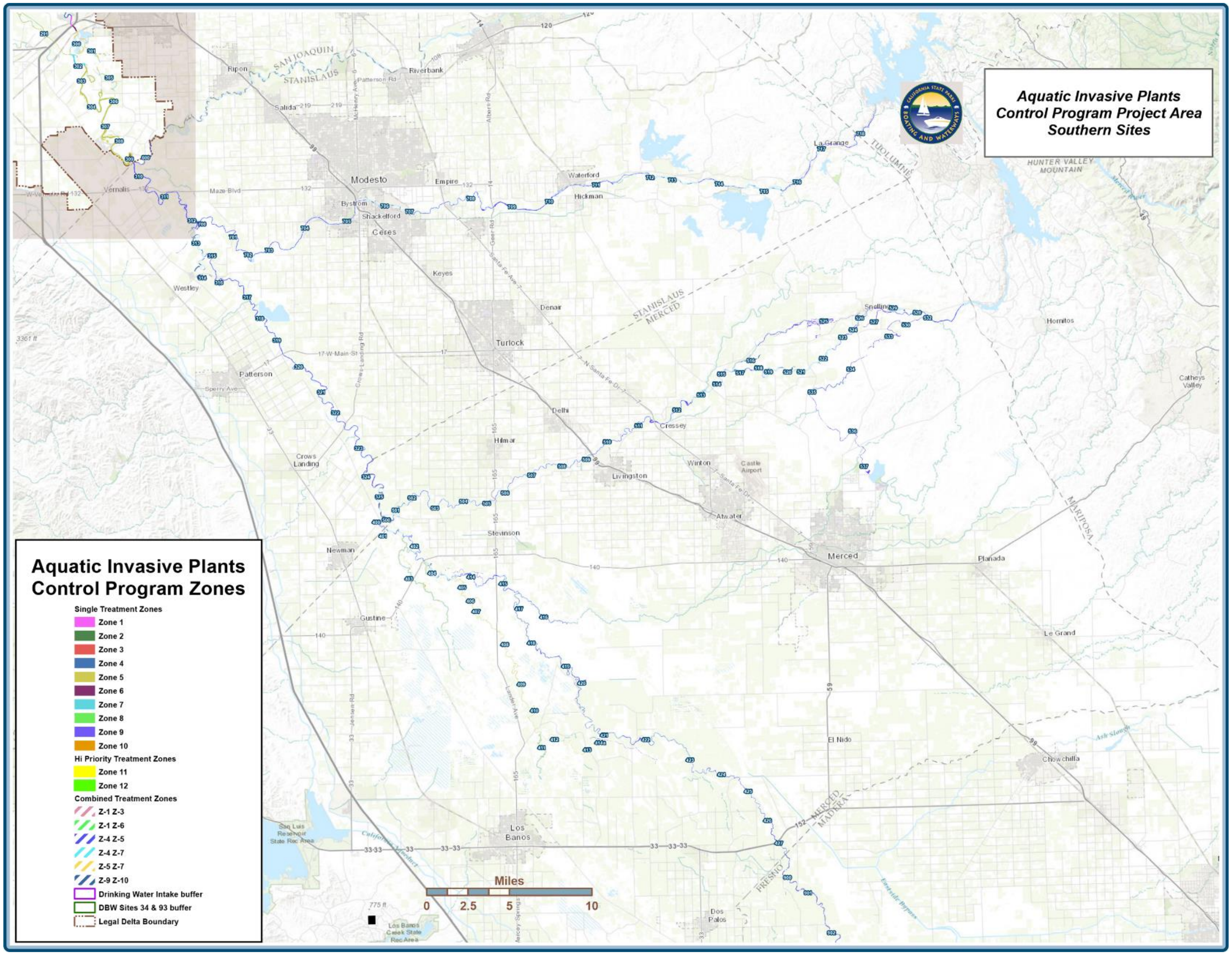
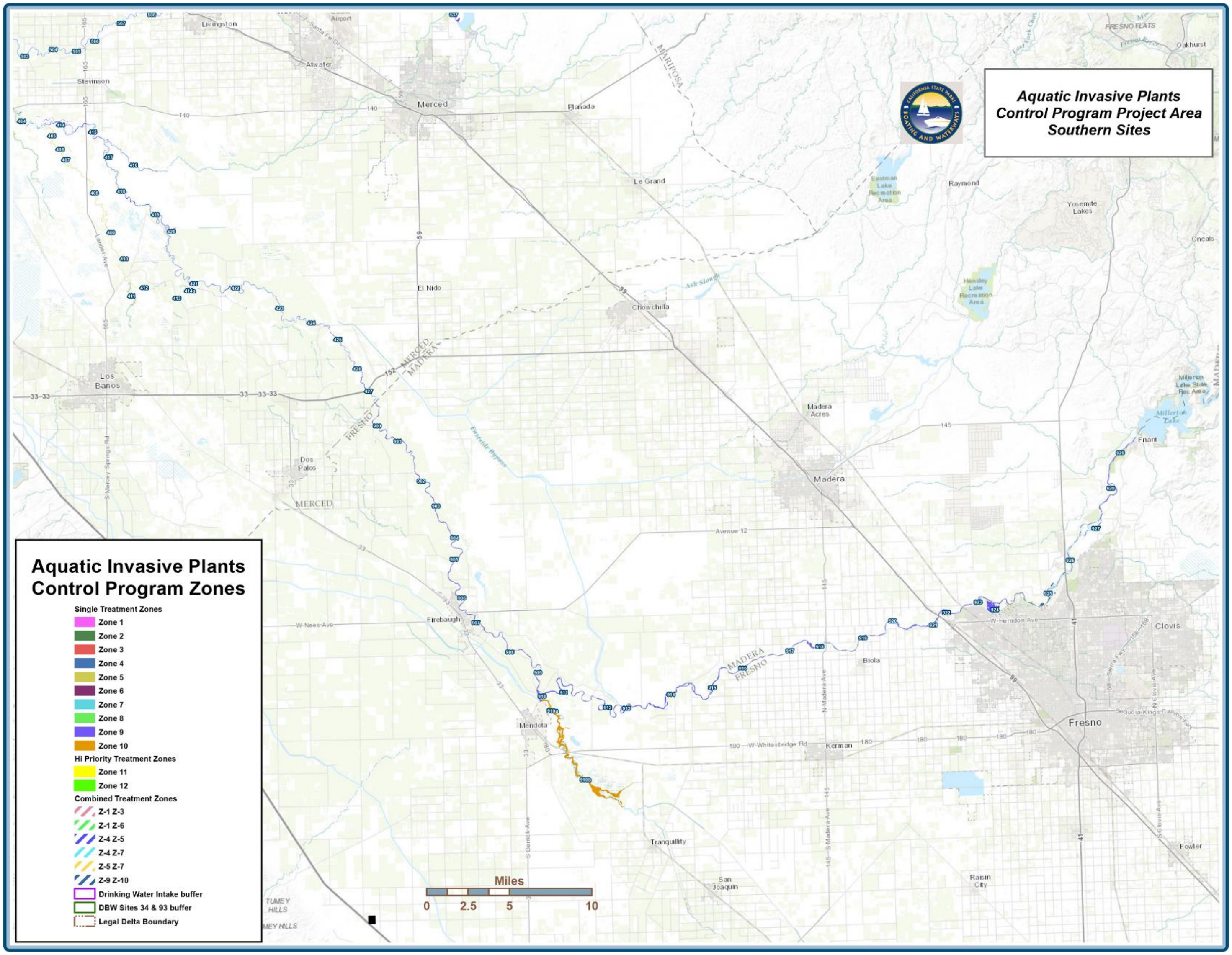


Exhibit 1-2b
Southern AIPCP Sites by Treatment Zone



A. Organization of the AIPCP Final PEIR

California Department of Parks and Recreation, Division of Boating and Waterways (DBW), as the lead agency under the California Environmental Quality Act (CEQA), has prepared this Final PEIR. This Final PEIR satisfies the procedural, analytical, and public disclosure requirements of CEQA. DBW has prepared this document pursuant to CEQA Guidelines (Title 14. California Code of Regulations, Section 15000 et. seq.). This Final PEIR is a programmatic EIR, as defined in CEQA Guidelines, Section 15168.

This Final PEIR is organized as follows:

Volume I – Chapters 1 to 7

- **Executive Summary** – provides overview of the Final PEIR and AIPCP, the AIPCP Environmental Checklist of environmental factors potentially affected by the AIPCP, and summary of mitigation measures.
- **Chapter 1: Introduction** – describes the organization and purpose of the Final PEIR.
- **Chapter 2: Program Description** – provides a description of AIPCP locations, operations, permits, compliance, and monitoring.
- **Chapter 3: Biological Resources Impacts Assessment** – provides descriptions of the environmental setting, potentially significant impacts, and mitigation measures related to AIPCP potential impacts on biological resources. This chapter includes discussions of potentially impacted special status species and critical habitats.
- **Chapter 4: Hazards and Hazardous Materials Impacts Assessment** – provides descriptions of the environmental setting, potentially significant impacts, and mitigation measures related to AIPCP potential impacts on worker safety and hazardous materials in the environment.
- **Chapter 5: Hydrology and Water Quality Impacts Assessment** – provides descriptions of the environmental setting, potentially significant impacts, and mitigation measures related to AIPCP potential impacts on water quality.
- **Chapter 6: Utilities and Service Systems and Agriculture and Forestry Resources Impacts Assessments** – provides descriptions of the environmental setting, potentially significant impacts, and mitigation measures related to AIPCP potential impacts on water utility intake pumps, agricultural crops, and agricultural irrigation pumps.
- **Chapter 7: Cumulative Impacts Assessment** – discusses the potential cumulative impacts of the AIPCP when considered in combination with other projects and programs in the Delta.
- **Chapter 8: Alternatives to the Proposed Project** - describes and evaluates project alternatives, including the “no project” analysis.
- **References** – contains references used in the preparation of the Final PEIR.
- **Maps** – provides 11” x 17” version of map exhibits in Volume I.

Volume II includes additional information to support the environmental review process, technical information that was used in the PEIR analysis, and the AIPCP’s collaboration approach.

Volume II – Appendices

- **Section 1: AIPCP Permits** – provides copies of the current AIPCP National Pollutant Discharge Elimination System (NPDES) permit; and the most recent versions of USFWS and NMFS Biological Opinion or Letter of Concurrence (when available).
- **Section 2: AIPCP Herbicide Labels and Material Safety Data Sheets** – provides copies of labels and material safety data sheets for AIPCP herbicides and adjuvants.
- **Section 3: UC Davis Toxicity Study Results** – provides copies of five recently completed studies evaluating herbicide toxicity and fish feeding/toxicity for biological control agents.
- **Section 4: Collaboration Guidelines for Delta AIP Control** – provides the latest version of guidelines to support a comprehensive, flexible, practical, inclusive, efficient, and effective approach to managing aquatic invasive species in the Delta.

- **AIPCP Programmatic Biological Assessment** (provided as a separate PDF file on the CD) – includes detailed analyses of the potential impacts of the AIPCP on listed species and critical habitats.
- **WHCP/SCP and EDCP Operational Management Plans** (provided as two separate PDF files on the CD)– DBW documents that identify best practices and day-to-day operations.
- **AIPCP Compliance Binder** (provided as a separate PDF file on the CD)– DBW documents that identify summarize environmental compliance requirements for the program.

B. Purpose of the AIPCP Final PEIR

This Final PEIR for the AIPCP provides DBW with the opportunity to carefully evaluate this new comprehensive program approach in the Delta environment and its current treatment practices for aquatic invasive plant control. Much has changed in the Delta since DBW began controlling aquatic weeds in 1983. The list of threatened and endangered species has expanded, new reduced risk aquatic herbicides and adjuvants have been added to the program, new physical and biological control approaches have been added to the program, and there are significant new water quality and environmental concerns in the Delta. The AIPCP is a legislatively authorized State of California program. The AIPCP is being implemented in order to address potential environmental, public health, and economic problems created by aquatic invasive plants in the Delta.

The current programmatic approach to aquatic plant control evaluates potential impacts of treatment methods rather than treatment of specific plant species. One purpose of this AIPCP Final PEIR is to maintain conformity between program operations, federal Endangered Species Act (ESA) compliance, and CEQA compliance. This AIPCP Final PEIR encompasses and supersedes prior environmental documentation for DBW's aquatic invasive plant control P/EIRs:

- The 2001 EIR for the *Egeria densa* Control Program (EDCP)
- The 2009 PEIR for the Water Hyacinth Control Program (WHCP)
- The 2014 PEIR for the Spongeplant Control Program (SCP).

There are two important characteristics of the AIPCP which make it somewhat different from many projects or programs that require EIRs: First, the AIPCP has long-term beneficial impacts. These beneficial impacts are in contrast to potential short-term detrimental impacts resulting from aquatic invasive plant control alternatives. Discussions of the overall environmental impact of the AIPCP must take into account trade-offs between potential short-term negative impacts and long-term positive impacts.

C. Biology and Invasion of Aquatic Invasive Plants

There are multiple floating and submersed aquatic invasive plants in the Delta, with new species entering the Delta periodically. Some species have been part of DBW's treatment program for over 30 years, while others have only recently been identified as invasive plants that require treatment. Often, as existing species are effectively treated and managed, new species take advantage of the room to grow and may become dominant in that location. The Delta is today characterized by a complex interrelationship of existing and emerging floating and submersed aquatic invasive plants, which requires an integrated, programmatic, and targeted management approach. **Exhibit 1-3** identifies characteristics of Delta invasive plants.

Since 2014, the AIPCP has incorporated five new species into its treatment programs. These five species are: water primrose, Eurasian watermilfoil, curlyleaf pondweed, fanwort, and coontail. The California Department of Fish and Wildlife (CDFW) is currently conducting a risk assessment for pennywort. Based on CDFW's determination, this species may be a potential addition to the AIPCP. **Exhibit 1-4** provides an overview of the plant species that currently fall within the AIPCP. Other invasive aquatic plant species may be added to the AIPCP over time. New species will be treated utilizing the treatment methods described in this PEIR.

Exhibit 1-3
Invasive Characteristics or Qualities of Aquatic Invasive Plants found in the Delta

Invasive Characteristic or Quality	Water hyacinth	*Egeria densa*	Sponge-plant	Curlyleaf pondweed	Water primrose	Eurasian watermilfoil	Fan-wort	Coon -tail	Penny-wort
Ecosystem engineer*	✓	✓	✓	✓	✓	✓	✓	✓	
Adaptable to local conditions	✓	✓		✓	✓	✓	✓	✓	✓
Fast growth rate	✓	✓	✓		✓	✓		✓	✓
Acclimatization to varying light		✓		✓		✓	✓	✓	
Flexible nutrient uptake		✓		✓		✓			
High productivity	✓	✓	✓	✓	✓	✓			✓
High dispersal via fragmentation/floating	✓	✓	✓	✓	✓	✓	✓	✓	✓
High potential to colonize disturbed habitat	✓	✓		✓	✓	✓	✓		✓
High seed production and/or germination	✓		✓	✓	✓	✓			✓
Ability to overwinter in the Delta	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ability to form mono-specific mats	✓	✓	✓	✓	✓	✓	✓	✓	✓

*Physically alters ecosystem processes, degrading habitat for native species

Exhibit 1-4
Invasive Plant Species Currently Within the AIPCP *Page 1 of 4*

Species	General Description	Reproduction/ Growth Patterns	Habitat
Floating Aquatic Vegetation			
Water hyacinth *(Eichhornia crassipes)* 	• Native to tropical and subtropical South America; has spread to more than fifty countries on five continents. • Non-native, invasive, free-floating aquatic macrophyte • Floating flowering perennial with lavender petals; leaves are rounded and waxy.	• Monocot, perennial • Reproduces vegetatively and sexually; new rosettes (daughter plants) are formed on floating stolons which grow from the mother plants; seedlings are produced in mild climate, when water recedes sufficiently to provide muddy substrate for early growth. • Leaves die in winter due to frost, but some shoot crowns remain alive and regenerate the population in spring.	• Linked plants form dense rafts in the water and mud • Free-floating except when stranded in the mud • Is not winter-hardy; its minimum growth temperature is 12 C (54 F); its optimum growth temperature is 25-30 C (77-86 F)
Spongeplant *(Limnobium laevigatum)*  	• Native to South America, Central America, and Central Mexico. • Leafy rosettes in a complex branching system; root is usually branched • Flowers are unisexual; however, male and female flowers exist on the same plant. • Leaves have pads of aerenchyma (spongy air spaces) on the undersides that provide buoyancy • When less dense, the leaves lay horizontally on the water. • When more dense, the leaves become vertical. • Leaves are generally one to three inches across. Mature plants may be 8 to 12 inches in height.	• Spongeplant reproduces both vegetatively and through seed production, with abundant seed pods and seedlings. • Spongeplant fruits develop under water. Seeds are released and germinate underwater when the fruit ruptures; seedlings float to the surface • Seedlings disperse easily by wind, currents, and tidal action. May also be dispersed by waterfowl, boats, and other mobile plants such as water hyacinth • Spongeplant seeds survive over multiple seasons	• Spongeplant is a floating aquatic plant that grows in dense floating mats or rooted in mud or wetland edges • Occurs from sea level to 2,800 meters • Is found mixed in, and under, other plants at many of the current spongeplant locations in the Delta.

Exhibit 1-4
Invasive Plant Species Currently Within the AIPCP *(continued)*

Page 2 of 4

Species	General Description	Reproduction/ Growth Patterns	Habitat
Pennywort (*Hydrocotyle ranunculoides*) (* potential addition; currently waiting on the Risk Assessment to be completed by CDFW)  	• Floating pennywort is a perennial that is native to California and is also found in other western states and elsewhere in North America; however, it exhibits many weedy characteristics • Found along pond and lake margins as well as marshes, swamps and slow flowing streams	• Pennywort reproduces by seed and vegetatively from creeping stems and stem fragments. • Mats can break off and float independently	• Usually forms dense low-growing mats that can spread across moist soil or form floating mats in shallow water • Is an extremely fast-growing plant; can grow up to 20 cm per day and double its biomass in 3-7 days
Water primrose complex *(Ludwigia* spp *)*  	• Native to Central and South America • Leaves ovate to lance-shaped, and up to six inches long. Leaves are covered on both sides by minute soft hairs. • Most water primroses have conspicuous yellow flowers. The flowers have four or five petals • Experts say that the taxonomy of *Ludwigia* species is currently in flux; multiple species, both native and nonnative, cause problems in the Delta.	• Reproduces vegetatively, through fragmentation and rhizomatous growth and seeds • Commonly occurs in marshes, swamps, ditches, ponds, and lake margins, where it forms dense floating mats up to 3 feet tall, crowding and shading out native species	• Occupies a similar ecological niche as spongeplant and water hyacinth, at the edges of channels or shallow flat, but often grows in higher elevations (e.g. levee banks) than water hyacinth. • Typically grows as monotypic, and will rapidly colonize previously de-vegetated areas or newly created habitat; also found growing within and over water hyacinth

Exhibit 1-4
Invasive Plant Species Currently Within the AIPCP *(continued)* *Page 3 of 4*

Species	General Description	Reproduction/ Growth Patterns	Habitat
Submersed Aquatic Vegetation			
Brazilian Waterweed (*Egeria densa*) 	• Native to Southeast Brazil and Uruguay. • Has few natural predators because it was introduced from Brazil disease and insect-free • Stems are usually one to two feet long, but can be much shorter or longer, growing to over 9 feet long • Leaves are small and strap-shaped, typically about one-inch long and one-quarter inch wide • Leaf margins have very fine saw teeth that require a magnifying lens to see. • Most of *Egeria densa*'s biomass is produced near the water surface.	• Reproduces asexually or vegetatively, through fragmentation. (Only male plants are found in the United States, thus all reproduction is vegetative, resulting in an extremely homogenous genotype.) • Severed plant fragments regenerate into new plants capable of establishing themselves at new locations. • In the Delta, plants fragmented in late-winter/early spring, as day-length increased and water temperature was approximately 10°C	• Thrives in shallow waters (< 10 feet deep), such as those found in much of the Delta. • In the Delta the plant does not completely senesce in the fall, as do most native plant species. • As a result, Egeria *densa* continues producing biomass, some of which persists through the winter.
Curlyleaf pondweed (*Potamogeton crispus)* 	• Native to Eurasia, Africa, Australia • Perennial • Oblong, crinkled leaves; leaf edges are wavy and finely toothed • Can provide habitat for aquatic life in the winter months, however excessive growth in the spring leads to dense mats that displace native vegetation and impact the ecological stability of the waterbody	• Unlike other plants, actively grows during winter months when most plants are dormant • Reproduces vegetatively by spindle-shaped turions (winter buds that form at leaf axils and stem tips); turions lie dormant during summer, germinate in fall. • Also spreads via fragmentation and seed	• Tolerate extreme conditions including cold water, low light, polluted, disturbed, or turbid waters where many native plants cannot survive. • Mid-summer die-offs can increase in nutrients that can cause harmful algal blooms

Exhibit 1-4
Invasive Plant Species Currently Within the AIPCP *(continued)* *Page 4 of 4*

Species	General Description	Reproduction/ Growth Patterns	Habitat
Eurasian watermilfoil *(Myriophyllum spicatum)* 	• Is a submersed, rooted perennial macrophyte • Originated in temperate and tropical Eurasia and Northern Africa • Stems are reddish-brown to whitish-pink. They are branched and commonly grow to lengths of six to nine feet • Leaves are deeply divided, soft and feather-like	• Overwinters in California, and reproduces sexually and vegetatively • Sloughing of lower stems produces nutrient loading in the water column, contributing to low dissolved oxygen levels • EWM shades and outcompetes native plants, reducing both richness and cover of submersed, emergent, and floating native plant species • DBW commonly sees EWM establishing in areas where *Egeria densa* has been successfully treated.	• Is common in a wide variety of aquatic habitats • Rapidly colonizes disturbed or previously unvegetated areas • Tolerates a wide range of water conditions • Excessive growth of EWM reduces sedimentation (increasing water clarity) and provides cover for predators of endangered fish species such as Delta smelt.
Carolina fanwort *(Cabomba caroliniana)* 	• Is a submersed, rooted perennial macrophyte. • Considered invasive on four continents, and is regulated as a noxious weed in California	• In the Delta, fanwort reproduces vegetatively through fragmentation • It grows well in low light and turbid conditions • Fanwort prefers shallow water, but can grow in up to 10 meters	• Fanwort is alleopathic, reducing growth of nearby aquatic plants • Forms monospecific mats, alters water quality (reduced dissolved oxygen), and fouls and discolors water • In 2014, fanwort was found in a few Delta locations, but by 2016 was reported to be spreading rapidly
Coontail *(Ceratophyllum demersum)* 	• Is a submersed, free-floating, root-less macrophyte • Native in 38 of California's 58 counties, but exhibits weedy qualities in some environments • Has feathery, fan-shaped leaves that are arranged in whorls on the stem	• Primarily reproduces vegetatively, through stem fragmentation and turions; also forms viable seed (fruit) • Forms dense canopies, shading out other submersed plants • Coontail is alleopathic, negatively impacting phytoplankton, cyanobacteria, and algae. • Excessive growth can result in depletion of dissolved oxygen	• In the Delta, coontail is commonly found associated with *Egeria densa*. • Coontail is found throughout the Delta, primarily in slower moving waters, • Similar to other invasive submersed species, coontail reduces turbidity and provides habitat and shelter for predatory fish

Photos from CA State Parks, Division of Boating and Waterways.

Below is a description of each species, organized by Floating Aquatic Vegetation (FAV) and Submersed Aquatic Vegetation (SAV). FAV is not rooted in sediment, and therefore floats on the surface of the water, moving with the tides and water flow throughout the Delta. SAV, on the other hand, is rooted in the sediment and remains in place. The distinction between FAV and SAV has implications on treatment options for the invasive plants. These are the species that are currently being controlled through the AIPCP; new species may be added over time, but treated using approved AIPCP control methods. As a result, they do not need to be considered within this PEIR, and if approved through the AB763 risk assessment process, can be added under this PEIR in the future.

Floating Aquatic Vegetation (FAV)

Water Hyacinth: Water hyacinth (*Eichhornia crassipes*) is native to tropical and subtropical South America. Water hyacinth was introduced into the United States in 1884 at the Cotton States Exposition in New Orleans, where it was used as a decoration. This ornamental plant was distributed as display samples and extra plants were released into local waterways. By 1895, water hyacinth had spread across the Southeast and was growing in 40-km long mats that blocked navigation in the St. Johns River in Florida. The invasion of water hyacinth in California was slower than in the Southeast, probably due to water flows and the more temperate climate in the Delta. Water hyacinth was first reported in 1904 in a Yolo County, California slough. It spread gradually for many decades, and was reported in Fresno and San Bernardino Counties in 1941, and in the Sacramento-San Joaquin Delta in the late 1940s and early 1950s. There were increased reports of water hyacinth in the Delta region during the 1970s, and by 1981, water hyacinth covered 1,000 acres of the Delta, and 150 miles of the 700 miles of Delta waterways. There are no clear estimates of total water hyacinth coverage over time. However, water hyacinth treatments in the Delta since 1983 have ranged from less than 500 acres, up to approximately 4,500 acres in 2015 and 2016.

Spongeplant: Spongeplant was first seen in California in a pond system in the East Bay in 1996. This infestation was eradicated. The next identified infestations of spongeplant were found in 2003 in ponds near Arcata and Redding. In 2007, spongeplant was identified in the Sacramento-San Joaquin Delta near Antioch. The Antioch infestation apparently was washed out of the Delta after a storm. In 2009 and 2010, spongeplant was found again in the Delta. In 2013, spongeplant was identified in twenty locations within the Delta. Most mats were small (no more than 30 square feet), and many were inter-mixed with other aquatic plants (native and non-native). Spongeplant is found mixed in, and under, other plants at many locations in the Delta. The invasion of spongeplant in California, and the Delta specifically, is relatively new. Spongeplant has characteristics that promote its further establishment and spread, such as multiple reproductive strategies, fast growth, short juvenile period, and seeds that germinate without pretreatment. Spongeplant is found in wet climates with winter temperatures above 0°C (Cook and Urmi-König 1983). In the Delta, spongeplant seedlings from 0.2 cm to 2 cm in diameter have survived frost and mild freezes (Anderson 2011a). Spongeplant stays protected from frost under taller-statured plants such as water hyacinth, cattails and tules. In addition, these species provide a safe environment for spongeplant. Spongeplant begins to grow as temperatures and day length increase. United States Department of Agriculture – Agricultural Research Service (USDA-ARS) has identified green seedlings in February. Spongeplant grows in extremely dense mono-specific mats, similar to water hyacinth. It has the capacity to cover large areas of open water, and can cause significant reductions in dissolved oxygen (Cal-IPC 2011). Dense spongeplant mats have the potential to block open water needed by waterfowl and other wildlife, as well as negatively impact pumps in the Delta.

Water primrose: Water primrose (*Ludwigia* spp.) has recently become widespread in the Delta, forming expansive mats of dense vegetation, successfully competing with water hyacinth and floating pennywort at the edges of channels or shallow flats. The taxonomy of water primrose is in flux, with a complex of several species causing problems in the Delta. Water primrose currently infests several Delta waterways and appears to be the most dominant floating/emergent species after water hyacinth. Water primrose is an emergent aquatic plant that occupies a similar ecological niche as spongeplant and water hyacinth. While water primrose is considered an emergent species, DBW currently manages water primrose similar to water hyacinth and other FAVs. If left untreated, water primrose infestations can continue to grow rapidly and spread during the growing season. Water primrose was added to the SCP in fall 2016, with treatments following the same protocols, and within the same overall treatment acres, as spongeplant.

Floating pennywort: Floating pennywort (*Hydrocotyle ranunculoides*) (a potential program addition) is a perennial herb that is native to California and is also found in other western states and elsewhere in North America. Floating pennywort is found along pond and lake margins as well as marshes, swamps and slow flowing streams. It is an extremely fast-growing plant. Although the native pennywort was once the predominate species in the Sacramento-San Joaquin Delta, water primrose has displaced it and in fact grows over floating mats of pennywort. Pennywort usually forms dense low-growing mats that can spread across moist soil or form floating mats in shallow water. These mats can break off and float independently. In natural areas, pennywort is considered a desirable component of aquatic ecosystems but because of its creeping habit, floating pennywort can become a nuisance and can especially become a problem in high use navigational areas such as marinas Pennywort reproduces by seed and vegetatively from creeping stems and stem fragments.

Submersed Aquatic Vegetation (SAV)

Egeria densa: *Egeria densa* (Brazilian Waterweed) is a submersed, non-native aquatic plant, introduced into the Delta approximately 65 years ago. Spread of *Egeria densa* outside its native range has been attributed to the fact that it was once considered an important "oxygenator" for ponds and aquaria, and thus became widely available as an aquarium plant, which then made its way to the Delta. Outside the Delta, this plant also occurs in the Sierra Nevada, central coast, San Franc-isco Bay, and the Jacinto Mountains. This fast growing weed obstructs waterways, crowds out native plants, impedes anadromous fish migration and boat navigation, slows water flows, entraps sediments, and clogs agricultural and municipal water intakes. *Egeria densa* negatively impacts delta smelt by reducing turbidity and overwhelming littoral (near shore) habitats (USFWS 2008). *Egeria densa* may infest as much as 15,000 surface water acres, or twenty-two percent (24%) of the Delta's approximately 68,000 acres. (The legal Delta is approximately 61,619 acres. The Delta and its tributaries include approximately 68,000 acres). *Egeria densa* is very adaptable to local conditions. Factors that support *Egeria densa'*s invasiveness include: a relatively fast growth rate, acclimatization to different light regimes (particularly its ability to grow in low-light environments), flexible nutrient uptake from water column and sediments, high productivity in low to medium nutrient environments, high phenotypic plasticity, high dispersal via fragmentation, and high potential to colonize disturbed areas (Yarrow et al. 2009). *Egeria densa* thrives in shallow waters (< 10 feet deep), such as those found in much of the Delta. In addition, *Egeria densa* in the Delta does not completely senesce in the fall, as do most native plant species. As a result, E*geria densa* continues producing biomass, some of which persists through the winter.

Curlyleaf pondweed: Curlyleaf pondweed (*Potamogeton crispus*) is native to Eurasia, Africa, Australia and is a perennial. Curlyleaf pondweed is found in shallow to deep water of lakes and rivers and has oblong, crinkled leaves; leaf edges are wavy and finely toothed. Unlike other plants, curlyleaf pondweed actively grows during winter months when most plants are dormant. It also has been found growing under ice. Curlyleaf pondweed tolerates extreme conditions including cold water, low light, polluted, disturbed, or turbid waters where many native plants cannot survive. While it can provide habitat for aquatic life in the winter months, excessive growth in the spring leads to dense mats that displace native vegetation. It reproduces vegetatively by spindle-shaped turions (winter buds that form at leaf axils and stem tips); turions lie dormant during summer and germinate in fall. It can also spread via by fragmentation. Mid-summer die-offs release nutrients, such as nitrogen and phosphorus, from the decaying plants into the water column, which may cause harmful algal blooms.

Eurasian watermilfoil: Eurasian watermilfoil (*Myriophyllum spicatum*) is a submersed perennial macrophyte. Eurasian watermilfoil overwinters in California, and reproduces sexually and vegetatively. Eurasian watermilfoil is common in a wide variety of aquatic habitats, and rapidly colonizes disturbed or previously unvegetated areas. Eurasian watermilfoil is commonly seen in areas where *Egeria densa* has been successfully treated. Sloughing of lower stems produces nutrient loading in the water column, contributing to low dissolved oxygen levels. Eurasian watermilfoil shades and outcompetes native plants, reducing both richness and cover of submersed, emergent, and floating native plant species. Excessive growth of Eurasian watermilfoil reduces sedimentation (increasing water clarity) and provides cover for predators of endangered fish species such as delta smelt. Eurasian watermilfoil is prevalent in several Delta locations, including Franks Tract, Sandmound Slough, Taylor Slough, and Discovery Bay.

Carolina fanwort: Carolina fanwort *(Cabomba caroliniana)* is a submersed perennial macrophyte. Fanwort is considered invasive on four continents, and is regulated as a noxious weed in California. In the Delta, fanwort reproduces vegetatively through fragmentation. Fanwort prefers shallow water, but can grow in up to 10 meters. It grows well in low light and turbid conditions. It forms monospecific mats, alters water quality (reduced dissolved oxygen), and fouls and discolors water. CDFW reports that in Canada fanwort has been shown to alter habitat structure and invertebrate communities, with potential negative effects on native fish populations. In 2014, fanwort was found in a few Delta locations, but by 2016 was reported to be spreading rapidly in the Delta.

Coontail: Coontail *(Ceratophyllum demersum)* is a submersed, free-floating macrophyte. Coontail is native in 38 of California's 58 counties, but exhibits invasive characteristics in some environments. Coontail primarily reproduces vegetatively, through stem fragmentation and turions. It also produces seed-bearing fruit prolifically. Coontail forms dense canopies, shading out other submersed plants. In the Delta, coontail is commonly found associated with *Egeria densa*. Similar to other invasive submersed species, coontail reduces turbidity and provides habitat and shelter for predatory fish. Excessive growth can result in depletion of dissolved oxygen. Coontail is found throughout the Delta, primarily in slower moving waters, including Franks Tract, Bishop Cut, 14 Mile Slough, and Mildred Island.

[i] The legal definition of the Sacramento-San Joaquin Delta is as follows. These boundaries are reflected in Exhibit 1-1. 12220. The Sacramento-San Joaquin Delta shall include all the lands within the area bounded as follows, and as shown on the attached map prepared by the Department of Water Resources titled "Sacramento-San Joaquin Delta," dated May 26, 1959:

Beginning at the Sacramento River at the I Street bridge proceeding westerly along the Southern Pacific Railroad to its intersection with the west levee of the Yolo By-Pass; southerly along the west levee to an intersection with Putah Creek, then westerly along the left bank of Putah Creek to an intersection with the north-south section line dividing sections 29 and 28, T8N, R6E; south along this section line to the northeast corner of section 5, T7N, R3E; west to the northwest corner of said section; south along west boundary of said section to intersection of Reclamation District No. 2068 boundary at northeast corner of SE 1/4 of section 7, T7N, R3E; southwesterly along Reclamation District No. 2068 boundary to southeast corner of SW 1/4 of section 8, T6N, R2E; west to intersection of Maine Prairie Water Association boundary at southeast corner of SW 1/4 of section 7, T6N, R2E; along the Maine Prairie Water Association boundary around the northern and western sides to an intersection with the southeast corner of section 6, T5N, R2E; west to the southwest corner of the SE 1/4 of said section; south to the southwest corner of the NE 1/4 of section 7, T5N, R2E; east to the southeast corner of the NE 1/4 of said section; south to the southeast corner of said section; west to the northeast corner of section 13, T5N, R1E; south to the southeast corner of said section; west to the northwest corner of the NE 1/4 of section 23, T5N, R1E; south to the southwest corner of the NE 1/4 of said section; west to the northwest corner of the SW 1/4 of said section; south to the southwest corner of the NW 1/4 of section 26, T5N, R1E; east to the northeast corner of the SE 1/4 of section 25, T5N, R1E; south to the southeast corner of said section; east to the northeast corner of section 31, T5N, R2E; south to the southeast corner of the NE 1/4 of said section; east to the northeast corner of the SE 1/4 of section 32, T5N, R2E; south to the northwest corner of section 4, T4N, R2E; east to the northeast corner of said section; south to the southwest corner of the NW 1/4 of section 3, T4N, R2E; east to the northeast corner of the SE1/4 of said section; south to the southwest corner of the NW 1/4 of the NW 1/4 of section 11, T4N, R2E; east to the southeast corner of the NE 1/4 of the NE 1/4 of said section; south along the east line of section 11, T4N, R2E to a road intersection approximately 1000 feet south of the southeast corner of said section; southeasterly along an unnamed road to its intersection with the right bank of the Sacramento River about 0.7 mile upstream from the Rio Vista bridge; southwesterly along the right bank of the Sacramento River to the northern boundary of section 28, T3N, R2E; westerly along the northern boundary of sections 28, 29, and 30, T3N, R2E and sections 25 and extended 26, T3N, R1E to the northwest corner of extended section 26, T3N, R1E; northerly along the west boundary of section 23, T3N, R1E to the northwest corner of said section; westerly along the northern boundary of sections 22 and 21, T3N, R1E to the Sacramento Northern Railroad; southerly along the Sacramento Northern Railroad; southerly along the Sacramento Northern Railroad to the ferry slip on Chipps Island; across the Sacramento River to the Mallard Slough pumping plant intake channel of the California Water Service Company; southward along the west bank of the intake channel and along an unnamed creek flowing from Lawler Ravine to the southern boundary of the Contra Costa County Water District; easterly along the southern boundary of the Contra Costa County Water District to the East Contra Costa Irrigation District boundary; southeasterly along the southwestern boundaries of the East Contra Costa Irrigation District, Byron-Bethany Irrigation District, West Side Irrigation District and Banta-Carbona Irrigation District to the northeast corner of the NW 1/4 of section 9, T3S, R6E; east along Linne Road to Kasson Road; southeasterly along Kasson Road to Durham Ferry Road; easterly along Durham Ferry Road to its intersection with the right bank of the San Joaquin River at Reclamation District No. 2064; southeasterly along Reclamation District No. 2064 boundary, around its eastern side to Reclamation District No. 2075 and along the eastern and northern sides of Reclamation District No. 2075 to its intersection with the Durham Ferry Road; north along the Durham Ferry Road to its intersection with Reclamation District No. 17; along the eastern side of Reclamation District No. 17 to French Camp Slough; northerly along French Camp Turnpike to Center Street; north along Center Street to Weber Avenue; east along Weber Avenue to El Dorado Street; north along El Dorado Street to Harding Way; west along Harding Way to Pacific Avenue; north along Pacific Avenue to the Calaveras River; easterly along the left bank of the Calaveras River to a point approximately 1,600 feet west of the intersection of the Western Pacific Railroad and the left bank of said river; across the Calaveras River and then north 18* 26' 36 west a distance of approximately 2,870 feet; south 72* 50' west a distance of approximately 4,500 feet to Pacific Avenue (Thornton Road); north along Pacific Avenue continuing onto Thornton Road to its intersection with the boundary line dividing Woodbridge Irrigation District and Reclamation District No. 348; east along this boundary line to its intersection with the Mokelumne River; continuing easterly along the right bank of the Mokelumne River to an intersection with the range line dividing R5E and R6E; north along this range line to the Sacramento-San Joaquin County line; west along the county line to an intersection with Reclamation District No. 1609; northerly along the eastern boundary of Reclamation District No. 1609 to the Cosumnes River, upstream along the right bank of the Cosumnes River to an intersection with the eastern boundary of extended section 23, T5N, R5E; north along the eastern boundary of said extended section to the southeast corner of the NE 1/4 of the NE 1/4 of said extended section; west to the southeast corner of the NE 1/4 of the NW 1/4 of extended section 14, T5N, R5E; west to an intersection with Desmond Road; north along Desmond Road to Wilder-Ferguson Road; west along Wilder-Ferguson Road to the Western Pacific Railroad; north along the Western Pacific Railroad to the boundary of the Elk Grove Irrigation District on the southerly boundary of the N 1/2 of section 4, T5N, R5E; northerly along the western boundary of the Elk Grove Irrigation District to Florin Road; west on Florin Road to the eastern boundary of Reclamation District No. 673; northerly around Reclamation District No. 673 to an intersection with the Sacramento River and then north along the left bank of the Sacramento River to I Street bridge. Section, range, and township locations are referenced to the Mount Diablo Base Line and Meridian. Road names and locations are as shown on the following United States Geological Survey Quadrangles, 7.5 minute series: Rio Vista, 1953; Clayton, 1953; Vernalis, 1952; Ripon, 1952; Bruceville, 1953; Florin, 1953; and Stockton West, 1952.

Crowe Horwath.

Section 2

Program Description

2. Program Description

This chapter of the Draft PEIR describes AIPCP objectives, program area, and the selected program alternative. This chapter is organized as follows:

A. Program Overview and Objectives

B. Program Area

C. Selected Program Alternative.

A. Program Overview and Objectives

The objective of the Aquatic Invasive Plant Control Program (AIPCP) is control the growth and spread of aquatic invasive plants (AIP) in the Sacramento-San Joaquin Delta (Delta), its surrounding tributaries, and Suisun Marsh to in support of the environment, economy, and public health. Because of the potential for spread, the long-term presence, and the persistence of invasive aquatic plants in the Delta, the AIPCP legislative mandates are for control, rather than eradication of aquatic invasive plants. The AIPCP is part of the California State Parks Division of Boating and Waterways (DBW) Aquatic Invasive Species Program. The mission of the Aquatic Invasive Species Program is to manage aquatic invasive plants and to help prevent the introduction and establishment of Dreissenid mussels in the Sacramento-San Joaquin Delta in partnership with other state, local, and federal agencies. However, the program described in this document addresses only control of aquatic invasive plants.

The AIPCP provides a comprehensive approach to aquatic invasive plant control in the Delta, and incorporates all previous Delta programs conducted by the Division of Boating and Waterways, including the Water Hyacinth Control Program (WHCP), Spongeplant Control Program (SCP) and *Egeria densa* Control Program (EDCP), and new invasive plant species incorporated through the process defined by Assembly Bill (AB) 763. The AIPCP is supported by the Collaboration Guidelines for Delta AIS Control (Guidelines). The Guidelines identify actions, goals, and metrics to support a comprehensive, adaptive, collaborative, flexible, practical, efficient, effective, and sustainable approach to managing AIS species in the Delta. A draft of the Collaboration Guidelines for Delta AIS Controls provided Volume II of this PEIR. The AIPCP adheres to an adaptive management strategy with annual evaluation. This adaptive strategy allows the program to respond to changing conditions in the Delta. It also facilitates adaptability to changes in other elements, such as regulatory environment, public health, and the economy.

The AIPCP's adaptive management approach to AIP control reflects the changing nature of the Delta ecosystem and the authorization granted by AB 763. It is based on the use of a comprehensive set of treatment tools and approaches to optimize efficacy and environmental protection and is defined by increased use of monitoring, performance metrics, and treatment triggers to guide program actions and reduce risks. A comprehensive and diverse and integrated set of tools will more effectively target treatments, with the aim to control infestations before they spread. For example, implementing management actions earlier should result in fewer acres of AIP that require multiple herbicide applications, thus lowering seasonal herbicide use overall.

The AIPCP aims for efficacious management actions to control aquatic invasive plants while at the same time strives to minimize non-target species impacts and to prevent environmental degradation in Delta waterways and tributaries. **Exhibit 2-1** identifies DBW's eleven annual objectives and performance measures for the AIPCP.

Exhibit 2-1
AIPCP Annual Objectives and Performance Measures

Objectives	Performance Measures
1. Reduce total acres infested with FAV and SAV.	• Acres infested with FAV or SAV in early season, mid-season, late-season (yearly) • Change in acres over time – total and by target location
2. Reduce SAV biomass at high priority navigation sites currently infested with SAV	• Percentage of biovolume and biocover (abundance and density measures) at selected sites, pre-treatment to post-treatment; metric goal: Vessel Hull Clearance (VHC)
3. Reduce SAV biomass at nursery sites (sites where the invasive plant is historically present, persistent from year to year, and from which the species is known to disperse)	• Biovolume and biocover metrics at nursery sites, pre-treatment to post-treatment • Percentage of biomass/biocover at nursery sites compared to prior year
4. Reduce FAV coverage at nursery sites and reduce the number of FAV nursery sites	• Acres of FAV coverage at nursery sites in early season, mid-season, late season (yearly) • Change in acres over time – total and by location(s)
5. Prevent boat navigation, agricultural, recreation, public access, and public safety incidents related to AIP	• Number of incidents related to AIP • Number of complaints related to AIP • Economic costs of invasive weed incidents in the Delta
6. Reduce the quantity of herbicides applied in the Delta and tributaries by implementing data-driven treatment approaches to target specific areas based on the presence and life-cycles (phenology) of AIP and sensitive species	• Percentage of herbicide active ingredient applied per acre as compared to previous year [Note: in order to reduce recent infestation levels to maintenance status, DBW may need to increase the amount of herbicide utilized over the next few years; once a maintenance level has been established, the goal would be to reduce annual herbicide applications.]
7. Reduce potential environmental impacts of the AIPCP by implementing reduced risk treatment approaches	• Percentage of reduced risk herbicide applied as compared to total herbicide applied (acres and/or a.i.) • Efficacy and extent of biocontrols in the Delta and tributaries
8. Minimize the total number of acres treated by implementing data-driven treatment approaches based on the presence of AIP and sensitive species	• Acres treated compared to previous year in order to achieve a maintenance threshold to target objective of ultimately reducing total acres treated
9. Support ecosystem restoration projects in the Delta by removing AIP in restoration sites and through collaboration with wildlife/restoration agencies and their projects	• Acres treated in ecosystem restoration projects
10. Minimize AIPCP environmental impacts, as measured by compliance with program permits and biological opinions	• Timely Annual Report to provide additional information about the program and meet regulatory requirements • No take of endangered species
11. Target and optimize physical/mechanical removal methods to meet specific management needs	• Acres and cubic yards physical/mechanical removal, by method

B. Program Area

The AIPCP includes portions of eleven counties that encompass much of the Sacramento-San Joaquin Delta and its upland tributaries. The eleven counties include: Alameda, Contra Costa, Fresno, Madera, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Tuolumne, and Yolo. The general boundaries for the treatment area in the Delta and its tributaries are as follows:

- West up to and including Sherman Island, at the confluence of the Sacramento and San Joaquin Rivers;
- West up to the Sacramento Northern Railroad to include water bodies north of the southern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel;
- North to the northern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel, plus waters within Lake Natoma;
- South along the San Joaquin River to Mendota, just east of Fresno;
- East along the San Joaquin River to Friant Dam on Millerton Lake;
- East along the Tuolumne River to LaGrange Reservoir below Don Pedro Reservoir; and
- East along the Merced River to Merced Falls, below Lake McClure.

Treatment Zones and Treatment Sites

The program area is divided into twelve treatment zones. The treatment zones are based on physical, hydrological, and geographical characteristics. The defining characteristics are as follows and in **Exhibit 2-2:**

- Water Characteristics
  - Tidal – primary Delta characteristic, encompasses Delta sites, other than those categorized as estuarine, which are influenced by tidal movement
  - Estuarine – Big Break and Sherman Island sites
  - Riverine – Tributary sites 310 and above
- Channel Type
  - Open channel – waterways, sloughs, and channels that have continuous connection to other waterways
  - Dead-end channel – waterways, sloughs, channels that have a dead-end not connecting to another waterway. Assumes low water flows. Can include an entire slough or sites that contain small dead-end channels
- Marina Status
  - No Marina – there is no marina present within the site
  - Open Marina – a marina with the majority of one side exposed to a free flowing waterbody
  - Closed Marina – a marina with an opening to a flowing waterbody allowing access to the marina. Assumes low flow conditions
- Flow
  - Med-high flow – medium to high flow conditions, assuming average hydrologic conditions
  - Low-med flow – low to medium flow conditions, assuming average hydrologic conditions. Also considers slower water movement in between islands and in back sloughs and side channels
- Special Priority – includes Stockton and Sacramento Deep Water Channels, Discovery Bay, US Bureau of Reclamation Tracy Fish Collection Facility, and selected ecosystem restoration projects.
- Potable Water or Plant Nursery Intakes – includes sites with drinking water intakes and irrigation intakes adjacent to nurseries.

Exhibit 2-2 provides the twelve treatment zones, characteristics, and associated treatment sites. Note that some treatment sites may encompass more than one type of treatment zone. For example, there are dead-end pockets on several of the riverine sites. **Exhibits 2-3 and 2-4** illustrate the distribution of treatment zones throughout the Northern and Southern sites. NOTE: 11x17 versions of all maps are provided the Appendix of this PEIR.

Exhibit 2-2
Treatment Zone Characteristics and Associated Treatment Sites

Zone	Water Characteristic	Channel Type	Marina Status	Flow	DBW Treatment Site Numbers
Z-1	Tidal	Open	Open Marina	Med-high flow	3, 12, 18a, 19a, 22, 32, 34, 38, 40, 42, 52, 53, 97, 98b, 107, 108, 110-112, 125, 209a, 212a, 213b, 240b, 241, 244, 248a, 249b, 250a
Z-2	Tidal	Open	Open Marina	Low-med flow	24a, 40, 81, 87b, 301
Z-3	Tidal	Open	Closed Marina		10, 14, 15, 40, 91a, 117, 118, 120b, 140, 250b, 251a, 252a, 286, 300
Z-4	Tidal	Open	No Marina	Med-high flow	1- 5, 7, 8, 10, 11, 13-16, 17a/b, 18b, 19b, 21a/b, 22, 23a/b, 24b, 28, 29, 32-34, 37-44, 50-60, 65-73, 78, 83a/b, 84a/b, 85a/b, 86a/b, 87b, 89a/b, 90a/b, 91a/b, 92a/b, 95, 96, 98a, 99a/b, 100, 101a/b, 102, 103a/b, 104a/b, 105, 106, 113 119a/b, 120a, 121a/b, 129, 135, 137-139, 141, 173-176, 200-202, 204, 206, 208, 209a/b, 210a/b, 211a/b, 212a/b, 213a/b, 214, 216, 217, 219, 240a, 241-245, 246a/b, 247a/b, 248b, 249a, 250a/b, 251a/b, 252a/b, 253a/b, 254, 255, 256a/b, 257a/b, 258a/b, 260, 261, 263-269, 285, 287-289, 290a/b
Z-5	Tidal	Open	No Marina	Low-med flow	9, 28, 32, 37, 39, 45-49, 53, 56, 65, 68, 74-77, 80, 81, 84a, 85a/b, 87a/b, 99a/b, 100, 101b, 121b, 122, 200, 215, 217, 262, 270-284, 290a, 291, 300, 303-309
Z-6	Tidal	Dead-end	Closed Marina		8, 20, 26, 62, 79, 88, 93, 94, 109, 112, 171, 265, 301, 305
Z-7	Tidal	Dead-end	No Marina		6, 20, 25, 26, 30, 31, 35, 36, 61, 63, 64, 69, 74-78, 82, 83b, 95, 97, 203, 205, 207, 213a, 214-216, 218, 219-239, 252b, 259, 263, 283, 284, 300, 302
Z-8	Estuarine				115-118, 123-134, 136
Z-9	Riverine	Open			310-325, 400,413, 414a, 414-427, 500-537, 700-718, 600, 900-929
Z-10	Riverine	Dead-end			313, 314, 325, 401, 404, 501, 513, 514, 516, 517, 519-522, 529, 706, 713, 715, 910a/b, 925, 926
Z-11	Special priority				8, 79, 93, 171, 290a
Z-12	Potable water or plant nursery intake				15, 34, 51, 89a/b, 93, 97, 109, 284

Exhibit 2-3
Northern Sites by Treatment Zone

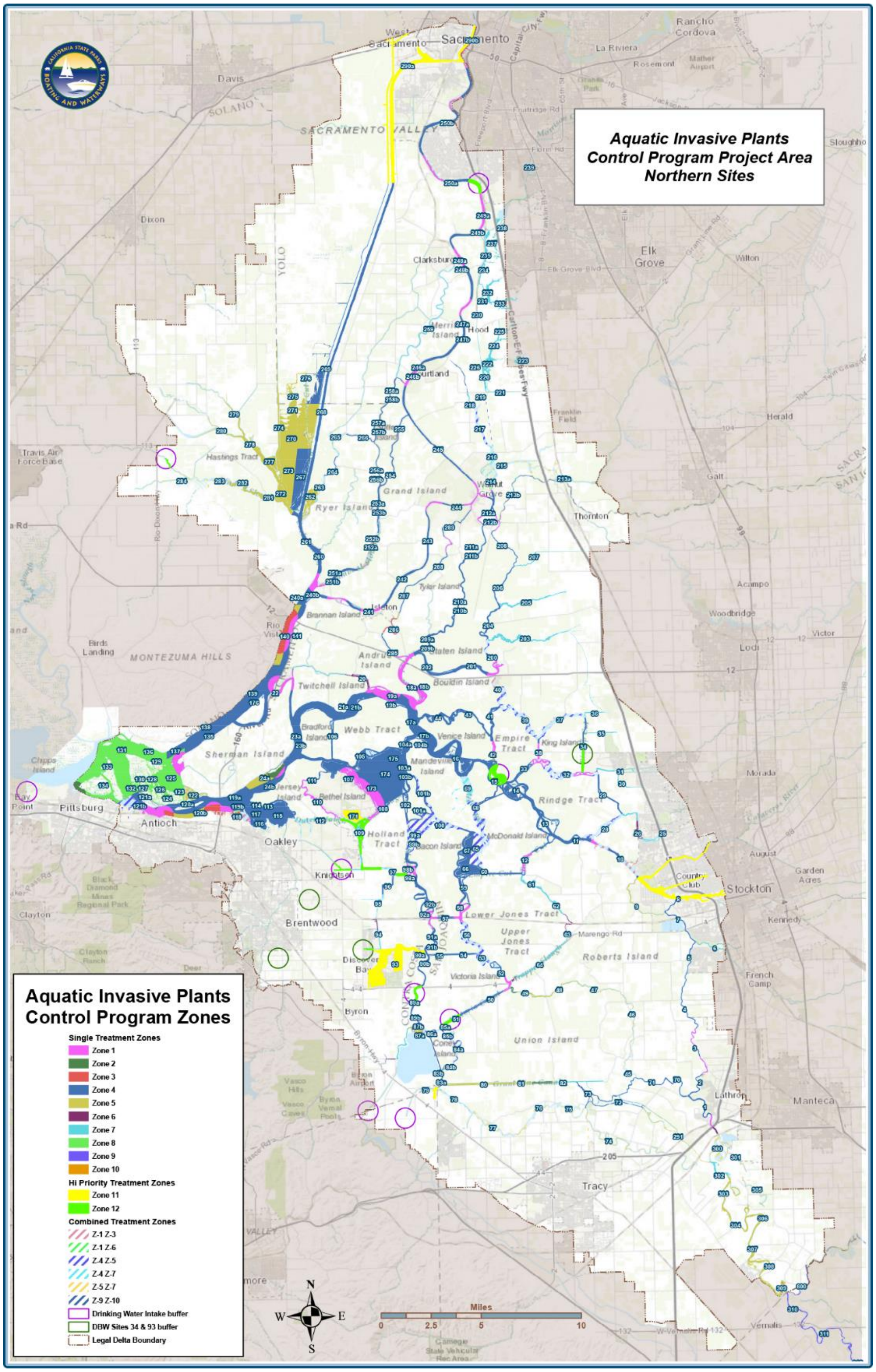


Exhibit 2-4a
Southern Sites by Treatment Zone

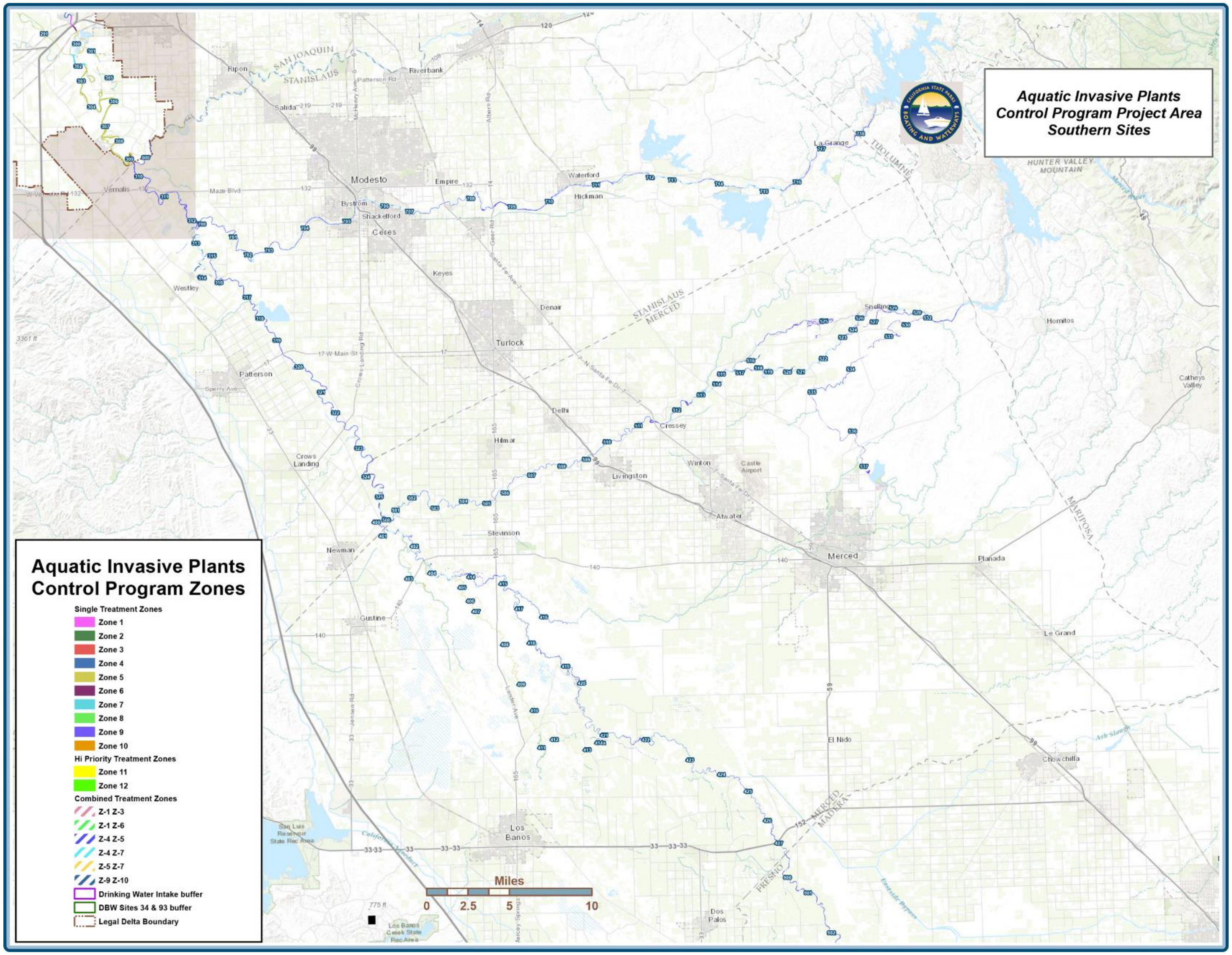
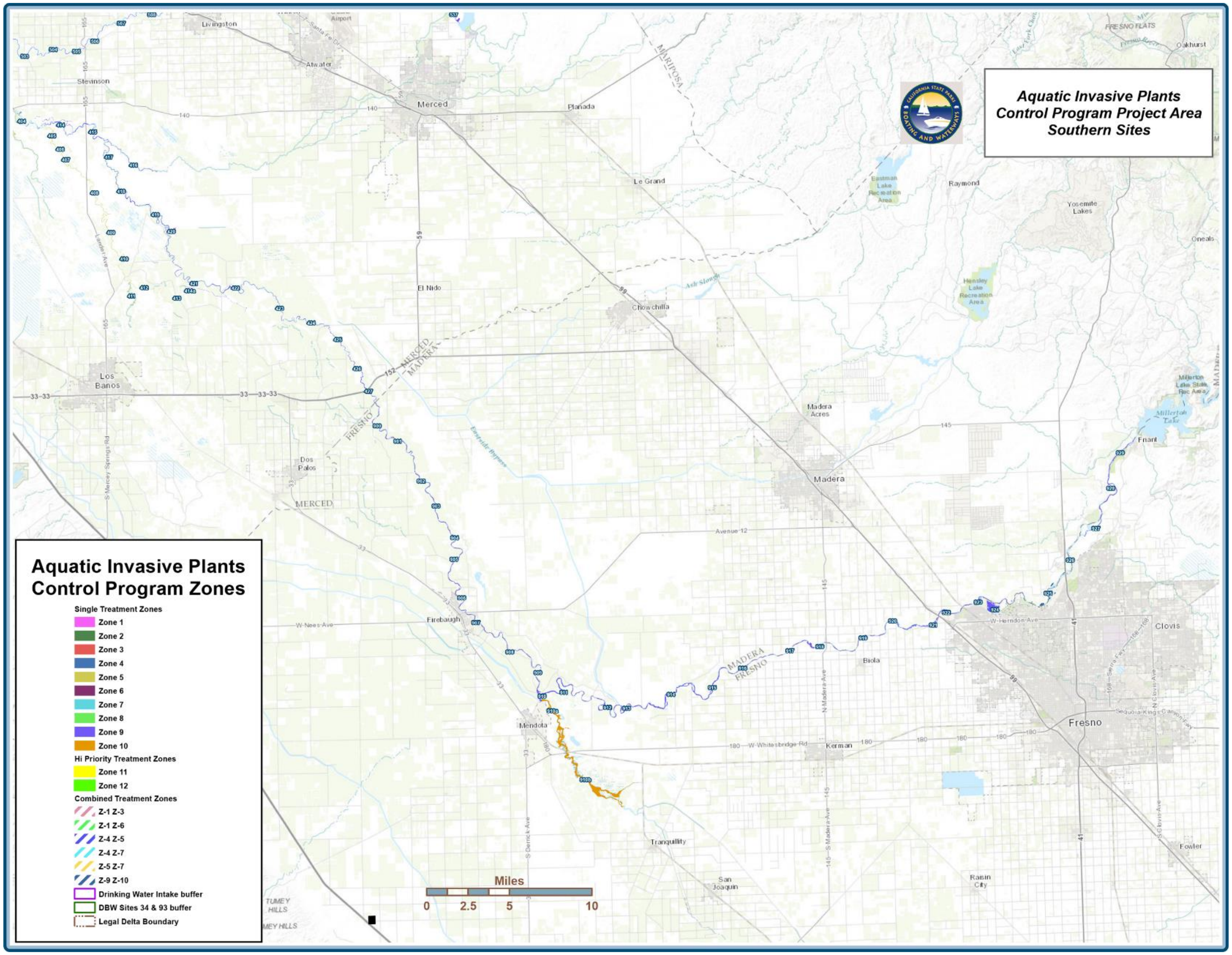


Exhibit 2-4b
Southern Sites by Treatment Zone



Within the AIPCP, the project area is further divided into approximately 418 treatment sites that average between one and two miles in length. The total number of treatment sites may be further defined and refined by AIPCP to reflect jurisdictional and operational factors. The numbering of treatments sites is not sequential, but is based on early WHCP numbering systems from the 1980s. The primary purpose of these defined treatment sites is to facilitate integrated monitoring results with planning and reporting of AIPCP activities.

In any given year, AIPCP will treat only a portion of the total treatment sites. Multiple treatments within a treatment site may be necessary because some types of aquatic invasive plants readily regrow following treatment, and many sites in the Delta cannot be treated during the ideal early-growth phase due to the potential presence of listed fish species. DBW will follow best management practices (BMPs) defined for each treatment zone that are based on the characteristics of the zone.

C. Selected Program Alternative

As part of its programmatic approach to controlling FAV and SAV, the DBW analyzed and proposed a diverse set of treatment tools that may minimize the amount of herbicide applied to Delta waterways, reduce potential for species resistance, minimize environmental and ecosystem impacts, and enable earlier treatment in areas where there are current restrictions. The AIPCP strives for the widest range of flexibility possible in terms of available tools. The tools proposed include treatment options that are not currently in use, but may become desirable in the future if new species emerge. For instance, the addition of new herbicides to the program does not automatically indicate that DBW will use them. Including as diverse a set of tools as possible in the current program supports the program’s proactive (as opposed to reactive) philosophy. The tools proposed fall into three categories, also illustrated in **Exhibit 2-5**:

1. Herbicide
2. Physical (mechanical harvesting, booms/barriers, hand-picking, etc.)
3. Biological (biocontrol).

DBW conducted a rigorous analysis of all proposed tools and respected the need to control aquatic invasive species while minimizing resulting environmental and ecosystem impacts to Delta waterways and its surrounding tributaries and Suisun Marsh. When selecting AIPCP herbicides, DBW considered efficacy, legal and regulatory compliance, and ecosystem impacts. DBW rejected several herbicides due to toxicity concerns and is including only those not expected to adversely harm sensitive species at the concentrations used. In including new herbicides to a more flexible and strategic program, DBW may minimize the amount of herbicide applied to Delta waterways, reduce adverse health effects, increase efficacy, or reduce environmental impact.

The selected AIPCP alternative is an adaptive and strategically integrated aquatic invasive plants management program. It will be based on an adaptive management approach with annual re-evaluation and adjustments as necessary. This enables DBW the flexibility to adapt to changes in the Delta ecosystem and maintain a proactive rather than reactive approach. The AIPCP will utilize treatment protocols that respect the need to control aquatic invasive plants with the need to minimize resulting environmental impacts to Delta waterways and its surrounding tributaries and Suisun Marsh. It will include a diverse set of potential treatment options to enable targeted treatments with the aim to control infestations before they spread. Earlier treatment may result in fewer acres that require herbicide treatment and therefore lower herbicide use overall.

The proposed program consists of an integrated and adaptive approach, including herbicide treatment, physical treatment methods, and biological control agents, adjusting over time, as treatment methods, technology, and environmental factors change**.** The following principles guide program design:

- Collaborating with stakeholders
- Implementing science-based control
- Adopting an adaptive management approach
- Striving for the widest range of tools and flexibility
- Focusing on reduced risk strategies and ecosystem services
- Including mapping, monitoring, and performance metrics
- Being proactive rather than reactive.

Exhibit 2-5
Summary of Proposed AIPCP Control Methods

	FAV	SAV
Herbicides (X indicates the types of plants proposed for each method)		
2,4-D	X	
Glyphosate	X	
Penoxsulam	X	X
Imazamox	X	X
Diquat	X	X
Fluridone		X
Imazapyr	X	
Carfentrazone-ethyl	X	X
Endothall (Aquathol)		X
Flumioxazin	X	X
Florpyrauxifen-benzyl	X (label pending)	X (label pending)
Tank Mixes	X	X
Physical and Mechanical Methods		
Benthic mats		X
Hand/nets	X	
Diver handpicking, pulling		X
Diver suction harvesting		X
Booms and floating barriers	X	X
Curtains, screens	X	X
Surface excavators	X	
Harvesters	X	X
Cutters and shredders	X	
Herding	X	
Adjuvants and Dyes		
Agri-Dex	X	
Competitor	X	
Cygnet Plus	X	
Break-Thru SP 133	X (label pending)	
ColorFast	X	
Rhodamine WT		X
Bright Dyes		X
Biological Controls *(Water hyacinth only)*		
Neochetina weevil	X	
Plant hopper (*Megamelus scutellaris*)	X	

The selected program alternative is based on Integrated Pest Management (IPM). The State defines IPM as: a pest management strategy that focuses on long-term prevention or suppression of pest problems through a combination of techniques such as monitoring for pest presence and establishing treatment threshold levels, using non-herbicide practices to make the habitat less conducive to pest development, improving sanitation, and employing mechanical and physical controls. Pesticides that pose the least possible hazard and are effective in a manner that minimizes risks to people, property, and the environment, are used only after careful monitoring indicates they are needed according to pre-established guidelines and treatment thresholds.

To minimize potential environmental impacts, DBW selects the most appropriate control methods for a given site in the Delta based on the season and that site's conditions. This selected alternative is chosen to provide the greatest reduction in AIP biomass while avoiding or minimizing environmental impacts.

The AIPCP follows an adaptive management approach in which DBW seeks to improve efficacy and reduce environmental impacts over time as new and better information is available about the program. Within their adaptive management approach, DBW will include:

- Annual planning and program development in January of each year
- Continuous planning and program development
- Evaluating species and cover at the end of the prior treatment season
- Evaluating rainfall, snowpack, and estimated Delta flows
- Identifying nursery and problem areas
- Evaluating operational constraints
- Identifying roles of coordinating agencies
- Developing proposed SAV and FAV, strategies for the year
- Meeting with USFWS, NMFS, and other regulatory agencies to present the season treatment plan
- Continuously monitoring Delta conditions and adapting the plan as needed
- Maintaining ongoing communication with USFWS, NMFS, counties, and other regulatory agencies and stakeholders as the treatment season progresses.

1. Overall Framework

The AIPCP incorporates the control methods described in this section, and is guided by an overall framework to manage the direction of the program. This overall framework meets DBW's mission of controlling aquatic invasive plants in the Delta and surrounding tributaries in support of the environment, economy, and public health. This framework also considers DBW's role within the Delta, coordinating and collaborating with the many state, federal, and local entities with jurisdiction within the Delta. **Exhibit 2-6** identifies working groups that DBW's AIPCP team participates in. The AIPCP is designed with an understanding and awareness of the numerous initiatives in the Delta, including restoration efforts. The DBW operates as a Division of California Department of Parks and Recreation (State Parks), consistent with State Parks' mission: to provide for the health, inspiration and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high-quality outdoor recreation. Below, we describe the overall framework for the AIPCP in five important areas.

Exhibit 2-6
DBW Participation in Delta-Related Committees and Working Groups

Group	
California Aquatic Invasive Species Management Plan Coordinating Committee (CDFW)	Delta Protection Advisory Committee (DPC)
California Invasive Species Advisory Committee Stakeholder (CDFA)	South Delta FAV Coordination Taskforce (USBR)
Western Regional Panel on Aquatic Nuisance Species Stakeholder (CDFW)	Western Integrated Pest Management Seminar (CDFW)
Interagency Ecological Program-Aquatic Vegetation Project Workgroup (CDWR/CDFW/CDPR)	U.C. Davis Weed School (UCD)
Delta Inter-agency Invasive Species Coordination Team (SSJDC)	Tuolumne River Stakeholder Group (Turlock Irrigation District)
Delta Smelt Resiliency Strategy (CNRA)	Western Plant Management Society
Nutrient Scientific Technical Advisory Group (CVRWQCB)	Delta Conservation Framework Committee (CDFW)
California Cyanobacteria Harmful Algal Bloom Network (SWRCB/CDPH)	California Interagency Noxious and Invasive Plant Committee (CDWR)
Delta Regional Areawide Aquatic Weed Project (USDA-NASA-DBW)	

<u>Control Methods and Acres</u>

Starting in September and October of each year, the AIPCP Management Team, consisting of the USDA-ARS Federal Nexus, DBW's Deputy Director, Branch Chief, Field Supervisors, and Environmental Scientists, will begin a systematic process to propose methods, acres and locations to be controlled in the upcoming treatment season. [Note, that while SAV treatment locations and acres can be estimated with a fairly high degree of certainty, it is difficult to predict FAV treatment acres a year ahead of time.] As part of the annual reporting and planning process, the AIPCP will prepare maps that identify control acres and locations by category (SAV, FAV, restoration, mechanical, demonstration sites, etc.) for the prior year, and expected control acres and locations by category for the upcoming year. In order to develop projections for the upcoming year, the AIPCP will:

- Obtain and review information from the prior years' treatments based on: aerial monitoring (satellite, fixed wing, drone), point-intercept monitoring, hydroacoustic monitoring, water quality monitoring, ESA species surveys, and measurement against performance indicators
- Review feedback from citizen science and public stakeholders on the extent of infestations and problem sites
- Obtain input from the field crews and management
- Obtain input from DBW support staff
- Assess research/demonstration needs based on results of the prior years' studies and current challenges
- Review requests for restoration projects
- Review feedback from federal, state, and local partners
- Evaluate the impacts of water flow and temperature information for the upcoming year, to the extent information is available.

Based on this review, the AIPCP Management Team will identify minimum control acres for selected control methods for the upcoming year. The AIPCP will select methods from those evaluated in this BA, and total acres controlled with not exceed the 15,000-acre maximum evaluated in this BA.

Coordination with Restoration Agencies

There is an increased demand for DBW to provide control of aquatic invasive species at sites where other agencies are charged with ecological restoration. Currently, DBW is supporting the Natural Resource Agency's Delta Smelt Resiliency Strategy (DSRS) by treating *Egeria densa* in Little Hastings Tract and Decker Island (approximately 175 acres in total). Aquatic invasive plant treatments are now recognized as an essential component of many restoration projects in the Delta. At this point, the full extent of AIP control needs for restoration in the Delta is unknown. The Department of Water Resources (DWR) is required to restore 8,000 acres in the Delta as part of the 2008 State Water Project Biological Opinions. In addition, California EcoRestore is a new Natural Resources Agency initiative to restore more than 30,000 acres of Delta habitat including 9,000 acres of tidal and sub-tidal habitat by 2020. Currently, the AIPCP is the only program operating in the Delta that is authorized under the ESA to use herbicides and mechanical methods to control AIPs in the Delta. As a result, restoration agencies are dependent on the AIPCP to conduct treatments. The AIPCP supports these ecosystem restoration efforts as a component of the overall program, to the extent feasible.

To manage AIP control for restoration, DBW will request that restoration agencies submit proposed projects (timing, acres, AIP issues) to DBW in September of each year. DBW will evaluate the requests, comparing restoration to proposed treatment for the upcoming year. DBW will meet with restoration agencies each fall to evaluate, prioritize, and select restoration control sites for the upcoming year. The annual meeting will likely take place through an existing initiative, such as the Interagency Ecology Program (IEP) Aquatic Vegetation Project Work Team (PWT). AIPCP and their partners will consider factors such as the following in selecting restoration control sites: funding available from restoration agencies to fund restoration treatments by AIPCP, core AIPCP treatment needs, synergism with core treatments, criticality of restoration efforts, and the 15,000 maximum annual treatment acres.

New Control Methods

There is the possibility that new AIP control methods, not evaluated within this BA, will become available over the five years of this proposed action. In the event that new control methods become available during the next five years, DBW and USDA-ARS will conduct structured evaluations of each new control method. There are two categories of new control methods. First, those that, based on an evaluation of the likely effects of the new method, are not expected to result in effects on ESA species and critical habitat than the currently defined AIPCP. The second category is methods that could result in new effects to listed species or critical habitats, or for which there is inadequate information to determine effects.

USDA-ARS and DBW will identify new control methods through a variety of avenues. The scientific community supporting AIP control is relatively small. USDA-ARS representatives regularly review scientific literature and government reports and participate in scientific and trade group meetings where new methods are discussed. Such methods could include new physical control approaches (e.g. UV light or new types of harvesting machines), new aquatic herbicides, new labels for existing land-use herbicides that allow aquatic use, and label changes for existing aquatic herbicides that would make use in the project area feasible (for example, changes in irrigation restrictions following herbicide treatments). In identifying new control methods, USDA-ARS and DBW will consider criteria such as: efficacy, ecosystem effects, toxicity, herbicide loading, herbicide label requirements, resistance, compatibility with existing methods, and cost.

When a potential method is identified, USDA-ARs and DBW will conduct an initial literature review, review existing regulatory documents (USEPA pesticide registration and California Department of Pesticide Regulation (CDPR) registration data), and where available, evaluate the use of the method in other locations. If this initial review indicates that the method has potential for addition to the AIPCP, USDA-ARs and DBW will meet with NMFS and USFWS to present the initial information and identify potential information gaps. During this meeting, the group will discuss whether the method could be added through the first category (no new effects), or the second category (potential new effects or unknown effects).

For new herbicides, DBW will contract with UC Davis Aquatic Toxicology Laboratory to conduct acute and chronic toxicity testing for up to three fish species and one macroinvertebrate species, consistent with the toxicity testing conducted for the AIPCP in 2017. If the results of toxicity testing for the new herbicide are within the range of toxicity profiles of existing AIPCP herbicides, then DBW and USDA-ARS will propose the new herbicide be added to the program at the next annual planning review.

If the new herbicide has toxicity levels consistent with an herbicide with avoidance measures, the AIPCP will implement the same avoidance measures for the new herbicide. For example, in the unlikely event that a newly registered herbicide had a toxicity profile similar to diquat, the AIPCP would follow the same avoidance measures as are in place for diquat. Through the toxicity testing and parallel avoidance measures, USDA-ARS and DBW will ensure that only new herbicides that do not change the effects determination of the AIPCP will be incorporated into the program. When a new control method is approved by USFWS and NMFS, DBW and USDA-ARS will first use the treatment method in a Demonstration Investigation Zone (DIZ). DIZs are described in detail later in this section.

The second category of new control methods includes those for which the potential effects may be greater than those identified in the current AIPCP activities, or for which there is not enough information to determine the effects of the new method. For example, UV treatment of aquatic invasive plants is currently being tested in Lake Tahoe. Should this method prove effective in Lake Tahoe, USDA-ARS and DBW may want to incorporate UV treatment into the AIPCP. However, as a new control method, there is relatively little known about the potential for effects on listed species and critical habitats. For these types of control methods, USDA-ARS and DBW will initiate a separate section 7 consultation that could be tiered to the AIPCP programmatic document, or obtain a section 10 research permit to further evaluate the method before seeking to add it to the AIPCP. Prior to following either of these paths, USDA-ARs and DBW will consult informally with USFWS and NMFS to determine the best path forward.

Risk Assessments for New Plant Species

AB 763 requires that DBW consult with appropriate state, local, and federal agencies if it identifies a species of aquatic plant that may be invasive and need to be controlled or eradicated. After concurrence from these agencies, DBW will notify CDFW of the potential threat from that aquatic plant. AB 763 requires CDFW, after receipt of that notice, in consultation with other appropriate local, state, and federal agencies, to conduct a risk assessment of that aquatic plant species to determine whether the plant species presents a threat to the environment, economy, or human health, as determined after consideration of specified factors. AB 763 requires the risk assessment to specify whether the aquatic plant under consideration has been determined to be an invasive aquatic plant. It requires CDFW, within 60 days after completing that assessment, to report its findings to DBW so that DBW may take any necessary action to control and, when feasible, eradicate an invasive aquatic plant, as authorized under AB 763.

New potential invaders may be brought to the attention of the AIPCP team through program monitoring, or by field crews, citizen scientists, marina operators, or federal, state, or local agencies operating in the Delta. When a potential threat is identified, DBW and USDA-ARS will work with CDFA, CDFW and others to determine whether the species warrants submission for an AB 763 risk assessment. The AIPCP will also coordinate with California Aquatic Invasive Species Management Plan (CAISMP) initiatives to identify potential invaders to California waterways.

There are a number of aquatic invasive plant species that the AIPCP is tracking. These species, not yet in the Delta, are highly invasive and could pose a significant threat. Two, for example, are hydrilla and lagarospiphon (oxygen weed).

There may be situations when an aquatic invasive plant is identified in the project area, and the risk is such that immediate treatment is warranted. In these instances, DBW and USDA-ARS will coordinate with CDFA to deploy a rapid response. Currently, CDFA is the only state entity with authorization to implement a rapid response approach when a new noxious weed is identified. Rapid response authority, in coordination with CDFA, would allow the AIPCP to quickly treat invasions of new species (using only approved AIPCP treatment methods) without waiting for the AB 763 risk assessment. Once an initial threat was controlled, species treated under a rapid response could be proposed for inclusion in the AIPCP under the AB 763 process.

This section provides description of the treatment methods that may be implemented as part of the AIPCP. A key component of the AIPCP will be to conduct annual adaptive planning. This effort will include:

- Annual planning and program development in January of each year
- Continuous planning and program development
- Evaluating species and cover at the end of the prior treatment season

- Evaluating rainfall, snowpack, and estimated Delta flows
- Identifying nursery and problem areas
- Evaluating operational constraints
- Identifying roles of coordinating agencies
- Developing proposed SAV and FAV strategies for the year
- Meeting with USFWS, NMFS, and other regulatory agencies to present the season treatment plan
- Continuously monitoring Delta conditions and adapting the plan as needed
- Maintaining ongoing communication with USFWS, NMFS, counties, and other regulatory agencies and stakeholders as the treatment season progresses.

Exhibit 2-7 provides a visual of the AIPCP's adaptive management approach. The AIPCP Adaptive Management Plan is provided in **Appendix 2a** at the end of this chapter. The three large circles represent interconnected feedback loops for daily operations, annual planning and operations, evaluation of new control methods, and monitoring. Items in blue inform the larger circles. For example, daily operations are guided by permits and regulatory requirements, fish surveys, and NPDES monitoring requirements. Actions in red illustrate ongoing program adaptations. Regulatory and cooperating entities are identified in white and green. Information from daily operations such as monitoring results and efficacy feeds into the annual planning circle, also influenced by strategic planning, initiatives such as the Delta Smelt Resiliency Strategy, Sacramento Valley Salmon Resiliency Strategy, ESA/CESA compliance, hydrological conditions, economic impacts, and public health concerns. Through the annual planning process, DBW and their partners will also identify management questions. Through evaluation and monitoring, DBW and their partners will identify science needs and metrics, develop studies and monitoring plans, and conduct studies and monitoring plans. The results of studies and monitoring will result in adaptive adjustments to the program, which will feed back into the annual planning and operations, and ultimately into daily operations.

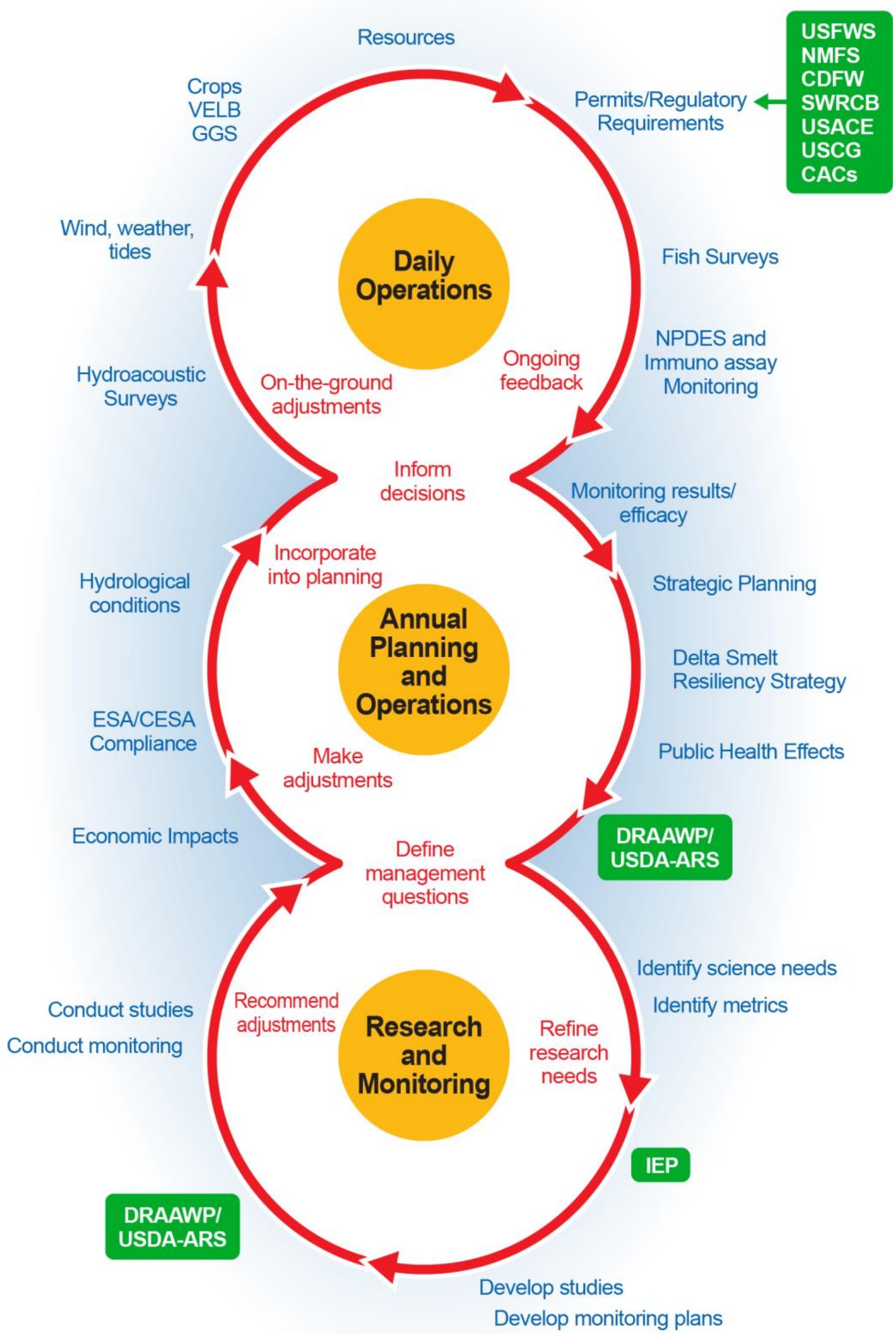
<u>Demonstration Investigation Zones</u>

The AIPCP will implement Demonstration Investigation Zones (DIZs) as a method to closely monitor control methods, further evaluate potential effects of control, evaluate efficacy, and promote adaptive management while limiting the potential for negative impacts of new and relatively untested treatment methods. DIZs will support science-based management of AIPs in the project area. DIZ control and monitoring will <u>only utilize activities that are proposed under the AIPCP action</u> described in the BA.

DIZ activities and locations will be defined during the annual process prior to the beginning of the treatment season. All proposed control methods not previously utilized in the WHCP, EDCP, or SCP, will be evaluated first through a DIZ. These evaluations will typically occur in 10 to 20 acre plots to allow DBW and USDA-ARS to conduct a controlled assessment of each method. DBW and USDA-ARS will choose DIZ locations that spatially and temporally avoid contact with or threats to listed species. Sites will also be chosen to represent typical conditions and target plants, and to minimize off-site movement of new herbicides or control methods. Biological control releases will occur in one acre plots. Examples of potential DIZs include:

- Testing the six new herbicides and tank mixes at varying concentrations and for different plant species
- Testing new application methods (for example use of drones or helicopters for herbicide treatments)
- DO monitoring after treatment of large infestations
- DO monitoring under different AIP species
- Testing new physical treatment methods
- Evaluating biocontrol releases.

Exhibit 2-7
AIPCP Adaptive Management Model



Protocols and Limitations for DIZ Implementation

AIPCP will only use herbicides that are approved by the USEPA, approved by California DPR, and included in the NPDES general permit. DBW and USDA-ARS will conduct pre-treatment and post-treatment water quality monitoring to ensure compliance with NPDES receiving water limitations, dissolved oxygen, baseline expectations for expected environmental concentrations, and other water quality parameters. The AIPCP will assess efficacy on the target SAV and FAV species and effects, if any, on listed species.

Additionally, DIZs will include the biological control releases described in detail later in this section of the BA. USDA-ARS has selected release locations that are suitable for control releases and are less likely to be treated with herbicides. USDA-ARS will follow specific procedures for release and monitoring of biocontrol agents, such as sampling of plants in the field followed by dissection in the lab.

As part of the annual planning process, the AIPCP will identify specific DIZ projects for the following treatment season, including control methods and herbicides. Prior to implementing each DIZ project, the AIPCP will develop an implementation plan, which will be provided to USFWS and NMFS. Each implementation plan will document the research questions to be answered, methodology, and monitoring approach. The AIPCP will document the results of each DIZ as part of the annual report process. Results of DIZs will be used to support the AIPCP's adaptive management and reduced risk approaches. Depending on outcomes, DIZ results could either support, or reject continued use of control methods.

2. AIPCP Permits, Consultations, and Reporting

The AIPCP must comply with National Pollution Discharge Elimination System (NPDES) permit requirements, the Endangered Species Act (ESA), California Endangered Species Act, CEQA, and other regulatory programs. This subsection provides an overview of these requirements.

NPDES General Permit

The DBW obtained an individual National Pollutant Discharge Elimination System (NPDES) permit in 2001 (CA0084654) from the Central Valley Regional Water Quality Control Board (CVRWQCB) for their aquatic weed control programs. The individual NPDES permit expired in March 2006. In April 2006, the CVRWQCB replaced the individual NPDES permit with a general NPDES permit (CAG990005). The State Water Resources Control Board (SWB) issued a new NPDES General Permit on March 5, 2013. This permit went into effect on December 1, 2013, with the most recent amendments approved in July 2016. The NPDES permit will guide DBW water quality monitoring for the AIPCP.

The key NPDES requirements for the AIPCP under the General Permit CAG990005, as of the July 2016 amendment, are as follows:

- **Dissolved oxygen** – specific DO limits depend on the location and season, but range from 5.0 mg/l (ppm) to 8.0 mg/l (ppm). DO levels are not to drop below these levels as a result of AIPCP treatments
- **Turbidity** – specific turbidity standards are not to increase above a specified number or percent of Nephelometric Turbidity Units (NTUs), depending on the initial level of natural turbidity. Generally, the AIPCP shall not increase turbidity more than 10 to 20 percent
- **pH** – AIPCP discharges shall not cause pH to fall below 6.5, or exceed 8.5, or change by more than 0.5 units
- **2,4-D residues** – maximum 2,4-D levels are based on EPA municipal drinking water standards, and shall not exceed 70 µg/l, or 70 ppb
- **Glyphosate residues** – maximum glyphosate levels are based on EPA municipal drinking water standards, and shall not exceed 700 µg/l, or 700 ppb
- **Diquat** – maximum diquat levels are based on EPA municipal drinking water standards, and shall not exceed 20 µg/l, or 20 ppb
- **Endothall** – maximum endothall levels are based on EPA municipal drinking water standards, and shall not exceed 100 µg/l, or 100 ppb

- **Fluridone** – maximum fluridone levels are based on EPA municipal drinking water standards, and shall not exceed 560 µg/l, or 560 ppb
- **Penoxsulam** - there are no specified limits for penoxsulam; however, DBW is required to monitor penoxsulam levels
- **Imazamox** – there are no specified limits for imazamox; however, DBW is required to monitor imazamox levels
- **Imazapyr** – has a receiving water monitoring trigger of 11.2 mg/l, or 11.2 ppm. DBW must monitor imazapyr levels and take specified actions if concentrations exceed 11.2 ppm
- **Flumioxazin** – has a receiving water monitoring trigger of 0.23 mg/l, or 0.23 ppm. DBW must monitor flumioxazin levels and take specified actions if concentrations exceed 0.23 ppm
- **Adjuvant residues** – there are no specified limits for adjuvants; however, DBW is required to monitor adjuvant levels
- **Monitoring** – requires a monitoring protocol. Monitoring is required at 6 treated sites for each herbicide and water body type with the exception of glyphosate, which will require monitoring at one location for each water body type. Sampling stations are identified as: “A” (where treatment occurred), “B” (downstream of the treatment area), and “C” (control, typically upstream). Sampling times are identified as: “1” (pre-treatment), “2” (immediately post-treatment), and “3” (within seven days after treatment). Thus, sample 2B is taken immediately post-treatment, downstream of the treatment location
- **Reporting** – the DBW is required to submit an annual report by March 1st of each year.

The SWB does not currently have receiving water thresholds or monitoring triggers for two proposed AIPCP herbicides: carfentrazone-ethyl and florpyrauxifen-benzyl. The AIPCP will not utilize these herbicides until they have been added to the NPDES permit. This would most likely occur when the permit is renewed in November 2018.

Once completed, the AIPCP will operate under the following regulatory authorities, in addition to the NPDES General Permit:

- **USFWS Biological Opinion (BO)** – USDA-ARS and DBW are seeking a new BO for compliance under Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)). Delta AIP control programs are currently operating under three USFWS BOs: 91410-2013-F-0005 for the WHCP, 08FBDT00-2013-F-0015 for the EDCP, as well as the newer Submersed Aquatic Vegetation (SAV) species, and 08FBDT00-2014-0029 for the SCP and water primrose.
- **NMFS BO or Letter of Concurrence (LoC)** – USDA-ARS and DBW are seeking compliance under Section 7 of the Endangered Species Act (50 CFR 402; 16 U.S.C. 1536 (c)) and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Delta AIP control programs are currently operating under three NMFS LoCs: 2013/9443 for the WHCP, 2013/9391 for the EDCP, as well as the newer SAV species, and 2014-394 for the SCP and water primrose.
- **CDFW Incidental Take permit under the California Endangered Species Act (CESA)** – With this PEIR DBW is currently in the process of obtaining an incidental take permit under CESA for the AIPCP.
- **CDFW Streambed Alteration and Routine Maintenance Agreement (RMA)** – DBW operates under a RMA for activities that could affect Delta channels, specifically mechanical harvesting operations.
- **California Environmental Quality Act (CEQA)** –DBW is currently developing this Environmental Impact Report (EIR) for compliance with CEQA requirements.
- **Section 10 Permit under the Rivers and Harbors Act** –DBW is currently seeking a Section 10 permit from the Army Corps of Engineers (USACE) for use of floating booms and other physical treatment methods.
- Approval of physical treatment methods potentially affecting navigation through permitting by the United States Coast Guard (USCG).

3. Estimated Maximum Control Acres

The AIPCP may control up to 10,400 acres in 2018 and up to 15,000 acres per year for all SAV and FAV treatments. For comparison, the previous treatment programs (WHCP, EDCP, SCP) allowed for controlling a combined total of 9,700 acres (5,000 acres of SAV, 4,500 acres of FAV, and 200 acres FAV with mechanical methods). The proposed AIPCP acreage represents the maximum ceiling allowed; it is not a target and does not convey an expectation. Currently, DBW and USDA-ARs have neither the resources or budget to treat 15,000 acres in a year. However, over the next five years, it is possible that conditions will arise that necessitate an increase in treatment acres in order to minimize the negative impacts of AIPs on the environment, economy, and public health. Total treatment acreage will be driven by invasive plant presence in a given year, and will be limited by a number of factors.

Limiting factors include:

- **Presence of Listed and Sensitive Species**: As emphasized throughout this document, DBW will minimize the potential to adversely harm a listed or sensitive species by seeking to avoid treatments when a species is likely to be located within the site.
- **Workforce Capacity**: Treatment acres will necessarily be constrained by the number of field crews and number of days with acceptable weather and good working conditions. DBW currently has 10 full-time treatment crews. As a point of reference, with DBW's existing resources of 10 field crews, using conservative assumptions, one crew can conduct herbicide applications on up to 8 acres of FAV per work day, and between 36 and 400 acres of SAV per work day. [Note that SAV control currently requires weekly applications in the treatment site over a 12-week period.] Crews typically work a four-day week. Unless additional crews are funded and staffed, the 15,000 acres will not be attainable.
- **Treatment Costs:** Financial resources may realistically constrain the number of treatment acres per year. Herbicide costs range from $12.70/gallon for 2,4-D (Weedar 64) to $39.20/pound for fluridone (Sonar PR), and up to $300/gallon for imazamox (Clearcast) and $2,400/gallon for penoxsulam (Galleon SC). Harvesting is estimated to cost $40,734 per treatment acre. DBW currently has the financial resources to treat up to approximately 10,000 acres – slightly above the current approved acreage and only two-thirds of the proposed maximum. Current financial resources are a limiting factor in the number of acres that can feasibly be treated.

While DBW does not anticipate treating the maximum acreage, it is important to have this annual maximum in place over the course of the five-year AIPCP. There are several requirements and benefits that support this maximum acreage:

- **Capacity to Treat Actual Invasive Plant Locations:** DBW analysis of plant locations in the Delta indicate that approximately 15,350 acres contain invasive plants under DBW's authority to treat. That number is based upon the approximately 4,000 acres treated previously for water hyacinth and spongeplant; the maximum 5,000 acres allowed for *Egeria densa* and other SAV, and an estimated 6,350 acres that contain infestations of the 6 additional invasive species to be treated through AIPCP (coontail, curlyleaf pondweed, Eurasian watermilfoil, fanwort, pennywort, and water primrose). Therefore, based on current plant coverage, the AIPCP requires capacity to treat up to 15,350 acres, based on the actual needs and constraints in a given year. We have rounded this number down to a maximum of 15,000 acres.

  In addition to the DBW analysis of acres of coverage, Boyer and Sutula (2015) report that over 7,166 acres (2,900 hectares) of the Delta are covered with SAV, of which *Egeria densa* is the most prominent species in the Delta. The authors also report that FAV water hyacinth covered approximately 1,977 acres (800 hectares) of the Delta in 2014. Based on 2007-2008 data, five of the target AIPCP species (*Egeria*, fanwort, Eurasian watermilfoil, curlyleaf pondweed, and coontail) covered 1,940 acres (785 hectares) in fall 2007 and 471 acres (191 hectares) in summer 2008 (Boyer and Sutula 2015).
- **Capacity for Additional Invasive Plant Treatments:** DBW has assumed responsibility for five additional invasive plants over the past 3 years, is in the process of completing the risk assessment for a sixth new plant, and is monitoring the possible future addition of other plants. For example, the City of Fresno has asked DBW to begin treating parrot feather in an irrigation canal. In the likely event that DBW becomes responsible for treating parrot feather or other plant species in the next five years, DBW will need the capacity to treat acres where those species are present.

- **Adaptive Management for Maximum Efficacy:** To use adaptive management principles effectively, DBW must have capacity to make data-driven decisions about the most effective treatment methods, timing, and locations. In some cases, treatment of more acres earlier in the season may result in more effective control, and therefore less herbicide used in the Delta within a season.
- **Uncertainty and Environmental Change:** Uncertainty related to drought conditions and climate change may impact the Delta in unknown ways. If conditions in the Delta result in substantial increases in invasions, it might be necessary to treat up to the maximum.

As part of the annual planning process, the AIPCP will identify the range of treatment acres, by category, at the start of the treatment season. **Exhibit 2-8** provides the proposed treatment allocation for the 2018 treatment season.

Exhibit 2-8
Proposed Control Acres Allocation for the 2018 Treatment Season

Treatment Approach	Anticipated Acres	Description
SAV Herbicide Treatments	Up to 5,000	• Consistent with recent EDCP treatments
FAV Herbicide Treatments	Up to 5,000	• Actual acres will depend on weather conditions during the 2017/2018 rainy season. Recent maximum acreage in drought years was 4,500; however, 2017 treatments will likely be closer to 2,000
Physical Control Methods	Up to 200	• Includes currently implemented mechanical and physical harvesting
Demonstration Investigation Zones	Up to 200	• Evaluation of new control methods as described in this BA and the annual plan
Total	**No more than 10,400**	

4. AIPCP Avoidance Measures

DBW has incorporated conservation and mitigation measures into the AIPCP project description. These measures have been developed over the last 35 years of program operation, and in coordination with USFWS, NMFS, and CDFW. Mitigation measures are described at the end of this chapter. Specific conservation and avoidance measures incorporated into the AIPCP include the following:

- **Avoidance** – the AIPCP has incorporated a number of measures to avoid the potential for impacts on listed species:
  - Using USFWS and CDFW fish surveys prior to conducting herbicide treatments in order to determine whether delta smelt are likely to be in potential treatment sites, and avoiding treatment when listed fish species are present
  - Utilizing historical fish mapping in combination with fish surveys to avoid herbicide and mechanical treatments in areas where listed fish species may be present (further described below)
  - Following the allowable locations and treatment dates for 2,4-D applications
  - Conducting environmental observation surveys and avoiding treatments if listed species are present in a site
  - Conducting surveys of valley elderberry shrubs, applying herbicides downwind of valley elderberry, maintaining a 100 feet buffer from valley elderberry shrubs for herbicide treatments (with the exception of selected sites where backpack style sprayers will be utilized), and spoiling of harvested plants at least 100 feet away from elderberry shrubs
  - Evaluating habitat for giant garter snake, avoiding disturbance of giant garter snake, spoiling of harvested plants outside of the May 1st to October 1st giant garter snake active season in approved spoil sites

- **Environmental training** – Prior to the start of each treatment season, DBW will conduct environmental awareness training for all field crew members. Training will be conducted by a USFWS and NMFS-approved biologist. The training includes: species identification and impact avoidance guidelines; protocol for identification and protection of valley elderberry shrubs; protocol for identification and protection of delta smelt, Chinook salmon, steelhead, green sturgeon, and associated protected habitats; and protocol for take of protected species. In addition, field crew members will be trained to use and calibrate spray equipment and to adhere to the AIPCP Operations Management Plan. The intent of environmental awareness training also includes daily project site pre-treatment surveys to determine if treatments should be performed that day.
- **Dissolved oxygen** – DO levels of above 5.0 ppm and below 3.0 ppm are required for treatment (in addition to the NPDES DO requirements). DBW may treat if DO is below 3.0 ppm
- **Monitoring** – ESA compliance requires that DBW comply with the NPDES permit monitoring requirements
- **Reporting** – requires DBW to report results and impacts (including take) by January 31st of each year. Each year, DBW will prepare a AIPCP Annual Report that fulfills reporting requirements of NPDES, USFWS, and NMFS. The annual report will describe the treatment program, herbicide use, permit requirements, monitoring protocols, monitoring results, and compliance with permit requirements. DBW may prepare separate reports for the FAV and SAV programs.

Fish Avoidance

To further minimize potential to impact delta smelt, AIPCP will seek to delay treatments in treatment sites likely to be used as spawning and rearing habitat for delta smelt during months when delta smelt have historically been present. DBW will augment the fish survey data identified above with the historical fish survey mapping to focus treatments in those areas where fish are currently not present, and historically not likely to be present. DBW will also monitor status of the Delta Cross Channel gates to determine whether juvenile emigrating Sacramento River winter-run Chinook salmon are likely to be present in the interior Delta.

The appendix provides summary maps illustrating delta smelt, longfin smelt, and salmonid presence in the Delta by month and treatment site for a typical wet year (2011), drought years (2012-2016), and the current very wet year (2017). Copies of these 21 maps, plus a series of 105 maps for delta smelt, longfin smelt, Winter-run Chinook salmon, Spring-run Chinook salmon, and Central Valley steelhead are available upon request. Note that four of the fish surveys (20 mm Survey, Fall Midwater Trawl, Spring Kodiak Trawl, and Smelt Larval Survey) do not distinguish between winter, spring, and fall Chinook; we included all Chinook identified in these surveys. Green sturgeon were not found in any of the surveys. Based on the historical and current surveys, DBW will seek to avoid specific areas where special status fish species are likely to be present.

These avoidance measures are precautionary, as toxicity data summarized in Chapter 3 and provided in Section 6 of the BA demonstrate that AIPCP herbicide treatments are at levels well below levels likely to result in adverse effects to fish. Given efficacy requirements and the low herbicide concentrations for several SAV treatments, there will be cases were SAV treatments take place in sites where fish may be present. DBW will identify SAV treatment locations prior to the start of each treatment season.

Based on the historical fish survey data provided in the Appendix, to the extent possible, DBW will avoid mechanical harvesting and herbicide treatments in the sites and time periods identified. The data summarizes results from nine surveys: Mossdale Trawls, Sacramento Trawls, Chipps Island Trawls, Beach Seine, Early Delta Smelt Monitoring (EDSM) Trawls, Spring Kodiak Trawl, Smelt Larval Survey, 20mm Survey, and Fall Midwater Trawl. Data were mapped and evaluated separately for wet years and combined drought years. There is one set of maps for the wet water year October 2010 through June 2011. There is an additional set of maps for the combined drought years 2012 through 2016, for October through June. There are three additional maps for the current wet year (January through March 2017). Wet and drought years show significantly different fish presence patterns, with fewer fish in the Delta in wet years. The maps do not cover July through September, which have historically been months where listed fish species are not found in the Delta.

5. Overview of AIPCP Control Methods

As described above, the AIPCP will utilize a mix of herbicide, physical/mechanical, and biological control treatment methods. These methods are briefly described in the following pages. The AIPCP Programmatic Biological Assessment (DBW and USDA-ARS 2017) provides additional detail on the selected alternative.

Reflecting the different characteristics of the zones, DBW will follow best management practices (BMPs) defined for each treatment zone (see Exhibits 2-2, 2-3, and 2-4 for zone definitions). Best management practices include defining the type of treatment within each zone; methods used; preferred timing for each method; application practices for herbicides; and methods and approaches for physical and biological treatments. **Exhibits 2-9** and **2-10** portray the best management practices for each zones for both floating and submersed aquatic vegetation, respectively.

The AIPCP will implement pre- and post-season surveys to identify locations and coverage of target invasive plant species, and supplement these formal surveys with mid-season evaluations of plant locations and coverage. Starting in January, and again in October and November, field crews will conduct visual surveys of all treatment sites. For each site, crews will record the extent of target plant coverage (acres and percent coverage), and status of target plants at the treatment sites.

In the early season survey, field crews will identify problem areas such as those with the greatest impact on navigation, public safety, nursery areas, and sites close to pumps or other structures (Treatment Zone Z-11 sites, for example). Treatment crews will also identify crops adjacent to treatment sites in order to help select the appropriate herbicide for treatment. Crews will validate field survey information with data from the prioritization process and note any changes. This survey information will be used to help prioritize treatment locations at the start of the treatment season, when necessary, and to measure efficacy of treatments at the end of the season.

