Water Hyacinth Control Program

FINAL

Programmatic Environmental Impact Report

Volume II – Appendices A to E

November 30, 2009

A program for effective control of Water Hyacinth in the Sacramento-San Joaquin Delta and its tributaries.

Copies of this Final Programmatic Environmental Impact Report in hard copy form, or on computer compact disc (CD), can be obtained from the California Department of Boating and Waterways.

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Cover photo: March 14, 2008, by NewPoint Group, Inc., of the Wheeler Island Duck Club, at Honker Bay.

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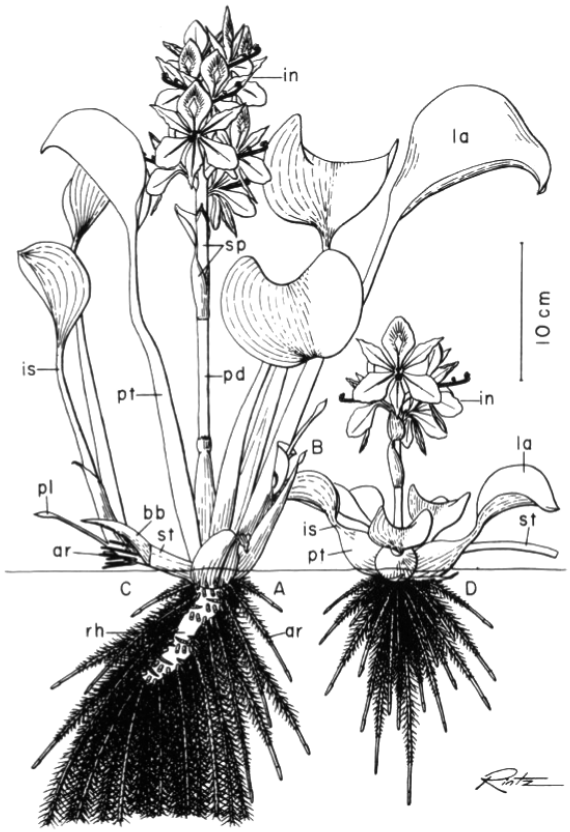

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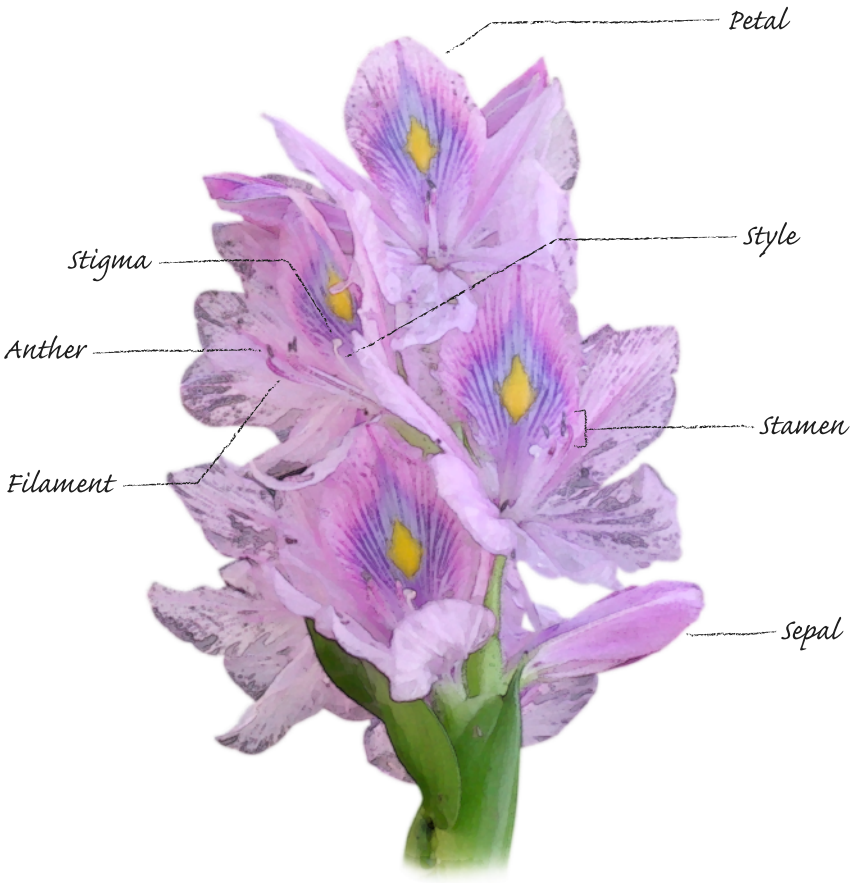
Water hyacinth *(Eichhornia crassipes)*



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Acronyms and Abbreviations

Acronyms and Abbreviations

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.e.** – Active ingredient
5. **AGR** – Agricultural supply (Basin Plan beneficial use)
6. **AHS** – Agricultural Health Study
7. **ALS** – Amyotrophic lateral sclerosis
8. **AMPA** – Aminomethylphosphonic acid
9. **APMP** – Aquatic Pesticide Monitoring Program
10. **Bay-Delta Estuary** – San Francisco Bay and Sacramento-San Joaquin Delta
11. **BA** – Biological Assessment
12. **BDCP** – Bay Delta Conservation Plan
13. **BMP** – Best Management Practices
14. **BO** – Biological Opinion
15. **C** – Centigrade/Celsius
16. **CAC** – County Agricultural Commissioner
17. **CALFED** – California-Federal Bay Delta Program
18. **CCWD** – Contra Costa Water District
19. **CDFA** – California Department of Food and Agriculture
20. **CDFG** – California Department of Fish and Game
21. **CE** – California Endangered
22. **CEQA** – California Environmental Quality Act
23. **CESA** – California Endangered Species Act
24. **cfs** – Cubic feet per second
25. **CI** – Confidence Interval
26. **COA** – Coordinated Operations Agreement
27. **COMM** – Commercial sport fishing (Basin Plan beneficial use)
28. **COLD** – Cold freshwater habitat (Basin Plan beneficial use)
29. **CNDDB** – California Natural Diversity Database
30. **CNPS** – California Native Plant Society
31. **CR** – California Rare
32. **CSC** – California Species of Special Concern

Acronyms and Abbreviations *(continued)*

33. **CT** – California Threatened
34. **CVP** – Central Valley Project
35. **CVRWQB** – Central Valley Regional Water Quality Control Board
36. **CWA** – Clean Water Act
37. **dBA** – Decibels
38. **DBW** – California Department of Boating and Waterways
39. **DCC** – Delta Cross Channel
40. **Delta** – Sacramento-San Joaquin Delta
41. **DMA** – Dimethylamine salt
42. **DO** – Dissolved oxygen, measured in mg/l or ppm
43. **DOC** – California Department of Conservation
44. **DPR** – California Department of Pesticide Regulation
45. **DPS** – Distinct Population Segment
46. **DRERIP** – Delta Regional Ecosystem Restoration Implementation Plan
47. **DWSP** – Delta Water Supply Project
48. **DWR** – California Department of Water Resources
49. **EA** – Environmental Assessment
50. **EC50** – Effective concentration for 50 percent of target
51. **EDCP** – *Egeria densa* Control Program
52. **EFH** – Essential Fish Habitat
53. **EIR** – Environmental Impact Report
54. **EIS** – Environmental Impact Statement
55. **ERP** – Ecosystem Restoration Program
56. **ESA** – Endangered Species Act (federal)
57. **EST** – Estuarine habitat (Basin Plan beneficial use)
58. **ESU** – Evolutionary Significant Unit
59. **EWA** – Environmental Water Account
60. **FC** – Federal Candidate (for consideration of endangered or threatened status)
61. **FCH** – Federal Critical Habitat
62. **FCHP** – Federal critical habitat for this species proposed
63. **FE** – Federal Endangered
64. **FETAX** – Frog Embryo Teratogenesis Assay – *Xenopus*
65. **FIFRA** – Federal Insecticide, Fungicide, and Rodenticide Act
66. **FMWT** – Fall Midwater Trawl