Prior to treatments, AIPCP will release a public notice announcing the program. AIPCP treatments generally take place in heavily infested waterways, which are usually unsuitable for water recreation. If recreationists are present when treatment occurs, treatments crews will inform recreationists about the treatment, asking them to move to a different location, or crews will move treatments to a different location.

During the treatment season, as crews work throughout the Delta, they will continue to monitor and record plant infestations by site. This ongoing survey will assist the management team in identifying mid-season adjustments to prioritizing treatment sites and determining treatment effectiveness.

Exhibit 2-9
Best Management Practices (BMPs) for Floating Aquatic Vegetation (FAV) *Page 1 of 2*

	Best Management Practices		
Zone *(See Exhibit 2-2)*	**Herbicide**	**Physical**	**Biological**
Z-1	• Use application practices to avoid drift and exposure to marina residents and users.	• Booms, floating barriers • Curtains, screens • Excavators • Hand/net removal • Harvesters, conveyors • Herding	• Generally no releases; monitoring for natural dispersal may occur; may include some releases at selected marinas
Z-2	• Use application practices to avoid drift and exposure to marina residents and users.	• Booms, floating barriers • Curtains, screens • Excavators • Hand/net removal • Harvesters, conveyors • Herding	• Generally no releases; monitoring for natural dispersal may occur; may include some releases at selected marinas
Z-3	• Use application practices to avoid drift and exposure to marina residents and users.	• Booms, floating barriers • Curtains, screens • Excavators • Hand/net removal • Harvesters, conveyors • Herding	• Generally no releases; monitoring for natural dispersal may occur; may include some releases at selected marinas
Z-4	• Follow herbicide label requirements	• Booms, floating barriers • Curtains, screens • Excavators • Harvesters, conveyors	• Neochetina weevil (*N. bruchi* and *N. eichhorniae*) • Planthopper *(Megamelus scutellaris*)
Z-5	• Follow herbicide label requirements	• Booms, floating barriers • Curtains, screens • Excavators • Harvesters, conveyors	• Neochetina weevil (*N. bruchi* and *N. eichhorniae*) • Planthopper *(Megamelus scutellaris*)
Z-6	• Use application practices to avoid drift and exposure to marina residents and users.	• Booms, floating barriers • Curtains, screens • Excavators • Hand/net removal • Harvesters, conveyors • Herding	• Neochetina weevil (*N. bruchi* and *N. eichhorniae*) • Planthopper *(Megamelus scutellaris*)

Exhibit 2-9
Best Management Practices (BMPs) for Floating Aquatic Vegetation (FAV) *(continued)* *Page 2 of 2*

Zone *(See Exhibit 2-2)*	Best Management Practices: Herbicide	Physical	Biological
Z-7	• Utilize application methods to avoid decrease in dissolved oxygen levels	• Booms, floating barriers • Curtains, screens • Cutters, shredders • Excavators • Hand/net removal • Harvesters, conveyors • Herding	• Neochetina weevil (*N. bruchi* and *N. eichhorniae*) • Planthopper *(Megamelus scutellaris)*
Z-8	• Follow herbicide label requirements		
Z-9	• Follow herbicide label requirements	• Use booms or floating barriers to prevent FAV from moving to reduce downstream impacts	• N/A (no releases; monitoring for natural dispersal may occur)
Z-10	• Utilize application methods to avoid decrease in dissolved oxygen levels		• N/A (no releases; monitoring for natural dispersal may occur)
Z-11	• Use herbicide application in combination with physical control, as necessary, to reduce impact of FAV to vessel navigation	• Booms, floating barriers • Curtains, screens • Cutters, shredders • Excavators • Hand/net removal • Harvesters, conveyors • Herding	• N/A
Z-12	• Consult herbicide label on restrictions for drinking water and buffers around water intake. • Follow terms and conditions in MOU (if applicable) • Use herbicide application in combination with physical control, as necessary, to reduce impact of FAV to water intake operations	• Booms, floating barriers • Curtains, screens • Cutters, shredders • Excavators • Hand/net removal • Harvesters, conveyors • Herding	• N/A

Exhibit 2-10
Best Management Practices (BMPs) for Submersed Aquatic Vegetation (SAV) *Page 1 of 2*

	Best Management Practices		
Zone *(See Exhibit 2-2)*	**Herbicide**	**Physical**	
Z-1	• Prescribe application rate that accounts for short herbicide residence time. Use in combination with curtains as needed to maintain prescribed concentration. • Use vortex spreader for application near boat docks/slips.	• Booms, floating barriers • Curtains, screens	• Diver assisted suction removal • Diver hand removal, hand pulling
Z-2	• Prescribe application rate that accounts for moderate to herbicide residence time. Use in combination with curtains as needed to maintain prescribed concentration. • Use vortex spreader for application near boat docks/slips.	• Benthic mats • Booms, floating barriers • Curtains, screens	• Diver assisted suction removal • Diver hand removal, hand pulling
Z-3	• Prescribe application rates that account for long herbicide residence time in marina. • Use vortex spreader for application near boat docks/slips.	• Benthic mats • Harvesters, conveyors • Booms, floating barriers	• Curtains, screens • Diver assisted suction removal • Diver hand removal, hand pulling
Z-4	• Prescribe application rate that accounts for short herbicide residence time. Use in combination with curtains as needed to maintain prescribed concentration.		
Z-5	• Prescribe application rate that accounts for moderate to herbicide residence time. Use in combination with curtains as needed to maintain prescribed concentration.		
Z-6	• Prescribe application rates that account for long herbicide residence time. • Use vortex spreader for application near boat docks/slips.	• Benthic mats • Harvesters, conveyors • Booms, floating barriers	• Curtains, screens • Diver assisted suction removal • Diver hand removal, hand pulling
Z-7	• Prescribe application rates that account for long herbicide residence time.	• Benthic mats • Harvesters, conveyors • Booms, floating barrier	• Curtains, screens • Diver assisted suction removal • Diver hand removal, hand pulling
Z-8	• Prescribe application rate that accounts for short herbicide residence time. Use in combination with curtains as needed to maintain prescribed concentration.		
Z-9	• Prescribe application rate that accounts for short herbicide residence time. Use in combination with curtains as needed to maintain prescribed concentration and prevent downstream movement of herbicide.		

Exhibit 2-10
Best Management Practices (BMPs) for Submersed Aquatic Vegetation (SAV) *(continued)* *Page 2 of 2*

	Best Management Practices	
Zone *(See Exhibit 2-2)*	**Herbicide**	**Physical**
Z-10	• Prescribe application rates that account for long herbicide residence time.	
Z-11	• Prescribe application rates that account specific conditions in the site.	• Harvesters, conveyors • Booms, floating barriers • Curtains, screens
Z-12	• Consult herbicide label on restrictions for drinking water and buffers around water intakes • Follow terms and conditions in MOU (if applicable) • Prescribe application rate appropriate for sensitive nursery plants	• Harvesters, conveyors • Booms, floating barriers • Curtains, screens

<u>Aquatic Herbicide Use</u>

To treat various SAV and FAV, the AIPCP proposes to utilize eleven different herbicide active ingredients: 2,4-D, glyphosate, penoxsulam, imazamox, diquat, fluridone, imazapyr, carfentrazone-ethyl, endothall, flumioxazin, and florpyrauxifen-benzyl (see Exhibit 2-5). Six of these herbicides have been previously approved for use in the WHCP, SCP and/or EDCP. The AIPCP is proposing five additional herbicides to ensure that adequate effective options are available for the AIPCP's adaptive management strategy. All eleven herbicides are included in the program description and biological impact assessment.

When selecting AIPCP herbicides, DBW considered efficacy, legal and regulatory compliance, and ecosystem impacts. In including new herbicides to a more flexible and strategic program, DBW may minimize the amount of herbicide applied to Delta waterways, reduce adverse health effects, increase efficacy, or reduce environmental impact.

For liquid herbicide formulations applied to FAV, crews will conduct treatments with hand-held or fixed sprayers applied from aluminum airboats or aluminum outboard motor boats. The work boats will be equipped with direct metering of herbicides, adjuvants, and water pump systems. Prior to spray treatments, crews measure the wind speed and direction to ensure that treatment is allowed. The crews will spray the herbicide mixture directly onto the plants utilizing pump-driven hand-held or fixed spray nozzles. Treatment crews will determine the appropriate spray nozzle size to ensure that herbicide is deposited on small and/or vertically oriented plant leaves. Nozzle size is chosen to minimize the exposure of any non-target species to herbicide spraying. The pump will mix calibrated amounts of herbicide, adjuvant, and water.

For SAV, herbicide applications will typically be conducted once or twice per week over a two to sixteen-week treatment period. Some herbicides may require shorter exposure periods. Treatment crews use injection hoses to apply aqueous herbicide into treatment areas, and a broadcast method to apply pellets. Both methods are applied from airboats or outboard motor work boats. Prior to the start of the treatment season, AIPCP will design a treatment protocol for each selected site that is intended to maintain a pre-determined concentration of herbicide in the water column during the treatment period. The treatment protocol takes into account tidal movement, water depth, and herbicide concentrations.

The AIPCP will apply herbicides or adjuvants/surfactants no higher than label-specified rates. Treatment crews will follow specific label requirements related to wind, dissolved oxygen, drinking water intakes, agricultural intakes, and total acres treated. Treatment crews will use USFWS and DWR fish presence maps and weekly survey data to ensure that migratory fish are not impacted by the AIPCP.

Photo: Spongeplant (DBW).

Photo: DBW staff preparing for herbicide treatment (DBW).

The amount type and amount of herbicide used and number of acres treated in a given year will be determined based upon the target plant distributions and the magnitude of infestation. However, the AIPCP will also determine the appropriate herbicide(s) in accordance with regulatory limits, local water conditions and levels, weather, staff levels, and other factors.

Most weed species benefit from herbicide treatment when the target plant is in the early growth phases, between 5 percent and 25 percent of maximum size (Spencer and Ksander 2005). For target plant species in the Delta, this generally means that the ideal treatment time is early in the calendar year. Treating individual patches during the early growth phase will not only increase herbicide efficacy and reduce the total amount of herbicide required, but will also reduce the potential for spread of invasive plants. In addition, early treatments will reduce program resource needs and costs. The AIPCP proposes an approach that considers several specific treatment triggers and environmental conditions (such as the presence of listed species), rather than relying on calendar dates alone. In this way, the AIPCP will seek to optimize the balance between improved herbicide efficacy and minimizing ecosystem risks.

The AIPCP will treat sites with target plant infestations, within time and resource constraints. Within a given treatment location, AIPCP will treat according to current herbicide label requirements to limit potential for decaying plants to result in low dissolved oxygen levels. **Exhibit 2-11** summarizes current requirements related to dissolved oxygen and frequency of repeat treatments, as well as summarizing the situations in which each herbicide will generally be utilized. Dissolved oxygen requirements on herbicide labels apply to slow moving waters. Within the AIPCP, this applies to dead-end channels (treatment zones Z-6, Z-7, and Z-10). The remainder of the AIPCP action area is estuarine, tidal, or riverine, with regular water exchange. In addition, DBW may treat dead-end locations when DO levels are below 3 ppm (levels at which fish are not present), and above the Basin Plan limits. When DO is in the mid-range (between 3 ppm and Basin Plan limits) treatments may be limited. **Exhibit 2-12** summarizes regulatory status and toxicity characteristics of each herbicide.

Exhibit 2-11
Summary Comparison of AIPCP Treatment Herbicides

Page 1 of 3

Herbicide	Application Rates (FAV) or Concentrations (SAV)	Duration & Frequency of Treatment	NPDES Limit	Dissolved Oxygen (DO) Restrictions[a]	Description / Likelihood of Use
Diquat	FAV: 128 oz/acre SAV: 370 ppb	14-21 days between applications	20 ppb	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location); treat 1/3-1/2 water body at a time	• Fast-acting contact herbicide but short-term efficacy • Binds quickly to sediment • For use in unforeseen infestations conditions only
2,4-D	FAV: 128 oz/acre	21 days between applications; maximum of 2 applications per season	70 ppb	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location); for dense infestations, may be appropriate to treat in strips	• Relatively fast-acting systemic herbicide • Several crop restrictions; may require drift protection
Fluridone	SAV: 10 ppb	Requires 12 week applications	560 ppb	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location)	• Slow-acting systemic herbicide • Primarily used as pellet formulation • Low concentrations for ~12 weeks • Weekly monitoring with FasTEST
Glyphosate	FAV: 120 oz/acre	24 hours between applications	700 ppb	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location); if the entire water surface area must be treated, treat in strips	• Slow-acting systemic herbicide • EPA Reduced Risk Herbicide • Less effective on FAV than 2,4-D • Currently the primary treatment method for FAV • Requires higher concentration than new herbicides
Imazamox	FAV: 64 oz/acre SAV: 125 ppb	10-14 days between applications; may be effective in as little as 2-4 weeks	Monitoring is required	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location); no label restrictions	• Relatively fast-acting systemic herbicide • EPA Reduced Risk Herbicide • Effective on water hyacinth

Exhibit 2-11
Summary Comparison of AIPCP Treatment Herbicides *(continued)* *Page 2 of 3*

Herbicide	Application Rates (FAV) or Concentrations (SAV)	Duration & Frequency of Treatment	NPDES Limit	Dissolved Oxygen (DO) Restrictions[a]	Description/ Likelihood of Use
Penoxsulam	FAV: 5.6 oz/acre SAV: 25 ppb	10-14 days between applications for 8-12 weeks	Monitoring is required	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location). For dense infestations, may be appropriate to treat in sections	• Slow-acting systemic herbicide • EPA Reduced Risk Herbicide • For irrigation, <1 ppb
Imazapyr	FAV: 16 oz/acre	4 days between applications; maximum 3 applications per season	Monitoring trigger 11.2 ppm	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location). Treat 1/2 water body at a time	• Slow-acting systemic herbicide • EPA Reduced Risk Herbicide • Effective on emergent part of plant • For irrigation, <1 ppb or 120 days • Initial AIPCP use limited to DIZ
Florpyrauxifen-benzyl	*Confidential; pending label registration:* FAV: 15.3 oz/acre SAV: 50 ppb	TBD	TBD	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location). TBD	• Moderately fast-acting systemic herbicide • Approved by with USEPA in September 2017; pending CA DPR review • USEPA Reduced Risk Herbicide • Irrigation restrictions on label could be limiting • Initial AIPCP use limited to DIZ
Carfentrazone	FAV: 13.5 oz/acre SAV: 200 ppb	14 days between applications	None specified	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location). Treat 1/2 water body at a time for dense infestations	• Fast-acting contact herbicide • USEPA Reduced Risk Herbicide; not yet approved by CDPR • Used only as tank mix partner • Initial AIPCP use limited to DIZ
Flumioxazin	FAV: 12 oz/acre SAV: 500 ppb	28 days between applications; 4 hour contact time	None specified	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location). Treat in sections for dense infestations	• Fast-acting contact herbicide • Slightly to moderately toxic to fish/inverts, though not at application concentrations • Used only as tank mix partner • Initial AIPCP use limited to DIZ

Exhibit 2-11
Summary Comparison of AIPCP Treatment Herbicides *(continued)* *Page 3 of 3*

Herbicide	Application Rates (FAV) or Concentrations (SAV)	Duration & Frequency of Treatment	NPDES Limit	Dissolved Oxygen (DO) Restrictions[a]	Description / Likelihood of Use
Endothall (Aquathol K)	SAV: 5 ppm	7 days between 5 ppm applications; up to 72 hour contact time	100 ppb	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location). Treat in sections for dense infestations	• Fast-acting contact herbicide • USEPA Reduced Risk Herbicide • Effective on curlyleaf pondweed and as tank mix for SAV • Requires only 1-2 treatments • Used primarily as tank mix partner • Initial AIPCP use limited to DIZ
Tank Mixes	Initially, same as individual herbicide rates/ concentrations	Variable	AIPCP will adhere to NPDES limits for each component	No treatment if DO >3 ppm and <Basin Plan limit (5-8 ppm by location). AIPCP will adhere to label requirements for each component	• Contact plus systemic herbicide • Multiple modes of action may increase efficacy, speed of response, and duration of control; may reduce overall herbicide use • Initial AIPCP use limited to DIZ

[a] In all cases, the AIPCP will not conduct herbicide treatments when dissolved oxygen levels are between 3 ppm and the Basin Plan limit (5 ppm to 8 ppm, depending on location). The additional restrictions in the Exhibit apply specifically to treatments taking place in dead-end channels within treatment zones Z-6, Z-7, and Z-10.

Exhibit 2-12
Summary AIPCP Treatment Herbicides' Regulatory Status and Toxicity

Treatment Options	CDPR Status	USEPA Fish Toxicity Classification*	USEPA Macroinvertebrate Toxicity Classification*	EPA Reduced Risk Herbicide
Existing DBW Herbicides				
2,4-D	Approved	Practically non-toxic	Moderately toxic to practically non-toxic	No
Glyphosate	Approved	Slightly toxic to practically non-toxic	Slightly toxic to practically non-toxic	Yes
Penoxsulam	Approved	Practically non-toxic	Slightly toxic	Yes
Imazamox	Approved	Practically non-toxic	Practically non-toxic	Yes
Diquat	Approved	Slightly toxic	Very highly toxic to highly toxic	No
Fluridone	Approved	Slightly toxic	Moderately toxic to slightly toxic	No
Proposed Additional Herbicides				
Imazapyr	Approved	Practically non-toxic	Practically non-toxic	No
Carfentrazone-ethyl	Approved for terrestrial use; aquatic label may be resubmitted for CDPR review	Moderately toxic	Moderately toxic	Yes
Endothall (dipotassium salt)	Approved	Slightly toxic to practically non-toxic	Slightly toxic to practically non-toxic	No
Flumioxazin	Conditionally approved	Moderately toxic to slightly toxic	Slightly toxic	No
Florpyrauxifen-benzyl	Not yet approved	TBD	TBD	TBD
Tank Mixes	Variable	Variable	Variable	Variable

** USEPA Ecotoxicity Categories for Aquatic Organisms based on Acute Lethal Concentration (LC_{50} or EC_{50}):*
<0.1 mg/L = very highly toxic; 0.1-1 mg/L = highly toxic; >1-10 mg/L = moderately toxic; >10-100 mg/L =slightly toxic;
>100 mg/L = practically nontoxic (USEPA 2016a)

Treatment sites throughout the northern and southern Delta range from 0.4 acres to 1,722.4 acres in size, with an average of 166.6 acres per site. In the event that there are multiple plant infestations or mats spread out within a site, the AIPCP will treat all infestations in the site as time and resources allow. Repeat treatments may utilize different control options, depending on site conditions.

On any given treatment day, treatment acres per day are limited by: (1) the number of crews available; (2) travel time to reach the site; (3) time required to set-up, conduct monitoring, and treat a site; (4) the plant growth at a particular site; (5) applicable herbicide label restrictions; (6) fish presence protocols; and (7) weather and tide conditions. Choice of herbicide is based on numerous factors, including label restrictions, efficacy, irrigation restrictions, water quality, dissolved oxygen, and resource limitations.

The AIPCP will follow these guidelines when determining whether a given FAV infestation requires follow-up treatments:

a. DBW will conduct one treatment if the initial herbicide treatment was effective in killing the plant at that site, after the herbicide has had time to take effect.

b. DBW will treat previously treated plants additional times in a given site if prior treatment(s) was not effective in killing the plants. In this case, DBW will comply with applicable label requirements about the amount of time required between applications.

c. DBW will conduct follow-up treatments in dead-end channels when buffer strips or portions of the mat were left untreated during the first herbicide application. DBW will return to treat the remainder of the site after the specified time between treatments, per herbicide label requirements. In this case, DBW is treating new plants within a given infestation, not the previously treated plants.

e. The actual number of locations and numbered treatment sites that will be treated more than once or migrated into the previously treated site depends on factors such as herbicide efficacy, plant growth and tidal movement that cannot be easily predicted. The AIPCP will seek to minimize the number of times that a given infestation is treated, and will follow herbicide labels regarding total number of applications allowed in a given location.

Physical and Mechanical Treatments

The AIPCP will utilize 10 physical and mechanical removal approaches, as illustrated in Exhibit 2-5. These are important tools that can supplement the herbicide treatments, particularly at times of year or in locations when herbicide use is not possible. These control methods will not impede the free flow of water in the floodway, jeopardize public safety, or adversely impact floodplain values and functions.

Mechanical removal can be costly. It will be used to supplement herbicide treatment and, in addition, when immediate removal of weeds is required. Mechanical removal will primarily be utilized to remove dense mats of weeds in locations where herbicide treatment must be avoided, such as sites with many valley elderberry shrubs along the shoreline. DBW environmental scientists will consult the IEP database, historical maps, and survey mechanical removal sites immediately prior to weed removal to ensure that no listed species are present. If listed species are thought to be present, mechanical removal operations at that site will be postponed.

The AIPCP will implement an operation protocol similar to the protocol for herbicide treatment prior to conducting mechanical removal. AIPCP environmental scientists will check IEP monitoring data to help ensure that listed species are not present at the removal site. In addition, the equipment operator will utilize the same Environmental Checklist to evaluate presence of listed species or sensitive habitats. If listed species or sensitive habitats are present, the operator will not conduct mechanical removal at that site.

➢ *Benthic Mats*

The AIPCP will incorporate benthic barriers in isolated instances for SAV control. This method, which is well-established, has been proposed but not yet used in the Delta for EDCP operations.

Benthic barriers consist of a physical cover over aquatic weeds, preventing sunlight from reaching the plants. Without the ability to photosynthesize, plants typically die back within approximately four to eight weeks (New York DEC 2005, Madsen 2000). The AIPCP will utilize benthic barriers to control SAV in selected locations where they are likely to be most effective, including relatively small areas (2 acres or less), and high-intensity use areas such as docks, boat launch areas, and swimming areas. Benthic barriers can be an important tool in removing new infestations in these areas (Madsen 2000), and may be especially effective in high-water flow areas of the Delta where herbicide treatments will not be effective.

Benthic barriers are non-selective, killing all plants underneath the barrier. Depending on the material, benthic barriers may also kill macroinvertebrates that are under the mat, although any potential AIPCP impact will be limited by the small scale in which it will be feasible to use benthic barriers in the Delta. Benthic barriers can be made from a variety of different materials, including textiles (burlap, jute), plastic, woven synthetics, or screens (Washington DOE 2012). According to Washington DOE, an ideal benthic barrier should be durable, heavier than water, reduce or block light, prevent plants from growing into and under the fabric, be easy to install and maintain, and should readily allow gases produced by rotting weeds to escape without buoying the fabric upwards. To avoid potential issues with gas production under the mats, Gunnison and Barko (1992) recommend deploying barriers early in the year when the standing crop is low, and under cooler temperature conditions when microbial decomposition rates are low. Secure anchoring is also required to keep the mat in place in the event that gaseous buildup occurs (Aquatic Plant Management c1994-2016).

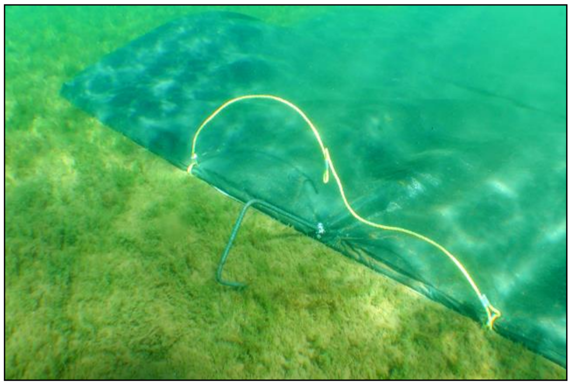


Photo: Benthic barrier fastened with rebar, Emerald Bay, courtesy of TRCD.

Photo: Benthic barrier installation, Emerald Bay, courtesy of TRCD.

The experience gained by the Tahoe Resource Conservation District (TRCD) can inform AIPCP's use of benthic barriers, although sediment and water movement characteristics are different in the Delta. The TRCD found benthic barriers to be very effective in controlling Eurasian watermilfoil in areas where there are isolated infestations such as Emerald Bay, Lakeside Beach and Marina, and near Ski Run Marina (Jim Brockett October 2012; Cartwright personal communication April 2017). AIPCP will utilize a similar method and approach to TRCD, adjusting for Delta characteristics as necessary.

Benthic barriers require USACE and CDFW permits and additional permitting from the CVRWQCB. The AIPCP will obtain all necessary additional permits prior to implementing this method.

- *Hand/Net Removal*

The AIPCP will incorporate physical removal of target plans by hand or with pool-skimmer type nets. This will occur throughout the year at times or locations where herbicide treatments are not possible. As treatment crews survey for target plants, they will conduct hand removal in selected areas, such as those with dense infestations or in nurseries.

- *Diver Hand Removal / Diver Hand Pulling*

This method involves a contracted SCUBA diver using a small rake or hand-tool when needed to pick target SAV species, such as *Egeria densa*. Divers will ensure that they remove the entire plant and place all plant fragments in net bags. Because SAV such as *Egeria densa* reproduce vegetatively, plant fragments can be a source of new infestations if not removed from the water. Collected plants will be disposed of in approved locations away from the water's edge and sensitive habitats, typically on nearby farm fields.

Key issues related to handpicking include removal of the entire root crown and fragments (Greenfield et al. 2004), disposal of plants away from the shore (New York State DEC 2005), and the need for certified SCUBA divers. For AIPCP, handpicking is likely to be most effective when used to remove small, localized infestations, and/or in conjunction with benthic barriers, described above.

- *Diver Assisted Suction Removal*

This method is essentially equivalent to vacuuming the plants, which are then removed to a basket on a boat, barge, or nearby dock. SCUBA divers hold a hose, typically 3 to 5 inches in diameter, that is attached to a high pressure water pump located on the boat, barge, or dock. The hose extends about 50 feet from the pump (USACE 2005). The pump creates a venturi effect, creating suction to pull the plant through the hose and into the collection basket. Water and any sediment is drained back into the waterbody, and the plant mass is disposed of at an approved site away from the shore. Divers may use small rakes or tools to ensure that the plant is removed at the root, and then guide the plant into the hose. This method can be highly selective, as trained divers can literally pick and choose which plants to remove.

Diver assisted suction removal was first developed by the British Columbia Ministry of the Environment in the 1970s, and has been used in states such as Washington, Idaho, and New York, primarily for removal of Eurasian watermilfoil (Washington DOE 2012, New York State DEC 2005). The Tahoe Resource Conservation District (TRCD) is currently utilizing this method at several locations in Lake Tahoe (Brockett October 2012), primarily in conjunction with benthic barriers. These methods may be more challenging in the Delta due to high turbidity restricting divers' visibility.

Similar to handpicking, it will be important to ensure that the complete root crown and all plant fragments are collected in order to prevent reinfestation. This method can cause a temporary disruption in sediment, with the extent of disruption dependent on the substrate and depth of plant roots. If sediment disruption significantly increases turbidity, AIPCP could utilize silt curtains to localize the temporary increase in turbidity. Suction harvesting is most effective in fast-moving water, small high-use areas, isolated and early infestations, and as a follow-up to herbicide treatment in small areas (Madsen 2000, Greenfield et al. 2004).

The method can be expensive, and is limited by underwater visibility and diver safety concerns (USACE 2012). Diver assisted suction removal requires a United States Army Corps of Engineers (USACE) permit and additional permitting from the CVRWQB.

- *Booms and floating barriers*

The AIPCP will incorporate floating barriers, such as booms, flexible barges, or floating balloons, in limited instances. This method will be new to AIPCP operations, and may be used to help contain a variety of target SAV and FAV.

Booms and floating barriers are physical structures that are placed on the water's surface to restrict movement of target plants. The barriers themselves do not cause plant death. Rather, their purpose is to prevent the spread of SAV and FAV plants or fragments. Such barriers are non-selective, may be deployed for variable periods of time, and are reusable.

Such barriers may be used with herbicides or other physical/mechanical treatment methods to capture plant fragments that may be dispersed and prevent regrowth (Haller 2014). Barriers may also be used independent of other treatment methods to contain the living plants within a particular location, such as to prevent them from impeding navigation.

The AIPCP will utilize floating barriers in selected locations where they are likely to be most effective, including high-use areas such as marinas and adjacent to shipping channels, and to prevent plants from clogging water intakes. They may be particularly important for containing infestations in areas where herbicides or mechanical removal may not be feasible, though as mentioned above they may also be used in conjunction with other removal techniques to enhance overall efficacy. Depending upon the target plants, AIPCP may use curtains or screens in conjunction with floating barriers to enhance efficacy in the water column beneath the surface.

Temporary placement of booms or curtains may limit passage of recreational and commercial vessels. DBW will work closely with the United States Army Corps of Engineers USACE) and United States Coast Guard (USCG) prior to placement of booms and curtains. DBW will obtain an USACE Regional General Permit (RGP) for applicable physical control methods, notify USCG, and utilize required lighting/signage. DBW will not place booms or curtains in locations that will block critical navigation pathways.

- *Curtains and screens*

The AIPCP will incorporate curtains and screens along with floating barriers. Although this method will be new to AIPCP operations as a specific control method, the EDCP included the use of silt curtains as needed to localize excessive turbidity created by diver assisted suction removal. In the AIPCP, curtains and screens may be used to help contain a variety of target SAV. When used with floating barriers, curtains may also improve containment of FAV.

Curtains and screens are made of flexible polyester and vinyl fabrics or a screen material that is anchored in the water column and vertically suspended (Francingues and Palermo 2005). These materials contain target plants or fragments in a defined area and reduce turbidity created by other control methods. Such barriers are non-selective, may be deployed for variable periods of time, and are reusable. DBW anticipates using curtains and screens that extend up to one meter in the water below the surface.

The curtains and screens do not cause plant death, but instead help prevent the spread of SAV and FAV plants or fragments – particularly when used in conjunction with mechanical harvesters, shredders, or cutters that disperse fragments. Curtains and screens may also be used independent of other treatment methods to contain the living plants within a particular location; for example, this may be done to prevent SAV from impeding navigation in the Delta's deep channels.

DBW will deploy curtains and screens at sites where they are most likely to be effective, which may include:

- To contain infestations in areas where herbicides or mechanical removals may not be feasible;
- In conjunction with booms and floating barriers to contain SAV or FAV fragments created by mechanical cutters or shredders; and
- Possibly to slow herbicide dilution in a desired treatment area to extend the herbicide contact time and improve efficacy of treatment on the target plants.

DBW will secure any required permits from federal, state and local agencies. DBW will conduct frequent inspection and monitoring to remove the captured biomass and other debris, and ensure the materials are in functional condition. Curtains and screens will not be used in areas where they may impede navigation.

➢ *Surface Excavators*

One mechanical removal approach will be to park an excavator and dump truck on a concrete boat ramp or levee and mechanically lift target FAV from the waterway surrounding the ramp, as shown in the photos below. Excavators are used to collect floating vegetation, and they generally do not extend deeper than one meter below the surface. Crews will support the excavation by herding plants that are outside of the excavator's reach closer to the equipment. This mechanical removal approach will be used only in limited locations when plant growth is concentrated near a boat ramp. There may be relatively few locations within the Delta that are appropriate for excavation. CDFA has successfully utilized this approach to clear irrigation canals of spongeplant over the last several years.


Photos: Surface excavator removal (DBW).

➢ *Harvesters*

AIPCP will utilize mechanical equipment, known as harvesters, that are designed specifically to safely remove aquatic weeds from waterways. This mechanical equipment utilizes cutters and conveyors to physically remove the plant from the water, and onto the bed of the equipment. The equipment will collect and unload vegetation using a conveyor system on a boom, adjusted to the appropriate cutting height for the target plant. Cutter bars will collect material and bring it aboard the vessel using the conveyor. When the vessel has reached capacity (between 2,000 and 15,000 pounds of plant material), the cut plant material will be offloaded to a dump truck parked at a nearby boat ramp to offload the collected material. The removed biomass will be spoiled at an authorized location away from the water, typically on nearby farm fields. Spoil sites will be selected to meet the following criteria:

1. On the property of a willing landowner (private, state, federal, county, or other local government)
2. On or beyond the levee toe
3. At least 50 feet from giant garter snake habitat and valley elderberry shrubs and have low and/or no habitat value for giant garter snake
4. No burrowing owl habitat present
5. No special status plants present
6. Site surveyed and approved by a CDFW-approved Environmental Scientist

Photo: Mechanical cutter and conveyor equipment being used on water hyacinth (DBW).

➢ *Cutters and Shredders*

The AIPCP will utilize mechanical cutters and shredders. These are similar to the harvesters used in the WHCP and SCP, except that they lack a conveyor system to collect the removed plant material. Shredding machines are often able to mince or grind FAV into small, non-viable fragments or pulps, thereby rendering unnecessary the use of a conveyor or other biomass removal method.

Shredders consist of small barges with large blades designed to cut the FAV plant material into smaller fragments. They are non-selective of the plants, animals and fish with which they come into contact. AIPCP will not use shredders in locations with sensitive species.

Shredders are most effective during the flowering stage of plants before seed development to limit reproduction by seed (Madsen 2000). They may be counterproductive for some species, such as Eurasian watermilfoil, while the plants are still spreading because fragmentation may increase spread (USGS 2016). This can be prevented by using shredders prior to seed development, by ensuring that the shredders produce small enough fragments that are non-viable, or if curtains or booms are used to collect the fragments for subsequent removal.

Shredders will be used to supplement other AIPCP control options when immediate treatment is needed. The AIPCP will primarily deploy shredders to remove dense FAV infestations when herbicide treatments must be avoided, such as at sites with many valley elderberry shrubs along the shoreline. AIPCP environmental scientists will consult the IEP database, historical maps, and survey mechanical removal sites immediately prior to weed removal to ensure that no listed species are present. If listed species are present, mechanical removal operations at that site will be postponed.

In the event that shredders are determined to produce viable plant fragments after their use, the AIPCP will use curtains and/or booms to contain the biomass and reduce the risk of reinfestation.

- *Herding*

Herding refers to the moving of plant mats by pushing or pulling mats either to removal locations or to the main channel. Once in a main channel, the plants will flow out of the Delta and into saline waters, where they are likely to die.

For herding plants out of the Delta, field supervisors will consider tides, storm events, and dam releases to select appropriate days and times for herding to take place. Crews will not herd in areas where physical damage to emergent, native vegetation is likely to occur such as among stands of cattails (*Typha* spp.), *Phragmites* spp., bulrushes *(Scirpus spp.)*, or native cordgrass (*Spartina foliosa*). In addition, AIPCP will limit the total amount of plant herded in one area to avoid impeding navigation. Depending on the extent of the target plant invasion, timing, and logistical limitations of herding activities, AIPCP is not likely to use this method often.

The AIPCP will also utilize herding in conjunction with mechanical removal should it be warranted, based on the extent of infestation. Crews will push mats or sections of mats toward an excavator located on a boat ramp or levee. This will maximize the amount of plant material that can be removed by the stationary excavator.

Biological Control Methods

The AIPCP will utilize two biological controls. These are important tools that can supplement the herbicide treatments, particularly at times of year or in locations when herbicide use is not possible due to permit restrictions or logistics. At this time, the AIPCP will not utilize biological controls for other aquatic invasive plants as they are not available. USDA-ARS will manage the use of AIPCP biological control methods.

Weed biological control involves the use of non-native insects or mites to suppress non-native, invasive weeds in their exotic range. The biological control agents are imported from the native range and are demonstrated to be safe prior to release, are able to sustain independent populations in the field, and are expected to reduce the size, growth, reproduction, and spread of the 'target' weed in ways that would not occur in the absence of biological control (Huffacker and Dahlsten 1999). The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS) is responsible for controlling introductions of species brought into the United States for biological control of weeds, in accordance with the Federal Endangered Species Act (ESA), and the National Environmental Policy Act (NEPA). See the AIPCP Programmatic Biological Assessment for a more detailed description of biological controls (DBW and USDA-ARS 2017). Biological controls will only be utilized for water hyacinth.

One new (to the Delta) biological control agent of water hyacinth, the planthopper *Megamelus scutellaris*, will be released and established in the Delta. One old agent, the weevil *Neochetina eichhorniae*, will be released as a 'new' agent and re-established. The one existing agent, *Neochetina bruchi*, may be augmented at specific sites, especially early in the field season when its impact is likely to be highest, based on experience from other regions.

In terms of locations of control, biological control must be considered in a separate framework from herbicide and mechanical control methods. Biological control agents are self-perpetuating and can disperse on their own. Both the weevil and the planthopper can disperse at least 50 meters per year, and likely much more, by hopping or flying. Passive dispersal on floating mats of plants is also likely to occur. In the case of the original USACE releases of *Neochetina* spp. in the early 1980s, follow-up surveys were not done until the early 2000s and found *N. bruchi* to be widely distributed (Akers et al. in review). *N. bruchi* is now confirmed as being ubiquitous in the Delta and well beyond (Hopper et al. 2017). Conceptually, a new biocontrol release at one site must be considered a release throughout the legal Delta. The division of the Delta into areas where biological control is spatially or temporally excluded is thus not feasible.

Biological control agents will be released as adults, either free of plant material (to determine exact counts of adults) or while feeding on colony-reared water hyacinth plants (typically the more convenient method; this approach maximizes adult survival in transit). In the latter case, these colony plants will be stranded on top of the resident plants, to kill them; the biocontrol agents will then disperse onto the resident plants.

Some releases will be made to complement the other control methods. For example, the weevils and planthopper could be released in areas with a high density of valley elderberry shrubs, or within the 0.5 km buffer from an agricultural water intake where herbicides cannot be applied. To effectively monitor establishment and impact, however, initial releases will focus most importantly on a limited number of backwater coves/flooded islands where herbicide and mechanical control are impossible due to logistical factors. Releases will be made throughout the treatment control season (specifically 1 March to 30 November). Most releases will occur between April and October, when warm temperatures and long daylengths will provide conditions most favorable for rapid mating, egg-laying and immature feeding and development. Once establishment is confirmed at the initial ‘nursery’ sites, plants will be re-distributed throughout the Delta, focusing on the specific locations where herbicide and mechanical control are excluded, as noted above.

USDA-ARS will collaborate with DBW to select specific biocontrol release locations based on presence of water hyacinth at the time of release, and to avoid sites that are scheduled for immediate herbicide treatment. Areas with specific sites suitable for biocontrol releases include sites in backwaters with little or no water movement during the release season (April-October). These sites are less likely to be treated by DBW, and are likely to maintain their water hyacinth population due to limited water movement. The 24 areas with specific sites suitable for biocontrol releases are listed below, and illustrated in **Exhibit 2-13.** For purposes of determining acres, the initial 24 release sites will encompass a maximum of 1 acre each, 24 acres in total. Dispersing up to 100 meters per year, by 2023 the circular concentric biocontrol area would be 48 acres per release site, or 1,164 acres maximum. However, actual biocontrol acreage would be expected to be no more than 50 percent of the value calculated above (582 acres), due to the discontinuous and non-circular nature of WH populations. These calculations do not consider passive movement of biocontrol agents on floating plants.

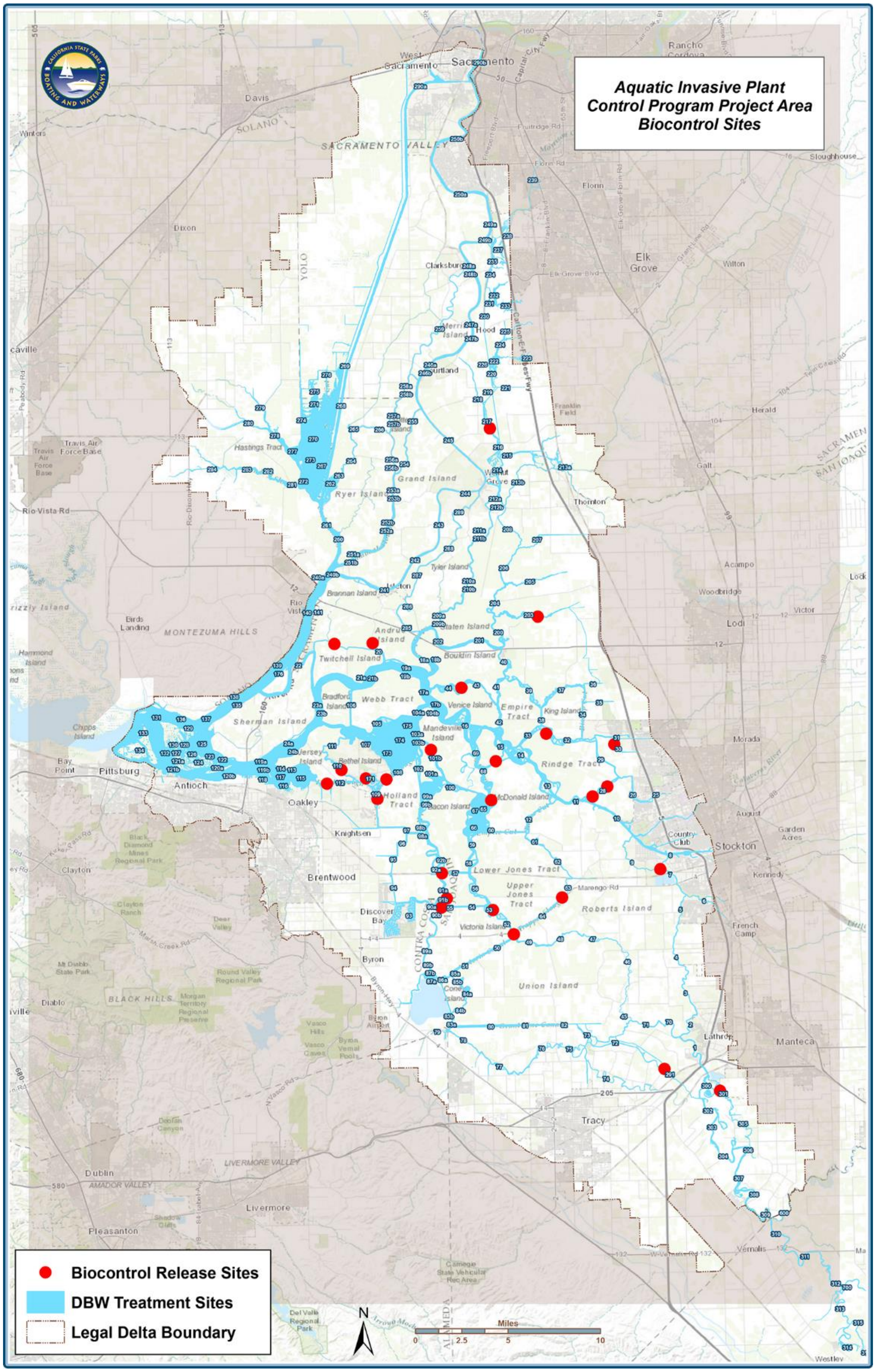
- **Central Delta:** Little Mandeville Island, Rhode Island, Fay Island, backwaters near Mildred Island, and Columbia Cut
- **Eastern Delta:** Disappointment Slough, Fourteenmile Slough (2 sites-northern and southern), Mosher Slough, and San Joaquin River near Stockton
- **Northern Delta:** Jackson Slough, Potato Slough, Sycamore Slough, and Snodgrass Slough
- **Western Delta:** Delta Coves, Sandmound Slough, Bethel Island, Sevenmile Slough, and Dutch Slough
- **Southern Delta:** Trapper Slough, Middle River, Old River (in the Woodward Island area), Walthall Slough, and Paradise Cut in the Four Corners area.

To release the water hyacinth planthopper, infested plants from tank-based colonies will be collected and the roots will be removed. A subset of the plants will be dissected in the lab to count planthopper adults and nymphs and estimate total planthopper density per plant. This information will be used to determine the number of plants needed to release approximately 1,000 adults and 5,000 nymphs per site.

To release the water hyacinth weevil, *Neochetina eichhorniae*, adults will be collected from mass rearing facilities at the USDA’s Exotic and Invasive Weeds Research Unit. The sex ratio of adults will be noted. Between 100 and 500 adults will be inoculated at each release site during summer months, depending on availability.

At each release site, four plots, each one square meter, will be delineated with a removable PVC square quadrats. The plots within each site will be 10 meters apart. Each plot will thus receive approximately 250 adults and 1,250 planthopper nymphs. Releases will be made by placing infested plants upside-down inside the plot to kill the infested plant and encourage the planthoppers or weevils to disperse to the plants in the plot. GPS coordinates will be used to locate plots in successive visits. Releases will likely be conducted over several weeks, with successive trips as planthoppers and weevils become available from colonies.

Exhibit 2-13
Potential Treatment Sites for AIPCP Biological Controls



After releases are complete, plots will be monitored monthly for the remainder of the growing season (through November of each year) and live adult and immature counts obtained. In the year following release, a transect that bisects the four release plots and extends 50 meters beyond the first and last plot will be delineated with GPS. The reason for the 50-meter extension is because the planthoppers can disperse at least 50 meters per year (Moran et al. 2016). This transect will be sampled at 15 meter intervals every one-to-two months depending on personnel, and live insect densities assessed. One plant will be collected from each sampling point, taken to the lab and dissected to assess plant size, live leaf counts, and live and dead above-water biomass. Transect sampling will continue to the end of the field season, or until the biological control agents are become abundant (more than 10 per plant) at a minimum of one end of the transect (whichever comes first).

Sampling of the initial release sites will continue in subsequent years. Four plots, each one square meter, will be sampled as described above to verify continued biological control agent presence and to monitor the impact on water hyacinth. Additional sampling will be conducted at between five and ten points with water hyacinth patches up to 1 km from each of the original 24 release sites, to document insect population expansion. That additional sampling will favor water hyacinth infestations that are not able to be treated with herbicides.

6. Selection of Treatment Methods

The AIPCP will follow a defined process to determine which treatment method(s) to implement in each site or treatment zone during the course of each treatment season, and this prioritization process will form the basis of the annual AIPCP treatment plan. **Exhibit 2-14** illustrates the decision process for FAV treatments, and **Exhibit 2-15** illustrates the decision process for SAV treatments.

Description of FAV Treatment Method Decision Process

Once the decision has been made to treat a particular priority level, the next step is to determine whether special status fish species are present at the site. Appendix 3-A provides a series of maps illustrating fish presence by month for wet and dry years. In addition, DBW will consult CDFW and USFWS fish survey data, as described previously. Sites where special status fish species are likely to be present will not be treated, with the exception of hand/net removal if necessary and possibly biocontrol releases for water hyacinth, or natural dispersal of the planthopper from other sites. For sites where fish species are not present, DBW will evaluate whether the site is appropriate for herbicide use. In general, most sites will be treated with herbicides. If herbicide use is not appropriate, DBW will consider several mechanical/physical removal methods, and select the one(s) most appropriate for the site. For sites where neither mechanical harvesting options or herbicides are initially appropriate, DBW will then consider the installation of booms or floating barriers. In some cases, once booms/barriers have been installed, DBW may be able to utilize herbicides.

Description of SAV Treatment Method Decision Process

Herbicides will be the primary SAV treatment method. In general, physical/mechanical treatment methods are less appropriate for SAV species. However, there are some situations where DBW may utilize physical/mechanical methods, or a combination of physical/mechanical methods and herbicides for treating SAVs. The planning for SAV treatment will occur earlier than for FAV species, as discussed above. Once a site has been selected for treatment, DBW will evaluate the most effective treatment approach. Physical treatment methods, such as benthic barriers and diver assisted suction removal may be used to control small infestations where herbicides cannot be used, such as immediately adjacent to water intakes. Floating barriers may be used to temporarily restrict tidal movement in some locations to allow for increased herbicide exposure. Finally, there may be limited situations where mechanical harvesting or cutters/shredders may be used to control SAV. In these situations, DBW may also temporarily deploy curtains to contain fragments.

Exhibit 2-14
FAV Treatment Method Decision Process

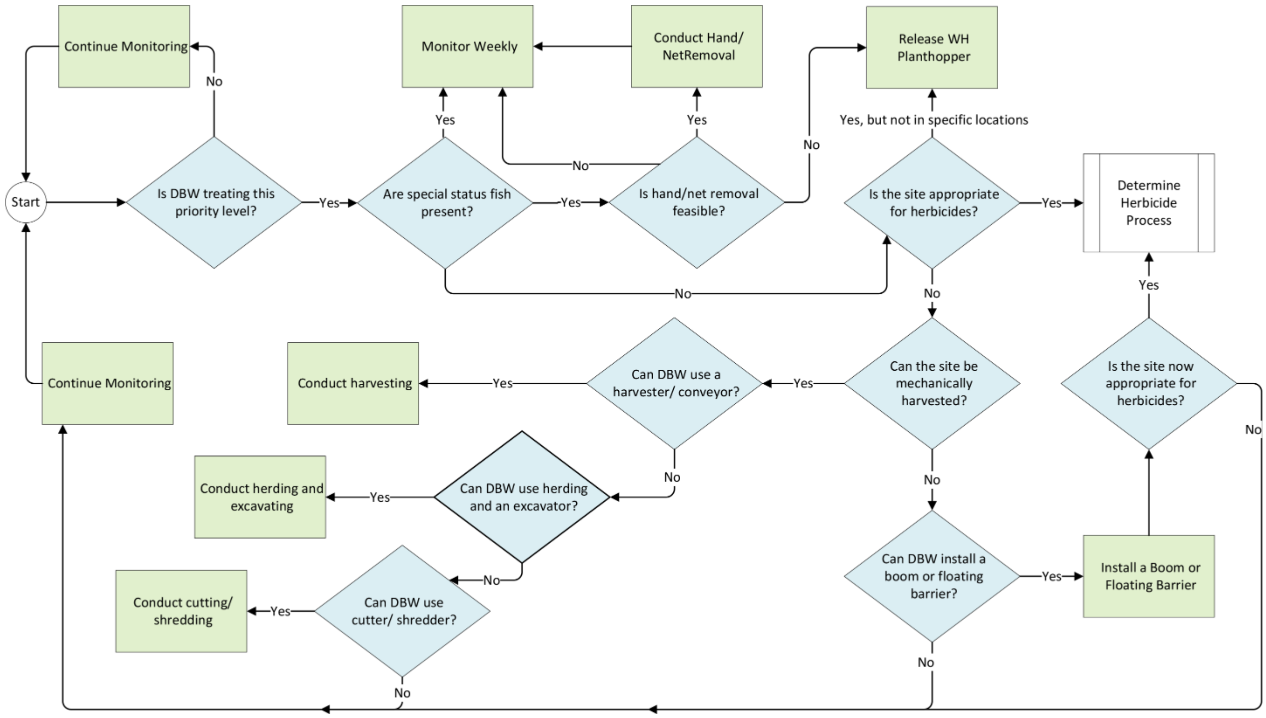
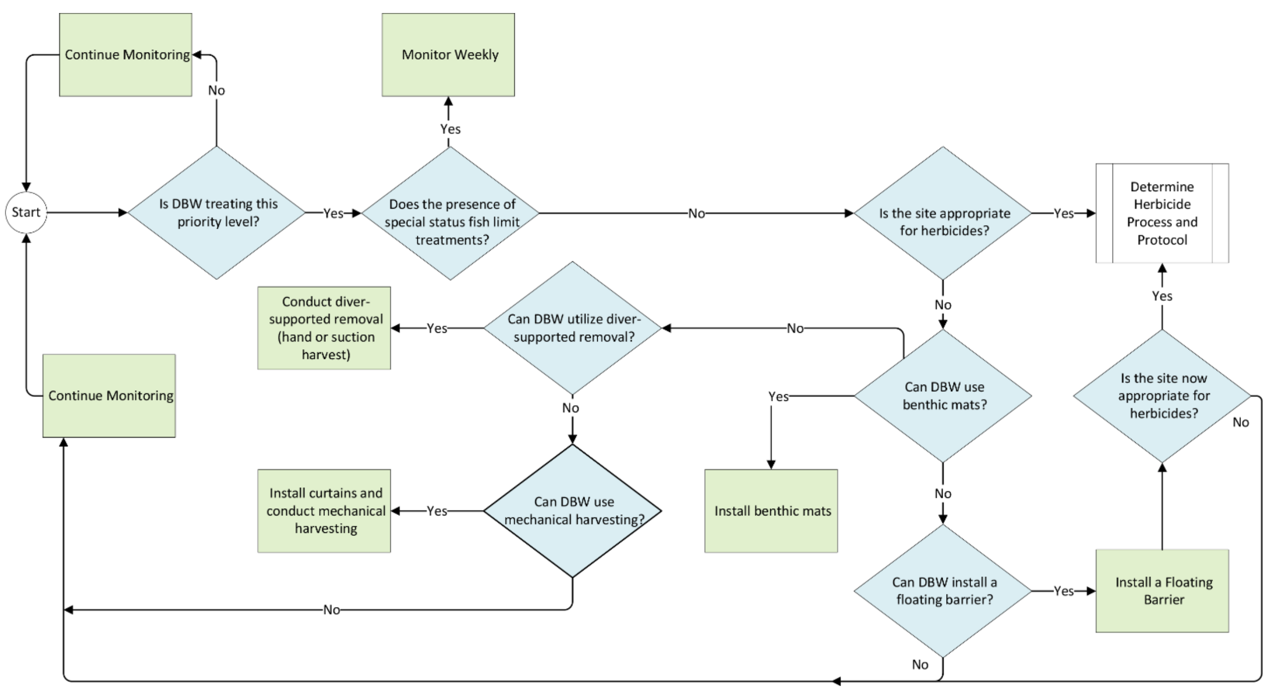


Exhibit 2-15
SAV Treatment Method Decision Process



7. AIPCP Environmental Monitoring

The AIPCP will conduct extensive monitoring for the program. The AIPCP is responsible for collecting water quality monitoring data, as well as collecting water samples for herbicide residue testing. AIPCP monitoring will include the four general areas described below. Overall AIPCP monitoring will be integrated, and inform and support regulatory compliance, program planning, and program performance. The AIPCP will coordinate monitoring efforts with the DRAAWP and Interagency Ecology Program (IEP) when appropriate.

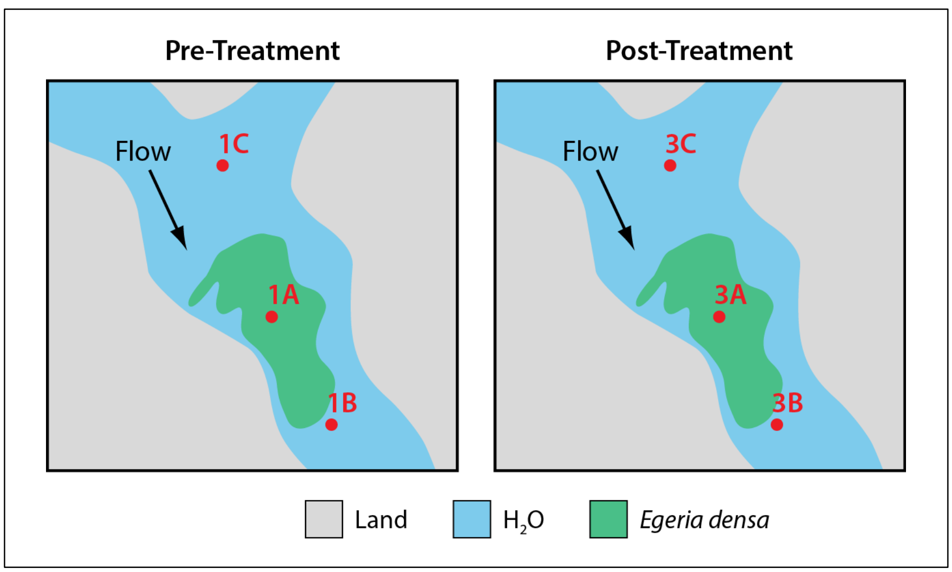
- NPDES and Immunoassay Monitoring
- SAV Hydroacoustic Monitoring
- FAV and SAV Point Intercept Assessment
- Program Performance Metrics.

NPDES and Immunoassay Monitoring

Based on NPDES permit requirements, AIPCP will follow a monitoring protocol. This protocol has historically fulfilled requirements of the Regional Water Quality Control Board, NMFS, and USFWS. At each monitoring site, DBW's environmental scientists will take the initial samples within 24 hours of the treatment start (upstream and adjacent to the treated mat). Post-application monitoring (downstream of the treatment area) will occur after the treatment period is over. For long-exposure treatments, such as the 12-week fluridone treatments, monitoring will continue until all sampling locations show non-detectable herbicide levels. At each sampling event, environmental scientists take samples from the following six locations, illustrated in **Exhibit 2-16:**

- 1A – Pre-treatment, in site
- 1B – Pre-treatment, downstream
- 1C – Pre-treatment, control
- 3A – Post-treatment, in site
- 3B – Post-treatment, downstream
- 3C – Post-treatment, control.

Exhibit 2-16
NPDES Monitoring Sites



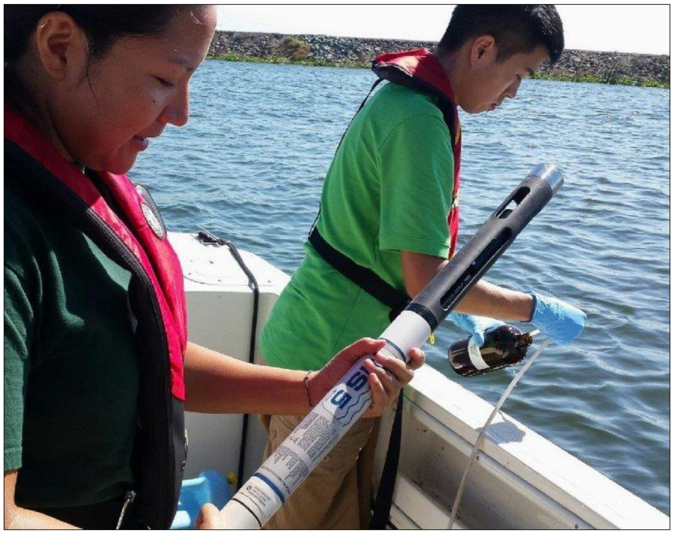


Photo: DBW staff conducting water sampling (DBW).

The AIPCP will select monitoring sites for all herbicides used, and different habitat types. At each monitoring site, DBW environmental scientists will monitor dissolved oxygen, turbidity, pH, and several other water quality measures. DBW environmental scientists will collect water in bottles and submit them to a Certified Analytical Laboratory to measure herbicide residue levels.

Coordination between treatment crews and monitoring crews will be structured. Treatment and monitoring plans will be established in advance. Pre-treatment monitoring will take place within 24 hours of the start of the treatment protocol. For FasTEST or other immunoassay monitoring, treatment crews will contact the monitoring crew when treatment is complete, so that the monitoring crew can obtain samples, as needed. Post-treatment monitoring will begin only after the treatment period within a given site is completed, thus there will be no overlap with treatment crews. Treatment and monitoring crews will be in separate vessels. Monitoring vessels will not carry herbicide to minimize any contamination that might occur.

DBW treatment crews also conduct monitoring, in addition to monitoring conducted by DBW environmental scientists. Treatment crews will monitor and report pre- and post-treatment dissolved oxygen, wind speed, temperature, acres treated, quantity of herbicide and adjuvant, presence of elderberry shrubs or other species of concern, and coordinates of treatment location. **Exhibit 2-17** lists monitoring requirements for DBW environmental scientists and DBW treatment crews.

In addition to the regular monitoring described above, for multi-week SAV herbicide treatments (for example fluridone treatments for *Egeria densa*), DBW will conduct additional herbicide monitoring at SAV treatment sites. Environmental scientists will obtain water samples at approximately 3 feet depth and submit these samples, overnight, to a laboratory. The laboratory will determine herbicide concentrations by an Enzyme-Linked Immunoassay (ELISA) test, typically providing results within 48 hours of the time the sample was taken. This quick and regular herbicide monitoring will allow DBW to ensure that herbicide concentrations are maintained at efficacious levels, and that water quality standards are not exceeded, particularly for irrigation. Depending on the immunoassay results, treatment crews may adjust future SAV herbicide applications to achieve an appropriate herbicide concentration.

Exhibit 2-17
AIPCP Environmental Monitoring Requirements

Treatment Crews (for each site treated)	Environmental Scientists (for each sample event)
1. Water temperature (ºC) 2. Dissolved oxygen (DO, mg/L or parts per million (ppm)) 3. Wind speed (mph) 4. Coordinates of treatment location 5. Presence of elderberry shrubs 6. Presence of species of concern 7. Acres treated 8. Quantity of herbicide	1. Water temperature (ºC) 2. Dissolved oxygen (DO, mg/L or ppm) 3. Turbidity (NTU) 4. pH 5. Salinity (ppt) 6. Specific conductance (mS/cm) 7. Water depth (feet) 8. Tide cycle 9. Water samples (pre-treatment, post-treatment, control; submitted to a Certified Analytical Laboratory)

Exhibit 2-18
General Permit Receiving Water Limits or Monitoring Triggers for AIPCP Herbicides

Herbicide Active Ingredient	Maximum Limitation
2,4-D	70 ppb
Fluridone	560 ppb
Glyphosate	700 ppb
Penoxsulam*	10.1 ppm
Imazamox*	9.4 ppm
Imazapyr*	11.2 ppm
Endothall	100 ppb
Diquat	20 ppb
Flumioxazin	NA

* There are no receiving water limitations, these values are monitoring triggers.

The State Water Quality Control Board NPDES General Permit, CAG 990005 and amending orders (May 20, 2014, March 3, 2015, and June 30, 2016) guide water quality monitoring. The General Permit requires a sampling frequency of six application events per year for each environmental setting (flowing water and non-flowing water), per herbicide. Once a discharger has provided the SWRCB with results from six consecutive application events showing concentrations that are less than the receiving water limitation/ trigger for an active ingredient in a specific environmental setting, sampling shall be reduced to one application event per year for that active ingredient in that environmental setting. **Exhibit 2-18** provides the receiving water limits and monitoring triggers for the AIPCP herbicides currently under the permit. Note that several of the receiving water limits exceed even the maximum potential use rate; the imazamox and penoxsulam limits are one thousand times greater than the maximum use rates. The AIPCP will work with the SWRCB to incorporate new herbicides into the General Permit as they are approved for aquatic use by CDPR. The AIPCP will revise their monitoring protocols, as appropriate, to comply with the any new NPDES General Permit requirements.

SAV Hydroacoustic Monitoring

Beginning in 2016, DBW undertook a more scientific rigorous process to inventory and map SAV, including curlyleaf pondweed and *Egeria densa* both pre- and post-treatment to better measure the outcomes and progress towards overall control of these invasive aquatic plants. Continuing the program initiated in 2016, DBW will employ hydroacoustic biomonitoring in a more robust and systematic fashion as part of its monitoring methods. DBW will map SAV treatment sites prior to the onset of treatment, then again after the end of the season, post-treatment. These surveys provided detailed quantitative metrics of the change in bio-volume in treated sites. The metrics set a baseline for future comparisons and will provide data DBW can use to guide next seasons treatments.

FAV and SAV Point Intercept Assessment

In 2017, DBW developed protocols for FAV and SAV point intercept assessments. The purpose of these assessments is to detect seasonal and long-term changes in FAV and SAV species composition, cover and distribution and evaluate treatment efficacy. The method of choice is point-intercept sampling, using rake pulls for SAV assessment and quadrat sampling for FAV assessment. Random sample points (5-20) are generated within SAV treatment sites or selected FAV sample sites in the Delta. The number of points determined for SAV assessments depends on the size of the treatment site. Five sample points are used for sites up to 10 acres, 10 sample points for sites between 10 and 99 acres, and 15 sample points for sites 100 acres or larger. For FAV sampling, 20 sample points are used for every site, regardless of size. At each point, the SAV and

FAV are evaluated and rated for density and/or cover on a scale of 1 to 4, with 1 representing low density or cover and 4 being topped out or dense plants with visible coverage of 75 percent or more. Plant health is also scored at each point on a scale of 1 to 5, with 1 representing complete necrosis and 5 representing completely healthy plants with green tissues. Sample points will be surveyed approximately 3 times during a calendar year using the same methods. DBW environmental scientists intend to conduct these surveys on an annual basis for continuous data collection that will inform the AIPCP.

Program Performance Metrics

In addition to the methods described above, if resources allow, DBW may also employ aerial surveys or other appropriate remote sensing methods to assist in site prioritization as well as follow-up evaluation. Remote sensing and cover assessment could include aerial monitoring (for example, fixed wing; drone; satellite (AVRIS, SPECTIR). Over the last few years, NASA has provided Landsat monitoring data to DBW through the DRAAWP. This information will support on-the-ground monitoring and inform program performance and planning for future treatment seasons. Based on the performance metrics identified earlier in Exhibit 2-1, DBW will seek to track the following measures. It is important to note that there are numerous technical challenges inherent in measuring FAV and SAV coverage, including the ability to identify species from aerial photogrammetry, movement of FAV species, growth of FAV species, and the size of the Project Area. DBW and USDA-ARS will adaptively manage program monitoring to improve measurement capabilities over time. Data to support program performance metrics will include the following:

- Acres of infestation (by FAV, SAV, species when possible)
- Biomass and biocover (from hydroacoustic monitoring)
- Acres of infestation in particular locations (nursery sites, problem sites)
- Herbicide application (pounds active ingredient)
- Acres treated in ecosystem restoration sites
- Number of incidents and complaints
- Acres/cubic yards of removal by physical/mechanical methods.

8. Mitigation Measures for the AIPCP

The AIPCP implements a number of mitigation measures to minimize or reduce potential impacts of the program. DBW is a stewardship agency. Projects and programs are designed and implemented to minimize impacts to the environment. The AIPCP follows applicable California Department of Parks and Recreation Standard Project Requirements, in addition to implementing the mitigation measures summarized below. The 19 mitigation measures have been incorporated in the AIPCP's daily operations. These mitigation measures have been developed over time, working with USFWS, NMFS, the State Water Resources Control Board, and local Agricultural Commissioners. **Exhibit 2-19** describes 19 AIPCP mitigation measures that AIPCP regularly implements to reduce or eliminate potential impacts of the AIPCP.

Exhibit 2-19
AIPCP Mitigation Measures

Page 1 of 6

Mitigation Measures	Mitigated Impact Areas
1. Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources Each year, prior to the start of the treatment season, AIPCP will conduct field crew environmental awareness training. Under this training, crews will be informed about the presence and life histories of special status species; habitats associated with species; sensitive habitats and wetlands; the terms and conditions of the program's biological opinions; incidental take procedures; and that unlawful take of an animal or destruction of its habitat is a violation of the Endangered Species Act and/or California Endangered Species Act. AIPCP also will provide crews with a special status species field guide for easy identification of special status species on-site. Prior to treating a site, crews will conduct a visual survey to determine whether special status plants, animals, or sensitive habitats are present. Crews will complete an Environmental Observations Checklist for each site to document the presence or absence of special status species. If any special status species or sensitive habitats are present at the site, the field crew will not perform any treatment. DBW Environmental Scientists will classify treatment sites as high, medium, or low potential for nesting birds. DBW also will examine CNDDB records to determine if special status bird species have been sited within AIPCP treatment locations, and prepare a map for field crews identifying such sites. For those treatment sites that have habitat characteristics that might support special status bird species, Environmental Scientists will survey the specific site. DBW will delay treatments at locations where nesting Swainson's hawks are present until after June 10th, the start of the post-fledging stage. At all treatment locations, crews will conduct a visual survey, following an established protocol, to determine whether special status plants, animals, or sensitive habitats are present, including bird nesting sites. DBW will follow a Swainson's hawk survey protocol consistent with the requirements in the 2015 CDFW-DBW Final Streambed agreement, including surveys focused on active Swainson's hawk nests during their nesting season (February 15 – July 31) within ¼ mile of the project work site. Crews will complete an Environmental Observations Checklist for each site to document the presence or absence of bird nesting sites. If nesting yellow-headed blackbird, Swainson's hawk, or tricolored blackbird are known to be present at the site, the field crew will not perform any treatment within one-quarter mile of the nesting site until the post-fledging stage. For mechanical harvesting operations, DBW Environmental Scientists will observe plant materials during harvesting, and to the extent possible, remove special status species such as Western Pond Turtle, from bycatch. Turtles and other special status species will be placed back in the water in a location away from the harvesting operation.	Biological Resources, Hydrology and Water Quality
2. Provide a 100 foot buffer between treatment sites and shoreline elderberry shrubs (*Sambucus* ssp.), host plant for the valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)* in most sites; in selected sites, utilize backpack style sprayers to direct spray on FAV adjacent to elderberry shrubs AIPCP will conduct a survey of treatment sites to prepare a map that identifies locations of elderberry shrubs, and provide this map to field crews. In most locations, AIPCP crews will ensure at least 100 feet of buffer between elderberry shrubs and herbicide treatments. Crews will also conduct treatments downwind of elderberry shrubs. For selected treatment sites where Priority 1 and Priority 2 treatment occurs adjacent to elderberry shrubs, DBW crews will utilize backpack style spray wands to target herbicide directly onto FAV species. DBW will photograph and monitor elderberry shrubs near these treatment sites. In addition, AIPCP environmental scientists will survey a sample of elderberry shrubs which could be potentially impacted by application activities at the beginning of the treatment season, and at the end of the treatment season. The environmental scientists will compare the health of elderberry shrubs at control sites (i.e. not adjacent to treatments) with elderberry shrubs located adjacent to treated sites. If elderberry shrubs located near treated sites show signs of adverse effects from treatment, AIPCP will develop additional mitigation measures to protect elderberry shrubs (for example, increasing the size of the buffer zone).	Biological Resources

Exhibit 2-19
AIPCP Mitigation Measures *(continued)*

Mitigation Measures	Mitigated Impact Areas
3. Minimize potential for drift when applying herbicides In addition to complying with the label application requirements, DBW will, to the degree possible, schedule herbicide applications to occur at high tide, or at a point in the tidal cycle determined by the field supervisor to provide the least non-target impact at a particular site. In general, treatment at high tide will allow for better spray accuracy and access, and will provide for greater dilution volume of herbicides. DBW crews will change nozzle type and spray pressures whenever conditions warrant, limiting the amount of herbicide which may inadvertently contact non-target species or enter the water.	Biological Resources, Agriculture and Forestry Resources, Hydrology and Water Quality
4. Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total To minimize the potential for negative impacts to covered species from exposure to diquat dibromide, DBW will only utilize diquat for unforeseen infestations. Diquat will only be utilized from August 1st through November 30th of each year, unless utilized in a controlled DIZ location where listed fish species will not be present. Diquat treatments will be limited to a total of 1 percent of AIPCP treatment acres in the Delta per year. Unforeseen infestations include situations in which aquatic invasive plant growth completely impedes navigation of Delta waters, such as a completely blocked slough that would impair the movement of emergency response vessels, or infestations that block water intake facilities and require immediate treatment. DBW will consult with USFWS and NMFS prior to utilizing diquat to help ensure that covered fish species are not likely to be present at the time of treatment.	Biological Resources, Hydrology and Water Quality
5. Minimize boat wakes and propeller noise to avoid disturbance to the habitat Operational procedures for AIPCP vessels will minimize boat wakes and propeller noise. These procedures will be particularly important in shallow water, or other sensitive habitats.	Biological Resources, Hydrology and Water Quality
6. Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed species are likely to be present The AIPCP will implement a historical mapping and survey-based approach to conducting treatments that allows for treatments in areas with invasive plant infestations when listed fish species are not likely to be present. AIPCP will use the historical wet and drought year monthly mapping results, in combination with current CDFW and USFWS fish survey results to identify locations were species are not likely to be present. These site-specific treatment time restrictions minimize potential exposure of migratory salmonids and sensitive juvenile fish to AIPCP herbicides or mechanical harvesting. Some SAV herbicide treatments using low herbicide concentrations may take place in sites where listed fish have been found historically, depending on water flow and herbicide efficacy requirements. Appendix 3-A provides historical maps of fish species location by month. Species-specific maps are provided in the AIPCP Biological Assessment Supplemental Materials.	Biological Resources

Exhibit 2-19
AIPCP Mitigation Measures *(continued)*

Page 3 of 6

Mitigation Measures	Mitigated Impact Areas
7. Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters AIPCP will conduct comprehensive monitoring. This monitoring is in compliance with the general NPDES permit, and prior NOAA-Fisheries and USFWS Biological Opinions/Letters of Concurrence. AIPCP will collect a pre-treatment sample no more than 24-hours prior the start of treatment, and collect post-treatment samples, continuing until the sampling location shows non-detectable herbicide levels. AIPCP will conduct water quality monitoring as required by the NPDES General Permit for each herbicide, and water body type. Water samples will be submitted to a certified analytical laboratory to measure herbicide and adjuvant concentrations, as appropriate. Should these levels exceed allowable limits, AIPCP will take immediate measures to reduce herbicide levels at future treatment sites. AIPCP will conduct additional immunoassay monitoring for selected SAV herbicide applications to more closely track herbicide levels. In the event that herbicide or adjuvant concentrations exceed allowable limits, DBW will take reasonable measures to document the extent of the associated.impacts and affected areas including photographic documentation of affected areas and any injured fish and wildlife. If dead fish or wildlife are found in the affected area, DBW will collect carcasses and deliver them to CDFW. DBW will meet with CDFW within ten days of the incident in order to develop a resolution including: site clean-up, site remediation and compensatory mitigation for the harm caused to fish, wildlife and the habitats on which they depend as a result of the incident. DBW will be responsible for all clean-up, site remediation and compensatory mitigation costs. DBW will take all reasonable measures to ensure that a resolution be achieved within a specified timeframe, generally six months from the date of the incident.	Biological Resources, Hydrology and Water Quality
8. Implement an adaptive management approach to minimize the use of herbicides in the long-term [Note: in order to reduce recent infestation levels to maintenance status, DBW may need to increase the amount of herbicide utilized over the next few years; once a maintenance level has been established, the goal would be to reduce annual herbicide applications] Under an adaptive management approach, AIPCP will seek to improve efficacy and reduce environmental impacts over time as new and better information is available. Specifically, AIPCP will evaluate the need for control measures on a site by site, month-to-month, basis; select appropriate indicators for pre-treatment monitoring; monitor indicators following treatment and evaluate data to determine program efficacy and environmental impacts; support ongoing research to explore impacts of the AIPCP and alternative control methodologies; report findings to regulatory agencies; and adjust program actions, as necessary, in response to recommendations and evaluations by USDA-ARS, DBW staff, regulatory agencies and stakeholders. In addition to this adaptive management approach, AIPCP will follow maintenance control practices that from a program standpoint seek to reduce the number of acres of invasive plants to be treated each year, until treatment acreage reaches a minimal level. This will reduce the volume of herbicide utilized by the AIPCP.	Biological Resources, Hydrology and Water Quality
9. Provide treatment crews with electronic mapping that identifies previously surveyed areas for giant garter snake habitat, valley elderberry shrub locations (see hard copy example in Chapter 3), and nesting special status birds. Application crews will use these maps as tools for performing pre-application visual inspections for the presence of giant garter snakes, valley elderberry longhorn beetle, or nesting special status birds. If giant garter snakes are present, treatment crews will not treat at that location. If valley elderberry shrubs are within 100 feet of the potential spray area, crews will generally not treat at that location (see Mitigation Measure 2 for exceptions). If nesting special status birds are present, treatment crews will not perform any treatment within 200 yards of the nesting site until the post-fledging stage.	Biological Resources

Exhibit 2-19
AIPCP Mitigation Measures *(continued)*

Mitigation Measures	Mitigated Impact Areas
10. Monitor dissolved oxygen levels pre- and post-treatment for all AIPCP treatments, and at selected locations in the Delta over time Based on the pre-treatment DO levels, the AIPCP application crew will determine whether to conduct treatment at that site. No treatment will be performed when dissolved oxygen levels are between 3 ppm (the level below which DO is considered to be detrimental to fish species) and the basin plan limits established by the Central Valley Regional Water Quality Control Board (CVRWQB). The basin plan limits depend on location and time of year, and range from 5 ppm to 8 ppm. DBW will maintain written and map summaries of specific DO numeric limits. When pre-treatment levels are below 3 ppm, fish species are not likely to be present due to the extremely low oxygen levels. When pre-treatment levels are above the basin plan limit, AIPCP treatments, following label guidelines and mitigation measures, are not expected to adversely affect special status fish, resident native or migratory fish, or sensitive riparian or wetland habitats.	Biological Resources, Hydrology and Water Quality
11. Collect plant fragments during and immediately following treatment To maximize containment of plant fragments, AIPCP crews will collect plant fragments that are released from physical/mechanical treatments. Crews will also be trained on the importance of minimizing fragment escape.	Biological Resources, Agriculture and Forestry Resources, Hydrology and Water Quality
12. Require treatment crews to participate in training on herbicide and heat hazards, as well as continuing education units required under California Department of Pesticide Regulation law AIPCP will provide training to ensure that treatment crews have the knowledge and tools necessary to conduct the program in a safe manner. Training will include reading, understanding, and following herbicide label requirements; purpose and proper use of Personal Protective Equipment; symptoms of herbicide poisoning and minimization of exposure; avoidance, symptoms, and treatment of heat exposure; and emergency medical procedures.	Hazards and Hazardous Materials
13. Follow best management practices to minimize the risk of spill and to minimize the impact of a spill, should one occur The AIPCP best management practices are listed in the WHCP/SCP Operations Management Plan and in the EDCP Operations Management Plan, which are incorporated into this PEIR by reference. These include several provisions to reduce the potential for spill, such as: fastening herbicide containers securely in boats in original, watertight containers; carrying a marker buoy and anchor line to mark any spills in water; reporting spills immediately to appropriate State and local agencies; stopping movement of land spills as soon as possible using absorbing materials; marking and monitoring spills in water for herbicide residues and environmental impacts, if appropriate. Treatment crews will include at least one person with a Qualified Applicators Certificate (QAC), and all crew members will participate in annual training on herbicide handling procedures. In the event of an accidental spill of materials deleterious to aquatic life, AIPCP shall take all reasonable measures to document the extent of the associated impacts and affected areas including photographic documentation of affected areas and any injured fish and wildlife. If dead fish or wildlife are found in the affected area then DBW shall collect carcasses, preserve them, and immediately deliver them to the California Department of Fish and Wildlife (CDFW). DBW shall meet and confer with CDFW within 10 days of the incident in order to develop a resolution including: site clean-up, site remediation and compensatory mitigation for the harm caused to fish, wildlife and all the habitats which they depend as a result of the incident. DBW shall take all reasonable measures to ensure that a resolution be achieved within a specified timeframe, generally six months from the date of the incident.	Biological Resources, Hazards and Hazardous Materials

Exhibit 2-19
AIPCP Mitigation Measures *(continued)* *Page 5 of 6*

Mitigation Measures	Mitigated Impact Areas
14. Implement safety precautions on hot days to prevent heat illness In addition to annual training on heat illness prevention, and compliance with CalOSHA's California Heat Illness Prevention Standard, AIPCP field supervisors will conduct special training sessions on days when weather is expected to be hot. This training will cover the symptoms of heat illness, and immediate actions to take should any symptoms occur. Field supervisors will cancel treatments if the weather is exceptionally hot. AIPCP may also provide bimini tops (shade covers) for AIPCP treatment boats.	Hazards and Hazardous Materials
15. Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities. The MOU is an agreement between CCWD and DBW. No applications shall occur within Rock Slough, or within one mile of the confluence of Rock Slough and Old River, or within one mile of CCWD's Old River or Mallard Slough intake pumps without consensual agreement between CCWD and DBW. Herbicide applications within one mile of CCWD's water intakes may only occur with prior consent of CCWD. In order to treat within one mile of an intake, AIPCP must notify CCWD at least two weeks in advance, and make every reasonable attempt to schedule applications during periods when CCWD's intakes are shut down for environmental or maintenance reasons, allowing at least two complete tidal cycles between application and restart. This measure is primarily aimed at reducing the potential for drinking water contamination from the AIPCP.	Hydrology and Water Quality, Utilities/Service Systems
16. Notify County Agricultural Commissioners about AIPCP activities Before an application may occur, AIPCP shall file Pesticide Use Recommendations (PUR) and a Notice of Intent (NOI) with the appropriate County Agricultural Commissioner (CAC) office, when required for restricted material or as requested by each county. Each NOI will include the site number, spray dates, locations, and herbicides and adjuvants to be used. NOIs will be submitted before the upcoming treatment week. Based on information in the NOIs, CAC's could inform land owners of particular periods of time during which irrigation should not occur. If necessary, AIPCP shall also obtain a Restricted Use Permit (RUP) from all appropriate CACs.	Agriculture and Forestry Resources, Hydrology and Water Quality
17. Follow environmental compliance measures for species avoidance, equipment operation, and spoiling when conducting mechanical harvesting operations and when installing or physical controls. The AIPCP will implement a protocol similar to that for herbicide treatment prior to conducting mechanical removal. Environmental scientists will check fish survey data to verify that listed fish species are not likely to be present at the removal site. The equipment operator will utilize the Environmental Checklist to evaluate presence of listed species or sensitive habitat prior to removal. If listed species or sensitive habitats are present, the operator will not conduct mechanical removal at that site. DBW will conduct mechanical removal of AIPs in sensitive giant garter snake habitat or areas where giant garter snakes have been sighted in the past, only between October 1st and May 1st. The mechanical harvester will maintain a speed of 2 to 2.5 knots in areas outside of sensitive giant garter snake habitat, areas where giant garter snake has been sighted in the past, during the active season, and areas where Western pond turtles or sensitive/listed species are likely to be present, so that if these species were in the area, they could move out of the way and/or be readily removed from bycatch. The operator will stop and reverse the mechanical harvester if a snake is seen within AIPs during removal. DBW will spoil all AIPs collected by mechanical removal outside of the May 1st to October 1st giant garter snake active season at an approved spoil location to ensure no hibernating giant garter snakes are buried under piles of collected spoils. The AIPCP will survey locations prior to the installation of physical control methods, such as floating barriers, curtains and screens, to ensure that sensitive species are not present during the installation.	Biological Resources

Exhibit 2-19
AIPCP Mitigation Measures *(continued)*

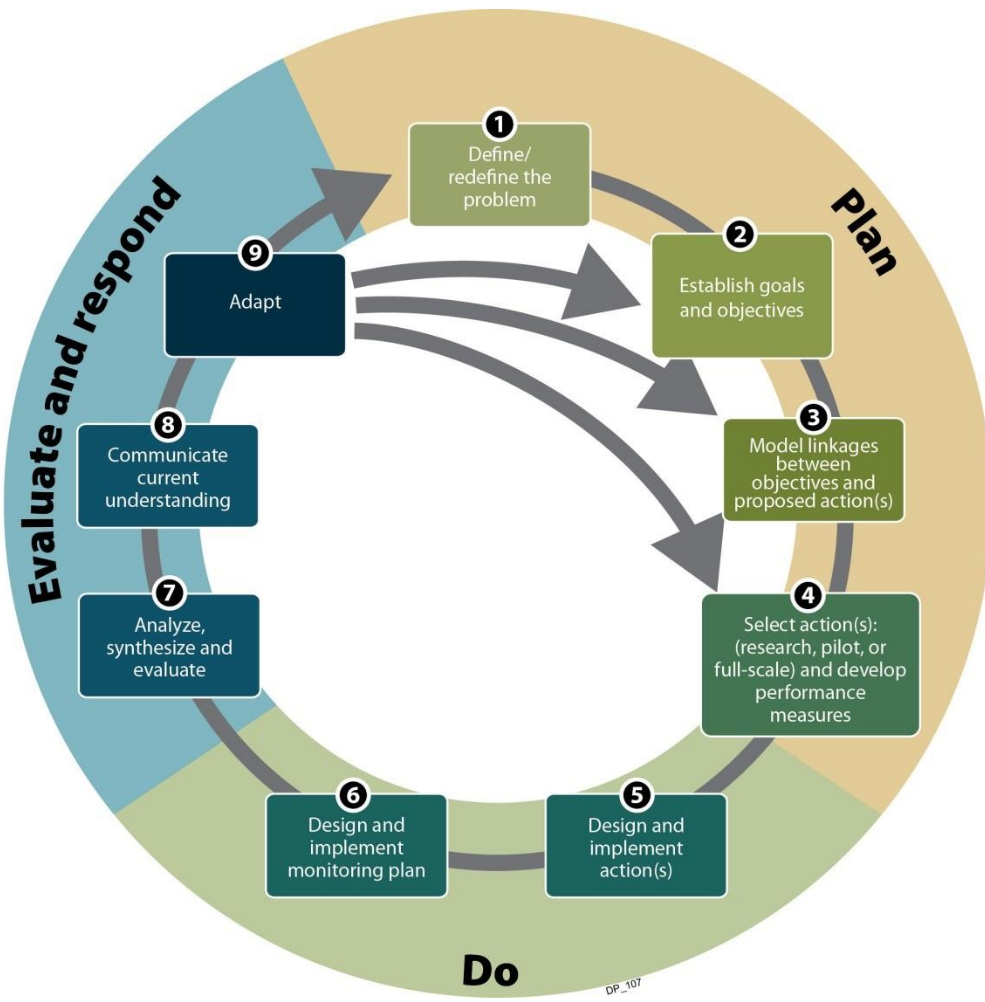
Mitigation Measures	Mitigated Impact Areas
18. Follow the Memorandum of Understanding (MOU) protocol for herbicide applications in Discovery Bay and Indian Slough The MOU is an agreement between the East Contra Costa Irrigation District (ECCID) and DBW. The MOU includes the items described in the following text. Provision of date, location and concentration levels for all treatments in the Discovery Bay and Indian Slough area will be shared with ECCID. Notification by DBW to ECCID of any changes made to the treatment schedule. DBW will provide the ECCID with maps of the treatment areas within Discovery Bay in addition to sonar hydro-acoustic map. Adjust application rates depending on Fluridone residue test results. Any changes in the treatment schedule will be sent to the ECCID contact person prior to the following week's treatment. Provide Fluridone herbicide residue test results to ECCID on a weekly basis. Test results include ECCID canal sampling locations E1 through E7. The test results will be emailed to the ECCID contact person by DBW staff. Application rates may be adjusted depending on Fluridone residue test results. Any changes in the treatment schedule will be sent to the ECCID contact person prior to the following week's treatment. During the treatment period, provide DBW with approximate pumping information pertaining to Station 1 at Bixler on a weekly basis. ECCID will provide DBW with crop information from growers/farmers utilizing water from ECCID (WURF data base) prior to the treatment season or whenever there is a change of crop planting. When available, the ECCID will provide DBW with the planting schedule and maps for farms that plant any crops/vegetables belonging to Solanaceae family. Provide DBW with a set of keys (Waiver agreement or Entry Permit) with access to Bixler headwall for testing purposes.	Agriculture and Forestry Resources
19. Visually inspect riparian habitat to document impacts from treatment AIPCP trained and approved staff will visually monitor and document the health of riparian vegetation adjacent to treatment sites that could be potentially impacted by application activities at the beginning and end of the treatment season. DBW Designated Biologists will conduct annual training for AIPCP staff on healthy riparian habitat characteristics, identification of damage to habitats, evaluation of extent of damage, survey methodology, and reporting. In addition to regular surveys by AIPCP trained and approved staff, Designated Biologists will perform visual inspections of randomly selected riparian locations during the treatment season. If any mortality of riparian vegetation occurs as a result of herbicide overspray within the treatment season, DBW will meet and confer with CDFW in order to develop a resolution and/or riparian enhancement plan.	Biological Resources

Appendix 2a
AIPCP Adaptive Management Plan

The Aquatic Invasive Plant Control Program (AIPCP) implements an adaptive management approach. This approach is imbedded in long-term, annual, and day-to-day operations, and is integrated throughout the Program Description. This Appendix summarizes the AIPCP's adaptive management plan in the context of the Delta Stewardship Council's (DSC) Delta Plan, Appendix C, Adaptive Management in the Delta.[1] **Exhibit 2a-1** illustrates the nine-step adaptive management framework adopted by the DSC.

This Appendix summarizes key aspects of the approach, organized into the three phases: Plan, Do, and Evaluate and Respond.

Exhibit 2a-1
AIPCP Adaptive Management Approach



Source: Delta Plan, Appendix C, page C-5.

[1] http://deltacouncil.ca.gov/sites/default/files/documents/files/AppC_Adaptive%20Management_2013.pdf

Phase One: Plan

There are four steps in the Plan phase. For the AIPCP, planning is an ongoing activity, and occurs over long-term, annual, and seasonal scales.

1. Define/Redefine the Problem

The AIPCP addresses problems that have been defined by legislation and authorized in Section 64 of the Harbors and Navigation code, beginning with Senate Bill 1344 (Statutes of 1982). Senate Bill 1344 designated DBW as the lead agency to control water hyacinth in the Sacramento-San Joaquin Delta (Delta), its tributaries, and Suisun Marsh. As the problem of invasive aquatic weeds in the Delta has grown, new legislation expanded DBW's authority to control additional species. The problems created by invasive aquatic plants are well documented, and include: unfavorable impacts to navigation and recreation, blocking agricultural and water intakes, reductions in water quality, and unfavorable effects to ecosystems. Aquatic invasive plants have been identified as ecosystem stressors in the Delta. It is expected that the extent of the AIP problem and plant species requiring control will continue to evolve over time.

2. Establish Goals and Objectives

The objective of the AIPCP is to control the growth and spread of aquatic invasive plants (AIP) in the Delta, its surrounding tributaries, and Suisun Marsh to support the environment, economy, and public health. The AIPCP aims for efficacious management actions to control AIP while at the same time striving to minimize non-target species impacts and prevent environmental degradation in Delta waterways and tributaries. Exhibit 2-1 in the preceding chapter identifies DBW's eleven annual objectives and performance measures for the AIPCP.

3. Model Linkages Between Objectives and Proposed Actions

The AIPCP's proposed actions (control AIPs through herbicide, physical, and biological control methods) are directly linked to the objectives identified in Exhibit 2-1. Each proposed control method is intended to help achieve one or more of the stated program objectives. The AIPCP will evaluate actions on an ongoing basis to determine the extent to which these linkages hold. Those actions that are not in support of the broader AIPCP objectives will be discontinued.

4. Select Actions and Develop Performance Measures

Each year, the AIPCP will develop an Annual AIPCP Integrated Pest Management Plan. The 2018 Plan is included in the AIPCP Programmatic Biological Assessment, incorporated by reference, and provided on a CD with this PEIR. The 2018 Plan identifies maximum treatment acres by category (SAV, FAV, mechanical, and Demonstration Investigation Zones (DIZ), herbicides to be utilized, physical control methods to be utilized, and DIZ projects (including the release of biological control agents). The 2018 program will be monitored using the performance measures identified in Exhibit 2-1.

Phase Two: Do

5. Design and Implement Actions

Prior to the start of each treatment season, DBW and its partners (including USDA-ARS, DBW, Interagency Ecology Program (IEP), CDFW, and others) will take the initial steps necessary to implement the Plan for the upcoming year. Activities within this step include ordering herbicides, ensuring the necessary equipment is procured and/or maintained, evaluating resource needs, coordinating across agencies for collaborative projects (for example, AIPCP support of DWR or CDFW restoration projects), and coordinating monitoring activities for day-to-day operations and DIZs. Throughout the treatment season, DBW and its partners will conduct the daily operations of the AIPCP, including using control methods, monitoring and evaluating treatment needs and efficacy, and communicating with stakeholders. The AIPCP implementation is, by necessity, flexible and adaptable to respond to real-time conditions in the Delta, weather, staffing, and regulatory requirements.

6. Design and Implement Monitoring Plan

The AIPCP includes multiple monitoring activities. Monitoring supports AIPCP compliance with the NPDES permit, USFWS and NMFS Biological Opinions, County Agricultural Commissioner requirements, California Department of Pesticide Regulation requirements, and program performance objectives. The AIPCP will coordinate monitoring efforts with the USDA-ARS and Interagency Ecology Program (IEP) when appropriate. Specific monitoring approaches are described in more detail in Chapter 2 for the following areas:

- NPDES water quality and immunoassay monitoring
- SAV hydroacoustic monitoring
- FAV quadrant monitoring and SAV point intercept assessment
- Program performance metrics.

Phase Three: Evaluate and Respond

7. Analyze, Synthesize, and Evaluate

Annually, in order to develop projections for the upcoming year and evaluate performance, the AIPCP will:

- Obtain and review information from the prior years, including: aerial monitoring (satellite, fixed wing, drone), point-intercept monitoring, hydroacoustic monitoring, water quality monitoring, ESA species surveys, and performance indicators
- Review feedback from citizen science and public stakeholders on the extent of infestations and problem sites
- Obtain input from all levels of the AIPCP organization
- Assess research/demonstration needs based on results of the prior years' studies, scientific literature, and current challenges
- Review requests for restoration projects
- Review feedback from federal, state, and local partners
- Evaluate the anticipated impacts of water flow and temperature information for the upcoming year, to the extent information is available.

8. Communicate Current Understanding

The AIPCP incorporates weekly communication and annual reporting. The AIPCP follows public notice requirements prior to the start of the treatment season. On a weekly basis, DBW distributes emails to interested parties to identify upcoming treatment SAV and FAV treatment locations, acres treated to date, and herbicides to be utilized. At the end of each treatment season, the AIPCP prepares detailed annual reports that summarize program performance and compliance with NPDES, USFWS, and NMFS requirements. In addition, DBW management meets regularly with Delta stakeholders to communicate program performance and obtain input and feedback from stakeholders.

9. Adapt

The AIPCP will continuously build on experience, evaluations, research, and new scientific knowledge to improve program operations, monitoring, and performance. Over the longer-term, the AIPCP will consider trends in invasive plant locations, growth, movement, and climate as part of the adaptive planning process. The information and knowledge acquired each treatment season will inform upcoming treatments and overall program planning on an ongoing basis.

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Section 3

Biological Resources and Impacts Assessment

3. Biological Resources Impacts Assessment

This chapter analyzes effects of the AIPCP on biological resources. The chapter is organized as follows:

A. Environmental Setting

B. Impact Analysis and Mitigation Measures.

The environmental setting describes the biological condition of the Sacramento-San Joaquin Delta. This discussion includes identification of habitat types, and special status plants, invertebrates, fish, amphibians, reptiles, birds, and mammals. This chapter does not provide a detailed discussion of the regulatory context in the Delta. Such a discussion is included in Chapter 7 – Cumulative Impacts Assessment, which contains a description of relevant regulations, programs, projects, and planning efforts that shape the current Delta.

The impact analysis provides an assessment of the specific environmental impacts potentially resulting from program operations. The discussion of impacts utilizes findings from DBW environmental monitoring and research projects, technical information from scientific literature, government reports, and relevant information on public policies. The impact assessment is based on technical and scientific information.

The mitigation measures are specific actions that DBW will undertake to avoid, or minimize, potential environmental impacts. As a stewardship agency, DBW designs and implements the program to minimize impacts to the environment. These AIPCP mitigation measures have been incorporated into the AIPCP's daily operations. DBW is undergoing, and will continue to undergo, consultation with various State and federal agencies, including USFWS, CDFW, NMFS, and CVRWQCB regarding impacts, mitigation measures, and conservation measures. Many of the mitigation measures result from conservation measures developed during the biological consultation process with USFWS and NMFS. Proposed mitigation measures may be revised, and/or additional mitigation measures incorporated, as a result of adaptive management and this ongoing consultation process with environmental regulatory agencies.

The AIPCP provides a comprehensive approach to aquatic invasive plant control in the Delta, and incorporates all previous Delta programs conducted by the Division of Boating and Waterways, including the Water Hyacinth Control Program (WHCP), Spongeplant Control Program (SCP) and *Egeria densa* Control Program (EDCP), and new invasive plant species incorporated through the process defined by Assembly Bill (AB) 763. The AIPCP is supported by the Collaboration Guidelines for Delta AIS Control (Guidelines). The AIPCP adheres to an adaptive management strategy with annual evaluation. This adaptive strategy allows the program to respond to changing conditions in the Delta. It also facilitates adaptability to changes in other elements, such as regulatory environment, public health, and the economy.

A. Environmental Setting

Exhibits 2-3 and 2-4, in Chapter 2, illustrate the AIPCP program area. The AIPCP occurs primarily in the Delta, with additional treatments occurring on lower stretches of the San Joaquin, Tuolumne, and Merced Rivers.

The Delta is arguably the most environmentally sensitive region in California today. The Delta also has been described as "heavily modified" (Sommer et al. 2007). Starting in the mid-1800's, the Delta has been subject to hydraulic gold mining, channelization and wetland reclamation, fish and other non-native species introductions, dams controlling water inflows, and water exports (Sommer et al. 2007).

Concerns about the Delta environment gained momentum in the early 1990s. In establishing the Delta Protection Commission in 1992, the California legislature recognized that the Delta is "a natural resource of statewide, national, and international significance, containing irreplaceable resources." In the seventeen years since the Delta Protection Commission was established, and particularly over the last few years, concerns about water quality, water quantity, increasing land subsidence, flooding, climate change, increased salinity, invasive species, risk of catastrophic earthquake, and declining fish populations have only increased.

In 2006, Governor Schwarzenegger established the Delta Vision Blue Ribbon Task Force to identify a sustainable strategy for managing the Delta. The Governor's Executive Order recognized that "failure to act to address identified Delta challenges and threats will result in potentially devastating environmental and economic consequences of statewide and national significance” (Executive Order S-17-06).

The Delta Vision Blue Ribbon Task Force established a strategic plan to meet twelve objectives, the first objective being: “The Delta ecosystem and a reliable water supply for California are the primary co-equal goals of a sustainable Delta” (Delta Vision Blue Ribbon Task Force 2008).

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The Delta Vision Blue Ribbon Task Force established a strategic plan to meet twelve objectives, the first objective being: “The Delta ecosystem and a reliable water supply for California are the primary co-equal goals of a sustainable Delta” (Delta Vision Blue Ribbon Task Force 2008).

In early 2008, Governor Schwarzenegger initiated another major collaborative planning effort, the Bay Delta Conservation Plan (BDCP). This initiative is led by the California Department of Water Resources (DWR), California Department of Fish and Wildlife (CDFW), U.S. Bureau of Reclamation (USBR), USFWS, and NMFS. The “purpose of the BDCP is to help recover endangered and sensitive species and their habitats in the Delta in a way that will also provide for sufficient and reliable water supplies” (DWR 2008). The BDCP examined four water conveyance and physical habitat restoration alternatives for the Delta, including a peripheral aqueduct or tunnel from the Sacramento River to the south Delta. On July 25, 2012, California Governor Edmund G. Brown Jr., Secretary of the Interior Ken Salazar, and NOAA Assistant Administrator for Fisheries Eric Schwaab outlined revisions to the proposed BDCP that, along with a range of alternatives, underwent public environmental review. The revised proposal for a peripheral tunnel included fewer water intake facilities (three versus five), and lower total water capacity (9,000 cfs versus 15,000 cfs) than earlier proposals (CNRA July 2012). The draft BDCP and corresponding EIR/EIS was released for 120 days of formal public review in December 2013. On April 30, 2015, State and Federal lead agencies announced the proposal of a modified conveyance facility with a different regulatory approach for gaining necessary permits and authorization. A Draft EIR/Supplemental Draft EIS for the “twin tunnels”, Alternative 4A (now known as California WaterFix), was made available for review in late 2015, and the final BDCP/California WaterFix EIR/EIS was completed in December 2016 (DWR and USBR 2016a).

California WaterFix (Alternative 4A) is the state’s plan to upgrade outdated infrastructure in the Sacramento-San Joaquin Delta (Delta) to secure California’s water supplies and improve the Delta’s ecosystem. The proposal involves construction of three new intakes, each with a maximum diversion capacity of 3,000 cubic feet per second, on the east bank of the Sacramento River. Each intake site would employ state-of-the-art on-bank fish screens and, although the diversions would be located outside of the main range for delta and longfin smelt, the fish screens would be designed to meet delta smelt criteria. Two 40- foot-wide underground pipelines would carry the diverted water by gravity flow approximately 30 miles to the expanded Clifton Court Forebay, where two pumping plants would be constructed to maintain optimal water levels in the forebay for the existing State Water Project (SWP) and Central Valley Project (CVP) pumping facilities

Over the last ten years the project has made significant progress, with 2016 marking completion of the environmental review documents. On December 22, 2016, the final environmental analysis for California WaterFix (Alternative 4A) were made available. The project’s Lead Agencies — the California Department of Water Resources and U.S. Bureau of Reclamation — identified WaterFix as the preferred alternative to modernize California’s primary water delivery system, guard against water supply disruptions, and improve conditions for threatened and endangered fish.

In January 2017, the Delta Stewardship Council’s Delta Science Program conducted the Aquatic Science Peer Review Phase 2B, representing an independent scientific evaluation of draft sections of U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions on California WaterFix for all federal Endangered Species Act (ESA)-listed aquatic species and their critical habitat. On June 26, 2017, California WaterFix received authorization under the U.S. Endangered Species Act when USFWS and NMFS issued biological opinions for the proposed project. The biological opinions allow WaterFix to continue moving toward construction as early as 2018. Both biological opinions found the construction and operations of WaterFix as proposed would not jeopardize the continued existence of ESA-listed species or destroy or adversely modify critical habitat for those species. These biological opinions will also be considered by permitting agencies, including the State Water Resources Control Board in its hearing now underway on a petition by DWR and the U.S. Bureau of Reclamation to allow for the change in points of diversion to add three new intakes on the Sacramento River as part of WaterFix.

The Delta Vision, Bay Delta Conservation Plan, and California WaterFix are just three of dozens of initiatives in the Delta directed toward improving water quality, managing water diversion, controlling floods, restoring ecosystems, reducing fish decline, and reducing invasive species. Many of these initiatives are described in Chapter 7.

The AIPCP is a minor element of this complex dynamic Delta environment. The AIPCP seeks to control only a small subset of the hundreds of invasive species in the Delta. The AIPCP operates within the context of an environment that has been managed and manipulated since the mid-1800s.

The challenge in today's Delta is to support gradual restoration of natural Delta ecosystems, where possible, while preventing further environmental deterioration. The specific challenge of the AIPCP is to control the growth of AIPs within this highly modified Delta environment. AIPs, left to grow unchecked, have the potential to significantly negatively impact the environment. At the same time, the AIPCP also must minimize potential negative impacts of AIP treatment.

1. Regulatory Settings

There are several Federal and State laws relevant to biological resources that are applicable in the AIPCP project area. Five such regulatory programs are described below.

<u>Endangered Species Act</u>

The Endangered Species Act (ESA) was signed into law in 1973 to conserve and protect species that are endangered or threatened, and the ecosystems on which they depend (NMFS 2008). The law is implemented by USFWS and NMFS. Major activities within the law include identification of listed species, identification of critical habitat, development of recovery plans, cooperation with states, interagency consultation (Section 7), international cooperation, enforcement, permits, and habitat conservation plans. When a federal project may result in "take" of an endangered or threatened species, the federal agency must obtain a biological opinion and Section 7 Incidental Take permit. The AIPCP is in the process of obtaining ESA Section 7 Biological Opinions or Letters of Concurrence from USFWS and NMFS through the consultation process. The federal nexus for this process is USDA-ARS. The biological opinions or letters of concurrence will incorporate conservation measures that DBW must follow to minimize the potential for take of endangered or threatened species.

<u>California Endangered Species Act</u>

The California Endangered Species Act (CESA) states that all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation, will be protected or preserved. CDFW works with all interested persons, agencies and organizations to protect and preserve such sensitive resources and their habitats. CESA, which is administered by the CDFW Habitat Conservation Planning Branch, protects wildlife and plants listed as threatened or endangered by the California Fish and Game Commission (CDFW 2008).

The law restricts "take" of listed species, and agencies must apply for an incidental take permit under CESA, similar to the process under ESA. As part of the permit process, the applicant must indicate that the measures to minimize or fully mitigate the impacts of the authorized take are 1) roughly proportional in extent to the impact of the taking on the species; 2) maintain the applicant's objectives to the greatest extent possible; and 3) capable of implementation.

CESA includes additional species that are not covered by the federal ESA, however implementation of CESA and ESA is typically closely coordinated between USFWS, NMFS, and CDFW. DBW will work with CDFW to obtain an incidental take program for the AIPCP as part of this PEIR.

Magnuson-Stevens Fishery Conservation and Management Act (MSA) – Essential Fish Habitat (EFH)

The Magnuson-Stevens Fishery Conservation and Management Act was originally passed in 1976, and amended most recently in 2006. The MSA governs marine fisheries in the United States (Pacific Fisheries Management Council “Backgrounder”). The MSA regulates fishing to waters 200 nautical miles off the U.S. coast, established fishery management councils, and includes provision to create fishery management plans, conserve and manage fishery resources, and prevent overfishing. The Pacific Fishery Management Council implements the MSA for Washington, Oregon, and California. The MSA defines essential fish habitat as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” The MSA requires fishery management councils to describe EFH within fishery management plans, and to minimize impacts on EFH. A habitat area of particular concern (HAPC) is a subset of EFH, and consists of sensitive areas that are particularly important in the fish life cycle. Estuaries, such as the Delta, are classified as HAPCs. The AIPCP could potentially impact EFH for salmon, as well as EFH for certain groundfish species that are regulated under the MSA.

Natural Community Conservation Plans (NCCP) and Habitat Conservation Plans (HCP)

The NCCP is a California planning program, while the HCP is a federal planning program (CDFW 2008; USFWS 2005b). Both programs are related to their respective endangered species laws. Within California, most entities prepare a joint NCCP/HCP. Both laws focus on broader ecosystem planning and protection of special status species, within the context of development of a particular project or region. The NCCP is intended to “conserve natural communities at the ecosystem scale while accommodating compatible land use.” The HCP provides planning and conservation measures, including mitigation, when a project or development could result in incidental take of a threatened or endangered species. The HCP process has evolved into a broad-based planning effort to incorporate conservation into development efforts. There are several NCCP/HCP planning efforts within the Sacramento/San Joaquin Delta, including those summarized below. To the extent that AIPCP activities are mitigated, and will result in long-term benefits to ecosystems, they are compatible with these planning efforts.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act authorizes the U.S. Secretary of the Interior to protect and regulate migratory birds (USFWS 2008). The law is implemented by the USFWS, and protects migratory birds, occupied nests, and eggs. The Migratory Bird Treaty Act was first passed in 1918, and has been amended several times since. The act implements conventions between the United States and Canada, Mexico, Japan, and the former Soviet Union to protect migratory birds. There are 836 bird species protected by the Act.

Lake and Streambed Alteration Agreement

Section 1602 of the California Fish and Game Code requires notification to the CDFW for any proposed activity that will 1) substantially divert or obstruct the natural flow of any river, stream, or lake; 2) substantially change or use any material from the bed, channel, or bank of any river, stream, or lake; or 3) deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake (Fish and Game Code, Section 1602). Upon receiving such a notification, the CDFW assesses whether the activity could substantially adversely affect an existing fish or wildlife resource, and if so, provides a draft agreement that includes measures to mitigate the potential effects on fish and wildlife while performing the activity. If a party receiving the draft agreement disagrees with any of the proposed measures and is unable to informally resolve the disagreement with CDFW, a panel of arbitrators may decide on the terms of the agreement. DBW obtained a Streambed Alteration/Routine Maintenance Agreement from CDFW in April 2015.

<u>Delta Reform Act and the Delta</u>

The Delta Stewardship Council (DSC) was created by the Delta Reform Act of 2009 to achieve the state mandated coequal goals for the Delta. "'Coequal goals' means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." (CA Water Code §85054). The Delta Plan was unanimously adopted by the Delta Stewardship Council on May 16, 2013. Subsequently its 14 regulatory policies were approved by the Office of Administrative Law, a state agency that ensures the regulations are clear, necessary, legally valid, and available to the public. The Delta Plan became effective with legally-enforceable regulations on September 1, 2013. The Plan is a comprehensive, long-term management plan for the Delta. Per Water Code Section 85225, a state or local agency that proposes to undertake a covered action, prior to initiating the implementation of that covered action, is required to submit a written certification to the Council, with detailed findings demonstrating that the covered action is consistent with the Delta Plan. The AIPCP is in consultation with the DSC regarding consistency with the Delta Plan, and will be sumitting a certification of consistency to the DSC finalization of this PEIR.

2. The Delta

At the confluence of the Sacramento and San Joaquin River basins, the Sacramento-San Joaquin Delta includes approximately 1,100 square miles and was originally a tidal marsh and land between the Sacramento and San Joaquin Rivers. The area was developed primarily for agriculture beginning in the mid-1800s. Today, Delta water is used to irrigate approximately 3 million acres of farmland, and provides urban water supplies to up to two-thirds of the state. The California State Water Project (SWP) and federal Central Valley Project (CVP) export approximately five million acre-feet of water annually from the Delta for agricultural, municipal, and industrial purposes in central and southern California. An almost equal amount of water is withdrawn from the Sacramento and San Joaquin Rivers for agricultural and municipal uses before it reaches the Delta. Approximately 25 percent of California’s drinking water comes from the Delta, and two-thirds of California households receive some drinking water from the Delta (URS Corporation 2007).

There are approximately 700 miles of rivers, sloughs, and connecting channels with a surface area of approximately 62,000 acres of water.[1] Delta river depths typically range between five and ten feet, with inland navigation channels for the ports of Sacramento and Stockton dredged to 30 feet. Among the sloughs, shipping channels, and rivers are approximately 70 major land tracts and low-lying islands. These lands are protected by 980 miles of levees, some of which are constructed and maintained by the U.S. Army Corps of Engineers while others are constructed and maintained by local reclamation districts. These levees control water movement in the Delta, protect against flooding, and control water quality and salinity. Maintenance of these levees is critical to protect low-lying islands that are subject to flooding.

Over 40 percent of the State’s runoff drains into the Delta. The Sacramento River contributes approximately 80 percent of Delta inflow, the San Joaquin River contributes approximately 15 percent, with the remaining five percent of flows contributed from the Cosumnes, Mokelumne, and Calaveras Rivers. Most of the Delta is subject to tidal action with mean fluctuations of approximately two to three feet.

Most of the Delta lies below sea level, largely as a result of early agricultural practices that reduced the volume of soil through oxidation and erosion (DWR 2013). Many islands within the Delta are 12 to 15 feet below sea level, and it is anticipated that elevation relative to sea level will continue to decline (DWR 2013).

The Delta climate is hot and dry in summer, and cool and moist in winter. Temperatures in the summer may reach over 100ºF, and drop to below freezing in the winter. Annual rainfall varies from approximately 10 to 18 inches and prevailing winds are from the west. Winds frequently range up to approximately 25 miles per hour.

[1] There are 61,619 water acres in the legal Delta, and another 6,180 water acres in southern sites within DBW’s aquatic weed control program treatment sites, for a total of 67,799 water acres.

The primary land use in the Delta is agricultural, with only about five percent urban use. The Delta supports a wide variety of field crops, vegetables, fruits, nuts, livestock, and poultry. Delta crops were valued at $702 million in 2009, and the agricultural industry is estimated to have an over $5 billion impact on the statewide economy (DWR 2013). Agricultural lands and the post-harvest flooding practices also provide a rich habitat for seasonabl habitat, including for migratory birds (DWR 2013).

Delta waterways also support a large variety of recreational uses, with 12 million user-days per year (Delta Protection Commission 2012). There are many public and private recreational areas including marinas and camping, primarily along waterfronts. Fishing and boating account for 70 percent of Delta recreation use. The economic impact of recreation is estimated to exceed a $250 million (DPC 2012).

The remainder of this Environmental Setting subsection describes habitat types within the Delta, and identifies special status species potentially impacted by the AIPCP. This subsection relies on the CALFED Bay-Delta Program Multi-Species Conservation Strategy, the Bay Delta Conservation Plan (BDCP) EIR/EIS (BDCP, 2013), and the AIPCP Programmatic Biological Assessment (DBW and USDA-ARS 2017). The AIPCP Programmatic Biological Assessment is incorporated by reference, and provided as a PDF file on the PEIR CD.

3. Natural Community Conservation Planning (NCCP) Program Habitats

The Delta consists of a wide variety of different habitat types. In order to provide a background framework from which to discuss the biological resource impacts of the AIPCP, the habitat types within the AIPCP area are first described. The NCCP's planning agreement (Section 2800 of the NCCPA) notes that natural communities are "those species and their habitat identified by the department that are necessary to maintain the continued viability of those biological communities." The CALFED Multispecies Conservation Strategy (MSCS) developed a classification system for eighteen habitats and two ecologically-based fish groups (CALFED July 2000). These categories include several habitat or vegetation types found in frequently used classification systems, such as the CDFW's California Wildlife Habitat Relationships System.

The BDCP identifies natural habitats more specific to the Delta region. In particular, there are 13 natural habitats identified in the Plan area, in addition to a separate community referred to as Cultivated Lands. Of these 14 habitats, eight fall within the AIPCP area, and are described below.

Additionally, two fish groups (anadromous and estuarine) also fall within the plan area. The fish groups were developed because typical habitat classifications, based on vegetation, land-use, and geography, do not adequately address these groups, which move between habitats. Fish species included within the two fish groups were defined as those that are most affected by CALFED water projects, depend on the Bay-Delta ecosystem, and are subject to established USFWS, NMFS, and CDFW recovery goals (USBR 2003, 5-20).

The CDFW (formerly CDFG) released a draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (CDFW 2011) as part of the CALFED process. After passage of the Delta Reform Act, CDFW coordinated their ongoing planning efforts with the Delta Conservancy and Delta Stewardship Council, as well as the BDCP. The challenge of meeting water supply and ecosystem needs in the Delta has also been the subject of three National Academy of Sciences studies since 2010.

California EcoRestore is a California Natural Resources Agency initiative implemented in coordination with state and federal agencies to advance the restoration of at least 30,000 acres of Delta habitat by 2020. EcoRestore is pursuing habitat restoration projects with clearly defined goals, measurable objectives, and financial resources. The program has identified 27 projects, distributed as follows, that will seek to restore several of the habitat categories described below:

- 3,500 acres managed wetland creation
- 9,000 acres tidal and sub-tidal habitat restoration
- 1,000+ acres Proposition 1 and 1E funded restoration projects
- 17,500+ acres floodplain restoration.

Tidal Perennial Aquatic

Tidal Perennial Aquatic (TPA) habitat is defined as deep water aquatic (greater than three meters deep from mean low tide), shallow aquatic (less than or equal to three meters from mean low tide), and un-vegetated intertidal (i.e., tidalflats) zones of estuarine bays, river channels, and sloughs (CALFED July 2000). This habitat can be found throughout the Delta, including sloughs, channels, and flooded islands. TPA habitat includes many marine, estuarine, anadromous, and resident fish, wildlife, and plants (CALFED July 2000). Resident and migratory fish, such as young salmon, striped bass, delta smelt, splittail, and native resident Bay-Delta fish, use the habitat for rearing, foraging, and escape cover (CALFED July 2000). Wildlife in TPA habitat includes shorebirds, wading birds, and waterfowl (CALFED July 2000). There are no special status plants associated with tidal perennial aquatic habitats (CALFED July 2000, C-2-1 to C-2-12). However, many animal species rely on tidal perennial aquatic habitat during some portion of their life cycle. The dominant vegetation includes wetland plants, although some TPA habitat includes unvegetated intertidal zones.

PA habitat often includes AIPCPs, including water hyacinth, water primrose, *Egeria densa*, hornwort, parrot's feather, and western milfoil. Mats of noxious weeds, such as spongeplant, water hyacinth, or *Egeria densa*, can clog waterways, shade habitat for native aquatic vegetation, and smother low-growing intertidal vegetation when washed onto channel banks (DWR 2006, 6.2-6).

There has been a substantial loss of historic shallow tidal waters, mainly as a result of reclamation and channel dredging and scouring. Many leveed lands in the Delta have subsided and are too low to support shallow tidal perennial aquatic habitat. Mid-channel islands and shoals have been shrinking or disappearing from progressive erosion of the remaining habitat.

Major factors contributing to the loss of mid-channel islands and shoals are gradual erosion from channels conveying water across the Delta to South Delta pumping plants, boat wakes, and dredging within the Delta or adjacent waters (streams and rivers).

Tidal Freshwater Emergent Wetland

Tidal freshwater emergent wetland (TFEW) habitat often occurs in the shallow, slow-moving, or stagnant edges of freshwater waterways in the intertidal zone and is subject to frequent long-duration flooding. It includes portions of the intertidal zones of the Delta that support emergent wetland plant species that are not tolerant of saline or brackish conditions (CALFED July 2000). Tidal freshwater emergent wetland occurs within the Delta along island levees, channel islands, and shorelines (USBR 2003, 5-11), including potential sites with AIPs.

The dominant vegetation for tidal freshwater emergent wetland habitat includes bulrush, tules, cattails, and common reed. Several special status plant species potentially affected by the AIPCP are found within this habitat, including Suisun Marsh aster, wooly rose-mallow, Delta tule pea, Mason's lilaeopsis, and Delta mudwort (CALFED July 2000, C-2-1 to C-2-12). Freshwater emergent wetlands are among the most productive wildlife habitats in California, providing food, cover, and water for more than 160 species of birds, as well as many mammals, reptiles, and amphibians (USBR 2003, 5-10).

Historically, freshwater marshes were widespread throughout the Delta and backwaters of the upper Sacramento River. Many types of wetlands and their inhabitants have disappeared. Between 30 and 50 percent of the original wetlands of the United States have been lost, mostly to urban development, water diversions, conversion of land to agriculture, or contamination. Until the 1950s, the rate of wetland loss in the United States was more than 800,000 acres per year, dropping to less than 80,000 acres per year in the 1980s and early 1990s (Heimlich 1998). The Clean Water Act has a policy of "no net loss of wetland" that has reduced wetland loss in the United States, estimated to be less than 60,000 acres per year in the late 1990s.

In California, 90 percent of the original five million acres of wetlands has been lost, much of it within the Delta. Levees and other land uses led to loss of fresh emergent wetland in the Delta, reducing habitat for wetland wildlife species as well. Fresh emergent wetland losses have also substantially reduced the area available for biological conversion of nutrients in the Delta. The Delta now contains insufficient wetland area to provide adequate levels of nutrient transformation, which results in lower water quality in San Francisco Bay (USBR 2003, 5-10).

Valley/Foothill Riparian

Valley/foothill riparian (VFR) habitat includes all successional stages of woody vegetation, within active and historical floodplains of low-gradient reaches of streams and rivers generally below an elevation of 300 feet (CALFED July 2000). VFR habitat encompasses the approximately 0.1- to 1.0-mile width of woody vegetation along riverine habitats, including Delta waterways such as the Sacramento, San Joaquin, Cosumnes, Mokelumne, and Calaveras rivers and other sloughs, streams, and ephemeral creeks (USBR 2003, 5-16). AIPs may occur adjacent to, but not within, VFR.

Valley/foothill riparian habitat is dominated by cottonwood, sycamore, alder, ash, and valley oak tree overstory; and a blackberry, poison oak, and wild grape understory (USBR 2003, 5-15). None of the special status plants impacted by the AIPCP fall within this habitat. However, valley elderberry shrub, protected for the valley elderberry longhorn beetle, exist in this habitat. Over 225 species of birds, mammals, reptiles, and amphibians depend on riparian habitats and cottonwood-willow riparian areas support more breeding avian species than any other broad California habitat type (USBR 2003, 5-15).

The condition of riverine aquatic and nearshore habitats in the Delta has not been well documented, however, these habitats have been degraded by channel straightening; channel incising; channel dredging and clearing; instream gravel mining; riparian zone grazing; flow modifications; removal and fragmentation of shoreline riparian vegetation; and the loss of sediment, bedload, and woody debris from upstream watershed sources (USBR 2003, 5-15).

Nontidal Perennial Aquatic

The nontidal perennial aquatic (NPA) natural community is found in association with any terrestrial habitat and often transitions into nontidal freshwater perennial emergent wetland and valley/foothill riparian. It is distributed throughout the BDCP area in all conservation zones and occurs mostly in small isolated patches along drainage and irrigation ditches in a cultivated landscape. This community can range in size from small ponds in upland areas to small lakes, such as the North and South Stone Lakes.

NPA habitat typically has poor wildlife value because shorelines and adjacent lands are generally insufficient to support nesting and protection (CALFED July 2000). If these habitats are restored, ecological value may improve and these habitats could provide nesting and foraging habitat for birds (CALFED July 2000). Nonplant primary producers such as diatoms, desmids, and filamentous green algae often form the base of the foodweb where they dominate open water habitat. Plant species found in this community vary with inundation depth and distance from shore, from submerged aquatics (e.g., pondweed and *Egeria*) to floating aquatic vegetation (e.g., duckweed and water hyacinth) that are found closer to shore and which may increase the rates of sediment and organic matter accumulation.

Nontidal Freshwater Perennial Emergent Wetland

Nontidal freshwater perennial emergent wetland (NFPEW) habitat includes permanent (natural and managed) wetlands, including meadows, dominated by wetland plant species that are not tolerant of saline or brackish conditions (CALFED July 2000). NFPE habitat occurs throughout the Delta in areas where soils are inundated or saturated for all or most of the growing season, such as landward sides of levees, constructed waterways, ponds, and on Delta islands in low-lying areas among crop and pasture land (USBR 2003, 5-12). Portions of the AIPCP treatment area are within this classification.

Vegetation and wildlife for nontidal freshwater permanent emergent habitats are similar to tidal freshwater emergent wetland habitats (USBR 2003, 5-11). Special status plant species potentially affected by the project and within this habitat include: wooly rose-mallow, Sanford’s arrowhead, marsh skullcap, and side-flowering skullcap. The decline of nontidal freshwater perennial emergent wetland habitats is similar to that described for tidal freshwater emergent wetland habitats.

Managed Wetland

Managed seasonal wetland habitat includes wetlands dominated by native or non-native herbaceous plants, excluding croplands farmed for profit (e.g., rice), that land managers flood and drain during specific periods to enhance habitat values for specific wildlife species. Ditches and drains associated with managed seasonal wetlands are included in this habitat type (CALFED July 2000). Managed seasonal wetlands occur throughout the Delta, and are within the AIPCP project area, including private lands managed primarily for waterfowl or state and federal wildlife areas/refuges (USBR 2003, 5-14). AIPCP treatment sites may occur adjacent to managed seasonal wetland habitat.

Vegetation and wildlife species associated with managed seasonal wetland habitats are similar to those associated with natural seasonal wetland habitats, with the exception of vernal pool species (USBR 2003, 5-14). There are no plant species of concern potentially affected by the project within this habitat classification.

The extent and quality of managed seasonal wetlands vary, based on the practices that create and maintain this type of habitat.

Other Natural Seasonal Wetland

Natural seasonal wetland habitat includes vernal pools and other nonmanaged seasonal wetlands with natural hydrologic conditions that are dominated by herbaceous vegetation. These habitats also annually collect surface water or maintain saturated soils at the ground surface for enough of the year to support a variety of wetland plant species. Alkaline and saline seasonal wetlands that were not historically part of a tidal regime are included in natural seasonal wetlands (CALFED July 2000). Vernal pools, including those recently protected in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005a) are found within the broader AIPCP control area, but are not adjacent to waterways, and thus will not be impacted by the program. The three vernal pool regions that are within the Delta are the Solano-Colusa region, Southeastern Sacramento Valley region, and San Joaquin region (USFWS 2005a).

Cultivated Lands

Cultivated Lands habitat includes agricultural lands farmed for small grains, field crops, truck crops, forage crops, pastures, orchards, and vineyards (USBR 2003, 5-15). Of the total BDCP area, 66 percent is cultivated. Of the total acreage of irrigated land in the Delta, which encompasses both seasonally flooded and upland cropland, corn is currently the predominant cover type (28 percent), followed by alfalfa (21 percent), pasture (12 percent), and tomatoes (8 percent). Orchards cover 4 percent of the total irrigated land acreage in the Delta, and asparagus covers 3 percent. AIPs may be situated in waterways adjacent to upland cropland habitat.

Anadromous Fish Group

The anadromous fish group includes tidal perennial aquatic, valley riverine aquatic, montane river aquatic, saline emergent, and tidal freshwater emergent aquatic habitats. Fish species of concern associated with these habitats include Sacramento river winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead evolutionary significant units (ESUs), and green sturgeon (USBR 2003, 5-22). All of these species are potentially impacted by the AIPCP, and are discussed in this chapter.

Estuarine Fish Group

The estuarine fish group includes tidal perennial aquatic, valley riverine aquatic, saline emergent, and tidal freshwater aquatic habitats. Fish species of concern associated with these habitats include tidewater goby, delta smelt, longfin smelt, Sacramento splittail, and Sacramento perch (USBR 2003, 5-22). Three of these species, delta smelt, longfin smelt, and Sacramento splittail, may potentially be impacted by the AIPCP, and are discussed in this chapter.

4. Special Status Species

The AIPCP occurs on waterways within portions of 11 counties: Alameda, Contra Costa, Fresno, Madera, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Tuolumne, and Yolo. DBW obtained lists of State and federal special status species occurring within these 11 counties from the USFWS, and the California Natural Diversity Database (CNDDB). Federal endangered and threatened species are regulated by USFWS and NMFS, through the Endangered Species Act (ESA). California threatened and endangered species are regulated by CDFW, through the California Endangered Species Act (CESA).

The 30 special status species that may occur in, or utilize, habitats potentially impacted by the AIPCP are identified in **Exhibit 3-1.** There are eleven special status plants, one invertebrate, eleven fish, one amphibian, two reptiles, four birds, and six critical habitats potentially impacted by AIPCP activities.

Under the ESA, the federal government may identify critical habitats for specific listed species. Critical habitats are defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. The six species that are potentially impacted by the AIPCP, and for which critical habitat has been designated, are: (1) delta smelt, (2) Central Valley steelhead, (3) North American green sturgeon, Southern Distinct Population Segment (DPS), (4) Central Valley spring-run Chinook salmon, (5) Sacramento River winter-run Chinook salmon, and (6) California red-legged frog. Parts of the critical habitat for the first five of these species occur within the AIPCP, however none of the designated critical habitat for the California red-legged frog occurs within the AIPCP area. Below is the current status of each of these species; potential impacts of the AIPCP on these species are described in the impacts analysis section.

The majority of the special status species identified for these 11 relevant counties do not occur in, or utilize, waterways, channels, and channel banks of the Delta or its tributaries. For example, many of the identified species occur in mountainous or coastal habitats within the 11 counties, not within the Delta region. Other species may occur within the Delta, but are not at all likely to be impacted by AIPCP activities. This programmatic EIR does not consider these majority special status species.

Exhibit 3-22 identifies more than 250 species that are not expected to be impacted by the AIPCP, but that may occur within the 11 AIPCP counties. Less than ten percent of all the special status species identified for the 11 AIPCP counties could be potentially impacted by the AIPCP.

No new primary data surveys were conducted specifically for this PEIR. However, data from previous DBW and prior relevant plant or wildlife surveys were included in this PEIR. DBW has monitored and reviewed environmental impacts of their aquatic weed control programs each year since 1983.

Exhibit 3-1
Special Status Species Potentially Impacted by the AIPCP *Page 1 of 2*

Invertebrates		
Scientific Name	**Common Name**	**Status***
1. *Desmocerus californicus dimorphus*	valley elderberry longhorn beetle	FT

Fish		
Scientific Name	**Common Name**	**Status**
1. *Acipenser medirostris*	green sturgeon	FT, FCH, CSC
2. *Acipenser transmontanus*	white sturgeon	CSC
3. *Entosphenus* tridentatus	Pacific lamprey	CSC
4. *Hypomesus transpacificus*	delta smelt	FT (approved FE)[1], FCH, CE
5. *Lampetra ayresi*	river lamprey	CSC
6. *Oncorhynchus mykiss*	Central Valley steelhead	FT, FCH
7. *Oncorhynchus tshawytscha*	Central Valley spring-run Chinook salmon	FT, FCH, CT
8. *Oncorhynchus tshawytscha*	Central Valley fall and late-fall Chinook salmon	CSC
9. *Oncorhynchus tshawytscha*	Sacramento River winter-run Chinook salmon	FE, FCH, CE
10. *Pogonichthys macrolepidotus*	Sacramento splittail	CSC
11. *Spirinchus thaleichthys*	longfin smelt	CT, under consideration for federal listing

Amphibians		
Scientific Name	**Common Name**	**Status**
1. *Rana aurora draytonii*	California red-legged frog	FT, FCH, CSC

Reptiles		
Scientific Name	**Common Name**	**Status**
1. *Clemmys marmorata*	western pond turtle	CSC
2. *Thamnophis gigas*	giant garter snake	FT, CT

Birds		
Scientific Name	**Common Name**	**Status**
1. *Agelaius tricolor*	tricolored blackbird	CSC
2. *Laterallus jamaicensis coturniculus*	California black rail	CT
3. *Xanthocephalus xanthocephalus*	yellow-headed blackbird	CSC
4. *Buteo Swainsoni*	Swainson's hawk	CT

[1] USFWS initiated a five-year review to assess endangered species classification on March 25, 2009.

Exhibit 3-1
Special Status Species Potentially Impacted by the AIPCP *(continued)* *Page 2 of 2*

Plants		
Scientific Name	**Common Name**	**Status***
1. *Carex comosa*	bristly sedge	CNPS 2.1
2. *Hibiscus lasiocarpus*	wooly rose-mallow	CNPS 2.2
3. *Lathyrus jepsonii var. jepsonii*	Delta tule pea	CNPS 1B.2
4. *Lilaeopsis masonii*	Mason's lilaeopsis	CR, CNPS 1B.1
5. *Limonsella subulata*	Delta mudwort	CNPS 2.1
6. *Potamogeton zosteriformis*	Eel-grass pondweed	CNPS 2.2
7. *Sagittaria sanfordii*	Sanford's arrowhead	CNPS 1B.2
8. *Scutellaria galericulata*	marsh skullcap	CNPS 2.2
9. *Scutellaria lateriflora*	side-flowering skullcap	CNPS 2.2
10. *Symphyotrichum lentum*	Suisun Marsh aster	CNPS 1B.2
11. *Trichocoronis wrightii var. wrightii*	Wright's trichocoronis	CNPS 2.1

* Status Key

FE – federal endangered
FT – federal threatened
FCH – federal critical habitat specified for this species (of the six critical habitats identified in Exhibit 3-1, five include areas within the AIPCP, and could potentially be impacted by the AIPCP. Critical habitat for the California red-legged frog does not occur within the AIPCP area.)
FC – federal candidate for consideration of endangered or threatened
FCHP – federal critical habitat for this species is proposed
CE – California endangered
CT – California threatened
CR – California rare
CSC – California species of special concern
CNPS – California Native Plant Society listings:
1B.1: plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California
1B.2: plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California
2.1: plants rare, threatened, or endangered in California, but more common elsewhere; seriously threatened in California
2.2: plants rare, threatened, or endangered in California, but more common elsewhere; fairly threatened in California

Bolds above indicate plant has been found in DBW surveys.

5. Invertebrates

Only one special status invertebrate, the valley elderberry longhorn beetle, could potentially be affected by AIPCP operations.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle is classified as federally threatened. The most recent 5-year review of valley elderberry longhorn beetle, completed in September 2006, recommended delisting the beetle, primarily due to the fact that conservation actions have resulted in protection of 50,000 acres of riparian habitat and the restoration of 1,500 acres of beetle habitat. In addition, the number of occurrences increased from 10 locations in 1980, to 190 known locations in 2006 (USFWS 2009a).

Source: www.fws.gov.

Photo: Valley Elderberry Longhorn Beetle.

On September 10, 2010, USFWS received a petition from the Pacific Legal Foundation requesting that USFWS delist the valley elderberry longhorn beetle. USFWS initiated a 12-month status review on August 19, 2011, to determine if delisting was warranted (Federal Register, August 19, 2011). The USFWS published its proposed rule in the Federal Register on October 2, 2012, recommending the delisting of the valley elderberry longhorn beetle and the removal of designated critical habitat. However, USFWS withdrew the proposed rule in on September 17, 2014 based on their determination that the proposed rule did not fully analyze the best available information (79 FR 55873).

Valley elderberry longhorn beetle is a dimorphic species strictly tied to its host plant, the elderberry (*Sambucus* ssp.) during its entire life cycle. Adults emerge from pupation inside the wood of the elderberry in the spring as the trees begin to flower. The exit holes made by the emerging adults are distinctive small oval openings. Often these holes are the only clue that beetles occur in an area. Adults eat elderberry foliage until approximately June when they mate. Females lay eggs in crevices in the bark. Upon hatching, larvae begin to tunnel into the shrub, where they will spend one to two years eating interior wood, which is their sole food source.

Valley elderberry longhorn beetle historically occurred throughout the Sacramento and San Joaquin valleys and into the foothills of the Coast Ranges and the Sierra Nevada to 2,200-foot in elevation. Elderberry shrub is a common component of riparian forests and savannah areas (USFWS 2004c). Recent surveys have found beetles in only scattered localities along the Sacramento, American, San Joaquin, Kings, Kaweah, and Tuolumne rivers and their tributaries. Valley elderberry shrubs with evidence of beetles have been spotted in AIPCP treatment sites along the Sacramento and Cosumnes Rivers (CNDDB 2006).

Over the last 150 years, agricultural and urban development has destroyed 90 percent of Central Valley riparian vegetation, which included the elderberry host plant, resulting in extreme fragmentation of the beetle's habitat.

The valley elderberry longhorn beetle is threatened by habitat loss and fragmentation, invasion by Argentine ants, agricultural conversion, levee construction, removal of riparian vegetation, riprapping of shoreline, and possibly other factors such as pesticide drift, exotic plant invasion, and grazing (USFWS 2004).

6. Fish

Fish dependent on the Delta as a migration corridor, nursery, or permanent residence include striped bass, American shad, sturgeon, Chinook salmon, steelhead, catfish, largemouth bass, and numerous less known marine and freshwater species. Since 1993, 87 species of fish have been identified in the Delta during the CDFW/ Interagency Ecology Program (IEP) fall midwater trawl (FMWT) survey, and salvage at the SWP pumping plant. In these two surveys, introduced species accounted for over 40 percent of the total number reported (Sommer et al. 2007) (more recently the share of introduced species has grown).

The majority of fish species and counts found in the Delta are non-native. **Exhibit 3-2** summarizes beach seine survey data for 26 Delta sites from 1995 to 2015 (Mahardja et al. 2017). Mahardja et al. examined the survey time series to evaluate changes in catch per effort, fish community composition, and biomass per volume, comparing these results to the same time period as the pelagic organism decline (POD). This is particularly concerning to Mahardja et al., who note that "the concurrent nature of these changes [POD and pelagic zooplankton] therefore can be interpreted as a major shift in the ecosystem from a largely pelagic food web to a littoral one" (Mahardja et al. 2017, p.7).

Exhibit 3-2 shows the dominance of invasive fish species found over the last 22 years. Of the 1.6 million fish surveyed, 91 percent were invasive species, dominated by Mississippi silverside. There were 32 different invasive species captured, and fifteen different native species captured. The maximum number of any native species captured was 86,258 (splittail), as compared to the 1.1 million Mississippi silverside captured.

Exhibit 3-3, also from Mahardja et al., illustrates some interannual variability, but a substantial overall increase in non-native fish species biomass over the time period. The study also found an increase in the composition of littoral fish biomass over the study period, with over 50 percent of the total biomass comprised of non-native Centrarchid species and Mississippi Silversides. Silversides are known to be heavy predators of Delta smelt (Bennett 2005; Sommer 2017).

Of more than 80 fish species in the Delta, important game fish include American shad, Chinook salmon, steelhead, and striped bass. Although all these fish spend most of their adult lives in the lower bays or in the ocean, the Delta is an important habitat for most of them. Two of these species (American shad and striped bass) are invasive, and two are listed species (Chinook salmon and steelhead).

Two Natural Community Conservation Plan (NCCP) habitat types for fish are present in the Delta: the Anadromous Fish Group, and the Estuarine Fish Group. Special status fish from each of these groups are potentially impacted by the AIPCP, and are described below. Delta fish habitat types include estuary, fresh water, and marine water. Transition from one zone to the next is gradual, and the zones move up or downstream depending on the amount of fresh water entering the estuary, outflow regime and water year hydrology.

Delta aquatic habitat varies from dead-end sloughs to deep, open-water areas of the lower Sacramento and San Joaquin rivers and Suisun Bay. A scattering of flooded islands also offer submerged vegetative shelter. Channel banks are varied and include riprap, tules, emergent marshes, and native riparian habitat. The dominant channel banks are those that have been modified for flood control or navigation. There have also been substantial increases in the invasive aquatic weed, *Egeria densa*, over the past twenty years, further modifying the habitat (Feyrer et al. 2007). Water temperatures generally reflect ambient air temperatures, but riverine shading may moderate summer temperatures in some areas.

Food supplies for Delta fish communities consist of phytoplankton, zooplankton, benthic invertebrates (living in the sediment), insects, and fish. General productivity is in constant flux. Monitoring of productivity is ongoing, including an evaluation of the interrelationships of the food web by the IEP for the Delta and Suisun Marsh. Evaluations of zooplankton in the Delta have found that all native zooplanktons have decreased in abundance since they were first monitored in the 1970s. At the same time, many introduced species are now more abundant (Mecum 2005). Monitoring data for zooplankton, phytoplankton, and benthic organisms indicate that overall productivity at lower food chain levels has decreased during the past 30 years.

The entrapment zone (at the X2 salinity line) concentrates sediments, nutrients, phytoplankton, some fish larvae, and fish food organisms. Biological standing crop (biomass) of phytoplankton and zooplankton in the estuary was historically highest in this zone. However, phytoplankton levels no longer show a peak in the entrapment zone, since introduced clams began cropping production in 1987. Keeping the entrapment zone in the upper reaches of Suisun Bay creates more desirable habitat for some species than could be maintained in narrower channels upstream in the Delta.

Flows caused, provided, or controlled by the CVP and SWP affect fish in numerous ways. Flows toward project pumps can draw both fish and fish food organisms into export facilities. Most large fish are screened out, but many do not survive screening and subsequent handling. Most fish less than about an inch long, and fish food, pass through the screens. In addition, the draw of the pumps may cause water in some channels to flow too fast for optimal fish food production, and reverse flows in some channels may confuse migrating fish. Delta flows may act as cues for anadromous fish outmigrating to the ocean.

Exhibit 3-2
Numbers and Species of Fish Collected in Delta Fish Surveys at 26 Locations (March through August) (1995 to 2015)

#	Common Name	Scientific Name	Status*	Total Count	2001 and 2003 Percent
1	Mississippi silverside	*Menidia beryllina*	I	1,118,510	69%
2	Threadfin shad	*Dorosoma petenense*	I	148,819	9%
3	Red shiner	*Cyprinella lutrensis*	I	120,282	7%
4	Western mosquitofish	*Gambusia affinis*	I	13,569	0.8%
5	Yellowfin goby	*Acanthogobius flavimanus*	I	13,390	0.8%
6	Redear sunfish	*Lepomis microlophus*	I	9,934	0.6%
7	Largemouth bass	*Micropterus salmoides*	I	8,345	0.5%
8	Bluegill	*Leposmis macrochirus*	I	7,274	0.5%
9	Golden shiner	*Notemigonus crysoleucas*	I	6,730	0.4%
10	Striped bass	*Morone saxatilis*	I	4,212	0.3%
11	American shad	*Alosa sapidissima*	I	3,274	0.2%
12	Shimofuri goby	*Tridentiger bifasciatus*	I	2,796	0.2%
13	Rainwater killifish	*Lucania parva*	I	2,778	0.2%
14	Fathead minnow	*Ptychocheleius grandis*	I	2,259	0.1%
15	Common carp	*Cyprinus carpio*	I	1,845	0.1%
16	Spotted bass	*Micropterus puntulatus*	I	1,660	0.1%
17	Bigscale logperch	*Percina macrolepida*	I	1,236	0.1%
18	Wakasagi	*Hypomesus nipponensis*	I	1,052	0.1%
19	Smallmouth bass	*Micropterus dolomieui*	I	325	0.02%
20	Black crappie	*Pomoxis nigromaculatus*	I	257	0.02%
21	Unknown black bass	*Micropterus spp*	I	255	0.02%
22	Hardhead	*Mylopharodon conoephalus*	I	131	0.01%
23	White crappie	*Pomoxis annularis*	I	77	0.005%
24	Green sunfish	*Lepomis cyanellus*	I	64	0.004%
25	Goldfish	*Carassius auratus*	I	42	0.003%
26	White catfish	*Ameiurus catus*	I	41	0.003%
27	Black bullhead	*Ameiurus melas*	I	34	0.002%
28	Brown bullhead	*Ameiurus nebulosus*	I	25	0.002%
29	Warmouth	*Lepomis gulosus*	I	24	0.001%
30	Redeye bass	*Micropterus coosae*	I	20	0.001%
31	Channel catfish	*Ictalurus punctatus*	I	10	0.001%
32	Shokihaze goby	*Tridentiger barbosus*	I	3	0.0002%

Exhibit 3-2
Numbers and Species of Fish Collected in Delta Fish Surveys at 26 Locations (March through August) (1995 to 2015) *(continued)*

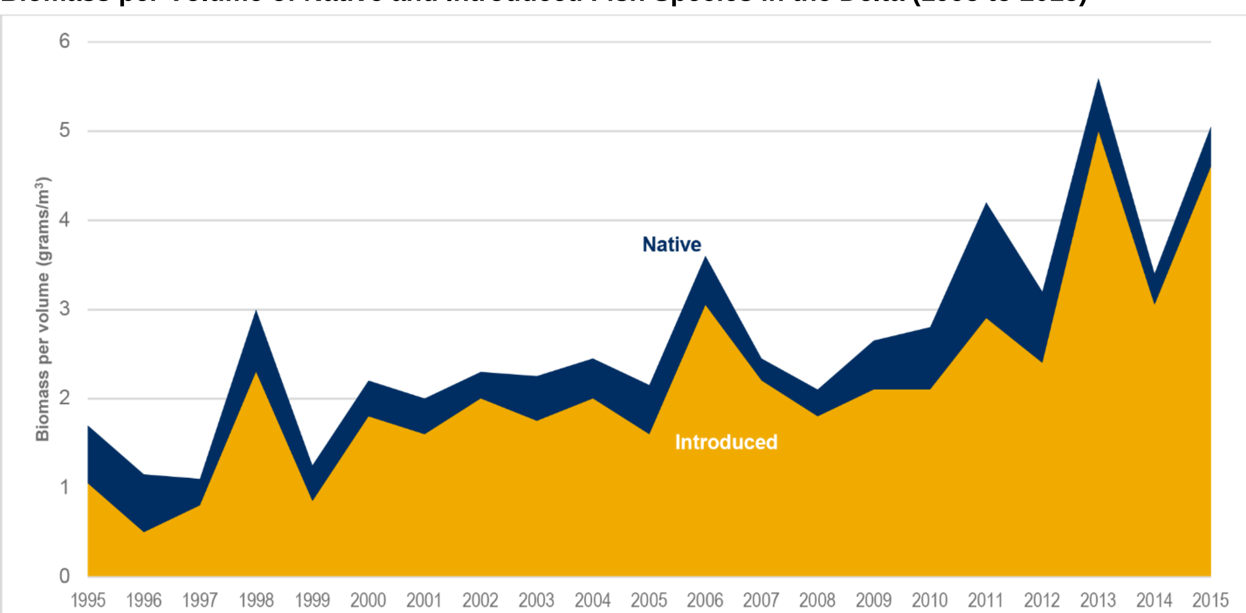
Page 2 of 2

#	Common Name	Scientific Name	Status*	Total Count	2001 and 2003 Percent
1	Splittail	*Pogonichthys macrolepidotus*	N	86,258	5.3%
2	Sacramento sucker	*Catostomus occidentalis*	N	35,149	2.2%
3	Sacramento pikeminnow	*Ptychocheleius grandis*	N	11,080	0.7%
4	Tule perch	*Hysterocarpus traski*	N	6,408	0.4%
5	Hitch	*Lavinia exilicauda*	N	1,445	0.1%
6	Delta smelt	*Hypomesus transpacificus*	N	1,295	0.1%
7	Three-spine stickleback	*Gasterosteus acculeatus*	N	1,120	0.1%
8	Prickly sculpin	*Cottus asper*	N	999	0.1%
9	Pacific staghorn sculpin	*Leptocottus armatus*	N	908	0.1%
10	Sacramento blackfish	*Orthodon microlepidotus*	N	127	0.01%
11	Starry flounder	*Platyichthys stellatus*	N	58	0.004%
12	Chameleon goby	*Tridentiger trigonocephalus*	N	33	0.002%
13	California roach	*Hesperoleucus symmetricus*	N	32	0.002%
14	Longfin smelt	*Spirinchus thaleichthys*	N	29	0.002%
15	Pacific herring	*Clupea palasii*	N	18	0.001%
	Total, All Species			1,614,232	

Source: Mahardja et al. 2017

* “I” identifies invasive or non-native species, “N” identifies native species.

Exhibit 3-3
Biomass per Volume of Native and Introduced Fish Species in the Delta (1995 to 2015)



Factors other than CVP and SWP operations that affect fish include water diversions within the Delta; upstream spawning conditions and diversions; municipal, industrial, and agricultural water pollution; habitat reduction; legal and illegal harvesting; competition from introduced species; natural predator/prey interactions; reduced food abundance; temperature; and drought. Cumulative effects of these and other factors have contributed to declining populations of many Delta fish.

Abundance of four important Delta fish species, native longfin smelt and delta smelt, and introduced striped bass and threadfin shad, have declined sharply since 2002. The decline was unexpected, given moderate winter-spring flows in the immediately preceding years. The Interagency Ecological Program (IEP) initiated a Pelagic Organism Decline (POD) working group in 2005 to evaluate causes of the decline.

The POD working group initially evaluated three general factors that appeared to be individually, or in concert, lowering pelagic productivity: invasive species (including the Asian clam, which consumes plankton); toxins; and water project operations (Armor et al. 2005). Increased water flows from the Delta through CVP and SWP operations have been targeted by many as a major cause of fish decline (Contra Costa Times 2006).

Analyses conducted in parallel with the POD working group examined other potential causes of pelagic organism decline. Engineers at the Contra Costa Water District hypothesized that salinity may be a threat to dwindling delta smelt (Taugher 2006). The engineers hypothesized that shifting the timing of State water project deliveries may have led to saltier water in the fall, and for same reason, may be leading to fewer delta smelt.

A presentation made by DWR environmental scientists at the 4th Biennial CALFED Science Conference on October 24, 2006, found declines in indices for habitat quality associated with salinity and turbidity variables. The scientists opined that turbidity indicators can be closely associated with submerged aquatic vegetation (including the invasive *Egeria densa*) (Feyrer et al. 2007). DWR scientists are also studying the effects of toxic algae in the Delta to determine whether it poses a serious threat to human health, and to determine if it plays a role in the Delta's ongoing ecosystem concerns (Taugher 2005). The algae, *Microsystis aeruginosa* (Microcystis toxins) was first discovered in the Delta circa 1999.

A San Francisco State University study considered the impact of ammonia in wastewater released from the Sacramento Regional County Sanitation District facility in Freeport (Weiser 2008). Ammonia may disrupt the Delta food chain by reducing the availability of phytoplankton. This in turn reduces the amount of zooplankton available for fish species such as the delta smelt. Because the Sacramento region has grown significantly, the volume of wastewater has increased. In early 2009, a CalFed panel reported that ammonia is a likely contributor to environmental shifts in the Delta. The panel recommended further research (Weiser 2009).

In 2010, a study by the UC Davis Aquatic Toxicology Laboratory and the CDFW was published analyzing two years of toxicity monitoring data in the Delta (Werner et al. 2010). The study results supported the claim that the water in the North Sacramento-San Joaquin estuary was at times acutely toxic to sensitive invertebrates. The authors found that sites in the Lower Sacramento River had the largest number of acutely toxic samples, high occurrence of piperonyl butoxide (PBO) effects on ampiphod growth, and the highest total ammonia/ammonium concentrations.

By 2010, the POD working group refined their analysis, developing three conceptual modeling approaches for identifying causes of pelagic organism decline. The "basic POD conceptual model" was introduced in 2006 and groups the effects of potential drivers into four categories: (1) previous abundance; (2) habitat; (3) top-down effects; and (4) bottom-up effects (Baxter et al. 2010). Previous abundance considers stock-recruitment levels and survival among different life stages. Habitat considers analyses of water clarity, salinity, temperature, and contaminants. Top-down effects evaluate predator relationships, including how invasive species such as *Egeria densa* improve habitats for invasive prey species (e.g. largemouth bass). Bottom-up effects consider the importance of food resources, particularly for delta smelt. The change in species composition of Delta zooplankton, with dominance of invasive plankton species, is of particular interest. The second conceptual model approach, introduced in 2008, is a "species-specific conceptual model" that shows how key population drivers affect each of the four POD species in each season. The most recent conceptual model, introduced in 2010 as a working hypothesis to be tested, suggests that the POD represents a rapid ecological regime shift that followed a longer-term erosion of ecological resilience (Baxter et al. 2010).

In other related actions, a federal court decision dated December 14, 2007, required the Bureau of Reclamation and CDWR to restrict water exports to specified levels in order to protect delta smelt larvae and juveniles. The decision also required the agencies to obtain a new biological opinion from the USFWS for the Operation Criteria and Plan (OCAP) for the SWP and CVP.

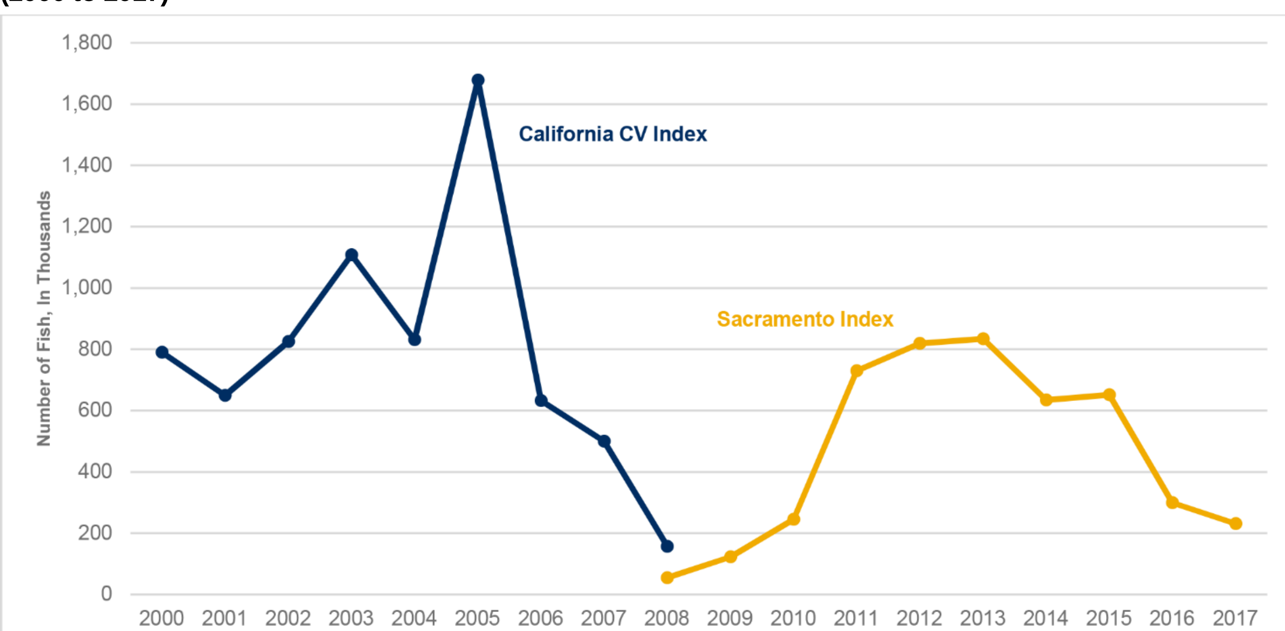
The USBR prepared a biological assessment for OCAP in August 2008. In June 2009, NMFS delivered its biological opinion and conference opinion on the proposed long-term operations on the CVP and SWP, concluding that the proposed action would likely jeopardize the continued existence of several threatened and endangered species. The biological opinion included a Reasonable and Prudent Alternative (RPA) that would allow the projects to continue operating without causing jeopardy or adverse modification. The RPA includes measures to improve habitat, reduce entrainment, and improve salvage, through both operational and physical changes in the system. Additionally, the RPA includes development of new monitoring and reporting groups to assist in water operations through the CVP and SWP systems and a requirement to study passage and other migratory conditions.

Salmon abundance has not followed the same pattern as pelagic species. As a result of low abundance measures, the Pacific Fishery Management Council (PFMC) and NMFS have closed the commercial and recreational ocean salmon fisheries from Cape Falcon (in northern Oregon), south into California several times over the last ten years.

The causes of this unprecedented decline are unknown, but likely factors include ocean temperature changes, in-stream water withdrawals, habitat alternations, dam operations, construction, pollution, and changes in hatchery operations (PFMC 2008b).

Exhibit 3-4 preseason estimates of Central Valley adult Chinook salmon stock forecasts in thousands of fish. The Central Valley Index was used for the 2000 to 2008 period, and includes fall, late fall, spring, and winter-run (PFMC 2008b). The Sacramento Index was used for the 2008 to 2017 period, and includes fall run (PFMC 2009 and 2017).

Exhibit 3-4
Preseason Adult Chinook Salmon Stock Forecasts Central Valley Index (CVI) and Sacramento Index (SI) (2000 to 2017)



Source: PFMC, February 2008, February 2009, March 2017.

<u>Green Sturgeon</u>

Photo: Green Sturgeon.

Green sturgeon (*Acipenser medirostris*) southern population (south of the Eel River), found in San Francisco Bay and the Delta, was designated as a federal threatened species by NMFS in July 2006. Critical habitat was designated in October 2009. Take prohibitions were established in June 2010. In August 2015, NMFS conducted a 5-year Review Summary and Evaluation of the DPS of the green sturgeon and recommended that the status threatened remain in place. The Southern DPS is separate from green sturgeon found at the Eel River and north to British Columbia (NMFS February 2005). The green sturgeon is also listed as a California species of special concern by CDFW. There are many studies currently underway by a number of universities and state and federal agencies to better understand the distribution, migration, spawning habitat utilization, and population genetics of green sturgeon.

Green sturgeon is a large, olive green, bony-plated, prehistoric looking fish, with a shovel-like snout and vacuum cleaner-like mouth used to siphon food from the mud. Green sturgeon can reach over seven feet in length, weigh up to 350 pounds, and may live to be 60 to 70 years of age (CBD 2006). The Sacramento River contains the only known spawning population of southern DPS green sturgeon.

IEP fish monitoring in the San Francisco Bay, Delta, and river systems captured only 34 green sturgeons between April 2001 and September 2006, out of more than 100,000 fish sampled (IEP 2006). Most captured sturgeon (17) were found at facilities adjacent to the SWP and CVP pumps in the South Delta, indicating that they are found throughout the Delta. Another 14 sturgeon, most small, at less than 100mm, were found along the Sacramento River between Red Bluff and Colusa, and three were found during Chipps Island midwater trawls, west of AIPCP sites, near Suisun Marsh. Sturgeon captured at Chipps Island were generally larger, between 400 and 550mm in length, but still in juvenile stages. There is a significant need for additional information on abundance, distribution, population dynamics, mortality rates, and threats to green sturgeon. The CDFW Central Valley Bay-Delta Branch is conducting studies of both white and green sturgeon to increase understanding of these issues (CDFW 2006c). A one-day symposium, *Sturgeon in the Sacramento-San Joaquin Watershed: New Insights to Support Conservation and Management, held in March 2015*, presented results of recent work and identified additional questions (Klimley et al. 2015).

The following information on green sturgeon is quoted from Moyle et al., (1995):

> "In California, green sturgeon have been collected in small numbers in marine waters from the Mexican border to the Oregon border. They have been noted in a number of rivers, but spawning populations are known only in the Sacramento and Klamath Rivers… The San Francisco Bay system, consisting of San Francisco Bay, San Pablo Bay, Suisun Bay and the Delta, is home to the southernmost reproducing population of green sturgeon...
>
> "The habitat requirements of green sturgeon are poorly known, but spawning and larval ecology probably are similar to that of white sturgeon. However, the comparatively large egg size, thin chorionic layer on the egg, and other characteristics indicate that green sturgeon probably require colder, cleaner water for spawning than white sturgeon (S. Doroshov, pers. comm.). In the Sacramento River, adult sturgeon are in the river, presumably spawning, when temperatures range between 8°C to 14°C. Preferred spawning substrate likely is large cobble, but can range from clean sand to bedrock. Eggs are broadcast-spawned and externally fertilized in relatively high water velocities and probably at depths >3 in (Emmett et al., 1991). The importance of water quality is uncertain, but silt is known to prevent the eggs from adhering to each other (C. Tracy, minutes to USFWS meeting)…
>
> "The ecology and life history of green sturgeon have received comparatively little study evidently because of their generally low abundance in most estuaries and their low commercial and

sportfishing value in the past. Adults are more marine than white sturgeon, spending limited time in estuaries or fresh water…

"Juveniles and adults are benthic feeders, and may also take small fish. Juveniles in the Sacramento-San Joaquin Delta feed on opossum shrimp (*Neomysis mercedis*) and amphipods (*Corophium* sp.) (Radtke 1966). Adult sturgeon caught in Washington had been feeding mainly on sand lances (Ammodyies hexapterus) and callianassid shrimp (P. Foley, unpublished). In the Columbia River estuary, green sturgeon are known to feed on anchovies, and they perhaps also feed on clams (C. Tracy, minutes to USFWS meeting)."

There has been substantial habitat loss in the Sacramento River above Keswick and Shasta dams (NMFS February 2005, 15). Threats to green sturgeon include concentration of spawning sites, small population size, lack of population data, potentially growth-limiting and lethal temperatures, harvest concerns, loss of spawning habitat, entrainment by water projects, influence of toxic material, and exotic species (NMFS February 2005, 13-14). Recent research efforts are seeking to increase understanding of both green and white sturgeon movements and distribution, habitat selection, physiology and behavior, and population biology (Klimley et al. 2015).

White Sturgeon

Photo: White Sturgeon.

The white sturgeon is identified as a covered species in the BDCP. It is not listed under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA).

As a diadromous fish, white sturgeon inhabit riverine, estuarine, and occasionally marine habitats at various stages during their long life. Historically, white sturgeon ranged from Ensenada, Mexico to the Gulf of Alaska. Currently, spawning populations are found in the Sacramento–San Joaquin, Columbia, Snake, and Fraser River systems (Moyle 2002). In California, white sturgeon are most abundant in the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta) and Sacramento River (Moyle 2002), but they have also been observed in the San Joaquin River system, particularly in wet years (CDFW 2002; Beamesderfer et al. 2004).

The Delta and Suisun Bay serve as a migratory corridor, feeding area, and juvenile rearing area for white sturgeon. These corridors allow the upstream passage of adults and the downstream emigration of juveniles. Adult white sturgeon move from the waters of San Francisco Bay into the Delta and lower Sacramento River during the late fall and winter to spawn. They spawn preferentially in the Sacramento River between the Red Bluff Diversion Dam and Jelly's Ferry Bridge, at river mile 267, in areas characterized by swift currents and deep pools with gravel (USFWS 1995a; Schaffter 1997; CDFW 2002; Moyle 2002). Adult white sturgeon have been documented in the Yolo Bypass in the toe drain and at the base of Fremont Weir (Webber et al. 2007; Sommer and Mejia 2013) and in other bypasses in the Sacramento watershed (Healey and Vincik 2011). Larval and juvenile white sturgeon inhabit the lower reaches of the Sacramento and San Joaquin Rivers and the Delta (Stevens and Miller 1970).

The abundance and age structure of the population fluctuates substantially in response to highly variable annual reproductive success. In recent decades the population tends to be dominated by strong year classes produced in years with high spring flows. High spring flows were the norm prior to the major dam building effort on the rim of the Central Valley (Moyle 2002). Recent analyses of the abundance of white sturgeon 117 to 168 centimeters based on harvest data from 2007 to 2009 indicate current populations between about 43,000 and 57,000 fish (DuBois and Gingras 2011). From 2000 to 2009 the abundance of age 15 white sturgeon ranged from 3,252 to 6,539 (DuBois et al. 2011). The abundance of age-15 fish is the metric by which progress toward the Central Valley Project Improvement Act (CVPIA) recovery goal (11,000 fish) is assessed.

<u>Pacific Lamprey</u>

The Pacific lamprey is not listed under the California Endangered Species Act (CESA) or federal Endangered Species Acts (ESA). A broad group of west coast conservation organizations petitioned the U.S. Fish and Wildlife Service (USFWS) on January 27, 2003 to list Pacific lamprey, along with three other lamprey species on the West Coast, as threatened or endangered (Klamath-Siskiyou Wildlands Center et al. 2003). However, the petition was declined in a 90-day finding on December 27, 2004, citing insufficient evidence that listing was warranted (69 Federal Register [FR] 77158).

In the Central Valley, Pacific lamprey occurs in the Sacramento and San Joaquin Rivers (Moyle 2002) and many of their tributaries including the Stanislaus, Tuolumne, Merced, and King Rivers (Brown and Moyle 1993) (69 FR 77158). Individuals emigrating from Sacramento and San Joaquin River watersheds pass through the AIPCP project area during winter and spring on their way to the Pacific Ocean. Emigrating adults pass through the AIPCP project area on their way upstream towards spawning grounds between March and June. It is unknown to what extent Pacific lamprey use the Plan Area for purposes other than a migration corridor, but some studies (Brown and Michniuk 2007) have found ammocoetes within Sacramento–San Joaquin River Delta (Delta) sloughs, especially in the North Delta.

Population trends are unknown in California, although anecdotal evidence indicates that populations have been in decline (Moyle 2002) (69 FR 77158). There are no monitoring programs that target Pacific lamprey in the Delta and those that catch Pacific lamprey do not catch them regularly enough to establish trends through time. In addition, Pacific lamprey are inconspicuous and often overlooked, and ammocoetes can be difficult to distinguish from ammocoetes of the co-occurring river lamprey.

The high density and limited mobility of lamprey ammocoetes in streams can potentially make them more vulnerable to channel alterations such as channelization, loss of riffle and side channels, and scouring (Streif 2007; Luzier et al. 2009). Loss or alteration of habitat can also limit spawning if it occurs in spawning reaches.

<u>Delta Smelt</u>

The delta smelt (*Hypomesus transpacificus*) is State listed as endangered, and federally listed as threatened, with a recent decision to reclassify the federal listing from threatened to endangered. Delta smelt was first listed as threatened in 1993, with critical habitat designated in 1994.

Source: www.fws.gov.

Photo: Delta Smelt.

Critical habitat for this species includes Suisun Bay (including contiguous Grizzly and Honker bays); the length of Goodyear, Suisun, Cutoff, First Mallard, and Montezuma sloughs; and existing continuous waters within the Sacramento-San Joaquin Delta. Delta smelt is native to the Sacramento-San Joaquin estuary. It is found primarily in the lower Sacramento and San Joaquin Rivers, in the Delta above their confluence, in Suisun Marsh water channels and in Suisun Bay. Delta smelt is endemic to low-salinity and freshwater habitats of the Delta (Bennett 2005).

Delta smelt spawn in fresh water from February to June, with peak spawning in April and May. Spawning has been reported to occur at about 45°F to 59°F in tidally influenced rivers and sloughs, including dead-end sloughs and shallow edgewaters of the upper Delta. Longer spawning seasons, based on this temperature range, are thought to result in more cohorts in a given season (Bennett 2005, 34). The spawning microhabitat for delta smelt is not known, and eggs have not been found in the field. Smelt are thought to spawn at night, broadcasting eggs just above the substratum, where the demersal (deposited near the bottom) and adhesive eggs mostly likely attach to submerged vegetation, rocks, or tree roots (Bennett 2005, 17).

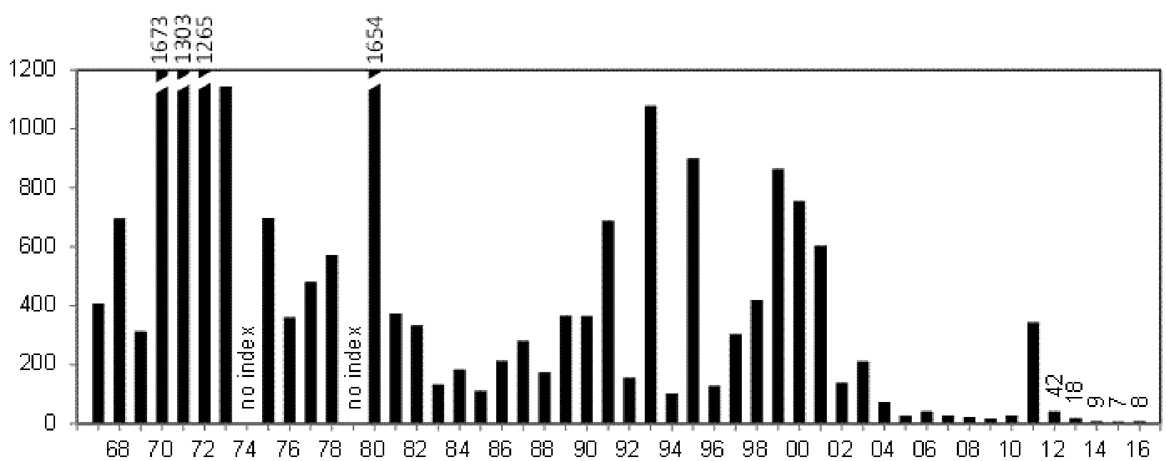
Newly hatched larvae are planktonic and drift downstream near the surface in nearshore and channel areas to the freshwater/saltwater interface. Mager et al. (1996) found that larvae hatched in 10 to 14 days under laboratory conditions and started feeding on phytoplankton at day four and on zooplankton at day six. Growth is rapid through summer, and juveniles reach 40 to 50 millimeters (fork length) by early August. Growth slows in fall and winter, presumably to allow for gonadal development. Adults range from 55 to 120 millimeters, but most do not grow larger than 80 millimeters.

As Delta smelt abundance has declined and habitat conditions have changed, their distribution has become more restricted. Currently, delta smelt rarely occur in the central and south Delta, especially during summer/fall because the water is too warm or too clear to sustain them. In both old and recent surveys, most smelt have been caught in the arc of habitat from the Cache–Lindsay Slough Complex in the north Delta, down the Sacramento River, to Montezuma Slough in Suisun Marsh. This arc of tidal habitat is connected by flows from the Sacramento River (Moyle et al. 2016).

Delta smelt abundance indices declined significantly in the early 2000s, as part of the broader Pelagic Organism Decline (POD). In 2011, following a high water year, delta smelt indices increased to their highest level since 2001. However, the indicators are still far below historical levels, and declined to under 10 in 2014, 2015, and 2016. **Exhibit 3-5** provides a summary of Fall Midwater Trawl (FMWT) surveys for delta smelt from 1967 to 2016.

Because delta smelt has only a one-year life-cycle, they are particularly sensitive to threats. In addition, delta smelt have a limited diet, produce low number of eggs, are poor swimmers, are easily stressed, and reside primarily in the moving interface between saltwater and freshwater. There are many potential reasons for delta smelt decline, including: high or low Delta water outflow, reduction in preferred food prey organisms, toxic substances, disease, competition, predation, and loss of genetic integrity (CDFW 2005, 73). In addition, delta smelt larvae, juveniles, and adults are entrained in diversions of the CVP and SWP. Although some species of fish can be salvaged at fish screening facilities, delta smelt suffer 100 percent mortality (USFWS March 2004, 11). In the USFWS 5-Year Review, fisheries biologist Peter Moyle indicated that Delta smelt will never be out of danger of extinction unless there are permanent and reliable changes made to the flow and temperature regimes that favor the smelt (USFWS March 2004, 27).

Exhibit 3-5
Delta smelt Fall Midwater Trawl Indices, all ages (1967-2016)



Source: California Department of Fish and Game (http://www.dfg.ca.gov/delta/data/fmwt/Indices/sld002.asp)

Bennett (2005) concluded that there is a 55 percent chance that the delta smelt population would become "quasi-extinct" (less than 8,000 fish) within 20 years. New analyses of threats to delta smelt are considering factors such as water quality and water flows on a regional, rather than a Delta-wide scale (Nobriga et al. 2008). Nobriga et al., (2008) found that at a regional level water clarity, salinity, and temperature were indicators of delta smelt habitat suitability.

In response to the dramatic decline in delta smelt populations, the California Natural Resources Agency developed the Delta Smelt Resiliency Strategy (Strategy) in July 2016. The Strategy is a science-based document designed to address immediate and near-term needs of delta smelt to promote their resiliency to drought conditions and future variations in habitat (CNRA 2016). The Strategy has two primary goals: improved delta smelt vital rates and improved habitat conditions. Improved habitat conditions includes reducing the levels of invasive species (e.g., aquatic weeds and nonnative predators).

River Lamprey

River lamprey (*Lampetra ayresi*) is a California species of special concern on the "watch list." River lamprey has no federal listing. The USFWS evaluated Pacific lamprey, western brook lamprey, and river lamprey in 2004, and found no basis for listing these species (USFWS 2004c). No critical habitat has been designated for this species.

Source: www.hoatzin.de.

Photo: River Lamprey.

River lamprey are more widely distributed in British Columbia. Relatively little is known of the river lamprey's distribution, abundance, life history, and habitat requirements in California (USFWS 2004c). The following is quoted from Moyle et al. (1995):

> "The habitat requirements of spawning adults and ammocoetes [larvae] have not been studied in California. Presumably, the adults need clean, gravelly riffles in permanent streams for spawning, while the ammocoetes require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and temperatures do not exceed 25°C.
>
> "River lampreys have been collected from large coastal streams from fifteen miles north of Juneau, Alaska, down to San Francisco Bay. In California, they have been recorded only from the lower Sacramento and San Joaquin rivers and from the Russian River (Lee and others 1980), but they have not really been looked for elsewhere. Wang (1980) indicates that a landlocked population may exist in upper Sonoma Creek (Sonoma County), a tributary to San Francisco Bay…
>
> "Trends in the populations of river lamprey are unknown in California, but it is likely that they have declined, along with the degradation of suitable spawning and rearing habitat in rivers and tributaries. River lamprey are abundant in British Columbia, the center of their range, but there are relatively few records from California, the southern end of their range.
>
> "The river lamprey has become uncommon in California, and it is likely that the populations are declining because the Sacramento, San Joaquin, and Russian Rivers and their tributaries have been severely altered by dams, diversions, pollution, and other factors. Two tributary streams where spawning has been recorded in the past (Sonoma and Cache Creeks) are both severely altered by channelization, urbanization, and other problems."

Central Valley Steelhead

Central Valley steelhead (*Oncorhynchus mykiss*), which are the anadromous form of rainbow trout, are federally listed threatened, a status that was confirmed in 2005 (NMFS 2005b). NMFS is developing a recovery plan for Central Valley steelhead. Central Valley steelhead migrate to the ocean as juveniles and return to fresh water to spawn when they are 2 to 4 years old. Spawning migration (through the Delta) can be anytime from August through March.

Source: www.fs.fed.us.

Photo: Central Valley Steelhead.

Steelhead usually do not die after spawning. Survivors return to the ocean between April and June, and some make several more spawning migrations. Juvenile steelhead usually remain in fresh water for the first year, then migrate to the ocean between November and May. Steelhead are found in the Delta predominantly during migration.

Steelhead are primarily threatened by loss of the vast majority of historical spawning habitats above impassable dams, and mixing with hatchery fish (NMFS 2005b). California began implementing measures to protect steelhead in 1998, including 100 percent marking of all hatchery steelhead, zero bag limits for unmarked steelhead, gear restrictions, closures, and designation of size limits to protect smolts (NMFS 2007).

Chinook Salmon

There are four distinct runs of Chinook salmon (*Oncorhynchus tshawytscha*), distinguished by their timing of upstream migration and spawning season. The runs are named for the season during which the adults enter fresh water. Four of these runs are special status species and will be discussed below: winter-run, spring-run, and fall-run and late fall-run. NMFS is developing recovery plans for the winter- and spring-run species.


Source: www.fws.gov.

Photo: Chinook Salmon.

In 1989, the Sacramento River winter-run Chinook salmon was listed as threatened under the federal ESA by NMFS (54 FR 32085). NMFS reclassified the winter-run as endangered in 1994 (59 FR 440), and reaffirmed this classification in 2005 (NMFS 2005). Winter-run Chinook salmon were classified by the State as endangered in 1989. In 1993, NMFS designated critical habitat for the winter-run Chinook from Keswick Dam (Sacramento river mile 302) to the Golden Gate Bridge (58 FR 33212) (Federal Register 2004).

Central Valley spring-run salmon was listed as threatened by both the State and federal governments in 1999, and reaffirmed as threatened by the federal government in 2005. Critical habitat for Central Valley spring-run Chinook salmon was designated in September 2005. Critical habitat within the Delta includes portions of three hydrologic units: Sacramento Delta, Valley Putah-Cache, and Valley-American. Unlike winter-run Chinook, which utilize only the Sacramento River, spring-run Chinook utilize primarily the Feather and Yuba Rivers, with smaller populations likely in the Sacramento River and Big Chico Creek (NMFS 2005b).

Central Valley fall-run and late fall-run Chinook salmon runs were listed as a species of special concern by NMFS in 2004. All four runs of Chinook salmon are found in the Delta only during migration to and from the Pacific Ocean. They do not spawn or rear in the Delta.

The life span of Chinook salmon ranges from two to seven years. Although Chinook salmon can spend 1½ to 5 years in the ocean before returning to natal streams to spawn, most return to fresh water 2½ years after entering the ocean.

Chinook salmon eggs are laid in nests (called "redds") excavated by the female in loose gravel. Juvenile salmon may migrate downstream to the estuary immediately after emerging from the redd, or they may spend a year or more in fresh water. The length of juvenile residence time in fresh water and estuaries varies between salmon runs and depends on a variety of factors, including season of emergence, streamflow, turbidity, water temperature, and interaction with other species.

There are two general types of Chinook salmon life history strategies, stream type and ocean type. Stream-type juveniles remain in the river for a year or more before migrating to the ocean. Ocean-type juveniles typically move to the ocean during their first few months. Although California races typically follow the ocean pattern, some juveniles of the fall, late-fall, and spring runs may emigrate as age-one smolts. Apparently all winter-run salmon migrate during the first few months after emergence.

Adult winter-run salmon immigrants enter the Sacramento River from December through June, peaking in March and April. Adults remain in the Sacramento River until spawning in May through August (CDFW 2005, 64). Juveniles spend five to nine months in the river and Delta before entering the ocean. Juveniles begin to move out of the upper river no earlier than fall, when water temperatures in lower reaches are suitable for migration (NMFS 2005, 145).

The entire historical spawning habitat of the Sacramento River winter-run Chinook salmon was blocked by construction of Shasta Dam. All spawning now occurs in the Sacramento River, below Keswick Dam (NMFS 2005, 145). The population size of winter-run Chinook salmon may have been as high as 200,000, dropped to 100,000 in the 1960s, and fell well below 5,000 between 1982 and 2001. Population estimates have increased to just under 10,000 since 2001 (NMFS 2005, 147).

Spring-run Chinook salmon traditionally spawned in upper reaches of Central Valley rivers and their tributaries, which are now blocked by dams. The spring run in the Sacramento River system generally enters fresh water between February and June, moving upstream and entering tributary rivers from February through July, peaking in May and June (CDFW 2005, 66). Fish migrate into headwaters and hold in pools through the summer, spawning from mid-August through mid-October. This is a distinguishing feature of this run, as adults hold over during the summer in colder pools in the upper river areas and do not spawn until fall, sometime between late August and October. Some juveniles emerge in early November, continuing through April, emigrating from the tributaries as fry from mid-November through June (CDFW 2005, 66). “Yearlings” remain in the stream until the following October, and emigrate starting in October through the following March (CDFW 2005, 66).

There are three independent populations of spring-run Chinook salmon, which utilize tributaries of the Sacramento River: Mill Creek, Deer Creek, and Butte Creek (NMFS 2007). There are also four dependent populations of spring-run Chinook salmon, utilizing Kings River, and Big Chico, Antelope, Clear, Thomes, Cottonwood, Beegum, and Stony Creeks (NMFS 2007).

Central Valley fall-run Chinook salmon fry (i.e., juveniles shorter than 2 inches long) generally emerge from December through March, with peak emergence occurring by the end of January. Most fall-run Chinook salmon fry rear in fresh water from December through June, with emigration as smolts occurring primarily from January through June. Central Valley late fall-run Chinook salmon fry generally emerge from April through June. Late fall-run fry rear in fresh water from April through the following April and emigrate as smolts from October through February (Snider and Titus 2000).

Adult Central Valley fall- and late fall-run Chinook salmon migrating into the Sacramento River and its tributaries primarily use the western and northern portions of the Delta, whereas adults entering the San Joaquin River system to spawn use the western, central, and southern Delta as a migration pathway. Fall- and late fall-run Chinook salmon must migrate through the Delta toward the Pacific Ocean and use the Delta, Suisun Marsh, and the Yolo Bypass for rearing to varying degrees, depending on their life stage (fry versus juvenile), size, river flows, and time of year.

Delta operations of the CVP and SWP affect adult and juvenile Chinook salmon as they pass through the Delta on their way to and from spawning and nursery areas in the Sacramento and San Joaquin River systems. Flow direction and velocity in Delta channels, operation of the Delta Cross Channel, and exposure of fish to the export pumps are major water project-related factors affecting salmon survival.

Adult salmon require presence of homestream water to guide them to their spawning grounds. Salmon from the Sacramento River system outmigrating through the Delta as juveniles in spring and early summer may be affected by altered flow patterns in the lower San Joaquin River. Some are also diverted to the interior Delta through Georgiana Slough and the Delta Cross Channel, where survival is lower than if they continued downstream in the Sacramento River. Exposure to water project fish screens results in losses due to predation by larger fish in front of screens, screen inefficiency, and attrition in the process of handling and hauling salvaged fish.

Other factors leading to declines in Chinook salmon include loss of most historical spawning habitat; degradation of remaining habitat, genetic threats from hatchery fish or other runs, predation by non-native species, and excessively high water temperatures (NMFS 2005, 153-155).

Sacramento Splittail

Sacramento splittail (*Pogonichthys macrolepidotus*) was proposed as threatened by the USFWS in January 1994, and officially listed as threatened in February 1999. Following a court challenge and mandated reevaluation in 2000, the USFWS delisted Sacramento splittail in 2003 (USFWS 2006). In August 2007, the Center for Biological Diversity submitted a notice of intent to sue the USFWS to require reconsideration of the splittail listing, and also to sue for political interference with the decision to delist the splittail (CBD 2008). Sacramento splittail is listed as a California species of special concern. No critical habitat is currently designated for this species.


Source: www.fws.gov.

Photo: Sacramento Splittail.

Sacramento splittail is a large minnow endemic to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Estuary). Once found throughout low elevation lakes and rivers of the Central Valley from Redding to Fresno, this native species is now confined to lower reaches of the Sacramento and San Joaquin rivers, the Delta, Suisun and Napa marshes, and tributaries of north San Pablo Bay (CDFW 1994). Although Sacramento splittail is considered a freshwater species, adults and sub-adults have an unusually high tolerance for saline waters, up to 10-18 ppt (Meng 1993), for a member of the minnow family (CDFW 1994). Therefore, Sacramento splittail is often considered an estuarine species. When splittail were more abundant, they were commonly found in Suisun Bay and Suisun Marsh. Salt tolerance of splittail larvae is unknown (CDFW 1992).

Juveniles and adults use shallow edgewater areas lined by emergent aquatic vegetation. Submerged vegetation provides food sources and escape cover. Shallow, seasonally flooded vegetation is also apparently a preferred splittail spawning habitat. Year class strength appears to be primarily controlled by inundation of floodplain areas (high rainfall years), which provides spawning, rearing and foraging habitat. The splittail's life history pattern, featuring high fecundity, relatively long life span, and ability to migrate to spawning areas, shows an ability to adapt to a variable environment (Moyle et al. 2004).

Sacramento splittail is a relatively long-lived minnow, reaching ages of five and possibly up to seven years. Both males and females usually reach sexual maturity in their second year. Like most cyprinids, splittail has high fecundity, ranging from 5,000 to 100,000 eggs per female.

Timing and location of splittail reproduction have varied during separate investigations. From 1978 to 1983, samples of larvae indicate that splittail spawned in tidal freshwater and oligohaline (brackish, 0.5 to 5ppt saline) habitats such as Montezuma and Suisun sloughs and San Pablo Bay, from late January or early February through July. However, most spawning activity appears to occur in the Sacramento and San Joaquin Rivers and their tributaries. Splittail in the Delta are most abundant in the north and west portions when populations are low, but are more evenly distributed in years with higher reproductive success (Moyle et al. 2004).

Splittail eggs are adhesive or become adhesive soon after contacting water. Eggs appear to be demersal, are believed to be laid in clumps, and attach to vegetation or other submerged substrates. Larvae become free swimming five to seven days after hatching; feeding begins after five days post-hatch.

Young splittail appear to seek out shallow, vegetated areas protected from strong currents near spawning grounds and move downstream as they grow. They apparently move or are carried with higher spring flows downstream into the estuary and bays, where they are captured regularly by midwater trawl sampling in Suisun Bay near Montezuma Slough, in the vicinity of Pittsburgh Power Plant near New York Slough, near Antioch, and sometimes as far downstream as Carquinez Strait and San Pablo Bay.

Juvenile splittail abundance is often highest in wet years. In 1994, the midwater trawl index once again showed a decline in young-of-the-year abundance, but the 1995 year class was exceptionally strong. In most surveys, the number of adult splittail has been variable since 1979, without a discernible trend, but Suisun Marsh surveys showed a major decline after 1981, with little or no resurgence since then. Again, 1995 abundance indices were the highest on record for CVP and SWP salvages, the San Francisco Bay Study otter trawl, and the (San Francisco) Bay Study midwater trawl (Sommer et al. 1997).

There are several different monitoring programs that measure splittail abundance, although none are focused on splittail. These surveys show that splittail have high natural variability (due to their life history), some successful reproduction takes place every year, and most successful reproduction years occur with relatively high outflow (Moyle et al. 2004, 13).

A major factor in species decline appears to be habitat constriction associated with the reduction of water flows and changed hydraulics in the Delta. There is a strong positive correlation between splittail year class success and outflows, with reduced survival during years of low outflow and high diversion (CDFW 2006a). A number of other factors may also influence splittail abundance, including loss of prey, effects of drought and climate change on habitat, non-native competitors and predators, and possible threats of disease and environmental contaminants (CDFW 2006a).

<u>Longfin Smelt</u>

Longfin smelt (*Spirinchus thaleichthys*) is designated as a California threatened species. The USFWS initiated a status assessment of the longfin smelt in April 2009. No critical habitat has been granted to this species.

Source: swr.nmfs.noaa.gov.

Photo: Longfin Smelt.

The longfin smelt is a small, planktivorous fish that is found in several Pacific coast estuaries from San Francisco Bay to Prince William Sound, Alaska. Within California, longfin smelt have been reported from Humboldt Bay and the mouth of the Eel River. However, data are infrequently collected from Humboldt Bay, and there are no recent records from the Eel River (SFEP 1992a). In California, the largest longfin smelt reproductive population inhabits the Bay-Delta Estuary (CDFW 1992). This four to five inch long (adult), pelagic anadromous species spawns in fresh waters of the Delta and lower rivers, rears throughout the Estuary, and matures in brackish and marine waters (SFEP 1997).

Longfin smelt can tolerate salinities ranging from fresh water to sea water. Spawning occurs in fresh to brackish water or fresh water, over sandy-gravel substrates, rocks, or aquatic vegetation (Meng 1993; CUWA 1994).

In the Bay-Delta Estuary, the longfin smelt life cycle begins with spawning in the lower Sacramento and San Joaquin Rivers, the Delta, and freshwater portions of Suisun Bay (SFEP 1992). Spawning may take place as early as November and extend into June, with peak spawning occurring from February to April (Meng 1993). Eggs are adhesive and, after hatching, larvae are carried downstream by freshwater outflow to nursery areas in the lower Delta and Suisun and San Pablo Bays (SFEP 1992). The principal nursery habitat for larvae is productive waters of Suisun and San Pablo Bays. Adult longfin smelt are found mainly in Suisun, San Pablo, and San Francisco Bays, although their distribution is shifted upstream in years of low outflow (Meng 1993).

With the exceptions that both longfin smelt and Delta smelt spawn adhesive eggs in river channels of the eastern Estuary and have larvae that are carried to nursery areas by freshwater outflow, the two species differ substantially. Consistently, a measurable portion of the longfin smelt population survives into a second year (SFEP 1992a). During the second year of life, they inhabit San Francisco Bay and, occasionally, the Gulf of the Farallones; thus, longfin smelt are often considered anadromous. Longfin smelt are also more broadly distributed throughout the Estuary, and are found at higher salinities, than Delta smelt (Sommer et al. 2002).

Because longfin smelt seldom occur in fresh water except to spawn, but are widely dispersed in brackish waters of the Bay, it seems likely that their range formerly extended as far up into the Delta as salt water intruded. The easternmost catch of longfin smelt in the fall midwater trawl was at Medford Island in the Central Delta. They have been caught at all stations of the Bay Study. A pronounced difference between the two species in their region of overlap in Suisun Bay is by depth; longfin smelt are caught more abundantly at deep stations (10 meters), whereas Delta smelt are more abundant at shallow stations (<3 meters) (SFEP 1992a).

A strong relationship exists between freshwater outflow during spawning and larval periods and subsequent abundance of longfin smelt (SFEP 1997). Outflow disperses buoyant larvae, increasing likelihood that some will find food. By reducing salinities in Suisun and San Pablo Bays, outflow may also provide habitat with few marine or freshwater competitors and predators (marine species often do not tolerate lower salinities, and freshwater species have mechanisms to avoid being washed downstream (SFEP 1997)).

The factor most strongly associated with recent declines in abundance of longfin smelt has been the increase in water diverted by the SWP and the CVP during winter and spring months when longfin smelt are spawning (NHI 1992a; DWR 1992). Pumping changes the hydrology of the Delta and increases exposure of larval, juvenile, and adult longfin smelt to predation and entrainment (NHI 1992b). Salvage data indicate that longfin smelt have been more vulnerable to pumping operations since 1984. This increase in vulnerability may be due to concentration of longfin smelt populations in the upper Estuary, within the zone of influence of the pumps, as a result of reduced Delta outflow. Also, decreases in outflow fail to disperse larvae downstream to Suisun Bay nursery areas, away from effects of Delta pumping (Meng 1993).

Longfin smelt have declined significantly from historic levels. Prior to the drought years 1987 through 1994, the FMWT Survey recorded longfin smelt averages of approximately 17,000 fish (Federal Register May 6, 2008). The average dropped to less than 600 during the drought, and then increased to approximately 4,000 from 1995 to 2000. Since 2001, FMWT surveys have averaged less than 600 longfin smelt per year, although there have not been drought conditions. A study of FWMT, San Francisco Bay Study, and Suisun Marsh Survey data, found significant declines in longfin smelt abundance (Rosenfield and Baxter 2007).

7. Amphibians

California Red-Legged Frog

Source: www.fws.gov.

Photo: California Red-Legged Frog.

The California red-legged frog (*Rana aurora draytonii*) is listed as federal threatened, and a California species of special concern. The California red-legged frog is the largest frog native to California. Habitat of the California red-legged frog is characterized by dense, shrubby vegetation associated with deep, still, or slow-moving water. They are infrequent inhabitants where introduced aquatic predators (e.g., bullfrogs) are present. Red-legged frogs rely on dense cover to protect them while breeding and foraging. They were found historically throughout the Central Valley, along the Pacific Coast, and in the San Francisco Bay area. Today the frog occupies only about 30 percent of its original range and is found primarily along the coast between San Francisco and Ventura. The USFWS finalized critical habitat designation for the California red-legged frog in May 2006. There are thirty critical habitat units covering 4.1 million acres in 28 counties. None of the designated habitat overlaps with AIPCP treatment sites.

California red-legged frogs breed from late November to April. At breeding sites, males typically call in small mobile groups (three to seven individuals) to attract females. Females attach eggs to emergent vegetation where embryos hatch six to 14 days after fertilization. Larvae require four to five months to attain metamorphosis. Juvenile frogs seem to favor open, shallow aquatic habitats with dense submergent vegetation. They frequently are active during the day, spending daylight hours basking in the warm surface water layer associated with floating and submergent vegetation. Adult frogs are wary and highly nocturnal. Introduced predators (particularly bullfrogs), habitat modification and destruction, and drought have all contributed to the decline of the species.

8. Reptiles

Giant Garter Snake

Photo: Giant Garter Snake.

Source: www.californiaherps.com.

The giant garter snake (*Thamnophis gigas*) is listed as State and federal threatened. Giant garter snakes are the largest garter snake in North America and are endemic to the valley floor wetlands in the Sacramento and San Joaquin Valleys. They inhabit sloughs, ponds, small lakes, and other low-gradient waterways, including irrigation canals where water is present throughout the summer. Giant garter snakes are usually found close to water, forage in the water for food, and will retreat to water to escape predators and disturbance (USFWS May 2004). These snakes typically avoid larger waterways with predatory fish, and woodland streams with excessive cover.

Giant garter snakes may exceed five feet in length, are dull brown with a checkered pattern of black spots on the dorsal side, and have a dull yellow, mid-dorsal stripe. The head is elongated with a pointed snout (CDFW 2005, 128).

Giant garter snake diet consists of small fishes, tadpoles, and frogs. Components of essential giant garter snake habitat include: adequate water during the active season (early-spring through mid-fall) to provide food and cover; emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; upland habitat with grassy banks and openings in waterside vegetation for basking; and higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter (CDFW 2005, 17).

Giant garter snakes are most active from early spring through mid-fall, with its activity dependent on local weather conditions. During the winter between November and April, they are generally inactive, although some may move short distances on warmer days. During the active season, giant garter snakes generally remain in close proximity to wetland habitats but can move over 800 feet from the water during the day (East Contra Costa County Habitat Conservation Plan Association, 2006).

Giant garter snakes are currently found in only a small number of populations. Loss of wetlands, development, levee construction, grazing, and agriculture have all fragmented and reduced giant garter snake habitat (CDFW 2005, 18).

Western Pond Turtle

Photo: Western Pond Turtle.

Source: www.fws.gov.

The western pond turtle (*Clemmys marmorata*) includes two subspecies, the northwestern pond turtle (*Clemmys marmorata marmorata*) and the southwestern pond turtle (*Clemmys marmorata palida*). Both subspecies are designated as California species of special concern by CDFW. No critical habitat has been designated for this species.

Western pond turtles occur in suitable aquatic habitats throughout California west of the Sierra-Cascade crest and in parts of Oregon and Washington (Stebbins 1985). The northwestern subspecies is found generally north of San Francisco Bay, while the southwestern subspecies is found south of San Francisco Bay. The two subspecies may intergrade throughout the Delta and San Joaquin Valley (Stebbins 1985), or intergrades may be restricted to the Delta region with San Joaquin Valley populations represented by the southwestern pond turtle (USFWS 1992).

Western pond turtles are omnivorous. In addition to aquatic vegetation, turtles feed on larval dragonflies, mayflies, stoneflies, caddisflies, beetles, and other aquatic invertebrates (DBW 2001). Carrion is reported to be a common food item. Western pond turtles are a common prey item for river otters, raccoons, minks, coyotes, and bears.

Western pond turtles are found in association with a wide variety of wetlands, including ponds, marshes, lakes, streams, and irrigation ditches (Stebbins 1985). Suitable habitat is typically well-vegetated and contains exposed logs, rocks, or other basking sites from which turtles can easily escape into the water when disturbed (Stebbins 1985). Egg-laying may occur along sandy wetland margins or at upland locations as far as 1,300 feet from water (DBW 2001). Hatchlings and juveniles apparently require a more specialized aquatic habitat than do adults (USFWS 1992). Western pond turtles may move overland for short distances: females to lay eggs; entire local populations to reach new water and escape drying bodies of water (Zeiner et al. 1988).

Historic populations of western pond turtles in California have declined extensively (possibly as much as 90 to 99 percent in the Central Valley since 1850) as riparian corridors have been stripped of vegetation, flood plains diminished, and natural waterways channelized, leveed, and riprapped. Young turtles are vulnerable to a wide variety of predators including many introduced species such as bullfrogs and game fish (DBW 2001). Pond turtles may be victims of bioaccumulation of heavy metals and other toxins, which have increased dramatically in California's waterways since the industrialization of the state (DBW 2001). In the San Joaquin Valley, western pond turtles declined between 1880 and 1990 from an estimated 10 million or more, to less than 5,000 (DBW 2001).

Commercial collecting, wetland and upland habitat loss, and introduced predators have all been implicated in the decline of western pond turtles (USFWS 1992). Less than 10 percent of wetlands historically found throughout the species' range in California persist today (USFWS 1992).

9. Birds

<u>California Black Rail</u>

The California black rail (*Laterallus jamaicensis coturniculus*) is listed as a threatened species in California. There is no critical habitat for this species.

Source: www.birdphotography.com.

Photo: California Black Rail.

The California black rail is believed to have occurred historically from Tomales Bay in Marin County, south along the coast into northern Baja California, and in inland marshes of San Francisco Bay, the Delta, the San Bernardino-Riverside area, and along the lower Colorado River and the Salton Sea (Steinhart 1990). Throughout its range, the species is known to inhabit tidal salt, brackish, and freshwater marshes.

Highest densities of breeding black rails occur in larger undiked tidal marshes associated with the Petaluma and Napa Rivers, and in some bayshore marshes of San Pablo Bay. Elsewhere in San Pablo Bay, Suisun Bay, Suisun Marsh, and the Delta, distribution of the species is patchy due to habitat loss and fragmentation.

California black rail is the most secretive of rails, moving through and hiding under dense marsh vegetation. Black rails utilize undiked tidal marshes that include a high marsh elevational zone. They are critically dependent on the narrow upper peripheral halophyte zone above the area of extreme and frequent tidal action where insect abundance is greatest. Marsh elevation, freshwater inflow, and tidal regime may be variables that control occurrence of black rails in wetlands (DWR 1994).

The population of California black rail subspecies has been reduced to just a few thousand, the bulk of which are now limited to the northern San Francisco Bay area. Suitable California black rail habitat is limited in the Delta. The few areas of marsh vegetation that form suitable habitat are either shrinking from inundated substrates or are dominated by willows.

Loss, conversion, and fragmentation of natural tidal marshes have reduced historic habitat of California black rails. Domestic animals such as cats and introduced exotics such as red fox continue to threaten the species' existence. Black rail mortality has been reported from collisions with power lines, transmission towers, and automobiles (Zeiner et al. 1990).

California black rails are rarely found in the project area (Herbold and Moyle 1989). The only documented locations of black rails in the Delta are on instream berm islands, and these islands are slowly disappearing (DWR 1996).

<u>Yellow-Headed Blackbird</u>

Photo: Yellow-Headed Blackbird.

Source: www.fws.gov.

The yellow-headed blackbird (*Xanthocephalus xanthocephalus*) is a California species of special concern, priority 3. There is no critical habitat designated for this species.

Yellow-headed blackbirds are primarily migrant and summer residents of California, with current ranges in the Central Valley, northeastern California, and southern deserts (information on this species from: Jaramillo 2008). Yellow-headed blackbirds are present from April to early October, breeding from mid-April to late July.

Yellow-headed blackbirds breed in marshes with tall emergent vegetation, such as tules or cattails. They generally prefer open areas and edges over relatively deep water, and nest in low vegetation. Most nests are attached to cattails, tules, or willows. Males choose territories with open water, and females choose waterway edges with moderately dense vegetation and extensive channels. The diet of yellow-headed blackbirds consists of seed, and to a minor extent, insects.

Yellow-headed blackbirds are threatened by habitat loss, specifically wetland drainage for irrigation, flood control, or water diversion. They are sensitive to water depth, and lowering water levels may adversely affect breeding. Loss of historic wetlands has reduced the number of breeding yellow-headed blackbirds in the Delta, however they have been identified in the Delta in Sacramento, Yolo, San Joaquin, and Contra Costa counties. The species may also be present along rivers in the San Joaquin Valley.

<u>Tricolored Blackbird</u>

Photo: Tricolored Blackbird.

Source: www.fws.gov.

The tricolored blackbird (*Agelaius tricolor*) is a California species of special concern, priority 1. There is no critical habitat designated for this species.

Tricolored blackbirds are most numerous in the Central Valley and vicinity, and are largely endemic to California (CNDDB 1997). Most breeding occurs in California's Central Valley from mid-March through early August (Beedy 2008). A first breeding effort occurs primarily from the San Joaquin Valley south to Kern County, and separately in southern Sacramento County (DBW 2001). An itinerant breeding effort following this occurs in other portions of the Sacramento Valley, including north of the Delta in Glenn and Colusa counties. A large portion of the population is believed to overwinter in the Delta. Large numbers observed there indicate that the region may be especially important for overwintering adults and juveniles.

Tricolored blackbirds are highly colonial birds. These birds breed near fresh water, preferably in emergent wetlands with tall, dense cattails and tules, but also in thickets of willow, blackberry, wild rose, and tall herbs (Zeiner et al. 1990). Tricolored blackbirds create dense colonies of nests in cattail marshes, typically from a few centimeters to 1.5 meters above water or ground in freshwater marshes (Beedy 2008). They may also nest slightly higher, in willows and other riparian trees (Beedy 2008). Nesting sites are adjacent to open accessible water, provide protected nesting substrate, and suitable nearby foraging space with adequate insect prey (Beedy 2008).

The tricolored blackbird population has been declining, at least since the 1930s. Habitat loss is thought to be the primary reason for this decline. Recent conversion of pastures and grasslands to vineyards in Sacramento County has resulted in loss of several large colonies (Beedy 2008).

<u>Swainson's Hawk</u>

Photo: Swainson's hawk.

Source: CDFW.

The Swainson's hawk (*Buteo Swainsoni*) was listed as a threatened species in 1983 by the California Fish and Game Commission. This listing was based on loss of habitat and decreased numbers across the state. The information on Swainson's hawk is CDFW's Non-Game Wildlife Program website (CDFW 2014b).

The Swainson's hawk is a medium-sized buteo with relatively long, pointed wings which curve up somewhat in a slight dihedral while the bird is in flight. The most distinctive identifying feature of adults is dark head and breast band distinctive from the lighter colored belly, and the underside of the wing with the linings lighter than the dark gray flight feathers. Adult females weigh between 900 and 1100 grams (32 to 39 oz), and males from 800 to 1000 grams (28 to 35 oz).

The Swainson's Hawk breeds in the western United States and Canada and winters in South America as far south as Argentina. A raptor adapted to the open grasslands, it has become increasingly dependent on agriculture, especially alfalfa crops, as native communities are converted to agricultural lands. The diet of the Swainson's hawk in California is varied, but mainly consists of small rodents called voles; however other small mammals, birds, and insects are also taken.

Swainson's Hawks often nest peripheral to riparian systems. They will also use lone trees in agricultural fields or pastures and roadside trees when available and adjacent to suitable foraging habitat.

The most recognized threat to Swainson's hawks in the loss of their native foraging and breeding grounds. As important foraging areas are converted to urban landscapes or other unsuitable habitat, the aptitude for the landscape to support breeding pairs decreases. Other threats include climate change, infrastructure placement, disease, pesticide poisoning, and electrocution.

10. Plants

Eleven special status plant species were identified as potentially affected by the AIPCP as those that are located, or potentially located, in those habitat types that will be directly impacted by AIP treatments. Species on channel banks immediately adjacent to treatment sites may potentially be affected by herbicide drift, although DBW takes steps to minimize drift, as described in mitigation measures. The eleven plant species that are potentially impacted by the AIPCP are identified in Exhibit 3-1, and are described below.

In botanical surveys conducted by DBW in 2002 and 2003 at AIPCP treatment sites, two emergent or submergent special status plants, and two additional special status plants were identified: Suisun Marsh aster (common on Sherman Island), wooly rose-mallow (common on Old River and Middle River), Delta tule pea (on Delta island interiors and the lower Sacramento River), and elderberry, protected for the valley elderberry longhorn beetle. **Exhibit 3-6** identifies submergent and emergent plants found in DBW's botanical surveys.

Exhibit 3-6
Common Submergent and Emergent Plants Identified in DBW Botanical Surveys (2002 and 2003)

Submergent

Common Name	Scientific Name	Native/Nonnative *(if specified)*
1. Coontail	*Ceratophyllum demersum*	Nonnative
2. Brazilian elodea	*Egeria densa*	Nonnative
3. Eurasion water milfoil	*Myriophyllum spicatum*	Nonnative
4. curly leaf pondweed	*Potamogeton crispus*	Nonnative
5. fanwort	*Cabomba caroliniana*	Nonnative
6. long-leaved pondweed	*Potamogeton nodosus*	Native
7. southern naid	*Najas guadalupensis*	Native
8. sago pondweed	*Stuckenia pectinata*	Native

Emergent

Common Name	Scientific Name	Native/Nonnative *(if specified)*
1. pennywort	*Hydrocotyle ranunculoides*	Native
2. common tule	*Scirpus acutus*	Native
3. California bullrush	*Scirpus californicus*	Native
4. smartweed	*Polygonum*	Native
5. water hyacinth	*Eichhornia crassipes*	Nonnative
6. yellow water primrose	*Ludwigia spp*	Nonnative
7. common reed	*Phragmites australis*	Native
8. cattail	*Typha latifolia*	Native
9. flatsedge	*Cyperus odoratus*	Native
10. rush	*Juncus*	Native
11. spike rush	*Eleocharis*	Native
12. bur marigold	*Bidens cernua*	Native

<u>Bristly Sedge</u>

Bristly sedge (*Carex comosa*) has no federal or State status. It is included on the California Native Plant Society (CNPS) List as rare, threatened, or endangered in California, but more common elsewhere, and seriously threatened in California. No critical habitat has been designated for this species.

Bristly sedge is recognized by male and female flowers on separate spikes. It is a monocot perennial herb with slender rhizomes, the stem is erect and smooth, growing up to five feet tall (USGS 2006).

Source: calphotos.berkeley.edu.

Photo: Bristly sedge.

Bristly sedge is native to California (USDA-NRCS 2017).
It is found in marshes and swamps, as well as coastal prairies, and valley and foothill grasslands. It has been found in three topographic quadrants that include AIPCP treatment sites: Holt, Bouldin Island, and Courtland (CNPS 2008). Bristly sedge is more common in wetlands in the Midwest and East. Bristly sedge is threatened by marsh drainage (CNPS 2008). Bristly sedge is associated with the nontidal freshwater permanent emergent habitat classification within the Delta (CALFED July 2000, C-2-3).

Wooly Rose-Mallow

Wooly rose-mallow (*Hibiscus lasiocarpus*) is on the CNPS List as rare, threatened, or endangered in California, but more common elsewhere, and fairly threatened in California. The plant has no State or federal status. No critical habitat has been designated for this species.

Photo: Wooly Rose Mallow.

Wooly rose-mallow native to California (Calflora 2006). It occurs along the Sacramento River and adjoining sloughs from Butte County to the Delta. Wooly rose-mallow has been found throughout the Delta, and has been identified in several topographic quads covering AIPCP treatment sites, including: Stockton West, Holt, Woodward Island, Clifton Court Forebay, Thornton, Terminous, Isleton, Rio Vista, Jersey Island, Bouldin Island, and Courtland (CNPS 2008). Outside of California, the species is widespread, but threatened. Wooly rose-mallow is primarily found in western North America, but occurs as far east as Missouri (CNDDB 1992).

Wooly rose-mallow is a rhizomatous perennial emergent herb. It grows three to seven feet, and has two to four-inch white and rose flowers (Jepson Flora Project 1993). Within the Delta, wooly rose-mallow is found in tidal freshwater emergent and nontidal freshwater permanent emergent habitats (CALFED July 2000, C-2-7). It is associated with tules, willows, buttonwillow, and other marsh and riparian species on heavy silt, clay, or peat soils (CNDDB 1992).

Wooly rose-mallow is seriously threatened by development, agriculture, recreation, and channelization of the Sacramento River and its tributaries (CNPS 2006). Preferred habitat has been altered or destroyed by levee construction and maintenance, agricultural development, and marsh reclamation (CALFED July 2000, 303).

Delta Tule Pea

Delta tule pea (*Lathyrus jepsonii Greene ssp. Jepsonii*) is on CNPS List as rare, threatened, or endangered in California and elsewhere, and fairly threatened in California. It has no State or federal status. No critical habitat has been designated for this species.

Photo: Delta Tule Pea.

Delta tule pea native to California (USDA-NRCS 2017). It occurs on the Delta islands of the lower Sacramento and San Joaquin Rivers and westward through Suisun Bay to the lower Napa River. The plant also has been reported in western Alameda and Santa Clara counties (Calflora 2006).

Delta tule pea has been identified in a number of topographic quads covering AIPCP treatment sites, including: Stockton West, Holt, Woodward Island, Thornton, Terminous, Isleton, Rio Vista, Jersey Island, Bouldin Island, Antioch North, and Courtland (CNPS 2008). Delta tule pea is associated with saline emergent and tidal freshwater emergent habitats within the Delta (CALFED July 2000, C-2-7).

Delta tule pea is a sprawling perennial vine found in coastal and Valley freshwater marshes. It has been observed in association with a broad spectrum of other plants ranging from common tule to Valley oak to arrowgrass. It prefers sites above tidal influence, which are still within the area of soil saturation (CNDDB 1992). It is threatened by agriculture, water diversions, salinity, and erosion (CNPS 2006).

Mason's Lilaeopsis

Mason's lilaeopsis *(Lilaeopsis masonii)* is State listed rare and is included on the CNPS List as rare, threatened, or endangered in California and elsewhere, and seriously threatened in California. It has no federal status. No critical habitat has been designated for this species.

Mason's lilaeopsis native to California (USDA-NRCS 2017). It is found in the Delta from the margins of the Napa River in Napa County, east to the channels and sloughs of the Delta (CDFW 2005, 444). Mason's lilaeopsis is found in topographic quads throughout AIPCP treatment sites, including: Holt, Union Island, Woodward Island, Clifton Court Forebay, Thornton, Terminous, Lodi South, Isleton, Rio Vista, Jersey Island, Bouldin Island, and Antioch North (CNPS 2008). Mason's lilaeopsis is found in tidal freshwater emergent habitats within the Delta (CALFED July 2000, C-2-8). DBW botanical surveys in 2002 and 2003 found Mason's lilaeopsis to be common at the tidal edge clay.

Photo: Mason's Lilaeopsis.

Mason's lilaeopsis is a minute, turf-forming, perennial herb in the carrot family. It is found in tidal zones, on mud-banks and flats along sloughs and rivers, in freshwater marshes, brackish marshes, and in riparian scrub, that are in some way, influenced by saline water. Mason's lilaeopsis is semi-aquatic, growing on saturated clay soils that are regularly inundated by water. It is often found with other rare plants such as Delta mudwort, Suisun Marsh aster, and Delta tule pea (CDFW 2005, 444).

This species is threatened by development, bank and channel-stabilization, flood control projects, widening of Delta channels for water transport, dredging and dumping of spoils, boat wake overwash, recreation (fishing trails), levee maintenance, erosion, agriculture, and in some areas, by water hyacinth (CDFW 2005, 444).

<u>Delta Mudwort</u>

Delta mudwort (*Limosella subulata* Ives.) has no federal or State status. It is included on CNPS List as rare, threatened, or endangered in California, but more common elsewhere, and seriously threatened in California. No critical habitat has been designated for this species. Delta mudwort is not native to California, it was introduced and naturalized in the wild (Calflora 2006).

Photo: Delta Mudwort.

Delta mudwort native to California (USDA-NRCS 2017). It is found in the Delta, along the Sacramento River near Bradford and Twitchell Islands, near Holland Tract, Victoria Island, and Mandeville Island (Calflora 2006). The plant also has been located in Marin County at Drakes Bay, and in Oregon, Washington, and on the Atlantic coast (CNPS 2006). Delta mudwort has been found in ten topographic quads that include AIPCP treatment sites, including: Stockton West, Holt, Woodward Island, Clifton Court Forebay, Thornton, Terminous, Rio Vista, Jersey Island, Bouldin Island, and Antioch North (CNPS 2008). DBW botanical surveys in 2002 and 2003 found Delta mudwort to be common at the tidal edge clay.

Delta mudwort is a low-growing stoloniferous herb with white to lavender flowers (Jepson Flora Project 1993). Delta mudwort occurs in intertidal fresh- and brackish-water marshes. In the Delta, it is associated with the tidal freshwater emergent habitat classification (CALFED 2000, C-2-8). It grows on exposed mud often associated with Mason's lilaeopsis, aquatic pigmy-weed, or dwarf spike-rush (CNDDB 1992).

The intertidal habitats available to Delta mudwort are limited. Levee construction and maintenance, recreational boating, and trampling from fishing access are possible threats to Delta mudwort populations (CNDDB 1992).

<u>Eel-Grass Pondweed</u>

Eel-grass pondweed (*Potamogeton zosteriformis*) is included on CNPS List as rare, threatened, or endangered in California, but more common elsewhere, and fairly threatened in California. It has no State or federal status. No critical habitat has been designated for this species.