Acronyms and Abbreviations *(continued)*

67. **FONSI** – Finding of No Significant Impact
68. **FT** – Federal Threatened
69. **GI** – Gastrointestinal
70. **GWR** – Groundwater recharge (Basin Plan beneficial use)
71. **HAPC** – Habitat Areas of Particular Concern
72. **HCP** – Habitat Conservation Plan
73. **HQ** – Hazard Quotient
74. **IARC** – International Agency for Registration of Carcinogens
75. **IEP** – Interagency Ecology Program
76. **IND** – Industrial service supply (Basin Plan beneficial use)
77. **IPM** – Integrated Pest Management
78. **K_{oc}** – Soil adsorption coefficient, normalized by organic matter
79. **LC5** – Lethal concentration for 5 percent of subjects
80. **LC10** – Lethal concentration for 10 percent of subjects
81. **LC50** – Lethal concentration for 50 percent of subjects
82. **LD50** – Lethal dose or lethal dietary dose for 50 percent of subjects
83. **LH** – Luteinizing hormone
84. **LOC** – Level of Concern
85. **LOD** – Limit of detection
86. **LOEC** – Lowest Observable Effect Concentration
87. **LOEL** – Lowest Observable Effect Level
88. **MAF** – Million acre feet
89. **MATC** – Maximum Acceptable Toxicant Concentration
90. **MCL** – Maximum Contaminant Level
91. **MCP** – Maintenance Control Practices
92. **MCPA** – 4-chloro-2-methylphenoxyacetic acid
93. **MIGR** – Migration of aquatic organisms (Basin Plan beneficial use)
94. **mM** – millimolar, a concentration of one thousandth of a mole per liter
95. **MOE** – Margin of Error or Margin of Safety
96. **MOU** – Memorandum of Understanding
97. **MRA** – Montane Riverine Aquatic
98. **MRDL** – Maximum Residual Disinfectant Level
99. **MSA** – Magnuson-Stevens Fishery Conservation and Management Act

Acronyms and Abbreviations *(continued)*

100. **MSDS** – Material Safety Data Sheet
101. **MUN** – Municipal and domestic supply
102. **NAV** – Navigation (Basin Plan beneficial use)
103. **NBA** – North Bay Aqueduct
104. **NCCP** – Natural Community Conservation Plan
105. **ND** – Non-detectable
106. **NFPE** – Nontidal Freshwater Permanent Emergent
107. **NHL** – Non-Hodgkin lymphoma
108. **NIH** – National Institute of Health
109. **NMFS** – National Marine Fisheries Service
110. **NOAA-Fisheries** – National Oceanic and Atmospheric Administration-Fisheries (also previously referred to as NMFS, National Marine Fisheries Service)
111. **NOEC** – Non-observable effect concentration
112. **NOEL** – Non-observable effect level
113. **NOI** – Notice of Intent
114. **NOP** – Notice of Preparation
115. **NPDES** – National Pollution Discharge Elimination System
116. **NPE** – Nonylphenol ethoxylates
117. **NRDC** – Natural Resources Defense Council
118. **NTU** – Nephelometric Turbidity Units
119. **OCAP** – Operations Criteria and Plan
120. **OMP** – Operations Management Plan
121. **OMR** – Old and Middle River
122. **OR** – Odds Ratio
123. **OSHA** – Occupational Safety and Health Administration
124. **PCA** – Pest Control Advisor
125. **PEIR** – Program Environmental Impact Report
126. **PFMC** – Pacific Fisheries Management Council
127. **PG&E** – Pacific Gas and Electric
128. **POD** – Pelagic Organism Decline
129. **POEA** – Polyethoxylated tallowamine
130. **ppb** – parts per billion (µg/l)
131. **ppm** – parts per million (mg/l or mg/kg)