Eel-grass pondweed native to California (USDA-NRCS 2017). It is found in the Delta in two topographic quads, Jersey Island and Bouldin Island. It is also found in Lake County, northeastern California, Idaho, Oregon, Utah, and Washington (CNPS 2008).

Photo: Eel-Grass Pondweed.

Source: www.elacuarista.com.

Eel-grass pondweed is an annual aquatic herb of the pondweed family. It is a monocot, and generally found in fresh to alkaline water, and grows less than 60 centimeters tall. Eel-grass pondweed blooms in June and July. It is found in various freshwater marsh and swamp habitats including lake beds, ponds, and streams (CALFED 1999, 376). Eel-grass pondweed is associated with the valley riverine aquatic habitat classification category in the Delta (CALFED July 2000, C-2-10).

Eel-grass pondweed has very small populations and occupies only a small area, making it vulnerable to decline and extinction from genetic problems and events such as floods, insect attacks, disease, or extended droughts (CALFED 1999, 376).

Sanford's Arrowhead

Sanford's arrowhead (*Sagittaria sanfordii*) is on CNPS List as rare, threatened, or endangered in California and elsewhere, and fairly threatened in California. The plant has no State or federal status. No critical habitat has been designated for Sanford's arrowhead.

Photo: Sanford's Arrowhead.

Source: calphotos.berkeley.edu.

Sanford's arrowhead native to California (USDA-NRCS 2017). It is distributed throughout the northern part of the north coast, Central Valley, and northern south coast of California (CALFED July 2000, 382). It has been recently observed at several locations within Sacramento County (Calflora 2006), and observed historically in seven topographic quads included in AIPCP treatment sites: Stockton West, Lathrop, Isleton, Fresno North, Turner Ranch, Mendota Dam, and Stevinson (CNPS 2008). Sanford's arrowhead is found within nontidal freshwater permanent emergent habitats within the Delta (CALFED July 2000, C-2-10).

Sanford's arrowhead is a rhizomatous perennial emergent herb. It is a monocot with blades 14 to 25 cm in length and small white flowers that bloom from May through October (Jepson Flora Project 1993). It grows in freshwater marshes, ponds, ditches, and various other freshwater habitats (CALFED 1999, 382).

Sanford's arrowhead is threatened by grazing, development, dumping, road maintenance, pond maintenance, herbicide spraying, clearing of channel vegetation, non-native plants, and channel alteration (CALFED 1999, 382).

Marsh Skullcap

Marsh skullcap (*Scutellaria galericulata*) is included on CNPS List as rare, threatened, or endangered in California, but more common elsewhere, and fairly threatened in California. It has no State or federal status. No critical habitat has been designated for this species.

Photo: Marsh Skullcap.

Source: cricket.biol.sc.edu.

Marsh skullcap native to California (USDA-NRCS 2017). It has been found in San Joaquin and Contra Costa Counties, within the Woodward Island and Bouldin

Island topographic quadrants, although it is noted that these occurrences need further study. It is more commonly found in northeastern California, Oregon, and elsewhere (CNPS 2008). Marsh skullcap is typically found at elevations above 1,000 meters (Jepson Flora Project 1993).

Marsh skullcap is a shrub-like annual perennial herb in the mint family. It grows 20 cm to 80 cm in height, and has violet-blue flowers that bloom from June through September (Jepson Flora Project 1993). Marsh skullcap is found in meadows and seeps, marshes and swamps, and lower montane coniferous forests (CNPS 2006). It is found in the nontidal freshwater permanent emergent habitat classification within the Delta (CALFED July 2000, C-2-11). Known populations of marsh skullcap are threatened by erosion (CALFED 1999, 386).

<u>Side-Flowering Skullcap</u>

Side-flowering skullcap *(Scutellaria lateriflora)* has no federal or State status. It is included on CNPS List as rare, threatened, or endangered in California, but more common elsewhere, and fairly threatened in California. No critical habitat has been designated for this species.

Photo: Side-Flowering Skullcap.

Side-flowering skullcap native to California (USDA-NRCS 2017). It is found in Sacramento and San Joaquin counties on the Sacramento River near Locke (Calflora 2006). Within the AIPCP area, side-flowering skullcap has been found in the Bouldin Island topographic quadrant (CNPS 2008). It has also been found in Inyo county. Side-flowering skullcap is associated with non-tidal freshwater permanent emergent and natural seasonal wetlands within the Delta (CALFED July 2000).

Side-flowering skullcap is a rhizomatous perennial herb with blue flowers and loosely branching stems, 20 to 60 cm in height (Jepson Flora Project 1993). It blooms from July to September. This skullcap occurs in marshes and swamps, and meadows and seeps. Threats to the plant include altered water regimes (CALFED 1999).

<u>Suisun Marsh Aster</u>

Photo: Suisun Marsh Aster.

Suisun Marsh aster (*Symphyotrichum lentum*) is on CNPS List as rare, threatened, or endangered in California and elsewhere. The plant has no State or federal status. No critical habitat has been designated for Suisun Marsh aster.

Suisun Marsh aster has a historical range that includes Suisun Bay and the Delta (CALFED 1999, 190). It has been observed in many topographic quads covered by AIPCP sites, including: Vernalis, Union Island, Lathrop, Woodward Island, Thornton, Terminous, Isleton, Rio Vista, Jersey Island, Bouldin Island, and Antioch North (CNPS 2008). Suisun Marsh aster is found within saline emergent and tidal freshwater emergent habitat classifications in the Delta (CALFED July 2000, C-2-2).

Suisun Marsh aster is a slightly succulent perennial rhizomatous herb of the sunflower family that grows over three feet tall (CALFED 1999, 190). It is a dicot, and has small violet flowers that bloom from May to November (Jepson Flora Project 1993). Suisun Marsh aster grows in brackish and freshwater marshes. It occurs along brackish sloughs, riverbanks, and levees affected by tidal fluctuations, usually around the mid- to high-tide mark (CALFED 1999, 190). Associated species include marsh plants such as bulrush, cattail, common reed, willow, and rose mallow. The plants are often found at, or near, the water's edge.

Factors leading to decline of this species include marsh alteration, trampling by livestock, recreational use, riprap, levee repair and maintenance, competition from non-native plants, and habitat loss (CALFED 1999, 190).

Wright's Trichocoronis

Photo: Wright's Trichocoronis.

Wright's trichocoronis (*Trichocoronis wrightii var. wrightii*) is on the CNPS List as rare, threatened, or endangered in California, but more common elsewhere, and seriously threatened in California. The plant has no State or federal status. No critical habitat has been designated for this species.

Wright's trichocoronis is native to California (USDA-NRCS 2017). It is found in meadows and seeps, marshes and swamps, riparian forests, and vernal pools (CNPS 2008). It is found in the northern Central Valley (Colusa County), as well as Merced and San Joaquin Counties. Wright's trichocoronis has been found in two topographic quadrants covering AIPCP treatment sites: Turner Ranch and Lathrop (CNPS 2008). There are also plant populations in Riverside County, and Texas. There is confusion related to the origin of the plant. It may be native to California, or may have been introduced to California and naturalized into the wild (CNPS 2008; Calflora 2008).

Wright's trichocoronis is an annual herb. It grows to two feet in height, with white or bluish flowers. The plant grows in moist locations, and usually occurs in wetlands. Wright's trichocoronis is nearly extirpated in the Central Valley, due to habitat lost to agriculture and urbanization (CNPS 2008).

11. Essential Fish Habitat

Recognizing the importance of habitat to the viability of fish species, in 1996 Congress added new habitat provisions to the Magnuson-Stevens Fishery Conservation and Management Act (MSA). The MSA is the federal law that regulates marine fisheries management in the United States (PFMC 2005a). The MSA is implemented through the activities of eight management councils. The Pacific Fisheries Management Council (PFMC) has jurisdiction over California, Oregon, and Washington.

Each management council is required to develop fishery management plans, which among other requirements, describe essential fish habitat (EFH) (PFMC 2006a). Councils are to minimize impacts on EFH from fishery and other activities, and to coordinate and consult with NMFS and other federal agencies that undertake activities that could impact EFH. Because EFH and Endangered Species Act (ESA) consultations often overlap, agencies are encouraged to coordinate regulatory activities to the extent possible (NMFS April 2004).

The primary focus of EFH is promoting long-term health of ocean fisheries through fishery management activities such as catch-limits. The intended purpose of the EFH guidance process is to avoid or minimize adverse impacts of activities on EFH by forward, informed planning (PFMC 1999, A-74).

Essential fish habitat includes habitats necessary to ensure healthy fisheries now, and in the future, and is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (PFMC 2006). EFH consists of both the water column and underlying surface (seafloor, vegetation, etc.) of a particular area. The PFMC has developed documents for four EFH: Coastal Pelagic Species, Groundfish, Salmon, and Highly Migratory Species. Two of these EFH are within the AIPCP area, Salmon and Groundfish. In addition, as a subset of EFH, the PFMC defines "habitat areas of particular concern" (HAPC). There are currently five HAPC types identified in the Fisheries Management Plan for groundfish, one of which (estuaries) potentially overlaps with AIPCP treatment locations. The other HAPC types are: canopy kelp, seagrass, rocky reefs, and specific "areas of interest" (PFMC 2006a).

Chinook Salmon

Amendment 14 to the Pacific Coast Salmon Plan, *Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon*, describes habitat and potential impacts for three salmon species: Chinook salmon, Coho salmon, and Puget Sound pink salmon. Only one of these species, Chinook salmon, is found within AIPCP treatment sites. EFH for Chinook salmon includes freshwater and marine habitat, encompassing "all currently viable waters and most of the habitat historically accessible to salmon…" (PFMC 1999, A-2). EFH is inclusive, and encompasses USGS hydrologic units (watersheds) from Washington to Central California, including the Sacramento-San Joaquin Delta unit. Critical habitat for winter-run and spring-run Chinook salmon also overlap with EFH, and AIPCP treatment sites, in the Delta.

Amendment 14 describes habitat requirements and habitat concerns for six life stages of salmon: (1) adult migration pathways, (2) spawning and incubation, (3) stream rearing habitat, (4) smolt migration pathways, (5) estuarine habitat, and (6)marine habitat. Three of these life stages move through, or temporarily reside in the Delta, potentially within or near AIPCP treatment locations: adult migration pathways, smolt migration pathways, and estuarine habitat. Characteristics of Chinook salmon, including migration patterns in the Delta, are described earlier in this Chapter.

<u>Groundfish</u>

The *Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery* provides a chapter addressing EFH for groundfish (PFMC 2006b). As with pacific salmon, the PFMC took an inclusive approach in identifying groundfish EFH for 80-plus species of groundfish included in the management plan. The groundfish fish management plan covers over 60 species of rockfish, 12 species of flatfish, six species of roundfish, as well as sharks, skates, and several other species. All of these species are managed for fishery values. Groundfish EFH is defined as:

- "Depths less than or equal to 3,500 m (1,914 fathoms) to mean higher water level (MHHW) or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5ppt [i.e. freshwater] during the period of average annual low flow.
- Seamounts in depths greater than 3,500 m as mapped in the EFH assessment GIS.
- Areas designated as HAPCs not already identified by the above criteria" (PFMC 2006b).

Groundfish EFH includes areas within the AIPCP, as the Delta could fall within the first definition above, as well as the estuary HAPC. There are two groundfish species identified by NMFS as potentially impacted by the AIPCP: starry flounder (*Platichthys stellatus*) and English sole (*Parophrys vetulus*). A description of these two species, and their habitats, is below.

➤ *Starry Flounder*

Starry flounder (*Platichythys stellatus*) is a flatfish found throughout the rim of the north Pacific Ocean. It is commonly found in nearshore waters and estuaries off the west coast of the United States (Ralston 2005). Starry flounder usually grows to 12 to 14 inches, and has distinctive light-dark bars on both the dorsal and anal fins. Starry flounder is tolerant to a wide range of salinities, and has been observed in the Sacramento and San Joaquin Rivers in freshwater, at salinities of 0.02 to 0.06ppt (Ralston 2005).

Source: www.afsc.noaa.gov.

Photo: Starry Flounder.

Adults move inshore in late winter or early spring to spawn (from November to February in California), and move offshore to deeper waters in summer and fall (Ralston 2005; PFMC November 2005b). Eggs and larvae float at the surface (epipelagic), while juveniles and adults are demersal (bottom fish). Eggs are found in polyhaline (18 to 30ppt saline) and euhaline (30 to 40ppt saline, i.e. seawater), while juveniles are found in mesohaline (5 to 18ppt saline) to freshwater (<0.5ppt saline). Both adults and larvae are found in euhaline to freshwater. Larvae are thought to move into estuarine waters with the tide, with metamorphosis to juveniles occurring at 10 to 12mm in length. Juveniles remain in estuarine waters until age two, when most migrate into the ocean. Larvae are planktivorous, while juveniles and adults are carnivorous, feeding on a wide number of copepods, amphipods, annelid worms, mollusks, and crabs.

IEP fish monitoring in the Delta and San Francisco Bay captured 275 starry flounder (out of about 33,000 fish) between April, 2004 and September, 2006 (IEP 2006). Given the size of the starry flounder captured (mostly from 50 to 200mm), the fish were predominantly juveniles between two-plus months and two-years of age. Most captured fish were either at Chipps Island and Suisun Slough, both west of the AIPCP project area, or salvaged at the Skinner or Tracy fish facilities in the South Delta, indicating that starry flounder are found throughout the Delta. A study evaluating fish composition from Delta surveys occurring from 1995 to 2015 at 26 sites found only 58 starry flounder (out of 1.6 million fish) (Mahardja et al. 2017).

- *English Sole*

English sole (*Parophrys vetulus*) is also a flatfish, found from the southeast Bering Sea to Baja California. English sole is an important commercial fish, particularly off the coasts of Washington, Oregon, and Northern and Central California (PFMC November 2005). English sole primarily inhabit estuaries and near-shore areas. English sole is a right-eyed flatfish, typically brown to olive brown in color, sometimes with white speckles. Adult females are over 35cm long, while males are somewhat smaller.

Source: hmsc.oregonstate.edu.

Photo: English Sole.

In California, English sole spawn in January and February in deeper water (PFMC November 2005; Stewart 2005). Larvae are thought to move to near-shore areas or estuaries with the tide. Larvae metamorphose into juveniles in spring and early summer. Near shore areas and estuaries are considered nurseries for this species, where juveniles rear until fall/winter, when most emigrate to somewhat deeper waters. Juveniles spend one or two years in coastal estuaries and/or the open coast, in part determined by water temperature (the upper lethal limit for English sole is 26.1C). Eggs are found in polyhaline waters, optimally at 25ppt to 28ppt, while adults are found in euhaline waters. Juveniles and larvae occur in polyhaline (most dense saltwater type that is classified as brackish) and euhaline (able to wide range of salinity)waters. Juvenile English sole are also temperature sensitive, with 18C appearing to be the upper tolerance. Optimal conditions for larval survival were temperatures of 8 to 9C and 25 to 28ppt salinity – indicating that larval English sole are not likely to be found within the AIPCP. Like starry flounder, English sole larvae are planktivorous, while juveniles and adults are carnivorous.

IEP fish monitoring in the Delta and San Francisco Bay between April, 2001 and September, 2006 captured only thirteen English sole (IEP 2006). All fish were in the juvenile size range (45mm to 89mm in length), and all were found within San Pablo or San Francisco Bays. Lower salinity levels and somewhat higher temperatures found within the Delta (and AIPCP treatment areas) are not consistent with English sole habitat, as described in the literature; however, they are included in this PEIR in the event that they might be present in estuarine habitat.

12. Wildlife

The complex interface between land and water in the Delta provides rich and varied habitat for wildlife, especially birds. Wildlife habitats include agricultural land, riparian forest, riparian scrub-shrub, emergent freshwater marsh, heavily shaded riverine aquatic, and grassland/rangeland.

Although much of the Delta is used for agriculture, the land also provides habitat for wildlife. Many agricultural fields are flooded in winter, providing foraging and roosting sites for migratory waterfowl. Aside from these seasonally used areas, tens of thousands of acres are managed specifically for wildlife. Major State, federal, and private wildlife areas in Delta areas are shown in **Exhibit 3-7.** There has been a significant increase in protected habitat acreage in the Delta over the last ten years, including conversion of agricultural land to natural habitat (Arambura 2005).

The Delta is particularly important to waterfowl migrating via the Pacific Flyway. The principal attraction for waterfowl is winter-flooded fields, mainly cereal crops, which provide food and extensive seasonal wetlands. The Delta and other Central Valley wetlands provide winter habitat for 60 percent of waterfowl on the Pacific Flyway and 91 percent of waterfowl that winter in California. More than a million waterfowl are frequently in the Delta at one time, although this occurs during winter months when there are no AIPCP treatments. While there are a number of special status bird species that inhabit the eleven county AIPCP region, only three of these species may be potentially impacted by the AIPCP.

Small mammals find suitable habitat in the Delta and upland areas. Vegetated levees, remnants of riparian forest, and undeveloped islands provide some of the best mammalian habitat in the region. Species include muskrat, mink, river otter, beaver, raccoon, gray fox, and skunks.

While there are a number of special status mammal species in the eleven county AIPCP region, none of these species is likely to be impacted by the AIPCP. None of these mammal special status species are expected to frequent specific treatment locations during the treatment season. In the extremely unlikely event that a special status mammal species did occur within a treatment site, herbicide levels for the AIPCP are well below those likely to impact mammals (DBW 2001).

Exhibit 3-7
Major Wildlife and Habitat Areas in the Sacramento-San Joaquin Delta

Name	County	Owner/Manager	Acreage
1. Yolo Bypass Wildlife Area	Yolo County	CDFW	17,770
2. Lower Sherman Island Wildlife Area	Sacramento County	CDFW/Sacramento County	3,115
3. White Slough Wildlife Area	San Joaquin County	CDFW/DWR/ San Joaquin County	800
4. Rhode Island Wildlife Area	Contra Costa County	CDFW/Contra Costa County	67
5. Miner Slough and Decker Island Wildlife Areas	Solano County	Solano County	50
6. Woodbridge Ecological Reserve	San Joaquin	CDFW	360
7. Antioch Dunes National Wildlife Refuge	Contra Costa	USFWS	67
8. Stone Lakes National Wildlife Refuge	Sacramento	USFWS, Sacramento County, others	17,640
9. Jepson Prairie Reserve	Solano	Solano Land Trust	1,566
10. Cosumnes Preserve	Sacramento and San Joaquin Counties	The Nature Conservancy	11,085
11. Liberty Island	Solano and Yolo Counties	Trust for Public Land	4,760
12. Conservation easements	All Delta counties	Various	12,656
13. Decker Island	Solano	CDFW	648
14. Grizzly Island	Solano	CDFW	14,300
Total			84,884

B. Impact Analysis and Mitigation Measures

This biological resources impact analysis provides an assessment of the specific environmental impacts potentially resulting from program operations. The discussion of impacts utilizes findings from DBW research projects, technical information from scientific literature, relevant information on public policies, and the AIPCP Program Biological Assessment (DBW and USDA-ARS 2017). The Programmatic Biological Assessment provides additional detailed analyses of potential impacts on biological resources, and is incorporated by reference and provided as an appendix to this PEIR. Impact assessments are based on technical and scientific information.

In determining significance, where possible, the extent of the impacts is quantified (e.g. persistence of herbicides in the water column over time and herbicide toxicity levels compared to herbicide treatment levels). However, in many instances it was not possible to quantify the extent of a particular impact accurately. In such cases, the analysis is primarily qualitative.

For purposes of this analysis, a Biological Resource impact (designated with the letter ‘B’) is considered to be significant and require mitigation if it would result in any of the the significance thresholds listed below. Significance thresholds that are not relevant for the AIPCP are dismissed, as noted below. For those significance thresholds that are not dismissed, the potential impact is described and mitigation measures are identified. The significance thresholds are:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the CDFW, NMFS, or USFWS
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the CDFW, NMFS, or USFWS
- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means
- Interfere substantially with the movement of any native resident or migratory fish, or wildlife species, or with established native resident or migratory wildlife corridors, or impede use of native wildlife nursery sites
- Conflict with any local policies or ordinances protecting biological resources, such as tree preservation policies or ordinances (dismiss)
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan (dismiss).

Following each Biological Resource impact, associated mitigation measures are addressed. These include specific actions that the AIPCP will undertake to avoid or minimize potential impacts. CA State Parks – DBW is a stewardship agency. Projects and programs are designed and implemented to minimize impacts to the environment. The 20 mitigation measures have been incorporated in the AIPCP’s daily operations. The AIPCP continues to undergo consultation with various State and federal agencies, including USFWS, NMFS, CDFW, and CVRWQCB regarding impacts, conservation measures, and mitigation measures. Many of the discussed mitigation measures are specific conditions that result from the biological consultation process with USFWS and NMFS. Proposed mitigation measures may be revised and/or additional mitigation measures incorporated as a result of this ongoing consultation process with regulatory agencies.

Exhibit 3-8 provides a summary of potential AIPCP impacts for each of the significance criteria areas. The remainder of this chapter analyzes eight specific impacts and associated mitigation measures.

For each of the eight potential AIPCP impacts, there is a description of the impact, analysis of the impact, classification of the impact level, and when appropriate, mitigation measures to reduce the impact level are provided. The impact levels are as follows:

1. Unavoidable or potentially unavoidable significant impact – an impact that may result in significant adverse effects, and cannot be mitigated with certainty. Mitigation measures for these impacts are described.
2. Avoidable significant impact – an impact that may result in significant adverse effects that can be mitigated to a less than significant level. Mitigation measure for these impacts are described.
3. Less than significant impact – an impact that is likely to result in less than significant adverse effects, without mitigation.
4. No impact – no adverse effects resulting from the proposed action.

The impact assessment for this PEIR takes a conservative approach. Fourteen mitigation measures are identified and incorporated to reduce the potential for impacts to biological resources. Impacts are classified as “unavoidable or potentially unavoidable” including in situations where these impacts are possible, but likely to be insignificant or discountable.

Exhibit 3-8
Crosswalk of Biological Resources Significance Criteria and Impacts of the AIPCP

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	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the CDFW, NMFS, or USFWS?					
Impact B1: Herbicide overspray	1, 2, 3, 4, 5, 19	X			
Impact B2: Herbicide toxicity	1, 2, 3, 4, 6, 7, 8, 9, 13	X			
Impact B3: Herbicide bioaccumulation				X	
Impact B4: Food web effects	1, 3, 4, 6, 7, 8	X			
Impact B5: Dissolved oxygen levels	10		X		
Impact B6: Treatment disturbances	1, 5, 6, 17	X			
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the CDFW, NMFS, or USFWS?					
Impact B1: Herbicide overspray	1, 2, 3, 4, 5, 19	X			
Impact B5: Dissolved oxygen levels	10		X		
Impact B6: Treatment disturbances	1, 5, 6, 17	X			
Impact B7: Plant fragmentation	11, 17		X		
Impact B8: Spoiling of harvested AIPs				X	
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?					
Impact B1: Herbicide overspray	1, 2, 3, 4, 5, 19	X			
Impact B5: Dissolved oxygen levels	10		X		
Impact B6: Treatment disturbances	1, 5, 6, 17	X			
Impact B7: Plant fragmentation	11, 17		X		
Impact B8: Spoiling of harvested AIPs				X	
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?					
Impact B2: Herbicide toxicity	1, 2, 3, 4, 6, 7, 8, 9, 13	X			
Impact B4: Food web effects	1, 3, 4, 6, 7, 8	X			
Impact B5: Dissolved oxygen levels	10		X		
Impact B6: Treatment disturbances	1, 5, 6, 17	X			

Exhibit 3-8
Crosswalk of Biological Resources Significance Criteria and Impacts of the AIPCP *(continued)*

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	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?					AIPCP has no known significant conflicts with local policies or ordinances protecting biological resources
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?					AIPCP has no known conflicts with various conservation plans, programs, or other initiatives in the Delta. AIPCP's reduction in an invasive species is supportive of these conservation efforts

It is important to note that the growth and spread of AIP species in the Delta is, in and of itself, are widely considered as stressors for endangered species. As part of the 2017 Delta Smelt Resiliency Strategy (DSRS) action for enhanced aquatic weed control (California Department of Natural Resources July 2016), DBW conducted herbicide treatments of SAV in two Delta locations, Little Hastings Tract and Decker Island. The purpose of these treatments was to improve habitat for delta smelt. Herbicide treatments of SAV in these sites began during the week of June 5, 2017 and continued for 16 consecutive weeks. DWR and DBW are planning on treatments to support the DSRS in future years. The enhanced weed control study plan involves a multi-agency partnership between the California Department of Water Resources, DBW, UC Davis, and the California Department of Fish and Wildlife. The study, still in process, aims to understand effects of SAV herbicide treatment on delta smelt habitat, water quality, and the food web.

The public review BDCP included a series of conservation measures to reduce stressors in the Delta, including invasive aquatic vegetation. Conservation Measure 13 (CM13) "would control the growth of invasive aquatic vegetation, such as Brazilian waterweed (*Egeria densa*), water hyacinth, and other nonnative submerged and floating aquatic vegetation. CM 13 would rely on existing control methods by the California Division of Boating and Waterways *Egeria Densa* and Water Hyacinth Control Programs. The primary control method would be the application of herbicides as specific as possible to species and site conditions. Limited mechanical removal of invasive vegetation would also be used. Other removal methods could be implemented, depending on site-specific conditions, current research, and intended outcomes. An early detection and rapid response program would be implemented, and restoration sites would be designed to minimize the risk of invasive vegetation establishment and propagation" (CNRA 2013a). In comparison to DBW's identification of potential for unavoidable or potentially unavoidable significant impacts due to the AIPCP, the BDCP/WaterFix EIR/EIS (DWR and USBR 2016a) does not predict significant impacts, and concludes that control of invasive aquatic vegetation would provide a net benefit to covered fish species. While DBW agrees with the net benefit conclusion, it is prudent to consider the potential for, and seek to mitigate, significant impacts, should they occur.

<u>Impact B1 – Herbicide overspray: effects of herbicide overspray on special status species, riparian or other sensitive habitats, and wetlands</u>

A primary treatment of the AIPCP is herbicides. The program will utilize up to eleven herbicides: 2,4-D, glyphosate, penoxsulam, imazamox, diquat dibromide, fluridone, imazapyr, endothall, carfentrazone, flumioxazin, and floropyrausifen-benzyl. Of these, fluridone and endothall will only be utilized for SAV treatment, with potential for effects on native submersed plants, but no impact from herbicide overspray. Below, the characteristics of the remaining nine herbicides are briefly described.

- *Herbicide Summaries from Literature*

2,4-Dichlorophenoxyacetic acid, dimethylamine (DMA) salt, or 2,4-D is a systemic herbicide specific to broadleaf plants and is most effective in plants with a large enough leaf area to absorb sufficient quantities. 2,4-D is water soluble and chemically stable. The herbicide mimics the plant hormone auxin, causing rapid cell division and abnormal growth. 2,4-D can be absorbed by both foliage and roots.

Plant death from 2,4-D typically occurs within three to five weeks after treatment, although during periods of warm weather, plants may show signs of dying within hours of spraying. Any broadleaf vegetation subject to overspray will be vulnerable to 2,4-D activity. Most of the special status plants and several other native plants are broadleaf species. Sensitive riparian habitats and wetlands near AIPCP treatment sites also include other potentially impacted broadleaf plants.

Glyphosate is a broad spectrum, non-selective, systemic herbicide. Glyphosate is water soluble, and is absorbed across the plant surface and translocated throughout the plant. Glyphosate inhibits activity of the shikimic acid pathway enzymes, found only in plants and microorganisms. Glyphosate is not metabolized by plants (Schuette 1998).

Plants begin to show symptoms of glyphosate treatment (gradual wilting and yellowing) within two to seven days. Exposure of any non-target plants to glyphosate, including those in sensitive riparian and wetland habitats, could result in loss of individual plants and habitat impacts.

Penoxsulam (2-(2,2-difluoroethoxy)-N-(5,8-dimethoxyl[1,2,4] triazolo[1,5-c]pyrimidin-2-yl)-6-trifluoromethyl) benzenesulfonamide), is a broad spectrum systemic herbicide in the triazolopyrimidine sulfonamide family. This herbicide inhibits the enzyme acetolactate synthase (ALS), which regulates the production of three essential amino acids: valine, leucine, and isoleucine (Washington DOE 2012). ALS inhibitors such as penoxsulam slowly starve plants of these amino acids, eventually killing the plants by halting DNA synthesis. These biochemical pathways are not present in animals.

Plants absorb penoxsulam through leaves, shoots, and roots. The herbicide affects new growth more rapidly than older plant tissue. Symptoms following treatment with penoxsulam include immediate growth inhibition, a chlorotic growing point with reddening, and slow plant death over a period of 60 to 120 days (Washington DOE 2012). Exposure of any non-target plants to penoxsulam, including those in sensitive riparian and wetland habitats, could result in loss of individual plants and habitat impacts.

The ammonium salt of imazamox (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-(methyoxymethyl)-3-pyridinecarboxylic acid), is in the imidazolinone herbicide family. The mode of action is similar to penoxsulam, inhibiting the acetolactate synthase (ALS) enzyme, blocking the synthesis of three essential amino acids, leucine, isoleucine, and valine (Washington DOE 2012).

Imazamox is a relatively fast-acting systemic herbicide. It is rapidly absorbed into the foliage and translocated throughout the plant by phloem and xylem tissues (Washington DOE 2012). Imazamox inhibits plant growth within the first 24 hours, with visual symptoms appearing about one week after treatment. Symptoms include yellowing leaves and general discoloration. Exposure of any non-target plants to imazamox, including those in sensitive riparian and wetland habitats, could result in loss of individual plants and habitat impacts.

Diquat dibromide (6,7-dihydrodipyrido(1,2-a:2',1'-c) pyrazinediium dibromide) is a post-emergent, non-selective, fast-acting, contact herbicide. Diquat is a photosynthetic electron flow diverter. Diquat is rapidly absorbed by green plant tissues and results in rapid disruption of cell membranes and rapid kill (Washington DOE 2002), with effects visible within a few days. The bipyridyliums penetrate into the cytoplasm, causing the formation of peroxides and free electrons upon exposure to light, destroying the cell membranes. Because the herbicide is so fast-acting, diquat is not translocated to other portions of the plant, acting only on the portions that the herbicide contacted. Any portions of non-target plants exposed to diquat, including those in sensitive riparian and wetland habitats, could result in damage to plants, loss of individual plants, and habitat impacts. Diquat will only be utilized for treating unforeseen infestations, and no more than 1 percent of total treatment acres in total during a treatment season. DBW has not utilized diquat for more than ten years.

Like penoxsulam and imazamox, imazapyr is an ALS inhibitor, although it is in the imidazolinone chemical class. Habitat consists of 28.7 percent of the isopropylamine salt of imazapyr (2-[4,5-dihydro-4-methyl-4(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid). Imazapyr is a slow-acting, systemic, broad-spectrum, pre- and post-emergent herbicide. Imazapyr inhibits the enzyme acetolactate synthase in plants, blocking the production of three essential amino acids (valine, leucine, and isoleucine) (AMEC Geometrix 2009). This enzyme is not present in animals.

Imazapyr is absorbed by leaves and roots, and accumulates in the meristem region of the plant. Imazapyr is most effective when target plants are growing rapidly. The rate of plant death is slow, and it may take several weeks or months for complete plant death. Treated plants stop growing soon after spray application, and chlorosis appears first in the newest leaves, with necrosis spreading from this point (BASF 2008).

Carfentrazone-ethyl is a fast-acting contact herbicide, though it is slower on aquatic macrophytes than in terrestrial uses (Washington DOE 2012). Cell membrane damage causes plant drying and disintegration, with symptoms appearing on aquatic plants in two to five days (Washington DOE 2012). Symptoms include leaf bronzing and blackening necrosis (Washington DOE 2012).

The mode of action for carfentrazone-ethyl is inhibition of the protoporphyrinogen oxidase (protox) enzyme, inducing formation of peroxides that attack cell membrane lipids and proteins (Washington DOE 2012). The product label states that it is effective on the following aquatic weeds which are now, or may become, nuisances in the Delta: water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), water primrose (*Ludwigia spp.*), alligatorweed (*Alternanthera philoxeroides*), giant salvinia (*Salvinia molesta)*, duckweed (*Lemnoideae*), and Eurasian watermilfoil (*Myriophyllum spicatum*).

Flumioxazin is a fast-acting, broad-spectrum contact herbicide effective on a variety of SAV, EAV and FAV. Of concern in the Delta, Clipper is approved for use on several SAV species, including: curlyleaf pondweed, coontail, fanwort, and Eurasian watermilfoil. USEPA reports that flumioxazin is in the N-phenylphthalimides chemical family, and its mode of action is protoporphyrinogen oxidase (PPO) inhibition (Massachusetts DAR 2013).

Flumioxazin causes peroxidation in susceptible plants upon their exposed to sunlight after treatment (Washington DOE 2012). Flumioxazin works best when applied early in the morning (WI DNR 2012). Symptoms include necrosis as soon as one day after treatment, and death soon after (Washington DOE 2012).

Florpyrauxifen-benzyl is a fast-acting, highly selective contact herbicide in the arylpicolinate family (Washington DOE 2017). The mode of action is to mimic auxins, which causes plants to first exhibit over-stimulated growth, then growth stunting, and finally cell and tissue death. Notably, auxin-mimics affect monocots and dicots differently because of the complexities of each plant's specific auxin growth hormones; this provides some selectivity in the target species affected by SX-1552 (Richardson et al. 2016).

Fluridone (1-methyl-3-phenyl-f-[3-(trifluoromethyl)phenyl]-4(1H)-pyridinone) is a slow-acting selective systemic aquatic herbicide used primarily to control broad-leaved, submersed aquatic macrophyte species. Fluridone moves from exposed shoots to rhizomes and roots. Fluridone inhibits formation of carotenoid pigments (including carotene) through inhibition of the phytoene desaturase enzyme. Carotenoids protect chlorophyll from photooxidation; therefore, the lack of carotenoids results in the degradation of chlorophyll when exposed to sunlight. Because carotene and chlorophyll are formed primarily during new growth, fluridone is most effective when the plant is growing rapidly, such as during spring and fall growth phases. Symptoms include white (chlorotic) or pink growing points that appear on the target weed seven to ten days following initial treatment. Weed control is achieved after thirty to ninety days of treatment under optimal conditions.

Endothall is an herbicide in the dicarboxylic acid chemical class (EXTOXNET 1995). Its exact mode of action is not known (Madsen et al. 2010). Hypotheses about its mode of action include cellular disruption, possibly including interference with protein or lipid synthesis or disrupting the transport of nutrients across cell membranes (Tresch et al. 2011; Washington DOE 2010).

Endothall is a fast-acting herbicide that is effective on most SAV. It has been classified as a contact herbicide, though recent research indicates that it is translocated throughout hydrilla and Eurasian watermilfoil more effectively than some systemic herbicides, such as fluridone, penoxsulam and triclopyr (UPI Aquatics undated; Ortiz et al. WAPMS conference presentation 2017). The herbicide therefore exhibits the fast-acting characteristic typically associated with contact herbicides, but it may function as a systemic herbicide in some plants. Endothall is not thought to be translocated to the same extent in all aquatic plants (Keckemet 1968; Madsen et al. 2010). Plants treated with endothall may begin to die within days of contact. Senseman (2007) reports that symptoms include plant defoliation and brown desiccated tissue (Madsen et al. 2010).

- *Adjuvant Summaries from Literature*

The AIPCP will utilize adjuvants with herbicides to ensure contact and translocation of herbicides for FAV and EAV. Adjuvants have been demonstrated to increase herbicides' contact time with plants; in water flowing at less than 3 centimeters per second, adjuvants increased the contact time of 2,4-D and of endothall on Eurasian watermilfoil (Getsinger and West=terdahl 1988). AIPCP will incorporate adjuvants to increase the efficacy of the herbicides, which may help reduce the required amount or frequency of herbicide use in the Delta.

The AIPCP will not utilize polyethoxylated tallow amine (POEA) surfactants, which are known to be toxic to amphibians, or nonylphenoloethoxylate (NPE) surfactants, which are known to be toxic to fish and some invertebrates. The AIPCP will utilize four adjuvants. Agridex®, a crop oil concentrate adjuvant, has been used for several years by the WHCP and SCP. Competitor®, a vegetable oil based adjuvant, has been included in the SCP. Cygnet Plus®, a deposition aid, will be incorporated into the AIPCP. Break-Thru SP 133, a fatty acid ester, will be incorporated into the AIPCP if and when it is approved for aquatic use by the California Department of Pesticide Regulation. DBW is likely to utilize Competitor, Cygnet Plus, and Break-Thru SP 133 only if there are problems obtaining a supply of Agridex.

Relatively little is known about impacts of adjuvants on plants. However, use of these chemicals in concentrations specified on the labels is not expected to negatively impact special status species, sensitive habitats, or wetlands.

- *Potential Impact from Herbicide Overspray*

The potential for impacts resulting from herbicide overspray depend on the amount of exposure, concentration of herbicide, and proximity of sensitive habitats, wetlands, and special status plants. One study found that only three to four percent of 2,4-D droplets drift beyond the target zone, and no significant amount of material is collected as drift (HSDB 2001). Blankenship and Associates (County of Lake 2004) found that using conservative application rates, detectable adverse effects could result from less than one percent spray drift of glyphosate or 2,4-D.

In 2017, DBW conducted a study to evaluate actual in-situ herbicide concentrations in the water after a water hyacinth canopy is treated. Study locations had either 100% water hyacinth coverage or 15% water hyacinth coverage. The study involved spraying water hyacinth mats with the maximum application concentration of 4,553 ppm 2,4-D and monitoring the subsequent 2,4-D concentrations in the water beneath the plants. Preliminary results indicate that in sites with 100% water hyacinth coverage, the post-treatment 2,4-D concentration ranged from 0 to 4 ppm in 1-liter containers; in sites with 15% water hyacinth coverage, the post-treatment 2,4-D concentration ranged from 0 to 45 ppm in one liter containers. The highest result – 45 ppm in 1-liter containers under 15% coverage mats – approximates a conservative concentration of less than 4 ppm at 1 meter beneath the surface over one acre. This indicates preliminarily that approximately 0.09% of the 2,4-D application (4,500 ppm) may reach the water beneath a water hyacinth mat that covers 25% of a location; an even lower percentage of sprayed herbicide reaches the water beneath 100% coverage mats.

The study was also conducted with glyphosate in sites with 100%, 15% and 0% water hyacinth coverage using the maximum glyphosate concentration of 6,066 ppm. Preliminary results in sites with 100% coverage had 15-18 ppm glyphosate in the containers; sites with 15% coverage had 20-22 ppm glyphosate in the containers; and sites with 0% water hyacinth coverage had 19-27 ppm glyphosate in the containers. The highest result – 27 ppm in the collection containers under sites with 0% water hyacinth –

approximates a conservative concentration of 2.4 ppm in 1 acre-meter, or that approximately 0.04% of the glyphosate application (6,066 ppm) may reach the water next to water hyacinth in the event of drift or overspray. Similar overspray percentages are expected from any herbicide. The amount of overspray potential also depends on the shape and size of the AIP mat. Overspray that could impact native plants is likely to occur only at the edge of the mat, where other plants may be present. It is also important to consider the extent of AIP treatments as compared to the project area. Over the last two years, FAV and EAV treatments took place on approximately 4,500 acres, 6.6 percent of the project area. Maximum proposed FAV/EAV treatment could potentially be as high as 11,000 acres, representing 16 percent of the project area. Total SAV treatments have typically encompassed 2,000 to 3,000 acres per year, but could be as high as 4,000 acres, representing 5.9 percent of the project area. DBW implements mitigation measures, described below, to further minimize potential to harm native plants. Thus, the percent of the project area that might be subject to overspray is relatively small as compared to the project area.

For FAV and EAV treatments, the concentration of herbicide active ingredient leaving the spray nozzle is high enough (ranging from 105 ppm to 6,066 ppm, depending on the herbicide) to cause adverse effects. There is the potential that uncontrolled herbicide overspray could affect nearby non-target vegetation. SAV treatments target lower concentrations in the water column (20 ppb to 2 ppm depending on the herbicide) that could potentially impact native submersed plants.

Depending on the herbicide and concentration in water, AIP treatments could result in limited loss of native submerged aquatic vegetation growing in and around treatment areas. Such vegetation may be utilized by special status fish for rearing, coverage, and forage.

Loss of aquatic plants near AIPs for cover, rearing, and forage area of special status species could constitute a significant impact under certain conditions. However, dense canopies of AIPs reduce light levels for submerged plant photosynthesis and thus can effectively shade out native vegetation.

While there is a potential risk to sensitive habitats, wetlands, and special status plants due to herbicide overspray, the likelihood of such effects occurring is low, and likely to be insignificant if it does occur. Herbicide application will be focused directly on target plants to decrease the possibility that concentrated herbicides would come in contact with sensitive plants, or result in impacts to sensitive habitats or wetlands. When AIPs are growing within or immediately under native plants, DBW will utilize hand removal with nets, rather than herbicide treatments.

➢ *Impact Assessment and Mitigation Measures*

DBW will follow herbicide label instructions that reduce herbicide drift. These steps include using the largest size spray droplets, and lowest spray pressure, that will provide sufficient coverage and control. Furthermore, DBW will not treat at a particular site if the wind is greater than 10 mph (or 7 mph in Contra Costa County, per the existing Memorandum of Understanding between DBW and the Contra Costa Water District).

Should any herbicide damage to special status plants, or sensitive riparian or wetland habitats occur, it would represent a significant impact. This impact would be an **unavoidable or potentially unavoidable significant impact.** This impact would potentially be reduced, but not below significance, by implementing the following mitigation measures.

- **Mitigation Measure 1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources.

  Each year, prior to the start of the treatment season, AIPCP management will conduct field crew environmental awareness training. Under this training, crews will be informed about the presence and life histories of special status species; habitats associated with species; sensitive habitats and wetlands; the terms and conditions of the program's biological opinions; incidental take procedures; and that unlawful take of an animal or destruction of its habitat is a violation of the Endangered Species Act and/or California Endangered Species Act.

  AIPCP also will provide crews with a special status species field guide for easy identification of special status species on-site. Prior to treating a site, crews will conduct a visual survey to determine whether special status plants, animals, or sensitive habitats are present. Crews will complete an Environmental

Observations Checklist for each site to document the presence or absence of special status species. If any special status species or sensitive habitats are present at the site, the field crew will not perform any treatment.

DBW Environmental Scientists will classify treatment sites as high, medium, or low potential for nesting birds. DBW also will examine CNDDB records to determine if special status bird species have been sited within AIPCP treatment locations, and prepare a map for field crews identifying such sites. For those treatment sites that have habitat characteristics that might support special status bird species, Environmental Scientists will survey the specific site. DBW will delay treatments at locations where nesting Swainson's hawks are present until after June 10th, the start of the post-fledging stage.

At all treatment locations, crews will conduct a visual survey, following an established protocol, to determine whether special status plants, animals, or sensitive habitats are present, including bird nesting sites. DBW will follow a Swainson's hawk survey protocol consistent with the requirements in the 2015 CDFW-DBW Final Streambed agreement, including surveys focused on active Swainson's hawk nests during their nesting season (February 15 – July 31) within ¼ mile of the project work site. Crews will complete an Environmental Observations Checklist for each site to document the presence or absence of bird nesting sites. If nesting yellow-headed blackbird, Swainson's hawk, or tricolored blackbird are known to be present at the site, the field crew will not perform any treatment within one-quarter mile of the nesting site until the post-fledging stage. For mechanical harvesting operations, DBW Environmental Scientists will observe plant materials during harvesting, and to the extent possible, remove special status species such as Western Pond Turtle, from bycatch. Turtles and other special status species will be placed back in the water in a location away from the harvesting operation.

Mitigation Measure 2 – Provide a 100-foot buffer between treatment sites and shoreline elderberry shrubs (*Sambucus* ssp.), host plant for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) in most sites; in selected sites, utilize backpack style sprayers to direct spray on FAV adjacent to elderberry shrubs.

AIPCP will conduct a survey of treatment sites to prepare a map that identifies locations of elderberry shrubs, and provide this map to field crews. See example maps in **Exhibit 3-9.** In most locations, AIPCP crews will ensure at least 100 feet of buffer between elderberry shrubs and herbicide treatments. Crews will also conduct treatments downwind of elderberry shrubs. For selected treatment sites where Priority 1 and Priority 2 treatment occurs adjacent to elderberry shrubs, DBW crews will utilize backpack style spray wands to target herbicide directly onto FAV species. DBW will photograph and monitor elderberry shrubs near these treatment sites.

In addition, AIPCP environmental scientists will survey a sample of elderberry shrubs which could be potentially impacted by application activities at the beginning of the treatment season, and at the end of the treatment season. The environmental scientists will compare the health of elderberry shrubs at control sites (i.e. not adjacent to treatments) with elderberry shrubs located adjacent to treated sites. If elderberry shrubs located near treated sites show signs of adverse effects from treatment, AIPCP will develop additional mitigation measures to protect elderberry shrubs (for example, increasing the size of the buffer zone).

- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.

  In addition to complying with the label application requirements, DBW will, to the degree possible, schedule herbicide applications to occur at high tide, or at a point in the tidal cycle determined by the field supervisor to provide the least non-target impact at a particular site. In general, treatment at high tide will allow for better spray accuracy and access, and will provide for greater dilution volume of herbicides. DBW crews will change nozzle type and spray pressures whenever conditions warrant, limiting the amount of herbicide which may inadvertently contact non-target species or enter the water.

Exhibit 3-9
Valley Elderberry Shrub Locations and Giant Garter Snake Habitat Valuation – Northern Sites

Page 1 of 2

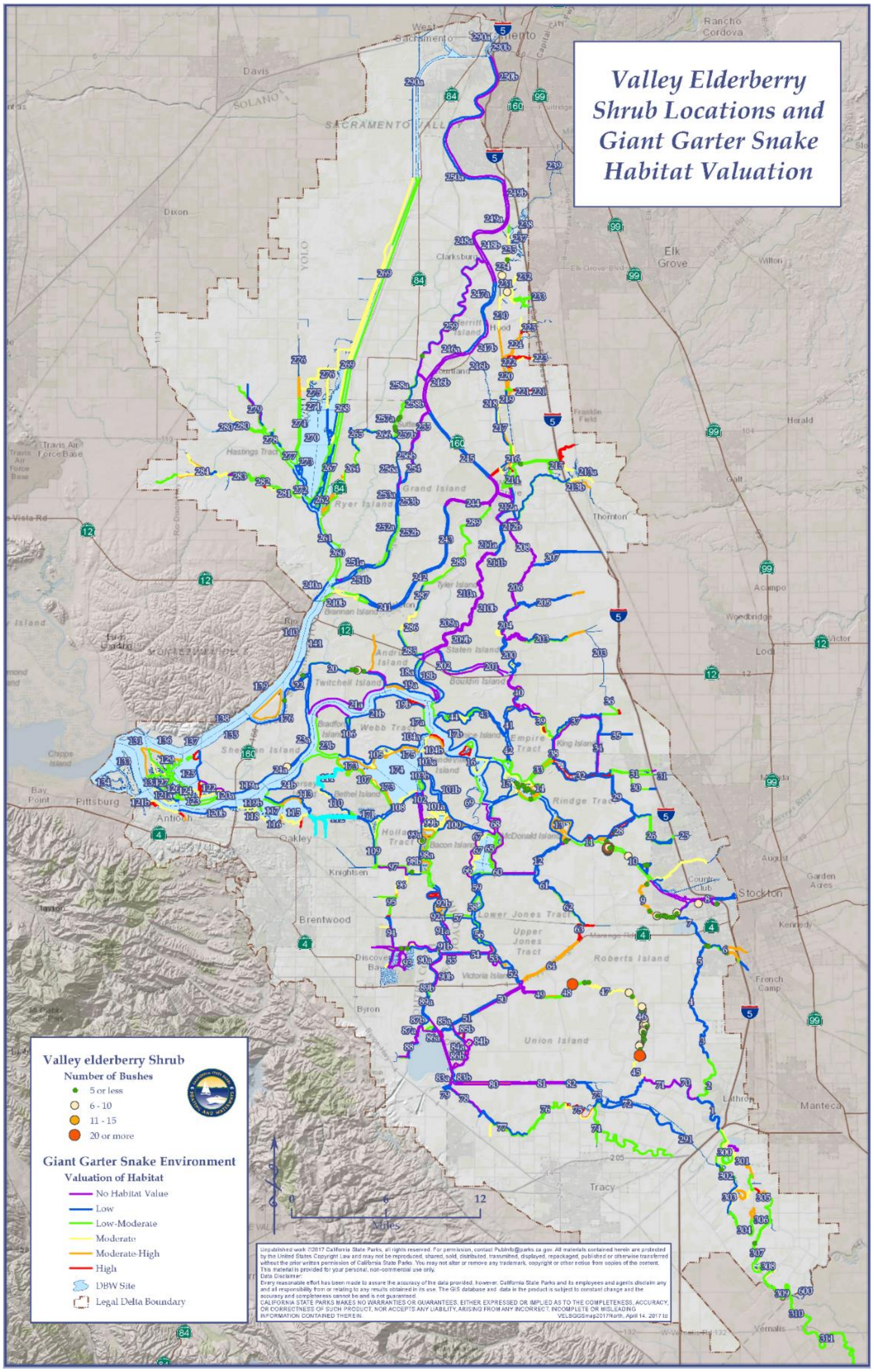
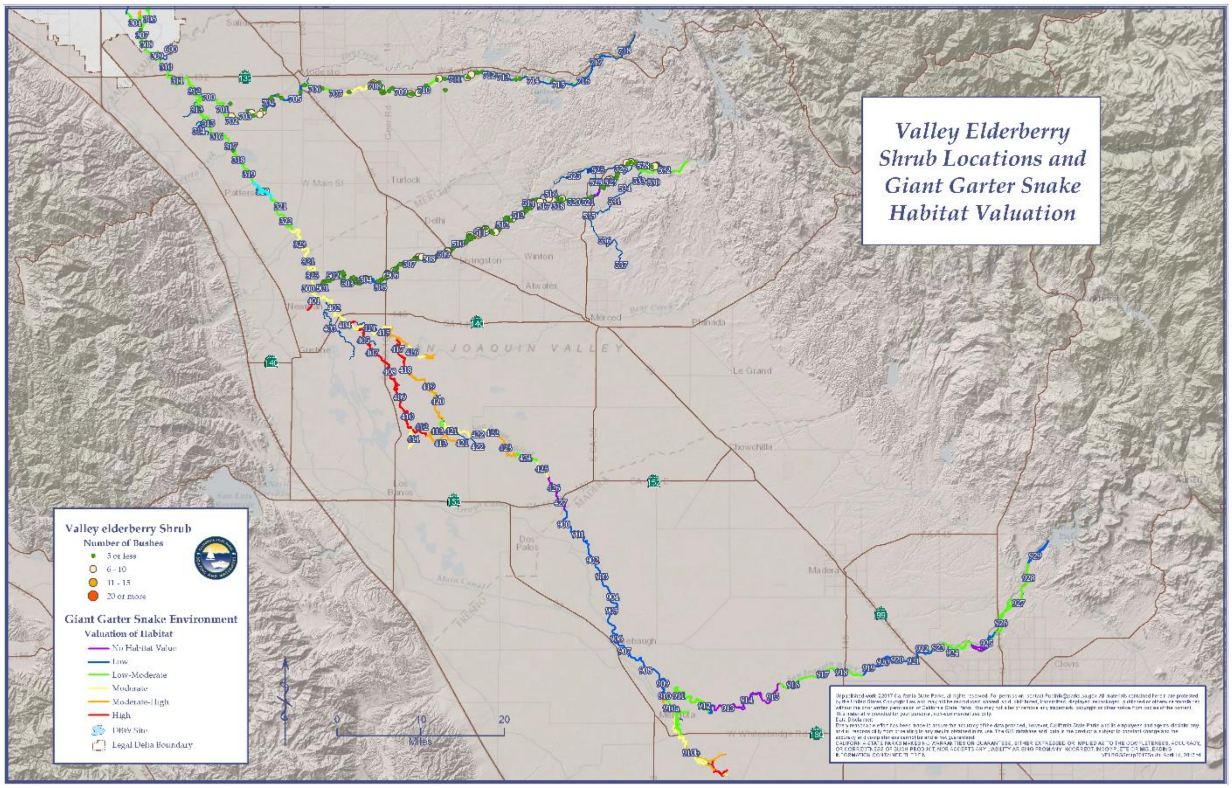


Exhibit 3-9
Valley Elderberry Shrub Locations and Giant Garter Snake Habitat Valuation – Southern Sites *(continued)*

Page 2 of 2



NOTE: Large-scale versions of the map Exhibits in this PEIR are provided in this volume.

- **Mitigation Measure 4** – Restrict diquat treatments to unforeseen infestations and for no more than 1 percent of treatment acres in total.

  To minimize the potential for negative impacts to covered species from exposure to diquat dibromide, DBW will only utilize diquat for unforeseen infestations. Diquat will only be utilized from August 1st through November 30th of each year, unless utilized in a controlled DIZ location where listed fish species will not be present. Diquat treatments will be limited to a total of 1 percent of AIPCP treatment acres in the Delta per year. Unforeseen infestations include situations in which aquatic invasive plant growth completely impedes navigation of Delta waters, such as a completely blocked slough that would impair the movement of emergency response vessels, or infestations that block water intake facilities and require immediate treatment. DBW will consult with USFWS and NMFS prior to utilizing diquat to help ensure that covered fish species are not likely to be present at the time of treatment.

- **Mitigation Measure 5** – Minimize boat wakes and propeller noise to avoid disturbance to the habitat.

  Operational procedures for DBW vessels will minimize boat wakes and propeller noise. These procedures will be particularly important in shallow water, or other sensitive habitats.

- **Mitigation Measure 19** – Visually inspect riparian habitat to document impacts from treatment.

  AIPCP trained and approved staff will visually monitor and document the health of riparian vegetation adjacent to treatment sites that could be potentially impacted by application activities at the beginning and end of the treatment season. DBW Designated Biologists will conduct annual training for AIPCP staff on healthy riparian habitat characteristics, identification of damage to habitats, evaluation of extent of damage, survey methodology, and reporting. In addition to regular surveys by AIPCP trained and approved staff, Designated Biologists will perform visual inspections of randomly selected riparian locations during the treatment season. If any mortality of riparian vegetation occurs as a result of herbicide overspray within the treatment season, DBW will meet and confer with CDFW in order to develop a resolution and/or riparian enhancement plan.

There is uncertainty as to how habitats will respond to removal of AIPs. For example, under the WHCP, some areas which had previously been heavily infested with water hyacinth, became heavily infested with native pennywort or non-native water primrose. Native SAVs (such as pondweeds) increased following treatment of *Egeria densa* in Franks Tract.

It may be that existing imbalances in Delta ecosystem functions may promote some monospecific growth in some situations, even of native species. While removing invasive species is a positive first step, there is need for additional research on Delta ecosystem restoration following removal of non-native species. DWR is currently conducting ecosystem restoration pilot studies to evaluate planting of native species following AIP treatments (Darin, 2017).

Impact B2 – Herbicide toxicity: toxic effects of herbicides on special status species, native resident fish, and migratory fish

There is the potential for direct toxic effects on special status or common fish, amphibian, reptile, and bird species, and resident native and migratory fish, due to the use of AIPCP herbicides and adjuvants. Toxic effects may be acute, chronic, or sublethal.

Acute toxic effects are typically measured in LC50 levels over 48 or 96 hours, the concentration at which there is 50 percent mortality (lethal concentration) among test organisms. Chronic effects are typically measured in 7-day, or longer, LC50 levels. Toxicity tests may also measure a no observed effect level (NOEL). LC50 values are usually expressed in parts per million (ppm or mg/l) or parts per billion (ppb or µg/l). Length of test time is also typically indicated. Sublethal effects are more difficult to measure, as they may be reflected in subtle responses such as reduced ability to avoid predators, or more identifiable effects such as reduced enzyme activity, lesions, or tissue damage.

There have been hundreds of toxicity tests of AIPCP herbicides on various animal species over the last 30 years, including government studies, registrant studies for EPA registration, and university studies. DBW has also funded a number of toxicity tests using AIPCP herbicides in 2003-2005, and again starting in 2014.

(These older studies are summarized in Volume II of the Spongeplant PEIR; the recent studies are provided in Volume II appendices of this PEIR).

For this herbicide toxicity impact assessment, please refer to the AIPCP Programmatic Biological Assessment for a detailed analysis of potential toxic impacts of the AIPCP. Below are summary results of herbicide concentrations following treatment; acute, chronic, and sublethal toxicity endpoints for fish, amphibians, reptiles, and bird species; and the toxicity of AIPCP herbicides to invertebrates under Impact B4 – Food web effects. All proposed AIPCP herbicides have been thoroughly tested and evaluated through USEPA studies, California Department of Pesticide Regulation, scientific literature, university studies, and government evaluations (US Forest Service, Washington Department of Ecology, and others). These documents are evaluated and referenced in the AIPCP Programmatic Biological Assessment.

Toxic effects result from the combination of exposure and toxicity. Exposure refers to the degree of contact of an organism with a chemical. Exposure consists of a concentration component, and a temporal component. The concentration component of exposure depends on an initial concentration of the herbicide treatment, and dilution factors. The temporal component of exposure depends on dissipation of the herbicide, as well as water flow and movement of the organism. Toxicity depends on the specific interactions between the herbicide and organism in question.

The AIPCP utilizes pump-driven hand-held spray nozzles to treat FAVs and EAVs, and direct application to water with hoses (liquid) or broadcast methods (granules) to treat SAVs. For spraying, the pump mixes calibrated amounts of herbicide, adjuvant, and water. DBW applies the herbicides at, or below, the herbicide label-specified rates.

Exhibits 3-10 through **3-13** compare conservative the maximum instantaneous expected environmental concentrations to the lowest, most conservative acute and chronic fish NOEC endpoints for each herbicide. The comparisons are as conservative as possible out of an abundance of caution. Note that this is a summary table only; the AIPCP Programmatic Biological Assessment provides additional toxicity data for each herbicide. These exhibits illustrate that many AIPCP herbicides are several hundreds of times greater than the lowest fish NOEC values available.

Exhibit 3-10
Summary: Conservative Instantaneous FAV Concentrations and Lowest Fish 96-hour NOECs

Herbicide Active Ingredient	Highest FAV Concentration (instantaneous ppm) in 1-m deep water @ conservative 20% drift	Lowest Fish 96-hour NOEC (ppm)	Conservative Concentration vs. Conservative Toxic Endpoint
Penoxsulam	0.0020	0.0112 (LOEC; early life stage)	6 times lower
Diquat	0.0448	0.43 (LC50; early life stage)	10 times lower
Carfentrazone-ethyl	0.0045	0.8	178 times lower
Glyphosate	0.1135	25	220 times lower
Imazapyr	0.0056	> 1.6	286 times lower
Flumioxazin	0.0086	<3.125 (inverse dose response)	363 times lower
2,4-D	0.0852	> 45 (LC50)	528 times lower
Imazamox	0.0112	25	2232 times lower
Florpyrauxifen-benzyl	0.0059	100	16,949 times lower
Agridex	0.000094	0.113 (LOEC; early life stage)	1,202 times lower
Cygnet Plus	0.000094	6.3	67,021 times lower
Competitor	0.000094	>35.55 (LC50; early life stage)	378,191 times lower
Break-Thru SP 133	0.000049	>1,000	20,408,163 times lower

Exhibit 3-11
Summary: Conservative Instantaneous FAV Concentration vs. Lowest Fish 96-hour NOEC (Times Greater)

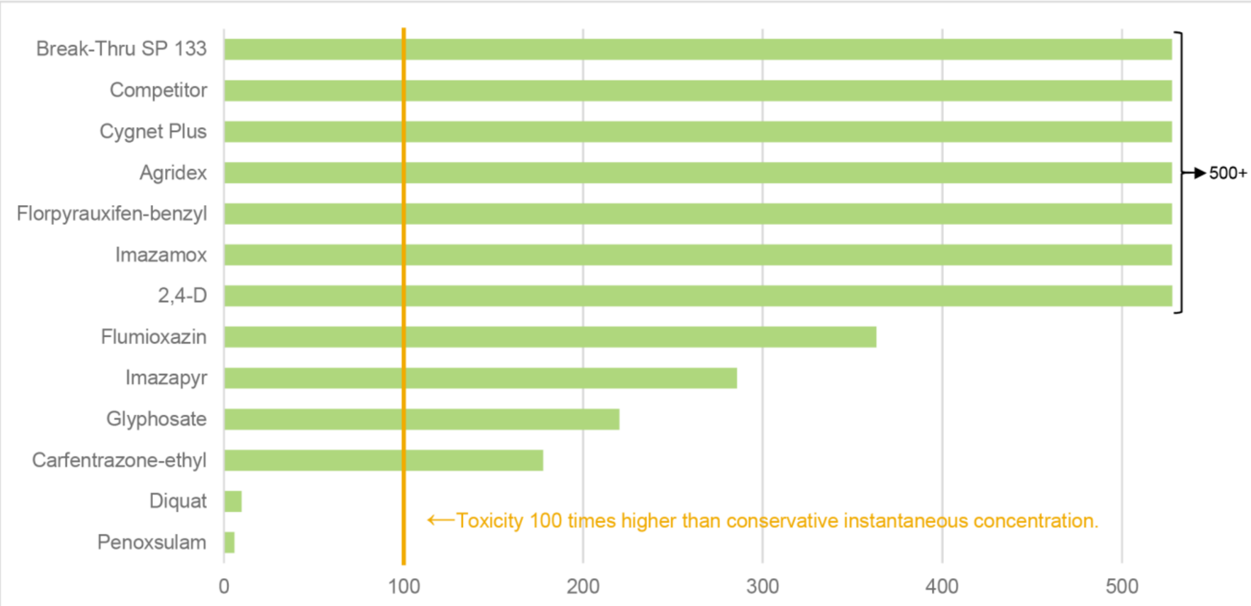
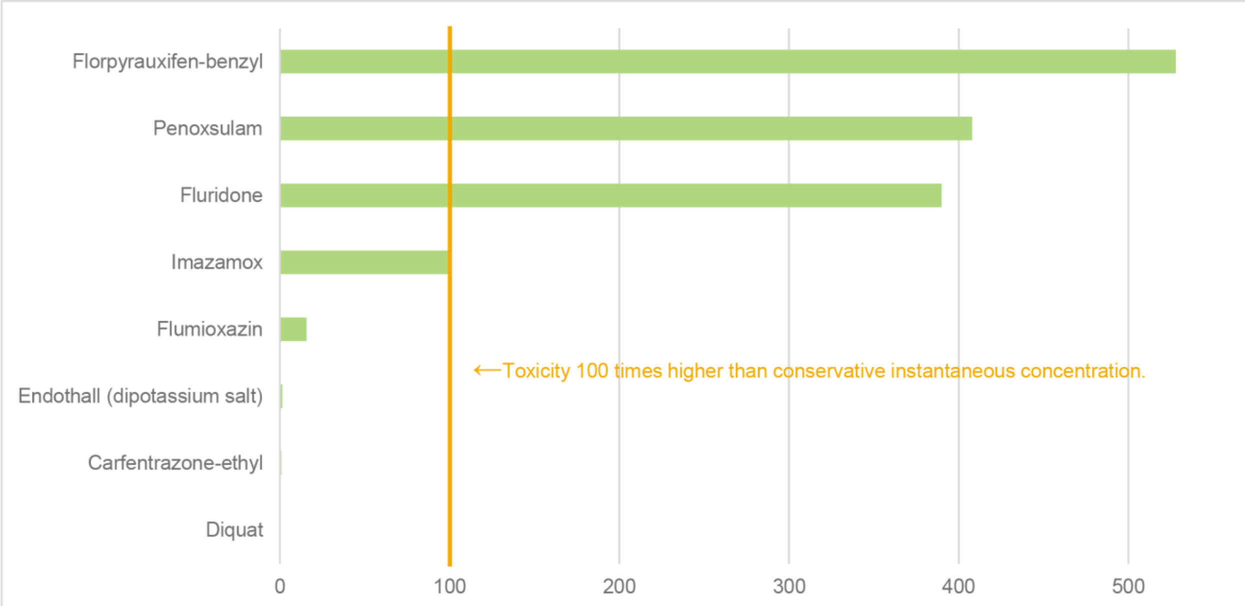


Exhibit 3-12
Summary: Conservative Instantaneous SAV Concentrations and Lowest Fish 7-day NOECs

Herbicide Active Ingredient	Highest Target SAV Concentration (ppm)	Lowest Fish 7-day NOEC (ppm)	Conservative Concentration vs. Conservative Toxic Endpoint
Diquat	0.370	0.37 (LC50; early life stage)	Equal
Carfentrazone-ethyl	0.200	<0.195	Approx. Equal
Endothall (dipotassium salt)	2.000	3.1	1.6 times lower
Flumioxazin	0.400	6.3	16 times lower
Imazamox	0.125	12.5	100 times lower
Fluridone	0.010	3.9	390 times lower
Penoxsulam	0.025	10.2 (NOAEC; technical grade; 36 days)	408 times lower
Florpyrauxifen-benzyl	0.050	50	1,000 times lower

Exhibit 3-13
Summary: Conservative Instantaneous SAV Concentration vs. Lowest Fish 7-day NOEC (Times Greater)



For FAV the concentration is based on a conservative assumption of 20 percent overspray, diluted in the top meter of water. For SAV, the concentration is based on the target concentration of herbicide in the water column. This concentration is typically diluted in the tidal Delta. For example, the target concentration for fluridone is 0.01 ppm; however, the measured concentration after treatment is typically closer to 0.002 to 0.005 ppm. Note that the herbicide concentrations are in parts per billion, while toxicity levels are parts per million, 1,000 times larger. Only a small number of the toxicity metrics are below these conservative concentrations. DBW will carefully monitor any situations where these herbicides are utilized for SAV treatments to avoid the unlikely potential for negative impacts on fish.

Mixing of any herbicide that reaches the water occurs through the entire depth of water at the site, and tidal movement and through water Delta flow dilutes herbicides further. The Delta is not a stationary water environment, thus, the concentration of herbicide immediately after treatment is not stable, but rather readily dilutes (in addition to active ingredient degradation pathways). There are two tidal cycles in the Delta every day, with typical water fluctuations of three to five feet in each cycle. In addition, the Delta functions in a complex hydrological system consisting of inflows from rivers and reservoirs, Delta exports, and tidal fluctuations.

Approximately 30 km3 of freshwater enter the Delta (and then San Francisco Bay) annually, with peak flows in early March (Knowles 2000). Freshwater inflows and Delta exports are the major influences of salinity in the Delta. Illustrating the movement of water within the Delta, the X2 salinity line (distance of the near-bottom 2 psu isohaline line from the Golden Gate) varies by up to 30 km during the course of a year (Knowles 2000).

* * * * *

It is extremely unlikely that there would be acute toxic impacts from AIPCP herbicide or adjuvants to special status fish, amphibians, reptiles, or birds, or that AIPCP herbicides would result in toxic effects that would impact native resident or migratory fish species due to the low concentration levels and the diluting concentrations in the constantly moving water. In addition, given the limited treatment acreage, the potential for sublethal toxic impacts to special status fish, amphibians, reptiles, or birds, or native resident and migratory fish is likewise low. However, should such sublethal toxic impacts result, they would constitute an **unavoidable or potentially unavoidable significant impact.** These impacts would potentially be reduced by implementing the following mitigation measures.

- **Mitigation Measure 1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources.
- **Mitigation Measure 2** – Provide a 100 foot buffer between treatment sites and shoreline elderberry shrubs (*Sambucus* ssp.), host plant for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) in most sites; in selected sites, utilize backpack style sprayers to direct spray on FAV adjacent to elderberry shrubs.
- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.
- **Mitigation Measure 4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total.
- **Mitigation Measure 6** – Implement temporal and spatial limitations and restrictions on herbicide treatments to minimize treatments during times, and at locations, where listed species are likely to be present.

  The AIPCP has implemented a historical mapping and survey-based approach to conducting treatments that allows for treatments in areas with invasive plant infestations when listed fish species are not likely to be present (see Map Appendix). AIPCP will use the historical wet and drought year monthly mapping results, in combination with current CDFW and USFWS fish survey results to identify locations were species are not likely to be present. These site-specific treatment time restrictions minimize potential exposure of migratory salmonids and sensitive juvenile fish to AIPCP herbicides or mechanical harvesting. Some SAV herbicide treatments using low herbicide concentrations may take place in sites where listed fish have been found historically, depending on water flow and herbicide efficacy requirements. **Exhibit 3-14** summarizes fish location and treatment timing. The Appendix to this PEIR provides historical maps of fish species location by month. Species-specific maps are provided in the AIPCP Biological Assessment Supplemental Materials. These treatment time restrictions minimize potential exposure of migratory salmonids and sensitive juvenile fish to AIPCP herbicides. **Exhibit 3-15** illustrates spawning and migration times for several special status fish, in relation to AIPCP treatment times.

- **Mitigation Measure 13** – Follow best management practices to minimize the risk of spill and to minimize the impact of a spill, should one occur.

  The AIPCP best management practices are listed in the WHCP/SCP Operations Management Plan and in the EDCP Operations Management Plan, which are incorporated into this PEIR by reference. These include several provisions to reduce the potential for spill, such as: fastening herbicide containers securely in boats in original, watertight containers; carrying a marker buoy and anchor line to mark any spills in water; reporting spills immediately to appropriate State and local agencies; stopping movement of land spills as soon as possible using absorbing materials; marking and monitoring spills in water for herbicide residues and environmental impacts, if appropriate. Treatment crews will include at least one person with a Qualified Applicators Certificate (QAC), and all crew members will participate in annual training on herbicide handling procedures.

  In the event of an accidental spill of materials deleterious to aquatic life, AIPCP shall take all reasonable measures to document the extent of the associated impacts and affected areas including photographic documentation of affected areas and any injured fish and wildlife. If dead fish or wildlife are found in the affected area then DBW shall collect carcasses, preserve them, and immediately deliver them to the California Department of Fish and Wildlife (CDFW). DBW shall meet and confer with CDFW within 10 days of the incident in order to develop a resolution including: site clean-up, site remediation and compensatory mitigation for the harm caused to fish, wildlife and all the habitats which they depend as a result of the incident. DBW shall take all reasonable measures to ensure that a resolution be achieved within a specified timeframe, generally six months from the date of the incident.

Exhibit 3-14
AIPCP Special Status Fish Presence by Water Year Category, Species, and Month

Page 1 of 5

Type/Year	Delta smelt	Winter-run Chinook	Spring-run Chinook	CV Steelhead	Longfin smelt	Combined
OCTOBER						
Wet 10-11	135, 137, 139	250b	None	1	133	1, 133, 135, 137, 139, 250b
Drought 12-16	133, 135, 137, 138, 139, 140, 141, 268, 270, 273	250b, 290b	None	None	135, 136, 137, 138	133, 135, 136, 137, 138, 139, 140, 141, 250b, 268, 270, 273, 290b
NOVEMBER						
Wet 10-11	None	250b, 290b	290b	None	None	250b, 290b
Drought 12-16	135, 136, 137, 138, 139, 140, 141, 250b	250a, 250b, 290b	250a, 250b, 290b	None	120a, 120b, 133, 135, 136, 137	120a, 120b, 133, 135, 136, 137, 138, 139, 140, 141, 250a, 250b, 290b
DECEMBER						
Wet 10-11	137, 245	1, 18a, 18b, 137, 140, 141, 204, 241, 247a, 250a, 250b, 255, 290b	1, 24a, 24b, 137, 140, 204, 241, 244, 246b, 247a, 248b, 250a, 250b, 289, 290b	None	69, 92a, 92b, 136, 140, 141	1, 18a, 18b, 24a, 24b, 69, 92a, 92b, 136, 137, 140, 141, 204, 241, 244, 245, 246b, 247a, 248b, 250a, 250b, 255, 289, 290b
Drought 12-16	16, 24a, 24b, 42, 104b, 119a, 119b, 120a, 120b, 133, 135, 137, 138, 139, 140, 141, 240a, 240b, 251a, 251b, 260, 261, 269, 272, 273	10, 16, 23a, 23b, 40, 92a, 92b, 102, 104a, 104b, 120a, 120b, 131, 132, 133, 134, 135, 136, 137, 139, 139, 140, 141, 204, 208, 209a, 209b, 240a, 240b, 243, 244, 247a, 248b, 250a, 250b, 251a, 251b, 260, 261, 269, 272, 273, 290b	10, 13, 23a, 23b, 24a, 24b, 40, 92a, 92b, 104b, 133, 134, 135, 137, 139, 140, 141, 204, 204, 205, 208, 209a, 209b, 240a, 240b, 241, 243, 247a, 250a, 250b, 251a, 251b, 260, 261, 269, 270, 272, 273, 285, 290b	24a, 24b, 102, 120a, 120b, 133, 138, 139, 204, 206, 208, 240a, 240b, 244, 251a, 251b, 260, 261, 272, 273, 290b	131, 133, 135, 136, 137, 138, 139, 140, 141, 250b, 260	10, 13, 16, 23a, 23b, 24a, 24b, 40, 42, 92a, 92b, 102, 104a, 104b, 119a, 119b, 120a, 120b, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 204, 205, 206, 208, 209a, 209b, 240a, 240b, 241, 243, 244, 247a, 248b, 250a, 250b, 251a, 251b, 260, 261, 269, 270, 272, 273, 285, 290b

Exhibit 3-14
AIPCP Special Status Fish Presence by Water Year Category, Species, and Month *(continued)*

Type/Year	Delta smelt	Winter-run Chinook	Spring-run Chinook	CV Steelhead	Longfin smelt	Combined
JANUARY						
Wet 10-11	132, 133	120a, 120b, 132, 240b, 250a, 260	18a, 24a, 40, 120a, 120b, 137, 140, 240b, 241, 243, 244, 247a, 248b, 250a, 250b, 260, 289, 290b	120a, 120b, 250b	10, 22, 40, 42, 102, 120a, 120b, 125, 132, 133, 134, 135, 138, 139, 174, 175, 262, 272, 273	10, 18a, 22, 24a, 40, 40, 42, 102, 120a, 120b, 125, 132, 133, 134, 135, 137, 138, 139, 140, 174, 175, 240b, 241, 243, 244, 247a, 248b, 250a, 250b, 260, 262, 272, 273, 289, 290b
Drought 12-16	16, 24a, 24b, 104b, 120a, 120b, 134, 139, 140, 141, 262, 270, 271, 273, 260, 261	24a, 24b, 40, 92a, 92b, 102, 120a, 120b, 132, 133, 137, 140, 240b, 244, 247a, 250a, 250b, 251a, 251b, 255, 269, 272, 273, 290b	40, 92a, 92b, 132, 133, 137, 140, 212a, 212b, 227, 240a, 240b, 241, 244, 247a, 247b, 250a, 250b, 260, 261, 269, 273, 289, 290b	1, 16, 132, 206, 208, 240a, 240b, 244, 250b, 267, 272, 273, 290b	13, 21a, 21b, 22, 24a, 24b, 40, 42, 60, 66, 87a, 87b, 92a, 92b, 102, 120a, 120b, 125, 132, 133, 134, 135, 137, 138, 174, 175, 240a, 240b, 262, 269, 272, 273	1, 13, 16, 21a, 21b, 22, 24a, 24b, 40, 42, 60, 66, 87a, 87b, 92a, 92b, 102, 104b, 120a, 120b, 125, 132, 133, 134, 135, 137, 138, 139, 140, 141, 174, 175, 206, 208, 212a, 212b, 227, 240a, 240b, 241, 244, 247a, 247b, 250a, 250b, 251a, 251b, 255, 260, 261, 262, 267, 269, 270, 271, 272, 273, , 289, 290b, 260, 261
Wet 17	None	250a, 250b, 290b	250a, 250b, 255, 285, 290b	250b	None	250a, 250b, 255, 285, 290b
FEBRUARY						
Wet 10-11	137, 240b, 262, 269	140, 244, 250b, 260, 261	120a, 120b, 137, 140, 240b, 243, 244, 247a, 247b, 250a, 250b, 260, 261, 285, 289, 300	240a, 240b, 244, 250b, 251a, 251b, 260, 261, 269	13, 17a, 17b, 22, 42, 60, 66, 87a, 87b, 102, 120a, 120b, 125, 132, 133, 134, 135, 137, 138, 139, 174, 175, 240a, 240b, 262, 272, 273	13, 17a, 17b, 22, 42, 60, 66, 87a, 87b, 102, 120a, 120b, 125, 132, 133, 134, 135, 137, 138, 139, 140, 174, 175, 240a, 240b, 243, 244, 247a, 247b, 250a, 250b, 251a, 251b, 260, 261, 262, 269, 272, 273, 285, 289, 300
Drought 12-16	16, 24a, 24b, 104b, 133, 134, 135, 137, 138, 139, 140, 141, 141, 240a, 240b, 260, 261, 267, 269, 270, 272, 273, 290b	10, 16, 21a, 21b, 24a, 24b, 40, 42, 104b, 104b, 120a, 120b, 133, 134, 135, 137, 138, 139, 208, 212a, 212b, 240a, 240b, 244, 247a, 250a, 250b, 251a, 251b, 255, 260, 261, 289, 290b	10, 13, 21a, 21b, 24a, 24b, 40, 42, 104b, 133, 134, 137, 140, 208, 243, 247a, 248a, 248b, 250a, 250b, 255, 260, 261, 290b	16, 24a, 24b, 40, 60, 66, 137, 208, 244, 244, 250a, 250b, 251a, 251b, 260, 261, 269, 269, 272, 273, 290b	13, 17a, 17b, 21a, 21b, 22, 24a, 24b, 40, 42, 60, 66, 87a, 87b, 92a, 92b, 102, 124, 125, 132, 133, 134, 135, 137, 138, 139, 240a, 240b, 262, 269, 272, 273	10, 13, 16, 17a, 17b, 21a, 21b, 22, 24a, 24b, 40, 42, 60, 66, 87a, 87b, 92a, 92b, 102, 104b, 120a, 120b, 124, 125, 132, 133, 134, 135, 137, 138, 139, 140, 141, 208, 212a, 212b, 240a, 240b, 243, 244, 247a, 248a, 248b, 250a, 250b, 251a, 251b, 255, 260, 261, 262, 267, 269, 270, 272, 273, 289, 290b
Wet 17	None	None	1, 250b	250b	140, 141	1, 140, 141, 250b

Exhibit 3-14
AIPCP Special Status Fish Presence by Water Year Category, Species, and Month *(continued)* *Page 3 of 5*

Type/Year	Delta smelt	Winter-run Chinook	Spring-run Chinook	CV Steelhead	Longfin smelt	Combined
MARCH						
Wet 10-11	24a, 24b, 125, 137, 138, 139, 244, 247a, 250a, 262, 268, 269, 272, 273	1, 137, 138, 139, 244, 250b, 260	1, 40, 120a, 120b, 137, 140, 212a, 212b, 241, 244, 247a, 247b, 250a, 250b, 255, 260, 300, 309	1, 208, 250b	13, 17a, 17b, 21a, 21b, 24a, 24b, 120a, 120b, 132, 133, 134, 135, 137, 138, 139, 174, 175, 240a, 240b, 262, 268, 272, 273, 282, 284	1, 13, 17a, 17b, 21a, 21b, 24a, 24b, 40, 120a, 120b, 125, 132, 133, 134, 135, 137, 138, 139, 140, 174, 175, 208, 212a, 212b, 240a, 240b, 241, 244, 247a, 247b, 250a, 250b, 255, 260, 262, 268, 269, 272, 273, 282, 284, 300, 309
Drought 12-16	13, 16, 17a, 17b, 21a, 21b, 22, 24a, 24b, 42, 60, 66, 87a, 87b, 92a, 102, 104b, 120a, 120b, 133, 134, 135, 137, 138, 139, 140, 174, 240b, 247a, 250a, 250b, 260, 262, 268, 269, 270, 272, 273, 282	1, 2, 3, 10, 13, 18a, 18b, 22, 25a, 25b, 40, 132, 133, 134, 135, 137, 138, 139, 204, 206, 208, 209a, 209b, 240a, 240b, 243, 244, 247a, 250a, 250b, 260, 261, 262, 264, 272, 272, 282, 289, 290b	1, 10, 11, 13, 22, 24a, 24b, 120a, 120b, 133, 134, 137, 139, 140, 141, 240a, 240b, 245, 247a, 247b, 250a, 250b, 255, 260, 261, 262, 264, 267, 269, 270, 272, 273, 282, 290b	1, 16, 17a, 18a, 18b, 24a, 24b, 40, 42, 60, 66, 102, 102, 133, 134, 138, 139, 140, 141, 204, 206, 208, 209a, 209b, 240a, 240b, 244, 250b, 272, 273, 290b	10, 13, 15, 17a, 17b, 21a, 21b, 22, 24a, 24b, 40, 41, 60, 66, 86a, 87a, 87b, 92a, 92b, 102, 124, 125, 132, 133, 134, 135, 137, 138, 139, 174, 175, 240a, 240b, 262, 264, 268, 272, 273, 282, 284	1, 2, 3, 10, 11, 13, 15, 16, 17a, 17b, 18a, 18b, 21a, 21b, 22, 24a, 24b, 25a, 25b, 40, 41, 42, 60, 66, 86a, 87a, 87b, 92a, 92b, 102, 104b, 120a, 120b, 124, 125, 132, 133, 134, 135, 137, 138, 139, 140, 141, 174, 175, 204, 206, 208, 209a, 209b, 240a, 240b, 243, 244, 245, 247a, 247b, 250a, 250b, 255, 260, 261, 262, 264, 267, 268, 269, 270, 272, 273, 282, 284, 289, 290b
Wet 17	140	250b	8, 120a, 120b, 140, 250a, 250b, 260, 272	250b	None	8, 140, 260, 272, 120a, 120b, 250a, 250b

Exhibit 3-14
AIPCP Special Status Fish Presence by Water Year Category, Species, and Month *(continued)*

Type/Year	Delta smelt	Winter-run Chinook	Spring-run Chinook	CV Steelhead	Longfin smelt	Combined
APRIL						
Wet 10-11	60, 66, 134, 137, 240b, 250a, 262, 268, 272, 273, 282, 282	1, 24a, 24b, 139, 250b	1, 2, 3, 24a, 24b, 244, 250a, 250b, 289, 290b	1, 137, 138, 250b	135, 262, 268	1, 2, 3, 24a, 24b, 60, 66, 134, 135, 137, 137, 138, 139, 240b, 244, 250a, 250b, 262, 268, 268, 272, 273, 282, 289, 290b
Drought 12-16	13, 15, 16, 17a, 17b, 21a, 21b, 22, 24a, 24b, 60, 66, 102, 120a, 120b, 132, 133, 134, 135, 137, 138, 139, 140, 141, 174, 175, 240b, 244, 247a, 250a, 250b, 255, 262, 264, 268, 269, 270, 272, 273, 282, 284, 289	1, 2, 22, 25a, 25b, 120a, 120b, 121b, 122b, 132, 133, 134, 135, 138, 139, 147, 204, 206, 208, 209a, 209b, 240a, 240b, 243, 250b, 260, 261, 272, 284	1, 2, 3, 8, 21b, 22, 120a, 120b, 121a, 125, 133, 134, 137, 138, 139, 140, 141, 240a, 240b, 241a, 241b, 246b, 247a, 247b, 250a, 250b, 251a, 251b, 260, 261, 272, 273, 284, 290b	1, 22, 24a, 24b, 40, 132, 133, 134, 137, 139, 209a, 209b, 240a, 240b, 244, 250b, 251a, 251b, 261, 262, 269, 272, 273	1, 15, 17a, 17b, 21a, 21b, 22, 24a, 24b, 42, 60, 66, 86a, 87a, 87b, 92a, 92b, 102, 124, 125, 133, 134, 135, 137, 138, 139, 174, 175, 240a, 240b, 262, 268, 269, 272, 273, 282, 284	1, 2, 3, 8, 13, 15, 16, 17a, 17b, 21a, 21b, 22, 24a, 24b, 25a, 25b, 40, 42, 60, 66, 86a, 87a, 87b, 92a, 92b, 102, 120a, 120b, 121a, 121b, 122b, 124, 125, 132, 133, 134, 135, 137, 138, 139, 140, 141, 147, 174, 175, 204, 206, 208, 209a, 209b, 240a, 240b, 241a, 241b, 243, 244, 246b, 247a, 247b, 250a, 250b, 251a, 251b, 255, 260, 261, 262, 264, 268, 269, 270, 272, 273, 282, 284, 289, 290b
MAY						
Wet 10-11	13, 22, 133, 134, 135, 137, 138, 139, 140, 141, 174, 250a, 261, 262, 268, 269, 272, 273, 282, 284	1, 21a, 21b, 244	1, 24a, 24b, 250b	1, 240a, 240b, 250b, 260, 261, 272, 273	137, 139, 272, 273	1, 13, 21a, 21b, 22, 24a, 24b, 133, 134, 135, 137, 138, 139, 140, 141, 174, 240a, 240b, 244, 250a, 250b, 260, 261, 262, 268, 269, 272, 273, 282, 284
Drought 12-16	17a, 17b, 21a, 21b, 22, 24a, 24b, 42, 60, 66, 92a, 102, 120a, 120b, 125, 133, 134, 135, 137, 138, 139, 140, 141, 206, 240b, 250a, 260, 261, 262, 264, 268, 269, 270, 272, 273, 282, 284	1, 2, 10, 24a, 24b, 92a, 92b, 120a, 120b, 132, 133, 134, 137, 138, 139, 208, 240a, 240b, 244, 261, 268, 269, 272, 273, 282, 284	1, 10, 120a, 120b, 132, 133, 134, 137, 138, 139, 140, 240a, 240b, 243, 244, 250b, 251, 260, 268, 269, 282, 284	1, 13, 132, 133, 134, 137, 138, 250a, 250b, 290b	1, 22, 124, 125, 132, 133, 134, 135, 137, 138, 139, 140, 262, 268, 272, 273, 282, 284	1, 2, 10, 13, 17a, 17b, 21a, 21b, 22, 24a, 24b, 42, 60, 66, 92a, 92b, 102, 120a, 120b, 124, 125, 132, 133, 134, 135, 137, 138, 139, 140, 141, 206, 208, 240a, 240b, 243, 244, 250a, 250b, 251, 260, 261, 262, 264, 268, 269, 270, 272, 273, 282, 284, 290b

Exhibit 3-14
AIPCP Special Status Fish Presence by Water Year Category, Species, and Month *(continued)* *Page 5 of 5*

Type/Year	Delta smelt	Winter-run Chinook	Spring-run Chinook	CV Steelhead	Longfin smelt	Combined
			JUNE			
Wet 10-11	21b, 24a, 24b, 120a, 120b, 121a, 132, 134, 135, 140, 141, 240b, 262, 268, 272, 273, 282, 284	None	1	250b, 307	None	1, 21b, 24a, 24b, 120a, 120b, 121a, 132, 134, 135, 140, 141, 240b, 250b, 262, 268, 272, 273, 282, 284, 307
Drought 12-16	17a, 17b, 22, 24a, 24b, 42, 60, 66, 120a, 120b, 125, 133, 134, 135, 137, 138, 139, 140, 141, 240a, 240b, 262, 268, 272, 273, 282, 284	134	134	1, 208	1, 10, 125, 132, 133, 134, 135, 137, 138, 139, 268, 282, 284	1, 10, 17a, 17b, 22, 24a, 24b, 42, 60, 66, 120a, 120b, 125, 132, 133, 134, 135, 137, 138, 139, 140, 141, 208, 240a, 240b, 262, 268, 272, 273, 282, 284

Exhibit 3-15
Proposed Period of AIPCP Treatments; Periods of Peak Spawning in the Delta; and Migration and Emigration of Special Status Fish Species through the Sacramento-San Joaquin River System

<table>
<tr><th>Jan.</th><th>Feb.</th><th>Mar.</th><th>Apr.</th><th>May</th><th>June</th><th>July</th><th>Aug.</th><th>Sep.</th><th>Oct.</th><th>Nov.</th><th>Dec.</th></tr>
<tr><td></td><td></td><td colspan="4">AIPCP treatment at selected sites</td><td colspan="3">AIPCP peak treatment period</td><td colspan="2"></td><td></td></tr>
<tr><td></td><td></td><td colspan="5">Delta smelt spawning</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Longfin smelt spawning</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">Adult winter-run Chinook salmon migration</td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5">Juvenile winter-run Chinook salmon emigration</td><td></td><td></td><td></td><td colspan="4"></td></tr>
<tr><td></td><td></td><td colspan="5">Adult spring-run Chinook salmon migration</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Juvenile spring-run Chinook salmon emigration</td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="5">Central Valley steelhead migration</td><td></td><td></td><td colspan="5"></td></tr>
<tr><td colspan="12">Green sturgeon juveniles and spawning adult migration/emigration</td></tr>
</table>

- **Mitigation Measure 7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters.

  AIPCP will conduct comprehensive monitoring. This monitoring is in compliance with the general NPDES permit, and prior NOAA-Fisheries and USFWS Biological Opinions/Letters of Concurrence. AIPCP will collect a pre-treatment sample no more than 24-hours prior the start of treatment, and collect post-treatment samples, continuing until the sampling location shows non-detectable herbicide levels. AIPCP will conduct water quality monitoring as required by the NPDES General Permit for each herbicide, and water body type. Water samples will be submitted to a certified analytical laboratory to measure herbicide and adjuvant concentrations, as appropriate. Should these levels exceed allowable limits, AIPCP will take immediate measures to reduce herbicide levels at future treatment sites. AIPCP will conduct additional immunoassay monitoring for selected SAV herbicide applications to more closely track herbicide levels.

  In the event that herbicide or adjuvant concentrations exceed allowable limits, DBW will take reasonable measures to document the extent of the associated.impacts and affected areas including photographic documentation of affected areas and any injured fish and wildlife. If dead fish or wildlife are found in the affected area, DBW will collect carcasses and deliver them to CDFW. DBW will meet with CDFW within ten days of the incident in order to develop a resolution including: site clean-up, site remediation and compensatory mitigation for the harm caused to fish, wildlife and the habitats on which they depend as a result of the incident. DBW will be responsible for all clean-up, site remediation and compensatory mitigation costs. DBW will take all reasonable measures to ensure that a resolution be achieved within a specified timeframe, generally six months from the date of the incident.

- **Mitigation Measure 8** – Implement an adaptive management approach to minimize the use of herbicides in the long-term.

  Under an adaptive management approach, AIPCP will seek to improve efficacy and reduce environmental impacts over time as new and better information is available. Specifically, AIPCP will evaluate the need for control measures on a site by site, month-to-month, basis; select appropriate indicators for pre-treatment monitoring; monitor indicators following treatment and evaluate data to determine program efficacy and environmental impacts; support ongoing research to explore impacts of the AIPCP and alternative control methodologies; report findings to regulatory agencies; and adjust program actions, as necessary, in response to recommendations and evaluations by USDA-ARS, DBW staff, regulatory agencies and stakeholders.

  In addition to this adaptive management approach, AIPCP will follow maintenance control practices that from a program standpoint seek to reduce the number of acres of invasive plants to be treated each year, until treatment acreage reaches a minimal level. This will reduce the volume of herbicide utilized by the AIPCP.

- **Mitigation Measure 9** – Provide treatment crews with electronic mapping that identifies previously surveyed areas for giant garter snake habitat, valley elderberry shrub locations (see hard copy example in Exhibit 3-9), and nesting special status birds.

  Application crews will use these maps as tools for performing pre-application visual inspections for the presence of giant garter snakes, valley elderberry longhorn beetle, or nesting special status birds. If giant garter snakes are present, treatment crews will not treat at that location. If valley elderberry shrubs are within 100 feet of the potential spray area, crews will generally not treat at that location (see Mitigation Measure 2 for exceptions). If nesting special status birds are present, treatment crews will not perform any treatment within 200 yards of the nesting site until the post-fledging stage.

Impact B3 – Herbicide bioaccumulation: effects of herbicide bioaccumulation on special status species

The AIPCP will have a less than significant impact on special status species due to bioaccumulation of herbicides. Bioaccumulation is an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Compounds accumulate in organisms whenever they are taken up and stored faster than they are broken down (metabolized) or excreted. Bioaccumulation of chemicals in herbicides can occur in plant or animal tissues due to direct uptake or exposure, or in animal tissues by consumption and ingestion of other plant or animal species that have bioaccumulated these chemicals.

2,4-D

According to most sources, 2,4-D does not bioaccumulate in plants, and there is no evidence that 2,4-D accumulates to a significant level in mammals or other organisms (EXTOXNET 1993). The half-life of 2,4-D in living organisms is between 10 and 20 hours, and most 2,4-D is excreted in the urine (EXTOXNET 1993; NPTN 2008). The National Library of Medicine Hazardous Substance Data Bank states that 2,4-D is metabolized in fish and that bioconcentration is not expected to be appreciable (HSDB 2001). In a study exposing channel catfish and bluegill to 2 ppm 2,4-D by intraperitoneal injection, the fish excreted 90 percent of the herbicide within six hours (HSDB 2001). The researchers concluded there was no evidence for bioaccumulation in channel catfish and bluegills (Sikka et al. 1977).

Wang et al. (2004) evaluated bioaccumulation factors of 2,4-D, exposing carp and Nile tilapia to 0.5ppm 2,4-D. The 2,4-D bioaccumulation factor in carp dropped from 45 percent after seven days to 22 percent after 14 days. For Nile tilapia, the bioaccumulation factor dropped from 33 percent after five days to 17 percent after 14 days. This study indicates that 2,4-D does not bioaccumulate in fish.

Tu et al. (2001) reported on studies in Russia that found residues of 2,4-D in eggs, milk, and meat, however the type of 2,4-D was not reported. Tu et al., (2001) also reported on an Oregon study that found that 2,4-D risk to browsing wildlife is low. In aquatic species, the highest concentrations of 2,4-D were typically reached shortly after application, and dissipated within three weeks following exposure (Tu et al. 2001). After animals were removed from contaminated waters, they tended to excrete 2,4-D residues.

There is some evidence that fish take up 2,4-D, but seemingly at low levels that do not adversely affect fish or other species ingesting them. Folmar (1980) found fish present within a spray plot take up enough 2,4-D, or breakdown enough phenols, to impart an objectionable taste for the flesh for several days after spraying. Water column concentrations of 500 ppb imparted an "inferior" taste, while 100 ppb imparted an "acceptable" taste. These levels are significantly higher than those found even immediately after AIPCP treatments.

Glyphosate

Glyphosate has virtually no tendency to bioconcentrate (Siepmann 1995). Glyphosate is poorly absorbed from the digestive tract, and is largely excreted unchanged by mammals. It has no significant potential to accumulate in animal tissue, and a very low potential for glyphosate to build up in the tissues of aquatic invertebrates or other aquatic organisms (EXTOXNET 1996). Glyphosate is also not expected to bioaccumulate in plants (County of Lake 2005). Carp exposed to 0.05 ppm glyphosate had a bioaccumulation factor (concentration in fish/ concentration in water) of 42 percent after seven days, decreasing to 25 percent after 14 days (Wang et al. 2004). The same 0.05 ppm exposure in Nile tilapia resulted in a 65 percent bioaccumulation factor after five days, decreasing to 13 percent after 14 days (Wang et al. 2004), indicating that glyphosate does not bioaccumulate in fish.

In a glyphosate product fact sheet, Monsanto (2002) states that “in laboratory studies conducted with glyphosate, bioconcentration factors were less than 1.0, indicating that glyphosate does not accumulate in fish. The low bioaccumulation factor is a result of glyphosate being readily soluble in water, and therefore subject to rapid elimination from organisms in water. Other animal species studied including marine mollusks and crustaceans, also showed low potential for bioaccumulation.”

Penoxsulam

USEPA considers penoxsulam to have low potential to bioaccumulate in aquatic organisms (USEPA January 2007). A European risk assessment also determined a low bioaccumulation potential for penoxsulam in birds and mammals (Washington DOE 2012). The bioconcentration factor (BCF) of penoxsulam in crayfish after 14 days exposure was 0.02 ml/g (values less than 100 are considered low) (USEPA January 2007; FOOTPRINT 2009).

Imazamox

Imazamox does not bioaccumulate (Washington DOE 2012). In a study of bluegill sunfish, imazamox did not significantly bioaccumulate, and concentrations of imazamox in whole fish and edible tissue were less than the minimum detectable limit (USEPA 2008a).

Diquat Dibromide

Diquat dibromide has little or no potential to bioaccumulate in fish and aquatic invertebrate species (Washington DOE 2012). Those species that do adsorb diquat rapidly eliminated more than 50 percent of the herbicide within a few days, with the possible exception of bivalves, which may continue to release diquat for more than 28 days (Washington DOE 2002). The highest bioconcentration factor found in invertebrates was approximately 32, well below levels considered high. Bioconcentration factors in several fish species were less than one (Washington DOE 2002).

Diquat does adsorb in plants, with concentrations of over 1,000 ppm found in macrophytes and algae following treatment at less than one ppm diquat (Washington DOE 2002). Plants are an important removal pathway of diquat from water, and research suggests that diquat is adsorbed to the surfaces of plants by an ion exchange mechanism (Washington DOE 2002). Bacteria associated with the surface of dead and dying plants degrade about 32 percent of the plant-bound diquat, with the remainder rapidly binding to sediment, where it becomes less bioavailable.

Fluridone

Studies indicate that fluridone has a low potential for accumulation in fish and other aquatic organisms (USEPA 1986). The CDFW analyzed Chinook salmon smolts for residues of fluridone and the primary fluridone metabolite, 4-hydroxy fluridone in 2005 (Hosea 2005). The smolts were collected at three sites in the Delta during regular trawls monitoring salmon movement in the Delta. All smolts were from either the Feather River or Merced hatcheries. No residues of >10ppb of either fluridone or 4-hydroxy fluridone were detected in any of the smolt samples. The study determined that salmon are not concentrating fluridone in their tissues, and presented several possible reasons: (1) dilution of fluridone after treatment, (2) short residence time of smolts in treatment areas, and (3) rapid adsorption of fluridone to sediments and suspended solids, reducing bioavailability.

Several researchers have observed instances of low bioaccumulation of fluridone and its metabolites; even though these studies generally involved exposure to much higher concentrations of the chemical than would be used under AIPCP. West and others identified total average bioconcentration factors (BCF) for total fluridone residues of 1.33 for edible tissue, 7.38 for inedible tissue, and 6.08 for whole body (West et al. 1983). These data were obtained from 175 fish samples collected between one day and 12 months after treatment. West concluded that the low BCF in all fish species indicated that residues will not accumulate in fish as a result of fluridone applications. Residues in fish from lake trials were much lower than those from pond trials, reflecting the lower fluridone levels in lake water. In zooplankton, the bioconcentration factor of fluridone ranged from 0 to 10, and fluridone was not detected in zooplankton once it had dissipated from the water (West et al. 1979).

Muir and others reported bioconcentration factors of up to 85 in duckweed following exposure to 5.0 ppm of fluridone in water (West et al. 1983). West and others reported bioconcentration factors ranging from 0 to 15.5 in vascular plants following exposure to 0.10 ppm of fluridone in water (West et al. 1979). These peak values of fluridone residues were followed by a decline in concentrations as fluridone dissipated from the water column.

Kamarianos et al. (1989) found that Fluridone levels in carp after exposure to 0.042 ppm fluridone (in the form of Sonar AS) reached a maximum on the 13th day after treatment of 484 ug/kg, and decreased steadily from that point to 30.7 ug/kg after 84 days. The fluridone major metabolite (1-methyl-3-(4-hydroxyphenyl)-5-[3-(trifluroomethyl)phenyl]-4(iH)-pyridone) was not detected in any fish sample. Kamarianos concluded that there were no detrimental effects in fish productive aquatic ecosystems treated with fluridone.

Muir et al. (1982) evaluated uptake and bioconcentration of fluridone (concentration in the organism divided by concentration in the environment) in juvenile rainbow trout and chironomid larvae. While the larvae had slightly higher bioconcentration values (128 versus 91), both were well below the value considered low. Exposure in this study consisted of 0.05 ppm fluridone for up to 120 hours, and then placement in clean water to measure herbicide clearance.

No circumstance was identified in the scientific literature where fluridone irreversibly accumulated in biological tissues and remained after the dissipation of the chemical from the water column. SePRO Corporation reports that studies have shown that fluridone does not accumulate in fish tissue to any significant degree, and that the relatively minor amounts of fluridone that are absorbed by fish are eliminated as the concentrations of fluridone in the water decline (SePRO 2006). In conclusion, it is unlikely that fluridone use at AIPCP concentrations would result in bioaccumulation to any significant degree or in any way that would result in adverse impacts to fish (or other aquatic organisms).

Imazapyr

Imazapyr is reported to not bioaccumulate in animals (WI DNR 2012; WSDOT 2006). The product safety sheet states that the bioaccumulation potential has not been tested, but that the ingredient properties support a conclusion that imazapyr does not accumulate (SePRO 2016). In plants, imazapyr is absorbed by leaves and roots, and accumulates in the meristem region of the plant. The plant half-life of imazapyr is 15 to 37 days (Washington DOE 2009).

Carfentrazone-ethyl

Carfentrazone-ethyl has a low potential for bioaccumulation (Washington DOE 2012). In a 28-day study conducted by the registrant, fish were continuously exposed to expected environmental concentrations or radioactive-labeled carfentrazone. Results indicated that the fish eliminated half of the radioactivity in less than 24 hours, and eliminated 98.4-99.1% of the radioactivity within 14 days (Washington DOE 2012). Per the product MSDS, there is no potential for bioconcentration (SePRO 2015).

Endothall (dipotassium salt)

Studies indicate the bioaccumulation of dipotassium salt endothall in bluegills is unlikely, and that residue levels in tissues become undetectable within a few days after exposure to water treated with the herbicide (WI DNR 2012). Although studies have determined bioconcentration factors (BCFs) ranging from nearly zero to ten, the highest reported BCF of 10 was based on a microcosm study in which microorganisms may have mineralized the endothall and carbon (SERA 2009). EPA reports BCF factors of 0.35 and 0.08 for whole fish and the edible portion of the fish as reasonable upper bounds (SERA 2009). For mammals, the Forest Service estimates that endothall may have a modest potential for bioaccumulation (SERA 2009).

Flumioxazin

Flumioxazin does not accumulate through food chain (Washington DOE 2012). The EPA waived the requirement for a bioconcentration study due to the low octanol/water partition coefficient (log K_{ow} 2.55 at 20oC). In a study that exposed bluegill and channel catfish to 800 ppb – twice the maximum allowed aquatic application rate – total flumioxazin residues declined rapidly within three days, and did not bioaccumulate in the fish during the course of the 28 days (Washington DOE 2012).

Florpyrauxifen-benzyl

Based on the product chemistry, florpyrauxifen-benzyl is expected to temporarily bioaccumulate but be rapidly depurated or metabolized within 1-3 days after exposure to high concentrations above 150 µg/L (Washington DOE 2017). The higher K_{OC} of florpyrauxifen-benzyl causes it to moderately accumulate in the short-term in fish and freshwater invertebrates. The bioconcentration factor, or BCF, is approximately 350, though it is quickly eliminated from organisms' bodies (CT95= 1.7 days). The manufacturer does not expect long-term bioaccumulation (Mark Heilman March 2017; confidential). Washington DOE (2017) reports that Procellacor is depurated or metabolized within three days in freshwater organisms.

Adjuvants

There is limited information on bioaccumulation of adjuvants. The Material Safety Data Sheets (MSDS) for Agridex, Competitor, and Cygnet Plus state that no information on bioaccumulation is found (Bayer Crop Science 2004; Wilbur-Ellis 2010). The primary ingredient in Competitor, ethyl oleate, is approved by the Food and Drug Administration as a regulated food additive (Bakke 2007). Break-Thru SP133 is comprised of fatty acid esters and polyglycerol esters, and is readily biodegradable (Evonik 2015a).

Based on existing evidence, AIPCP herbicides and adjuvants are not likely to result in adverse effects on biological resources due to bioaccumulation of herbicide. **The impact of bioaccumulation on special status species is expected to be less-than-significant.** No mitigation measures are required.

<u>Impact B4 – Food web effects: effect of treatment on food webs, and resulting impact on special status species, sensitive habitats, and migration of species</u>

Special status fish species, or native resident or migratory fish, could be indirectly impacted if the AIPCP decreases the abundance of invertebrates, such as zooplankton, upon which these fish feed. While there is potential for toxic impacts to invertebrates due to the AIPCP, such food web effects are unlikely to occur. Similarly, while there is potential for toxic impacts to phytoplankton upon which zooplankton and invertebrates feed, these effects are not likely to be significant enough to result in detrimental effects to the Delta food web. See the AIPCP Programmatic Biological Assessment (DBW and USDA-ARS 2017) for detailed analysis of potential impacts of the AIPCP on the Delta food web.

Special status fish species, or native resident or migratory fish, could be indirectly impacted if AIPCP decreases the abundance of invertebrates, such as zooplankton, upon which these fish feed. While there is potential for toxic impacts to invertebrates due to AIPCP, such food web effects are unlikely. Typical prey items of special status fish are listed below. Loss of a significant quantity of any of these invertebrates could adversely impact certain special status fish species.

- Juvenile Chinook salmon feed on various aquatic and terrestrial insects, crustaceans, chironomid larvae and pupae, caddisflies (in fresh water), and *Neomysis*, *Cammarus*, and *Crangon* in more saline water (Wang 1986).
- Steelhead feed on terrestrial and aquatic insects, amphipods, crustaceans and small fish (Wang 1986).
- Juvenile delta smelt primarily eat copepods, planktonic crustaceans, small insect larvae, and mysid shrimp, while older fish feed almost exclusively on copepods (Moyle 1976). Over recent years, there have been significant declines in delta smelt's preferred food resources due to invasive species such as the overbite clam (Bennett 2005).
- Sacramento splittail are opportunistic benthic foragers that consume copepods, dipterans, detritus, algae, clams, and amphipods (DBW 2001).
- Longfin smelt feed primarily on *Neomysis mercedis*, although copepods and other crustaceans are important at times, especially to small fish (Moyle 1995, 1976).
- Juvenile green sturgeon feed on *Neomysis mercedis* and amphipods (Corophium) (Radtke 1966). Adults may feed on sand lances, clams, and shrimp (Moyle 1995).
- White Sturgeon feed on algae, aquatic insects, small clams, fish eggs, and crustaceans, but their diets become more varied as they age. Since its introduction into the Delta in the late 1980s, overbite clam has also become a significant food source (BDCP, 2013b).
- Pacific Lamprey prey on a wide variety of fishes, including salmon, Pacific herring, and flatfishes.

- Ammocoetes of the river lamprey feed on microscopic plants and animals (Wang 1986). As adults, river lamprey prey on a variety of fishes in the 10 to 30 cm size range, but the most common prey seems to be herring and salmon (Moyle 1995).

Macroinvertebrates depend on phytoplankton, which serve as the base of the food web. Phytoplankton plays a fundamental role in primary productivity (Jassby et al. 2003). There is potential for AIPCP treatments to affect algae within treatment sites, which could in turn affect macroinvertebrates. However, the potential impact of AIPCP treatments on phytoplankton is minimal compared to larger scale influences on phytoplankton in the Delta. Jassby et al. (2002) examined Delta-wide primary productivity (the rate at which plants incorporate inorganic carbon into organic matter) between 1975 and 1995. During the 21-year time period, primary productivity in the Delta varied by a factor of five. Factors that contributed to the variability included: (1) decreased phytoplankton mass due to the invasion of the clam *Corbula amurensis*, (2) long-term declines in total suspended solids leading to increased water transparency and phytoplankton growth rate, (3) river inflow affecting biomass and growth rates through fluctuations in flushing and total suspended solids, and (4) an unknown factor resulting in a long-term decline in winter phytoplankton growth rate (Jassby et al. 2002).

An analysis of phytoplankton (as chlorophyll a) in the Delta and Suisun Marsh between 1996 and 2005 found increases in much of the Delta and substantial declines in Suisun Marsh (Jassby 2008). Chlorophyll a, a green pigment in plants, is used as an approximate index of algal biomass (Jassby et al. 2003). Overall, there has been a long-term declining trend in chlorophyll a from the 1970s to 2005, as well as a decline in larger-celled phytoplankton, which are preferred food sources (Kimmerer et al. 2012). Delta chlorophyll a sampling levels between 1987 and 2006 have rarely risen about the threshold level of 10 µg per liter that is considered the point at which crustacean zooplankton become food-limited (Jassby 2008, Kimmerer et al. 2012). Suisun Marsh, which is highly affected by *Corbula amurensis*, has seen even greater declines in chlorophyll a (Jassby 2008).

Changes in phytoplankton communities can result in differing nutrient values. For example, diatoms and cryptophytes are generally more nutritious for many zooplankton species than cyanobacteria (Jassby 2008). Researchers have concluded that long-term declines of phytoplankton in the Delta have contributed to long-term declines in fish abundance; however, phytoplankton decline does not appear to be a major factor in the more recent pelagic organism decline (Kimmerer et al. 2012). Vanderstukken (2012) conducted a series of experiments that demonstrated that water hyacinth plants reduced phytoplankton populations through shading, as well as alleopathic effects. Other large AIP mats would have similar shading effects. The status of macroinvertbrates and phytoplankton in the Delta are strongly influenced by factors more significant, and on a wider scale, than AIPCP treatments.

Summary of Food Web Effects

Exhibits 3-16 through **3-19** compare conservative the maximum instantaneous expected environmental concentrations to the lowest, most conservative acute and chronic macroinvertebrate NOEC endpoints for each herbicide. The comparisons are as conservative as possible out of an abundance of caution. Note that this is a summary table only; the AIPCP Programmatic Biological Assessment provides additional toxicity data for each herbicide (DBW and USDA-ARS 2017). These exhibits illustrate that the majority of AIPCP herbicides are several hundreds of times greater than the lowest macroinvertebrate NOEC values available. The EECs are conservative, based on the estimated concentration immediately after application. As noted previously, these concentrations will dilute rapidly, never achieving the exposure time and concentrations of the comparison toxicity tests.

It is unlikely that there would be significant adverse effects to special status, resident native, or migratory fish from AIPCP impacts on the Delta food web. Four herbicides show potential for effects on macroinvertebrates, although exposure times in toxicity studies (typically 96-hours for EC50 and 7 days for NOEC) are longer than AIPCP exposures. There are likely to be adverse effects to some species, such as algae, diatom, and duckweed, that are sensitive to AIPCP herbicides, as shown in Exhibit 3-16. These impacts are likely to be highly localized. Given the low levels of herbicides utilized and temporal and geographic distribution of treatment acreage, the potential for significant food web effects to impact special status fish, resident native or migratory fish, is likewise low.

Exhibit 3-16
Summary: Conservative Instantaneous FAV Concentrations and Lowest Macroinvertebrate 96-hour NOECs

Herbicide Active Ingredient	Highest FAV Concentration (instantaneous ppm) in 1-m deep water @ conservative 20% drift	Lowest Macroinvertebrate 96-hour NOEC (ppm)	Conservative Concentration vs. Conservative Toxic Endpoint
Diquat	0.0448	0.048 (EC50)	Approx. Equal
Carfentrazone-ethyl	0.0045	0.195	43 times lower
Glyphosate	0.1135	100	881 times lower
2,4-D	0.0852	> 100 (EC50)	1,174 times lower
Imazamox	0.0112	50	4,464 times lower
Flumioxazin*	0.0086	50	5,814 times lower
Florpyrauxifen-benzyl	0.0059	50	8,475 times lower
Imazapyr	0.0056	100	17,857 times lower
Penoxsulam	0.0020	63.7 (LC50)	31,850 times lower
Cygnet Plus	0.000094	3.1	32,979 times lower
Agridex	0.000094	46.7 (LC50)	496,809 times lower
Competitor	0.000094	100 (EC50; 48-hour)	1,063,830 times lower
Break-Thru SP 133	0.000049	100 (48-hr)	2,040,816 times lower

Exhibit 3-17
Summary: Conservative Instantaneous FAV Concentration vs. Lowest Macroinvertebrate 96-hour NOEC (Times Greater)

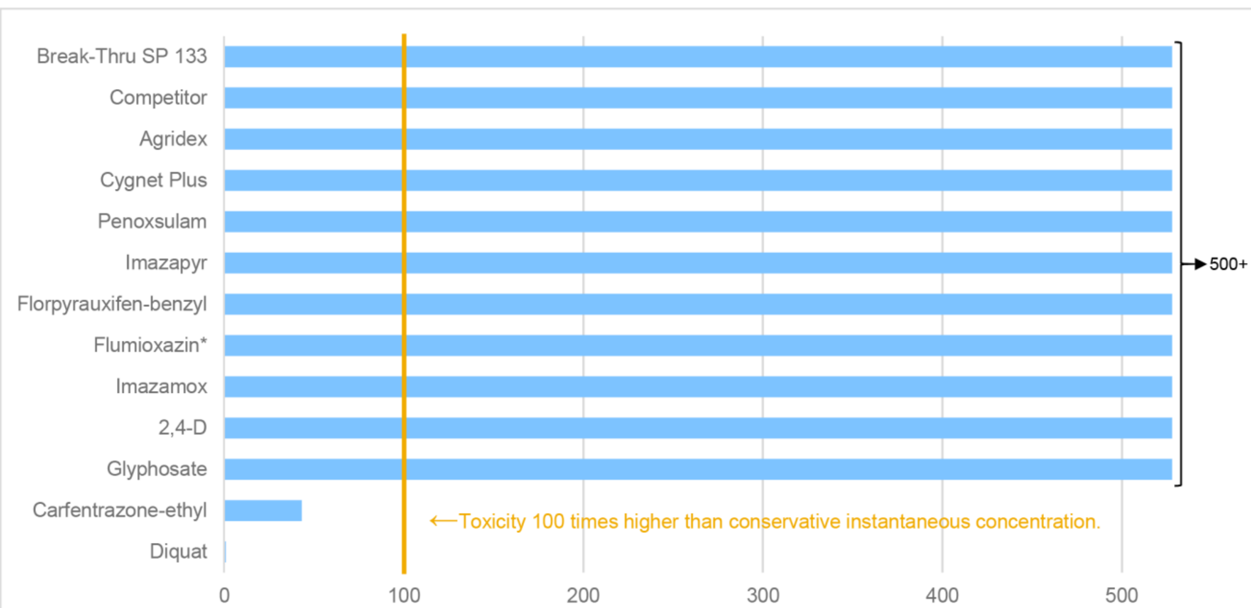
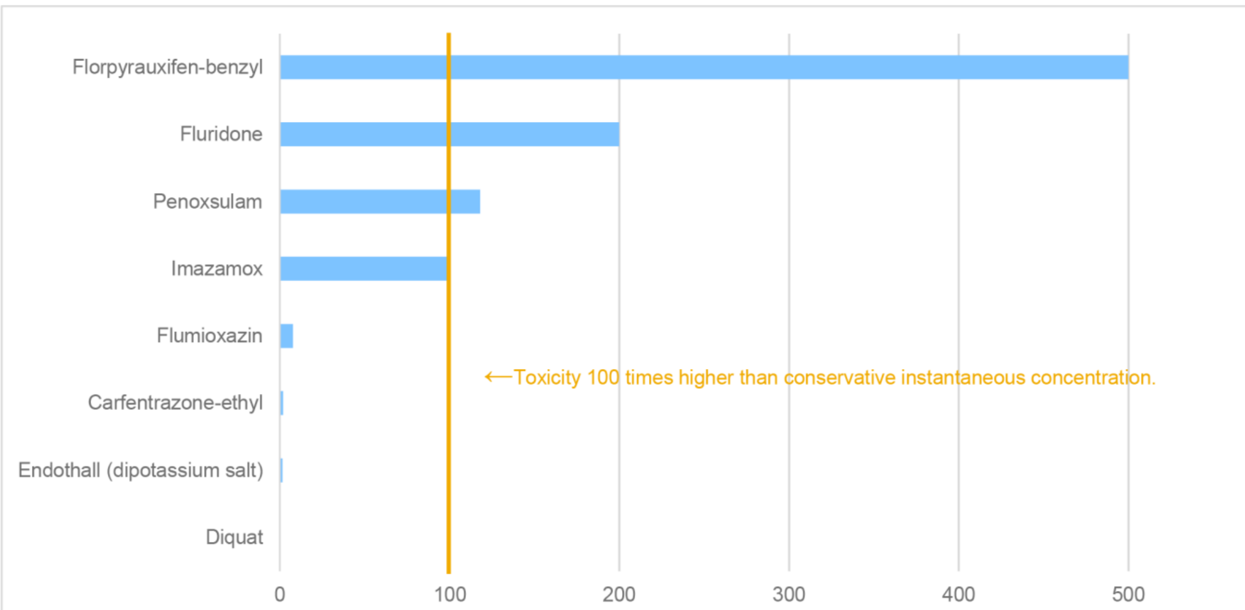


Exhibit 3-18
Summary: Conservative Instantaneous SAV Concentrations vs. Lowest Macroinvertebrate 7-day NOECs

Herbicide Active Ingredient	Highest Target SAV Concentration (ppm)	Lowest Macroinvertebrate 7-day NOEC (ppm)	Conservative Concentration vs. Conservative Toxic Endpoint
Diquat	0.370	0.012	31 times greater
Endothall (dipotassium salt)	2.000	2.34	1.2 times lower
Carfentrazone-ethyl	0.200	0.391	2 times lower
Flumioxazin	0.400	< 3.125 (inverse dose response)	8 times lower
Imazamox	0.125	12.5	100 times lower
Penoxsulam	0.025	>2.95 (NOAEC, 21-d, technical grade)	118 times lower
Fluridone	0.010	< 2	200 times lower
Florpyrauxifen-benzyl	0.050	25	500 times lower

Exhibit 3-19
Summary: Conservative Instantaneous SAV Concentration vs. Lowest Macroinvertebrate 7-day NOEC (Times Greater)



However, should food web effects result, they would constitute an **unavoidable or potentially unavoidable significant impact.** These impacts would potentially be avoided or reduced by implementing the following mitigation measures.

- **Mitigation Measure 1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources.
- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.
- **Mitigation Measure 4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total.
- **Mitigation Measure 6** – Implement temporal and spatial limitations and restrictions on treatments to minimize treatments during times, and at locations, where listed species are likely to be present.
- **Mitigation Measure 7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters.
- **Mitigation Measure 8** – Implement an adaptive management approach to minimize the use of herbicides in the long-term.

Impact B5 – Dissolved oxygen levels: effects of treatment on local dissolved oxygen (DO) levels, and resulting impact on special status species, resident native or migratory fish, sensitive habitat, and wetlands

The AIPCP could result in adverse indirect effects to special status fish, resident and migratory fish, and sensitive riparian and wetland habitats due to the rapid decay of AIPs following herbicide application. Decomposition of vegetative material may create an increased organic carbon load, which could in turn reduce dissolved oxygen concentrations. Low DO can result in fish kills, impede migration of salmonids, and kill aquatic invertebrates. These effects in turn may, at least temporarily, impair sensitive riparian and wetland habitats. However, DWR and the U.S. Bureau of Reclamation (1994) noted that in the Delta in general, constituents such as dissolved oxygen have not changed on a large enough scale to affect mobile organisms, specifically delta smelt and splittail.

Dissolved oxygen is the content of oxygen found in water. DO is determined by temperature, weather, water flow, nutrient levels, algae, and aquatic plants. Until very high oxygen levels are reached, a higher level of DO is beneficial. Fish begin to experience oxygen stress or exhibit avoidance at levels below 5 mg/liter (5 ppm). DO levels drop in warmer temperatures, and increase with precipitation, wind, and water flow. Running water, such as tidal water in the Delta, dissolves more oxygen than still water. High levels of nutrients in water reduce DO levels, while algae and aquatic plants can increase DO through photosynthesis, but decrease DO through respiration and decomposition. DO levels fluctuate throughout the day, and are typically lowest in the morning and peak in the afternoon. In deep, still waters, DO levels are lower in the hypolimnion (bottom layer of water) because there is little opportunity for oxygen replenishment from the atmosphere.

AIPCP herbicide labels include provisions regarding area to be treated and time before follow-up applications to address the potential for low dissolved oxygen following treatment, when appropriate. These herbicide label instructions have been developed to minimize the potential for DO impacts in enclosed waterways. However, much of the Delta and tributaries are tidal. Regular water exchange in these areas minimizes the potential for DO impacts. Following herbicide label instructions when applicable, there will likely be no significant effect on DO, except to increase DO levels once the plants have completed decomposition. Herbicides that result in slow plant decay do not have DO provisions.

Label requirements for treatments taking place in dead-end channels within treatment zones Z-6, Z-7, and Z-10 related to DO impacts are as follows:

- The label for 2,4-D notes that decaying weeds use up oxygen, and recommends treating part of the infestation at one time. For example, the label recommends applying 2,4-D in lanes separated by untreated strips, and delaying treatment of these strips for 21 days, until the treated dead vegetation has decomposed
- The label for glyphosate recommends treating an area in strips when there is full coverage of the weed in impounded areas to avoid oxygen depletion. The Delta does not contain impounded waters (for example a pond)

- The label for penoxsulam does not include specific provisions related to DO
- The label for imazamox does not include specific provisions related to DO
- The label for fluridone does not include specific provisions related to DO
- The label for imazapyr specifies treating one-half of a water body at one time
- The label for flumioxazin specifies treating dense infestations in sections
- The label for carfentrazone specifies treating one-half of a water body at one time
- The label for endothall specifies treating dense infestations in sections
- The label for diquat specifies that no more than one-third to one-half of a water body should be treated at one time, with a waiting period of 14 days for follow-up treatment of the remaining area.

The AIPCP Programmatic Biological Assessment (DBW and USDA-ARS 2017) provides a detailed analysis of dissolved oxygen effects following herbicide treatments in the Delta. These analyses show pre- and post-treatment data in the Delta indicate that there is not a significant change in DO after herbicide use. Additionally, for FAV, experiments conducted by DBW and USDA-ARS in the summer of 2016 indicate that there is little dissolved oxygen under water hyacinth mats even prior to treatment (Madsen, unpublished 2016). In the study, sites were selected from channel-side and backend sloughs, and sondes were used to record dissolved oxygen and temperature every 30 minutes. Sites included control (no herbicide) sites, as well as sites that receive treatments with glyphosate, imazamox, and 2,4-D. Weekly observations and data collection occurred at each site.

However, even short-term, localized impacts on dissolved oxygen could result in adverse effects on special status fish, resident native, or migratory fish, or impair sensitive riparian or wetland habitats in AIPCP treatment sites. Such reductions in dissolved oxygen would represent avoidable significant impacts. **These avoidable significant impacts would be reduced to a less-than-significant level** by implementing the following mitigation measures.

- **Mitigation Measure 10** – Monitor dissolved oxygen (DO) levels for all AIPCP treatments and at selected locations in the Delta over time.

  Based on the pre-treatment DO levels, the AIPCP application crew will determine whether to conduct treatment at that site. No treatment will be performed when dissolved oxygen levels are between 3 ppm (the level below which DO is considered to be detrimental to fish species) and the basin plan limits established by the Central Valley Regional Water Quality Control Board (CVRWQB). The basin plan limits depend on location and time of year, and range from 5 ppm to 8 ppm. DBW will maintain written and map summaries of specific DO numeric limits. When pre-treatment levels are below 3 ppm, fish species are not likely to be present due to the extremely low oxygen levels. When pre-treatment levels are above the basin plan limit, AIPCP treatments, following label guidelines and mitigation measures, are not expected to adversely affect special status fish, resident native or migratory fish, or sensitive riparian or wetland habitats. The current dissolved oxygen map summaries are shown in Chapter 5, Exhibits 5-13a and 5-13b.

Impact B6 – Treatment disturbances: effects of treatment disturbances on special status species, resident native or migratory fish, sensitive habitat, and wetlands

Operational activities associated with AIPCP mechanical harvesters, excavators, cutters and shredders, herbicide treatments, and activities requiring diving, all using motorized watercraft, may result in operational-related disturbances on special status species, or resident native or migratory fish species located nearby. The potential for direct affects to listed species depends on the amount of disturbance caused by the physical or mechanical treatment, and the presence and proximity of listed species in the treatment site.

In May 2003, San Francisco Estuary Institute (SFEI) initiated consultations with USFWS and NMFS to evaluate the impact of mechanical removal on endangered species. Both services issued letters indicating that formal consultation was not required, and approved the mechanical removal project with conditions. The conditions, included: (1) efforts be made to minimize the impacts on listed species; and (2) the project occur within the dates when sensitive species are least likely to be adversely affected (between July 15th and October 31st) (Greenfield et al. 2007). However, DBW monitoring data from current mechanical harvesting of water hyacinth, described below, indicates that there is potential for direct effects to species if they are present in the treatment site.

- *Benthic mats or barriers*

Benthic mats or barriers are not anticipated to disturb listed species, with the exception of the presence of divers for the one-time installation and periodic monitoring of the barriers.

- *Hand/net removal, diver hand removal, and diver-assisted suction removal*

Hand/net removal, diver hand removal, and diver-assisted suction removal are highly selective and low-impact activities that are not expected to have direct effects on listed species. Diver suctioning may temporarily increase sediments and turbidity (Madsen 2000), but the impacts are not expected to be significant or extensive.

- *Booms and floating barriers and curtains and screens*

Booms and floating barriers and curtains and screens may have potential effects on listed species by restricting their movement within the Delta. Depending on the exact placement, such control methods have the potential to delay fish access to spawning habitat or migratory passages. Additionally, the installation of equipment (such as train axels or Danforth type anchors) to anchor curtains and screens may cause a temporary increase in turbidity and effect macroinvertebrates and fish that are in the exact location. However, as noted in Section 3, the AIPCP will use these methods primarily in high-traffic areas such as marinas and adjacent to shipping channels, as well as to prevent plants from clogging water intakes. Curtains/screens are not anticipated to extend deeper than one meter in the water column andhave open passage along the channel bottom. Due to the limited extent with which floating barriers and curtains/screens may be used, there are not expected to be significant or extensive effects on listed species. The already limited potential for direct effects wil be mitigated by employing mitigation measures, including site surveys to ensure that listed or sensitive species are not present during the installation of these control methods. By referencing fish historical presence/absence maps and CDFW trawl data, the timing and locations will be chosen carefully to ensure that the placement of physical controls is not likely to impede sensitive species movement or access to spawning habitat in the Delta.

- *Surface Excavators*

Surface excavators have the potential to directly impact listed species if the species are inadvertently collected along with the biomass in the excavator. Additionally, surface excavators may cause a temporary increase in turbidity, although the excavators generally do not reach deep enough into the water to contact the sediment itself. As noted in the WaterFix biological opinion, turbidity does not typically have an acute effect on organisms unless suspended solids exceed 25 mg/L (NMFS 2017). Because of the small-scale and infrequent use of this method, and the fact that this method should not disturb bottom substrate, the impacts are not expected to be significant. DBW monitors turbidity in its water quality samples for NPDES compliance, and will monitor results to ensure turbidity does not exceed the 25 mg/L threshold at which acute effects would be expected. The already low potential for direct effects will be mitigated by ensuring that DBW employees and contractors use BMPs and are trained and qualified to survey the site prior to using the equipment. The machines will not be used if listed or sensitive species are present. DBW will review ongoing fish survey data, and evaluate the historical fish presence/absence maps provided in Section 12 when selecting sites for mechanical harvesting (including excavators, harvesters, cutters, and shredders).

- *Herding*

Herding may have direct impacts on sensitive species by temporarily disturb sensitive species as the boats and machines push FAV mats between locations.

➢ *Harvesters and cutters and shredders*

Harvesters and cutters and shredders have the potential for direct effects on listed species due to the mechanics of the cutting equipment and, for harvesters, the conveyor belt systems that will be used to remove biomass (and any potential bycatch) from the water. Engel (1990) reports that harvesting also has the potential for direct and indirect effects by removing macroinvertebrates, aquatic vertebrates, forage fishes, young-of-the-year fishes and gamefishers (cited in Madsen 2000). Additionally, fragmentation caused by cutting may spread invasive plant infestations, causing environmental problems, and both harvesting and cutting may suspend sediments, temporarily increasing turidity (Madsen 2000). While these methods may release nutrients, that is not considered as significant of an effect as other nutrient sources (Madsen 2000). This is affirmed by a USACE study that determined that shredding had mixed effects on nutrients and dissolved oxygen – plant decomposition tended to increase biochemical oxygen demand and nutrient cycling, but this was offset by increases in algal productivity and the increase in oxygen caused by the shredding machine's mixing of the water (James et al. 2000).

Because of the extremely small-scale and infrequent use of harvesting and shredding, the impacts are not expected to be significant. The low potential for direct effects will be mitigated by ensuring that DBW employees and contractors are trained to survey the site prior to using the equipment. The machines will not be used if listed or sensitive species are known to be present. AIPCP Environmental Scientists will survey bycatch and physically remove fish and reptiles from the bycatch. Harvesters will be trained to identify listed species and will reverse direction, allowing for removal of sensitive species. For example, Scientists removed all of the Western Pond Turtles identified in the Bycatch Species Surveys in 2016. Turtles, and when possible other species, were returned to the water, away from harvesting operations. Note that harvesters will have less potential of indirect effects on listed species because the removal of biomass from the water with conveyors will reduce the potential for dissolved oxygen decreases due to plant decomposition.

In 2016, DBW conducted visual surveys of bycatch in mechanical harvesting, and found no ESA listed species, but one California Species of Concern (Western pond turtle). Below is a list of the fish, reptile and amphibian species observed in the eight mechanical harvesting sites in 2016:

Fish		Reptiles	Amphibians
• American shad • Black crappie • Brown bullhead catfish • Common carp • Largemouth bass • Sculpin (unknown species) • Striped bass • Warmouth • White catfish	• Black bullhead catfish • bluegill • Catfish (multiple species) • Green sunfish • Redear sunfish • Spotted bass • Tule perch • Western mosquitofish • White crappie	• Red-eared slider • Valley garter snake (neonate) • Western pond turtle (CA Species of Special Concern)	• American bullfrog • Pacific tree frog

For all mechanical and physical methods, DBW will continue to utilize visual surveys and data to determine whether listed are present in the site. As indicated by the list of species reported above, mechanical treatments to date have not resulted in harm to federal or State endangered or threatened species as bycatch. However, a number of western pond turtles, a California Species of Concern, have been observed in mechanical harvesting bycatch at three of the five harvest locations. All turtles (and any other species that could be recovered) were removed from the bycatch by hand by the DBW Environmental Scientist and placed back into the waterway, away from the harvesting operation. **Exhibit 3-20** provides an DBW's mechanical harvesting bycatch survey data from the 2016 treatment season. In the event that the DBW Environmental Scientist does not recover a listed species from the bycatch, mechanical harvesting of AIPs could directly impact individual members of listed species. DBW will follow avoidance measures to minimize the potential to lose listed species in bycatch.

Exhibit 3-20
2016 Mechanical Harvesting Bycatch Species Observed *Page 1 of 2*

Location, Harvesting Date(s), and FAV Removed	Fish Observed in Bycatch	Reptiles Observed in Bycatch	Amphibians Observed in Bycatch	Invertebrates Observed in Bycatch
Stockton Deep Water Channel, Port and Waterfront Jan 4 - Feb 10, Mar 25 - Apr 30, June 1 – 13 <u>FAV Removed:</u> 17,805 Cubic Yards; 11 Acres	• American shad • black crappie • bluegill • common carp • largemouth bass • redear sunfish • spotted bass • striped bass • tule perch • white crappie	• red-eared slider • western pond turtle (12) (California Species of Concern)	• American bullfrog	• aquatic spiders (multiple spp.) • bryozoan • crayfish (multiple spp.) • damselflies • water beetle (multiple spp.)
Seven Mile Slough Sept 16 - Dec 30 <u>FAV Removed:</u> 33,125 Cubic Yards; 21 Acres	• black crappie • bluegill • brown bullhead catfish • catfish (multiple spp.) • largemouth bass • warmouth • western mosquitofish • white catfish • white crappie	• western pond turtle (2) (California Species of Concern)	• American bullfrog (adult and tadpoles) • Pacific tree frog	• aquatic spiders (multiple spp.) • amphipods • caterpillar (multiple spp.) • crayfish (multiple spp.) • damselflies • freshwater snail (multiple spp.) • Jerusalem cricket • ladybird beetle • nymph (unknown insect) • Neochetina weevil • water beetle (multiple spp.)
Old River, West Side Irrigation District Feb 10 - Mar 29 <u>FAV Removed:</u> 13,722 Cubic Yards; 9 Acres	• black bullhead catfish • bluegill • common carp • western mosquitofish		• American bullfrog • Pacific tree frog	• amphipods • crayfish (multiple spp.) • isopods
Sycamore Slough July 25 - Aug 23 <u>FAV Removed:</u> 12,800 Cubic Yards; 8 Acres	• American shad • black crappie • catfish (multiple spp.) • green sunfish • largemouth bass • sculpin (unknown spp.) • spotted bass • western mosquito fish • white crappie	• valley garter snake (neonate) western pond turtle (16) (California Species of Concern)	• American bullfrog (adult and tadpoles) • Pacific tree frog	• aquatic spider (multiple spp.) • bryozoan • caterpillar (multiple spp.) • crayfish (multiple spp.) • damselflies • freshwater leech • freshwater snail (multiple spp.) • grass shrimp • nymphs (unknown insect) • *Neochetina* weevil • water beetle (multiple spp.)

Exhibit 3-20
2016 Mechanical Harvesting Bycatch Species Observed *(continued)* *Page 2 of 2*

Location, Harvesting Date(s), and FAV Removed	Fish Observed in Bycatch	Reptiles Observed in Bycatch	Amphibians Observed in Bycatch	Invertebrates Observed in Bycatch
Snodgrass Slough Apr 6 – 29 FAV Removed: 6,075 Cubic Yards; 4 Acres	• black crappie • bluegill • green sunfish • western mosquito fish			• aquatic spiders (multiple spp.) • crayfish (multiple spp.) • isopods
Whiskey Slough Jan 4 - Jan 27 FAV Removed: 5700 Cubic Yards; 4 Acres				• amphipods

Disturbances from treatment vessels may also temporarily result in impacts to sensitive riparian or wetland habitats. The following discussion of potential adverse effects is adopted from the *Clear Lake Integrated Aquatic Plant Management Plan Draft Program EIR* (County of Lake 2005, p 7-34 to 7-35).

Boat noise has been identified as inducing the startle and alarm responses in fish (Scholik and Yan 2002). These responses cause fish to flee an area (Boussard 1981). Boat noise has also been shown to temporarily reduce auditory sensitivity of some fish species (Scholik and Yan 2002). However, the Delta is already heavily used by motorboats, and the current level of DBW vegetation management activities using boats have been conducted for over 30 years. Thus, fish are likely habituated to a substantial degree of boat-related noise. The AIPCP is not expected to result in significant additional boat disturbance to fish.

The flush response in birds is defined as the instinct to abandon a current location in response to an external stimulus. While loud noise may stimulate the flush response of nesting, foraging, and resting waterfowl of any species, research suggests that rapid visual disturbance from approaching watercraft is a more influential factor in flushing waterfowl than noise (Rogers 1998, 2000). This appears to be particularly true for watercraft that displace a large amount of water into the air because of hull shape, motor behavior, velocity, and/or method of steering. However, because faster-moving boats produce more noise, flushing may be a combined effect of approach, velocity, and noise (Burger 1998). Direction of approach seems to make little difference.

In addition, loud noises (approximately 120dBA), usually generated by propane cannons, are successfully used to flush resting birds from the ponds of agricultural areas, open pit mines, and other locations where bird presence is undesirable. Thus, it can be concluded that very loud noise can elicit a flush response in birds. It should be noted that different species exhibit different levels of skittishness to external stimuli, and that nesting birds are more reluctant to flush than non-nesting birds of the same species. Some bird species have also shown an ability to develop tolerance to external stimuli.

Airboat noise and related disturbances during AIPCP herbicide, biological, and some physical treatment are unlikely to result in significant impacts to special status fish; amphibians or reptiles; resident native or migratory fish; or sensitive riparian or wetland habitats. Airboat noise during AIPCP treatment has the potential to result in noise-related disturbances to waterfowl. Three special status bird species, yellow-headed blackbird (*Xanthocephalus xanthocephalus*), Swainson's hawk (*Buteo Swainsoni*), and tricolored blackbird (*Agelaius tricolor*), could nest adjacent to AIPCP treatment locations during summer treatment months. There is the potential that these species would be disturbed by AIPCP vessels. This disturbance would be temporary, and would occur at most one to two times per treated site. There is the potential that mechanical removal would directly impact fish or reptile species if they are captured in the bycatch and not removed. These disturbances would represent **an unavoidable or potentially unavoidable significant impact.** This impact would potentially be reduced by implementing the following mitigation measures.

- **Mitigation Measure 1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources.
- **Mitigation Measure 5** – Operate program vessels in a manner that causes the least amount of disturbance to the habitat.
- **Mitigation Measure 6** – Implement temporal and spatial limitations and restrictions on treatments to minimize treatments during times, and at locations, where listed species are likely to be present.
- **Mitigation Measure 17** – Follow environmental compliance measures for species avoidance, equipment operation, and disposal when conducting mechanical harvesting operations.

  The AIPCP will implement a protocol similar to that for herbicide treatment prior to conducting mechanical removal. Environmental scientists will check fish survey data to verify that listed fish species are not likely to be present at the removal site. The equipment operator will utilize the Environmental Checklist to evaluate presence of listed species or sensitive habitat prior to removal. If listed species or sensitive habitats are present, the operator will not conduct mechanical removal at that site. DBW will conduct mechanical removal of AIPs in sensitive giant garter snake habitat or areas where giant garter snakes have been sighted in the past, only between October 1st and May 1st. The mechanical harvester will maintain a speed of 2 to 2.5 knots in areas outside of sensitive giant garter snake habitat, areas where giant garter snake has been sighted in the past, during the active season, and areas where Western pond turtles are likely to be present, so that if these species were in the area, they could move out of the way and/or be readily removed from bycatch. The operator will stop and reverse the mechanical harvester if a snake is seen within AIPs during removal. DBW will dispose of all AIPs collected by mechanical removal outside of the May 1st to October 1st giant garter snake active season at an approved spoil location to ensure no hibernating giant garter snakes are buried under piles of collected spoils.

Impact B7 – Plant fragmentation: effects of plant fragmentation on sensitive habitat and wetlands

There is the potential for plant fragmentation resulting from AIPCP activities to impact sensitive habitats and wetlands. Physical and mechanical treatment methods have the potential to release AIP fragments.

With these methods, there is the potential that some plant fragments will float away from the boat before the crew can scoop up the plants. With herding, there is a possibility that some plants will escape the “cage”, and not be pushed out of the Delta. With mechanical removal, there is the possibility that some plants will not be captured by the equipment, and will float away. The use of curtains and booms in some locations may help restrain movement of plant fragments.

Many AIP species have been shown to successfully propagate from fragments. Thus, to the extent that plants or fragments “escape” the physical removal processes, they may propagate into new plants, and establish new plant colonies. This would potentially impair sensitive habitats and wetlands in the Delta.

Further spread of plant due to fragmentation would represent **an avoidable significant impact to sensitive habitats and wetlands, but would be reduced to a less-than-significant level** by implementation of the following two mitigation measures.

- **Mitigation Measure 11** – Collect plant fragments during and immediately following treatments.

  To maximize containment of plant fragments, crews will collect spongeplant fragments. Crews will also be trained on the importance of minimizing fragment escape.

- **Mitigation Measure 17** – Follow environmental compliance measures for species avoidance, equipment operation, and disposal when conducting mechanical harvesting operations.

Impact B8 – Spoiling of harvested plants: effects of spoiling following physical or mechanical removal on giant garter snake, sensitive habitat and wetlands

Spoiling of physically or mechanically removed AIPs, if not properly managed, could impair giant garter snake burrows, sensitive habitats and wetlands. Giant garter snakes typically inhabit small mammal burrows and other soil crevices throughout their winter dormancy period (October through April). This could include levees near plant removal locations.

To prevent spoil-related impacts, the removed biomass will be spoiled at an authorized location away from the water, typically on nearby farm fields. Spoil sites will be selected to meet the following criteria:

1. On the property of a willing landowner (private, state, federal, county, or other local government)
2. On or beyond the levee toe
3. At least 50 feet from giant garter snake habitat and valley elderberry shrubs and have low and/or no habitat value for giant garter snake
4. No burrowing owl habitat present
5. No special status plants present
6. Site surveyed and approved by a CDFW-approved Environmental Scientist.

Crews will leave AIPs in these dispersal areas to desiccate naturally, and will periodically monitor the areas to observe and record the fate of the plants and any effects of dispersal activities. Plant spoiling will result in a **less-than-significant level impact** that would occur to sensitive habitats and wetlands from plant spoiling.

* * * * *

This section identified 12 mitigation measures to address the eight potential impacts to biological resources. Several mitigation measures apply to more than one impact. **Exhibit 3-21** summarizes these biological resource mitigation measures.

Exhibit 3-21
Summary of Potential Biological Resource Impacts and Mitigation Measures

Mitigation Measure Summary[1]	Impacts Applied To
1. Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources	Impact B1: Herbicide overspray Impact B2: Herbicide toxicity Impact B4: Food web effects Impact B6: Treatment disturbances
2. Provide a 100 foot buffer between treatment sites and shoreline elderberry shrubs (*Sambucus* ssp.), host plant for the valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)* in most sites; in selected sites, utilize backpack style sprayers to direct spray on FAV adjacent to elderberry shrubs	Impact B1: Herbicide overspray
3. Minimize potential for drift when applying herbicides	Impact B1: Herbicide overspray Impact B2: Herbicide toxicity Impact B4: Food web effects
4. Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total	Impact B1: Herbicide overspray Impact B2: Herbicide toxicity Impact B4: Food web effects
5. Operate program vessels in a manner that causes the least amount of disturbance to the habitat	Impact B1: Herbicide overspray Impact B6: Treatment disturbances
6. Implement temporal and spatial limitations and restrictions on treatments and other removal methods to minimize treatments during times, and at locations, where listed species are likely to be present	Impact B2: Herbicide toxicity Impact B4: Food web effects Impact B6: Treatment disturbances
7. Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters	Impact B2: Herbicide toxicity Impact B4: Food web effects
8. Implement an adaptive management approach to minimize the use of herbicides in the long-term	Impact B1: Herbicide overspray Impact B2: Herbicide toxicity Impact B4: Food web effects
9. Provide treatment crews with electronic mapping that identifies previously surveyed areas for giant garter snake habitat, valley elderberry shrubs, and nesting special status birds	Impact B1: Herbicide overspray Impact B2: Herbicide toxicity
10. Monitor dissolved oxygen levels pre- and post-treatment for all AIPCP treatments, and at selected locations in the Delta over time	Impact B5: Dissolved oxygen levels
11. Collect plant fragments during and immediately following treatments	Impact B7: Plant fragmentation
17. Follow environmental compliance measures for species avoidance, equipment operations, and disposal when conducting mechanical harvesting operations	Impact B6: Treatment disturbances Impact B7: Plant fragmentation Impact B8: Spoiling of harvested AIPs

[1] Please refer to the text for the complete mitigation measure description.

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP

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Invertebrates		
Scientific Name	**Common Name**	**Status***
1. *Apodemia mormo langei*	Lange's metalmark butterfly	FE
2. *Branchinecta conservatio*	Conservancy fairy shrimp	FE
3. *Branchinecta longiantenna*	longhorn fairy shrimp	FE, FCH
4. *Branchinecta lynchi*	vernal pool fairy shrimp	FT, FCH
5. *Elaphrus viridis*	delta green ground beetle	FT
6. *Euphydryas editha bayensis*	bay checkerspot butterfly	FT
7. *Lepidurus packardi*	vernal pool tadpole shrimp	FE, FCH
8. *Speyeria callippe callippe*	callippe silverspot butterfly	FE

Fish		
Scientific Name	**Common Name**	**Status***
1. *Archoplites interruptus*	Sacramento perch	CSC
2. *Eucyclogobius newberryi*	tidewater goby	FE, CSC
3. *Lampetra hubbsi*	Kern brook lamprey	CSC
4. *Lavinia symmetricus ssp. 1*	San Joaquin roach	CSC
5. *Lavinia symmetricus ssp. 3*	Red Hills roach	CSC
6. *Mylopharodon conocephalus*	hardhead	CSC
7. *Oncorhynchus (=Salmo) clarki henshawi*	Lahontan cutthroat trout	FT
8. *Oncorhynchus (=Salmo) clarki seleniris*	Paiute cutthroat trout	FT
9. *Oncorhynchus kisutch*	coho salmon central CA coast	FE, SE
10. *Oncorhynchus mykiss*	Central California Coastal steelhead	FT, FCH

Amphibians		
Scientific Name	**Common Name**	**Status***
1. *Ambystoma californiense*	California tiger salamander, central population	FT, FCH, CSC
2. *Bufo canorus*	Yosemite toad	CSC, FC
3. *Hydromantes platycephalus*	Mount Lyell salamander	CSC
4. *Rana boylii*	Foothill yellow-legged frog	CSC
5. *Rana muscosa*	mountain yellow-legged frog	FC, CSC
6. *Spea hammondii*	western spadefoot	CSC

Reptiles		
Scientific Name	**Common Name**	**Status***
1. *Anniella pulchra*	silvery legless lizard	CSC
2. *Gambelia (=Crotaphytus) sila*	blunt-nosed leopard lizard	FE, CE
3. *Masticophis flagellum ruddocki*	San Joaquin whipsnake	CSC
4. *Masticophis lateralis euryxanthus*	Alameda whipsnake	FT, FCH, CT
5. *Phrynosoma coronatum (frontale population)*	coast (California) horned lizard	CSC
6. *Thamnophis hammondii*	two-striped garter snake	CSC

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

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Birds		
Scientific Name	**Common Name**	**Status***
1. *Ammodramus savannarum*	grasshopper sparrow	CSC
2. *Accipiter gentilis*	northern goshawk	CSC
3. *Asio flammeus*	short-eared owl	CSC
4. *Asio otus*	long-eared owl	CSC
5. *Athene cunicularia*	burrowing owl	CSC
6. *Charadrius alexandrinus nivosus*	western snowy plover	FT, CSC
7. *Charadrius montanus*	mountain plover	CSC
8. *Circus cyaneus*	northern harrier	CSC
9. *Coccyzus americanus occidentalis*	western yellow-billed cuckoo	FC, CE
10. *Coturnicops noveboracensis*	yellow rail	CSC
11. *Dendroica petechia brewsteri*	yellow warbler	CSC
12. *Empidonax traillii*	willow flycatcher	CE
13. *Falco peregrinus anatum*	American peregrine falcon	CE
14. *Geothlypis trichas sinuosa*	saltmarsh common yellowthroat	CSC
15. *Grus Canadensis Canadensis*	lesser sandhill crane	CSC
16. *Gymnogyps californianus*	California condor	FE
17. *Haliaeetus leucocephalus*	bald eagle	CE
18. *Icteria virens*	yellow-breasted chat	CSC
19. *Lanius ludovicianus*	loggerhead shrike	CSC
20. *Melospiza melodia maxillaris*	Suisun song sparrow	CSC
21. *Melospiza melodia pusillula*	Alameda song sparrow	CSC
22. *Melospiza melodia samuelis*	San Pablo song sparrow	CSC
23. *Pelecanus occidentalis californicus*	California brown pelican	FE
24. *Progne subis*	purple martin	CSC
25. *Rallus longirostris obsoletus*	California clapper rail	FE, CE
26. *Riparia riparia*	bank swallow	CT
27. *Rynchops niger*	black skimmer	CSC
28. *Sternula antillarum (=Sterna, =albifrons) browni*	California least tern	FE, CE
29. *Strix nebulosa*	great grey owl	CE
30. *Strix occidentalis caurina*	northern spotted owl	FT
31. *Toxostoma lecontei*	Le Conte’s thrasher	CSC

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

Mammals		
Scientific Name	**Common Name**	**Status***
1. *Ammospermophilus nelson*	Nelson's (=San Joaquin) antelope squirrel	CT
2. *Antrozous pallidus*	pallid bat	CSC
3. *Aplodontia rufia californica*	Sierra Nevada mountain beaver	CSC
4. *Corynorhinus townsendii*	Townsend's big-eared bat	CSC
5. *Dipodomys ingens*	giant kangaroo rat	FE, CE
6. *Dipodomys nitratoides brevinasus*	short-nosed kangaroo rat	CSC
7. *Dipodomys nitratoides exilis*	Fresno kangaroo rat	FE, FCH, CE
8. *Dipodomys nitratoides nitratoides*	Tipton kangaroo rat	FE
9. *Euderma maculatum*	spotted bat	CSC
10. *Eumops perotis californicus*	western mastiff bat	CSC
11. *Gulo gulo*	California wolverine	CT
12. *Lasiurus blossevillii*	western red bat	CSC
13. *Lepus americanus tahoensis*	Sierra Nevada snowshoe hare	CSC
14. *Martes pennanti*	fisher	FC, CSC
15. *Microtus californicus sanpabloensis*	San Pablo vole	CSC
16. *Neotoma fuscipes annectens*	San Francisco dusky-footed woodrat	CSC
17. *Neotoma fuscipes riparia*	riparian (San Joaquin Valley) woodrat	FE, CSC
18. *Nyctinomops macrotis*	big free-tailed bat	CSC
19. *Onychomys torridus tularensis*	Tulare grasshopper mouse	CSC
20. *Ovis canadensis californiana*	Sierra Nevada (=California) bighorn sheep	FE, CE
21. *Reithrodontomys raviventris*	salt marsh harvest mouse	FE, CE
22. *Scapanus latimanus parvus*	Alameda Island mole	CSC
23. *Sorex lyelli*	Mount Lyell shrew	CSC
24. *Sorex ornatus sinuosus*	Suisun shrew	CSC
25. *Sorex vagrans halicoetes*	salt-marsh wandering shrew	CSC
26. *Sylvilagus bachmani riparius*	riparian brush rabbit	FE, CE
27. *Taxidea taxus*	American badger	CSC
28. *Vulpes macrotis mutica*	San Joaquin kit fox	FE, CT
29. *Vulpes vulpes necator*	Sierra Nevada red fox	CT

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

Plants		
Scientific Name	**Common Name**	**Status***
1. *Agrosti hendersonii*	Henderson's bent grass	CNPS 3.2
2. *Agrosti humilis*	mountain bent grass	CNPS 2.3
3. *Allium jepsonii*	Jepson's onion	CNPS 1B.2
4. *Allium sharsmithiae*	Sharsmith's onion	CNPS 1B.3
5. *Allium tribracteatum*	three-bracted onion	CNPS 1B.2
6. *Allium tuolumnense*	Rawhide Hill onion	CNPS 1B.2
7. *Allium yosemitense*	Yosemite onion	CNPS 1B.3
8. *Amsinckia grandiflora*	large-flowered fiddleneck	FE, CE, CNPS 1B.1
9. *Amsinckia lunaris*	bent-flowered fiddleneck	CNPS 1B.2
10. *Anomobryum julaceum*	slender silver moss	CNPS 2.2
11. *Arabis bodiensis*	Bodie Hills rock-cress	CNPS 1B.3
12. *Arctostaphylos auriculata*	Mt. Diablo manzanita	CNPS 1B.3
13. *Arctostaphylos manzanita ssp. laevigata*	Contra Costa manzanita	CNPS 1B.2
14. *Arctostaphylos nissenana*	Nissenan manzanita	CNPS 1B.2
15. *Arctostaphylos pallida*	pallid Manzanita (=Alameda or Oakland Hills manzanita)	FT, CE, CNPS 1B.1
16. *Astragalus rattanii var. jepsonianus*	Jepson's milk-vetch	CNPS 1B.2
17. *Astragalus ravenii*	Raven's milk-vetch	CNPS 1B
18. *Astragalus tener var. ferrisiae*	Ferris' milk-vetch	CNPS 1B.1
19. *Astragalus tener var. tener*	alkali milk-vetch	CNPS 1B.2
20. *Atriplex cordulata*	heartscale	CNPS 1B.2
21. *Atriplex depressa*	brittlescale	CNPS 1B.2
22. *Atriplex joaquiniana*	San Joaquin spearscale	CNPS 1B.2
23. *Atriplex minuscula*	lesser saltscale	CNPS 1B.1
24. *Atriplex persistens*	vernal pool smallscale	CNPS 1B.2
25. *Atriplex subtilis*	subtle orache	CNPS 1B.2
26. *Atriplex vallicola*	Lost Hills crownscale	CNPS 1B.2
27. *Balsamorhiza macrolepis var. macrolepis*	big-scale balsamroot	CNPS 1B.2
28. *Blepharizonia plumosa*	big tarplant	CNPS 1B.1
29. *Botrychium lineare*	slender moonwort	CNPS 1B.3
30. *Botrychium lunaria*	common moonwort	CNPS 2.3
31. *Botrychium minganense*	mingan moonwort	CNPS 2.2
32. *Botrychium montanum*	western goblin	CNPS 2.1
33. *Brodiaea pallida*	Chinese Camp brodiaea	FT, CE, CNPS 1B.1
34. *Bruchia bolanderi*	Bolander's bruchia	CNPS 2.2

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

Plants *(continued)*		
Scientific Name	**Common Name**	**Status***
35. *California macrophylla*	round-leaved filaree	CNPS 1B.1
36. *Calochortus pulchellus*	Mt. Diablo fairy-lantern	CNPS 1B.2
37. *Calycadenia hooveri*	Hoover's calycadenia	CNPS 1B.3
38. *Calyptridium pulchellum*	Mariposa pussy-paws	FT, CNPS 1B.1
39. *Calystegia atriplicifolia ssp. buttensis*	Butte County morning-glory	CNPS 1B.2
40. *Calystegia purpurata ssp. saxicola*	coastal bluff morning-glory	CNPS 1B.2
41. *Camissonia benitensis*	San Benito evening-primrose	FT, CNPS 1B.1
42. *Camissonia sierra ssp. alticola*	Mono Hot Springs evening-primrose	CNPS 1B.2
43. *Campanula exigua*	chaparral harebell	CNPS 1B.2
44. *Campanula sharsmithiae*	Sharsmith's harebell	CNPS 1B.2
45. *Carex limosa*	mud sedge	CNPS 2.2
46. *Carex praticola*	northern meadow sedge	CNPS 2.2
47. *Carex tompkinsii*	Tompkin's sedge	CNPS 4.3
48. *Carex virdula var. viridula*	green yellow sedge	CNPS 2.3
49. *Carex vulpinoidea*	brown fox sedge	CNPS 2.2
50. *Carlquistia muirii*	Muir's tarplant	CNPS 1B.3
51. *Carpenteria californica*	tree-anemone	CNPS 1B.2
52. *Castilleja campestris ssp. succulenta*	succulent (=fleshy) owl's-clover	FT, FCH, CE, CNPS 1B.2
53. *Castilleja rubicundula ssp. rubicundula*	pink creamsacs	CNPS 1B.2
54. *Caulanthus californicus*	California jewelflower	FE, CE, CNPS 1B.1
55. *Caulanthus coulteri var. lemmonii*	Lemmon's jewelflower	CNPS 1B.2
56. *Ceanothus purpureus*	holly-leaved ceanothus	CNPS 1B.2
57. *Centromadia parryi ssp. congdonii*	Congdon's tarplant	CNPS 1B.2
58. *Centromadia parryi ssp. parryi*	pappose tarplant	CNPS 1B.2
59. *Chaenactis douglasii var. alpina*	alpine dusty maidens	CNPS 2.3
60. *Chamaesyce hooveri*	Hoover's spurge	FT, FCH, CNPS 1B.2
61. *Chlorogalum grandiflorum*	Red Hills soaproot	CNPS 1B.2
62. *Chorizanthe biloba var. immemora*	Hernandez spineflower	CNPS 1B.2
63. *Chorizanthe cuspidata var. cuspidata*	San Francisco Bay spineflower	CNPS 1B.2
64. *Chorizanthe robusta var. robusta*	robust spineflower	FE, CNPS 1B.1
65. *Cirsium andrewsii*	Franciscan thistle	CNPS 1B.2
66. *Cirsium crassicaule*	slough thistle	CNPS 1B.1
67. *Cirsium fontinale var. campylon*	Mt. Hamilton fountain thistle	CNPS 1B.2
68. *Cirsium hydrophilum var. hydrophilum*	Suisun thistle	FE, FCHP, CNPS 1B.1

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

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Plants *(continued)*		
Scientific Name	**Common Name**	**Status***
69. *Clarkia australis*	Small's southern clarkia	CNPS 1B.2
70. *Clarkia biloba ssp. brandegeeae*	Brandegee's clarkia	CNPS 1B.2
71. *Clarkia concinna ssp. automixa*	Santa Clara red ribbons	CNPS 4.3
72. *Clarkia franciscana*	Presidio clarkia	FE, CE, CNPS 1B.1
73. *Clarkia rostrata*	beaked clarkia	CNPS 1B.3
74. *Claytonia megarhiza*	fell-fields claytonia	CNPS 2.3
75. *Collomia rawsoniana*	Rawson's flaming trumpet	CNPS 1B.2
76. *Cordylanthus maritimus ssp. palustris*	Point Reye's bird's-beak	CNPS 1B.2
77. *Cordylanthus mollis ssp. hispidus*	Hispid bird's-beak	CNPS 1B.1
78. *Cordylanthus mollis ssp. mollis*	soft bird's-beak	FE, FCHP, CR, CNPS 1B.2
79. *Cordylanthus nidularius*	Mt. Diablo bird's-beak	CNPS 1B.1
80. *Cordylanthus palmatus*	palmate-bracted bird's beak	FE, CE, CNPS 1B.1
81. *Coreopsis hamiltonii*	Mt. Hamilton coreopsis	CNPS 1B.2
82. *Cryptantha crymophilia*	subalpine cryptantha	CNPS 1B.3
83. *Cryptantha hooveri*	Hoover's cryptantha	CNPS 1A
84. *Cryptantha mariposae*	Mariposa cryptantha	CNPS 1B.3
85. *Deinandra bacigalupii*	Livermore tarplant	CNPS 1B.2
86. *Deinandra halliana*	Hall's tarplant	CNPS 1B.1
87. *Delphinium californicum ssp. interius*	Hospital Canyon larkspur	CNPS 1B.2
88. *Delphinium inopinum*	unexpected larkspur	CNPS 4.3
89. *Delphinium recurvatum*	recurved larkspur	CNPS 1B.2
90. *Didymodon norrisii*	Norris' beard moss	CNPS 2.2
91. *Dirca occidentalis*	western leatherwood	CNPS 1B.2
92. *Downingia pusilla*	dwarf downingia	CNPS 2.2
93. *Draba asterophora var. asterophora*	Tahoe draba	CNPS 1B.3
94. *Draba incrassata*	Sweetwater Mountains draba	CNPS 1B.3
95. *Draba praealta*	tall draba	CNPS 2.3
96. *Draba sierrae*	Sierra draba	CNPS 1B.3
97. *Elymus scribneri*	Scribner's wheat grass	CNPS 2.3
98. *Epilobium howellii*	subalpine fireweed	CNPS 1B.3
99. *Eriastrum brandegeeae*	Brandegee's eriastrum	CNPS 1B.2
100. *Eriastrum hooveri*	Hoover's eriastrum	CNPS 4.2
101. *Erigeron aequifolius*	Hall's daisy	CNPS 1B.3
102. *Erigeron inornatus var. keilii*	keil's daisy	CNPS 1B.3

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

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Plants *(continued)*		
Scientific Name	**Common Name**	**Status***
103. *Eriogonum apricum var. apricum*	Ione buckwheat	FE, CE, CNPS 1B.1
104. *Eriogonum eastwoodianum*	Eastwood's buckwheat	CNPS 1B.3
105. *Eriogonum luteolum var. caninum*	Tiburon buckwheat	CNPS 1B.2
106. *Eriogonum nervulosum*	Snow Mountain buckwheat	CNPS 1B.2
107. *Eriogonum nudum var. regirivum*	Kings River buckwheat	CNPS 1B.2
108. *Eriogonum ovalifolium var. monarchense*	Monarch buckwheat	CNPS 1B.3
109. *Eriogonum temblorense*	Temblor buckwheat	CNPS 1B.2
110. *Eriogonum truncatum*	Mt. Diablo buckwheat	CNPS 1B.1
111. *Eriophyllum nubigenum*	Yosemite woolly sunflower	CNPS 1B.3
112. *Eryngium aristulatum var. hooveri*	Hoover's button-celery	CNPS 1B.1
113. *Eryngium pinnatisectum*	Tuolumne button-celery	CNPS 1B.2
114. *Eryngium racemosum*	Delta button-celery	CE, CNPS 1B.1
115. *Eryngium spinosepalum*	spiny-sepaled button-celery	CNPS 1B.2
116. *Erysimum capitatum ssp. angustatum*	Contra Costa wallflower	FE, FCH, CE, CNPS 1B.1
117. *Erythronium pluriflorum*	Shuteye Peak fawn lily	CNPS 1B.3
118. *Erythronium taylorii*	Pilot Ridge fawn lily	CNPS 1B.2
119. *Erythronium tuolumnense*	Tuolumne fawn lily	CNPS 1B.2
120. *Eschscholzia rhombipetala*	diamond-petaled California poppy	CNPS 1B.1
121. *Festuca minutiflora*	small-flowered fescue	CNPS 2.3
122. *Fissidens aphelotaxifolius*	brook pocket moss	CNPS 2.2
123. *Fritillaria falcata*	talus fritillary	CNPS 1B.2
124. *Fritillaria liliacea*	fragrant fritillary	CNPS 1B.2
125. *Fritillaria pluriflora*	adobe-lily	CNPS 1B.2
126. *Fritillaria viridea*	San Benito fritillary	CNPS 1B.2
127. *Gilia yorkii*	Monarch gilia	CNPS 1B.2
128. *Glyceria grandis*	American manna grass	CNPS 2.3
129. *Gratiola heterosepala*	Bogg's Lake hedge-hyssop	CE, CNPS 1B.2
130. *Hackelia sharsmithii*	Sharsmith's stickseed	CNPS 2.3
131. *Harmonia hallii*	Hall's harmonia	CNPS 1B.2
132. *Helianthella castanea*	Diablo helianthella	CNPS 1B.2
133. *Helodium blandowii*	Blandow's bog moss	CNPS 2.3
134. *Hesperolinon breweri*	Brewer's western flax	CNPS 1B.2
135. *Hesperolinon drymarioides*	drymaria-like western flax	CNPS 1B.2
136. *Hesperolinon sp. nov. "serpentinum"*	Napa western flax	CNPS 1B.1

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

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Plants *(continued)*		
Scientific Name	**Common Name**	**Status***
137. *Heterotheca monarchensis*	Monarch golden-aster	CNPS 1B.3
138. *Hoita strobilina*	Loma Prieta hoita	CNPS 1B.1
139. *Holocarpha macradenia*	Santa Cruz tarplant	FT, FCH, CE, CNPS 1B.1
140. *Horkelia cuneata ssp. sericea*	Kellogg’s horkelia	CNPS 1B.1
141. *Hulsea brevifolia*	short-leaved hulsea	CNPS 1B.2
142. *Imperata brevifolia*	California satintail	CNPS 2.1
143. *Iris hartwegii ssp. columbiana*	Tuolumne iris	CNPS 1B.2
144. *Isocoma arguta*	Carquinez goldenbush	CNPS 1B.1
145. *Ivesia campestris*	field ivesia	CNPS 1B.2
146. *Ivesia unguiculata*	Yosemite ivesia	CNPS 4.2
147. *Juglans hindsii*	Northern California black walnut	CNPS 1B.1
148. *Juncus leiospermus var. ahartii*	Ahart’s dwarf rush	CNPS 1B.2
149. *Juncus nodosus*	knotted rush	CNPS 2.3
150. *Lasthenia conjugens*	Contra Costa goldfields	FE, FCH, CNPS 1B.1
151. *Layia discoidea*	rayless layia	CNPS 1B.1
152. *Layia heterotricha*	pale-yellow layia	CNPS 1B.1
153. *Layia munzii*	Munz’s tidy-tips	CNPS 1B.2
154. *Layia septentrionalis*	Colusa layia	CNPS 1B.2
155. *Legenere limosa*	legenere	CNPS 1B.1
156. *Lepidium jaredii ssp. album*	Panoche pepper-grass	CNPS 1B.2
157. *Lepidium latipes var. heckardii*	Heckard’s pepper-grass	CNPS 1B.2
158. *Leptosiphon serrulatus*	Madera leptosiphon	CNPS 1B.2
159. *Lewisia congdonii*	Congdon’s lewisia	CNPS 1B.3
160. *Lewisia disepala*	Yosemite lewisia	CNPS 1B.2
161. *Lomatium congdonii*	Congdon’s lomatium	CNPS 1B.2
162. *Lomatium observatorium*	Mt. Hamilton lomatium	CNPS 1B.2
163. *Lomatium stebbinsii*	Stebbin’s lomatium	CNPS 1B.1
164. *Lotus rubriflorus*	red-flowered bird’s-foot-trefoil	CNPS 1B.1
165. *Lupinus citrinus var. citrinus*	orange lupine	CNPS 1B.2
166. *Lupinus gracilentus*	slender lupine	CNPS 1B.3
167. *Lupinus spectabilis*	shaggyhair lupine	CNPS 1B.2
168. *Madia radiata*	showy golden madia	CNPS 1B.1
169. *Malacothamnus aboriginum*	Indian Valley bush-mallow	CNPS 1B.2
170. *Malacothamnus arcuatus*	arcuate bush-mallow	CNPS 1B.2

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

Scientific Name	Common Name	Status*
Plants *(continued)*		
171. *Malacothamnus hallii*	Hall's bush-mallow	CNPS 1B.2
172. *Meconella oregana*	Oregon meconella	CNPS 1B.1
173. *Meesia triquetra*	three-ranked hump moss	CNPS 4.2
174. *Meesia uliginosa*	broad-nerved hump moss	CNPS 2.2
175. *Mielichhoferia elongata*	elongate copper moss	CNPS 2.2
176. *Mimulus filicaulis*	slender-stemmed monkeyflower	CNPS 1B.2
177. *Mimulus gracilipes*	slender-stalked monkeyflower	CNPS 1B.2
178. *Mimulus norrisii*	Kaweah monkeyflower	CNPS 1B.3
179. *Mimulus pulchellus*	yellow-lip pansy monkeyflower	CNPS 1B.2
180. *Monardella douglasii ssp. venosa*	veiny monardella	CNPS 1B.1
181. *Monardella leucocephala*	Merced monardella	CNPS 1A
182. *Monardella villosa ssp. globosa*	robust monardella	CNPS 1B.2
183. *Monolopia congdonii (=Lembertia congdonii)*	San Joaquin wooly-threads	FE, CNPS 1B.2
184. *Myurella julacea*	small mousetail moss	CNPS 2.3
185. *Navarretia leucocephala ssp. bakeri*	Baker's navarretia	CNPS 1B.1
186. *Navarretia myersii ssp. myersii*	pincushion navarretia	CNPS 1B.1
187. *Navarretia nigelliformis ssp. radians*	shining navarretia	CNPS 1B.2
188. *Navarretia prostrata*	prostrate vernal pool navarretia	CNPS 1B.1
189. *Neostapfia colusana*	Colusa grass	FT, FCH, CE, CNPS 1B.1
190. *Oenothera deltoides ssp. howellii*	Antioch Dunes evening-primrose	FE, FCH, CE, CNPS 1B.1
191. *Orcuttia inaequalis*	San Joaquin Valley Orcutt grass	FT, FCH, CE, CNPS 1B.1
192. *Orcuttia pilosa*	hairy Orcutt grass	FE, FCH, CE, CNPS 1B.1
193. *Orcuttia tenuis*	slender Orcutt grass	FT, FCH, CE, CNPS 1B.1
194. *Orcuttia viscida*	Sacramento Orcutt grass	FE, FCH, CE, CNPS 1B.1
195. *Petrophyton caespitosum ssp. acuminatum*	marble rockmat	CNPS 1B.3
196. *Phacelia ciliate var. opaca*	Merced phacelia	CNPS 1B.3
197. *Phacelia phacelioides*	Mt. Diablo phacelia	CNPS 1B.2
198. *Plagiobothrys chorisianus var.*	Choris' popcorn-flower	CNPS 1B.2
199. *Plagiobothrys diffusus*	San Francisco popcorn-flower	CE, CNPS 1B.1
200. *Plagiobothrys glaber*	hairless popcorn-flower	CNPS 1A
201. *Plagiobothrys hystriculus*	bearded popcorn-flower	CNPS 1B.1
202. *Plagiobothrys uncinatus*	hooked popcorn-flower	CNPS 1B.2
203. *Poa lettermanii*	Letterman's blue grass	CNPS 2.3
204. *Pohlia tundrae*	tundra thread moss	CNPS 2.3

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)*

Plants *(continued)*		
Scientific Name	**Common Name**	**Status***
205. *Polygonum marinense*	Marin knotweed	CNPS 3.1
206. *Potamogeton filiformis*	slender-leaved pondweed	CNPS 2.2
207. *Potamogeton robbinsii*	Robbins' pondweed	CNPS 2.3
208. *Pseudobahia bahiifolia*	Hartweg's golden sunburst	FE, CE, CNPS 1B.1
209. *Pseudobahia peirsonii*	San Joaquin adobe sunburst	FT, CE, CNPS 1B.1
210. *Ribes menziesii var. ixoderme*	aromatic canyon gooseberry	CNPS 1B.2
211. *Salix nivalis*	snow willow	CNPS 2.3
212. *Sanicula maritima*	adobe sanicle	CNPS 1B.1
213. *Sanicula saxatilis*	rock sanicle	CNPS 1B.2
214. *Schizymenium shevockii*	Shevock's copper moss	CNPS 1B.2
215. *Senecio aphanactis*	chaparral ragwort	CNPS 2.2
216. *Senecio clevelandii var. heterophyllus*	Red Hills ragwort	CNPS 1B.2
217. *Senecio (=Packera) layneae*	Layne's butterweed (=ragwort)	FT, CR, CNPS 1B.2
218. *Sidalcea keckii*	Keck's checker-mallow (=checkerbloom)	FE, FCH, CNPS 1B.1
219. *Sphagnum strictum*	pale peat moss	CNPS 2.3
220. *Sphenopholis obtusata*	prairie wedge grass	CNPS 2.2
221. *Streptanthus albidus ssp. peramoenus*	most beautiful jewel-flower	CNPS 1B.2
222. *Streptanthus fenestratus*	Tehipite Valley jewel-flower	CNPS 1B.3
223. *Streptanthus gracilis*	alpine jewel-flower	CNPS 1B.3
224. *Streptanthus hispidus*	Mt. Diablo jewel-flower	CNPS 1B.3
225. *Streptanthus insignis ssp. lyonii*	Arburua Ranch jewel-flower	CNPS 1B.2
226. *Streptanthus oliganthus*	Masonic Mountain jewel-flower	CNPS 1B.2
227. *Suaeda californica*	California seablite	FE, CNPS 1B.1
228. *Trifolium amoenum*	two-fork clover	FE, CNPS 1B.1
229. *Trifolium bolanderi*	Bolander's clover	CNPS 1B.2
230. *Trifolium depauperatum var. hydrophilum*	saline clover	CNPS 1B.2
231. *Triquetrella californica*	coastal triquetrella	CNPS 1B.2
232. *Tropidocarpum capparideum*	caper-fruited tropidocarpum	CNPS 1B.1
233. *Tuctoria greenei*	Greene's tuctoria (=Orcutt grass)	FE, FCH, CR, CNPS 1B.1
234. *Tuctoria mucronata*	Solano grass (=Crampton's tuctoria)	FE, CE, CNPS 1B.1
235. *Utricularia intermedia*	flat-leaved bladderwort	CNPS 2.2
236. *Verbena californica*	Red Hills (=California) vervain	FT, CT, CNPS 1B.1
237. *Viburnum ellipticum*	oval-leaved viburnum	CNPS 2.3
238. *Viola pinetorum ssp. grisea*	grey-leaved violet	CNPS 1B.3

Exhibit 3-22
Special Status Species in the Eleven (11) Counties within AIPCP Area, Not Likely to be Impacted by the AIPCP *(continued)* *Page 11 of 11*

* Status Key

- FE – federal endangered
- FT – federal threatened
- FCH – federal critical habitat specified for this species
- FC – federal candidate for consideration of endangered or threatened
- FCHP – federal critical habitat for this species is proposed
- CE – California endangered
- CT – California threatened
- CR – California rare
- CSC – California species of special concern
- CNPS – California Native Plant Society listings:
  - 1A: plants presumed extinct in California
  - 1B.1: plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California
  - 1B.2: plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California
  - 1B.3: plants rare, threatened, or endangered in California and elsewhere; not very threatened in California
  - 2.1: plants rare, threatened, or endangered in California, but more common elsewhere; seriously threatened in California
  - 2.2: plants rare, threatened, or endangered in California, but more common elsewhere; fairly threatened in California
  - 2.3: plants rare, threatened, or endangered in California, but more common elsewhere; not very threatened in California
  - 3.2: plants about which we need more information; fairly threatened in California
  - 4.2: plants of limited distribution; fairly threatened in California
  - 4.3: plants of limited distribution; not very threatened in California

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Section 4

Hazards and Hazardous Materials Impacts Assessment

4. Hazards and Hazardous Materials Impacts Assessment

This chapter analyzes the effects of the AIPCP related to hazards and hazardous materials. The chapter is organized as follows:

A. Environmental Setting

B. Impact Analysis and Mitigation Measures.

The environmental setting describes existing conditions related to hazards and hazardous materials in the Delta. The impact analysis provides an assessment of the specific environmental impacts due to hazards and hazardous materials potentially resulting from program operations. The discussion utilizes findings from DBW environmental monitoring and research projects, technical information from scientific literature, government reports, relevant information on public policies, and program experience. The impact assessment is based on technical and scientific information.

For each of the potential AIPCP impacts related to hazards and hazardous materials we provide a description of the impact, analyze the impact, classify the impact level, and identify mitigation measures to reduce the impact level. The mitigation measures are specific actions that DBW will undertake to avoid, or minimize, potential environmental impacts. DBW has undergone, and will continue to undergo, consultation with various local, State, and federal agencies regarding impacts and mitigation measures. Proposed mitigation measures may be revised, and/or additional mitigation measures incorporated, as a result of this ongoing consultation with regulatory agencies.

A. Environmental Setting

There are numerous laws and regulations at the federal, State, and local levels that address hazardous materials. The most relevant federal law relating to the AIPCP is the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). FIFRA establishes jurisdiction over the distribution, sale, and use of pesticides. At the State level, the California Department of Pesticide Regulation (DPR) implements one of the most rigorous pesticide oversight programs in the country. DPR oversight includes product evaluation and registration, environmental monitoring, residue testing of fresh produce, and local use enforcement through the County Agricultural Commissioners.

There are two major State laws related to hazardous materials. The first law is the Hazardous Materials Release Response Plans and Inventory Act of 1985. This law requires businesses using hazardous materials to prepare a hazardous materials business plan. The second law is the Hazardous Waste Control Act, which creates the State’s hazardous waste management program. The California program is more stringent than the federal Resource Conservation and Recovery Act (RCRA) that regulates hazardous waste.

1. Health Hazards

The Delta is a drinking water source for approximately 23 million Californians. If Delta projects compromise the quality of drinking water, more extensive treatment may be required. We discuss drinking water in Chapter 5, and water utility intake pumps in Chapter 6.

2. Hazardous Materials and Waste

Hazardous material and wastes are those substances that, because of their physical, chemical, or other characteristics, may pose a risk of endangering human health or safety or of endangering the environment (California Health and Safety Code Section 25260). In the Delta, hazardous waste sites associated with agricultural production activities include storage facilities and agricultural ponds or pits contaminated with fertilizers, herbicides, or insecticides.

Petroleum products and other materials may be present in the soil and groundwater near leaking underground storage tanks used to store these materials. Leaking or abandoned pesticide storage containers also may be present on farmland. Water from agricultural fields on which fertilizers and pesticides are applied may drain into ponds, and rinse water from crop duster tanks and other application equipment routinely is dumped into pits. Evaporation can increase chemical concentrations in pond water and cause chemicals to be deposited in underlying soil. Surface water percolation can pollute groundwater and expand the area of soil contamination.

Spills and leaking tanks or pipelines from industrial and commercial sites also can be sources of contaminants, such as petroleum hydrocarbons and polychlorinated biphenyls from old electrical transformers.

B. Impact Analysis and Mitigation Measures

For purposes of this analysis, we considered an impact related to hazards and hazardous materials to be significant and require mitigation if it would result in any of the significance thresholds listed below. Significance thresholds that are not relevant for the AIPCP are dismissed, as noted below. For those significance thresholds that are not dismissed, the potential impact is described and mitigation measures are identified. The significance thresholds are:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials
- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment
- Emit hazardous emissions or handle acutely hazardous materials, substances, or wastes within one-quarter mile of an existing or proposed school (dismiss)
- Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 (dismiss)
- For a project located within an airport land use plan, or where such a plan has not been adopted, within two miles of a public airport or public use airport, result in a safety hazard for people residing or working in the project area (dismiss)
- For a project within the vicinity of a private airstrip, result in a safety hazard for people residing or working in the project area (dismiss)
- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan (dismiss)
- Expose people or structures to a significant risk, injury, or death involving wildland fires (dismiss).

Exhibit 4-1 provides a summary of the potential AIPCP impacts for hazards and hazardous materials significance areas which could potentially be affected. Exhibit 4-1 also explains those hazards and hazardous materials significance areas in which there will be no impacts or beneficial impacts.

Impact H1 – General public exposure: there is potential for the AIPCP to create a significant hazard to the public through the routine transport, use, or disposal of AIPCP herbicides

The general public could be exposed to AIPCP herbicides through: consumption of drinking water contaminated with herbicides, consumption of fish or other aquatic organisms that have bioaccumulated AIPCP herbicide residues, or swimming or water skiing in areas recently treated with AIPCP herbicides. **The potential for the AIPCP to create a significant hazard to the public through routine transport, use, or disposal is expected to be less-than-significant.**

We discuss the potential for drinking water contamination by AIPCP herbicides in Chapter 5. The potential for AIPCP herbicides to be present in concentrations in excess of USEPA Maximum Contaminant Levels (MCLs) of 70 ppb for 2,4-D, 700 ppb for glyphosate, 560 ppb for fluridone, 100 ppb for endothall, and 20 ppb for diquat, is extremely low due to the application concentrations and resulting calculated environmental concentrations. In addition, DBW will implement mitigation measures (including Mitigation Measure 18, directed specifically at drinking water quality) to further reduce the potential for drinking water contamination by the AIPCP.

Exhibit 4-1
Crosswalk of Hazards and Hazardous Materials Significance Criteria and Impacts of the AIPCP

Significance Criteria and Impacts	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?					
Impact H1: General public exposure				X	
Impact H2: Treatment crew exposure	3, 4, 8, 12, 13, 14		X		
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?					
Impact H3: Accidental spills	13		X		
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?					AIPCP will not emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?					AIPCP will not be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?					AIPCP will not be located within an airport land use plan, or within two miles of a public airport or public use airport
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?					AIPCP will not be located within the vicinity of a private airstrip or result in a safety hazard for people residing in or working in the project area
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?					AIPCP will not impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?					AIPCP will not expose people or structures to wildland fires

We discuss the potential for AIPCP herbicides to bioaccumulate in fish or other aquatic organisms in Chapter 3. None of the AIPCP herbicides are expected to bioaccumulate in fish or aquatic species.

Potential exposure of the general public to AIPCP chemicals through water recreation is unlikely. We discuss the toxicity of AIPCP herbicides to humans under Impact H2, below. Herbicide exposure levels for the general public following AIPCP treatments are orders of magnitude lower than potentially toxic herbicide levels.

AIPCP treatments generally take place in heavily infested waterways, which are unsuitable for water recreation. It is unlikely that recreationists or nearby inhabitants would be close enough to AIPCP treatments to come in contact with herbicides. Inhalation exposure primarily applies to program applicators, not the general public (Washington DOE 2001). In addition, inhalation exposure is low for AIPCP herbicides following product label guidelines.

The AIPCP will adhere to all label requirements as they relate to any waiting periods for water recreation, drinking, fishing or other uses. There are no restrictions on the use of AIPCP herbicide treated water for potable use or recreation, including swimming and fishing. See the Biological Assessment Section 3 (Description of the Proposed Action) for further description of restrictions, if any, for each of the AIPCP herbicides.

This PEIR incorporates by reference the Spongeplant Control Program PEIR, which provides detailed information about exposure to 2,4-D, glyphosate, diquat, imazamox, and penoxsulam. Also incorporated by reference is the *Egeria Densa* Control Program PEIR, which provides detailed exposure information for fluridone. For the herbicides that are new to the AIPCP, a summary of risk conclusions as they relate to the general public follows:

- Imazapyr: dietary risks, residential handler dermal and inhalation risks, and aggregate risks are all below the U.S. EPA's level of concern (USEPA 2006)
- Carfentrazone-ethyl: U.S. EPA determined with reasonable certainty that exposure to carfentrazone-ethyl will not harm humans, including through aggregate dietary and non-occupational exposure (Washington DOE 2012).
- Endothall: Chronic dietary risks and aggregate risks do not exceed the U.S. EPA's level of concern, however drinking water risk for infants under one-year-old is at the level of concern due to conservative assumptions (US EPA 2005b). Endothall is a several dermal irritant (US EPA 2005b), although that is not likely to impact the general public as the public will not be present for the transport, preparation, or application of endothall.
- Flumioxazin: U.S. EPA determined that there is reasonable certainty that aggregate exposure to flumioxazin will not harm the general population (Washington DOE 2012).
- Florpyrauxifen-benzyl: U.S. EPA did not identify any risks of concern in registrant submitted toxicological studies for any routes of exposure, and determined that a quantitative risk assessment is not needed for dietary, residential, occupational, or aggregate exposure to humans (USEPA 2017d).

Based on existing research evidence, program operations, and monitoring results, AIPCP herbicide treatments are not likely to result in adverse effects on the general public due to drinking water exposure, consumption of aquatic species that have bioaccumulated AIPCP herbicides, or exposure to herbicides during recreation. **The potential for the AIPCP to create a significant hazard to the public through routine transport, use, or disposal is expected to be less-than-significant.**

<u>**Impact H2 – Treatment crew exposure:** there is potential for the AIPCP to create a significant hazard to treatment crews through the routine transport, use, or disposal of AIPCP herbicides; and/or through heat exposure</u>

The potential for the AIPCP to create a significant hazard to treatment crews through the routine transport, use, or disposal of AIPCP herbicides depends on the same two factors discussed for Biological Resources toxicity impacts: exposure and toxicity. In addition to potential hazards from herbicide exposure, AIPCP treatment crews are potentially at risk due to heat exposure. While the occurrence of significant hazard is improbable, **the potential for the AIPCP to create a significant hazard to treatment crews through routine transport, use, or disposal of herbicides or through heat exposure is expected to be an avoidable significant impact, reduced to a less than significant impact through implementation of mitigation measures.**

➢ Exposure to AIPCP Herbicides

Pesticide workers, such as DBW treatment crews, are exposed to higher levels of herbicides, and over longer time horizons, than the general public (Burns 2005). Each year, AIPCP treatments take place as many as four days a week, over a nine-month period. This small group of individuals is uniquely exposed to program herbicides over relatively long periods of time.

While animal toxicity studies can be used to assess the potential for human toxicity, particularly acute toxicity, it is much more difficult to determine whether there are long-term human impacts resulting from exposure to herbicides. Alavanja et al. (2004) noted that there are questions as to whether laboratory short-term toxicity studies of a single chemical are adequate to determine human exposure to a mix of chemicals over a lifetime, stating "neither animal testing alone or its interpretation in setting policy is sufficient to protect public health."

In reviewing the use of herbicides, the USEPA, World Health Organization (WHO), United States Forest Service (USFS), and other agencies evaluate the extensive scientific literature on each chemical, and identify exposure levels intended to ensure worker and public safety. These agencies reevaluate herbicide safety every few years as new studies are released.

In many exposure studies, pesticide worker exposures are based on answers to written or telephone questionnaires about their historical use of various chemicals, and/or about current chemical use. When subjects are deceased, researchers must rely on family members to answer detailed questions about past chemical exposure. Recall bias can result in both overestimating and underestimating chemical exposure. In some cases, researchers adjust reported exposure levels using exposure algorithms (e.g. increasing exposure factors if the worker does not wear personal protective equipment (PPE)). Even if there were perfect recollection of chemicals used and worker safety practices, these studies cannot measure actual amounts of chemical absorbed or inhaled.

Researchers also conduct biomonitoring to identify actual body loads of chemicals in exposed workers. Barr et al. (2006) note that biomonitoring can provide a "rough estimate of internal dose", given assumptions about factors such as chemical uptake, metabolism, and steady-state excretion. Biomonitoring includes measures of skin absorption, inhalation, and internal metrics. The amount of chemical absorbed by skin can be measured with patches, washing and wiping, and fluorescent tracers (Fenske 2005; Dosemeci et al. 2002). Exposure to chemicals is usually in milligram per kilogram body weight per day (mg/kg/day), or simply mg/kg body weight (mg/kg). Inhalation is measured through personal air or air sampling (Fenske 2005). Internal chemical concentrations can be measured in urine, saliva, sweat, semen, and blood (Fenske 2005; Dosemeci et al. 2002).

Urine samples are another tool for measuring actual body load of chemicals that are excreted in urine. Urine samples must be adjusted for volume, depending on whether they are 24 hour samples, first void samples, or spot samples (Barr et al. 2006). A single spot urine sample measurement can provide information on whether exposure occurred, and some information on the magnitude of the exposure, but cannot provide information on total body load of the chemical. There are methods of extrapolating from single urine samples to total urine volume (and thus to determine total body load), for example using urine creatinine concentrations. The creatinine method introduces some uncertainty into the measurement, but is valuable in cases when it is not practical to obtain 24-hour urine samples.

Numerous studies (Alavanja 2007; Hoar et al. 1986; Zahm and Blair 1992; Acquavella et al. 2004 and 2005; Mandel et al. 2005; Lavy et al. 1982) have shown that pesticide applicators that use PPE have lower risk and lower pesticide levels in blood or urine. In a talk to the North American Pesticide Applicator Certification and Safety Education Workshop in 2007, Dr. Michael Alavanja of the Agricultural Health Study, noted that proper glove use was the most influential item of PPE to mitigate chronic pesticide exposure (Alavanja 2007). Factors that increased exposure levels included fixing equipment during treatments, and more frequent mixing and loading of chemicals (Acquavella et al. 2004). In studies of urinary 2,4-D levels in applicators, predictors of herbicide levels included pesticide formulation, protective clothing and gear (especially gloves), handling practices, application equipment, personal hygiene, and type of spray nozzle used (Fenske 2005). Attitudes toward risk (as determined by questionnaires) played an important role in chronic exposure, as well (Alavanja 2007).

Exposure levels can also be influenced by outside factors and conditions. For example, SERA (2006) reported that several studies have found that sunscreen enhanced dermal absorption of 2,4-D. In addition, individuals that are pregnant, immune-compromised, malnourished, or have sickle-cell anemia, may be more sensitive to herbicides such as 2,4-D (SERA 2006).

The AIPCP conducts pre- and post-water sampling to monitor actual herbicide concentrations in the water, and therefore actual levels of treatment crew exposure.

AIPCP treatment crews follow herbicide label requirements for PPE. This includes use of coveralls, chemical resistant gloves, safety goggles, and waterproof shoes. DBW uses a laundry service to clean coveralls after a single day use. Liquid herbicides are mixed using a feeder tube to draw chemical into the mixing tank, so that direct contact with the chemicals is minimized; all mixtures are prepared outdoors to avoid risk of inhalation exposure in a confined space. Granular herbicides are either loaded into a hopper or Vortexx blower unit in an outdoor environment to minimize exposure. Potential exposure routes include dermal exposure when rinsing, or in the event that a feeder tube is broken. More likely exposure may occur through inhalation of drift in the event that the wind shifts during treatment. None of these exposure routes is likely, although they may occur in the event of broken or malfunctioning equipment or shifting wind.

All AIPCP herbicides have current registration both at the Federal and State level with USEPA and CDPR (Note: CPDR registration for carfentrazone-ethyl and florpyrauxifen-benzyl are pending; the AIPCP will not use these two herbicides until they are approved by CDPR). All precautions on the registered labels are followed as well as the Pesticide Safety Information Series (PSIS) N series, which relates to non-agricultural settings to minimize exposure and risk. As a part of the registration process, US EPA conducts a human health risk assessment for pesticides that estimates exposure and potential harmful effects to people who may be exposed through food and water they consume, air they breathe, through their work, or other activities that may lead to contact with pesticide residues on treated surfaces. If pesticide risk cannot be reduced through modifications to labels and using risk reduction methods, the product will not be allowed to be used (US EPA, https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/assessing-human-health-risk-pesticides accessed 2017-10-06).

Note that more detailed information about exposure to 2,4-D and glyphosate is available in the Spongeplant PEIR, which is incorporated by reference. The AIPCP Compliance Binder, including eight sections describing program requirements, is incorporated by reference and provided as a PDF file on the PEIR CD.

- Toxicity of AIPCP Herbicides to Humans

Acute toxicity of pesticides in humans is generally extrapolated from several different types of sources: acute toxicity studies in laboratory mammals, biomonitoring of exposed workers, and intentional or accidental human poisoning cases. The levels required to induce acute toxicity are several orders of magnitude higher than any potential exposure, even in the unlikely event of an accident, and thus it is highly unlikely that AIPCP activities would result in acute toxicity to AIPCP treatment crews.

Long-term or chronic toxicity effects may include solid tumors, hematological cancer, reproductive toxicity, teratogenicity, endocrine disruption, immunotoxicity, genotoxicity, mutagenicity, mental and emotional functioning, reproductive effects and damage to specific tissues or organs (Cohen 2007). For cancers, one of the key factors to consider is the link between exposure and biological plausibility. Is there a mechanism by which the pesticide in question could have induced the resulting cancer? Little is understood about the health effects of low doses of pesticide exposure over a long time period. There have been hundreds of studies examining the effects of chronic pesticide exposure over the last several decades. Long-term toxicity can be evaluated through in vivo and in vitro studies, as well as epidemiological studies. Many epidemiological studies focus on farmers and pesticide applicators, as they tend to be exposed to pesticides over a long time period. AIPCP treatment crew exposure may be similar to both of these groups.

One of the largest efforts aimed at identifying long-term health impacts related to pesticides is the Agricultural Health Study (AHS). AHS is a prospective cohort study of over 89,000 farmers, pesticide applicators and spouses in Iowa and North Carolina. The study is sponsored by the National Institute of Health (NIH) and USEPA. The goal of the AHS is to “investigate the effects of environmental, occupational, dietary, and genetic factors on the health of the agricultural population.”

Through the AHS, government scientists and collaborating academics and others have conducted a number of studies using the entire AHS cohort, as well as specific sub-groups. Data gathering has been ongoing. When they entered the program between 1993 and 1997, farmers and spouses completed questionnaires, and many completed a second, more detailed, take-home questionnaire. A Phase 2 follow-up took place between 1999 and 2003 (this included buccal (mouth) cell collection, a computer assisted telephone interview, and a mailed dietary questionnaire). A Phase 3 follow up began in 2005 (this included a third interview, DNA analysis, and questionnaire validation).

Overall, farmers and spouses in the AHS have a lower than expected risk of cancer than the general public in North Carolina and Iowa. However, for some specific cancers, such as prostate cancer, AHS participants have higher risks. While some cancers among AHS participants may be related to specific pesticides, there is not enough data yet to make any such conclusions (Alavanja et al. 2005). The AHS has shown that individuals that applied pesticides more than 400 days in their lifetimes had a higher risk of Parkinson's disease (as self-reported), compared with those that applied pesticides for fewer days. Again, there was not enough data to link the occurrence of Parkinson's to certain pesticides, although it is still being studied (Kamel et al. 2005).

In the AHS examination of prostate cancer among male pesticide applicators, researchers evaluated over 55,000 applicators and 45 pesticides. They also controlled for known and suspected risk factors. While the overall risk of prostate cancer among AHS participants was higher, there were no elevated risks for prostate cancer among farmers exposed to glyphosate-family and phenoxy herbicides (Alavanja et al. 2003).

Some of the most studied linkages between pesticides and cancer are those of non-Hodgkin lymphoma and 2,4-D, phenoxy herbicides, and/or pesticides in general. Much of this research followed a study by the Swedish researcher Hardell in 1981 that showed a link between phenoxy herbicides and NHL. However, various studies reach conflicting conclusions about potential linkages.

As referenced above, several federal and state agencies, including the USEPA, United States Forest Service (USFS), and CalEPA, periodically reevaluate herbicide safety as new scientific studies become available. **Exhibit 4-2** presents the conclusions of regulatory agencies as they relate to the potential toxic effects of AIPCP herbicides to treatment crews.

The AIPCP will use herbicides in accordance with the label requirements and restrictions, as approved by the USEPA and CDPR. Based on the approvals of those agencies during the herbicide registration processes, AIPCP herbicide treatments are not likely to result in adverse effects to treatment crews.

Exhibit 4-2
Regulatory Conclusions Regarding Occupational Risks *Page 1 of 2*

Active Ingredient	Occupational Risk Conclusion
2,4-D	"With the exception of mixing/loading wettable powder, all of the short-term and intermediate-term MOEs exceed the target of 100 with baseline personal protective equipment (PPE) (i.e., long-sleeved shirt, long pants, shoes plus socks, no respirator) or single layer PPE (i.e., long-sleeved shirt, long pants, shoes plus socks, gloves, no respirator) and are not of concern. The MOEs for handling wettable powder are above 100 with engineering controls (i.e. water soluble bags)." (USEPA 2005a)
Glyphosate	"…due to glyphosate's low acute toxicity and the absence of other toxicological concerns (especially carcinogenicity), occupational and residential exposure data are not required for reregistration." USEPA 1993) "Maximum potential glyphosate exposure in residential and occupational settings have been estimated at 0.47 mg/kg/day and 7 mg/kg/day, respectively, which are well-below the doses necessary to elicit the effects seen in these animal carcinogenicity and genotoxicity studies. Additionally, non-linear kinetics may also be occurring at the high doses." (EPA 2016b)
Penoxsulam	"A MOE of 100 is adequate to protect occupational pesticide handlers. All estimated MOEs are > 100 except for intermediate-term exposures to mixer/loaders not using gloves with liquid, open-pour loading in support of aerial operations (at either 1200 acres per day or 350 acres per day). Loaders using liquid open-pour in support of aerial operations (and who may experience intermediate-term exposures) should wear protective gloves. Generally speaking, HED advises the use of protective gloves for mixer/loaders. Otherwise, the proposed uses do not exceed HED's level of concern." (USEPA 2004b)
Imazamox	For Occupational/Residential Exposure: "…did not identify hazards for dermal or inhalation exposure risk assessment, for any duration since no hazard was seen at the Limit-Dose in animal studies via the oral and dermal routes, either following subchronic or chronic exposures. Therefore, quantification of risk is not required." (USEPA 2001).
Diquat	"For applicators participating in large-scale applications and for all workers (including homeowners) participating in small-scale applications, MOEs are greater than 100. Post-application exposure to diquat dibromide residues on treated foliage is a concern. For uses within the scope of the Worker Protection Standard for Agricultural Pesticides (WPS), EPA is requiring a longer interim Restricted Entry Interval (REI) and more stringent personal protective equipment (PPE) than usual, to reduce potential exposure and risk […]. For uses outside the scope of the WPS, post-application exposure risks also are posed. […] Therefore, a four-day reentry interval is being recommended for these workers." (USEPA 1995)
Fluridone	"The U.S. EPA typically uses a deposition-based approach with data from the Pesticide Handlers Exposure Database (e.g., PHED Task Force 1995), but the occupational exposure assessments for fluridone are not included in the recent TRED on fluridone" (SERA 2008)

Exhibit 4-2
Regulatory Conclusions Regarding Occupational Risks *(continued)* *Page 2 of 2*

Active Ingredient	Occupational Risk Conclusion
Imazapyr	For all scenarios, short- and intermediate-term risks do not exceed the Agency's level of concern (i.e., the MOEs are greater than 100) at either baseline PPE (long-sleeved shirt, long pants, no gloves, and no respirator), or with the addition of gloves. MOEs ranged from 10 to 1,100,000. Scenarios that require the addition of chemical resistant gloves include mixing and loading liquid formulations for aerial applications to aquatic sites, terrestrial non-crop sites, forestry sites, and areas grazed or cut for hay. The addition of chemical resistant gloves are also required for workers that are mixing, loading, and applying liquid and granular formulations via handwands, backpack spreaders and sprayers, and handgun sprayers for non-crop and aquatic uses. MOEs for these scenarios with the addition of chemical resistant gloves ranged from 460 to 22,000. (USEPA 2006)
Carfentrazone-ethyl	"EPA concluded that based on the completeness and reliability of the toxicity data and the conservative exposure assessment, there is a reasonable certainty that no harm to humans will result from aggregate exposure to residues of carfentrazone-ethyl, including all anticipated dietary exposure and all other non-occupational exposures." (Washington DOE 2012)
Endothall	In the absence of specific occupational exposure data for aquatic use scenarios, surrogate exposure scenarios were used to assess certain occupational scenarios…All risks for short-term exposures from mixing, loading, and applying liquid formulations are below the Agency's level of concern when workers wear an 80% (PF5) respirator (NIOSH TC-21C) (MOEs range from 1150 to 130,000). All risks for intermediate-term exposures from mixing, loading, and applying liquid formulations are below the Agency's level of concern when workers wear an 80% (PF5) respirator (NIOSH TC-21C) (MOEs range from 400 to 275,000) with the exception of mixing and loading liquids for ground-spray type applications at high rates (MOE = 250)… In addition, intermediate-term exposure assessments assume more than 30 days of exposure. It is unlikely that applications to large areas at high rates will be conducted for that length of time. As a result of these assumptions and the mitigation measures set forth in this RED, the Agency believes that the 80% respirator will adequately protect workers for the above scenarios. (USEPA 2005b)
Flumioxazin	"The short-term total MOEs ranged from 300 to 11,000 for handlers and the intermediate-term total MOEs ranged from 300 to 10,000. HED performed a post-application assessment using standard values and transfer coefficients to determine daily exposure associated with postapplication activities. All MOEs for postapplication exposure calculated on day of application were greater than 100." (EPA 2001b)
Florpyrauxifen-benzyl	"HED has determined that a quantitative risk assessment is not needed at this time for dietary, residential, occupational, or aggregate exposure. A qualitative human health risk assessment has been conducted to support the proposed uses of florpyrauxifen-benzyl. No risks of concern have been identified since no adverse effects were observed in the submitted toxicological studies for florpyrauxifen-benzyl regardless of the route of exposure." (USEPA 2017d)

➢ Exposure to Heat

DBW treatment crews work outdoors during the hottest summer months. Without proper precautions, there is potential for workers to suffer from heat illness. Heat illness is defined as a serious medical condition resulting from the body's inability to cope with a particular heat load, and includes heat cramps, heat exhaustion, heat syncope, and heat stroke (CCR Title 8, Section 3395). In response to a high number of heat-related deaths among outdoor workers in 2005, the State of California implemented Heat Illness Prevention Standards. These regulations outline preventative measures for employers to take to reduce the risk of heat illness among their employees.

CalOSHA, the State's job safety agency, further reviewed heat-related illness in early 2009. This additional review occurred in response to seven deaths and 60 worker injuries during 2008, despite the implementation of the Heat Illness Prevention Standards (Ferris 2008).

Heat illness covers a range of types and symptoms, ranging from headaches and nausea to death. Heat illness is preventable, but it is important to treat the first signs of heat illness seriously. Symptoms of several types of heat illness, as provided by CalOSHA, are listed below (CalOSHA 2008a):

- **Heat rash** – also called prickly heat, may occur in hot, humid environments where sweat is not easily removed from skin by evaporation. Heat rash can become serious if extensive, or infected
- **Fainting** – also called heat syncope, is a stage of heat stroke. Fainting may occur when a worker not acclimated to heat simply stands still in the heat
- **Heat cramps** – muscle spasms that occur when workers are hydrated, but have not replaced electrolytes lost in sweat
- **Heat exhaustion** – occurs when workers become dehydrated and/or have lost electrolytes. Workers will sweat, but may experience extreme weakness, fatigue, giddiness, nausea, or headache. Skin may become clammy and moist, complexion pale or flushed, and body temperate may be slightly higher than normal
- **Heat stroke** – is the most serious form of heat illness, and can result in death. Heat stroke is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. Symptoms include: mental confusion, delirium, loss of consciousness, convulsions, coma, and high body temperature (106 degrees Farenheit or more). Skin of heat stroke patients may be hot, dry, red, mottled, or bluish.

California's Heat Illness Prevention Standard includes four steps to preventing heat illness: training, water, shade, and planning. The regulations require employers to provide training on heat illness prevention; provide enough fresh water so that each employee can drink at least one quart per hour (and encourage them to do so); provide access to <u>at least</u> five minutes of rest in the shade when needed for preventative recovery; and develop and implement written procedures for complying with the heat illness prevention standard. DBW follows CalOSHA's Heat Illness Prevention guidelines, are available online at www.dir.ca.gov/dosh/heatillnessinfo.html.

CalOSHA encourages employers to proactively address heat illness by monitoring weather conditions, providing additional training on hot days, adjusting work shifts to avoid the heat, and promoting a "buddy system" so that workers can monitor each other (CalOSHA 2008a). CalOSHA also recently published a guide for employees to carry out tailgate training for workers (CalOSHA 2008b). In the event that weather conditions become too hot during the course of the day, treatment crews will terminate their operations early that day to avoid heat illness.

DBW treatment crews may be outside during hot weather for extended periods of time. In addition, use of coveralls and other PPE make workers more susceptible to heat illness. Workers may also be more susceptible to heat illness if they have not acclimated to warm temperatures. There is potential for DBW treatment crews to suffer adverse impacts to their health as a result of exposure to heat during normal AIPCP operations.

➢ Treatment crew exposure mitigation

To minimize exposure to herbicide, DBW treatment crews are required to utilize personal protective equipment (PPE) as specified on the herbicide labels, and described in the AIPCP Operations Management Plan.

DBW treatment crews are required to follow the PPE requirements specified on all herbicide labels. PPE requirements may include: coveralls, chemical-resistant gloves, chemical resistant footwear, chemical-resistant headgear for overhead exposure, and protective eye wear. In addition, a chemical-resistant apron should also be worn when cleaning equipment, mixing, or loading. Masks will also be available to treatment crews, if they prefer additional facial protection. Proper use of PPE has been proven to reduce herbicide exposure.

It is extremely unlikely that there would be acute health impacts to DBW treatment crews as a result of exposure to herbicides. It is also unlikely that there would be chronic health impacts to DBW treatment crews as a result of exposure to herbicides. However, given the uncertainties related to the long-term human health impacts of low level exposure to herbicides, it is important that DBW minimize the potential for adverse health outcomes as a result of long-term, low-level, exposure of DBW treatment crews to herbicides. There is also potential for acute health impacts to DBW treatment crews as a result of heat exposure during AIPCP treatments. **These potential impacts to DBW treatment crew health would be avoidable significant impacts.** These impacts would potentially be avoided, or reduced to a less-than-significant, level by implementing the following six mitigation measures.

- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.
- **Mitigation Measure 4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total.
- **Mitigation Measure 8** – Implement an adaptive management approach to minimize the use of herbicides.
- **Mitigation Measure 12** – Require treatment crews to participate in training on herbicide and heat hazards, as well as continuing education units required under California Department of Pesticide Regulation laws.

  AIPCP will provide training to ensure that treatment crews have the knowledge and tools necessary to conduct the program in a safe manner. Training will include reading, understanding, and following herbicide label requirements; purpose and proper use of Personal Protective Equipment; symptoms of herbicide poisoning and minimization of exposure; avoidance, symptoms, and treatment of heat exposure; and emergency medical procedures.

- **Mitigation Measure 13** – Follow best management practices to minimize the risk of spill, and to minimize the impact of a spill, should one occur.
- **Mitigation Measure 14** – Implement safety precautions on hot days to prevent heat illness.

  In addition to annual training on heat illness prevention, and compliance with CalOSHA's California Heat Illness Prevention Standard, DBW Field Supervisors will conduct special training sessions on days when weather is expected to be hot. This training will cover the symptoms of heat illness, and immediate actions to take should any symptoms occur. DBW will also provide bimini tops (shade covers) for AIPCP treatment boats.

Impact H3 – Accidental spill: there is potential for the AIPCP to create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment

A catastrophic spill of an AIPCP herbicide could result in adverse impacts to human health due to exposure of concentrated herbicides. In concentrated form, AIPCP herbicides could have acute toxic or corrosive effects if inhaled, ingested, or upon direct contact with skin or eyes. Such a spill could also result in adverse impacts to aquatic wetland and intertidal habitat and associated flora and fauna, including special status plants, fish, and wildlife. Impacts could occur to public water supplies, and agricultural production and operations following a spill. The degree of harm would depend on the amount and type of chemical spilled, environmental conditions (flow, tidal action, weather), and emergency response time.

DBW's WHCP and EDCP Operations Management Plans identify best management practices (BMP), including a Spill Avoidance BMP. The BMP provides procedures for spill prevention, cleanup, and notification. DBW follows these procedures to minimize the risk of spill, and to minimize the impact of a spill, should one occur. In 35 years of operation, there have not been any accidental spills of herbicide during DBW aquatic weed control operations.

Should an accidental spill of AIPCP herbicides occur, it would represent a significant impact. The potential for the AIPCP to result in an accidental spill is **an avoidable significant impact, reduced to a less-than-significant level by implementing the following mitigation measure.**

- **Mitigation Measure 13** – Follow best management practices to minimize the risk of spill, and to minimize the impact of a spill, should one occur.

This section identified six mitigation measures to address three potential impacts related to hazards and hazardous materials. Three mitigation measures (#3, #4, #8) were also identified in Chapter 3. The remaining three mitigation measures (#12 to #14) apply specifically to hazards and hazardous materials. **Exhibit 4-3** combines and summarizes the hazards and hazardous materials mitigation measures.

Exhibit 4-3
Summary of Potential Hazards and Hazardous Materials Impacts and Mitigation Measures

Mitigation Measure Summary	Relevant Impact
3. Minimize potential for drift when applying herbicides	Impact H2: Treatment crew exposure
4. Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total	Impact H2: Treatment crew exposure
8. Implement an adaptive management approach to minimize the use of herbicides	Impact H2: Treatment crew exposure
12. Require treatment crews to participate in training on herbicide and heat hazards, as well as continuing education units required under California Department of Pesticide Regulation law	Impact H2: Treatment crew exposure
13. Follow best management practices to minimize the risk of spill, and to minimize the impact of a spill, should one occur	Impact H2: Treatment crew exposure Impact H3: Accidental spill
14. Implement safety precautions on hot days to prevent heat illness	Impact H2: Treatment crew exposure

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Section 5

Hydrology and Water Quality Impacts Assessment

5. Hydrology and Water Quality Impacts Assessment

This chapter analyzes the effects of the AIPCP on hydrology and water quality. The chapter is organized as follows:

A. *Environmental Setting*
B. *Impact Analysis and Mitigation Measures.*

The environmental setting describes the hydrology and water quality status of the Delta. This discussion covers water quality requirements, surface water quality, surface water hydrology, Delta exports, and groundwater.

The impact analysis provides an assessment of the specific environmental impacts to hydrology and water quality potentially resulting from program operations. The discussion utilizes findings from AIPCP environmental monitoring and research projects, technical information from scientific literature, government reports, relevant information on public policies, and program experience. The impact assessment is based on technical and scientific information.

For each of the potential AIPCP impacts to hydrology and water quality, this chapter contains a description of the impact, analyze the impact, classify the impact level, and identify mitigation measures to reduce the impact level. Impact levels are as follows:

1. Unavoidable or potentially unavoidable significant impact – an impact that may result in significant adverse effects, and cannot be mitigated with certainty. Mitigation measures for these impacts are described.
2. Avoidable significant impact – an impact that may result in significant adverse effects that can be mitigated to a less than significant level. Mitigation measure for these impacts are described.
3. Less than significant impact – an impact that is likely to result in less than significant adverse effects, without mitigation.
4. No impact – no adverse effects resulting from the proposed action.

The mitigation measures are specific actions that the DBW will undertake to avoid, or minimize, potential environmental impacts. The DBW has undergone, and will continue to undergo, consultation with various local, State, and federal agencies, including the Central Valley Regional Water Quality Control Board (CVRWQCB) regarding impacts and mitigation measures. Proposed mitigation measures may be revised, and/or additional mitigation measures incorporated, as a result of this ongoing consultation with regulatory agencies and water providers.