Acronyms and Abbreviations *(continued)*

132. **ppt** – parts per thousand (g/l)
133. **PPE** – Personal Protective Equipment
134. **PRO** – Industrial process supply (Basin Plan beneficial use)
135. **PUR** – Pesticide Use Recommendations
136. **QAC** – Qualified Applicator Certificate
137. **QAPP** – Quality Assurance Project Plan
138. **RARE** – Rare, threatened, or endangered species (Basin Plan beneficial use)
139. **RCRA** – Resource Conservation and Recovery Act
140. **REC-1** – Water contact recreation (Basin Plan beneficial use)
141. **REC-2** – Non-water contact recreation (Basin Plan beneficial use)
142. **RfD** – Reference Dose
143. **ROD** – Record of Decision
144. **RPA** – Reasonable and Prudent Alternative
145. **RQ** – Risk Quotient
146. **RR** – Risk Ratio
147. **RUP** – Restricted Use Permit
148. **SDIP** – South Delta Improvement Program
149. **SFA** – Seasonally Flooded Agricultural
150. **SFEI** – San Francisco Estuary Institute
151. **SJRRP** – San Joaquin River Restoration Program
152. **SHELL** – Shellfish harvesting (Basin Plan beneficial use)
153. **SMR** – Standard Mortality Ratio
154. **SMUD** – Sacramento Municipal Utility District
155. **SOD** – Superoxide dismutase
156. **SPWN** – Spawning, reproduction, and/or early development (Basin Plan beneficial use)
157. **STS** – Soft tissue sarcoma
158. **SVWMA** – Sacramento Valley Water Management Agreement
159. **SWB** – State Water Board (Water Resources Control Board)
160. **SWP** – State Water Project
161. **SWRCB** – State Water Resources Control Board
162. **TDF** – Through-Delta Facility
163. **TFE** – Tidal Freshwater Emergent
164. **THM** – Trihalomethane

Acronyms and Abbreviations *(continued)*

165. **TPA** – Tidal Perennial Aquatic
166. **UC** – Upland Cropland
167. **USBR** – United States Bureau of Reclamation
168. **USDA-ARS** – United States Department of Agriculture – Agricultural Research Service
169. **USFS** – United States Forest Service
170. **USFWS** – United States Fish and Wildlife Service
171. **VAMP** – Vernalis Adaptive Management Plan
172. **VFR** – Valley/Foothill Riparian
173. **VRA** – Valley Riverine Aquatic
174. **WARM** – Warm freshwater habitat (Basin Plan beneficial use)
175. **WHCP** – Water Hyacinth Control Program
176. **WHO** – World Health Organization
177. **WILD** – Wildlife habitat (Basin Plan beneficial use)
178. **WOE** – Weight-of-evidence
179. **X2** – the line at which 2ppt (parts per thousand) saline occurs

Appendices

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WHCP Permits

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WHCP Permits

NPDES Statewide General Permit (CAG990005)

California Regional Water Quality Control Board

Central Valley Region

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Alan C. Lloyd, Ph.D.
Agency Secretary

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20 March 2006

Adam Morrill
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NOTIFICATION OF RECEIPT OF NOTICE OF INTENT (NOI) TO COMPLY WITH THE TERMS OF THE STATEWIDE 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)

We have received your NOI to seek coverage under the General Permit. For your reference, your Waste Discharge Identification Number (WDID #) is 5B34AP00002. This number should be referenced in letters and reports submitted regarding this permit.

Under the terms of the permit, the operations described in the NOI may commence upon the submittal of the NOI and annual fee (if first time enrollee). All conditions of this General Permit must be complied with. Any act of noncompliance constitutes a violation of the Clean Water Act and the Porter-Cologne Water Quality Control Act and is grounds for enforcement action.

As part of your NOI packet, we have reviewed your Aquatic Pesticides Application Plan (APAP). Your APAP is complete. Please be aware of the permit conditions and the following important date:

1. The Annual Report [1] must be submitted to the Regional Board by **1 March** of each year.

Failure to submit the required report is subject to a minimum penalty of $3,000 for each 30-day period a report is not submitted. This penalty is mandatory per § 13385.1 of the California Water Code.

If you have any questions, I can be reached at (916) 464-4636 or at ealejandrino@waterboards.ca.gov

Emily Alejandrino

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Environmental Scientist
Agriculture Unit

[1] Contents of Annual Report can be found on page 4 under Monitoring and Reporting Program in the General Permit.