A. Environmental Setting

1. Water Quality Regulatory Setting

The State Water Resources Control Board (SWB) regulates water quality in California, through the federal Clean Water Act (CWA), and the Porter-Cologne Water Quality Control Act. The State Water Code gives Regional Water Boards primary responsibility for formulating and adopting water quality control plans in each of the State's nine regions.

There are two plans that jointly specify water quality controls for the Delta, the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan), and the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. The Bay- Delta Plan, developed by the SWB, is complementary to the Basin Plan developed by the CVRWQCB. Water quality plans must also be approved by the USEPA.

Both plans consist of beneficial uses to be protected, water quality objectives, and a program for implementation of the water quality objectives. A primary goal of the water quality planning process is to identify and protect beneficial uses for surface and groundwater in a given region. **Exhibit 5-1** summarizes several of the beneficial uses for Delta waters.

Exhibit 5-1
Beneficial Uses in Delta Waters

Beneficial Use	Abbreviation	Beneficial Use	Abbreviation
Municipal and domestic supply	MUN	Commercial and sport fishing	COMM
Industrial service supply	IND	Warm freshwater habitat	WARM
Industrial process supply	PRO	Cold freshwater habitat	COLD
Agricultural supply	AGR	Migration of aquatic organisms	MIGR
Groundwater recharge	GWR	Spawning, reproduction, and/or early development	SPWN
Navigation	NAV	Estuarine habitat	EST
Water contact recreation	REC-1	Wildlife habitat	WILD
Non-contact water recreation	REC-2	Rare, threatened, or endangered species	RARE
Shellfish harvesting	SHELL	Preservation of biological habitats of special significance	BIOL

Water quality objectives are “the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area” (Water Code Section 13050(h), in CVRWQCB 2007). In establishing water quality objectives, the Regional Water Boards must consider the following:

- Past, present, and probable future beneficial uses;
- Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;
- Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;
- Economic considerations;
- The need for developing housing within the region;
- The need to develop and use recycled water (Water Code Section 13241).

The SWB and Regional Water Boards refine their respective plans over time to take into account new water quality issues. The most recent Bay-Delta Plan was published in December 2006, and the SWB is currently undergoing a four-phased process to develop and enact updates to the plan and flow objectives for priority tributaries to the Delta. The Basin Plan was most recently revised in October 2011. These plans specify surface water quality objectives for a range of categories, including: bacteria, biostimulatory substances, chemical constituents, color, dissolved oxygen, floating material, methylmercury, oil and grease, pH, pesticides, radioactivity, salinity, sediment, settleable material, suspended material, tastes and odors, temperature, toxicity, and turbidity. The Bay-Delta Plan identifies additional requirements for chloride, salinity, dissolved oxygen, delta outflow, river flows, and export limits. These Bay-Delta Plan water quality objectives are intended to protect municipal, industrial, agricultural, and fish and wildlife beneficial uses. The Bay-Delta Plan requirements supersede those of the Basin Plan.

The State Water Board is in the process of developing and implementing updates to the Bay-Delta Plan to protect beneficial uses in the Bay-Delta watershed. Phase I of this work involves updating San Joaquin River flow and southern Delta water quality requirements included in the Bay-Delta Plan. The proposed Phase II changes to the Bay-Delta Plan include: new inflow requirements for the Sacramento River, its tributaries, and eastside tributaries to the Delta (the Mokelumne, Calaveras and Cosumnes rivers); new and modified Delta outflow requirements; new requirements for cold water habitat; new and modified interior Delta flow requirements; recommendations for complementary ecosystem protection actions that others should take; and adaptive management, monitoring, evaluation, special study, and reporting provisions. The updates are expected to be adopted in late 2017.

One mechanism that the CVRWQCB uses to implement the Bay-Delta and Basin Plans is a National Pollutant Discharge Elimination System (NPDES) permit. NPDES permits are issued to entities that discharge to waterways, known as point source dischargers. In the 2001 Headwaters, Inc. v. Talent Irrigation case, the Ninth Circuit Court of Appeals held that discharges of pollutants from the use of aquatic pesticides to waters of the United States required coverage under a NPDES permit (CVRWQCB 2006). The DBW obtained an individual NPDES permit in March 2001, and operated under this permit for the WHCP and EDCP until April 2006. In April 2006, the DBW applied to operate under the General NPDES Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States – General Permit No. CAG990005 (General Permit).

After the Talent decision, there was some confusion regarding the need to obtain an NPDES permit for aquatic pesticide use. In November 2006, the USEPA issued a regulation stating that application of a pesticide in compliance with relevant requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) does not require a NPDES permit when the application is made directly in waters to control pests in the water, or when the application of the pesticide is made to control pests that are over (or near) waters (Federal Register 2006). The rulemaking was based on the USEPA's interpretation of the term "pollutant" under the Clean Water Act.

In theory, this regulation eliminated the need for a NPDES permit. However, there were at least two legal challenges to this regulation, and SWB legal counsel recommended that the SWB not rescind their general NPDES permits related to aquatic pesticides (SWB 2007). The USEPA ruling did mean that agencies operating under the General Permit had the option to terminate their coverage by the General Permit. The DBW elected to maintain coverage under the General Permit until legal challenges to the ruling were resolved. In January 2009, an appeals court vacated the USEPA rule that had allowed pesticides to be applied to U.S. waters without an NPDES permit. This ruling does not change DBW operations because DBW maintained permit coverage.

The key NPDES requirements for the AIPCP under the General Permit CAG990005, as of the July 2016 amendment, are as follows:

- **Dissolved oxygen** – specific DO limits depend on the location and season, but range from 5.0 mg/l (ppm) to 8.0 mg/l (ppm). DO levels are not to drop below these levels as a result of AIPCP treatments
- **Turbidity** – specific turbidity standards are not to increase above a specified number or percent of Nephelometric Turbidity Units (NTUs), depending on the initial level of natural turbidity. Generally, the AIPCP shall not increase turbidity more than 10 to 20 percent
- **pH** – AIPCP discharges shall not cause pH to fall below 6.5, or exceed 8.5, or change by more than 0.5 units
- **2,4-D residues** – maximum 2,4-D levels are based on EPA municipal drinking water standards, and shall not exceed 70 µg/l, or 70 ppb
- **Glyphosate residues** – maximum glyphosate levels are based on EPA municipal drinking water standards, and shall not exceed 700 µg/l, or 700 ppb
- **Diquat** – maximum diquat levels are based on EPA municipal drinking water standards, and shall not exceed 20 µg/l, or 20 ppb
- **Endothall** – maximum endothall levels are based on EPA municipal drinking water standards, and shall not exceed 100 µg/l, or 100 ppb
- **Fluridone** – maximum fluridone levels are based on EPA municipal drinking water standards, and shall not exceed 560 µg/l, or 560 ppb
- **Penoxsulam** - there are no specified limits for penoxsulam; however, DBW is required to monitor penoxsulam levels
- **Imazamox** – there are no specified limits for imazamox; however, DBW is required to monitor imazamox levels
- **Imazapyr** – has a receiving water monitoring trigger of 11.2 mg/l, or 11.2 ppm. DBW must monitor imazapyr levels and take specified actions if concentrations exceed 11.2 ppm
- **Flumioxazin** – has a receiving water monitoring trigger of 0.23 mg/l, or 0.23 ppm. DBW must monitor flumioxazin levels and take specified actions if concentrations exceed 0.23 ppm

- **Adjuvant residues** – there are no specified limits for adjuvants; however, DBW is required to monitor adjuvant levels
- **Monitoring** – requires a monitoring protocol. Monitoring is required at 6 treated sites for each herbicide and water body type with the exception of glyphosate, which will require monitoring at one location for each water body type. Sampling stations are identified as: "A" (where treatment occurred), "B" (downstream of the treatment area), and "C" (control, typically upstream). Sampling times are identified as: "1" (pre-treatment), "2" (immediately post-treatment), and "3" (within seven days after treatment). Thus, sample 2B is taken immediately post-treatment, downstream of the treatment location
- **Reporting** – the DBW is required to submit an annual report by March 1st of each year.

The SWB does not currently have receiving water thresholds or monitoring triggers for two proposed AIPCP herbicides: carfentrazone-ethyl and florpyrauxifen-benzyl. The AIPCP will not utilize these herbicides until they have been added to the NPDES permit. This would most likely occur when the permit is renewed in November 2018.

The Delta Stewardship Council finalized the Delta Plan in 2013. The Delta Plan includes 74 recommendations, which the DSC encourages project proponents to consider in designing and implementing projects and programs. Two recommendations relate specifically to water quality. The AIPCP, through its compliance with water quality regulations, seeks to meet both of the following recommendations:

- Protect Beneficial Uses: Delta Plan Recommendation WQ R1 calls for maintaining water quality in the Delta at a level that supports, enhances, and protects beneficial uses identified in the applicable State Water Resources Control Board or regional water quality control board water quality control plans.
- Special Water Quality Protections: Delta Plan Recommendation WQ R3 says where new or increased discharges of pollutants could adversely impact beneficial uses, the discharger should provide special water quality protections evaluated by the State Water Resources Control Board.

2. Surface Water Quality

The Bay-Delta Plan notes that "the Bay-Delta Estuary itself is one of the largest ecosystems for fish and wildlife habitat and production in the United States. Historical and current human activities (e.g. water development, land use, wastewater discharges, introduced species, and harvesting), exacerbated by variations in natural conditions, have degraded the beneficial uses of the Bay-Delta Estuary, as evidenced by the declines in populations of many biological resources of the Estuary" (SWB 2006).

Pollutants in Delta waterways include: pesticides (chlorpyrifos, DDT, diazinon, furan compounds, and Group A pesticides[1]), exotic species, mercury, salinity, dissolved oxygen, pathogens, and PCBs (CVRWQCB 2006). Potential sources of these pollutants include: agriculture, municipal point sources, urban runoff, storm sewers, resource extraction, and hydromodification. Concerns have been raised about ammonia levels in the Delta. One study concluded that ammonia concentrations present in the Sacramento River are not acutely toxic to delta smelt, but raised the concern that ammonia may be chronically toxic to delta smelt and other sensitive fish species (Werner et al. 2008b). Another study indicated that ammonia discharge from the Sacramento Regional Wastewater Treatment Plant inhibited phytoplankton nitrate uptake and decreased phytoplankton growth rates (Parker, 2010).

While evidence of gross pollution in the Delta has been largely eliminated, the recent rapid growth in population and industrial activity in tributary areas has left some problems unsolved and has created new ones. Existing water quality problems may be categorized as 1) eutrophication and associated dissolved oxygen fluctuations, 2) suspended sediments and turbidity, 3) salinity, 4) toxic material, and 5) bacteria.

Pesticides are found in the water and bottom sediments throughout the Delta. The more persistent chlorinated hydrocarbon pesticides are consistently found at higher levels than the less persistent organophosphate compounds. Sediments in the western Delta have the highest pesticide content. Pesticides have concentrated

[1] Group A pesticides include: aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane, endosulfan, and toxaphene.

in aquatic life, but long-term effects and the effects of intermittent exposure are not known. There are now concerns about the aquatic toxicity of pyrethroid-based pesticides, which are replacing organophosphorus pesticides such as diazinon and chlorpyrifos. These pesticides are being found more frequently in water and sediment samples.

The SWB monitors contaminants in sediment and sediment toxicity through the Stream Pollution Trends Monitoring Program (SPoT). The data provided by the SPoT program assists the SWB assess aquatic life beneficial uses. SPoT was initiated in 2008, and is part of the Surface Water Ambient Monitoring Program (SWAMP). There are 34 monitoring sites in Region 5 (the Central Valley Regional). Between 2008 and 2014, only seven of these sites have ever been toxic (38.6% or less survival rate at any one sampling event), and generally have low concentrations of measured chemicals, including pesticides (Phillips, 2016). The seven sites include sites in the southern Delta, Roberts Island, and near Grand Island.

There are number of water quality monitoring programs that measure pesticide concentrations in the Delta and surrounding waterways. Among these are: the Delta Regional Monitoring Program, Sacramento River Watershed Program, Sacramento-San Joaquin River Delta Data, San Joaquin River Restoration Program, Irrigated Lands Regulatory Program, and SWAMP. Results of these sampling programs are available on the California Environmental Data Exchange Network (CEDEN). The exhibits below summarize pesticide sampling data in the eleven AIPCP counties (note, these data cover all locations within each county, beyond the treatment area) from 2011 through 2016. Over the seven-year period, the programs conducted over 86,000 pesticide sampling events resulting in 7,882 positive samples (9.2 percent) for 172 different chemicals. There were another 112 pesticides that were monitored, but never identified. **Exhibit 5-2** identifies the most frequently measured pesticides and the number of positive samples. A positive sample means that detectable quantities of the pesticide were measured, not necessarily quantities above water quality or toxicity thresholds. The lower portion of Exhibit 5-2 shows the rankings and samples for proposed AIPCP herbicides. Of these herbicides, only glyphosate, fluridone, and penoxsulam were applied by DBW during the 2011 to 2016, time period.

The 53 positive glyphosate measurements listed in Exhibit 5-2 ranged from 1.5 ppb to 22 ppb. Glyphosate was found in 11 percent of the samples where it was evaluated. The EPA drinking water standard for glyphosate is 700 ppb. Of the positive glyphosate samples, 40 were obtained as part of the Irrigated Lands Regulatory Program (for agricultural monitoring of pesticides) in San Joaquin, Stanislaus, and Merced counties.

The 37 positive fluridone samples in Exhibit 5-2 ranged from 3.7 nanograms/liter (ng/l, the detection limit, equivalent to 0.0037 ppb) to 435.9 ng/l, or 0.4359 ppb. Fluridone was found in 24 percent of the samples it evaluated for. The EPA drinking water standard for fluridone is 560 ppb.

The two positive penoxsulam samples were 3.1 ng/l and 3.0 ng/l, slightly below the method detection limit, and well below the NPDES monitoring trigger of 10.1 ppm (equivalent to 10.1 million ng/l). Penoxsulam was found in 8 percent of the samples it was evaluated for.

As shown in Exhibit 5-2, diquat was identified in twelve samples, all in Freeport on the Sacramento River.

Diquat concentrations ranged from 0.1 ppb to 0.4 ppb, at the method detection limits. The EPA drinking water standard for diquat is 20 ppb. As noted, DBW has not applied diquat in their aquatic weed control programs since the mid-2000s.

These monitoring data show that there are a large number of pesticides found in water samples within the Delta and more broadly in AIPCP counties. The most commonly found pesticides are: diuron, an herbicide used throughout for crops such as alfalfa, wine grapes, asparagus, walnuts; chloripyrifos (an insecticide commonly used for alfalfa, almonds, citrus, and cotton); and several pyrethroid insecticides. Herbicides used by DBW for aquatic weed control are found infrequently, at low levels, and often may not be the result of DBW applications. The exception may be fluridone, which has been used primarily for EDCP treatments. However, all of the fluridone samples were well below levels of concern.

Bacteriological quality, as measured by the presence of coliform bacteria, varies depending on the proximity to waste discharges and significant runoff. The highest concentration of coliform organisms is generally in the western Delta and near major municipal waste discharges.

Exhibit 5-2
Pesticides Residues in Water Sampled in AIPCP Counties (2011 to 2016)

Rank	Pesticide*	Number of Positive Samples
1	Diuron	475
2	Chlorpyrifos	383
3	Bifenthrin*	346
4	Cyhalothrin	282
5	DDE(p,p') (DDT metabolite)	271
6	Esfenvalerate/Fenvalerate*	201
7	Diazinon, Total	187
8	Cyfluthrin*	177
9	Cypermethrin*	177
10	Permethrin*	155
11	Deltamethrin/Tralomethrin*	150
12	DDD(p,p') (DDT metabolite)	134
13	Simazine	120
14	Malathion	108
15	Dieldrin	98
47	Glyphosate	53
64	Fluridone	37
114	Diquat	12
157	Penoxsulam	2

* Pyrethroid pesticides

”Enrichment” in the Delta is a serious problem due to a high influx of nutrients. Enrichment problems in the Delta occur along the lower San Joaquin River and in certain areas receiving waste discharges but having little or no net freshwater flow. These problems occur mainly in the late summer and coincide with low streamflow, high temperature, and the harvest season when fruit and vegetable canneries are in full operation. Deepening channels for navigation has further depressed dissolved oxygen levels to the point that at times levels are insufficient to support aquatic life. In the fall, these circumstances, combined with reverse flows due to export pumping, have created conditions unsuitable for salmon passage through the Delta to spawning areas in the San Joaquin Valley.

Warm, shallow, dead-end sloughs of the eastern Delta support populations of potentially toxic blue-green algae (cyanobacteria, known as harmful algal blooms (HABs)) during the summer. In recent years, there has been an increased frequency of HABs, including in Discovery Bay and other regions of the Delta. HABs impact drinking water, recreation, fish, and wildlife. Floating, semi-attached and attached aquatic plants such as water primrose *(Ludwigia spp.),* water hyacinth *(Eichhornia crassipes), spongeplant (Limnobium laevigatum),* hornwort or coontail *(Ceratophyllum demersum),* Eurasian milfoil *(Myriophylum spicatum), and Egeria densa* frequently clog Delta waterways during summer. Extensive growth of these plants interferes with small boat traffic and contributes to the total organic load as these plants break loose and move downstream in the fall and winter.

Most Delta waters are turbid as a result of suspended silt, clay, and organic matter. Most of these sediments enter the Delta system with flow from major tributaries. Some enriched areas are turbid as a result of planktonic algal populations, but inorganic turbidity tends to suppress nuisance algal populations in much of the Delta. Continuous dredging to maintain deep channels for shipping also has contributed to turbidity and has been a significant factor in the temporary destruction of bottom organisms through displacement and suffocation. The appropriate turbidity level in Delta waters is a balance. The Delta Smelt Resiliency Strategy (DSRS) has a goal of increasing turbidity to promote Delta smelt habitat (CNRA July 2016).

Salinity control is necessary in the Delta because it is contiguous with the ocean and its channels are at, or below, sea level. Unless repelled by continuous seaward flow of fresh water, ocean water will advance up the estuary and degrade water quality. During winter and early spring, flows through the Delta are usually above the minimum required to control salinity (described as "excess water conditions"). At least for a few months in summer and during the fall of most years, however, salinity must be carefully monitored and controlled for "balanced water conditions". The Central Valley Project and State Water Project monitor and control salinity, and salinity levels are regulated by the State Water Resources Control Board under its water right authority (through the Bay-Delta and Basin Plans). There are concerns that Delta salinity is increasing as more water is diverted through the SWP and CVP.

Salinity intrusion is a problem mainly during years of below-normal runoff, although in recent years with higher export levels, salinity has also been a concern. The degree of seawater intrusion into the Delta, and thus one source of salinity, is a result of daily tidal fluctuations, freshwater inflow to the Delta from the Sacramento and San Joaquin Rivers, the rate of export at the SWP and CVP intake pumps, and the operation of various control structures such as the Delta Cross-Channel Gates and Suisun Marsh Salinity Control System (USBR 2003).

In the eastern Delta salinity is largely associated with agricultural drainage and the high concentration of salts carried by the San Joaquin River. The Banks and Jones pumping plant operations draw high quality Sacramento River water across the Delta and restrict the low quality area to the southeastern corner. In areas such as dead-end sloughs, irrigation returns cause localized problems. In the western Delta, incursion of saline water from San Francisco Bay is one of the main water quality problems.

Another concern is that Delta water contains trihalomethane (THM) precursors. THMs are suspected carcinogens produced when chlorine used for disinfection reacts with natural substances during the water treatment process. Dissolved organic compounds that originate from decayed vegetation act as precursors by providing a source of carbon in THM formation reactions. During periods of reverse Delta flow, bromides from the ocean mix with Delta water at the western edge of Sherman Island. When bromides occur in water along with organic THM precursors, THMs are formed that contain bromine as well as chlorine. Drinking water supplies taken from the Delta are treated to meet THM standards, set at 0.080 mg/l, MRDL (maximum residual disinfectant level) (USBR 2003). Contra Costa Water District (CCWD) reports that bromide in the Delta is 6.5 times above the national average (Taugher 2005). To reduce THM formation, CCWD has reduced the amount of chlorine used in their treatment process.

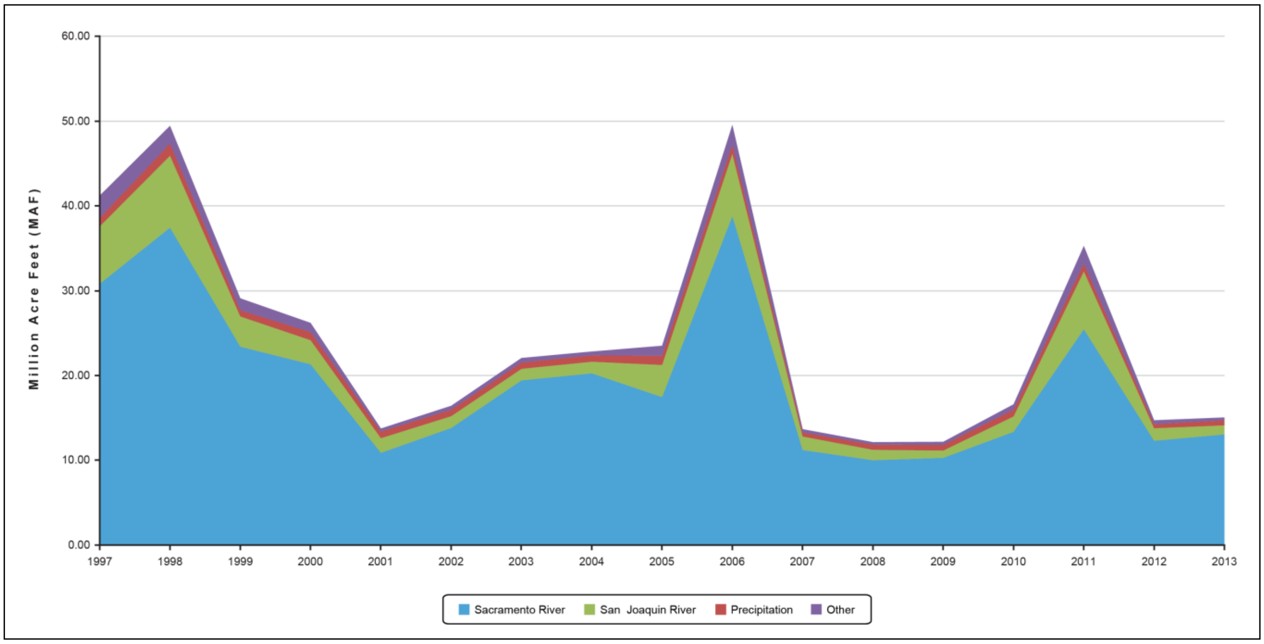
3. Surface Water Hydrology

Prior to the mid-1800s, the Delta was a floodplain consisting of marshes and tidal channels. Beginning around the 1850s, European settlers constructed levees to reclaim marshes and floodplains for farming. There are approximately 1,100 miles of levees in the Delta.

The Sacramento and San Joaquin Rivers unite at the western end of the Delta at Suisun Bay. Over 40 percent of the State's runoff drains into the Delta. The Sacramento River contributes roughly 80 percent of the Delta inflow in most years, the San Joaquin River contributes 15 percent, with the remaining 5 percent of flows contributed from the Mokelumne, Cosumnes, and Calaveras rivers. From Suisun Bay, water flows through Carquinez Strait into San Pablo Bay (the northern half of San Francisco Bay) and then through the Golden Gate to the Pacific Ocean.

Most of the Delta is subject to tidal action with mean fluctuations of approximately two to three feet. This tidal influence is important throughout the Delta. Historically, when mountain runoff dwindled during the summer, ocean water intruded upstream as far as Sacramento. During winter and spring, fresh water from heavy rains pushed the salt water back, sometimes past the mouth of San Francisco Bay.

Exhibit 5-3
Delta Water Balance in Million Acre Feet (MAF)
(1997 to 2013)



Source: California Department of Water Resources (2014)

With the addition of Shasta, Folsom, and Oroville dams, salt water intrusion during summer has been controlled by reservoir releases. Peaks in winter and spring flows have been dampened, and summer and fall flows have been increased. The result is relatively consistent salinity levels in the Delta throughout the year. However, in very wet years, reservoirs are unable to control runoff, so during the winter and spring the upper bays become fresh and even the upper several feet of water at the Golden Gate can be fresh.

On average, about 24 million acre-feet of water reaches the Delta annually, but actual inflow varies widely from year-to-year and within the year (DWR 2005). **Exhibit 5-3** provides the Delta water balance from 1997 to 2013. During this period, inflow ranged from 12 million acre-feet to 49 million acre-feet. There was even greater variation between extreme water years prior to 1997. For example, in 1977, a year of extraordinary drought, Delta inflow totaled about 5 million acre-feet (URS Corporation 2007). Inflow for 1983, an exceptionally wet year, was about 60 million acre-feet (URS Corporation 2007). On a seasonal basis, average natural flow to the Delta varies by a factor of more than 10 between the highest month in winter or spring and the lowest month in fall. Because of the large tidal flows compared to inflows, outflow must be calculated rather than measured. Calculated outflows are reasonably accurate on time scales longer than a few weeks but not at all accurate for shorter periods.

Delta hydraulics are complex. The influence of the tide is combined with freshwater outflow, resulting in flow patterns that vary daily. Inflow varies seasonally and is affected by upstream diversions. Hydraulics are further complicated by a multitude of agricultural, industrial, and municipal diversions for use in the Delta itself and by exports for the CVP and SWP. The primary factors currently influencing Delta hydrodynamic conditions are: river inflow from the Sacramento and San Joaquin Rivers; daily tidal inflow and outflow through the San Francisco Bay, and export pumping from the south Delta through the CVP Tracy Pumping Plant and the SWP Harvey O. Banks Pumping Plant (USBR 2003).

Delta hydraulics are likely to be further modified in the future due to climate change, sea level rise, risk of levee failure, and the California WaterFix. The WaterFix, which obtained USFWS and NMFS incidental take permits in July 2017, is an infrastructure project that would construct two tunnels to convey water from north to south Delta.

4. Delta Exports

The CVP, operated by the U.S. Bureau of Reclamation, and the SWP, operated by the Department of Water Resources, coordinate operations to manage the flow of water into, and out of, the Delta. Both agencies monitor and manage releases from upstream reservoirs and export pumping at the SWP Banks and CVP Tracy pumping plants (DWR 2005).

To minimize water level fluctuation caused by the SWP intake along Old River, Clifton Court Forebay is operated so water is drawn through the gates at high tides and the gates are closed at low tides. This operation provides a more constant head for the pumps and allows the Department of Water Resources to maintain optimum velocities in the channel and across the fish screens. The CVP draws water directly from the channels over the entire tidal cycle, resulting in a continuous flow toward the Jones Pumping Plant whenever it is operating.

Operational changes of the SWP and CVP can affect flow in the lower San Joaquin River along Sherman Island. When outflow is low, increases in export and internal use results in a net reverse flow in this portion of the river, so that net movement of water is upstream toward the pumps. Although they are small in relation to tidal flows, there is concern that net reverse flows may harm fish, including salmon, steelhead, delta smelt, and planktonic eggs and larvae of striped bass.

The CVP can pump a maximum of 4,600 cubic feet per second (cfs) into the Delta-Mendota Canal. This is equivalent to a maximum annual export volume of 3.33 million acre-feet; however, CVP export has historically averaged approximately 2.5 million acre-feet per year (DWR 2006). Adding the Contra Costa Canal brings the CVP export capacity to 4,900 cfs. The SWP can pump 10,300 cfs at Banks Pumping Plant (up to 4.2 maf annually, but an agreement with the U.S. Army Corps of Engineers limits pumping to 6,680 cfs).

The SWP typically exports approximately 2.6 million acre-feet per year, down from approximately 3 million acre-feet in 2005 (DWR 2012). The reduction is primarily attributable to the operational restrictions imposed on the SWP by the biological options (BOs) issued by the USFWS in December 2008 and the NMFS in June 2009.

Although significant changes to export mechanisms in the Delta are unlikely for many years, there are several initiatives to evaluate around-Delta export mechanisms (see Chapter 7 for additional discussion).

5. Groundwater

The groundwater hydrology of the Sacramento-San Joaquin Delta, as with the geology, is contiguous with that of the Sacramento River Basin. Large amounts of water are stored in thick sedimentary deposits in the Sacramento Valley groundwater basin. Groundwater is used intensively in some areas but only slightly in areas where surface water supplies are abundant.

Groundwater occurs in various degrees of confinement in the Sacramento Valley basin. Groundwater is generally unconfined in the relatively shallow alluvial fan, flood plain, and stream channel deposits and partially confined in and under the flood basin deposits. In the older Pleistocene and Pliocene formations, especially at deeper levels, water is confined beneath impervious thick clay and mudflow strata.

Groundwater levels fluctuate according to supply and demand on daily, seasonal, annual, and even longer bases. Short-term and long-term water level changes have been recorded for wells since the first documented measurements in 1929. In the low-lying central portion of the Sacramento Valley Basin, from the Delta north to Glenn and Butte counties, depth to water in wells is 10 feet or less. Groundwater levels in the central Delta are shallow, and land subsidence on several islands has resulted in groundwater levels close to the ground surface (DWR and USBR 2016a).

Groundwater is replenished through deep percolation of streamflow, precipitation, and applied irrigation water. Recharge by subsurface inflow is negligible compared to other sources. Groundwater quality is generally excellent throughout the area and is suitable for most uses, although at shallow depths within the Delta the water is often saline.

In September 2014, Governor Brown signed the Sustainable Groundwater Management Act (SGMA), establishing a regulatory system for groundwater in California. The act provides a framework for sustainable, local groundwater management, and is intended to halt overdraft and balance pumping and recharge of groundwater basins (DWR 2017a).

B. Impact Analysis and Mitigation Measures

For purposes of this analysis, an impact to hydrology and water quality is considered to be significant and require mitigation if it would result in any of the significance thresholds listed below. Significance thresholds that are not relevant for the AIPCP are dismissed, as noted below. For those significance thresholds that are not dismissed, the potential impact is described and mitigation measures are identified. The significance thresholds are:

- Violate any water quality standards or waste discharge requirements
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (dismiss)
- Substantially alter the existing drainage pattern of the site or area in a manner which would result in substantial erosion or siltation on- or off-site (dismiss)
- Substantially alter the existing drainage pattern of the site or area in a manner which would result in flooding on- or off-site (dismiss)
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff (dismiss)
- Otherwise substantially degrade water quality
- Otherwise substantially degrade drinking water quality
- Place housing within a 100-year flood hazard area (dismiss)
- Place structures which would impede or redirect flood flows within a 100-year flood hazard area (dismiss)
- Expose people or structures to a significant risk of loss, injury, or death involving flooding (dismiss)
- Inundation by seiche, tsunami, or mudflow. (dismiss)

Exhibit 5-4 provides a summary of the potential AIPCP impacts for hydrology and water quality significance areas which could potentially be affected and areas in which there will be no impacts. Potential impacts of the AIPCP on water intake pump systems are discussed in Chapter 6.

The first three potential impacts, Impact W1: Chemical constituents; Impact W2: Pesticides; and Impact W3: Toxicity; are closely related. Each of these potential impacts and their mitigation measures are discussed separately. However, to minimize duplication, this document may reference prior discussions of related impacts. In addition, more detailed discussions of Biological Resource impacts related to herbicide toxicity are referenced in in Chapter 3.

Impact W1 – Chemical constituents: following AIPCP herbicide treatment, waters may potentially contain chemical constituents that adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water quality or drinking water quality

AIPCP herbicide treatments involve spraying chemical constituents onto floating or emergent aquatic plants or applying herbicides directly into the water in infestations of submersed aquatic plants growing in the Delta and its tributaries. Related to FAV treatments, Anderson (1982) determined that 10 to 20 percent of herbicide reaches the water following water hyacinth treatment, either moving through the water hyacinth mat, or as a result of drift. AIPCP treatments for FAV are expected to result in similar amounts of overspray. This herbicide is considered a chemical constituent in the water. For SAV treatments, herbicide labels specify a target chemical concentration.

The Basin Plan water quality objectives related to chemical constituents are as follows: *"Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses… At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations…"* (CVRWQCB 2007). The relevant MCL levels for the AIPCP are:

- 70 ppb or μg/l for 2,4-D
- 700 ppb or μg/l for glyphosate
- 560 ppb or μg/l for fluridone
- 100 ppb or μg/l for endothall
- 20 ppb or μg/l for diquat.

For purposes of compliance with these MCLs, the relevant herbicide concentrations are in receiving waters, e.g., waters downstream of the treatment site. Four proposed AIPCP herbicides (imazamox, penoxsulam, flumioxazin, and imazapyr) have monitoring triggers rather than MCLs, and two proposed herbicides (carfentrazone-ethyl and florpyrauxifen-benzyl) have not yet been approved for the General NPDES. The potential for the AIPCP to result in chemical constituents is discussed later in this section. Refer to Chapter 3, Impact B2, for a more detailed description of calculated and actual maximum herbicide and adjuvant levels immediately following AIPCP treatments. Chapter 3, Impact B2, and the AIPCP Programmatic Biological Assessment also includes a discussion of the fate of AIPCP herbicides in water.

Exhibit 5-4
Crosswalk of Hydrology and Water Quality Significance Criteria, and Impacts of the AIPCP

Page 1 of 2

	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
a) Violate any water quality standards or waste discharge requirements?					
Impact W1: Chemical constituents	3, 4, 7, 8, 15	[X]			
Impact W2: Pesticides	1, 3, 4, 5, 7, 8, 15	[X]			
Impact W3: Toxicity	1, 3, 4, 5, 7, 8, 15	[X]			
Impact W4: Dissolved oxygen levels	10	[X]			
Impact W5: Floating material	11, 15, 16		[X]		
Impact W6: Turbidity					
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?					AIPCP will not deplete groundwater supplies or interfere substantially with groundwater recharge
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?					AIPCP will not alter the existing drainage pattern of the site or area in a manner which would result in erosion or siltation on- or off-site
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?					AIPCP will not alter the existing drainage pattern of the site or area, or increase the rate of runoff, in a manner which would result in flooding on- or off-site
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?					AIPCP will not create or contribute runoff water or provide additional sources of polluted runoff

Exhibit 5-4
Crosswalk of Hydrology and Water Quality Significance Criteria, and Impacts of the AIPCP *(continued)*

Page 2 of 2

	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
f) Otherwise substantially degrade water quality?					
Impact W1: Chemical constituents	3, 4, 7, 8, 15	[X]			
Impact W2: Pesticides	1, 3, 4, 5, 7, 8, 16	[X]			
Impact W3: Toxicity	1, 3, 4, 5, 7, 8, 15	[X]			
Impact W4: Dissolved oxygen levels	10	[X]			
Impact W5: Floating material	11, 15, 16		[X]		
Impact W6: Turbidity					
g) Otherwise substantially degrade drinking water quality?					
Impact W1: Chemical constituents	3, 4, 7, 8, 15	[X]			
Impact W2: Pesticides	1, 3, 4, 5, 7, 8, 15	[X]			
Impact W3: Toxicity	1, 3, 4, 5, 7, 8, 15	[X]			
h) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?					AIPCP will not place housing within a 100-year flood hazard area
i) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?					AIPCP will not place structures within a 100-year flood hazard area
j) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?					AIPCP will not expose people or structures to risk of loss, injury, or death involving flooding
k) Inundation by seiche, tsunami, or mudflow?					AIPCP will not result in inundation by seiche, tsunami, or mudflow

Since 2007, DBW monitored receiving waters directly downstream of the treatment sites, one hour after treatment. As in previous years, environmental scientists also returned to each site two to seven days later to sample upstream, within, and downstream of the treatment site. All samples were taken at two to three feet depth. These DBW monitoring results provide data on actual herbicide residue levels following treatments. Similar results are expected from AIPCP's utilization of these herbicides. **Exhibits 5-5** through **5-9** summarize monitoring data since 2007 for 2,4-D, glyphosate, penoxsulam, imazamox, and fluridone. With the exception of one 2,4-D measurement, samples have been below MCL levels. All samples of the adjuvant Agridex were at non-detectable levels. The calculated, test plot, and actual AIPCP herbicide levels indicate that herbicide and adjuvant levels in the Delta following herbicide treatment are low.

Exhibit 5-5
Number of Sites at Various 2,4-D Concentrations In and Downstream of FAV Treatment Sites

2,4-D Concentrations (2007-2016)	At Treatment Site, within 7 Days After Treatment (A)	Downstream of Treatment Site, Post-Treatment (B)
Not Detected (<0.1 ppb)	16	29
<1 ppb	50	27
1 to <10 ppb	12	20
10 to <50 ppb	0	3
50 to <100 ppb	0	1
100 to <200 ppb	1	0
Total Number of Samples	**79**	**80**

Exhibit 5-6
Number of Sites at Various Glyphosate Concentrations In and Downstream of FAV Treatment Sites

Glyphosate Concentrations (2007-2016)	At Treatment Site, within 7 Days After Treatment (A)	Downstream of Treatment Site, Post-Treatment (B)
Not Detected (<20 ppb)	63	63
≥ 20 ppb	0	0
Total Number of Samples	**63**	**63**

Exhibit 5-7
Number of Sites at Various Penoxsulam Concentrations (2014 and 2016)

Penoxsulam Concentrations (2014 and 2016)	At Treatment Site, within 7 Days After Treatment (A)	Downstream of Treatment Site, Post-Treatment (B)
Not Detected (<10 ppb)	4	4
≥ 10 ppb	0	0
Total Number of Samples	**4**	**4**

Exhibit 5-8
Number of Sites at Various Imazamox Concentrations (2014-2016)

Imazamox Concentrations (2014-2016)	At Treatment Site, within 7 Days After Treatment (A)	Downstream of Treatment Site, Post-Treatment (B)
Not Detected (<10 ppb)	12	12
≥ 10 ppb	0	0
Total Number of Samples	**12**	**12**

Exhibit 5-9
Number of Samples by Fluridone Concentration (2007 to 2016)

Year	Fluridone Concentrations	Within Treatment Site (A)	Downstream of Treatment (B)	Outside of Treatment Site (C)
2007	Not Detected	5	9	7
	1 to 5 ppb	10	6	8
2008	Not Detected	14	16	16
	1 to 5 ppb	2	0	0
2009	Not Detected	16	15	19
	1 to 5 ppb	4	4	0
2010	Not Detected	12	10	10
	1 to 5 ppb	0	2	2
2011	Not Detected	48	20	54
	1 to 5 ppb	331	9	6
2012	Not Detected	34	19	18
	1 to 5 ppb	14	3	4
2013	Not Detected	13	13	14
	1 to 5 ppb	10	10	9
2014	Not Detected	10	12	13
	1 to 5 ppb	5	3	2
2015	Not Detected	12	15	15
	1 to 5 ppb	9	6	6
2016	Not Detected	12	26	26
	1 to 5 ppb	16	3	3
	5 to 6 ppb	1	0	0
Total	**Not Detected**	**142**	**136**	**174**
	1 to 5 ppb	**16**	**3**	**3**
	5 to 6 ppb	**1**	**0**	**0**

The potential for AIPCP herbicide treatments to be present in water at concentrations that would adversely affect beneficial uses, or result in violations of MCL, levels is low because of the application concentrations and dilution. However, should AIPCP herbicide levels occur at such concentrations, it would constitute an **unavoidable or potentially unavoidable significant impact.** This impact would potentially be reduced by implementing the following mitigation measures.

- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.
- **Mitigation Measure 4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total.
- **Mitigation Measure 7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters.
- **Mitigation Measure 8** – Implement an adaptive management approach to minimize the use of herbicides.

- **Mitigation Measure 15 –** Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities.

  The MOU is an agreement between CCWD and DBW. No applications shall occur within Rock Slough, or within one mile of the confluence of Rock Slough and Old River, or within one mile of CCWD's Old River or Mallard Slough intake pumps without consensual agreement between CCWD and DBW. Herbicide applications within one mile of CCWD's water intakes may only occur with prior consent of CCWD. In order to treat within one mile of an intake, AIPCP must notify CCWD at least two weeks in advance, and make every reasonable attempt to schedule applications during periods when CCWD's intakes are shut down for environmental or maintenance reasons, allowing at least two complete tidal cycles between application and restart. This measure is primarily aimed at reducing the potential for drinking water contamination from the AIPCP.

Impact W2 – Pesticides: following AIPCP herbicide treatment pesticides may potentially be present in concentrations that adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water or drinking water quality

AIPCP herbicide treatments entail application of approved aquatic herbicides and adjuvants to treat aquatic invasive plants in Delta and tributary waterways. These treatments have the potential to adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water or drinking water quality. The following water quality objectives identified in the Central Valley Regional Water Quality Control Board basin plan (CVRWQCB 2007) are potentially relevant to the AIPCP:

- *"No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses.*
- *Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses.*
- *Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies (see State Water Resources Control Board Resolution No. 68-16 and 40 C.F.R. Section 131.12).*
- *Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.*
- *Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of pesticides in excess of the Maximum Contaminant Levels set forth in California Code of Regulations, Title 22, Division 4, Chapter 15" (CVRWQCB 2007).*

Below is a discussion of these five water quality objectives and the potential for AIPCP herbicide treatments to adversely affect beneficial uses related to these objectives. Several of these potential impacts are discussed in Chapter 3, and for Impacts W1 and W3.

➢ *Presence of AIPCP Herbicides in Concentrations that Adversely Affect Beneficial Uses*

See Exhibit 5-1 for a list of all beneficial uses in Delta waters. The beneficial uses that are most likely to be affected by AIPCP herbicide treatments are:

- Non-biological resource beneficial uses:
  - Municipal and domestic supply
  - Agricultural supply
- Biological resource beneficial uses:
  - Warm freshwater habitat
  - Cold freshwater habitat
  - Wildlife habitat
  - Preservation of biological habitats of special significance
  - Rare, threatened, or endangered species
  - Migration of aquatic organisms
  - Spawning, reproduction, and/or early development

As noted above under Impact W1, the potential for AIPCP herbicides to be present in concentrations that would affect municipal beneficial uses (e.g. to exceed the MCLs) is low. As noted in Chapter 6, the potential for AIPCP herbicides to be present in concentrations that would affect agricultural beneficial uses are avoidable, and can be mitigated to a less-than significant level.

The potential for AIPCP herbicide treatments to impact the biological resource beneficial uses are discussed in Chapter 3. These impacts represent unavoidable or potentially unavoidable impacts that could adversely affect beneficial uses. Below, and in Chapter 3, a number of mitigation measures that can reduce these potential impacts to biological resource beneficial uses are discussed.

➢ *Presence of AIPCP Herbicides in Bottom Sediments or Aquatic Life*

AIPCP herbicides are not considered to bioaccumulate in aquatic plant or animal life forms because the herbicides are excreted and/or metabolized following exposure. The potential for AIPCP herbicide bioaccumulation is discussed in Chapter 3, Impact B3. In Chapter 3, the expected impact of bioaccumulation of AIPCP herbicides on special status species was determined to be less than significant. Similarly, the potential for AIPCP herbicides to be present in any other aquatic life forms in concentrations that would adversely affect beneficial uses is less than significant.

Herbicide characteristics related to sediment are not necessarily the same as herbicide characteristics related to bioaccumulation. The 11 potential AIPCP herbicides exhibit very different characteristics in sediment, however none of the herbicides is likely to result in toxic effects to species present in sediment. This is due to the fact that most herbicides are sprayed on floating vegetation that is not stationary in the Delta. The potential for AIPCP herbicide treatments to result in concentrations that would adversely affect beneficial uses is less than significant. Soil adsorption characteristics of proposed AIPCP herbicides are as follows:

- 2,4-D: the soil adsorption coefficient, K_{OC}, for 2,4-D is relatively low, at 48 μg/g (University of California 2005). This means that 2,4-D does not persist in soil or sediments. The half-life of 2,4-D in soil is also relatively short, at 10 days (University of California 2005). The major method of 2,4-D breakdown in soil is microbial degradation (Walters 1999).
- Glyphosate: binds strongly to soil and sediment and becomes biologically unavailable (Monsanto 2002; Monsanto February 2005). The soil adsorption coefficient for glyphosate , K_{OC}, is 24,000 μg/g (University of California 2005). This is one of the highest K_{OC} values among pesticides, and indicates extremely strong binding to sediments. The half-life of glyphosate in soil is 47 days (University of California 2005). Once bound to sediments, glyphosate does not move back into the water, but is degraded by soil microbes and fungi to aminomethylphosphonic acid (AMPA), and then carbon dioxide and phosphate. AMPA also strongly adsorbs to soil (NPTN 2000), and is characterized as having little toxicity to non-target organisms (Monsanto February 2005).
- Penoxsulam: in sediment, penoxsulam is expected to degrade rapidly through anaerobic degradation (USEPA 2007). Penoxsulam is adsorbed by soil and has low to moderate leaching potential in most soil types, where it is broken down by microbial degradation (The Dow Chemical Company 2008).
- Imazamox: is mobile to highly mobile in soil (Washington DOE 2012; USEPA 2008). The organic carbon sorption coefficient, Koc, of imazamox is between 5 and 143 (indicating weak adsorption).
- Diquat: binds strongly to soil and sediment. When diquat comes in contact with soil, it is strongly adsorbed to clay particles or organic matter for a long period of time (several years) (EXTOXNET 1993). Diquat is biologically inactive in this bound state, and is often unavailable for further degradation (EXTOXNET 1993; Washington DOE 2002).
- Fluridone: the K_{OC} for fluridone is approximately 350 to 2,460 ml/g (USEPA 2004c) A study summarizing field dissipation data of fluridone found a half-life of 3 months in pond hydrosoil (West et al. 1983). To support early EDCP efforts, DBW commissioned CDFW to evaluate residues of fluridone in the sediment following fluridone treatments from 2002 to 2005. Fluridone was found in treatment site sediments, in some cases higher than the 180 ppb to 730 ppb expected range (Hosea 2005). Explanations include non-uniform distribution of fluridone pellets, timing of sample collection, and organic material/clay in the sediment. DWR is currently working with DBW to evaluate fluridone levels in sediment at treatment sites. *Egeria densa* likely uptakes fluridone through the root system, extending exposure time.

- Imazapyr: is very mobile and persists in soil. The K_{OC} of imazapyr is between 8 and 150, depending on the type of soil, indicating weak adsorption (AMEC Geomatrix 2009; SERA 2004). In soil, the degradation of imazapyr is essentially stable to hydrolysis, and aerobic and anaerobic soil degradation (Washington DOE 2009). In soil, imazapyr degrades primarily through microbial degradation. The soil half-life of imazapyr ranges from 210 days to 5.9 years, depending on climate, temperature, precipitation, wind, hydrology, soil characteristics, microbial activity, and chemical degradation (Washington DOE 2009).
- Carfentrazone-ethyl: rapidly degrades in soil and sediment, with four primary degradates that are persistent but less toxic than carfentrazone-ethyl (Washington DOE 2012). It does not accumulate in sediments (Washington DOE 2012; Koschnick et al. 2004). The organic carbon sorption coefficient, K_{oc}, of carfentrazone-ethyl is between 750 mg/L, indicating moderate adsorption (Gillespie et al. 2011).
- Endothall: is highly mobile in soil, but degrades rapidly (EXTOXNET 1995). The half-life of technical endothall in soil is 4-9 days (longer for soils with high organic content) (EXTOXNET 1995).
- Flumioxazin: in aerobic soil, the half-life of flumioxazin ranges from 11.9-17.5 days (Washington DOE 2012). The organic carbon sorption coefficient, K_{oc}, is 557, indicating moderate mobility in soil.
- Florpyrauxifen-benzyl: the soil sorption coefficient K_{OC} is 23,028-47,763, with an average of 34,200 (Mark Heilman March 2017; confidential). Per the manufacturer, the product will have a low potential for groundwater leaching or contamination, and higher soil adsorption than many other aquatic herbicides (Mark Heilman March 2017; confidential). This herbicide is currently in the USEPA pesticide registration process, and the potential impact of the high soil adsorption will be evaluated further.

➢ *Presence of AIPCP Herbicides in Concentrations that Exceed Applicable Antidegradation Policies*

In 1968, the SWB passed Resolution 68-16, *Statement of Policy with Respect to Maintaining High Quality Water in California* (CVRWQCB 2007). This resolution addresses the USEPA Clean Water Act requirement to adopt an “antidegradation” policy. The goal of the policy is to maintain high quality waters. This policy generally restricts Regional Water Boards and dischargers from reducing the water quality of surface or groundwaters even though such a reduction in water quality might still allow the protection of beneficial uses associated with the water (CVRWQCB 2007).

The waters of the Delta and its tributaries within the AIPCP project area are not high quality waters. Significant portions of the Delta and its tributaries are considered impaired due to pesticides, dissolved oxygen, salinity, mercury, exotic species, pathogens, and other discharges. If antidegradation policies did apply in the Delta, the relatively small volumes of AIPCP herbicides, applied annually to the project area’s approximately 68,000 water acres, would be extremely unlikely to exceed any such antidegradation policies.

➢ *Presence of pesticides at levels that shall not exceed the lowest levels technically and economically achievable*

Through their adaptive management approach and maintenance control (see Mitigation Measure 8), DBW seeks to minimize the amount of herbicide utilized in the AIPCP. Thus, the AIPCP will not result in pesticide levels in the Delta and tributaries that exceed the lowest levels technically and economically achievable.

➢ *Presence of AIPCP Herbicides in Concentrations in Excess of MCLs*

The potential for AIPCP herbicide treatments to exceed MCLs is discussed extensively under Impact W1, above, and in Chapter 3, Impact B2. The potential for AIPCP herbicides to be present in concentrations in excess of MCLs or monitoring triggers is low because of the application concentrations and expected dilution.

Pesticides present in Delta waters following AIPCP herbicide treatments are unlikely to bioaccumulate in species or accumulate in sediment, are unlikely to affect antidegradation policies, and are unlikely to be present in concentrations that exceed MCLs. The DBW will not apply AIPCP herbicides at levels that exceed the lowest levels technically and economically achievable.

It is also unlikely that pesticide concentrations resulting from AIPCP herbicide treatments will adversely affect beneficial uses, violate water quality standards, or otherwise substantially degrade water or drinking water quality. However, should such concentrations result, it would represent **an unavoidable or**

potentially unavoidable significant impact. This impact would be reduced by implementing the following mitigation measures.

- **Mitigation Measure 1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources.
- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.
- **Mitigation Measure 4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total.
- **Mitigation Measure 5** – Operate program vessels in a manner that causes the least amount of disturbance to the habitat.
- **Mitigation Measure 7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters.
- **Mitigation Measure 8** – Implement an adaptive management approach to minimize the use of herbicides.
- **Mitigation Measure 15 –** Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities.

Impact W3 – Toxicity: following AIPCP herbicide treatment toxic substances may potentially be found in waters in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life, violating water quality standards or otherwise substantially degrading water or drinking water quality

Application of AIPCP herbicides to Delta waters and tributaries could result in concentrations of herbicides that produce toxic responses. The water quality objectives for toxicity are as follows:

> *"All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. The objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Regional Water Board" (CVRWQCB 2007).*

In response to the SWB's initial interim NPDES permit for aquatic pesticides, prepared in 2001 (Order 2001-12-DWQ), Waterkeepers Northern California filed a lawsuit against the SWB. As part of the settlement with Waterkeepers Northern California, the SWB agreed to fund a comprehensive aquatic pesticide monitoring program to assess toxicity of pesticides in receiving water following aquatic pesticide treatments. The SWB contracted with the San Francisco Estuary Institute (SFEI) to conduct the study. In their 2004 study, SFEI found no toxicity for two AIPCP herbicides, 2,4-D and glyphosate.

DBW monitoring, and a review of scientific literature, as discussed in Chapter 3, Impact B2, also found no evidence of acute toxicity at herbicide levels likely to be present following AIPCP treatments. As discussed in Chapter 3, there is some evidence of potential sublethal effects on aquatic species, although data are not conclusive, particularly for likely herbicide levels following AIPCP treatments.

At the concentrations at which they will be applied, some AIPCP herbicides are known to be toxic to plants and algae. The method of action of AIPCP herbicides on plants is discussed in Chapter 3, Impact B1. Any broadleaf vegetation subject to overspray is vulnerable to contact herbicide activity. Exposure of any non-target plant to AIPCP herbicides could result in loss of plant species.

The potential for impacts resulting from herbicide overspray depend on the amount of exposure, concentration of herbicide, and proximity of sensitive habitats, wetlands, and plants. One study found that only three to four percent of 2,4-D droplets drift beyond the target zone, and no significant amount of material is collected as drift (HSDB 2001). Blankenship and Associates found that using conservative application rates, detectable adverse effects could result from less than one percent spray drift of glyphosate or 2,4-D (County of Lake 2004).

The concentration of active ingredient leaving the spray nozzle is high enough (ranging from 100 ppm to 6,000 ppm) to cause adverse effects. Thus, there is the potential that uncontrolled herbicide overspray could affect nearby non-target vegetation.

Treatment of aquatic invasive plants could result in loss of native submerged aquatic vegetation growing in and around treatment areas. While loss of non-target plant species could constitute a significant impact under certain conditions, it is expected to be less than significant for the AIPCP. Dense canopies of aquatic invasive plants reduce light levels for submerged plant photosynthesis and thus can effectively shade out native vegetation.

While there is a potential toxic risk to plants due to herbicide overspray, the likelihood of such effects occurring is low. Herbicide application will be focused directly on target plants to decrease the possibility that concentrated herbicides will come in contact with non-target plants. The DBW will follow herbicide label application instructions that reduce herbicide drift. These steps include using the largest size spray droplets, and lowest spray pressure, that will provide sufficient coverage and control. Furthermore, DBW will not treat at a particular site if the wind is greater than 10 mph (or 7 mph in Contra Costa County).

Should any acute or sublethal toxic effects to non-target plants or aquatic species occur, it would represent a significant impact. These impacts would be **unavoidable or potentially unavoidable significant impacts.** These impacts could be reduced by implementing the following mitigation measures. The seven mitigation measures for this impact are identical to the seven mitigation measures for Impact W2. Both sets of mitigation measures are directed toward reducing the potential for pesticide toxicity impacts following AIPCP treatments.

- **Mitigation Measure 1** – Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources.
- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.
- **Mitigation Measure 4** – Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total.
- **Mitigation Measure 5** – Operate program vessels in a manner that causes the least amount of disturbance to the habitat.
- **Mitigation Measure 7** – Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters.
- **Mitigation Measure 8** – Implement an adaptive management approach to minimize the use of herbicides.
- **Mitigation Measure 15 –** Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities.

Impact W4 – Dissolved oxygen: following AIPCP herbicide treatment, dissolved oxygen may potentially be reduced below Basin Plan and Bay-Delta Plan objectives, violating water quality standards or otherwise substantially degrading water quality

Dissolved oxygen levels may potentially be reduced below Basin Plan and Bay-Delta Plan objectives following AIPCP herbicide treatments, and the resulting rapid decay of aquatic macrophytes, and algae. Decomposition of vegetative material may create an organic carbon slug, which could in turn reduce dissolved oxygen concentrations.

The Basin Plan water quality objectives for dissolved oxygen in the AIPCP project area are as follows:

"Within the legal boundaries of the Delta, the dissolved oxygen concentration shall not be reduced below:

7.0 mg/l in the Sacramento River (below the I Street Bridge) and in all Delta waters west of the Antioch Bridge; 6.0 mg/l in the San Joaquin River (between Turner Cut and Stockton, 1 September through 30 November); and 5.0 mg/l in all other Delta waters except for those bodies of water which are constructed for special purposes and from which fish have been excluded or where the fishery is not important as a beneficial use.

For surface water bodies outside the legal boundaries of the Delta, the monthly median of the mean daily dissolved oxygen (DO) concentration shall not fall below 85 percent of saturation in the main water mass, and the 95 percentile concentration shall not fall below 75 percent saturation. The dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time:

- *Waters designated WARM 5.0 mg/l*
- *Waters designated COLD 7.0 mg/l*
- *Waters designated SPWN 7.0 mg/l" (CVRWQCB 2007).*

In addition, there are more stringent requirements for the Merced River from Cressy to New Exchequer Dam, of 8.0 mg/l (all year), and for the Tuolumne River from Waterford to La Grange, of 8.0 mg/l from October 15^{th} to June 15^{th}.

Dissolved oxygen is the content of oxygen found in water. DO is determined by temperature, weather, water flow, nutrient levels, algae, and aquatic plants. Generally, a higher level of DO is beneficial. Fish begin to experience oxygen stress or exhibit avoidance at levels below 5 mg/l (5 ppm).

DO levels drop in warmer temperatures, and increase with precipitation, wind, and water flow. Running water, such as tidal water in the Delta, dissolves more oxygen than still water. High levels of nutrients in water reduce DO levels, while algae and aquatic plants can increase DO through photosynthesis, but decrease DO through respiration and decomposition. DO levels fluctuate throughout the day, and are typically lowest in the morning and peak in the afternoon. In deep, still waters, DO levels are lower in the hypolimnion (bottom layer of water) because there is little opportunity for oxygen replenishment from the atmosphere.

There is the potential that, following herbicide treatment, the biomass of decaying aquatic vegetation will create a large biological oxygen demand, resulting in decreases in dissolved oxygen. These decreases in dissolved oxygen could adversely affect fish species and aquatic invertebrates present at the treatment location, and potentially impair sensitive riparian or wetland habitats. The extent of the DO impact depends on the speed at which plants decomposes following treatment (which is herbicide dependent) and the extent to which tides and wind move decaying plants away from the original location (which is variable).

AIPCP herbicide labels include provisions regarding area to be treated and time before follow-up applications to address the potential for low dissolved oxygen following treatment, when appropriate. Herbicide label restrictions related to dissolved oxygen are presented in **Exhibit 2-11** of this EIR. These herbicide label instructions have been developed to minimize the potential for DO impacts in enclosed waterways. However, much of the Delta and tributaries are tidal. Regular water exchange in these areas minimizes the potential for DO impacts. Following herbicide label instructions when applicable, there will likely be no significant effect on DO, except to increase DO levels once the plants have completed decomposition.

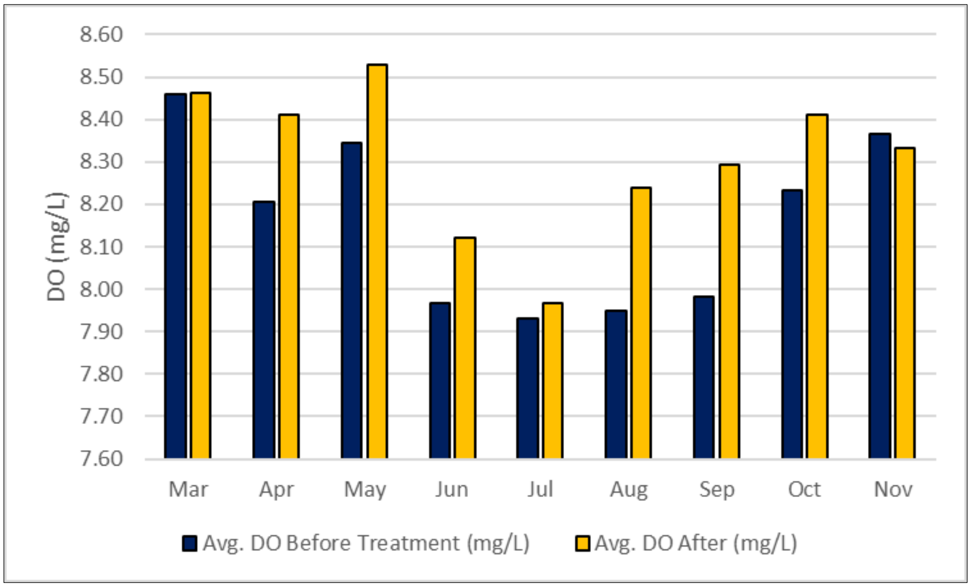
Dissolved oxygen levels under dense FAV mats are expected to be low. For water hyacinth, Toft (2000) and others have found lower levels of dissolved oxygen under hyacinth canopies. Average spot measures were below 5 ppm in hyacinth, and above 5 ppm in pennywort (Toft 2000). These results were supported by a study in Texas which found lower dissolved oxygen in hyacinth compared to other aquatic weeds, and a University of California, Davis study which found dissolved oxygen levels as low as 0 ppm below a solid water hyacinth mat (Toft 2000). Toft hypothesized that lower dissolved oxygen levels explained the absence of epibenthic amphipods and isopods beneath the hyacinth canopy at one of the test sites (Toft 2000). Thus, it is likely that fish and other mobile aquatic invertebrates will avoid areas under FAV mats with low dissolved oxygen, even prior to treatment (NMFS April 2006).

Historical monitoring of DO levels before and after aquatic weed treatments in the Delta indicate that DO effects are not likely to be significant. DBW tracks two sets of DO monitoring. At every herbicide application, treatment crews take DO samples immediately prior to treating, and immediately post-treatment. These levels would be expected to be similar, as they occur a few hours apart and the potential for lowering DO due to decaying water hyacinth would not occur immediately post-treatment. Data from Daily Treatment Logs support that there is no significant impact on DO immediately post-treatment.

Exhibit 5-10 presents average DO levels at all treatment sites prior to treatment, and the average DO levels at the same treatment sites after herbicide treatment. This source of this data is DBW crews. Various sites were treated with 2,4-D, glyphosate, imazamox, penoxsulam, and 2-4-D, and some additionally utilized Agridex. As shown on the exhibit, sites had, on average, higher DO readings after herbicide treatment than the same site DO level prior to herbicide treatment.

The DO monitoring that occurs with water quality sampling would be more likely to show potential decreases in DO, as post-treatment sampling occurs several days after treatment, when plant death symptoms are starting to occur. However, representative DO monitoring data from 2011 shows that herbicide treatments do not significantly impact DO.

Exhibit 5-10
Average DO Before and After FAV Herbicide Treatment (2016)



The data in **Exhibit 5-11** provide WHCP 2011 treatment and post-treatment DO levels taken at the time of water quality sampling, on the day of treatment, and between four and seven days post-treatment. These results are representative of DO monitoring results in later years. In five cases, DO levels increased. Note that the most significant increase occurred at Site 16. Site 16 DO was at an extremely low 2.06 mg/l prior to treatment (a level resulting in stress and avoidance for fish), and DO increased by six days post-treatment to 7.03 mg/l, a level safe for fish. In the other instance of extremely low DO prior to treatment, DO increased from 1.07 mg/l to 2.71 mg/l by five days post-treatment. In these two critical cases where DO levels prior to treatment were below levels safe for fish, DO levels improved following WHCP treatments. The average decrease in DO among the six 2011 monitoring sites with decreased DO was 0.79 mg/l, and in all cases where DO decreased, it was still well above the Basin Plan minimum of 5.0 mg/l. DBW and USDA-ARS will monitor pre- and post-treatment DO levels for the AIPCP.

In 2013, DBW conducted a pilot study for DO monitoring to assess impacts of water hyacinth and herbicide treatments on DO. DO levels were measured continuously under a water hyacinth mat located along Middle River at Union Point. Data revealed greater fluctuations of DO underneath water hyacinth compared to adjacent open water. Within the hyacinth, the lowest and highest DO concentrations were 1.43 mg/L and 11.76 mg/L, respectively. Whereas, DO ranged from 6.12 mg/L to 9.79 mg/L in open water. Diel (twice-daily) changes in DO were observed, with low DO levels occurring at night or early morning and highest concentrations occurring in the afternoon.

For FAV, experiments conducted by DBW and USDA-ARS in the summer of 2016 indicate that there is little dissolved oxygen under water hyacinth mats even prior to treatment (Madsen, unpublished 2016). In the study, sites were selected from channel-side and backend sloughs, and sondes were used to record dissolved oxygen and temperature every 30 minutes. Sites included control (no herbicide) sites, as well as sites that receive treatments with glyphosate, imazamox, and 2,4-D. Weekly observations and data collection occurred at each site.

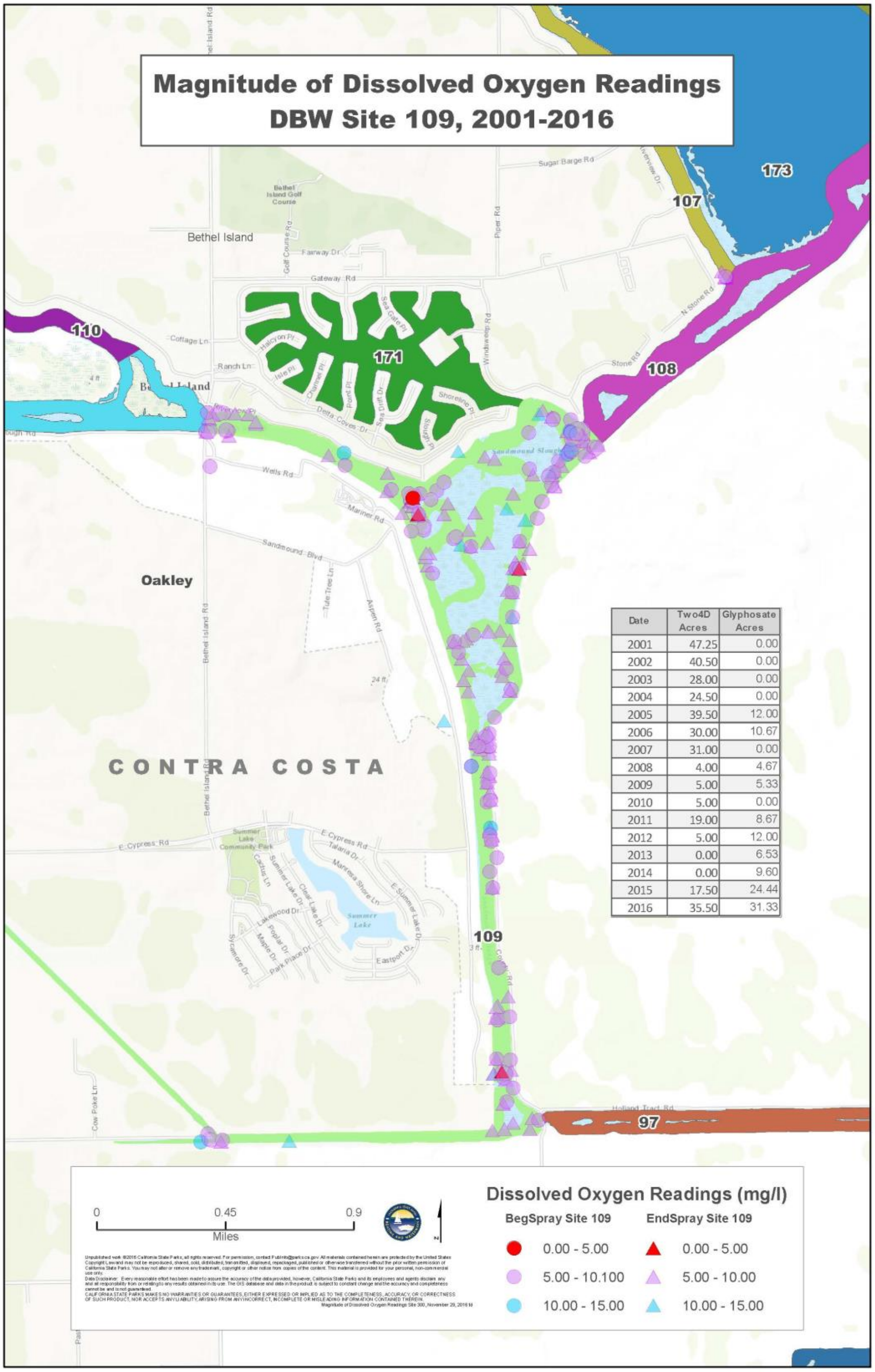
Exhibit 5-11
Comparison of Treatment and Post-Treatment Dissolved Oxygen Levels (in mg/l) (2011)

Site	Days Post Treatment	Treatment DO	Post-Treat DO	Difference (Post-Treatment)
2,4-D Treatments				
13	6	7.18	7.09	(0.09)
14	5	8.46	7.23	(1.23)
15	6	7.74	7.73	(0.01)
16*	6	2.06	7.03	4.97
58	6	7.06	7.15	0.09
59	4	6.92	6.98	0.06
68	6	7.86	7.97	0.11
Glyphosate Treatments				
216	7	9.80	8.40	(1.40)
217	7	7.70	6.18	(1.52)
300	5	8.50	8.00	(0.50)
301*	5	1.07	2.71	1.64
Average increase for five increased DO sites:				1.37
Average decrease for six decreased DO sites:				(0.79)

* Highlighted rows had DO levels harmful to fish prior to WHCP treatments.

Recent research on nontarget impacts of water hyacinth management in the Delta found no significant change in dissolved oxygen levels after herbicide treatment (Donley Marineau, unpublished dissertation 2017). This is further supported by the example in **Exhibit 5-12** that illustrates dissolved oxygen readings before and after herbicide treatment at Site 109 (Sandmound Slough). Exhibit 5-12 illustrates that at Site 109, there were only three measurements in which DO was between 0 and 5 mg/L, one pre-treatment and two immediately post-treatment. DBW has found consistent results at four additional locations that were selected for illustration because they are back-end sloughs with low flow, thus making them good examples of areas where dissolved oxygen might be a concern.

Exhibit 5-12
Magnitude of Dissolved Oxygen Readings at Site 109 (Sandmound Slough), 2001-2016



Date	Two4D Acres	Glyphosate Acres
2001	47.25	0.00
2002	40.50	0.00
2003	28.00	0.00
2004	24.50	0.00
2005	39.50	12.00
2006	30.00	10.67
2007	31.00	0.00
2008	4.00	4.67
2009	5.00	5.33
2010	5.00	0.00
2011	19.00	8.67
2012	5.00	12.00
2013	0.00	6.53
2014	0.00	9.60
2015	17.50	24.44
2016	35.50	31.33

In the history of the DBW aquatic weed control, reductions in DO levels below Basin Plan limits have occurred only infrequently as a result of herbicide treatments, and when they did occur, they were short-lived. Similarly minimal effects are expected from the AIPCP. However, should AIPCP treatments result in violations of the Bay-Delta Plan or Basin Plan water quality objectives for dissolved oxygen, it would constitute an **unavoidable or potentially unavoidable significant impact.** These impacts would potentially be reduced by implementing the following mitigation measure.

- **Mitigation Measure 10** – Monitor dissolved oxygen (DO) levels for all AIPCP treatments and at selected locations in the Delta over time.

  Note, the current dissolved oxygen map summaries are shown in **Exhibits 5-13a** and **5-13b.**

Exhibit 5-13a
AIPCP Dissolved Oxygen Limits – Northern Sites

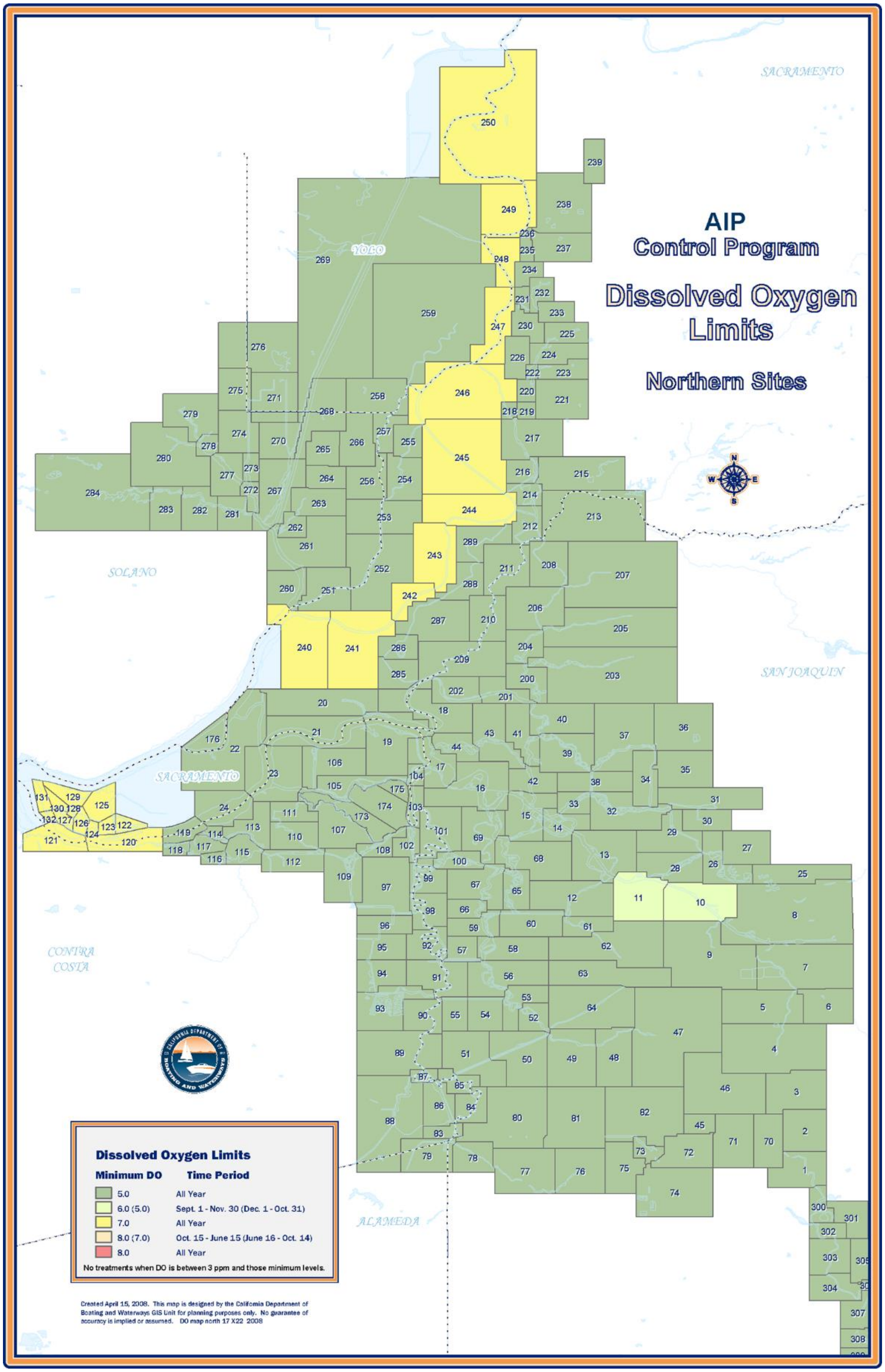
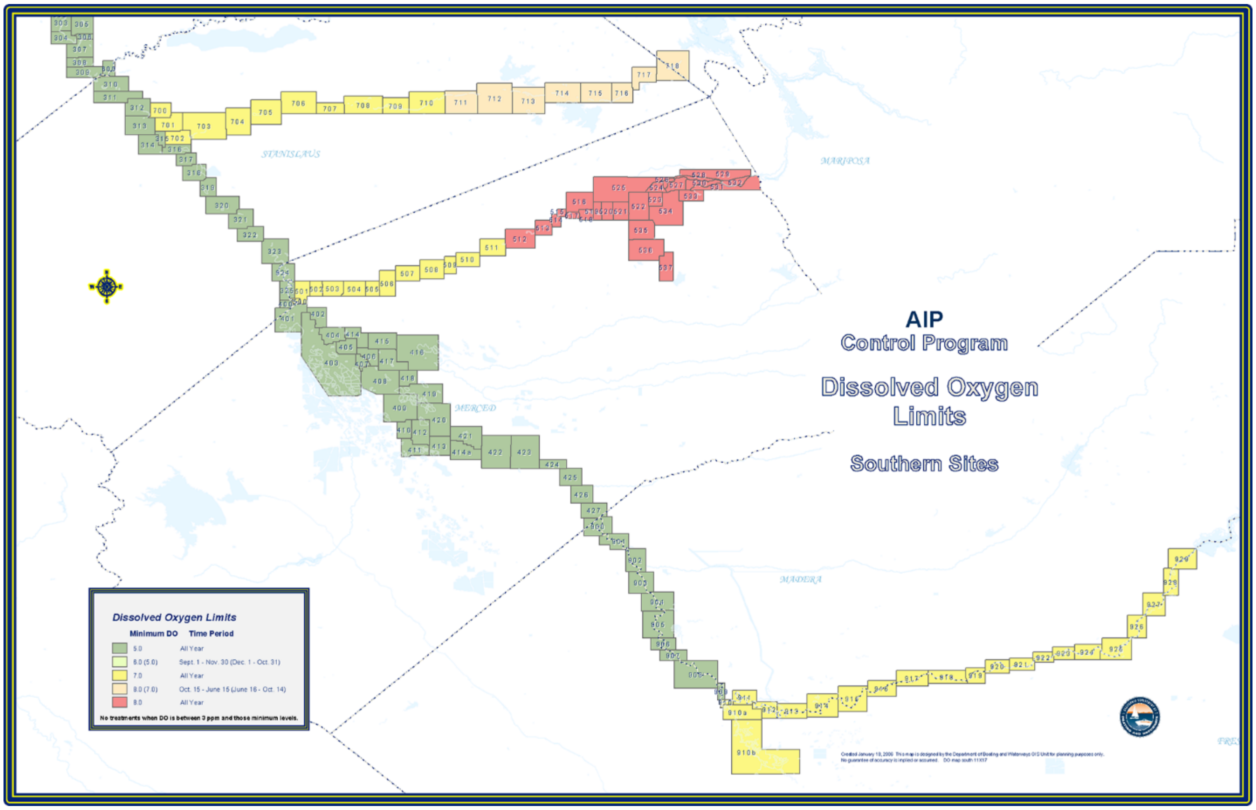


Exhibit 5-13b
AIPCP Dissolved Oxygen Limits – Southern Sites



* * * * *

Impact W5 – Floating material: following AIPCP treatment, waters may potentially contain floating plant fragments in amounts that cause nuisance or adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water quality

Herbicide treatments, hand removal with nets, mechanical harvesting, and herding may break fragments of aquatic invasive plants loose in Delta waterways. These plant fragments could result in a level of unacceptable nuisance or adversely affect beneficial uses. The Basin Plan specifies that *“water shall not contain floating material in amounts that cause nuisance or adversely affect beneficial uses”* (CVRWQCB 2007).

As discussed in Chapter 6, potential negative impacts from floating debris include increasing debris loading at water utility intake facilities and agricultural irrigation intakes. Municipal and domestic supply, industrial service supply, and agricultural supply, are designated beneficial uses of Delta waters.

The potential for plant fragments resulting from AIPCP treatments to result in violations of water quality standards or otherwise substantially degrade water quality is extremely low. However, should aquatic invasive plant debris resulting from the AIPCP cause nuisance or adversely affect beneficial uses, it would represent a significant impact. This impact would be an **avoidable significant impact, reduced to a less-than-significant level by implementing the following three mitigation measures:**

- **Mitigation Measure 11** – Collect plant fragments during and immediately following treatment.
- **Mitigation Measure 15 –** Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities.
- **Mitigation Measure 16** – Notify County Agricultural Commissioners about AIPCP activities.

  Before an application may occur, AIPCP shall file Pesticide Use Recommendations (PUR) and a Notice of Intent (NOI) with the appropriate County Agricultural Commissioner (CAC) office, when required for restricted material or as requested by each county. Each NOI will include the site number, spray dates, locations, and herbicides and adjuvants to be used. NOIs will be submitted before the upcoming treatment week. Based on information in the NOIs, CAC’s could inform land owners of particular periods of time during which irrigation should not occur. If necessary, AIPCP shall also obtain a Restricted Use Permit (RUP) from all appropriate CACs.

Impact W6 – Turbidity: AIPCP treatment may potentially result in changes to turbidity that cause nuisance or adversely affect beneficial uses, violating water quality standards or otherwise substantially degrading water quality

Operation of AIPCP vessels for treatment and monitoring may potentially result in changes in turbidity that violate water quality standards or otherwise substantially degrade water quality. Such turbidity increases could result in nuisance or adversely affect beneficial uses.

The AIPCP operates under the General NPDES permit CAG990005, and the Basin Plan objectives for turbidity. The Basin Plan turbidity objectives are as follows:

“Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

- Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases shall not exceed 1 NTU.
- Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
- Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
- Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

In Delta waters, the general objectives for turbidity apply subject to the following: except for periods of storm runoff, the turbidity of Delta waters shall not exceed 50 NTUs in the waters of the Central Delta and 150 NTUs in other Delta waters. Exceptions to the Delta specific objectives will be *considered when dredging operations can cause an increase in turbidity. In this case, an allowable zone of dilution within which turbidity in excess of limits can be tolerated will be defined for the operation and prescribed in a discharge permit" (CVRWQB 2007).*

DBW analyzed WHCP monitoring results from 2001 to 2005 to determine whether there were statistical differences between water quality parameters before, and after, water hyacinth treatment. In general, there was no statistical evidence that water quality degraded significantly as a result of aquatic herbicide treatments. Similar results are expected from the AIPCP, which will require substantially lower volumes of herbicide treatment than the WHCP.

DBW measured compliance with turbidity requirements by comparing pre-treatment turbidity levels with post-treatment turbidity levels measured at follow-up visits. For the 2001 to 2005 time period, DBW compared pre- and post-treatment turbidity for 352 pairs of samples. In all cases, the WHCP was in compliance with Basin Plan limits for changes in turbidity.

In 2009, 2010, 2011, and 2012, turbidity measurements were all within an acceptable range. However, the data was somewhat unreliable, as DBW experienced difficulties with the monitoring probes. DBW has been working with the manufacturer to address these problems. In 2006, 2007, and 2008, there were a total of 20 occasions and 10 sites for which turbidity levels exceeded basin plan limits. In all but three instances in each year, the exceedances were due to the sampling boat entering areas where it was very shallow, many submerged aquatic plants, agricultural discharges, inputs from more turbid tributaries, wading livestock, or instrument error. In the three other instances each year, there was no recorded explanation for the exceedance in the measured turbidity levels. In most cases, the exceedances occurred on the treatment day, and when the turbidity was measured on the follow-up sampling day, they were again within basin limits. In a few cases, the follow-up turbidity levels were still high. Therefore, if the WHCP was responsible for the turbidity violations, the effects were only temporary and most likely did not have any adverse effects on beneficial uses.

While exceedances in Basin Plan limits may occur within the Delta, it has been and will continue to be difficult to determine whether these exceedances were a result of the WHCP. However, any exceedances that are a result of future AIPCP activities are likely to be short-term. The AIPCP is not likely to result in increases in turbidity that create nuisance or adversely affect beneficial uses. As a result, **the impact of the AIPCP on turbidity is expected to be less than significant.**

This section identified mitigation measures to address five potential impacts to hydrology and water quality. Many of these mitigation measures are intended to reduce more than one potential impact. **Exhibit 5-14** combines and summarizes the hydrology and water quality mitigation measures.

Exhibit 5-14
Summary of Potential Hydrology and Water Quality Impacts and Mitigation Measures

Mitigation Measure Summary[1]	Impacts Applied To
1. Avoid treatment near special status species, and sensitive riparian and wetland habitat; and other biologically important resources	Impact W2: Pesticides Impact W3: Toxicity
3. Minimize potential for drift when applying herbicides	Impact W1: Chemical constituents Impact W2: Pesticides Impact W3: Toxicity
4. Restrict diquat treatments to unforeseen infestations and for no more than one percent of treatment acres in total	Impact W1: Chemical constituents Impact W2: Pesticides Impact W3: Toxicity
5. Operate program vessels in a manner that causes the least amount of disturbance to the habitat	Impact W2: Pesticides Impact W3: Toxicity
7. Monitor herbicide and adjuvant levels to ensure that the AIPCP does not result in potentially toxic concentrations of herbicides in Delta waters	Impact W1: Chemical constituents Impact W2: Pesticides Impact W3: Toxicity
8. Implement an adaptive management approach to minimize the use of herbicides in the long-term	Impact W1: Chemical constituents Impact W2: Pesticides Impact W3: Toxicity
10. Monitor dissolved oxygen (DO) levels pre- and post-treatment for all for all AIPCP treatments and at selected locations in the Delta over time	Impact W4: Dissolved oxygen
11. Collect plant fragments during and immediately following treatments	Impact W5: Floating material
15. Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities	Impact W1: Chemical constituents Impact W2: Pesticides Impact W3: Toxicity Impact W5: Floating Material
16. Notify County Agricultural Commissioners about AIPCP activity	Impact W5: Floating material

[1] Please refer to the text for the complete mitigation measure description.

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Section 6

Utilities and Service Systems and Agriculture and Forestry Resources Impacts Assessment

6. Utilities and Service Systems and Agriculture and Forestry Resources Impacts Assessment

This chapter analyzes effects of the AIPCP on utility and service systems, and agriculture and forestry resources. AIPCP effects on both of these resource areas are likely to be minimal. The chapter is organized as follows:

A. *Utility and Service Systems Impacts Assessment*

B. *Agriculture and Forestry Resources Impacts Assessment.*

For each resource area, the environmental setting is described, followed by the impact analysis and mitigation measures. The environmental setting sections describe the current status of utility and service systems, and agricultural resources, in the Delta. The discussions focus on water utility pumps and agricultural crops, which are areas of potential impact.

The impact analyses sections provide assessments of the specific environmental impacts potentially resulting from program operations. The discussion of impacts utilizes findings from DBW research projects, technical information from government reports, and program experience. The impact assessments are based on technical information.

A. Utilities and Service Systems Impacts Assessment

1. Environmental Setting

<u>Water-Related Infrastructure</u>

Water conveyance infrastructure consists of many agricultural, industrial, and municipal diversions for supplying water to the Delta itself and for export by the SWP and CVP. Diversions and conveyance require canals, waterways, levees, siphons, pumps, radial gates, and other miscellaneous infrastructure. Agricultural diversions are discussed in Section B of this chapter.

Most water conveyance facilities in the Delta have been developed under the authority of the federal government's Central Valley Project (CVP) and California's State Water Project (SWP). As part of CVP development, exportation of water from the Delta began in 1940 with the completion of the Contra Costa Canal. Other major federal units were completed during the early 1950s, including the Delta-Mendota Canal and the Delta Cross Channel (DCC). The DCC transfers water across the Delta from the Sacramento River to the C.W. "Bill" Jones Pumping Plant (formerly the Tracy Pumping Plant), which serves the Delta-Mendota Canal. Numerous SWP facilities have been developed in the Delta, including the Harvey O. Banks Delta Pumping Plant, the California Aqueduct, and the North Bay Aqueduct (NBA). Combined, the CVP and SWP typically export approximately five million acre feet of water annually for agricultural and urban use in Central and Southern California.

The Contra Costa Water District (CCWD) provides water to approximately 500,000 customers in central and eastern Contra Costa County. CCWD operates four intakes that divert drinking water from the Delta, located at Rock Slough, Old River, Victoria Canal, and Mallard Slough. There are power plants in the western Delta, at Antioch and Pittsburg, which utilize Delta waters for cooling. The East Bay Municipal Utility District operates the Mokelumne Aqueduct, providing water to 1.3 million people. Mokelumne Aqueduct pipelines cross through the southern portion of the Delta, but do not pump Delta waters.

Exhibit 6-1 and **Exhibit 6-2** identify major drinking water intake pumps in and near the AIPCP project area. The numbers in Exhibit 6-1 refer to the locations on Exhibit 6-2.

Exhibit 6-1
Delta Drinking Water Intakes

Intake Name	Jurisdiction	Waterbody
1. Barker Slough Intake	Department of Water Resources	Sacramento River and Deep Water Channel
2. Harvey O. Banks Pumping Plant	Department of Water Resources	Clifton Court Forebay
3. C.W. "Bill" Jones Pumping Plant	U.S. Bureau of Reclamation (USBR)	Delta-Mendota Canal
4. Rock Slough Intake	Contra Costa Water District	Rock Slough and Contra Costa Canal
5. Old River Intake	Contra Costa Water District	Old River
6. Mallard Slough Intake Pump Station	Contra Costa Water District and USBR	Mallard Slough and Suisun Bay
7. Victoria Canal Intake	Contra Costa Water District	Victoria Canal
8. Freeport Intake Facility (not shown)	Sacramento County Water Agency and East Bay MUD	Sacramento River
9. Delta Water Supply Project Intake (not shown)	City of Stockton Municipal Utilities District	Ward Cut – Stockton Deep Water Channel

Natural Gas Infrastructure

Natural gas was discovered in the Delta region in 1935 and has since been developed into a significant source and depot for underground storage. Gas fields, pipelines, underground storage areas, and related infrastructure are located in the Delta. Infrastructure consists mainly of pipelines and storage facilities owned by oil and gas companies, public utilities, and various independent leaseholders.

In 2013, there were approximately 233 operating natural gas wells in the Delta and Suisun Marsh (BDCP, Chapter 26 2013). There are more than 25 underground natural gas storage areas located throughout the Delta and surrounding vicinity. Pacific Gas and Electric (PG&E) maintains a storage area under McDonald Island in the Central Delta that provides approximately 33 percent of the peak natural gas supply for the PG&E service area (URS Corporation 2007). In addition, fuel pipelines carry gasoline and aviation fuel from the Bay Area to the Central Valley through the Delta.

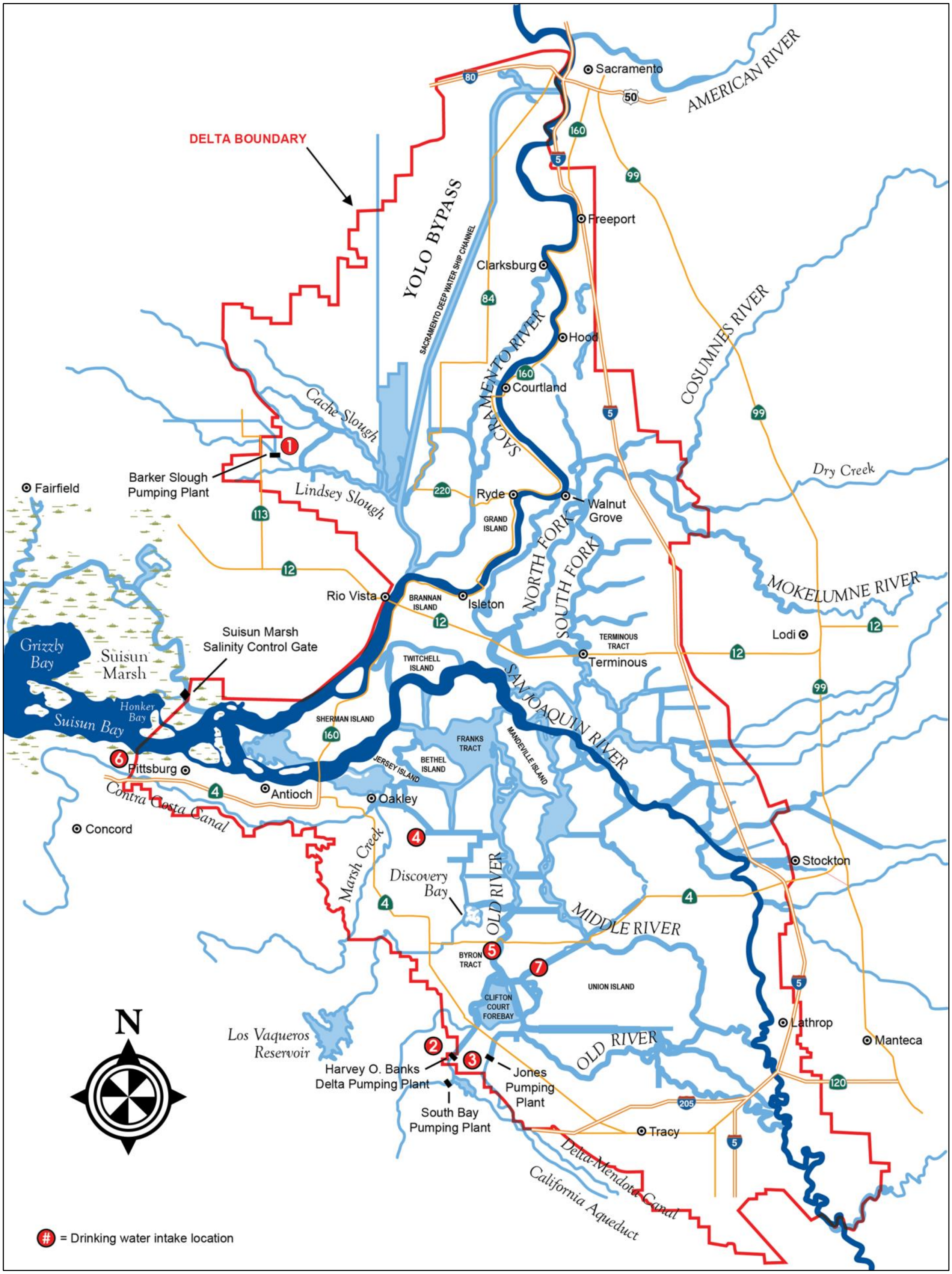
Public Services

Police protection is provided by various departments within the cities and counties of the Delta region. For example, the San Joaquin Sheriff's Department marine patrol division provides water patrol services to approximately 600 square miles of waterways in the Delta area. The Contra Costa County Sheriff's Department provides law enforcement services in the area. Fire protection service is provided by various departments in the Delta area, including the San Joaquin County Delta Fire Protection District and the Contra Costa Fire Protection District. Volunteer firefighters also respond to fire emergencies as needed. Fire suppression in areas not under the jurisdiction of a fire protection district is the responsibility of the landowners. Cities and counties in the region provide emergency services.

Solid Waste and Wastewater Treatment Services

There are over thirty solid waste facilities located in or adjacent to the Delta and Suisun Marsh (URS Corporation 2007). Most facilities are located at the periphery of the Delta. There are thirteen sewage treatment plants located in the Delta region, all located in the periphery, near developed areas (URS Corporation 2007).

Exhibit 6-2
Drinking Water Intakes in the Sacramento-San Joaquin Delta



Electric Utilities and Communication Infrastructure

Power transmission facilities have developed with the population growth of various communities surrounding the Delta. PG&E, Sacramento Municipal Utility District (SMUD), and the Western Area Power Administration have developed and oversee power transmission lines across the Delta islands and waterways. There are more than 500 miles of transmission lines and 60 substations within the Delta boundaries (URS Corporation 2007). Many of the transmission corridors are within the periphery of the Delta upland areas, including several natural gas-fired plants. Communication infrastructure in the region includes underground cable and fiber optic lines, and communication/transmission towers.

2. Impact Analysis and Mitigation Measures

For purposes of this analysis, an impact to utilities and service systems is considered to be significant and require mitigation if it would result in any of significance thresholds listed below. Significance thresholds that are not relevant for the AIPCP are dismissed, as noted below. For those significance thresholds that are not dismissed, the potential impact is described and mitigation measures are identified. The significance thresholds are:

- Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board (dismissed)
- Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities (dismissed)
- Require or result in the construction of new storm water drainage facilities or expansion of existing facilities (dismissed)
- Require new or expanded entitlements for water supply (dismissed)
- Result in a determination by the wastewater treatment provider that it does not have adequate capacity to serve the project (dismissed)
- Exceed permitted landfill capacity (dismissed)
- Result in noncompliance with federal, state, or local statutes and regulations related to solid waste (dismissed)
- Result in problems for local or regional water utility intake pumps.

Exhibit 6-3 provides a summary of the potential AIPCP impact for the one utility and service systems significance area which could potentially be affected. Exhibit 6-3 also explains those utility and service systems significance areas in which there will be no impacts. Potential impacts of the AIPCP on water quality are discussed in Chapter 5.

Impact U1 – Water utility intake pumps: effects of AIPCP treatments on water utility intake pumps

Herbicide and physical treatments may break fragments of aquatic invasive weeds loose into Delta waterways. These plant fragments could increase debris loading at intake facilities. Fragments have the potential to clog water utility intake pumps, requiring additional pump maintenance for affected water agencies.

The potential for plant fragments resulting from AIPCP treatments to cause adverse effects on water utility intake pumps is low. However, should plant debris resulting from the AIPCP clog or damage water utility intake pumps, it would represent a significant impact. This impact would be an **avoidable significant impact, reduced to a less-than-significant level by implementing the following two mitigation measures.**

- **Mitigation Measure 11** – Collect plant fragments during and immediately following treatment.
- **Mitigation Measure 15** – Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities.

Exhibit 6-3
Crosswalk of Utility and Service Systems Significance Criteria and Impacts of the AIPCP

	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?					AIPCP will have no wastewater treatment impacts
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?					AIPCP will not require construction or expansion of water or wastewater treatment facilities
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?					AIPCP will not require construction or expansion of storm water drainage facilities
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?					AIPCP will have no impact on water supplies
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?					AIPCP will have no impact on wastewater treatment capacity
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?					AIPCP will have no impact on landfill capacity. Harvested plants will be placed at approved spoil locations to naturally desiccate
g) Comply with federal, state, and local statutes and regulations related to solid waste?					AIPCP will comply with federal, state, and local statues and regulations related to solid waste
h) Result in problems for local or regional water utility intake pumps?					
Impact U1: Water utility intake pumps	11, 15		X		

B. Agriculture and Forestry Resources Impacts Assessment

1. Environmental Setting

The Delta is an important agricultural area. Farming in the Delta region began in the 1850s, following passage of the Swamp and Overflow Act, and Reclamation District Act, which provided for the sale of swamp and overflow lands for reclamation (DPC January 2001). Early farmers built a system of levees and irrigation ditches, and began growing a variety of vegetables, fruits, and grains. Over time, most farms have shifted from growing diverse crops, to growing a few crops, which are rotated (DPC January 2001). Crops that have been important at various times in the Delta include potatoes, asparagus, pears, and sugar beets. Characteristics that make the Delta well-suited to agriculture include: rich soil, ample water, a long growing season, mild climate, and proximity to end markets (DPC May 2001).

In 2015 California produced over 400 plant and animal commodities worth $47 billion in 2015 and over a third of the country's vegetables and two-thirds of the country's fruits and nuts are grown in California (CDFA 2016). California continues to set the pace for the rest of the nation as the country's largest agricultural producer and exporter (CDFA 2016). In 2015, California exported approximately 26 percent of its agricultural production by volume. In dollar terms, California's agricultural exports reached $20.69 billion for 2015 (CDFA 2016).

Exhibit 6-4 summarizes agricultural acres in Delta counties. In 2010, the Delta region had about 500,000 acres available for agriculture and the total cropped acreage in 2010 was 423,727 acres, not including approximately 38,000 acres of grazing land (DPC 2012). Of the Delta's 500,000 agricultural acres, approximately 80 percent is classified as prime farmland (DPC 2012). Total crop value in 2009 was about $702 million. Across all of California, the economic impact of Delta agriculture is 12,934 jobs, $819 million in value added, and $1.643 billion in output (DPC 2012).

Exhibits 6-5 and **6-6** identify the top ten Delta agricultural crops in 2009, based on annual average gross value, and acreage. These tables illustrate the diversity of agriculture in the Delta, with no single product dominating either acreage or economic output. This data, drawn from the Delta Protection Commission's 2012 Economic Sustainability Plan for the Sacramento-San Joaquin Delta, is the most recent available.

Exhibit 6-4
Total and Agricultural Acres in Delta Counties

County	Total County Acres	Total County Agricultural Acres (2010)	Approximate County Delta Acres	Delta Total Agricultural Delta Acres (in production) (2010)
1. San Joaquin	912,602	737,503	317,778	214,053
2. Yolo	653,452	479,858	91,861	54,986
3. Sacramento	636,083	328,593	118,717	66,428
4. Solano	582,373	358,225	88,071	72,499
5. Contra Costa	514,019	146,933	104,751	48,062
6. Alameda	525,338	204,233	6,422	5,352
Total	3,823,867	2,255,345	727,600	461,380

Sources: USDA Census of Agriculture (www.agcensus.usda.gov); DOC, http://www.consrv.ca.gov; Delta Protection Commission 2012.

Exhibit 6-5
Top Ten Delta Agricultural Crops, Based on 2009 Value

Agricultural Product	Annual Gross Value (in millions of dollars)
1. Processing tomatoes	$117.2
2. Wine grapes	105.0
3. Corn	93.0
4. Alfalfa	66.0
5. Asparagus	50.1
6. Pears	36.7
7. Turf	31.6
8. Potato	28.6
9. Blueberry	25.2
10. Wheat	17.5

Source: Delta Protection Commission 2012

Exhibit 6-6
Top Ten Delta Agricultural Products, Based on 2009 Acreage

Agricultural Product	Delta Irrigated Acres
1. Corn	105,362
2. Alfalfa	91,978
3. Processing tomatoes	38,123
4. Wheat	34,151
5. Wine grapes	30,148
6. Oats	15,847
7. Safflower	8,874
8. Asparagus	7,217
9. Pear	5,912
10. Bean, dried	5,493

Source: Delta Protection Commission 2012

2. Impact Analysis and Mitigation Measures

For purposes of this analysis, an impact to agriculture and forestry resources is considered to be significant and require mitigation if it would result in any of the significance thresholds listed below. Significance thresholds that are not relevant for the AIPCP are dismissed, as noted below. For those significance thresholds that are not dismissed, the potential impact is described and mitigation measures are identified. The significance thresholds are:

- Conflict with existing zoning for agricultural use, or a Williamson Act contract (dismissed)
- Involve other changes in the existing environment which, due to their location or nature, could result in conversion of farmland to non-agricultural use (dismissed)
- Conflict with existing zoning for forest land or timberland (dismissed)
- Result in the loss of forest land or conversion of forest land to non-forest use (dismissed)
- Adversely impact agricultural crops or agricultural operations.

Exhibit 6-7 provides a summary of the potential AIPCP impacts for the one agriculture and forestry resources significance area which could potentially be affected. Exhibit 6-7 also explains those agriculture and forestry resources significance areas in which there will be no impacts.

Exhibit 6-7
Crosswalk of Agriculture and Forestry Resources Significance Criteria and Impacts of the AIPCP

	Mitigation Measures	Unavoidable or Potentially Unavoidable Significant Impact	Avoidable Significant Impact	Less than Significant Impact	No Impact	Beneficial Impact
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?					AIPCP will not convert prime farmland, unique farmland, or farmland of statewide importance to non-agricultural use	
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?					AIPCP will not conflict with existing zoning from agricultural use, or a Williamson Act contract	
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in PRC section 12220 (g)), timberland (as defined by PRC section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?					AIPCP will not conflict with existing zoning or cause rezoning of forest land, timberland, or land zoned Timberland Production.	
d) Result in the loss of forest land or conversion of forest land to non-forest use?					AIPCP will not result in the loss of forest land or conversion of forest land to non-forest use.	
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forestland to non-forest use?					AIPCP will not involve other changes in the existing environment which would result in conversion of farmland to non-agricultural uses or forestland to non-forest use	
d) Adversely impact agricultural crops or agricultural operations, such as irrigation?						Removal of invasive weeds from Delta waterways could reduce clogging of agricultural pumps
Impact A1: Agricultural crops	3, 16, 18		X			
Impact A2: Irrigation pumps	11, 16, 18		X			X

Impact A1 – Agricultural crops: effects of AIPCP herbicide treatments on agricultural crops

There are approximately 1,800 agricultural diversions in the Delta. **Exhibit 6-8** illustrates agricultural diversions in the Delta. During the peak summer irrigation season, diversions from these facilities collectively exceed 5,000 cubic feet per second (URS Corporation May 2007). The AIPCP could adversely impact agricultural crops, since treatments would occur during the irrigation season, and irrigated vegetation might be affected.

AIPCP herbicides could potentially reduce growth or possibly kill crops they contact. DBW follows herbicide label requirements related to irrigation restrictions following herbicide applications.

AIPCP herbicide treatments occurring adjacent to agricultural crops could also result in adverse impacts due to herbicide drift. While there is a potential risk to agricultural crops due to herbicide overspray, the likelihood of such effects is low. Herbicide application will be focused directly on target plants to decrease the possibility that concentrated herbicides would come in contact with agricultural crops. The DBW will follow herbicide label instructions that reduce herbicide drift. These steps include using the largest spray droplets, and lowest spray pressure, that will provide sufficient coverage and control. Furthermore, DBW will follow its established treatment protocols, which prohibits herbicide treatment if winds are greater than 7 to 10 mph (depending on location).

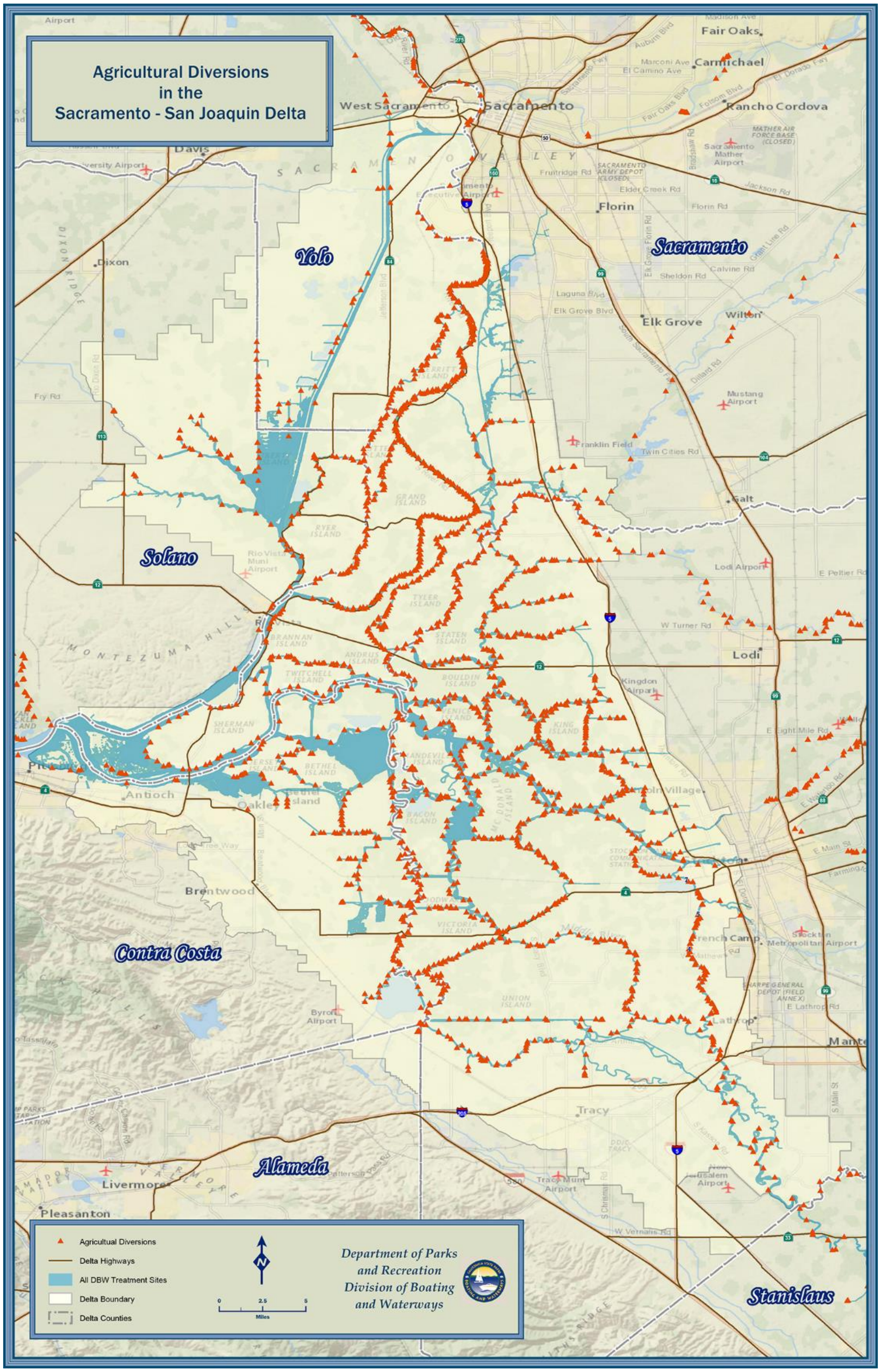
While there is also a potential risk to agricultural crops due to irrigating with water following AIPCP herbicide treatments, the likelihood of such effects is similarly low. Tidal movement and water flow in the Delta promote dilution of AIPCP herbicides.

Should agricultural crops adjacent to AIPCP treatment sites be adversely affected by herbicide drift or irrigation waters containing AIPCP herbicides, it would represent a significant impact. This impact would be an **avoidable significant impact, reduced to a less-than-significant level by implementing the following three mitigation measures.**

- **Mitigation Measure 3** – Minimize potential for drift when applying herbicides.
- **Mitigation Measure 16** – Notify County Agricultural Commissioners about AIPCP activities.
- **Mitigation Measure 18** – Follow the Memorandum of Understanding (MOU) protocol for herbicide applications in Discovery Bay and Indian Slough.

  The MOU is an agreement between the East Contra Costa Irrigation District (ECCID) and DBW. The MOU includes the items described in the following text. Provision of date, location and concentration levels for all treatments in the Discovery Bay and Indian Slough area will be shared with ECCID. Notification by DBW to ECCID of any changes made to the treatment schedule. DBW will provide the ECCID with maps of the treatment areas within Discovery Bay in addition to sonar hydro-acoustic map. Adjust application rates depending on Fluridone residue test results. Any changes in the treatment schedule will be sent to the ECCID contact person prior to the following week's treatment. Provide Fluridone herbicide residue test results to ECCID on a weekly basis. Test results include ECCID canal sampling locations E1 through E7. The test results will be emailed to the ECCID contact person by DBW staff. Application rates may be adjusted depending on Fluridone residue test results. Any changes in the treatment schedule will be sent to the ECCID contact person prior to the following week's treatment. During the treatment period, provide DBW with approximate pumping information pertaining to Station 1 at Bixler on a weekly basis. ECCID will provide DBW with crop information from growers/farmers utilizing water from ECCID (WURF data base) prior to the treatment season or whenever there is a change of crop planting. When available, the ECCID will provide DBW with the planting schedule and maps for farms that plant any crops/vegetables belonging to Solanaceae family. Provide DBW with a set of keys (Waiver agreement or Entry Permit) with access to Bixler headwall for testing purposes.

Exhibit 6-8
Crosswalk of Agriculture and Forestry Resources



Impact A2 – Irrigation pumps: effects of AIPCP treatments on agricultural irrigation

Herbicide or physical treatments may break fragments of aquatic invasive plants lose into Delta waterways. These fragments could increase debris loading at the 1,800 agricultural irrigation intakes located throughout the Delta. Fragments have the potential to clog water agricultural irrigation intakes, requiring additional intake maintenance for affected farmers.

The potential for fragments to cause adverse effects to agricultural irrigation intakes is low. In fact, if left untreated, aquatic invasive plants have the potential to interfere with water pumping at irrigation intakes throughout the Delta. Pumps clogged with aquatic weeds can result in inefficient pumping, increased

pumping costs, and possible mechanical failure of pumps. However, should fragments resulting from the AIPCP clog or damage agricultural irrigation intakes, it would represent a significant impact. This impact would be an **avoidable significant impact, reduced to a less-than-significant level** by implementing the following three mitigation measures.

- **Mitigation Measure 11** – Collect plant fragments during and immediately following treatment.
- **Mitigation Measure 16** – Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities.
- **Mitigation Measure 18** – Follow the Memorandum of Understanding (MOU) protocol for herbicide applications in Discovery Bay and Indian Slough.

This section identified five mitigation measures to address three potential impacts to utility and service systems and agriculture and forestry resources. Two mitigation measures are duplicative, as they each apply to two impacts. **Exhibit 6-9** combines and summarizes the utility and service systems and agriculture and forestry resources mitigation measures.

Exhibit 6-9
Summary of Potential Utility and Service Systems and Agriculture and Forestry Resources Impacts and Mitigation Measures

Mitigation Measure Summary[1]	Impacts Applied To
3. Minimize potential for drift when applying herbicides	Impact A1: Agricultural crops
11. Collect plant fragments during and immediately following treatments	Impact U1: Water utility intake pumps Impact A2: Irrigation pumps
15. Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities	Impact U1: Water utility intake pumps
16. Notify County Agricultural Commissioners about AIPCP activity	Impact A1: Agricultural crops Impact A2: Irrigation pumps
18. Follow the Memorandum of Understanding (MOU) protocol for herbicide applications in Discovery Bay and Indian Slough	Impact A1: Agricultural crops Impact A2: Irrigation pumps

[1] Please refer to the text for the complete mitigation measure description.

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Section 7

Cumulative Impacts Assessment

7. Cumulative Impacts Assessment

This chapter of the Draft PEIR provides an assessment of the AIPCP's potential to contribute to cumulative impacts in the Delta region. Section 15130 of the CEQA guidelines require that an EIR discuss the cumulative impacts of a project when the project's incremental effect is cumulatively considerable.

Section 15355 of the CEQA guidelines defines cumulative impacts as follows: "Cumulative impacts refer to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. The individual effects may be changes resulting from a single project or number of separate projects. The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time."

There are two possible approaches to discussing significant cumulative impacts. The first approach, utilized in this Draft PEIR, is to use a list of past, present, and probable future projects producing related or cumulative impacts. The second approach is to utilize projections in an adopted general plan or planning document. Within the first approach, factors to consider when determining whether or not to assess a related project include: the nature of each environmental resource being examined, location of the project, and type of project.

This chapter identifies related projects, and provides a discussion of potential cumulative impacts. The chapter is organized as follows:

A. *Related Project Summaries*
B. *Assessment of Cumulative Impacts.*

A. Related Project Summaries

There are numerous large and small-scale projects and plans in the Delta related to resource conservation, endangered species, restoration, water conveyance, water quality, and water use. Many of these projects have been in operation for several years, while others are in the early stages of planning and environmental permitting. In developing this summary of past, current, and future projects, we primarily utilized the July 2009, Delta-Mendota Canal/California Aqueduct Intertie EIS, the August 2008, Biological Assessment on the Continued Long-Term Operations of the Central Valley Project and the State Water Project, the Bay Delta Conservation Plan EIR/EIS, the 2013 and 2016 California Water Plan Update, California Natural Resources Agency plans and updates (including DWR and CDFW), the 2016 Final BDCP/California WaterFix EIR/EIS (DWR and USBR 2016a), and other environmental documentation and project summaries.

Most Delta-wide projects are of far greater scope than the AIPCP. For example, several of the projects described in this chapter involve significant Delta-wide operations that will influence Delta hydraulics and fisheries. Below, we describe several present and future planning efforts and projects (not including the AIPCP) with which the AIPCP may potentially contribute to cumulative impacts.

Related Planning Efforts

There are numerous conservation, water quality, and restoration initiatives taking place in the Delta. The Delta Conservation Framework website identifies 17 Delta planning documents that guide the Conservation Framework. The Delta Conservation Framework, in the early stages, will be completed in 2017 and guide Delta conservation efforts to 2050.

There are six key planning efforts that directly intersect the AIPCP, through water, aquatic invasive species, geographically, or some combination of these areas. **Exhibit 7-1** identifies these key plans, provides a brief description, and identifies key areas of intersection. These plans seek to improve water quality and habitat, in alignment with reducing the extent of aquatic invasive species in the Delta and other areas. Within these planning efforts, control of AIS is seen as an ecosystem benefit. Again, the challenge of the AIPCP is to support these control efforts while minimizing the potential for negative impacts on listed species and critical habitat.

Exhibit 7-1
Overview of Six Key California Water, Delta, and AIS Planning Efforts Related to the AIPCP

Page 1 of 4

Plan and Agency	Description	Relationship to AIPCP
California Water Plan Update 2013 (DWR)	DWR's long-standing commitment to regularly assess the state's water management challenges and opportunities; solution oriented strategies for sustainable management of water resources. Complements Water Action Plan. Critical themes: • Commit to Integrated Water Management – includes improved water quality, better flood management, restored and enhanced ecosystems, more reliable water supplies • Strengthen government agency alignment – includes increased coordination, leveraging existing networks, better alignment of planning, policies, regulations • Invest in innovation and infrastructure – includes development of analytical tools, structures and facilities to support human activities and natural infrastructure. Delta-specific components: among the Plan's 10 essential actions are: achieve the coequal goals for the Delta; protect and restore important ecosystems.	• Water quality • Habitat enhancements • Connection to aid players to achieve their goals • Not degrading water quality • Avenue to meet habitat enhancement goals • Water supply reliability
California Water Action Plan 2016 Update (Natural Resources Agency, CDFA, CalEPA)	First released in January 2014, this plan is a roadmap to put California on a path to sustainable water management. The solutions in the plan are intended to strike a balance between the need to provide for public health and safety, protect the environment, and support a stable California economy. The plan supports collaboration between federal, state, local and tribal governments, industry, and NGOs. The plan has three broad objectives: more reliable water supplies, the restoration of important species and habitat, and a more resilient, sustainable managed water resource system. The plan includes ten actions, including two directly related to the AIPCP (achieve the co-equal goals for the Delta and protect and restore important ecosystems).	• Balances public health, environment, economy • Promotes collaboration, including a coordinated approach to managing the Delta. • Develops and implements plans to recover threatened and endangered species in the Delta • Accelerates and implements habitat restoration through California EcoRestore through 15 restoration projects and 30,000 acres. • Supports implementation of near-term Delta ecosystem improvement projects (Yolo Bypass and others) • Supports restoring flows to the San Joaquin River and reintroducing Chinook salmon via the San Joaquin River Restoration Program. • Supports long-range planning (2017 to 2050) through the Delta Conservation Framework.

Exhibit 7-1
Overview of Six Key California Water, Delta, and AIS Planning Efforts Related to the AIPCP *(continued)*

Page 2 of 4

Plan and Agency	Description	Relationship to AIPCP
Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Basin Plan) (SWRCB)	Authorized under the Porter-Cologne Water Quality Control Act, establishes beneficial uses and includes a program of implementation to achieve water quality objectives. The State Water Board is in the process of developing and implementing updates to the Bay-Delta Plan to protect beneficial uses in the Bay-Delta watershed. Phase I of this work involves updating San Joaquin River flow and southern Delta water quality requirements included in the Bay-Delta Plan. The proposed Phase II changes to the Bay-Delta Plan include: new inflow requirements for the Sacramento River, its tributaries, and eastside tributaries to the Delta (the Mokelumne, Calaveras and Cosumnes rivers); new and modified Delta outflow requirements; new requirements for cold water habitat; new and modified interior Delta flow requirements; recommendations for complementary ecosystem protection actions that others should take; and adaptive management, monitoring, evaluation, special study, and reporting provisions. The updates are expected to be adopted in late 2017.	• Establishes water quality objectives to achieve defined beneficial uses for the Bay-Delta. Defines dissolved oxygen and other water quality objectives for the AIPCP.
California Wildlife Action Plan (CDFW)	Updated in 2015, this was the first major revision to the 2005 State Wildlife Action Plan (SWAP). The SWAP was mandated by Congress to receive funding for a State and Tribal Wildlife Grant Program. The plan includes conservation actions that respond to current and future challenges. Strategies focus on restoring ecological function and processes capable of withstanding the stresses imposed by a changing environment. The SWAP employs an ecosystem approach, sets three statewide goals (abundance and richness, enhance ecosystem conditions, and enhance ecosystem functions and processes. It considers species of greatest conservation needs, climate change, and prioritizes conservation targets (seven regions, including the Bay Delta and Central Coast).	• Supports collaboration and partnerships • Invasive plants/animals are identified as one of the pressures (stressors). There are strategies in ten categories that address invasive species. • Identifies species of greatest concern in the Bay Delta • Conservation Strategy 4 (Direct Management) includes “Manage invasive species” • Specific conservation target includes: “By 2025, miles of freshwater emergent wetland where native species are dominant are increased by at least 5% from 2015 miles.

Exhibit 7-1
Overview of Six Key California Water, Delta, and AIS Planning Efforts Related to the AIPCP *(continued)*

Plan and Agency	Description	Relationship to AIPCP
Delta Plan (Delta Stewardship Council)	Finalized in 2013, the Delta Plan was developed by the Delta Stewardship Council (DSC), established in 2009 with the Delta Reform Act. The Act also established the co-equal goals (providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem), and directed that 'covered actions' – plans, programs, and/or projects must be consistent with the Delta Plan. The Plan includes 73 Recommendations and 14 Policies (legal requirements). Next edition of the plan will be completed in 2018. The Plan remains in place, pending conclusion of legal appeals. Following the Delta Stewardship Council's adoption of refined output and outcome performance measures in February 2016, work to implement and further refine the performance measures has occurred, including: data sheet development and updates, external subject matter expert reviews, and a public workshop on the proposed refinements. As a result of the post-February 2016 evaluation process described above, many of the proposed performance measures have undergone significant changes and are currently in the process of environmental review prior to amendment into the Delta Plan. This includes proposed performance measure 4.10 *Prevention and reduction of key nonnative terrestrial and aquatic invasive species in the Delta and Suisun Marsh*. The DSC operates the Delta Plan Interagency Implementation Committee to coordinate and oversee DPC's activities as required by the Delta Reform Act, and facilitate work on the Delta Plan.	Designates six high priority locations in the Delta and Suisun March to protect, restore, and enhance to recover endangered species, rebuild salmon runs, and enhance wildlife habitat. Ecosystem Restoration policies and recommendations call for habitat restoration, prohibits actions that could bring in new exotic species or improve conditions for existing species, and supports prioritization and implementation of actions to control nonnative invasive species. Performance Measures include: • Four Administrative measures: ○ 100% of all proposed actions that have the reasonable probability of introducing, or improving the habitat conditions for, nonnative invasive species have demonstrated that the potential for new introductions of and/or improved habitat conditions for nonnative invasive species have been fully considered and avoided or mitigated in a way that appropriately protects the ecosystem. ○ The Department of Fish and Wildlife develops for consideration by the Fish and Game Commission proposes for new or revised fishing regulations designed to increase populations of listed fish species through reduced predation by introduced sport fish. ○ The Department of Fish and Wildlife and other appropriate agencies prioritize the list of "Stage 2 Actions for Nonnative Invasive Species." ○ The Department of Fish and Wildlife and other appropriate agencies fully implement the 2014 Ecosystem Restoration Program "Conservation Strategy" list for Strategic Goal 5. • One Outcome measure (proposed language for Delta Plan Amendment) ○ Prevention and reduction of kay nonnative terrestrial and aquatic invasive species in the Delta and Suisun Marsh. • Two Outcome measures (current language from the Delta Plan) ○ Progress toward managing aquatic and terrestrial invasive nonnative species in the Delta over the next decade. Long-term animal and plant monitoring surveys will be conducted by the Interagency Ecological Program agencies, the California Department [Division] of Boating and Waterways, the U.S. Department of Agriculture, the San Francisco Estuary Institute, and others. ○ Trends in the spatial distribution and coverage of nuisance nonnative aquatic plants [in the] Delta.

Exhibit 7-1
Overview of Six Key California Water, Delta, and AIS Planning Efforts Related to the AIPCP *(continued)*

Page 4 of 4

Plan and Agency	Description	Relationship to AIPCP
California Aquatic Invasive Species Management Plan Update (2017) (CDFW)	The CAISMP was first released on 2008 and currently being updated by CDFW. The update is intended to identify areas of improved coordination among agencies, address actions that will make the most impact combatting invasive species, identify priorities to support budget requests, and help obtain federal funding. The intent is to develop realistic recommendations with measurable targets, providing more focus than the initial plan. The current draft of the plan includes 66 actions in 8 objective categories, identifies lead agencies, budgets, and funding sources. CDFW has been leading the effort since late 2016, bringing together and coordinating numerous state agencies. The final plan is expected to be completed in January 2018.	DBW and USDA-ARS have been involved in the CAISMP planning effort. Several actions are directly related to DBW and/or USDA-ARS efforts in the Delta, including: • Use online portal to track projects with locations and control methods • Increase programs to monitor sites where AIS are likely to spread both for species new to state and for monitoring spread of existing species to new sites • Develop list of species likely to be introduced and experts on their management • Develop a framework for long-term monitoring of aquatic vegetation in the Delta and beyond areas currently under management • Develop proactive actions that will be helpful with development and implementation of rapid response • Expand acreage DBW is allowed to treat in the Delta as they add more aquatic plant species • Implement aquatic weed control action from the Delta Smelt Resiliency Strategy

Delta Projects

a. Central Valley Project (CVP) and State Water Project (SWP)

All activities within the Delta occur within the context of the CVP and SWP. The CVP and SWP are two major inter-basin water storage and delivery systems that divert and re-divert water from the southern portion of the Delta. Both the CVP and SWP include major reservoirs upstream of the Delta, and transport water via natural watercourses and canal systems to areas south and west of the Delta.

The USBR and DWR operate the CVP and SWP to divert, store, and convey water consistent with applicable law and contractual obligations. The Coordinated Operations Agreement (COA) defines the project facilities and their water supplies, sets forth procedures for coordination of operations, identifies formulas for sharing joint responsibilities for meeting Delta standards, identifies how unstored flow will be shared, sets up a framework for exchange of water and services, and provides for periodic review of the agreement (USBR August 2008). The Operations Criteria and Plan (OCAP) defines the ongoing operations of the CVP and SWP. The USBR prepared a biological assessment for the OCAP in August 2008. In 2008 and 2009, USFWS and NMFS delivered their biological opinions and conference opinions on the proposed long-term operations on the CVP and SWP, concluding that the proposed action would likely jeopardize the continued existence of several threatened and endangered species (see below).

b. Temporary Barriers Project

The DWR has installed temporary barriers in the South Delta in the spring and/or fall for most years since 1991 (DWR June 2008). After the 1991 test project proved successful, the DWR has continued to extend the project. The project consists of up to four rock barriers across South Delta channels. The barriers serve as “fish barriers”, to benefit migrating salmon, or “agricultural barriers”, to increase water levels, water quality, and circulation patterns for agricultural users. The barriers are located at the Head of Old River, Old River near Tracy, Grantline Canal, and Middle River.

A study published in 2011 found the barriers were not associated with decreases in the survival of route-specific or total Delta Chinook salmon or steelhead; in fact, two barriers were associated with an increase in route-specific and overall survival rates (Pope et al. 2011). As part of the Temporary Barriers project, DWR conducts monitoring of fish salvage, Swainson’s hawk, water elevations, water quality, and hydrologic modeling. The AIPCP coordinates AIP treatment activities with DWR as they relate to the temporary barriers.

c. USFWS BO – Reasonable and Prudent Alternative

The USFWS determined in December 2008 that a Reasonable and Prudent Alternative (RPA) is necessary for the protection of delta smelt (USBR June 2009). The RPA includes measures to: (1) prevent/reduce entrainment of delta smelt at Jones and Banks Pumping Plants; (2) provide adequate habitat conditions that will allow the adult delta smelt to successfully migrate and spawn in the Bay-Delta; (3) provide adequate habitat conditions that will allow larvae and juvenile delta smelt to rear in the Bay-Delta; (4) provide suitable habitat conditions that will allow successful recruitment of juvenile delta smelt to adulthood; and (5) monitor delta smelt abundance and distribution by continued sampling programs through the IEP. The RPA is comprised of the following actions:

- **Action 1:** To protect pre-spawning adults, exports would be limited starting as early as December 1st (depending on monitoring triggers) so that the average daily Old and Middle River (OMR) flows is no more negative than -2,000 cfs for a total duration of 14 days.
- **Action 2:** To further protect pre-spawning adults, the range of net daily OMR flows will be no more negative than -1,250 to -5,000 cfs (as recommended by smelt working group) beginning immediately after Action 1 is needed.
- **Action 3:** To protect larvae and small juveniles, the net daily OMR flows will be no more negative than -1,250 to -5,000 cfs (as recommended by smelt working group) for a period that depends on monitoring triggers (generally March through June 30th).
- **Action 4:** To protect fall habitat conditions, sufficient Delta outflow will be provided to maintain an average X2 for September and October no greater (more eastward) than 74 km (Chipps Island) in the fall following wet years and 81 km (Collinsville) in the fall following above normal years.

- **Action 5:** The head of Old River barrier will not be installed if delta smelt entrainment is a concern. If installation of the head of Old River barrier is not allowed, the agricultural barriers would be installed as described in the Project Description (of the OCAP BA).
- **Action 6:** A program to create or restore a minimum of 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh will be implemented within 10 years. A monitoring program will be developed to focus on the effectiveness of the restoration program (USBR July 2009, 6-4). DWR is evaluating restoration under the BO. Many of the locations may require AIP control. The AIPCP and DWR are collaborating on this effort.

d. NMFS BO – Reasonable and Prudent Alternative

The National Marine Fisheries Service (NMFS) determined (June 2009) that an RPA was necessary for the protection of salmon, steelhead, and green sturgeon (USBR July 2009). The RPA includes measures to improve habitat, reduce entrainment, and improve salvage, through both operational and physical changes in the system. Additionally, the RPA includes development of new monitoring and reporting groups to assist in water operations through the CVP and SWP systems and a requirement to study passage and other migratory conditions. The more substantial actions of the RPA include:

- Providing fish passage at Shasta, Nimbus, and Folsom Dams
- Providing adequate rearing habitat on the lower Sacramento River and Yolo Bypass through alteration of operations, weirs, and restoration projects
- Engineering projects to further reduce hydrologic effects and indirect loss of juveniles in the interior Delta
- Technological modifications to improve temperature management in Folsom Reservoir.

Overall the RPA is intended to avoid jeopardizing listed species or adversely modifying their critical habitat, but not necessarily achieve recovery. Nonetheless, the RPA would result in benefits to salmon, steelhead, green sturgeon and other fish and species that use the same habitats (USBR July 2009, 6-5).

Since the issuance of the initial RPA, NMFS has convened independent review panels to present and discuss technical reports, develop lessons learned, incorporate new science, and make appropriate adjustments to the 2009 RPA.

e. Delta Conservation Framework

The California Department of Fish and Wildlife is working with federal, state, and local agencies, and the Delta stakeholder community to develop a high-level conservation framework for the Sacramento-San Joaquin Delta, Yolo Bypass and Suisun Marsh. Building on prior Delta planning efforts, the *Delta Conservation Framework* will serve as the long-term continuation of California EcoRestore a recent California Natural Resources Agency led Delta restoration implementation initiative. The public draft Delta Conservation Framework was released in September 2017 and will guide Delta conservation efforts to 2050 (CDFW 2017).

f. Delta Stewardship Council (DSC) Delta Plan

In November 2009, the California legislature enacted the Sacramento-San Joaquin Delta Reform Act of 2009 as part of SBX71. This act established the Delta Stewardship Council, which was tasked with developing and implementing a legally enforceable, long-term management plan for the Delta. In 2012, the Delta Stewardship Council released the Delta Plan which includes 87 policies and recommendations aimed at achieving the State's coequal goals. The Council unanimously adopted the plan in May 2013, and the legally enforceable regulations became effective on September 1, 2013.

As of 2017, the DSC is developing three updates to the Delta Plan: 1) conveyance, storage, and operations; 2) Delta levees investment strategy; and performance measures. Exhibit 7-1 further describes the Delta Plan and its relationship to the AIPCPC. The AIPCP will be submitting a certificate of consistency, per Water Code Section 85225, to certify consistency with the Delta Plan.

g. Sacramento-San Joaquin Delta Conservancy Strategic Plan

The Delta Conservancy was created as a primary state agency to implement ecosystem restoration in the Delta and to support efforts that advance environmental protection and the economic well-being of Delta residents. In July 2017 the Delta Conservancy approved its 2017-2022 Delta Conservancy Strategic Plan, which acts as a roadmap for enhancing the Delta's ecosystem and economy and build off past successes to carry the Conservancy's mission forward during the next five years. The three strategic goals of the plan are: 1) Delta agricultural and economic enhancement; 2) Delta ecosystem viability; and 3) Conservancy organizational strength and sustainability.

h. Delta Smelt Resiliency Strategy (DSRS)

The DSRS was developed as a comprehensive strategy to improve conditions for the endangered Delta smelt. The DSRS is a joint state and federal effort. The DSRS was released in July 2016. In June 2017, DBW began implementing SAV control at two locations (Decker Island and Little Hastings Tract) in support of the DSRS. DWR and DBW are planning for coordinated SAV control in support of the DSRS in future years. The 2017 Progress Report summarizes a number of additional actions that occurred during the first year of the DSRS, including: North Delta food web adaptive management projects, outflow augmentation, reoperation of the Suisun Marsh salinity control gates, spawning habitat augmentation, sedimentation supplementation in the low salinity zone, roaring river distribution system food production, coordinating managed wetland flood and drain operations in Suisun Marsh, adjusting fish salvage operations during summer and fall, stormwater discharge management, Rio Vista Research Station and Fish Technology Center, near-term Delta smelt habitat restoration, and the Franks Tract restoration feasibility study (CNRA 2017a).

Franks Tract is considered to be suitable for low-salinity habitat for Delta smelt. CDFW is conducting a feasibility study for restoring the flooded island to reduce invasive aquatic weeds and predation, increase turbidity, and increase fish food production. The Metropolitan Water District of Southern California is conducting an engineering feasibility study, and DWR is conducting additional hydrodynamic modeling to evaluate changes in circulation patterns and effects on turbidity and water quality (CNRA 2017a). The AIPCP has conducted SAV treatments in portions of Franks Tract in most years since 2007.

i. Sacramento Valley Salmon Resiliency Strategy

Parallel to the DSRS, the Natural Resources Agency released the Sacramento Valley Salmon Resilience Strategy to address near- and long-term needs of Sacramento River runs, focusing primarily on the endangered winter-run Chinook salmon, threated Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead. Actions in the strategy are focused on reducing specific risks to salmon and steelhead at different stages of their migratory lives. Actions within the Delta include: restoring off-channel rearing, streambank, and riparian habitats and migratory conditions along the upper/middle/lower reaches of the Sacramento River; completing fish screen construction on major diversions along the Sacramento River; improving Yolo bypass adult fish passage, increasing juvenile salmonid access to Yolo bypass and increasing duration and frequency of Yolo bypass floodplain inundation; constructing a permanent Georgiana Slough non-physical barrier; and restoring tidal habitat in the Delta (CNRA June 2016b).

j. Central Valley Flood Protection Plan

The Central Valley Flood Protection Act of 2008 directed DWR to prepare the Central Valley Flood Protection Plan (CVFPP). The CVFPP is a flood management planning effort that addresses flood risks and ecosystem restoration opportunities in an integrated manner while concurrently improving ecosystem functions, operations and maintenance practices, and institutional support for flood management. It proposes a systemwide approach to flood management for the areas currently protected by facilities of the State Plan of Flood Control (SPFC). Under this approach, California will prioritize investments in flood risk reduction projects and programs that incorporate ecosystem restoration and multi-benefit projects. The CVFPP was adopted by the Central Valley Flood Control Board on June 29, 2012.

The CVFPP proposes a system-wide approach to address, among others the following issues: 1) physical improvements in the Sacramento and San Joaquin River basins; 2) urban flood protection; 3) small community flood protection; 4) rural/Agricultural area flood protection; and 5) ecosystem restoration opportunities (DWR 2013).

The 2017 Central Valley Flood Protection Plan Update was finalized in August 2017. The four primary themes of the 2017 update are: development of partnerships through robust stakeholder engagement, integration with broader water resource objectives, identification of policy issues and recommended actions to resolve them, and establishing stable funding to manage the flood system (DWR 2017b).

k. Stockton Deep Water Ship Channel Dissolved Oxygen Aeration Facility

The Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project was a multi-year study of the effectiveness of elevating dissolved oxygen (DO) concentrations in the channel. DO concentrations drop as low as 2 to 3 milligrams per liter (mg/L) during warmer and lower water flow periods in the San Joaquin River. The low DO levels can adversely affect aquatic life including the health and migration behavior of anadromous fish (e.g., salmon).

The objective of the study was to maintain DO levels above the minimum recommended levels specified in the State of California Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River basins. The aeration system is designed to be operated only when channel DO levels are below the Basin Plan DO water quality objectives (approximately 100 days per year) (DWR 2014d). DO levels in the Stockton Deep Water Ship Channel have improved since implementation of the aeration system, but are not consistently meeting water quality standards (USEPA 2015).

l. California WaterFix

This major collaborative planning effort is led by the California Department of Water Resources (DWR), California Department of Fish and Wildlife (CDFW), State Water Resources Control Board (SWB), U.S. Bureau of Reclamation (USBR), U.S. Fish and Wildlife Services (USFWS), and National Marine Fisheries Service (NMFS) (BDCP, 2013). Several water agencies, environmental organizations, and other organizations are also involved. In early 2008, Governor Schwarzenegger initiated this collaborative planning effort, initially through the Bay Delta Conservation Plan (BDCP). The “purpose of the BDCP is to help recover endangered and sensitive species and their habitats in the Delta in a way that will also provide for sufficient and reliable water supplies” (DWR March 2008). The BDCP examined four water conveyance and physical habitat restoration alternatives for the Delta, including a peripheral aqueduct or tunnel from the Sacramento River to the south Delta. On July 25, 2012, California Governor Edmund G. Brown Jr., Secretary of the Interior Ken Salazar, and NOAA Assistant Administrator for Fisheries Eric Schwaab outlined revisions to the proposed BDCP that, along with a range of alternatives, underwent public environmental review. The revised proposal for a peripheral tunnel included fewer water intake facilities (three versus five), and lower total water capacity (9,000 cfs versus 15,000 cfs) than earlier proposals (CNRA July 2012). The draft BDCP and corresponding EIR/EIS was released for 120 days of formal public review in December 2013. On April 30, 2015, State and Federal lead agencies announced the proposal of a modified conveyance facility with a different regulatory approach for gaining necessary permits and authorization. A Draft EIR/Supplemental Draft EIS for the “twin tunnels”, Alternative 4A (now known as California WaterFix), was made available for review in late 2015, and the final BDCP/California WaterFix EIR/EIS was completed in December 2016.

California WaterFix (Alternative 4A) is the state’s plan to upgrade outdated infrastructure in the Sacramento-San Joaquin Delta (Delta) to secure California’s water supplies and improve the Delta’s ecosystem. The proposal involves construction of three new intakes, each with a maximum diversion capacity of 3,000 cubic feet per second, on the east bank of the Sacramento River. Each intake site would employ state-of-the-art on-bank fish screens and, although the diversions would be located outside of the main range for delta and longfin smelt, the fish screens would be designed to meet delta smelt criteria. Two 40- foot-wide underground pipelines would carry the diverted water by gravity flow approximately 30 miles to the expanded Clifton Court Forebay, where two pumping plants would be constructed to maintain optimal water levels in the forebay for the existing State Water Project (SWP) and Central Valley Project (CVP) pumping facilities.

Over the last ten years the project has made significant progress, with 2016 marking completion of the environmental review documents. On December 22, 2016, the final environmental analysis for California WaterFix (Alternative 4A) were made available. The project’s Lead Agencies — the California Department of Water Resources and U.S. Bureau of Reclamation — identified WaterFix as the preferred alternative to modernize California’s primary water delivery system, guard against water supply disruptions, and improve conditions for threatened and endangered fish.

In January 2017, the Delta Stewardship Council's Delta Science Program conducted the Aquatic Science Peer Review Phase 2B, representing an independent scientific evaluation of draft sections of U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions on California WaterFix for all federal Endangered Species Act (ESA)-listed aquatic species and their critical habitat. On June 26, 2017, California WaterFix received authorization under the U.S. Endangered Species Act when USFWS and NMFS issued biological opinions for the proposed project. The biological opinions allow WaterFix to continue moving toward construction as early as 2018. Both biological opinions found the construction and operations of WaterFix as proposed would not jeopardize the continued existence of ESA-listed species or destroy or adversely modify critical habitat for those species. These biological opinions will also be considered by permitting agencies, including the State Water Resources Control Board in its hearing now underway on a petition by DWR and the U.S. Bureau of Reclamation to allow for the change in points of diversion to add three new intakes on the Sacramento River as part of WaterFix.

m. California EcoRestore

California EcoRestore is a California Natural Resources Agency initiative implemented in coordination with state and federal agencies to advance the restoration of at least 30,000 acres of Delta habitat by 2020. EcoRestore is pursuing habitat restoration projects with clearly defined goals, measurable objectives, and financial resources. The program has identified 27 projects, distributed as follows:

- 3,500 acres managed wetland creation
- 9,000 acres tidal and sub-tidal habitat restoration
- 1,000+ acres Proposition 1 and 1E funded restoration projects
- 17,500+ acres floodplain restoration.

n. Sacramento River and Stockton Deep Water Ship Channels

The Sacramento River Deep Water Ship Channel provides a deep-draft channel from Suisun Bay to an inland harbor at Washington Lake, west of the Sacramento River in the City of West Sacramento. The Stockton Deep Water Ship Channel extends from Suisun Bay into the San Joaquin River and ends at the turning basin in the City of Stockton, a distance of 43 miles. The John F. Baldwin Ship Channel extends from the Golden Gate to Chipps Island (in Suisun Bay).

The U.S. Army Corps of Engineers solicits bids annually for maintenance dredging in the Sacramento River and Stockton Deep Water Ship Channels. The U.S. Army Corps of Engineers is also preparing a feasibility study and EIS/EIR for deepening the existing 35-foot channel from the San Francisco Bay to the Port of Stockton to between 40 and 45 feet (USACE 2014).

o. San Joaquin River Restoration Program (SJRRP)

The SJRRP will implement the San Joaquin River litigation settlement involving the Natural Resources Defense Council (NRDC), Friant Water Users Authority, the Department of Interior, and NMFS (SJRRP 2007). The program is being implemented by the Bureau of Reclamation, USFWS, NMFS, DWR, and DFG. The goals of the program are to restore and maintain fish populations in "good condition" on the main stem of the San Joaquin River below Friant Dam, and to the confluence of the Merced River, and to reduce or avoid adverse water supply impacts to Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the settlement.

Federal legislation to fund the SJRRP was signed in March 2009, and the final Programmatic Environmental Impact Statement/Report was issued in July 2012. The settlement involves operation and maintenance of an interim hatchery facility, adjacent to the San Joaquin River Fish Hatchery, by the CDFW. The program will include developing and maintaining a genetically diverse brood stock of spring-run and, potentially, fall-run Chinook salmon through specified releases from Friant Dam to support migration and emigration. Interim flows began in fall 2009. The project also includes structural and channel improvements. Total costs are expected to range from $250 million to $800 million. The Program is implementing a range of initiatives aimed at restoring flows to the San Joaquin River in support of a self-sustaining Chinook salmon population. The project area falls within potential AIPCP treatment sites currently managed by Merced and Fresno Counties.

p. Suisun Marsh Habitat Management, Preservation, and Restoration Plan

A charter group consisting of members from the Bureau of Reclamation, USFWS, CDFW, DWR, the California Bay-Delta Authority, and the Suisun Resource Conservation District developed a management plan to restore 5,000 to 7,000 acres of tidal wetlands and enhance existing seasonal wetlands in Suisun Marsh (USBR June 2009). The plan was completed in 2014, will be implemented over 30 years, and is expected to contribute to the recovery of many terrestrial and aquatic species. The Record of Decision for the Final EIS/EIR for the plan, signed in April 2014, evaluated the 30-year plan to address use of resources within the approximately 52,000 acres of wetland and upland habitats in Suisun Marsh. The plan's objective is to achieve a multi-stakeholder approach to the restoration of tidal wetlands and the enhancement of managed wetlands and their functions (DWR 2014e). The Plan creates a framework for a broad partnership to restore 5,000 to7,000 acres of the marsh to tidal wetlands and enhance and protect more than 40,000 acres of managed wetlands (USBR 2014).

q. Fish Restoration Program Agreement

The Fish Restoration Program Agreement (FRPA), was signed between the CDFW and DWR in 2010 in order to address specific habitat restoration requirements of the USFWS and the NMFS Biological Opinions for SWP and CVP operations (DWR 2014c). FRPA is also intended to address the habitat requirements of the CDFW Longfin Smelt Incidental Take Permit (ITP) for SWP Delta operations.

The primary objective of the FRPA program is to implement the fish habitat restoration requirements and related actions of the Biological Opinions and the ITP in the Delta, Suisun Marsh, and Yolo Bypass and is focused on 8,000 acres of intertidal and associated subtidal habitat to benefit delta smelt, including 800 acres of mesohaline habitat to benefit longfin smelt, and a number of related actions for salmonids. The USFWS Biological Opinion allows DWR 10 years to implement the restoration of the required 8,000 acres. DWR and CDFW submit annual reports to USFWS and NMFS on the Fish Restoration Program. The most recent report, in April 2017, summarized progress on restoration efforts at Prospect Island, Decker Island, Bradmoor Island, Winter Island, Tule Red Tidal Habitat restoration, and several other related activities (DWR and CDFW 2016).

r. Sacramento Area Flood Control Agency (SAFCA) Flood Management Program

The Sacramento Area Flood Control Agency (SAFCA) Flood Management Program includes studies, designs, and construction of flood control improvements. In the South Sacramento area, SAFCA projects include the South Sacramento Streams Project and the Sacramento River Bank Protection Project.

The South Sacramento Streams Project consists of levee, floodwall, and channel improvements starting south of the town of Freeport along the Sacramento River to protect the City of Sacramento from flooding associated with Morrison, Florin, Elder, and Unionhouse creeks.

The Sacramento River Bank Protection Project, which is implemented and funded primarily through the U.S. Army Corps of Engineers, addresses long-term erosion protection along the Sacramento River and its tributaries. Bank protection measures typically consist of large angular rock placed to protect the bank, with a layer of soil/rock material to allow bank re-vegetation.

Existing Urban and Agricultural Pesticide Runoff

As discussed, the Delta is an important agricultural area. Fertilizers, pesticides, and herbicides are commonly used for crop yield optimization and crop quality protection. Pesticides and herbicides are designed to naturally break down to innocuous compounds; however, leaching of these chemical compounds into groundwater or surface water can be problematic for wildlife and water quality (DWR and Reclamation 2016). The wide variety of pesticides that has been applied, the numerous crops grown in the region, and the fact that predominant land use across the Delta supports agriculture indicate that persistent pesticides that have been widely applied (e.g., organochlorines) are likely to be found in the soils and potentially sediment throughout the Delta. The impact of agricultural practices in the Delta are substantial, and have become part of the economic and ecological landscape of the Delta. (DWR and Reclamation 2016).

A study funded through CALFED (Hoogeweg et al. 2011) developed a comprehensive simulation model to evaluate pesticides in the Delta as compared to co-occurrence of species of concern between 2000 and 2009. The study evaluated 38 pesticides identified by the CVRWQB as those of highest risk to aquatic life, focusing on pyrethrins and organophosphates. None of the 38 pesticides evaluated are utilized by AIPCP, WHCP or EDCP. Using a broader watershed approach covering the Sacramento River, San Joaquin River, and Bay-Delta. In the time period studied (2000-2008), 11,194,069 pounds of the high risk pesticides were applied, of which an average of 14.2% (1,589,558 pounds of a.i.) would be expected to reach Delta waters when considering runoff, erosion, discharge, and drift, according to the model (Hoogeweg et al. 2011).

The Hoogeweg study quantified toxicity thresholds (using risk quotients) for the 38 pesticides, and identified time and location of likely incidents (i.e. when estimated pesticide levels exceeded toxicity thresholds). The areas with greatest potential for concern within the Delta were the southern Delta estuary in San Joaquin County, and the confluence of the Cosumnes River, Dry Creek, and the Mokelumne River. Hoogeweg et al. also evaluated 30,000 water quality testing records from the same time period (2000 to 2009) and found that approximately 75 percent of the 250 testing locations had exceeded toxicity thresholds at least once, and as many as 185 times. This study illustrates the high degree of pesticide loading to Delta waters, with significant quantities of higher-toxicity pesticides, far exceeding the herbicide risk and use of AIPCP.

The remainder of this subsection describes three types of information important for understanding baseline pesticide ingredients in Delta waters: reported herbicide loading through the California Department of Pesticide Regulation (CDPR) Pesticide Use Reporting (PUR) database, modeled runoff and drift coefficients, and actual monitoring concentration data from the California Environmental Data Exchange Network (CEDEN).

Exhibit 7-2 presents CDPR PUR data of the pounds of AIPCP herbicide active ingredient (a.i.) applied in 2015 the six counties of the Delta. Note that these loading data include herbicides from all reported sources (including agriculture) and all locations within each county, including beyond the treatment area. A portion of these pounds of herbicide may be expected to reach the Delta water through runoff, erosion, discharge and drift, as described below.

By comparison, DBW applied 25,527 pounds of a.i. for aquatic weed control in 2015; this figure is included in the six-Delta county total on the exhibit. Loading from the DBW weed control programs in 2015 therefore constituted 1.8% of the six-Delta county total of 1,453,015 pounds of a.i. for AIPCP herbicides only, and 0.1% of the six-Delta county total of 24,150,544 pounds of a.i. for all pesticides.

Exhibit 7-3 presents CDPR PUR data of the pounds of AIPCP herbicide a.i. applied in 2015 in the five counties surrounding the Delta. Note that these loading data include herbicides from all reported sources (including agriculture), and that these counties are outside of the legal Delta, but include tributaries that are within the AIPCP treatment area. Note that only a small fraction of these counties is part of the AIPCP project area. A portion of these pounds of herbicide may be expected to reach the Delta water through runoff, erosion, discharge and drift, as described below.

Exhibit 7-2
Herbicide Loading (Pounds of A.I.) Applied by All Herbicide Users in the Six Counties of the Delta in 2015

	Alameda	Contra Costa	Sacramento	San Joaquin	Solano	Yolo	6 Counties in the Delta
2,4-D	495	2,526	19,152	31,082	15,476	14,990	83,721
Carfentrazone-ethyl	36	159	419	1,413	316	410	2,753
Diquat dibromide	1,239	668	5,304	514	170	342	8,238
Endothall, dipotassium salt	19	58	227	178	389	104	975
Florpyrauxifen-benzyl	0	0	0	0	0	0	0
Flumioxazin	254	449	1,589	5,783	1,032	1,875	10,983
Fluridone	3	2,712	320	1,416	63	22	4,536
Glyphosate	48,621	68,096	217,168	553,078	167,564	285,794	1,340,321
Imazamox, ammonium salt	0	10	52	89	36	148	334
Imazapyr, isopropylamine salt	247	130	5	99	94	75	650
Penoxsulam	5	5	100	119	34	243	505
Pounds of A.I. (AIPCP herbicides only)	**50,920**	**74,813**	**244,335**	**593,770**	**185,175**	**304,003**	**1,453,015**
Pounds of A.I. (all other non-AIPCP herbicides/pesticides)	305,389	505,544	4,535,130	12,220,782	1,265,933	3,864,751	22,697,529
Total Pounds of A.I. (all herbicides/pesticides)	**356,310**	**580,357**	**4,779,465**	**12,814,552**	**1,451,108**	**4,168,753**	**24,150,544**

Exhibit 7-3
Herbicide Loading (Pounds of A.I.) Applied by All Herbicide Users in the Five Counties Surrounding the Delta in 2015

	Fresno	Madera	Merced	Tuolumne	Stanislaus	5 Counties around the Delta
2,4-D	49,471	19,070	25,921	74	37,268	131,805
Carfentrazone-ethyl	1,094	618	1,471	2	878	4,062
Diquat dibromide	6,859	671	1,383	28	128	9,070
Endothall, dipotassium salt	6,312	106	7,982	0	2,607	17,006
Florpyrauxifen-benzyl	0	0	0	0	0	0
Flumioxazin	16,416	8,007	4,255	76	3,666	32,421
Fluridone	7	0	0	7	11	25
Glyphosate	1,735,870	854,263	766,095	18,514	655,563	4,030,306
Imazamox, ammonium salt	218	16	191	2	59	485
Imazapyr, isopropylamine salt	242	12	6	960	54	1,274
Penoxsulam	636	670	423	79	151	1,958
Pounds of A.I. (AIPCP herbicides only)	**1,817,126**	**883,434**	**807,728**	**19,741**	**700,384**	**4,228,413**
Pounds of A.I. (all other non-AIPCP herbicides/pesticides)	35,729,701	10,411,345	9,308,058	30,557	7,382,961	62,862,622
Total Pounds of A.I. (all herbicides)	**37,546,827**	**11,294,779**	**10,115,786**	**50,298**	**8,083,345**	**67,091,035**

Exhibit 7-4
Pesticide Residues in Water Samples in the 11 Counties In and Surrounding the Delta (2011 to 2016)

Rank	Pesticide*	Number of Positive Samples
1	Diuron	475
2	Chlorpyrifos	383
3	Bifenthrin*	346
4	Cyhalothrin	282
5	DDE(p,p') (DDT metabolite)	271
6	Esfenvalerate/Fenvalerate*	201
7	Diazinon, Total	187
8	Cyfluthrin*	177
9	Cypermethrin*	177
10	Permethrin*	155
11	Deltamethrin/Tralomethrin*	150
12	DDD(p,p') (DDT metabolite)	134
13	Simazine	120
14	Malathion	108
15	Dieldrin	98
47	Glyphosate	53
64	Fluridone	37
114	Diquat	12
157	Penoxsulam	2

* Pyrethroid pesticides

Finally, water quality monitoring data provide baseline herbicide concentrations in the Delta. There are a number of water quality monitoring programs that measure pesticide concentrations in the Delta and surrounding waterways, including: Delta Regional Monitoring Program, Sacramento River Watershed Program, Sacramento-San Joaquin River Delta Data, San Joaquin River Restoration Program, Irrigated Lands Regulatory Program, and Surface Water Ambient Monitoring Program (SWAMP). Results of these sampling programs are available on the California Environmental Data Exchange Network (CEDEN).

Exhibit 7-4 summarizes CEDEN sampling data in the eleven AIPCP counties from 2011 through 2016. Over the seven-year period, the programs conducted over 86,000 herbicide sampling events resulting in 7,882 positive samples (9.2 percent) for 172 different chemicals. A positive sample means that the sample contained detectable quantities of the herbicide, but not necessarily quantities above water quality or toxicity thresholds. Another 112 pesticides were monitored but not identified in the samples. The exhibit reports the 15 most frequently measured pesticides and the number of positive samples; below the yellow line, the exhibit provides the rankings and number of positive samples for proposed AIPCP herbicides. Of these herbicides on the exhibit, only glyphosate, fluridone, and penoxsulam were applied by DBW during the 2011 to 2016, time period.

These monitoring data illustrate the large number of pesticides found in water samples within the Delta and more broadly in the 11-counties in the AIPCP project area. The most commonly found pesticides between 2001 and 2016 were: diuron, an herbicide used for crops such as alfalfa, wine grapes, asparagus, walnuts; chloripyrifos, an insecticide commonly used for alfalfa, almonds, citrus, and cotton; and several pyrethroid insecticides. Herbicides used by DBW for aquatic weed control are found infrequently and at low levels, and often may not be the result of DBW applications. The exception may be fluridone, which has been used primarily for SAV treatments, though all fluridone samples were well below levels of concern.

B. Assessment of Cumulative Impacts

There is widespread acknowledgement among California policymakers that the Delta is in crisis. As the Governor's Delta Vision Blue Ribbon Task Force stated, "ecosystems have eroded, levees have deteriorated, fish populations have collapsed, and our system of delivering water has become ever more precarious" (Isenberg et al. 2008). There are numerous ongoing efforts, at the federal, State, and local level, to improve conditions in the Delta. The AIPCP operates within this context of a deteriorated Delta environment, and an active array of public programs seeking to reverse this deterioration. **Exhibit 7-5** compares the environmental resource areas for which the AIPCP has potentially significant impacts, with those of 18 other Delta projects and programs. Like the AIPCP, all of the identified programs are intended to improve conditions in the Delta, for sensitive species and habitats, agriculture, or water quality, or some combination of these areas. However, in creating these improved conditions, each program also has the potential to result in significant environmental impacts, at least temporarily. Most of these other Delta programs identified in this Section have significantly greater scope, and scale, than the AIPCP. The AIPCP affects only a relatively small aspect of the total Delta, while many of these programs have, or will have, substantial Delta-wide affects. Currently, several of these programs are still in the planning and permitting phases.

The two environmental resource areas that are most likely to be affected by cumulative impacts of the AIPCP, combined with these other Delta projects and programs, are biological resources, and hydrology and water quality. To the extent that any of these Delta projects create stress (of any kind) on special status species and habitats, this stress could be compounded by the combined impacts of each program. The potential for cumulative effects depends on co-location of AIPCP treatments and the other Delta project activities, which can be avoided. For example, while the potential impacts of the AIPCP on special status fish may be limited, if special status fish are already impacted by other Delta projects, the cumulative impact on special status fish may be significant.

The AIPCP will implement best management practices and mitigation measures, as described in Chapter 3, to minimize AIPCP impacts to biological resources. In addition, as these other projects and programs are implemented, they will also implement mitigation measures to minimize impacts on biological resources.

The potential for cumulative impacts to hydrology and water quality are similar to those of biological resources. The AIPCP will potentially result in unavoidable, potentially unavoidable, or avoidable impacts to water quality. Several of these other Delta programs may also result in at least temporary impacts to water quality, that when combined with the AIPCP impacts, would be cumulatively considerable. AIPCP mitigation measures, as described in Chapter 5, will minimize the AIPCP's contribution to water quality degradation in the Delta. These other Delta projects will also implement mitigation measures to minimize impacts to hydrology and water quality.

However, relative to the existing urban and agricultural pesticide runoff discussed above, AIPCP activities operate at a significantly smaller scale and with significantly lesser impacts on hydrology and water quality. As stated above, DBW applied 1.8% of the five-county total pounds of AIPCP herbicide active ingredient in 2015. The AIPCP seeks to minimize herbicide use and to use reduced risk herbicides in order to reduce the potential for additional herbicide burden on the Delta beyond that resulting from agricultural use. By shifting toward the use of reduced risk herbicides, DBW anticipates reducing the overall herbicide loading in the Delta.

For projects with construction-related impacts to biological resources, hydrology and water quality, or hazards and hazardous materials, the DBW will coordinate with the respective implementing agencies to avoid conducting AIPCP treatments in locations where construction is taking place. **This simple action will reduce or eliminate the potential for cumulative impacts during the construction phase of any Delta project.**

Exhibit 7-6 provides a summary of the potential cumulative impacts resulting from the AIPCP. It is likely that these cumulative impacts, should they occur, will be reduced, to some extent, by mitigation measures implemented by the AIPCP, and the other programs.

Exhibit 7-5
Comparison of Potential Impacts of the AIPCP and Projects in the Delta

Project	Objective	Environmental Resource Area – Potential Cumulative Impacts				
		Agriculture	Biological Resources	Hydrology and Water Quality	Hazards and Hazardous Materials	Utilities and Service Systems
AIPCP	Controlling growth and spread of aquatic invasive plants in the Delta		X	X		
a. Central Valley Project and State Water Project	Water storage and delivery		X	X		
b. Temporary Barriers Project	Benefit migrating salmon and benefit agricultural water users		X	X		
c. USFWS BO – Reasonable and Prudent Alternative	Protection of delta smelt		X			
d. NMFS BO – Reasonable and Prudent Alternative	Protection of salmon, steelhead, and green sturgeon		X			
e. Delta Conservation Framework	Guide Delta conservation efforts through 2050		X	X		
f. Delta Stewardship Council Delta Plan	Long-term management plan for the Delta to achieve coequal Delta goals		X	X		
g. Sacramento-San Joaquin Delta Conservancy Strategic Plan	Implement ecosystem restoration in the Delta		X	X		
h. Delta Smelt Resiliency Strategy	Improve conditions for Delta smelt		X	X		
i. Sacramento Valley Salmon Resiliency Strategy	Improve conditions for Sacramento Valley salmonids		X	X		
j. Central Valley Flood Protection Plan	Address flood risks and ecosystem restoration opportunities		X	X		
k. Stockton Deep Water Ship Channel Dissolved Oxygen Aeration Facility	Raise DO levels to support aquatic life		X	X		
l. California WaterFix	Recover sensitive species and habitats while upgrading facilities and maintaining water supplies		X	X		
m. California EcoRestore	Advancing the restoration of 30,000 acres of Delta habitat by 2020		X	X		
n. Sacramento River and Stockton Deep Water Ship Channels	Maintenance dredging and long-term channel improvements		X	X		
o. San Joaquin River Restoration Program	Restore fish, maintain water supplies		X	X		
p. Suisun Marsh Habitat Management, Preservation, and Restoration Plan	Restore and enhance tidal wetlands		X	X		
q. Fish Restoration Program Agreement	Implement fish habitat restoration requirements		X	X		
r. Sacramento Area Flood Control Agency (SAFCA) Flood Management Program	Study, design, and construct flood control improvements		X	X		

Exhibit 7-6
Summary of Potential Cumulative Impacts Resulting from the AIPCP

Resource Area and Potential Impact	Cumulative Impact	Description
IV. Biological Resources		
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the CDFG or USFWS	[X]	The AIPCP may result in adverse impacts to special status species present in treatment areas through herbicide overspray, herbicide toxicity, food web effects, dissolved oxygen levels, and/or treatment disturbances. There is a potential for these listed projects to result in temporary or permanent adverse effects to special status species.
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the CDFG or USFWS	[X]	The AIPCP may result in adverse impacts to riparian or other sensitive habitats due to herbicide overspray, dissolved oxygen levels, treatment disturbances, and/or plant fragmentation. There is a potential for these listed projects to result in temporary or permanent adverse effects to riparian or other sensitive habitats.
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means	[X]	The AIPCP may result in adverse impacts to wetlands through herbicide overspray, dissolved oxygen levels, treatment disturbances, and/or plant fragmentation. There is a potential for these listed projects to result in temporary or permanent adverse effects to wetlands
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites	[X]	The AIPCP may result in adverse impacts to migratory fish through herbicide toxicity, food web effects, dissolved oxygen levels, and/or treatment disturbances. There is a potential for these listed projects to result in temporary or permanent adverse effects to migratory fish.
VII. Hazards and Hazardous Materials		
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials in the environment	[X]	The AIPCP may result in exposure to hazardous materials due to accidental spills of herbicide.
VIII. Hydrology and Water Quality		
a) Violate any water quality standards or waste discharge requirements	[X]	The AIPCP may result in violations of water quality standards due to chemical constituents, pesticides, toxicity, dissolved oxygen levels, floating material, and/or turbidity. There is a potential for these listed projects to result in temporary or permanent violations of water quality standards.
f) Otherwise substantially degrade water quality	[X]	The AIPCP may degrade water quality due to chemical constituents, pesticides, toxicity, dissolved oxygen levels, floating material, and/or turbidity. There is a potential of these listed projects to result in temporary or permanent degradation of water quality.
g) Otherwise substantially degrade drinking water quality	[X]	The AIPCP may result in degradation of drinking water quality through chemical constituents, pesticides, and/or toxicity. There is potential for these listed projects to result in temporary or permanent degradation of drinking water quality.

In addition to serving the program purpose of controlling invasive species, the AIPCP is expected to improve a number of beneficial uses of Delta waters and improve water quality.

By reducing the amount of invasive plants clogging pumps and intake pipes, the AIPCP will improve municipal, industrial, and agricultural beneficial uses. As an example of this, one concern resulting from water hyacinth in the Delta in the 1980s was untreated plants blocking water pumps (USACE 1985). In fact, the Bureau of Reclamation estimated that the WHCP saved the Bureau $400,000 per year in reduced operating and maintenance costs associated with removing water hyacinth from just the Tracy Pumping Plant (DBW 2001). Similarly, clogging of agricultural pumps by untreated aquatic invasive plants can result in inefficient pumping, increased pumping costs, and possible mechanical failure of pumps. Prior to the start of the WHCP, in a letter to the U.S. Army Corps of Engineers, the San Joaquin Farm Bureau Federation stated that growers were facing increased costs from efforts to open clogged channels where water hyacinth was decreasing the flow of water to pumps and clogging screens (USACE 1985). Current invasive plant infestations could potentially result in similar negative impacts to irrigation intakes if untreated.

By reducing the amount of invasive plants clogging Delta and tributary waterways, the AIPCP will also improve navigation and recreation beneficial uses. Large mats have blocked shipping channels in recent years, as some radar equipment was unable to sense the difference between water hyacinth mats and land. By removing plants, the AIPCP helps remove such barriers to navigation and recreational use.

The AIPCP is also expected to improve water quality in the Delta, specifically related to dissolved oxygen and turbidity. By removing monospecific mats of invasive plants from Delta and tributary waterways, the AIPCP will result in increased DO levels, increased turbidity, and improved native habitats for aquatic species. *Egeria densa* has been shown to reduce turbidity of Delta waters, increasing the risk of predation for Delta smelt. The Delta Smelt Resiliency Strategy has a goal of increasing turbidity to promote Delta smelt habitat (CNRA July 2016). These benefits will result in improvements to warm freshwater habitat, cold freshwater habitat, migration of aquatic organisms, spawning, reproduction, and/or early development, and estuarine habitat beneficial uses.

AIPs form dense mono-specific mats, crowd out native plants, are often ecosystem engineers, lower dissolved oxygen, and block light. These detrimental impacts on ecosystems that can be reduced through control of these invasive species. Dense canopies of AIPs reduce light levels for submerged plant photosynthesis and thus can effectively shade out native vegetation. Removal of AIPs and prevention of further spread of AIPs could improve habitat for sensitive species (through opening up shallow water habitat, regrowth of native plant species, improving navigation channels, and increased DO levels). There also are potential positive impacts to the Delta food web resulting from the AIPCP. Rapid growth and invasion of AIPs reduces open water habitat and impairs wetlands and sensitive riparian habitats, altering the natural food web. In addition, once dead FAV have decayed or floated away, dissolved oxygen levels at treatment sites will increase, improving fish habitat. Removing large patches of FAV or SAV will allow DO levels to increase, thus enhancing the ability of fish to move unimpeded in Delta waters. It could be argued that such a benefit outweighs the impact of short-term localized decreases in dissolved oxygen.

Crowe Horwath.

Section 8

Alternatives to the Proposed Project

8. Alternatives to the Proposed Project

CEQA requires that an EIR (or PEIR) discuss a reasonable range of alternatives that could avoid, or substantially lessen, the significant environmental impacts of the proposed program, even if the alternative might impede to some degree attainment of program objectives, or the alternative would be costlier. The discussion of each program alternative should provide sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed program. An EIR must also evaluate the impacts of the “No Program Alternative” to allow decision makers to compare the impacts of approving the proposed program with the impacts of not approving the proposed program.

This chapter identifies, discusses, and compares alternative options that were considered for controlling AIPs in the Delta and surrounding tributaries, as authorized by legislation. Note that these are hypothetical alternatives, not courses of action being implemented in the program. **Exhibit 8-4** provides a summary of the expected impacts of the program alternatives on the five resource areas for which the AIPCP has potentially significant impacts. This chapter is organized as follows:

A. Program Alternatives Considered

B. Additional Treatment Alternatives Rejected as Infeasible

A. Program Alternatives Considered

In over 35 years of operating aquatic weed control programs in the Delta, the DBW has examined and tested a broad range of potential control methods. In developing this AIPCP, DBW considered new and emerging control methods, aquatic weed control operations in other regions, and the current state of scientific information. Reflecting an adaptive management approach, the AIPCP is designed to incorporate new information and experience. The selected AIPCP alternative reflects DBW’s prior experience as well as new methods being utilized successfully in other regions, and provides flexibility to continue to adapt the program over time.

The objective of the Aquatic Invasive Plant Control Program (AIPCP) is control the growth and spread of aquatic invasive plants (AIP) in the Sacramento-San Joaquin Delta (Delta), its surrounding tributaries, and Suisun Marsh to in support of the environment, economy, and public health. Because of the potential for spread, the long-term presence, and the persistence of invasive aquatic plants in the Delta, the AIPCP legislative mandates are for control, rather than eradication of aquatic invasive plants. Exhibit 2-1 identifies

The program alternatives consist of single-method approaches, as compared to the integrated multiple-method approach of the selected alternatives. The selected alternative includes all of the approaches within alternatives 1 through 3. Exhibit 2-1 identifies eleven specific objectives of the AIPCP, also listed below:

1. Reduce total acres infested with FAV and SAV.
2. Reduce SAV biomass at high priority navigation sites currently infested with SAV
3. Reduce SAV biomass at nursery sites (sites where the invasive plant is historically present, persistent from year to year, and from which the species is known to disperse)
4. Reduce FAV coverage at nursery sites and reduce the number of FAV nursery sites
5. Prevent boat navigation, agricultural, recreation, public access, and public safety incidents related to AIP
6. Reduce the quantity of herbicides applied in the Delta and tributaries by implementing data-driven treatment approaches to target specific areas based on the presence and life-cycles (phenology) of AIP and sensitive species
7. Reduce potential environmental impacts of the AIPCP by implementing reduced risk treatment approaches
8. Minimize the total number of acres treated by implementing data-driven treatment approaches based on the presence of AIP and sensitive species
9. Support ecosystem restoration projects in the Delta by removing AIP in restoration sites and through collaboration with wildlife/restoration agencies and their projects
10. Minimize AIPCP environmental impacts, as measured by compliance with program permits and biological opinions
11. Target and optimize physical/mechanical removal methods to meet specific management needs

Program Alternative 1 – Herbicide Control Only

The herbicide control only alternative would include only the herbicide control aspects of the selected program alternative. DBW could utilize the eleven herbicides identified in **Exhibit 8-1,** selected tank mixes, and adjuvants/dyes (Agridex, Competitor, Cygnet Plus, Break-Thru SP 133, ColorFast, Rhodamine WT, and Bright Dyes). All herbicide applications would follow label and program operational requirements. This alternative would not include physical or biological control methods.

The herbicide control only alternative would result in all of the potential impacts related to use of herbicides described in Sections 3 through 7 of this PEIR, without the additional flexibility that an integrated management approach would provide. This herbicide only approach would not allow for adaptive adjustment of treatment methods to site-specific and season-specific needs and requirements, and may require more herbicide to be used as compared to the selected alternative in which herbicides are one of several tools for controlling invasive plants. In addition, the herbicide only approach would not provide any treatment alternatives during the portions of the year when herbicide treatments are limited or prohibited, or in areas where AIPs are growing within native plants that might be harmed by herbicide treatments.

Alternative 1 would not meet objectives 7, 10, and 11, and would make it more difficult for the AIPCP to meet the remaining program objectives.

Exhibit 8-1
Summary AIPCP Treatment Herbicides' Regulatory Status and Toxicity

Treatment Options	CDPR Status	USEPA Fish Toxicity Classification*	USEPA Macroinvertebrate Toxicity Classification*	EPA Reduced Risk Herbicide
Existing DBW Herbicides				
2,4-D	Approved	Practically non-toxic	Moderately toxic to practically non-toxic	No
Glyphosate	Approved	Slightly toxic to practically non-toxic	Slightly toxic to practically non-toxic	Yes
Penoxsulam	Approved	Practically non-toxic	Slightly toxic	Yes
Imazamox	Approved	Practically non-toxic	Practically non-toxic	Yes
Diquat	Approved	Slightly toxic	Very highly toxic to highly toxic	No
Fluridone	Approved	Slightly toxic	Moderately toxic to slightly toxic	No
Proposed Additional Herbicides				
Imazapyr	Approved	Practically non-toxic	Practically non-toxic	No
Carfentrazone-ethyl	Approved for terrestrial use; aquatic label may be resubmitted for CDPR review	Moderately toxic	Moderately toxic	Yes
Endothall (dipotassium salt)	Approved	Slightly toxic to practically non-toxic	Slightly toxic to practically non-toxic	No
Flumioxazin	Conditionally approved	Moderately toxic to slightly toxic	Slightly toxic	No
Florpyrauxifen-benzyl	Not yet approved	TBD	TBD	TBD
Tank Mixes	Variable	Variable	Variable	Variable

** USEPA Ecotoxicity Categories for Aquatic Organisms based on Acute Lethal Concentration (LC_{50} or EC_{50}):*
<0.1 mg/L = very highly toxic; 0.1-1 mg/L = highly toxic; >1-10 mg/L = moderately toxic; >10-100 mg/L =slightly toxic; >100 mg/L = practically nontoxic (USEPA 2016a).

Exhibit 8-2
Physical and Mechanical Treatment Methods

	FAV	SAV
Benthic mats		X
Hand/nets	X	
Diver hand removal, hand pulling		X
Diver assisted suction removal		X
Booms and floating barriers	X	X
Curtains, screens	X	X
Surface excavators	X	
Harvesters	X	X
Cutters and shredders	X	
Herding	X	

Program Alternative 2 – Physical and Mechanical Methods Only

The physical and mechanical only alternative would include expanded, year-round, implementation of a combination of the ten treatment methods identified in **Exhibit 8-2.** These methods represent the physical and mechanical control methods of the Selected Alternative and are described in Subsection D.

Physical/mechanical treatment methods avoid all impacts resulting from application of herbicides. Because of high costs and logistical challenges, fewer acres of AIPs would be treated under this alternative. Several of the physical methods would require removal of AIP to spoil sites. The higher volume of material to be sent to spoil sites might present challenges for transport and availability of sites. Increased utilization of mechanical harvesting methods could result in higher levels of bycatch of species, potentially increasing impacts to special status species.

Physical/mechanical methods only would result in fewer recreational and ecosystem benefits, as compared to the selected program alternative, because significantly less AIPs would be controlled in any given year. While physical/mechanical methods provide important treatment tools during the winter months, in areas when herbicides cannot be used, and in selected areas with heavy infestations, these methods alone are not a feasible program alternative. If the AIPCP were to employ these methods exclusively, there would be significant increases in the cost required to rent, operate, and maintain the equipment. Widespread use of physical/mechanical removal would also require additional spoil sites at which to dispose of the removed biomass, and could increase the risk to sensitive species in bycatch. Even if sufficient resources were available, the slow pace at which physical and mechanical methods can be deployed would mean that fewer acres within the project area could be feasibly managed as compared to a program alternative that includes other tools.

Alternative 2 would not meet objectives 1 through 10.

Program Alternative 3 – Biological Controls Only

The biological control only alternative would consist of expanded use of biological controls in the program area. These methods represent the biological control components of the selected alternative and are described further in subsection D. Weed biological control involves the use of non-native insects or mites to suppress non-native, invasive weeds in their exotic range. Currently, there are only two biological control agents that could be utilized in the Delta, as shown in **Exhibit 8-3.** These two agents are specific to controlling water hyacinth.

Exhibit 8-3
Biological Control Methods

	FAV	SAV
***Neochetina* weevil**	X	
Plant hopper (*Megamelus scutellaris*)	X	

While this approach would not result in any of the impacts of herbicide or physical control, the biological control only method would leave all other AIPs in the program area without control. In addition, biological controls are generally implemented as tools that can supplement herbicide treatments by reducing the size, growth, reproduction, and spread of the target weed.

This alternative would not result in the ecosystem and recreation benefits as compared to the selected program alternative because significantly less AIPs would be controlled in any given year. Biological control methods only is not a viable option to control AIPs in the Delta because currently there is only one invasive plant species in the program area with approved biological control agents. In addition, these agents alone would not provide effective control of water hyacinth given the extent of water hyacinth invasion.

Alternative 3 would not meet objectives 1 through 9 and objective 11, and would make it more difficult to meet objective 10.

Program Alternative 4 – No Program Alternative

The uncontrolled growth of AIPs which would result from the No Program Alternative would lead to negative impacts to navigation, recreation, water quality, agriculture, and Delta ecosystems. Without control of FAV and SAV infestations, the following negative effects are expected, based on past history, scientific research in the Delta, and other areas subject to aquatic plant invasions:

- Navigation along the Stockton and Sacramento Deep Water Shipping Channels would be impaired
- Recreational boating and other water-based activities would be limited in areas with infestations
- Agricultural intakes and water intakes would be blocked by FAV or SAV species
- Dissolved oxygen levels under FAV mats would drop to levels below beneficial uses
- Turbidity in and under FAV and SAV mats would decline to levels detrimental to fish
- Aquatic habitats could be adversely impacted by FAV and SAV infestations, outcompeting native plants and making the Delta less suitable for listed species.

While it would avoid potential impacts due to herbicides and physical controls, the No Program Alternative would not achieve the goals and objectives 1 through 11 of the AIPCP. The No Program Alternative would also be counter to existing state law – laws that were enacted to address significant problems created by AIPs. The Harbors and Navigation Code, Section 64, specifies that it is “necessary that the state, in cooperation with agencies of the United States, undertake an aggressive program for the effective control of water hyacinth, *Egeria densa*, and South American spongeplant *(Limnobium laevigatum)* in the Delta, its tributaries, and the marsh [Suisun Marsh].” AB 763 (Statutes of 2013) further emphasized the problems posed by the spread of invasive aquatic plants and the importance of a coordinated response.

Comparison of Alternatives Considered

Exhibit 8-4 provides a comparison of the alternatives considered, each of which was discussed above.

Exhibit 8-4
Comparison of AIPCP Alternatives

Page 1 of 2

Resource	Program Alternative 1 – Herbicide Control Only	Program Alternative 2 – Physical and Mechanical Control Only	Program Alternative 3 – Biological Control Only	Program Alternative 4 – No Program Alternative
1. Biological Resources	Under alternative 2, there would be the same potential impacts to biological resources due to herbicide use as discussed in Chapter 3, for the selected program alternative. There would be no potential impacts to special status species due to mechanical harvesting.	Under alternative 3 there would be no biological impacts due to herbicide use. There is the potential for mechanical removal to kill, injure, or disturb mammals, birds, reptiles, amphibians, fish, and insects, and to damage or kill plants if not mitigated appropriately.	Under alternative 4 there would be no biological impacts due to herbicide use or mechanical harvesting. Biological controls would not result in impacts to biological resources; however, the increased growth in AIPs, particularly species other than water hyacinth, could result in direct and indirect negative impacts to biological resources.	Under the no program alternative, uncontrolled growth of AIPs would result in direct and indirect negative impacts to Delta ecosystems, fish habitat, and special status fish and plant species. To the extent that local landowners would conduct ad hoc herbicide treatments, there would be additional potentially significant impacts to biological resources.
2. Hazards and Hazardous Materials	Under alternative 2, there would be the same potential impacts related to hazards and hazardous materials due to herbicide use as discussed in Chapter 4, for the selected program alternative.	Alternative 3 would result in no impacts related to hazards and hazardous materials.	Alternative 4 would result in no impacts related to hazards and hazardous materials.	Under the no program alternative, there would be no impacts related to hazards and hazardous materials, except to the extent that landowners conducted ad hoc herbicide treatments.
3. Hydrology and Water Quality	Under alternative 2, there would be the same potential impacts to hydrology and water quality due to herbicide use as discussed in Chapter 5, for the selected program alternative.	Alternative 3 would not have a significant impact on Delta water quality or nutrient loading. There would be temporary impacts on turbidity.	Alternative 4 would result in no significant impacts to hydrology and water quality.	Under the no program alternative, uncontrolled growth of AIPs could result in reduced DO levels in and under mats and reduced turbidity in dense SAV infestations. There would be no impacts to water quality due to herbicide treatments.

Exhibit 8-4
Comparison of AIPCP Alternatives *(continued)* *Page 2 of 2*

Resource	Program Alternative 1 – Herbicide Control Only	Program Alternative 2 – Physical and Mechanical Control Only	Program Alternative 3 – Biological Control Only	Program Alternative 4 – No Program Alternative
4. Utilities and Service Systems	Under alternative 2, there would be the same potential impacts to utilities and service systems due to herbicide use as discussed in Chapter 6, for the selected program alternative.	Under alternative 3, there would be less control of AIPs than under the selected program alternative. This would potentially result in significant impacts to utility pump systems due to clogging by plants.	Under alternative 4, there would be less control of AIPs than under the selected program alternative. This would potentially result in significant impacts to utility pump systems due to clogging by plants.	Under the no program alternative, uncontrolled growth of AIPs would result in potentially significant impacts to utility pump systems due to clogging.
5. Agricultural Resources	Under alternative 2, there would be the same potential impacts to agricultural resources due to herbicide use as discussed in Chapter 6 for the selected program alternative.	Under alternative 3, there would be less control of AIPs than under the selected program alternative. This would potentially result in significant impacts to agricultural irrigation systems due to clogging by plants. There would be no potential for negative impacts to crops due to herbicide treatments.	Under alternative 4, there would be less control of AIPs than under the selected program alternative. This would potentially result in significant impacts to agricultural irrigation systems due to clogging by plants. There would be no potential for negative impacts to crops due to herbicide treatments.	Under the no program alternative, uncontrolled growth of AIPs would result in potentially significant impacts to agricultural irrigation systems due to clogging by plants. There would be no potential for negative impacts to crops due to herbicide treatments.

Exhibit 8-5 provides a summary of the potential impacts of the alternatives considered, identifying only the highest impact level in each category. Exhibit 8-5 identifies impacts that are likely to occur due to uncontrolled invasions of AIPs that will result from the alternative in addition to impacts likely to occur from implementing the control methods. This exhibit presents the same environmental factors considered in the Executive Summary in Exhibit ES-3. Within the table, the following significance thresholds are used:

- U/PU = Unavoidable or potentially unavoidable significant impact
- A = Avoidable significant impact
- L = Less than significant impact
- N = No impact

Exhibit 8-5
Comparison of AIPCP Alternatives

Environmental Factors	Selected Alternative	Program Alternative 1: Herbicide Control Only	Program Alternative 2: Physical and Mechanical Control Only	Program Alternative 3: Biological Control Only	Program Alternative 4: No Program Alternative
I. Aesthetics	N	N	N	N	N
II. Agriculture and Forestry Resources	A	A	U/PU	U/PU	U/PU
III. Air Quality	L	L	L	N	N
IV. Biological Resources	U/PU	U/PU	U/PU	U/PU	U/PU
V. Cultural Resources	N	N	N	N	N
VI. Geology and Soils	N	N	N	N	N
VII. Greenhouse Gas Emissions	L	L	L	N	N
VIII. Hazards and Hazardous Materials	A	A	N	N	N
IX. Hydrology and Water Quality	U/PU	U/PU	U/PU	U/PU	U/PU
X. Land Use Planning	N	N	N	N	N
XI. Mineral Resources	N	N	N	N	N
XII. Noise	L	L	L	N	N
XIII. Population and Housing	N	N	N	N	N
XIV. Public Services	N	N	N	N	N
XV. Recreation	L	L	U/PU	U/PU	U/PU
XVI. Transportation/Traffic	N	N	N	N	U/PU
XVII. Tribal/Cultural Resources	N	N	N	N	N
XVIII. Utilities and Service Systems	A,	A	U/PU	U/PU	U/PU
XIX. Mandatory Findings of Significance	U/PU	U/PU, A	U/PU	U/PU	U/PU

U/PU = Unavoidable or potentially unavoidable significant impact; A = Avoidable significant impact;
L = Less than significant impact; N = No impact

B. Additional Treatment Alternatives Rejected as Infeasible

In addition to the four program alternatives described in this chapter, the DBW considered a number of other treatment alternatives for controlling aquatic invasive plants in the Delta. The DBW determined that these alternatives were legally, technically, or operationally infeasible; would fail to meet most of the basic project objectives; or would result in significant environmental impacts. **Exhibit 8-6** briefly summarizes five alternatives that were not considered for further analysis.

Exhibit 8-6
Potential AIPCP Methods Rejected as Infeasible

Control Method	Description	Reason Rejected
1. Triploid Grass Carp	Sterilized, herbivorous fish that provide control by consuming aquatic weeds and other plants in waterways.	The extent that some of the AIP species in the Delta are a preferred food for triploid grass carp is unknown. In addition, the California Department of Fish and Wildlife prohibits the use of triploid grass carp in non-enclosed water bodies.
2. Selected Herbicides	Topramezone, bispyribac sodium, copper complex/chelate, copper sulfate, quinclorac, sodium carbonate peroxyhydrate, triclopyr, hydrothol formulation of endothall.	These herbicides were rejected due to concerns related to toxicity to aquatic species and/or irrigation restrictions that preclude their use in the Delta.
3. Shade Barriers	Use of shade fabrics placed over aquatic weeds to limit the amount of photosynthetically available light.	Utilizing shade fabrics in the Delta would be technically challenging, difficult to maintain, and expensive.
4. Water Level Manipulation	Pumping or releasing water via a dam or weir to dewater an area.	Delta channels do not have structures available to control water levels. In addition, some AIP seeds can germinate after years of exposure to air.
5. Flow Rate Manipulation	Increasing or decreasing water flow through a channel for weed control.	Flow rates in the Delta could not be artificially increased to create enough force to flush AIPs fully out of the Delta.

References

References

1. Acquavella, J.F., B.H. Alexander, J.S. Mandel, C. Gustin, B. Baker, P. Chapman, and M. Bleeke. 2004. Glyphosate biomonitoring for farmers and their families: results from the Farm Family Exposure Study. Environmental Health Perspectives. 112:3: 321-326.
2. Acquavella, J.F., C. Gustin, B.H. Alexander, and J.S. Mandel. 2005. Implications for epidemiologic research on variation by pesticide in studies of farmers and their families. Scandinavian Journal of Work and Environmental Health. 31(S1):105-109.
3. Akers, R.P., Weaver, R., Pitcairn, M.J. In review. Biological control of water hyacinth in California's Sacramento-San Joaquin River Delta: observations on establishment and spread.
4. Alavanja, M.C., C. Samanic, M. Dosemeci, J. Lubin, R. Tarone, C. Lynch, C. Knott, K. Thomas, J. Hoppin, J. Barker, J. Coble, D. Sandler, and A. Blair. 2003. Use of agricultural pesticides and prostate cancer risk in the Agricultural Health Study Cohort. American Journal of Epidemiology. 157:9:800-814.
5. Alavanja, M.C., D.P. Sandler, C.F. Lynch, C. Knott, J.H. Lubin, R. Tarone, K. Thomas, M. Dosemeci, J. Hoppin, and A. Blair. 2005. Cancer incidence in the Agricultural Health Study. Scandinavian Journal of Work and Environmental Health. 31(S1):39-45.
6. Alavanja, M.C., J.A. Hoppin, and F. Kamel. 2004. Health effects of chronic pesticide exposure: cancer and neurotoxicity. Annual Review of Public Health. 25:155-197.
7. Alavanja, M.C. 2007. Behavioral findings from the Agricultural Health Study, presentation to the 2007 North American Pesticide Applicator Certification and Safety Education Workshop. Portland, Maine.
8. Anderson, Lars W.J. 1982. Experimental application of 2,4-dichlorophenoxy acetic acid (2,4-D) for the control of water hyacinth in the delta. Davis, California. United States Department of Agriculture, Agricultural Research Service. 7pp.
9. Anderson, Lars W.J. 2011a. New aquatic weed threatens the Sacramento-San Joaquin Delta. UC Weed Science – Agriculture and Natural Resources Blogs. June 20, 2011. http://ucanr.org.
10. Aquatic Plant Management. c1994-2016. Washington State Department of Ecology (Washington DOE). Olympia, WA. www.ecy.wa.gov/programs/wq/plants/management. Accessed January 5, 2017.
11. Arambura, Margit. 2005. Update on acquisition of land in the Primary Zone since January 1, 1993 by public agencies and nonprofit groups. Sacramento, California. Delta Protection Commission, Agenda Item, January 14, 2005.
12. Armor, Chuck et al. 2005. Interagency Ecological Program synthesis of 2005 work to evaluate the pelagic organism decline (POD) in the Upper San Francisco Estuary. Sacramento, California. IEP.
13. Bakke, David. 2007. Analysis of issues surrounding the use of spray adjuvants with herbicides. USFS, Pacific Southwest Region. 61pp.
14. Barr, D.B., K. Thomas, B. Curwin, D. Landsittel, J. Raymer, C. Lu, K.C. Donnelly, and J. Acquavella. 2006. Biomonitoring of exposure in farmworker studies. Environmental Health Perspectives. 114:6:936-942.
15. Baxter, R., R. Breuer, L. Brown, M. Chotkowski, F. Feyrer, M. Gringras, B. Herbold, A. Mueller-Solger, M. Nobriga, T. Summer, and K. Souza. 2010. Interagency Ecology Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results. Interagency Ecology Program. December 2010. 259pp.
16. Bay Area Air Quality Management District (BAAQMD). 2017. CEQA Air Quality Guidelines. May 2017. http://www.baaqmd.gov/plans-and-climate/california-environmental-quality-act-ceqa/updated-ceqa-guidelines.
17. Bayer Crop Science. 2004. Material safety data sheet, Agridex® non-ionic surfactant. Available at: www.bayercropscience.c(om.au.
18. Beamesderfer, R., M. Simpson, G. Kopp, J. Inman, A. Fuller, and D. Demko. 2004. Historical and current information on green sturgeon occurrence in the Sacramento and San Joaquin Rivers and tributaries. Prepared for State Water Contractors by S.P. Cramer and Associates, Inc., Gresham, Oregon. 46 pages.
19. Beedy, E.C. 2008. Tricolored blackbird *(Agelaius tricolor)*, in: Shuford, W.D. and Gardali, T., editors. 2008. California Bird Species of Special Concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento, California. 450pp.

20. Bennett, William A. September 2005. Critical assessment of the delta smelt population in the San Francisco Estuary, California. *San Francisco Estuary and Watershed Science* 3, no.2. http://repositories.cdlib.org/jmie/sfews/vol3/iss2/art1.
21. Boussard, A. 1981. The reactions of roach (*Rutilus rutilus*) and rudd (*Scardinius erythrophthalmus*) to noises produced by high speed boating. Pages 188–200 in *Proceedings of 2nd British Freshwater Fisheries Conference, Southampton*.
22. Boyer, K. and M. Sutula. 2015. Factors Controlling Submersed and Floating Macrophytes in the Sacramento-San Joaquin Delta. Southern California Coastal Water Research Project. Technical Report No. 870. Costa Mesa, CA.
23. Brockett, James. Personal communication October 24, 2012, re: benthic barriers and diver-assisted suction harvesting. Tahoe Resource Conservation District.
24. Brown, L. R. and D. Michniuk. 2007. Littoral Fish Assemblages of the Alien-Dominated Sacramento-San Joaquin Delta, California, 1980-1983 and 2001-2003. Estuaries and Coasts 30:186–200.
25. Brown, L. R. and P.B. Moyle. 1993. Distribution, Ecology, and Status of the Fishes of the San Joaquin River Drainage, California. California Fish and Game 79(3):96–114.
26. Burger, J. 1998. Effects of Motorboats and Personal Watercraft on Flight Behavior over a Colony of Common Terns. *The Condor* 100:528–534.
27. Burns, C. 2005. Cancer among pesticide manufacturers and applicators. Scandinavian Journal of Work and Environmental Health. 31(S1):9-17.
28. CALFED Bay-Delta Program. 2000. Ecosystem Restoration Program (ERP) Volume 1. Sacramento, California: Prepared for the CALFED Bay Delta Program. CD-ROM version.
29. CALFED Bay-Delta Program. June 1999. Multispecies Conservation Strategy Technical Report. Sacramento, California. CALFED.
30. CALFED Bay-Delta Program. July 2000. Multi-Species Conservation Strategy. Sacramento, CA: CALFED Bay Delta Program.
31. Calflora. Accessed 2006. Information on California plants for education, research and conservation. Berkeley, California. The Calflora Database. http://www.calflora.org.
32. California Department of Fish and Wildlife (CDFW) (formerly California Department of Fish and Game – CDFG). 1992. Estuary dependent species. Entered by the CDFA for the State Water Resources Control Board 1992 Water Quality/Water Rights Proceedings of the San Francisco Bay-Sacramento-San Joaquin Delta. WRINT-DFG-6. 97pp.
33. CDFW. 1994. Impact of water management on splittail in the Sacramento-San Joaquin Delta. WRINT-DFG-5. 7pp.
34. CDFW. 2002. California Department of Fish and Wildlife comments to NMFS regarding green sturgeon listing. 79 pages plus appendices.
35. CDFW. 2011a. DRAFT Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions. Ecosystem Restoration Program. Sacramento, CA.
36. CDFW. 2014b. Non Game Wildlife Program, Swainson's hawk in California. Accessed May 9, 2014.
37. CDFW. 2017. Delta Conservation Framework. Accessed October 6, 2017. https://www.wildlife.ca.gov/Conservation/Watersheds/DCF.
38. CDFW. Accessed 2006a. Sacramento Splittail. Sacramento, California. CDFG, Habitat Conservation Planning Branch. http://www.dfg.ca.gov/habcon.
39. CDFW. Accessed 2006c. Sturgeon Study. CDFW, Central Valley Bay-Delta Branch. http://www.delta.dfg.ca.gov/baydelta/monitoring/stur.asp.
40. CDFW. Accessed July 2, 2008. "Natural Community Conservation Planning (NCCP). http://www.dfg.ca.gov/habcon/nccp/index.html.
41. CDFW. July 2005. The status of rare, threatened and endangered plants and animals in California, 2000-2004. Sacramento, California. CDFG.
42. California Department of Food and Agriculture (CDFA). 2016. California Agricultural Statistics Review, 2015-2016. https://www.cdfa.ca.gov/statistics/PDFs/2016Report.pdf. Accessed June 20, 2017.

43. California Department of Industrial Relations, Division of Occupation Safety and Health (CalOSHA). 2008a. Heat illness prevention: what you need to know. Oakland, California. CalOSHA.
44. CalOSHA. 2008b. Heat hazards in agriculture: a guide for employees to carry out tailgate training for workers. Berkeley, California. Prepared by the Labor Occupational Health Program, UC Berkeley.
45. California Department of Natural Resources (CDNR). July 2016. Delta Smelt Resiliency Strategy. Sacramento, CA. http://resources.ca.gov/docs/Delta-Smelt-Resiliency-Strategy-FINAL070816.pdf.
46. California Natural Diversity Database (CNDDB). 1992. Sacramento, California. California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch.
47. CNDDB. 1997. Sacramento, California. California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch.
48. California Natural Resources Agency (CNRA). July 25, 2012. Governor Brown and Obama Administration outline path forward for Bay Delta Conservation Plan (press release). Sacramento, California. 4pp.
49. CNRA. December 2013b. Draft BDCP Environmental Impact Report/Environmental Impact Statement (EIR/EIS). Sacramento, California. Natural Resources Agency.
50. CNRA. July 2016. Delta Smelt Resiliency Strategy. http://resources.ca.gov/docs/Delta-Smelt-Resiliency-Strategy-FINAL070816.pdf. Accessed September 2016.
51. CNRA. June 2017a. Delta Smelt Resiliency Strategy Progress Report. http://resources.ca.gov/docs/Delta-Smelt-Resiliency-Strategy-Update.pdf. Accessed October 8, 2017.
52. CNRA. June 2017b. Sacramento Valley Salmon Resiliency Strategy. http://resources.ca.gov/docs/Salmon-Resiliency-Strategy.pdf. Accessed October 8, 2017.
53. California State Water Resources Control Board (SWB). December 2006. Water quality control plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Sacramento, California. California Water Boards. 48pp.
54. California Urban Water Agencies (CUWA). 1994. Evaluation of potential effects of the proposed EPA salinity standard on the biological resources of the San Francisco Bay/Sacramento-San Joaquin Estuary (Draft). Sacramento, California. Prepared by R2 Resource Consultants, Inc. for the California Urban Water Agencies. 65pp.
55. Cal-IPC. 2011. “Cal-IPC Plant Assessment Form: Limnobium laevigatum.” http://www.cal-ipc.org/paf/site/paf/459. Accessed February 3, 2014.
56. Cartwright, Nicole. Personal communication April 6, 2017 re: diver suctioning for weed control. Tahoe Resource Conservation District.
57. Center for Biological Diversity (CBD). Accessed July 22, 2008. Sacramento splittail. http://www.biologicaldiversity.org/species/fish/Sacramento_splittail/index.html.
58. Central Valley Regional Water Quality Control Board (CVRWQCB). 2007. The water quality control plan (basin plan) for the California Regional Water Quality Control Board Central Valley Region, fourth edition, the Sacramento River Basin and the San Joaquin River Basin. Sacramento, California. CVRWQCB. Revised October 2007 (with approved amendments).
59. CNPS. 2008. Inventory of rare and endangered plants (online edition, v7-08c, 7/09/08). Sacramento, CA. http://www.cnps.org/inventory.
60. Cohen, M. 2007. Environmental toxins and health, the health impacts of pesticides. Australian Family Physician. 36:12:1002-1004.
61. Contra Costa Times. March 3, 2006. Science vs. politics. ContraCostaTimes.com.
62. Cook, Christopher D.K. and Katharina Urmi-König. 1983. "A Revision of the Genus *Limnobium* including *Hydromystria* (Hydrocharitaceae). Aquatic Botany. 17:1-27.
63. County of Lake. 2004. Clear Lake ecological risk assessment. Prepared by Blankenship and Associates. 152pp.
64. County of Lake. 2005. Draft Program EIR, Clear Lake Integrated Aquatic Plant Management Plan. Lake County, California.
65. Darin, Gina. 2017. Presentation at the 2017 Delta Invasive Species Symposium. University of California Davis. August 29, 2017.

66. DBW and USDA-ARS. 2017. Aquatic Invasive Plant Control Program (AIPCP): Biological Assessment. California Department of Parks and Recreation, Division of Boating and Waterways. Sacramento, CA.
67. DBW. 2001. Water Hyacinth Control Program Biological Assessment. DBW, Sacramento, CA.
68. Delta Protection Commission (DPC). January 2001. Background report on agriculture. Sacramento, California. Delta Protection Commission. February 1994, reprinted January 2001.
69. DPC. 2012. Economic Sustainability Plan for the Sacramento-San Joaquin Delta. Sacramento, CA.
70. DPC. May 2001. Update on agriculture in the primary zone of the Delta. Sacramento, California. Delta Protection Commission.
71. Delta Vision Blue Ribbon Task Force. June 2008. Delta Vision Strategic Plan Preliminary Draft. Sacramento, California. Task Force. 86pp.
72. Department of Water Resources (DWR) and U.S. Bureau of Reclamation (USBR). 1994. Biological assessment: effects of the Central Valley Project and State Water Project on delta smelt and Sacramento splittail. Prepared for the USFWS. Sacramento, California.
73. DWR. 1992. Bay-Delta fish resources. Sacramento, CA. Department of Water Resources. WRINT-DWR-30. 46pp.
74. DWR and USBR. 2016a. Bay Delta Conservation Plan / California WaterFix Final Environmental Impact Report/ Environmental Impact Statement. Prepared by ICF International. http://baydeltaconservationplan.com/FinalEIREIS.aspx. Accessed June 20, 2017.
75. DWR. 1994. Summary of sensitive plant and wildlife resources in Suisun Marsh during water years 1984-1994. Sacramento, California. DWR Environmental Services Office. 107pp.
76. DWR. 1996. Water quality conditions in the Sacramento-San Joaquin Delta, 1970-1993. Report to the State Water Resources Control Board in accordance with Water Right Decision 1485, Order 4(f). Sacramento, California. DWR Environmental Services Office. 102pp.
77. DWR. 2005. State Water Plan. Sacramento, California. DWR.
78. DWR. 2006. South Delta Improvements Program EIS/EIR, Volume 1d: Chapters 7-13. Sacramento, California. California Department of Water Resources.
79. DWR. 2012. The State Water Project Final Delivery Reliability Report – 2011. Sacramento, CA. 64pp.
80. DWR. 2013. California Water Plan Update 2013. Sacramento, California. 78pp.
81. DWR. 2014c. Fish Restoration Program. Accessed April 14, 2014. http://www.water.ca.gov/environmentalservices/frpa.cfm.
82. DWR. 2014e. The Suisun Marsh. http://www.water.ca.gov/suisun/. Accessed April 14, 2014.
83. DWR. 2017a. SGM Sustainable Groundwater Management. Accessed August 23, 2017. http://www.water.ca.gov/groundwater/sgm/.
84. DWR. 2017b. Central Valley Flood Protection Plan 2017 Update. Accessed October 8, 2017.http://www.water.ca.gov/cvfmp/docs/2017/2017CVFPPUpdate-Final-20170828.pdf.
85. DWR. Accessed June 26, 2008. Temporary barriers project information. http://baydeltaoffice.water.ca.gov/sdb/tbp/web_pg/tembar.cfm.
86. DWR. March 2008. Notice of preparation, environmental impact report and environmental impact statement for the Bay Delta Conservation Plan. Sacramento, California. DWR. 12pp.
87. Donley Marineau, Erin. 2017. Unpublished manuscript. University of California, Davis.
88. Dosemeci, M., M.C.R. Alavanja, A. Rowland, D. Mage, S.H. Zahm, N. Rothman, J.H. Lubin, J.A. Hoppin, D.P. Sandler, A. Blair. 2002. A quantitative approach for estimating exposure to pesticides in the Agricultural Health Study. Annals of Occupational Hygiene. 46:2:245-260.
89. Dow Chemical Company. 2008. Product safety assessment, penoxsulam. 233-00438-MM-0908.
90. DuBois, J. and M. Gringas. 2011. Using Harvest Rate and Harvest to Estimate White Sturgeon Abundance. Interagency Ecological Program for the San Francisco Estuary Newsletter (3) Summer.
91. DuBois, J., T. MacColl, and E. Haydt. 2011. Sturgeon Fishing Report Card: Preliminary Data Report. Stockton, CA: California Department of Fish and Game.

92. East Contra Costa County Habitat Conservation Plan Association. October 2006. The final East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan, An Introduction. Martinez, California. ECCHCPA.
93. Evonik. 2016a. Break-Thru SP 133 nonionic spreader/penetrant label.
94. Extension Toxicology Network (EXTOXNET). 1993. Diquat. Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis. Accessed November 3, 2016. pmep.cce.cornell.edu/profiles/extoxnet.
95. EXTOXNET. 1993. 2,4-D. Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis. Accessed June 19, 2008. http://extoxnet.orst.edu.
96. EXTOXNET. 1995. Endothall. Pesticide Information Project of Cooperative Extension Offices of Cornell University, Michigan State University, Oregon State University, and University of California at Davis.. pmep.cce.cornell.edu/profiles/extoxnet. Accessed November 3, 2016.
97. Federal Register. May 6, 2008. Endangered and Threatened Wildlife and Plants; Petition To List the San Francisco Bay-Delta Population of the Longfin Smelt (*Spirinchus thaleichthys*) as Endangered. 50 CFR Part 17. 24911-24915
98. Federal Register. August 19, 2011. Endangered and threatened wildlife and plants; 90-day finding on a petition to delist the valley elderberry longhorn beetle. 50CRF Part 17. 51929-51931.
99. Federal Register. November 27, 2006. Application of pesticides to waters of the United States in compliance with FIFRA. 71:227:68483-68492.
100. Fenske, R.A.. 2005. State-of-the-art measurement of agricultural pesticide exposures. Scandinavian Journal of Work and Environmental Health. 31(S1):67-73.
101. Ferris, S. 2008. Cal-OSHA to review handling of heat cases. The Sacramento Bee. December 31, 2008. P.A3.
102. Feyrer, F., Nobriga, M.L., and Sommer, T.R.. 2007. Multidecadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. Canadian Journal Fish Aquatic Science. 64:723-734.
103. Folmar, L.C. 1980. Effects of short-term field applications of acrolein and 2,4-D (DMA) on the flesh of rainbow trout. Bull. Environ. Contam. Toxicol. 24:217-224.
104. FOOTPRINT. 2006. Pesticide Properties Database. Database collated by the University of Hertfordshire th the EU-funded FOOTPRINT project (FP6-SSP-022704). www.eu-footprint.org/ppdb.html. Accessed July 26, 2012.
105. Francingues, N.R. and M.R. Palermo. 2005. Silt curtains as a dredging project management practice. DOER Technical Notes Collection (ERDC TN-DOER-E21). U.S. Army Engineer Research and Development Center, Vicksburg, MS. http://el.erdc.usace.army.mil/dots/doer/doer.html.
106. Greenfield, B.K. and T.P. McNabb. 2004. Chapter 2: Control costs, operation, and permitting issues for non-chemical plant control: case studies in the San Francisco Bay-Delta region, California. Journal of Aquatic Plant Management. In: Aquatic Pesticide Monitoring Program Nonchemical Alternatives Year 3 Report. Oakland, CA. San Francisco Estuary Institute. 15-24.
107. Gunnison, Douglas and J.W. Barko. 1992. Factors influencing gas evolution beneath a benthic barrier. Journal of Aquatic Plant Management. Vol. 30:23-28.
108. Haller, William T. Mechanical Control of Aquatic Weeds. 2014. In: Gettys A, Haller W, and Petty D, editors. Biology and Control of Aquatic Plants: A Best Management Practices Handbook. 3rd ed. Marietta (GA): Aquatic Ecosystem Restoration Foundation, P. 43-50.
109. Hazardous Substance Data Bank (HSDB). 2001. U.S. National Library of Medicine. 2001. Hazardous Substances Databank (i.e., TOXNET). Bethesda, MD, 10-9 pp.
110. HSDB. Accessed July 23, 2012. National Library of Medicine HSDB Database. Imazamox. http://toxnet.nlm.nih.gov.
111. Heimlich, Ralph E. et al. September 1998. Wetlands and Agriculture: Private Interests and Public Benefits. Washington D.C. U.S. Department of Agriculture, Agricultural Economic Report No. 756.
112. Hoar, S., A. Blair, F. Holmes, C. Boysen, R. Robel, R. Hoover, and J. Fraumeni. 1986. Agricultural herbicide use and risk of lymphoma and soft-tissue sarcoma. Journal of the American Medical Association. 256:9:1141-1147.

113. Hopper, J.V., P.D. Pratt, K.F. McCue, M.J. Pitcairn, P.J. Moran, and J.D. Madsen. 2017. Spatial and temporal variation of biological control agents associated with Eichhornia crassipes in the Sacramento-San Joaquin River Delta, California. Biological Control 111:13-22.

114. Hosea, R.C. 2005. Residue of Fluridone and Diquat Dibromide in Sediment from the Sacramento-San Joaquin Delta, California, 2002-2005. California Department of Fish and Game.

115. Hosea, R.C., K.Z. Bjurstrom, and E.E. Litrell. 2004. Acute oral and dermal toxicity of aquatic herbicides and a surfactant to garter snakes. Rancho Cordova, California. California Department of Fish and Game, Pesticide Investigations Unit. 22pp.

116. Huffacker, C.B. and D.L. Dahlsten. 1999. Scope and significance of biological control. In: Bellows, T.S., and Fisher, T.W. (eds.), Handbook of Biological Control, pp. 1-16. Academic Press, New York.

117. Interagency Ecological Program (IEP). Accessed 2006. Bay Delta and tributaries Project – data retrieval, green sturgeon, starry flounder, and English sole.

118. Jaramillo, A. 2008. Yellow-headed blackbird *(Xanthocephalus xanthocephalus),* in: Shuford, W.D. and Gardali, T., editors. 2008. California Bird Species of Special Concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento. 450pp.

119. Jassby, Alan D. 2008. Phytoplankton in the upper San Francisco Estuary: recent biomass trends, there causes and their trophic significance. San Francisco Estuary and Watershed Science. 6(1):1-24.

120. Jassby, Alan D., James E. Cloern, and Anke B. Müller-Solger. 2003. Phytoplankton fuels Delta food web. California Agriculture. 57(4):104-109.

121. Jassby, Alan D., James E. Cloern, and Brian E. Cole. 2002. Annual primary production: patterns and mechanisms of change in a nutrient-rich tidal ecosystem. Limnol. Oceanogr. 47(3):698-712.

122. Jepson Flora Project. 1993. The Jepson Herbarium. University of California, Berkeley. Various sources of resources including Consortium of California Herbaria, CalPhotos, the California Native Plant Society, California Exotic Pest Plant Council, USDA-Plants database and various external sites. Hickman, J.E. The Jepson Manual: Higher Plants of California. Revised from Jepson, W.L.'s Manual of the Flowering Plants of California and Jepson Online Interchange.

123. Kamel, F., L. Engel, B. Gladen, J. Hoppin, M. Alavanja, and D. Sandler. 2005. Neurologic symptoms in licensed private pesticide applicators in the Agricultural Health Study. Environmental Health Perspectives. 113:7:877-882.

124. Keckemet, O. 1968. Chemical, toxicological and biological properties of endothall. Hyacinth Control J. 8:50-51.

125. Kimmerer, W.J., A.E. Parker, U.E. Lidström, and E.J. Carpenter. 2012. Short-term and interannual variability in primary production in the low-salinity zone of the San Francisco Estuary. Estuaries and Coasts. 35:913-929.

126. Klamath-Siskiyou Wildlands Center, Siskiyou Regional Education Project, Umpqua Watersheds, Friends of the Eel, Northcoast Environmental Center, Environmental Protection Information Center, Native Fish Society, Center for Biological Diversity, Oregon Natural Resources Council, Washington Trout, and Umpqua Valley Audubon Society. 2003. A Petition for Rules to List: Pacific Lamprey (*Lampetra tridentate*), River Lamprey (*Lampetra ayresi*), Western Brook Lamprey (*Lampetra richardsoni*); and Kern Brook Lamprey (*Lampetra hubbsi*) as Threatened or Endangered under the Endangered Species Act. January 23, 2003.

127. Klimley, P., E.D. Chapman, J.J. Cech, Jr., D.E. Cocherell, N.A. Fangue, M. Gingras, Z. Jackson, E.A. Miller, E.A. Mora, J.B. Poletto, A.M. Schreier, A. Seesholtz, K.J. Sulak, M.J. Thomas, D. Woodbury, and M.T. Wyman. December 2015. Sturgeon in the Sacramento–San Joaquin Watershed: New Insights to Support Conservation and Management. San Francisco Estuary and Watershed Science, 13(4). 19pp.