STATE WATER RESOURCES CONTROL BOARD

FACT SHEET

WATER QUALITY ORDER NO. 2004-0009-DWQ

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL IN WATERS OF THE UNITED STATES GENERAL PERMIT NO. CAG990005

BACKGROUND

On March 12, 2001, the Ninth Circuit Court of Appeals held that discharges of pollutants from the use of aquatic pesticides to waters of the United States require coverage under a National Pollutant Discharge Elimination System (NPDES) permit (Headwaters, Inc. v. Talent Irrigation District[1]). The Talent decision was issued just prior to the major season for applying aquatic pesticides. Because of the serious public health, safety, and economic implications of delaying applications of aquatic pesticides, the State Water Resources Control Board (State Water Board) adopted an interim NPDES permit, Water Quality Order (Order) No. 2001-12-DWQ on an emergency basis.

Order No. 2001-12-DWQ imposed requirements on any discharge of aquatic pesticides from public entities to waters of the United States in accordance with the State Water Board's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (Policy). The Policy establishes procedures for implementing water quality standards for priority pollutants[2] in NPDES permits.

Section 5.3 of the Policy allows for short-term or seasonal exceptions from its requirements for resource or pest management conducted by public entities. In order to qualify for an exception from meeting priority pollutant standards, a public entity must fulfill the requirements listed in section 5.3 and the State Water Board must decide to grant the exception. Among other requirements, entities seeking an exception to complying with water quality standards for priority pollutants must submit California Environmental Quality Act (CEQA) documents. Because of the emergency adoption of Order No. 2001-12-DWQ, the State Water Board invoked an exemption to the requirements of section 5.3 and issued the permit incorporating a categorical exception to water quality standards for priority pollutants.

Order No. 2001-12-DWQ required that dischargers develop a best management practices (BMPs) plan that minimizes adverse impacts to receiving waters and a monitoring and reporting plan that is representative of each type of aquatic pesticide application.

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[1] Headwaters, Inc. v. Talent Irrigation District, (9th Cir. 2001) 243 F.3d 526.

[2] The water quality standards for priority pollutants are listed in 40 Code of Federal Regulations (CFR), § 131.38 (b)(1), and include acrolein and copper.

ORDER NO. 2001-12-DWQ LAWSUIT

In August 2001, Waterkeepers Northern California (Waterkeepers) filed a lawsuit against the State Water Board challenging several aspects of Order No. 2001-12-DWQ. In a settlement agreement, the State Water Board agreed to fund a comprehensive aquatic pesticide monitoring program (APMP) that would assess pesticide alternatives, receiving water toxicity caused by residual aquatic pesticides, and other monitoring parameters. The State Water Board contracted with the San Francisco Estuary Institute (SFEI) to conduct the program. On February 5, 2004, SFEI provided the draft report to APMP's Steering Committee. On April 13, 2004, SFEI circulated the final report publicly. The report made the following conclusions:

1. **2,4-D**

   The study monitored the effects of 2,4-D D (in the 2,4-D dimethylamine salt formulation) and a nonylphenolethoxylate surfactant at the Stone Lake National Wildlife Refuge. No toxicity was observed at this sampling event.

2. **Acrolein**

   APMP work with acrolein this year focused on development of a field sampling method that would allow for accurate determination of concentrations in the environment. Toxicity testing is difficult for acrolein due to its rapid breakdown and volatilization. As acrolein is labeled as an aquatic pesticide, it is also functionally a biocide with very low Lowest Observed Effect Concentration (LOEC)/No Observed Effect Concentration (NOEC) values. Therefore, anywhere acrolein is found, it can be considered toxic. The most appropriate monitoring at this time would be chemical characterization only. The current U.S. Environmental Protection Agency (USEPA) method has an adequate Method Detection Limit (MDL); however, commonly used field sampling techniques are insufficient and will lead to erroneous results.

3. **Copper**

   Copper sulfate applications were monitored in two reservoirs. In one reservoir treatment area treated with dissolved copper sulfate, toxicity (in the form of mortality) was observed for at least 24 hours after application in juvenile trout. Lethal (mortality) and sublethal (reproduction) toxicity were observed in Ceriodaphnia (water flea) up to one week after application.