128. Knowles, Noah. 2000. Natural and human influences on freshwater flows and salinity in the San Francisco Bay-Delta estuary and watershed. IEP Newsletter, Volume 13, No. 1:15-23.

129. Lavy, T.L., J.D. Walstad, R.R. Flynn, and J.D. Mattice. 1982. (2,4-dichlorophenoxy)acetic acid exposure received by aerial application crews during forest spray operations. Journal of Agric. Food Chem. 30:2:375-381.

130. Luzier, C. W., J. Brostrom, C. Cook-Tabor, D. Goodman, R. D. Nelle, K. G. Ostrand, H. Schaller, and B. Streif. 2009. Proceedings of the Pacific Lamprey Conservation Initiative Work Session – October 28–29, 2008. Portland, OR: U. S. Fish and Wildlife Service, Regional Office. Available: http://www.fws.gov/columbiariver/publications/Lamprey_Conservation_Proceedings_Final_09.pdf.

131. Madsen, J.D. 2016. Unpublished study. USDA-ARS.

132. Madsen, J.D., R.M. Wersal, K.D. Getsinger, and J.G. Skogerboe. 2010. Combinations of Endothall with 2,4-D and Triclopyr for Eurasian Watermilfoil Control. Technical Report ERDC/TN APCRP-CC-14, U.S. Army Engineer Research and Development Center, Environmental Laboratory, U.S. Army Corps of Engineers, Washington, D.C., 10 pp.
133. Madsen, John. 2000. Advantages and disadvantages of aquatic plant management techniques. US Army Engineer Research and Development Center Environmental Laboratory. Originally in North America Lake Management Society, LakeLine. 20 (1):22-34. www.aquatics.org/pubs/madsen2.htm.
134. Mager RC, Doroshov SI, Van Eenennaam JP. 1996. Development of laboratory culture of delta smelt, *Hypomesus transpacificus*. Sacramento, California. California Department of Water Resources report (DWR B-59306). 65 p.
135. Mahardja, B, M.J. Farruggia, B. Schreier, and T. Sommer. 2017. Evidence of a Shift in the Littoral Fish Community of the Sacramento-San Joaquin Delta. PLoS ONE 12(1): e0170683. https://doi.org/10.1371/journal.pone.0170683.
136. Mandel, J.S., B.H. Alexander, B.A. Baker, J.F. Acquavella, P. Chapman, and R. Honeycutt. 2005. Biomonitoring for farm families in the Farm Family Exposure Study. Scandinavian Journal of Work and Environmental Health. 31(S1):98-104.
137. Massachusetts Department of Agricultural Resources (DAR) Pesticide Program and Massachusetts Department of Environmental Protection (DEP) Office of Research and Standards. 2013. Flumioxazin. Boston, MA.
138. Mecum, W. Lee. Spring 2005. Zooplankton monitoring. *IEP Newsletter* 18: 10-15.
139. Meng, L. 1993. Status report on Sacramento splittail and longfin smelt. University of California Davis. Submitted to the U.S. Fish and Wildlife Service. 15pp.
140. Monsanto Company. February 2005. AquaMaster™ herbicide material safety data sheet. St. Louis, Missouri. Monsanto Company.
141. Monsanto Company. January 2002. AquaMaster™ technical fact sheet. http://www.monsanto.com/ito/pdfs/aquaFactSheet.pdf. (Accessed August 4, 2008).
142. Moran, P.J., M.J. Pitcairn, and B. Villegas. 2016. First establishment of the planthopper, *Megamelus scutellaris* Berg, 1883 (Hemiptera: Delphacidae), released for biological control of water hyacinth in California. Pan-Pacific Entomol. 92:32-43.
143. Moyle, P.B. 1976. Inland fishes of California. Berkeley, CA. University of California Press. 405pp.
144. Moyle, P.B. 2002. Inland fishes of California. University of California Press, Berkeley.
145. Moyle, P.B., L.R. Brown, J.R. Durand, and J.A. Hobbs. July 2016. Delta Smelt: Life History and Decline of a Once-Abundant Species in the San Francisco Estuary. San Francisco Estuary and Watershed Science, 14(2). 32pp.
146. Moyle, P.B., R. M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. June 1995. Fish species of special concern in California. Department of Wildlife and Fisheries Biology, University of California Davis. 272pp.
147. Moyle, P.B., R.D. Baxter, T. Sommer, T.C. Foin, and S.A. Matern. 2004. Biology and Population Dynamics of Sacramento Splittail (Pogonichthys macrolepidotus) in the San Francisco Estuary: A Review. San Francisco Estuary and Watershed Science [online serial] 2(2), Article 3.
148. National Pesticide Telecommunications Network (NPTN). Accessed June 19, 2008. 2,4-D. Oregon State University. http://ace.orst.edu/info/nptn/.
149. Natural Heritage Institute (NHI). 1992a. Causes of decline in estuarine fish species. Testimony of the Natural Heritage Institute presented by Dr. Peter Moyle, University of California Davis, to the State Water Resources Control Board. 35pp.
150. NHI. 1992b. Petition for listing longfin smelt and Sacramento splittail under the Endangered Species Act. Submitted by the Natural Heritage Institute to the U.S. Fish and Wildlife Service. 32pp.
151. New York State Department of Environmental Conservation (New York DEC). 2008. Registration of the Pesticide Product Sapphire Containing the New Active Ingredient Penoxsulam. Division of Solid and Hazardous Materials. Albany, NY.
152. National Marine Fisheries Service (NMFS). 2005b. Final assessment of the National Marine Fisheries Service's Critical Habitat Analytical Review Teams (CHARTs) for seven salmon and steelhead evolutionarily significant units (ESUs) in California (July 2005). Prepared by NOAA Fisheries Protected Resources Division, Southwest Region.

153. NMFS. 2007. 2007 recovery outline for the evolutionarily significant units of winter-run and spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and the distinct population segment of California Central Valley steelhead (*O. mykiss*). NOAA-Fisheries, Southwest Region. May 7, 2007. 41pp.

154. NMFS. 2017. Biological Opinion for the California WaterFix. June 23, 2017. Sacramento, CA.

155. NMFS. Accessed July 1, 2008. NOAA-Fisheries Office of Protected Resources, Endangered Species Act. http://www.nmfs.noaa.gov/pr/laws/esa.

156. NMFS. April 2004., Essential Fish Habitat Consultation Guidance, Version 1. Silver Springs, Maryland. NOAA-Fisheries Service, Office of Habitat Conservation.

157. NMFS. April 2006. Water hyacinth control program biological and conference opinion. Long Beach, CA. NOAA-Fisheries Southwest Region. 123pp.

158. NMFS. February 2005. Green Sturgeon (*Acipenser medirostris*) Status Review Update. Santa Cruz, CA. NOAA-Fisheries, Southwest Fisheries Science Center, Biological Review Team.

159. NMFS. June 2005. Updated status of Federally Listed ESUs of West Coast salmon and steelhead, NOAA Technical Memorandum NMFS-NWFSC-66. Seattle, Washington. NOAA-Fisheries.

160. Nobriga, M.L., T.R. Sommer, F. Feyrer, and K. Fleming. February 2008. Long-term trends in summertime habitat suitability for delta smelt (Hypomesus transpacificus). San Francisco Estuary and Watershed Science. 6:1-13: http://repositories.cdlib.org/jmie/sfews/vol6/iss1/art1.

161. Pacific Fishery Management Council (PFMC). August 1999. Appendix A, Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon, Amendment 14 to the Pacific Coast Salmon Plan. Portland, Oregon. PFMC.

162. PFMC. 2008b. Preseason Report I, Chapter II, Chinook salmon assessment. Portland, Oregon. PFMC.

163. PFMC. 2009. Preseason Report I, Stock abundance analysis for 2009 ocean salmon fisheries. Portland, Oregon. PFMC.

164. PFMC. 2017. Preseason Report I, Stock Abundance Analysis and Environmental Assessment Part 1. Portland Oregon. PFMC.

165. PFMC. Accessed July 3, 2008. Backgrounder: The Magnuson-Stevens Act; Backgrounder: Essential Fish Habitat. www.pcouncil.org/.

166. PFMC. January 28, 2005a. Information sheet: the Magnuson-Stevens Act. Portland, Oregon. PFMC. http://www.pcouncil.org.

167. PFMC. July 24, 2006a. Essential fish habitat. Portland, Oregon. PFMC. http://www.pcouncil.org.

168. PFMC. November 2005b. Pacific Coast groundfish fishery management plan for the California, Oregon, and Washington Groundfish Fishery, Appendix B, Part 2, groundfish life history descriptions. Portland, Oregon. PFMC.

169. PFMC. September 2006b. Pacific coast groundfish fishery management plan for the California, Oregon and Washington groundfish fishery, as amended through Amendment 19. Portland, Oregon. PFMC. Chapter 7.

170. Parker, Alexander E., Al M. Marchi, Jan Davidson-Drexel, Richard C. Dugdale, and Frances P. Wilkerson. 2010. Effect of ammonium and wastewater effluent on riverine phytoplankton in Sacramento River, CA. Technical report for the California State Water Resources Board. 73pp.

171. Phillips, B.M., Anderson, B.S., Siegler, K., Voorhees, J.P., Tadesse, D., Weber, L., Breuer, R. 2016. Spatial and Temporal Trends in Chemical Contamination and Toxicity Relative to Land Use in California Watersheds: Stream Pollution Trends (SPoT) Monitoring Program. Fourth Report - Seven-Year Trends 2008-2014. California State Water Resources Control Board, Sacramento, CA.

172. Pope, Adam, Rebecca Buchannan, Adam Seaburg, and Kevin Clark. 2011. 2011 Annual Technical Report. San Joaquin River Group Authority. Davis, CA. 162-177.

173. Ralston, Stephen. 2005. An assessment of starry flounder off California, Oregon, and Washington. Santa Cruz, California. NOAA Fisheries, Southwest Fisheries Science Center.

174. Rogers, J.A. 2000. Buffer Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbances by Personal Watercraft in Florida. (Study 7520, in *Annual Report*.) Gainesville, Florida. Florida Bureau of Wildlife Diversity Conservation.

175. Rogers, J.A. 1998. Sworn Affidavit of James A. Rogers, Jr., Ph.D., Wildlife Biologist, Florida Game and Freshwater Fish Commission, United States District Court, Southern District of Florida (Monroe County), Aug. 10, 1998. 5 p.
176. Rosenfield, J.A. and R. D. Baxter. 2007 (estimated). Population dynamics and distribution patterns of longfin smelt in the San Francisco Estuary. University of California, Davis Center for Integrated Watershed Science and Management and CDFG. 45pp.
177. San Francisco Estuary Project (SFEP). March 1992. Status and trends report on aquatic resources in the San Francisco Estuary. Public Report. Oakland, California. San Francisco Estuary Project. 257pp.
178. San Joaquin River Restoration Program (SJRRP). December 2007. Fact sheet. SJRRP. 4pp.
179. Schaffter, R. 1997. White Sturgeon Spawning Migrations and Location of Spawning Habitat in the Sacramento River, California. California Department of Fish and Game 83:1–20.
180. Scholik, A. R., and Yan, H. Y. 2002. Effects of boat engine noise on the auditory sensitivity of the fathead minnow, Pimephales promelas. Environmental Biology of Fishes 63:203–209.
181. Schuette, J. 1998. Environmental fate of Glyphosate. Sacramento, California. Department of Pesticide Regulation, Environmental Monitoring Program. 13pp.
182. SePRO. 2006. Sonar: An Effective Herbicide that Poses Negligible Risk to Human Health and The Environment. SePro Corporation, www.sepro.com.
183. Syracuse Environmental Research Associates (SERA). 2006. 2,4-D – human health and ecological risk assessment. Arlington, VA. Prepared for USFS Forest Service.
184. SERA. 2008. Fluridone – human health and ecological risk assessment. Arlington, VA. Prepared for USFS Forest Service.
185. SFEP. State of the estuary 1992-1997: vital statistics, new science, environmental management. Oakland, California. San Francisco Estuary Project.
186. Sikka, H.C., H.T. Appleton, and E.O. Gangstad. 1977. Uptake and metabolism of dimethylamine salt of 2,4-dichlorophenoxyacetic acid by fish. Journal of Agriculture and Food Chemistry. 25:5:1030+.
187. Snider, B., and R.G. Titus. 2000. Timing, composition, and abundance of juvenile anadromous salmonid emigration in the Sacramento River near Knights Landing, October 1996-September 1997. California Department of Fish and Game, Habitat Conservation Division, Stream Evaluation Program Technical Report No. 00-04.
188. Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The collapse of pelagic fishes in the upper San Francisco Estuary. Fisheries 32(6):270-277.
189. Sommer, T., L. Conrad, G. O'Leary, F. Feyrer, and W.C. Harrell. 2002. Spawning and rearing of splittail in a model floodplain wetland. Transactions of the American Fisheries Society. 131:966-974.
190. Sommer, T., R. Baxter, and B. Herbold. 1997. The resilience of splittail in the Sacramento-San Joaquin Estuary. Transactions of the American Fisheries Society. 126:961-976.
191. Sommer, Ted and Francine Mejia. 2013. A place to call home: a synthesis of Delta Smelt habitat in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science, 11(2). http://escholarship.org/uc/item/32c8t244. Accessed June 2017.
192. Spencer, D.F. and G.G. Ksander. 2005. Seasonal growth of water hyacinth in the Sacramento/San Joaquin Delta, California. Journal of Aquatic Plant Management. 43:91-94.
193. Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. 2nd edition. Boston, MA. Houghton Mifflin Company.
194. Stevens, D. E. and L. W. Miller. 1970. Distribution of Sturgeon Larvae in the Sacramento-San Joaquin River System. California Department of Fish and Game, Water Projects Branch Report 1. 56:80–86.
195. Stewart, Ian J. May 25, 2005. Status of the U.S. English sole resource in 2005. Seattle, Washington. NOAA-Fisheries, Northwest Fisheries Science Center.
196. Streif, B. 2007. Pacific Lamprey – Lampetra tridentata. Portland, OR: U.S. Fish and Wildlife Service. Available: http://www.fws.gov/pacific/fisheries/sphabcon/lamprey/pdf/111407%20PL%20Fact%20Sheet.pdf.

197. SWB. January 2, 2007. Memo: new pesticide regulation. To Tom Howard, Acting Executive Director, from Michael A.M. Lauffer, Chief Counsel. Sacramento, California. SWB. 5pp.

198. Taugher, Mike. December 26, 2005. Water quality can be hard to swallow. Contra Costa Times.

199. Toft, J.D. 2000. Community effects of the non-indigenous aquatic plant water hyacinth (*Eichhornia crassipes*) in the Sacramento/San Joaquin Delta, California. University of Washington. 86pp.

200. Tu, Mandy, Callie Hurd, John M. Randall, and The Nature Conservancy. 2001. Weed Control Methods Handbook: Tools & Techniques for Use in Natural Areas. Accessed via All U.S. Government Documents (Utah Regional Depository). http://digitalcommons.usu.edu/govdocs/533.

201. United States Army Corps of Engineers (USACE). 1985. State Design Memorandum Water hyacinth Sacramento-San Joaquin Delta California. Sacramento District, U.S. Army Corps of Engineers. 24pp.

202. USACE. 2005. Diver dredge. http://el.erdc.usace.army.mil/pmis/MechanicalControls/MechanicalControlInfo.aspx?mechID=4.

203. USACE. 2014. San Francisco Bay to Stockton (JFB). Accessed April 28, 2014. www.spn.usace.army.mil/Missions/ProjectsandPrograms/ProjectsbyCategory/ProjectsforNavigableWaterways/SanFranciscoBaytoStockton(JFB).aspx.

204. USACE. April 2012. ANS Control Fact Sheets. GLMRIS.ANL.GOV.

205. United States Bureau of Reclamation (USBR). July 2003. Environmental water account draft environmental impact statement and environmental impact report. Sacramento, California. USBR.

206. USBR. April 24, 2014. Federal Agencies Announce Signing of Record of Decision for Suisun Marsh Habitat Management, Preservation, and Restoration Plan. https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=46624. Accessed October 8, 2017.

207. USBR. August 2008. Biological assessment on the continued long-term operations of the Central Valley Water Project and the State Water Project. Sacramento, California. USBR Mid-Pacific Region. 1,089 pp.

208. USBR. June 2009. Draft environmental impact statement, Delta-Mendota California aqueduct intertie. Sacramento, California. USBR.

209. United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS). 2017. The PLANTS Database. http://plants.usda.gov. National Plant Data Team, Greensboro, NC. Accessed October 20, 2017.

210. United States Environmental Protection Agency (USEPA). 1986. Pesticide Fact Sheet – Fluridone. Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, D.C.

211. USEPA. 1993. Reregistration Eligibility Decision (R.E.D.) Facts: Glyphosate. Office of Prevention, Pesticides and Toxic Substances.

212. USEPA. 1995. R.E.D. for Diquat Dibromide. Office of Prevention, Pesticides and Toxic Substances.

213. USEPA. 2001. Imazamox – Report of the Hazard Identification Assessment Review Committee. https://www3.epa.gov/pesticides/chem_search/cleared_reviews/csr_PC-129171_11-Jul-01_a.pdf. Accessed October 5, 2017.

214. USEPA. 2001b. Pesticide Fact Sheet: Flumioxazin. Office of Prevention, Pesticides and Toxic Substances. Washington DC.

215. USEPA. 2004a. Ecological Risk Assessment for the Section 3 Registration of the New Chemical Penoxsulam for Uses on Rice. Environmental Fate and Effects Division (EFED). Washington DC. 55pp.

216. USEPA. 2004b. Pesticide Fact Sheet: Penoxsulam. Office of Prevention, Pesticides and Toxic Substances. Washington DC.

217. USEPA. 2004c. Human Health Risk Assessment for Fluridone. Report dated August 17, 2004.

218. USEPA. 2005a. R.E.D. for 2,4-D. Office of Prevention, Pesticides and Toxic Substances. Washington DC.

219. USEPA. 2005b. R.E.D. for Endothall. Office of Prevention, Pesticides and Toxic Substances. Washington DC.

220. USEPA. 2006. R.E.D. for Imazapyr. Office of Prevention, Pesticides and Toxic Substances. Washington DC.

221. USEPA. 2015. SF Bay Delta: Stockton Deep Water Ship Channel in the San Joaquin River Low Dissolved Oxygen. SF Bay Delta Water Quality Progress Report: Stockton Deep Water Ship Channel. https://www.epa.gov/sfbay-delta/tmdl-progress-assessment-documents-dissolved-oxygen. Accessed October 8, 2017.

222. USEPA. 2016a. Reduced Risk and Organophosphate Alternative Decisions for Conventional Pesticides.
223. USEPA. 2016b. Glyphosate Issue Paper: Evaluation of Carcinogenic Potential. Office of Pesticide Programs (OPP). September 12, 2016.
224. USEPA. January 2007. Ecological Risk Assessment: Section 3, New Uses on Turf and for Control of Aquatic Vegetation in Aquatic Environments, Penoxsulam. Environmental Fate and Effects Division (EFED). Washington DC. 188pp.
225. USEPA. September 2008. Ecological Risk Assessment Evaluating Imazamox for the Proposed New Use on Clearfield Rice. Washington DC. 85pp.
226. USEPA. 2017a. Greenhouse Gas Equivalencies Calculator. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator. Accessed October 18, 2017.
227. USEPA. 2017d. Memorandum: Florpyrauxifen-benzyl: New Active Ingredietn, First Food Use, Human Health Risk Assessment for the Establishment of Permanent Tolerances on Rice, Fish, and Shellfish and Registration for Uses on Rice and Freshwater Aquatic Weed Control. USEPA Office of Pesticide Programs, Health Effects Division. June 1, 2017.
228. United States Fish and Wildlife Service (USFWS). 1992. Federal Register. Endangered and threatened wildlife and plants: 90-day finding and commencement status reviews for a petition to list the western pond turtle and California red-legged frog. Department of Interior. 57(193): 45761-45762. October 5, 1992.
229. USFWS. 1995a. Sacramento-San Joaquin Delta Native Fishes Recovery Plan. Portland, OR.
230. USFWS. 2004c. Endangered and threatened wildlife and plants: 90-Day finding on a petition to list Three species of lampreys as threatened or endangered. Oregon. USFWS.
231. USFWS. 2005a. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Portland, Oregon. USFWS.
232. USFWS. 2005b. Habitat Conservation Plans: Section 10 of the Endangered Species Act. http://www.fws.gov/endangered/hcp/.
233. USFWS. 2008. Biological Opinion on the Coordinated Operations of the Central Valley Project and State Water Project in California. December 15, 2008. Sacramento, CA.
234. USFWS. 2009a. Spotlight Species 5-Year Action Plan 2010-2014, Valley elderberry longhorn beetle. Sacramento Fish and Wildlife Office, Sacramento, CA.
235. USFWS. Accessed 2006. Sacramento Splittail. Sacramento, California. USFWS, Sacramento Office. http://www.fws.gov/sacramento/es/animal_spp_acct/sac_splittail.htm.
236. USFWS. March 31, 2004. 5-Year Review *Hypomesus transpacificus* (delta smelt). Sacramento, CA. USFWS, Sacramento Fish and Wildlife Office.
237. USFWS. May 21, 2004. Reinitiation of formal endangered species consultation on the proposed water hyacinth control program in the Sacramento-San Joaquin Delta in nine counties, California. Sacramento, California. USFWS, Sacramento Fish and Wildlife Office. 59pp.
238. United States Geological Service (USGS). Accessed 2006. Longhair sedge. (Northern Prairie Wildlife Research Center. USGS. http://www.npwrc.usgs.gov/resource/plants/floramw/species.
239. USGS. 2016. *Myriophyllum spicatum*. Nonindigenous Aquatic Species Database, Gainesville, FL, and NOAA Great Lakes Aquatic Nonindigenous Species Information System, Ann Arbor, MI. https://nas.er.usgs.gov/queries/greatlakes/FactSheet. Revised March 21, 2016. Accessed December 29, 2016.
240. University of California. 2005. Pesticide choice: best management practice (BMP) for protecting surface water quality in agriculture, Publication 8161. University of California, Division of Agriculture and Natural Resources. http://anrcatalog.ucdavis.edu. 8pp.
241. URS Corporation. May 2007. Status and Trends of Delta-Suisun Services. Sacramento, California. California Department of Water Resources. 53pp.
242. Vanderstukken, Martin. 2012. Control of phytoplankton by submerged macrophytes – the role of competition in relation to zooplankton grazing. Associate K.U. Leuven. July 8, 2012.
243. Walters, J. 1999. Environmental fate of 2,4-Dichlorophenoxyacetic acid. Sacramento, California. Department of Pesticide Regulation, Environmental Monitoring Program. 12pp.

244. Wang, Y.S., C.G. Jaw, and Y.L. Chen. 2004. Accumulation of 2,4-D and glyphosate in fish and water hyacinth. Water, Air, and Soil Pollution. 74:397-403.

245. Washington Department of Ecology (DOE). 2001. Herbicide risk assessment for the aquatic plant management final supplemental environmental impact statement, appendix C, volume 3: 2,4-D. Olympia, Washington. Department of Ecology.

246. Washington DOE. 2002. Appendix A: Final Risk Assessment for Diquat Dibromide. Prepared by Kathleen Emmett, Washington DOE Water Quality Program. Olympia, Washington. 354pp.

247. Washington DOE. 2009. Human Health and Ecological Effects Risk Assessment: Imazapyr Risk Assessment, Washington State. Submitted to Washington State Department of Agriculture, Olympia, WA. Prepared by AMEC Geomatrix, Inc. Lynnwood, WA. Project 14858.000. Report dated June 2009.

248. Washington DOE. 2012. Environmental Impact Statement for Penoxsulam, Imazamox, Bispyribic-sodium, Flumioxazin, & Carfentrazone-ethyl. Publication no. 00-10-040Addendum1. Olympia, WA. 98pp.

249. Washington DOE. 2017. Supplemental Environmental Impact Statement for State of Washington Aquatic Plant and Algae Management. Prepared by TRC Environmental.

250. Webber, J. D., S. N. Chun, T. R. MacColl, L. T. Mirise, A. Kawabata, E. K. Anderson, T. S. Cheong, L. Kavvas, M. M. Rotondo, K. L. Hochgraf, R. Churchwell, and J. J. Cech. 2007. Upstream Swimming Performance of Adult White Sturgeon: Effects of Partial Baffles and a Ramp. Transactions of the American Fisheries Society 136:402–408.

251. Weiser, Matt. 2008. Ammonia from Sacramento waste could hurt Delta ecosystem. Sacramento, California. The Sacramento Bee. June 1, 2008. Page A8.

252. Weiser, Matt. 2009. Wastewater ammonia found ‘likely’ to add to Delta woes. Sacramento, California. The Sacramento Bee. April 23, 2009. Page B1.

253. Werner, I., L.A. Deanovic, M. Stillway, and D. Markiewicz. 2008b. The effects of wastewater treatment effluent-associated contaminants on delta smelt. Final report to California State Water Resources Control Board. Davis, CA. 60pp.

254. Werner, I., L.A. Deanovic, M. Stillway, and D. Markiewicz. 2010. Toxicity of SRWTP Effluent to Delta Smelt and Surrogate Species. Final Report. December 6, 2010. www.water.ca.gov/iep/docs/pod/Werner_et_al_Delta_Smelt_Ammonia_2010_Final_Report.pdf.

255. Wilbur-Ellis. 2010. Competitor Label and MSDS. Fresno, California.

256. Wisconsin Department of Natural Resources (WI DNR). January 2012. Chemical Fact Sheets for Diquat, Endothall, Flumioxazin, Fluridone, Glyphosate, Imazamox, Imazapyr, and Penoxsulam. DNR PUB-WT-969-75 and 977. Madison, WI.

257. Yarrow, M., V.H. Marin, M. Finlayson, A. Tironi, L.E. Delgado, and F. Fischer. 2009. The ecology of *Egeria densa* Plancon (Liliopsida: Alismatales): A wetland ecosystem engineer? Revista Chilena de Historia Natural. 82:299-313.

258. Zahm, S.H., and A. Blair. 1992. Pesticides and non-Hodgkin’s lymphoma. Cancer Research (Supplement). 52:5485s-5488s.

259. Zeiner, D.C., W.F. Laudenslayer, Jr., and K.E. Mayer, editors. 1990. California’s wildlife: Volume II birds. Sacramento, California. California Department of Fish and Game. 272pp.

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Appendix
Maps

Appendix
Maps

This appendix includes a series of maps that summarize the fish survey data presented in Exhibit 3-32, which summarizes the series of 105 maps provided in the Supplemental Materials to the AIPCP Programmatic Biological Assessment (BA). The 21 maps are summary maps illustrating delta smelt, longfin smelt, Winter-run Chinook salmon, Spring-run Chinook salmon, and Central Valley steelhead presence in the Delta by month and treatment site for a typical wet year (2011), drought years (2012-2016), and the current very wet year (2017). 11x17 versions of these maps are available in the Draft PEIR.

The data summarizes results from nine surveys: Mossdale Trawls, Sacramento Trawls, Chipps Island Trawls, Beach Seine, Early Delta Smelt Monitoring (EDSM) Trawls, Spring Kodiak Trawl, Smelt Larval Survey, 20mm Survey, and Fall Midwater Trawl. We mapped and evaluated data separately for wet years and combined drought years. There is one set of maps for the wet water year October 2010 through June 2011. There is an additional set of maps for the combined drought years 2012 through 2016, for October through June. There are three additional maps for the current wet year (January through March 2017).

Wet and drought years show significantly different fish presence patterns, with fewer fish in the Delta in wet years. The maps do not cover July through September, which have historically been months where listed fish species are not found in the Delta. Note that four of the fish surveys (20 mm Survey, Fall Midwater Trawl, Spring Kodiak Trawl, and Smelt Larval Survey) do not distinguish between winter, spring, and fall Chinook; we included all Chinook identified in these surveys. Green sturgeon were not found in any of the surveys. Based on the historical and current surveys, DBW will seek to avoid specific areas where special status fish species are likely to be present.

These avoidance measures are precautionary, as toxicity data summarized in Chapter 3 with detail provided in Section 6 of the BA demonstrate that AIPCP herbicide treatments are at levels well below levels likely to result in adverse effects to fish. Given efficacy requirements and the low herbicide concentrations for several SAV treatments, there will be cases were SAV treatments take place in sites where fish may be present. DBW will identify SAV treatment locations prior to the start of each treatment season. The AIPCP will also utilize these maps in selecting timing of mechanical harvesting in order to minimize the potential for bycatch of listed fish species.

Exhibit 3A-1
Map #1

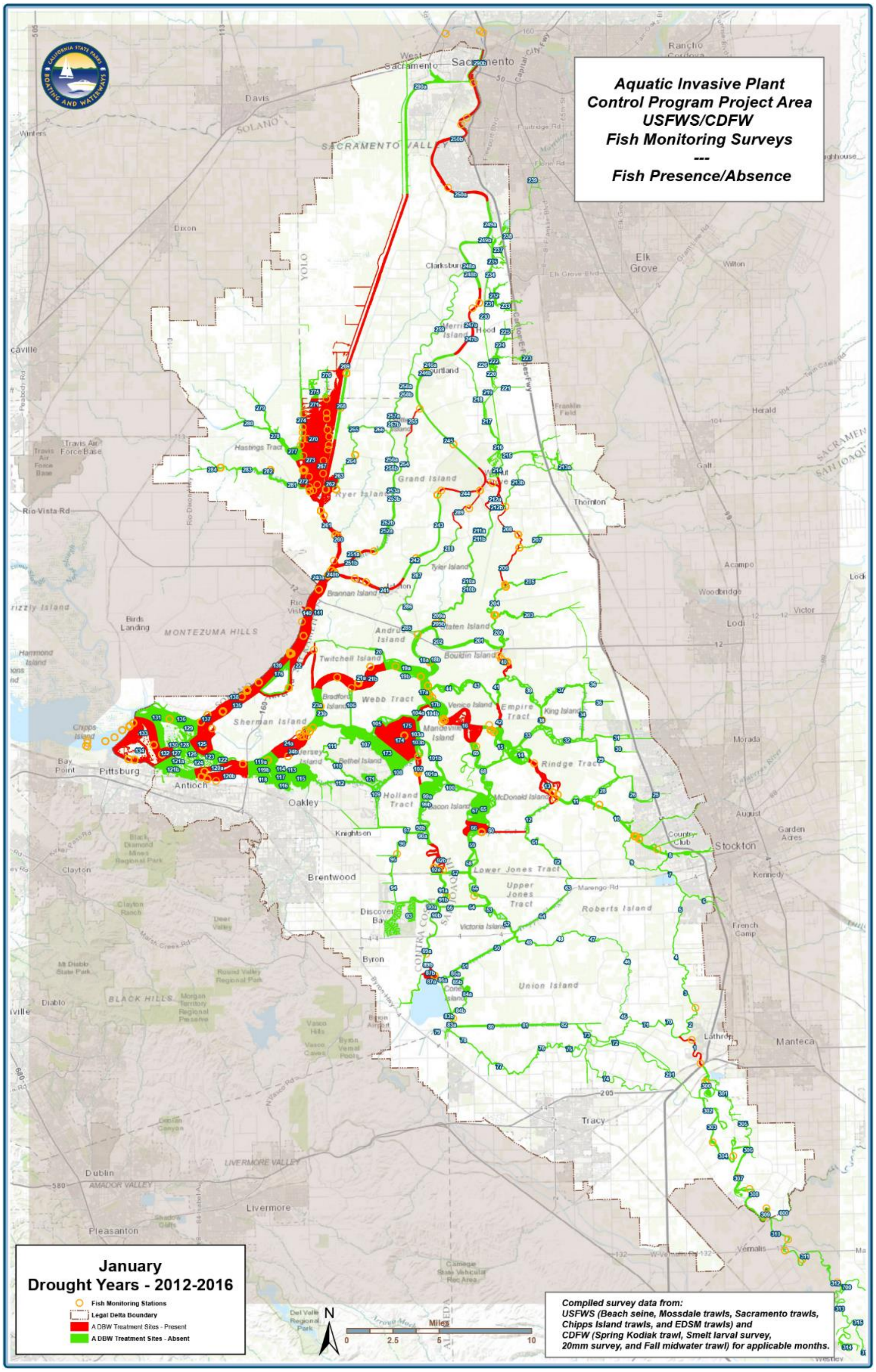
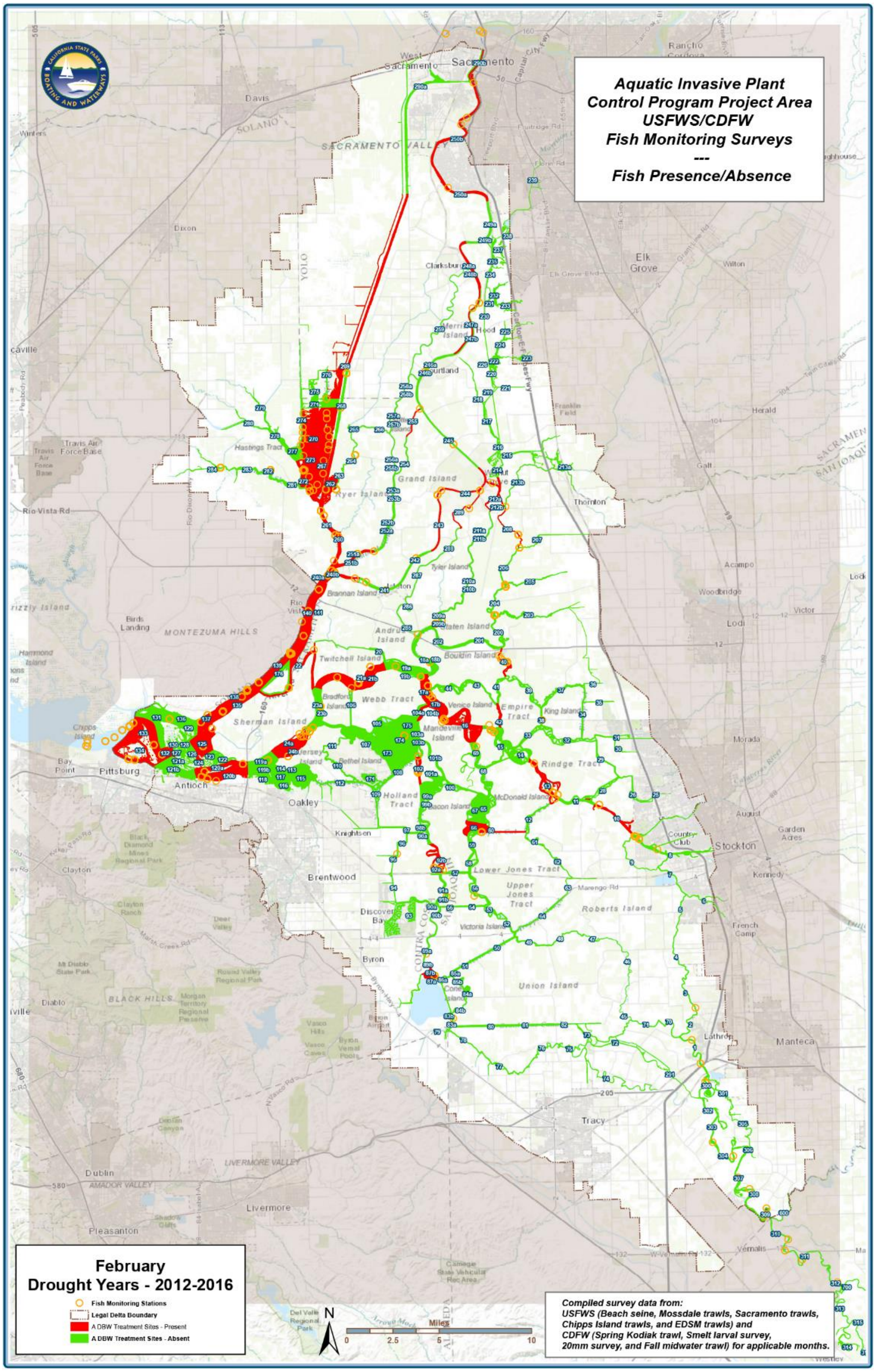


Exhibit 3A-2
Map #2



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Map #3

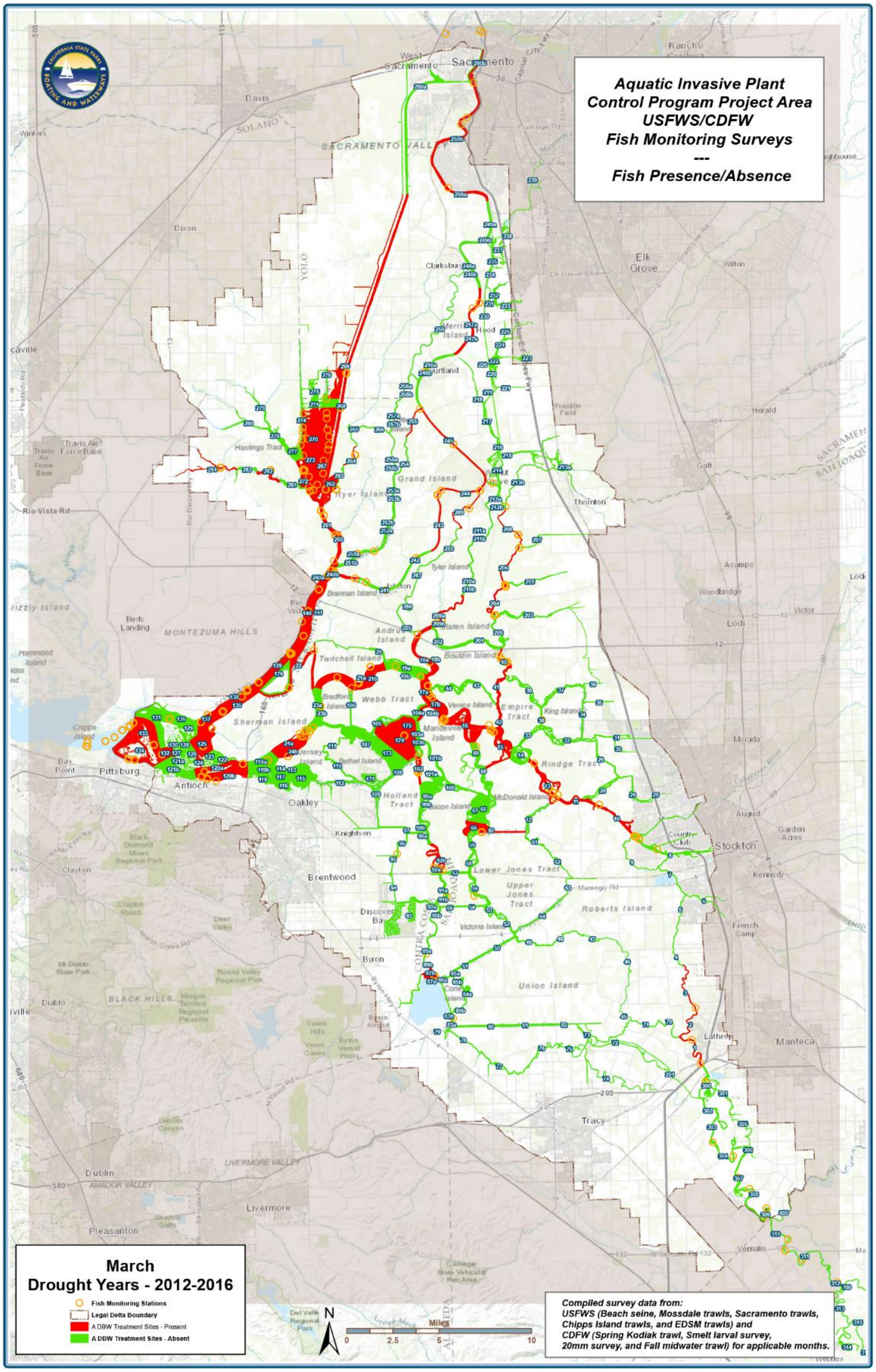
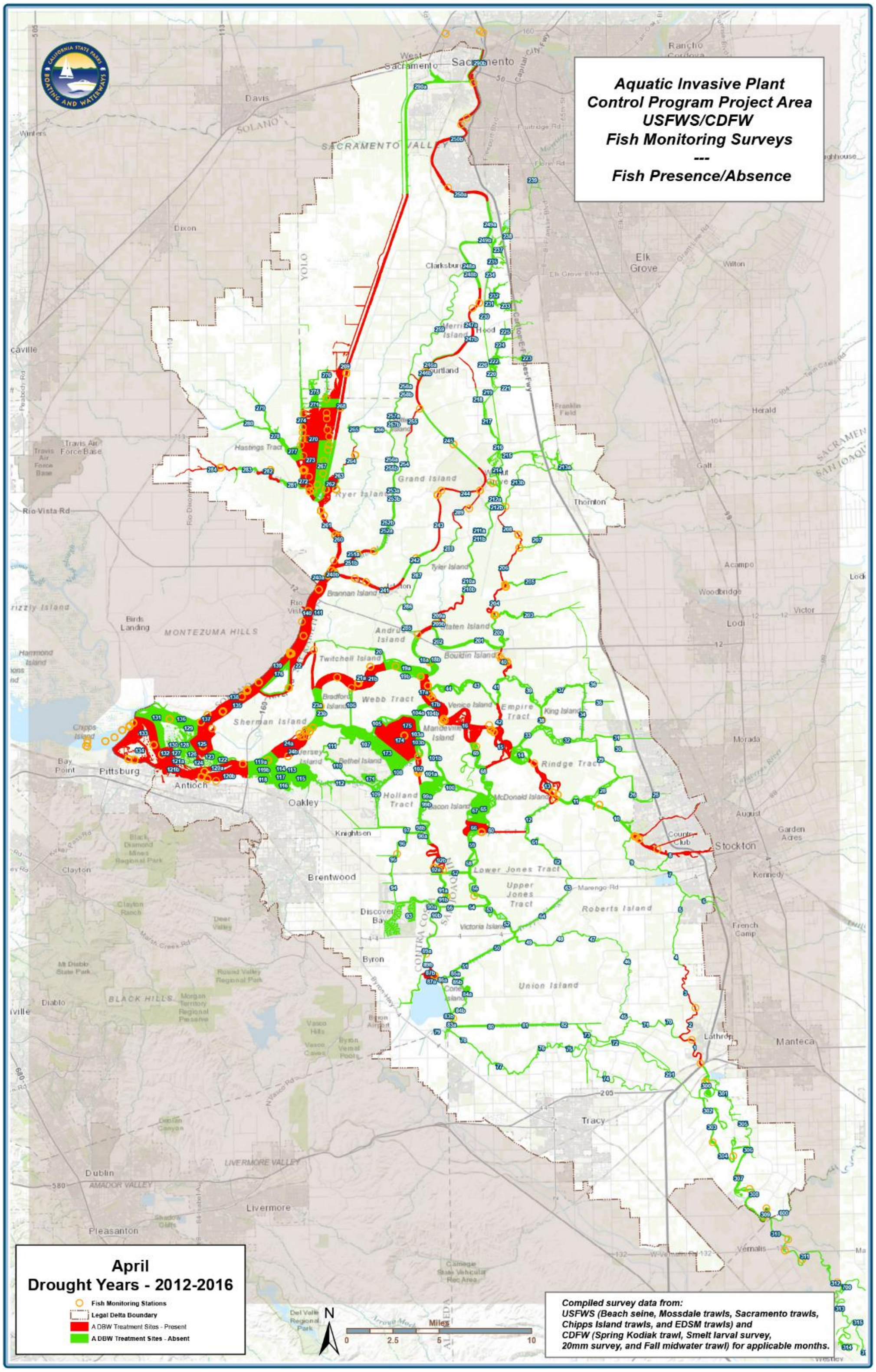


Exhibit 3A-4
Map #4



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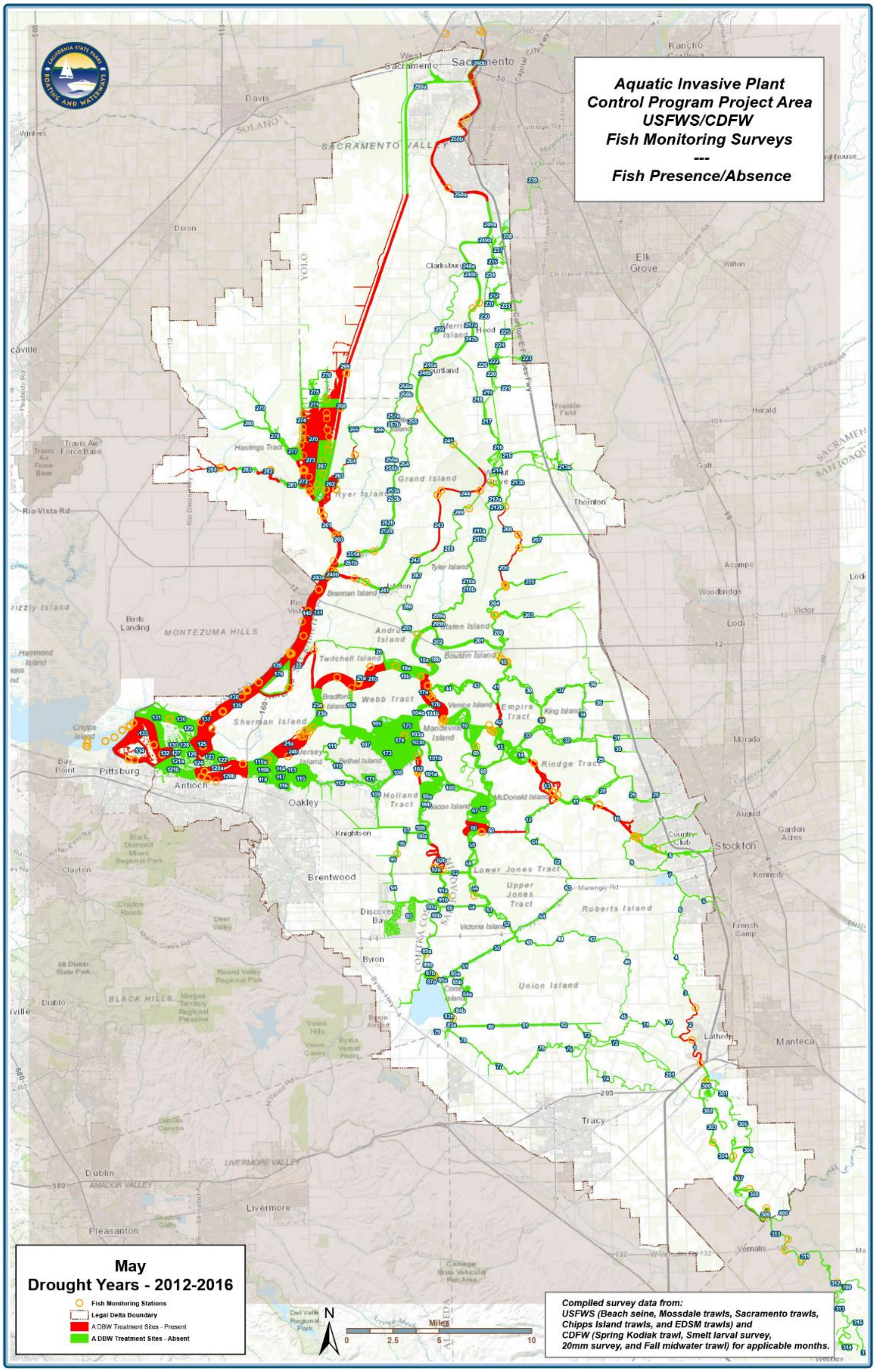
Map #5



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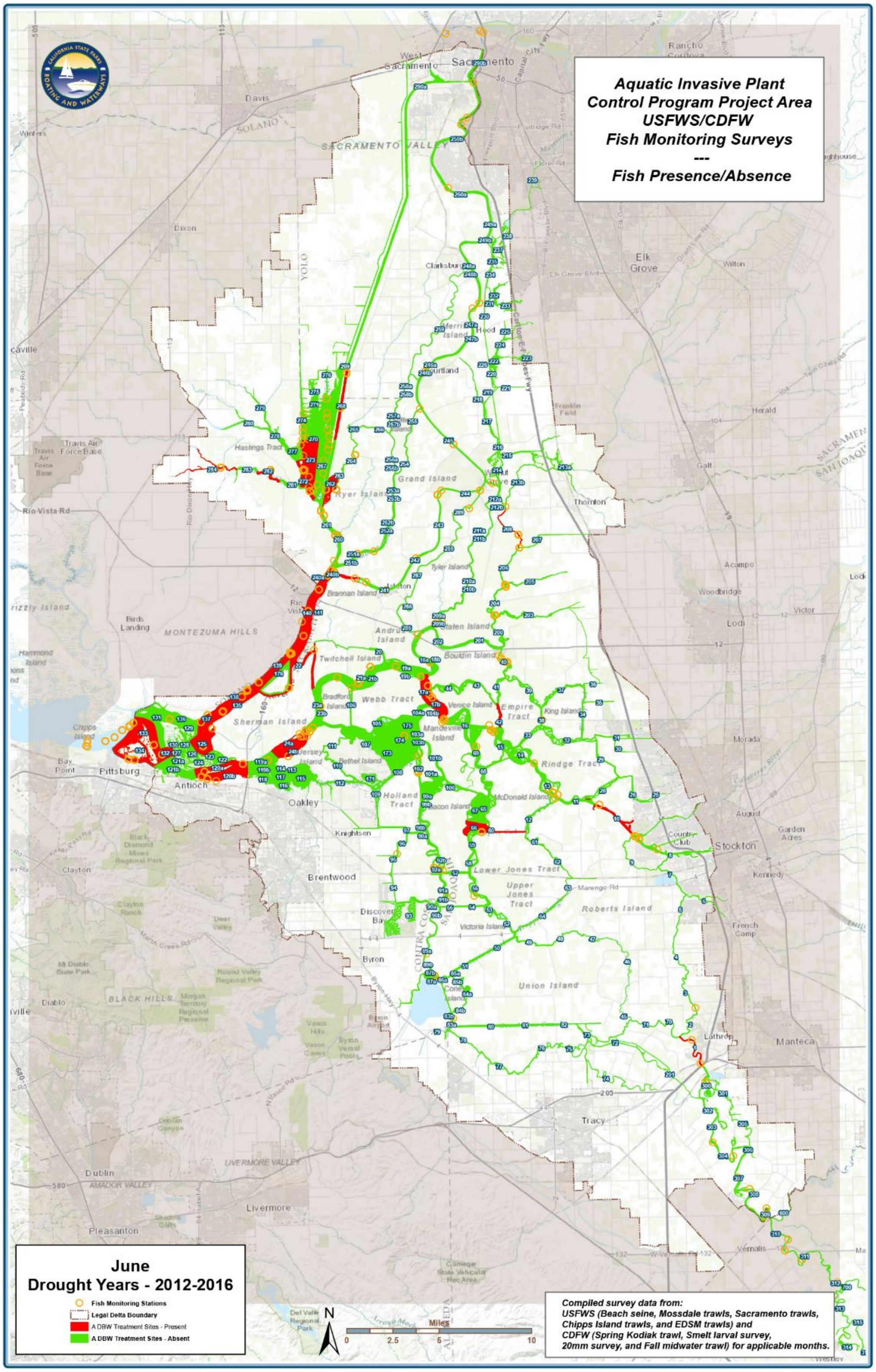
Map #6



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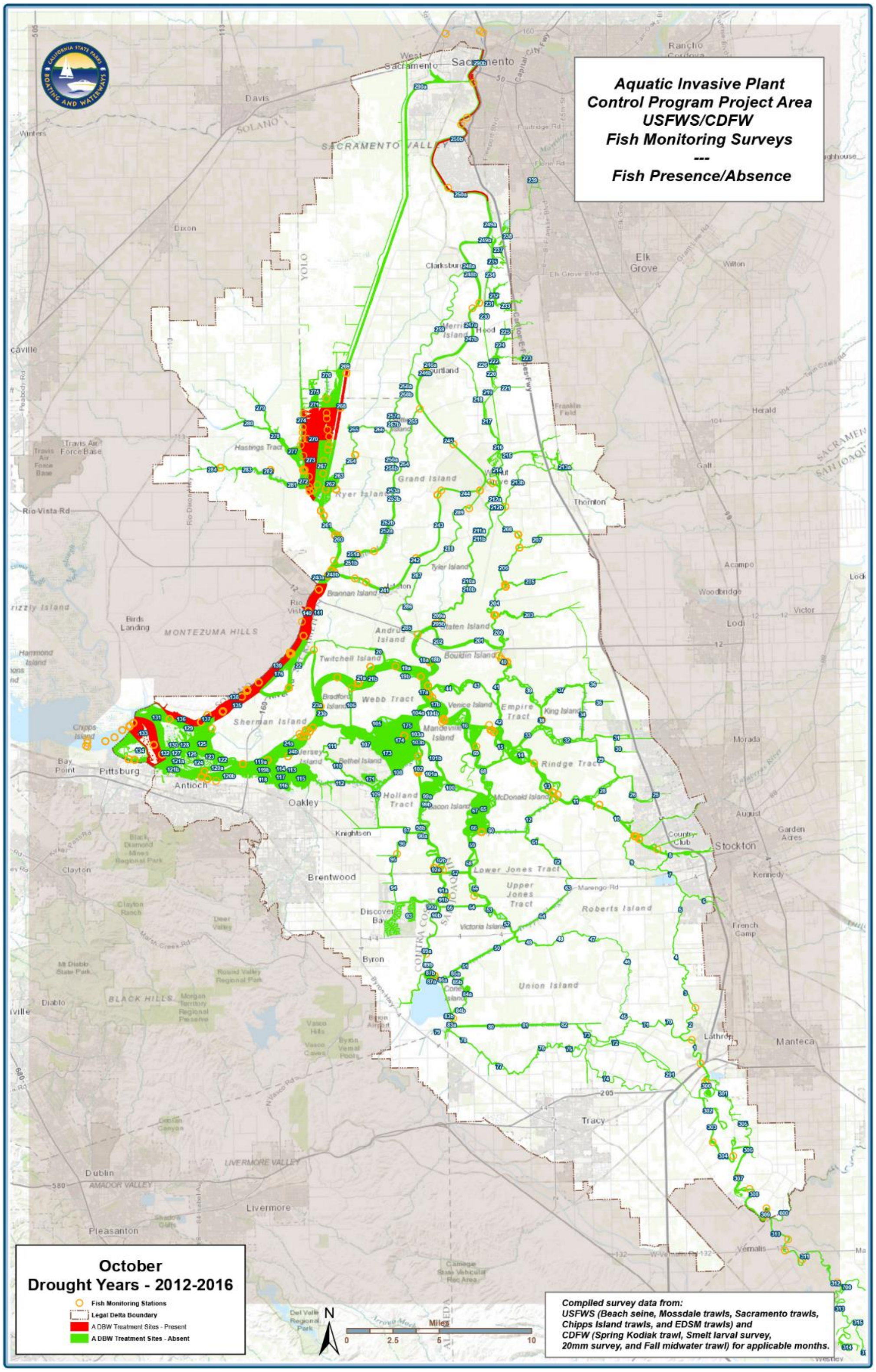
Map #7



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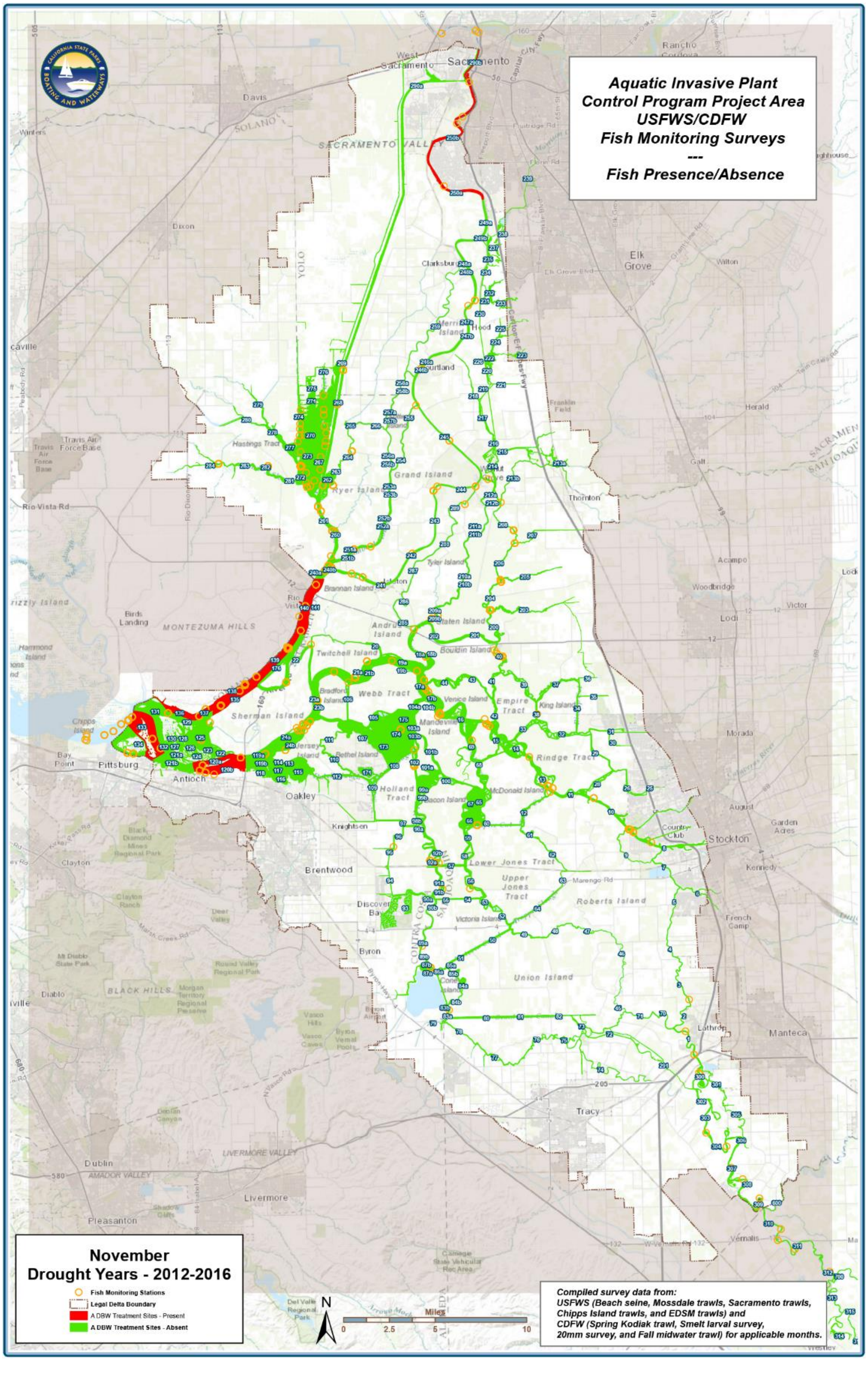

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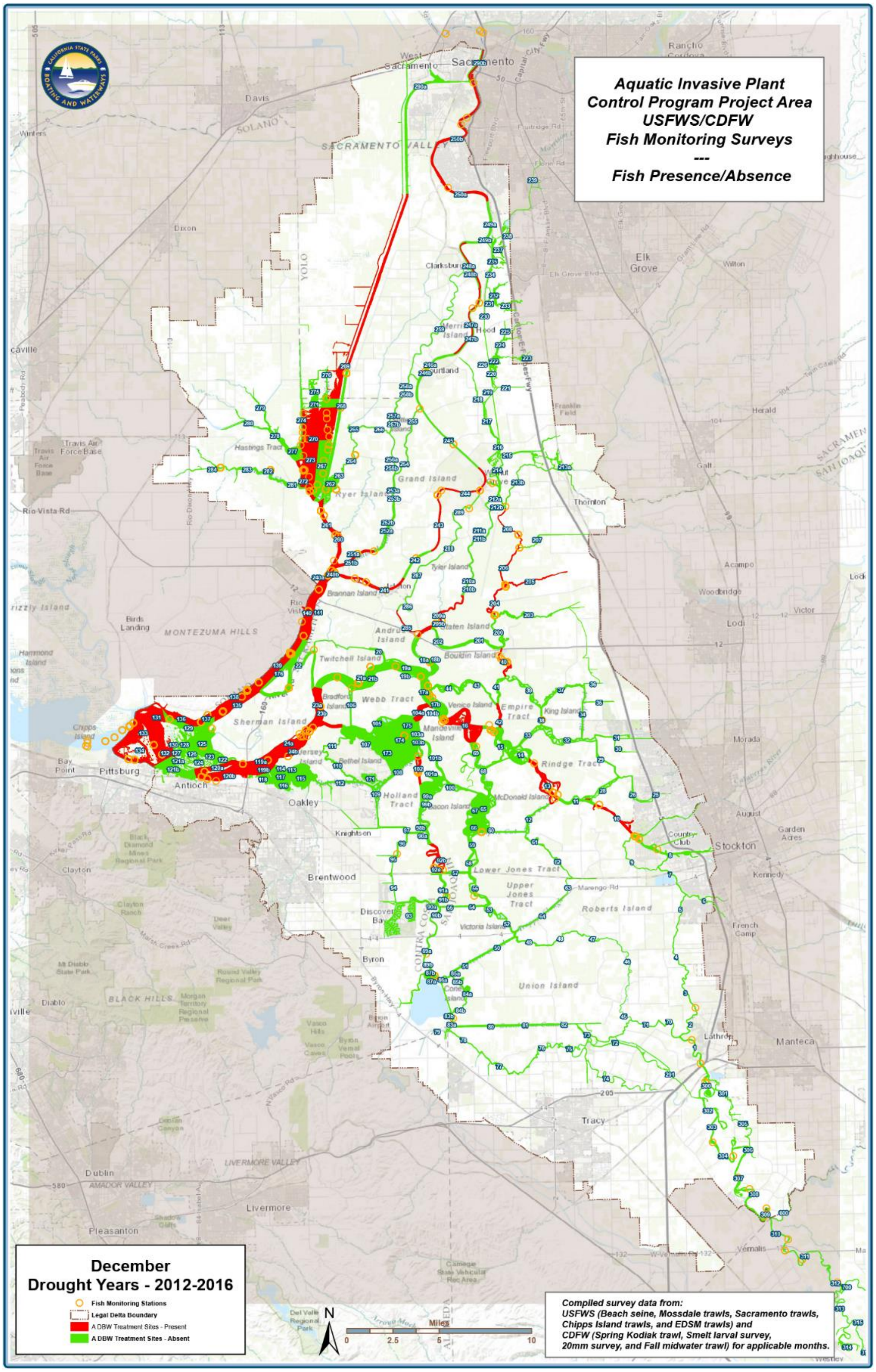
Map #9



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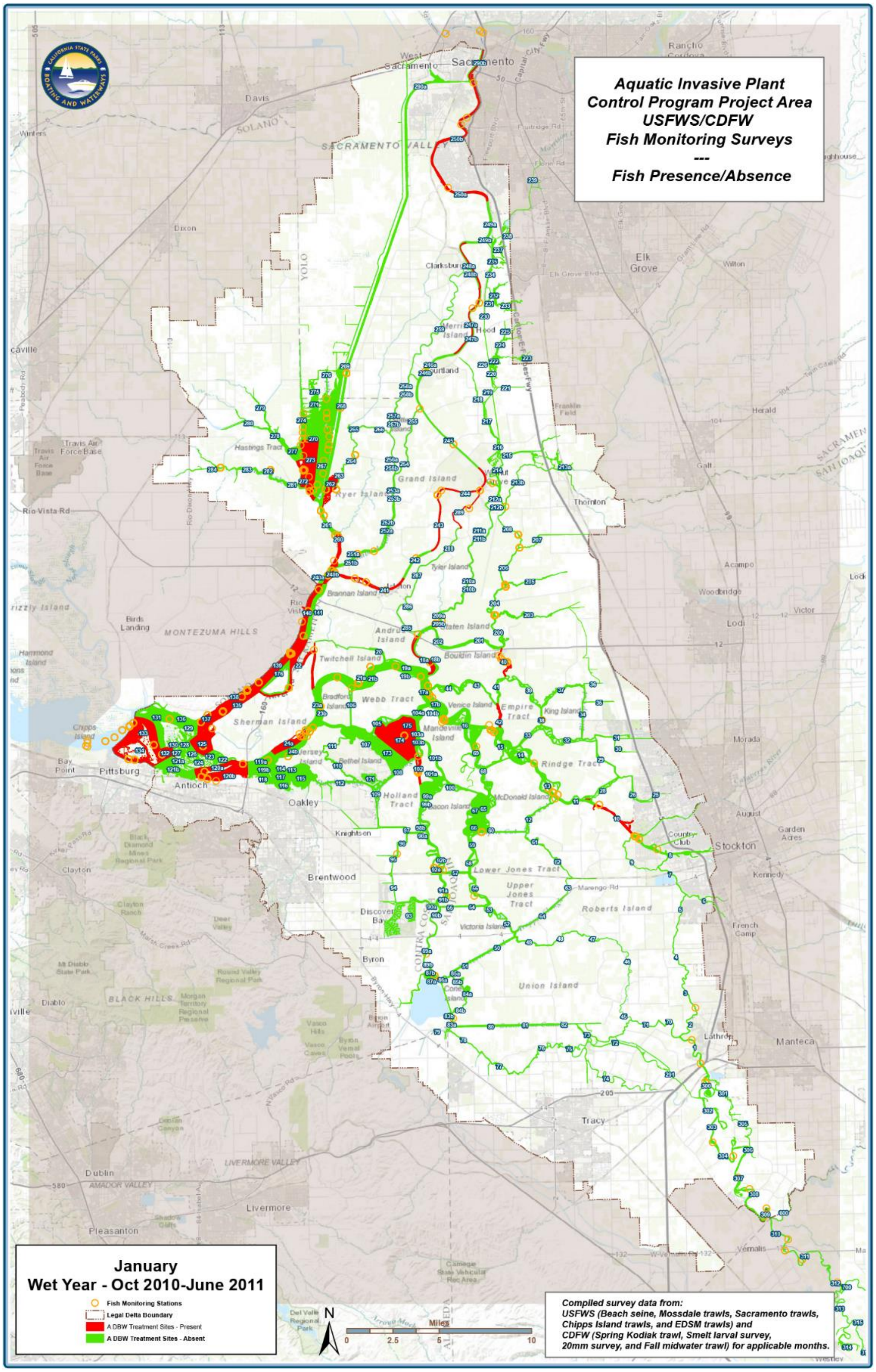
Map #10



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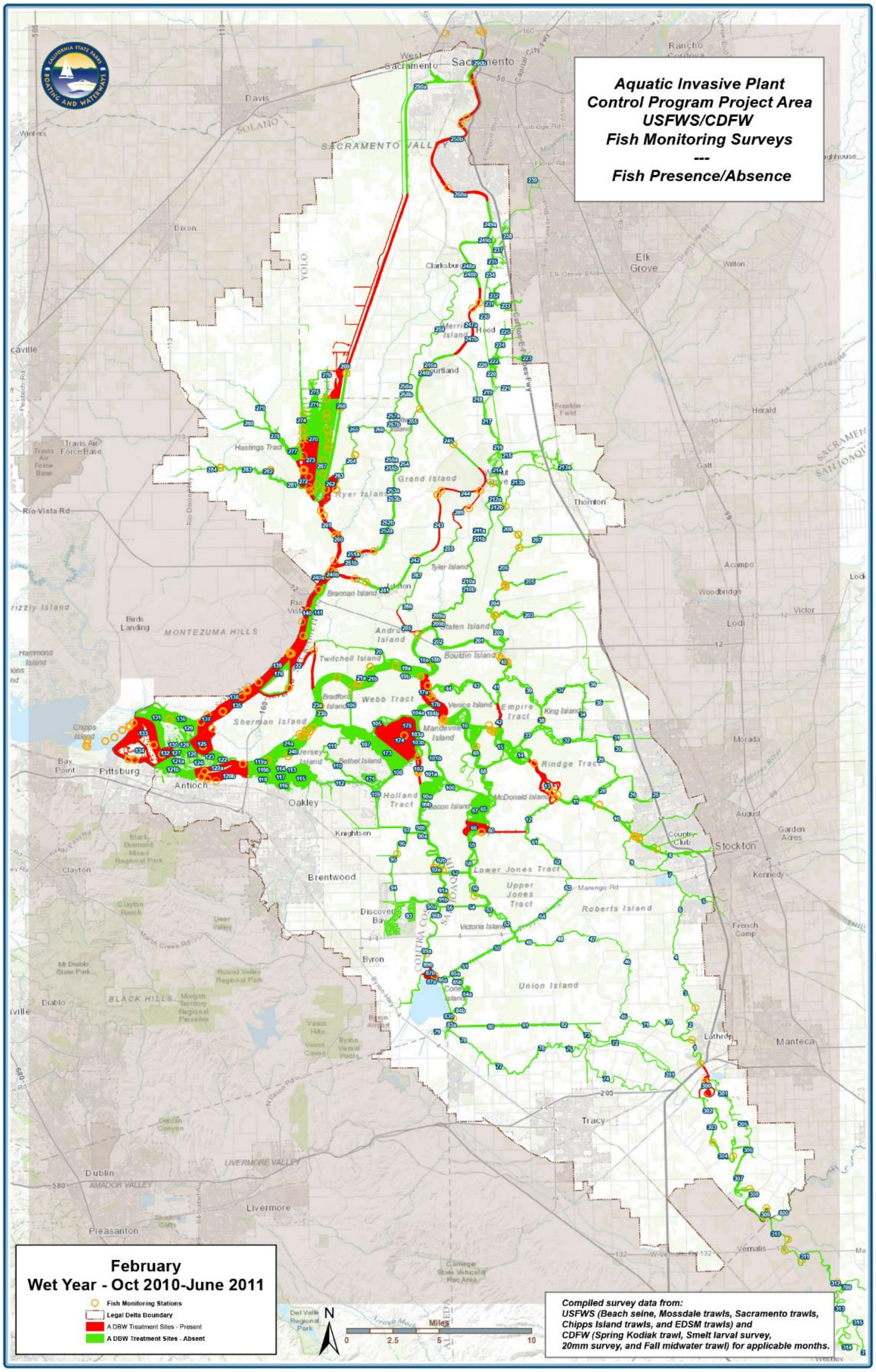
Map #11



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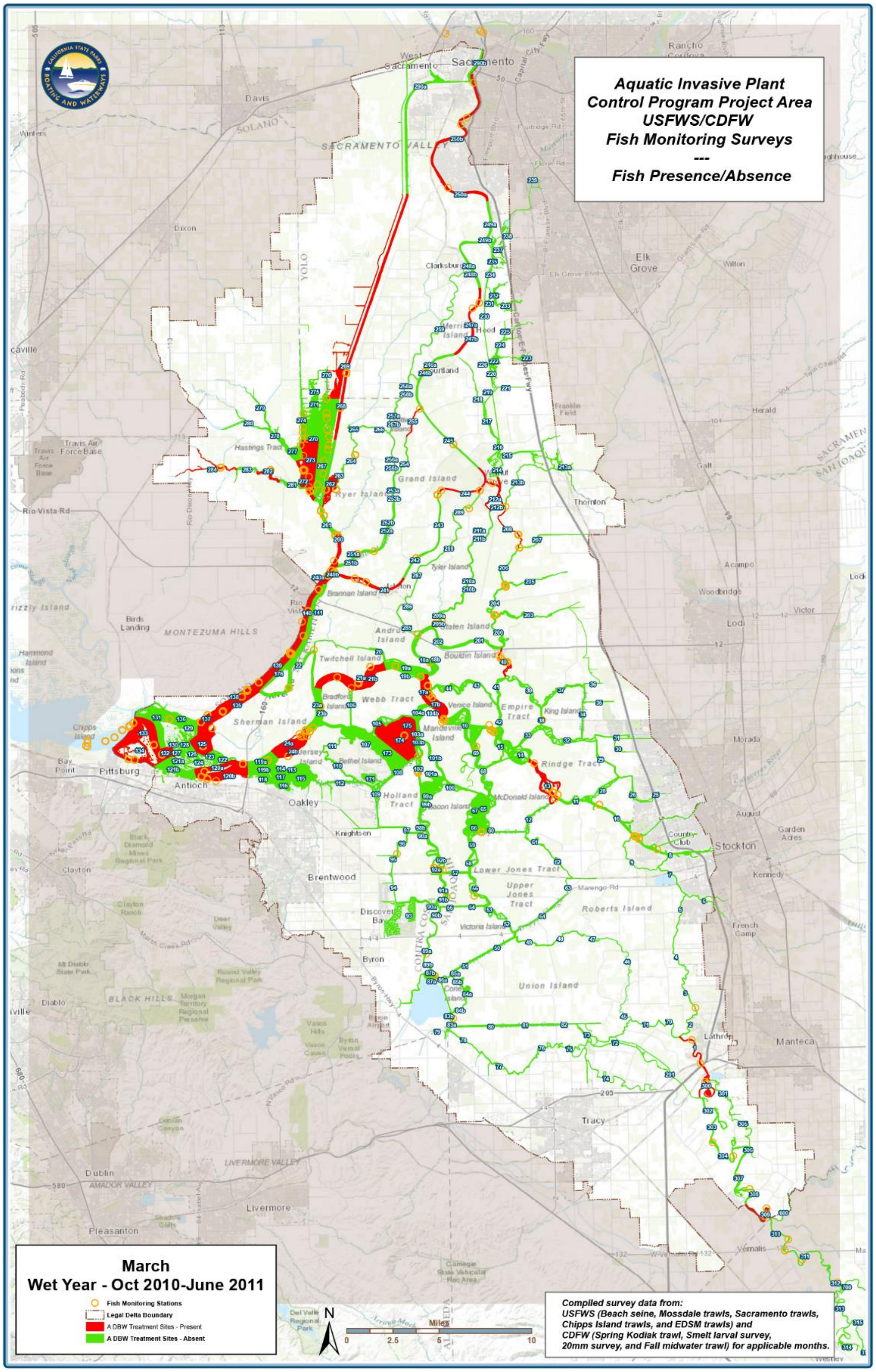
Map #12



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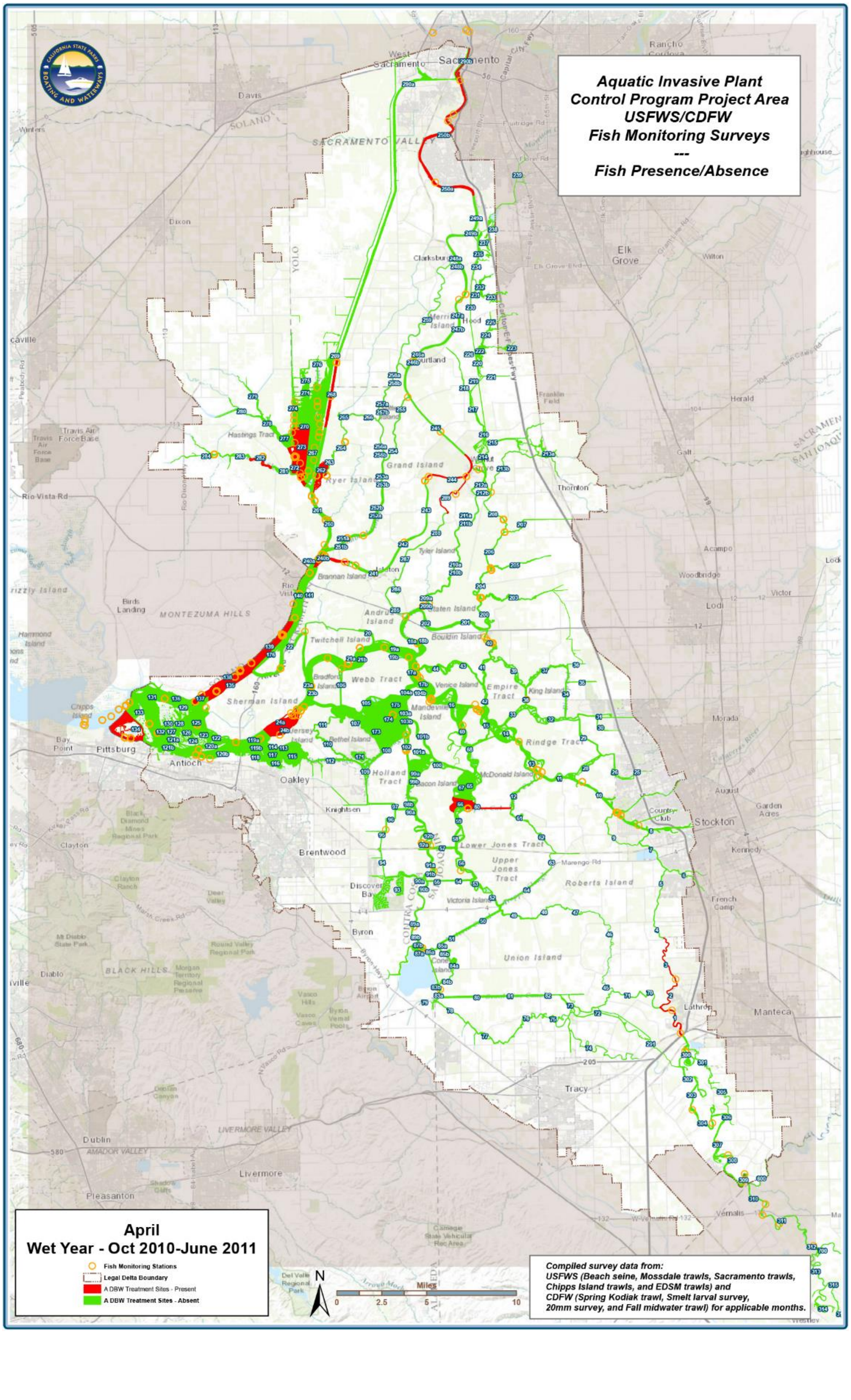
Map #13



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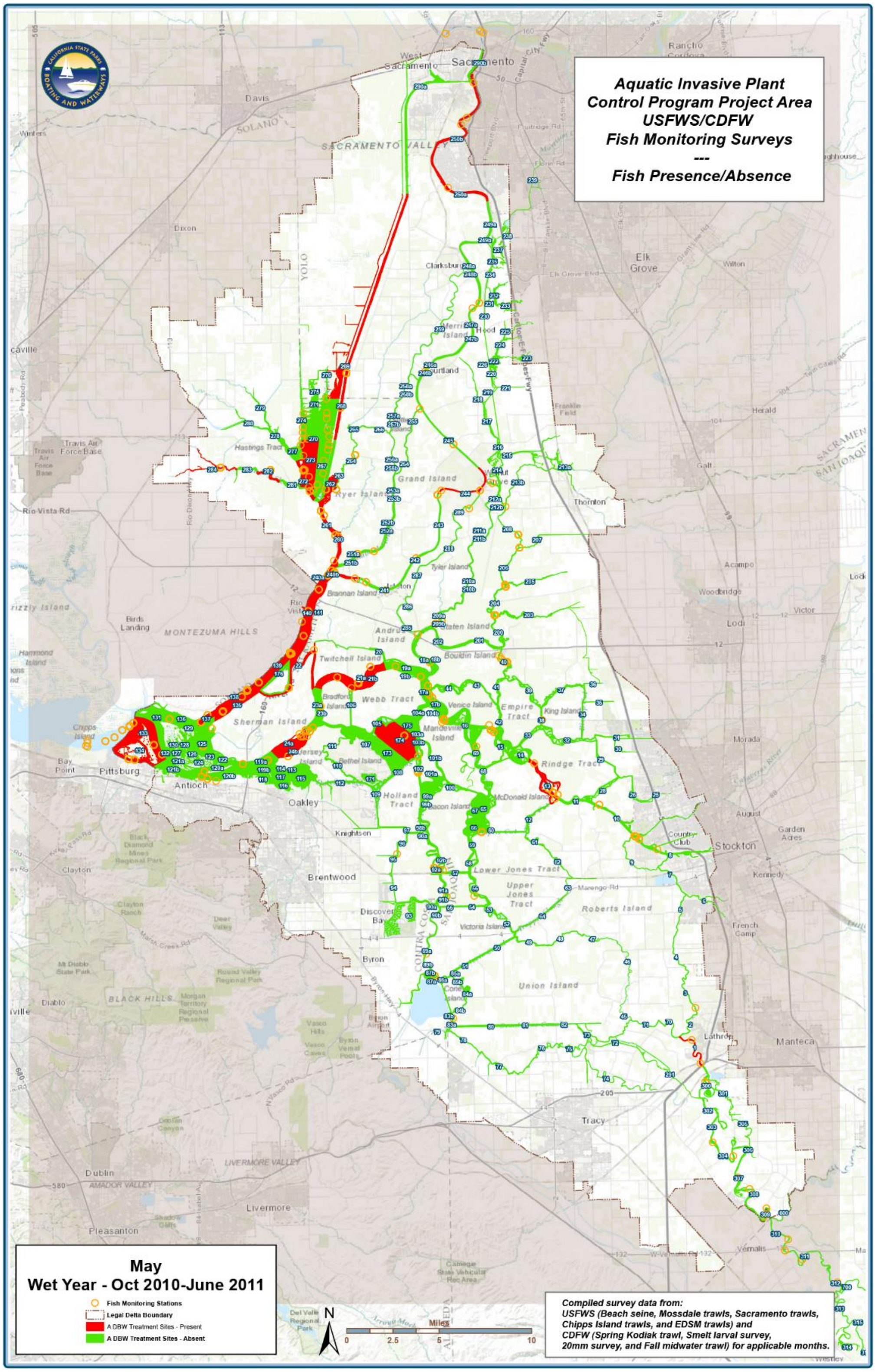
Map #14



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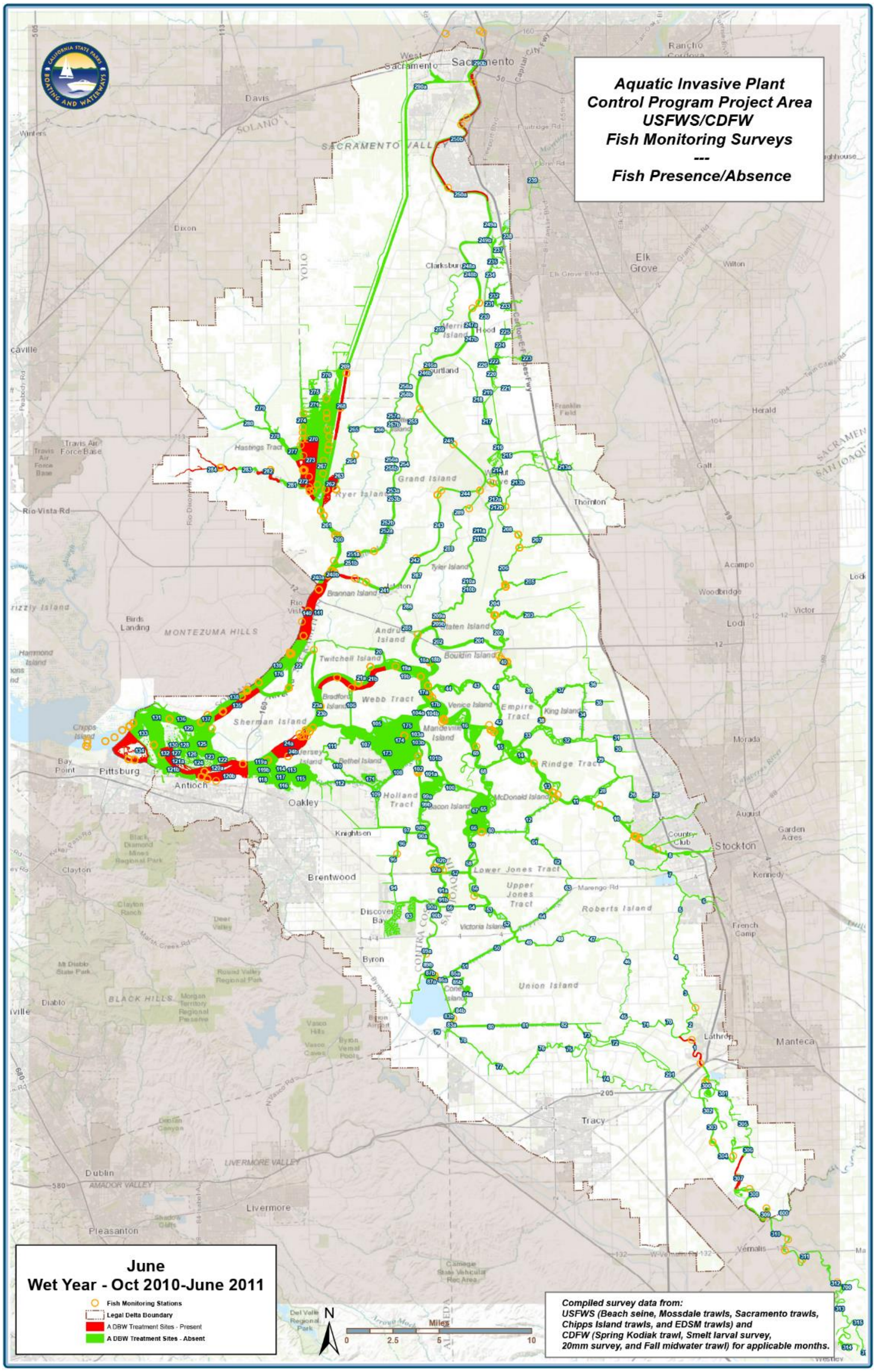
Map #15



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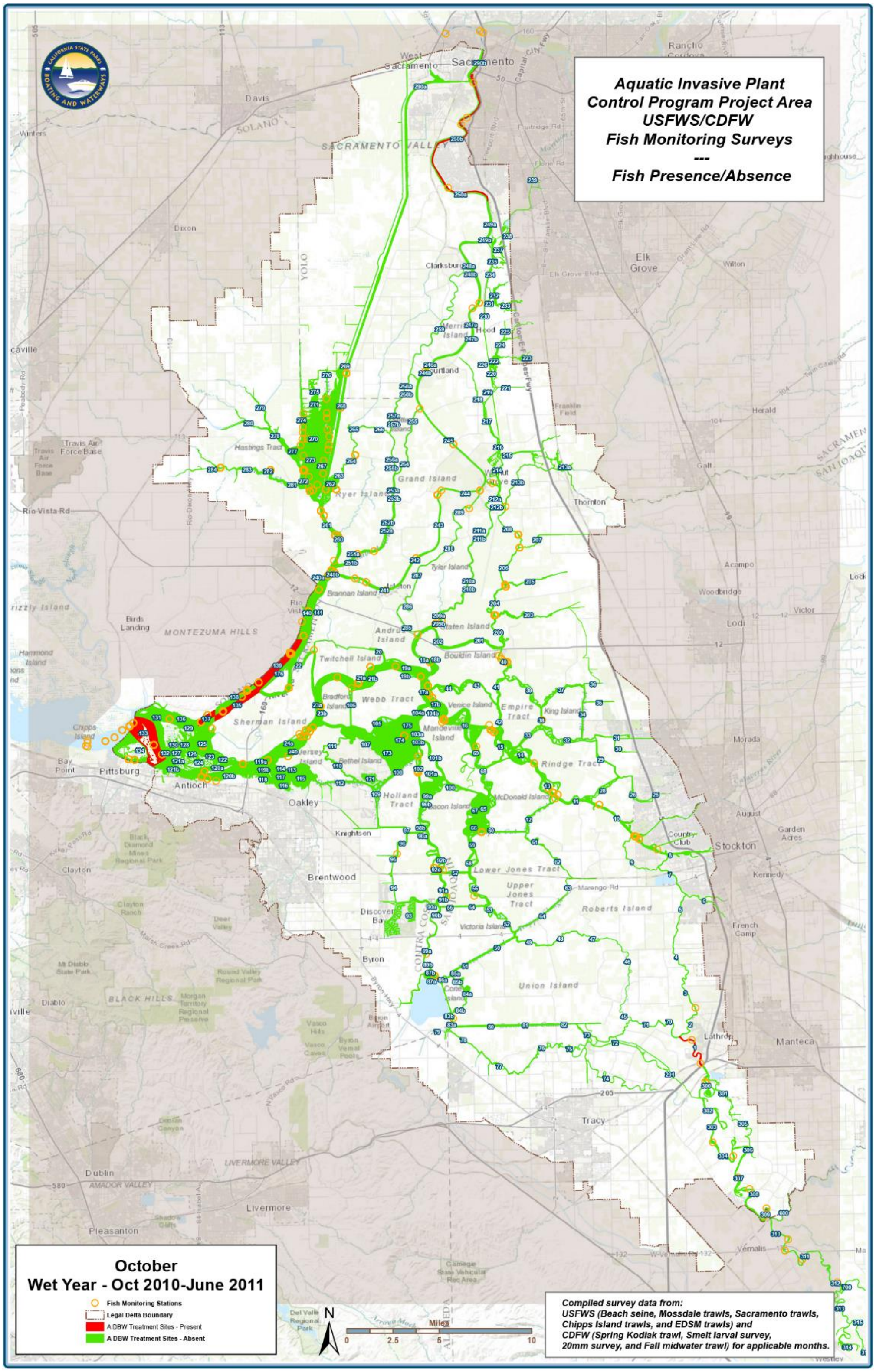
Map #16



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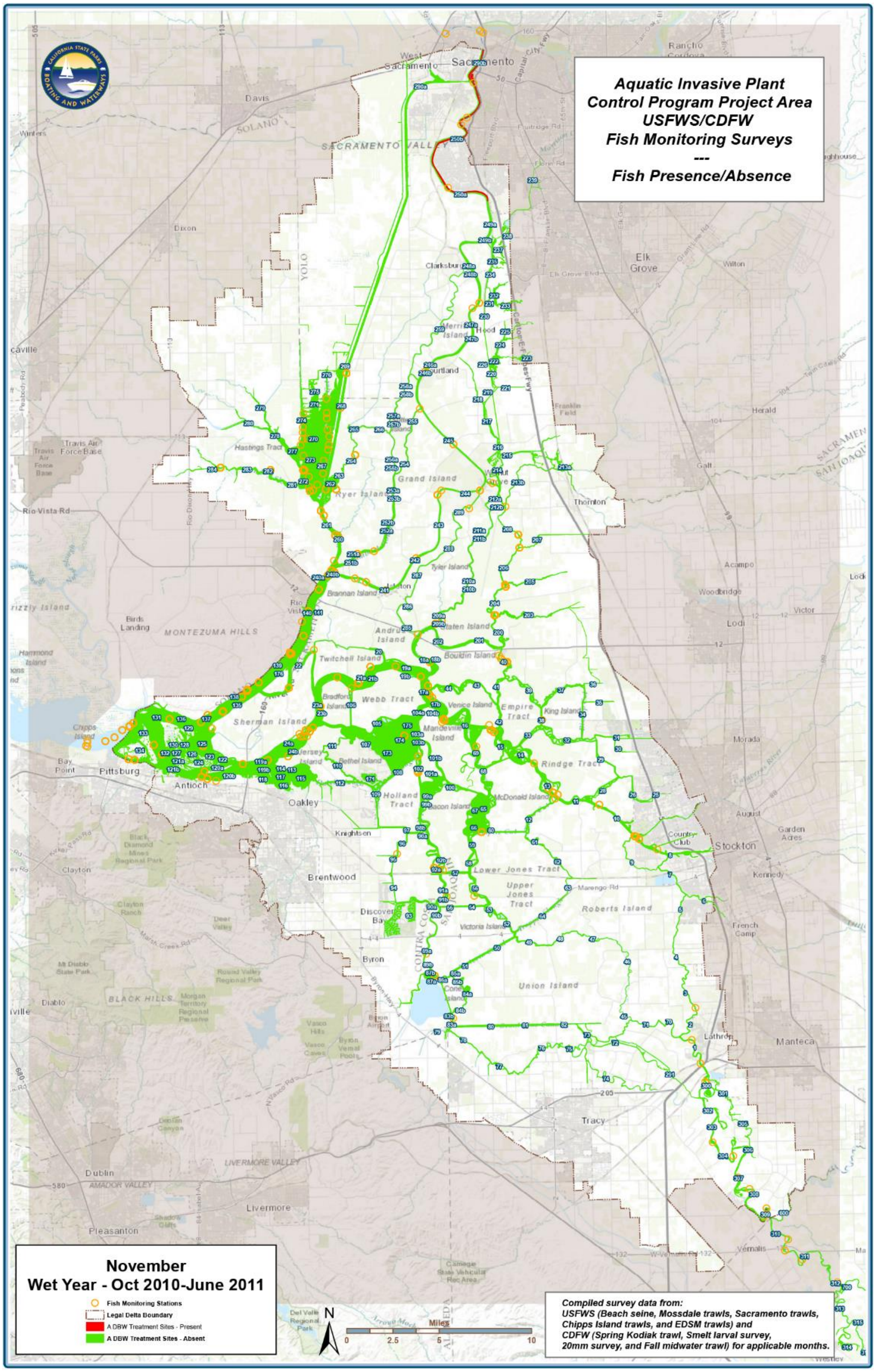
Map #17



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Map #18

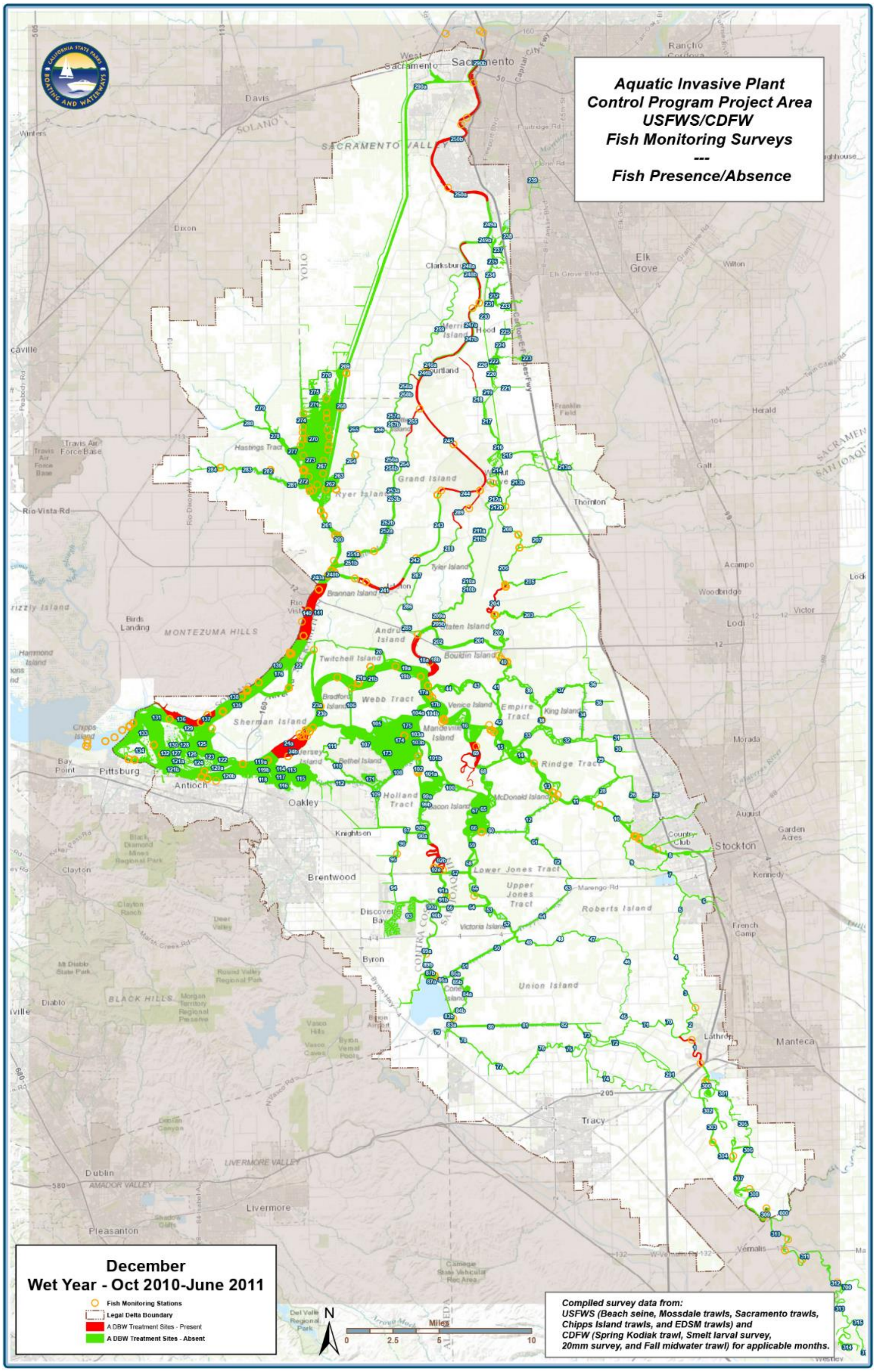
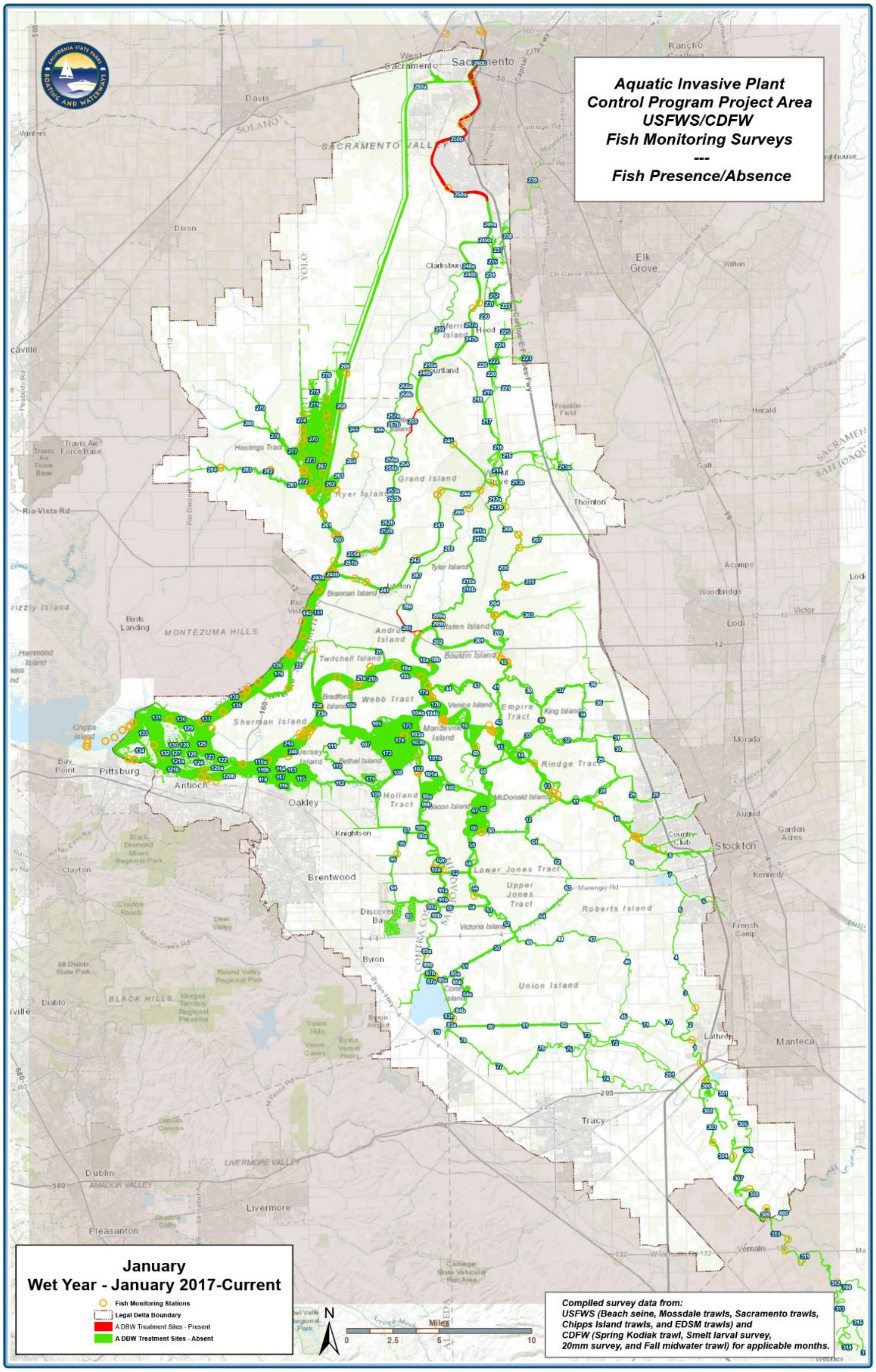


Exhibit 3A-19
Map #19



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Map #20

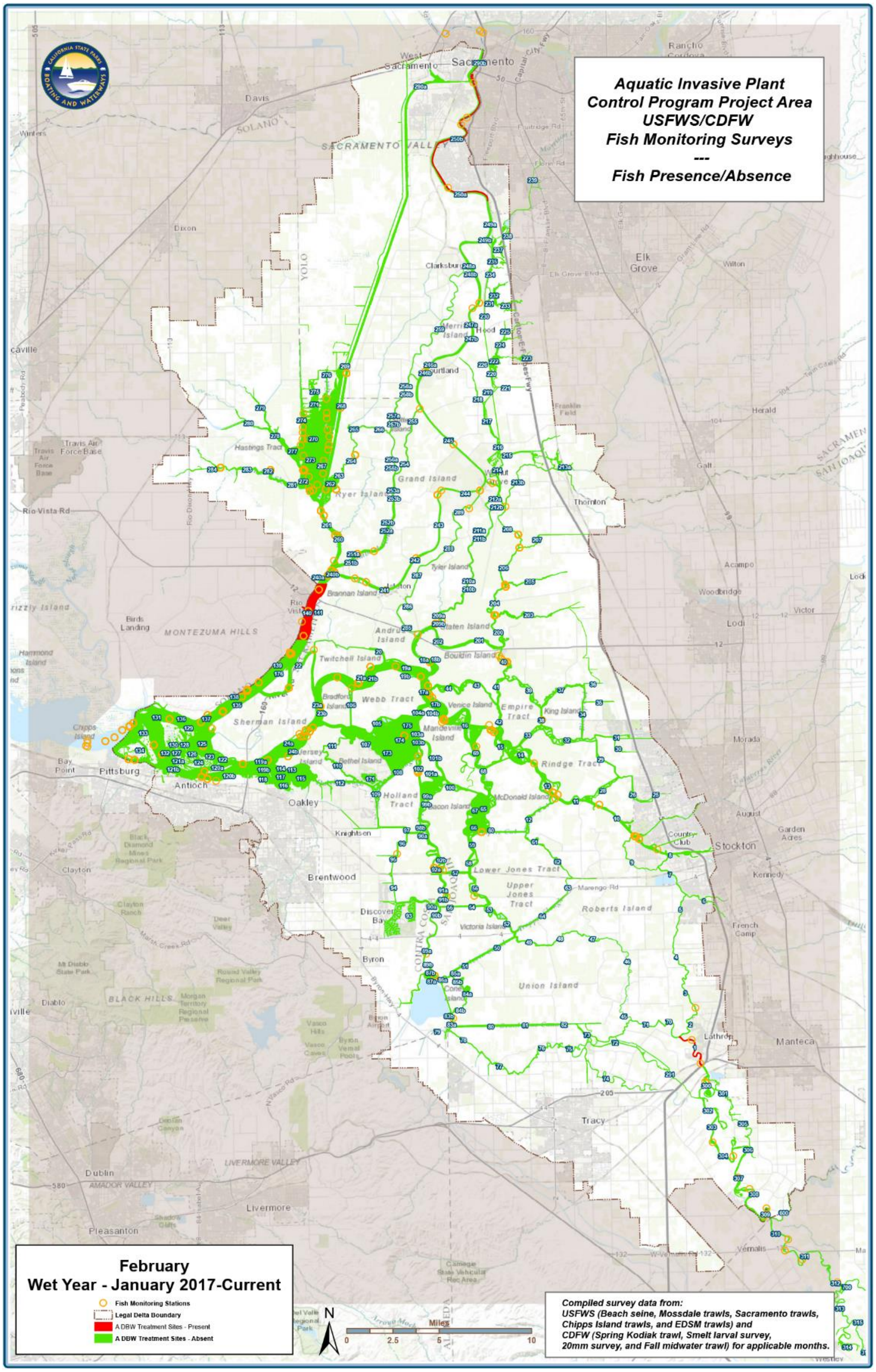

Exhibit 3A-21
Map #21