   In the reservoir treated with granular copper sulfate applications, significant mortality was observed in Ceriodaphnia and juvenile trout water toxicity tests immediately after application within the treatment area. Follow up water sampling was not conducted because the reservoir received only one application in 2003. Mortality and growth inhibition was also observed in a number of the sediment samples. Sediment copper concentrations exceeded National Oceanographic and Atmospheric Administration

(NOAA) Effect Ratio Low and Medium values. However, the limited toxicity observed in the sediments indicates that the majority of the copper is not bioavailable.
Chelated copper pesticides were monitored during applications in two irrigation canal systems. One system used a product of mixed copper ethanolamines and the other the same product of mixed copper ethanolamines in an emulsified formulation. Chelated copper formulations are likely to have distinct behavior from copper sulfate and each other in aquatic environments based on the chelating agent and other adjuvants.

In both systems where monitoring occurred, the water samples were almost uniformly toxic pre-application and post application. Therefore, no definitive conclusions can be drawn about the toxicity of mixed copper ethanolamines. Copper carbonate is the active ingredient in other chelated copper products and no monitoring of copper carbonate-based pesticides was conducted.

4. **Glyphosate**

Glyphosate was monitored at several locations. It was commonly used with a nonylphenolethoxylate surfactant. No toxicity was found to be associated with the glyphosate applications.

5. **Diquat Dibromide or Diquat**

Diquat was sampled at two locations (one small pond and one Delta slough). At both sites, 100 percent mortality was observed in the acute and chronic Ceriodaphnia toxicity tests one hour after application. Twenty four hours after application to the Delta slough, no toxicity was observed in the treatment area. Additional samples were not gathered from the pond site.

6. **Fluridone**

Fluridone was sampled at several locations. In Costa Ponds, the fluridone water concentration ranged from 0.05 µg/L before application to 7.2 µg/L one hour after application. The fluridone porewater concentration ranged from 0.08-1.24 µg/L. Toxicity was observed in all *Selenastrum* tests conducted, including the water collected before pre-application. This indicates that fluridone was not the only cause of toxicity. No toxicity was observed in the Ceriodaphnia or fathead minnow tests. Monitoring during an application of liquid fluridone, the pesticide was found to accumulate in the tissue of fish and crayfish two weeks after application. At four weeks after the cessation of treatment, tissue concentrations had returned to pre-application levels.

In Big Bear Lake, the fluridone sediment concentrations ranged from 5.88-300 µg/L. Toxicity in the Hyallela tests (10 and 28 day tests) was observed but bore no correlation to sediment fluridone concentration. The sediment fluridone concentration was also not correlated to the pore water fluridone concentration.

7. **Triclopyr**

Only one site treated with triclopyr (in the triclopyr, triethylamine salt formulation) was monitored in 2003. It was used with a nonylphenolethoxylate surfactant. No toxicity was observed.

8. **Nonionic Surfactants**

There is a wide range of surfactants available, but the most commonly used surfactants for aquatic pesticides applications are Target Prospreader Activator and R-11. Both are nonylphenolethoxylate surfactants. There are only limited data available on surfactants.

In summary, these results show that no toxicity was found with the use of 2,4-D, glyphosate and triclopyr. Toxicity testing is difficult for acrolein. Results were inconclusive for diquat and fluridone. Toxicity was conclusive only in copper-based applications. To confirm these results, additional monitoring will be conducted in 2004.

The APMP includes a section on Alternative or Non-Chemical Methods to Aquatic Pest Control. The report found that water quality impacts from alternative or non-chemical methods were temporary or not apparent. Turbidity increased, but usually returned to pre-project status within days. Shredding in stagnant water bodies indicated decreases in dissolved oxygen, increases in nutrients, and an increase in biochemical oxygen demand. Shredding is not selective in its impacts and will shred non-target species within the area being controlled. In water bodies where harvesting was conducted routinely, the effects on water quality appeared to be short-lived, and unlikely to adversely affect beneficial uses. Alum and gypsum may be a substitute for copper in controlling algae, but more research is needed to adequately produce useful results.

Data results indicated that the relative cost-effectiveness of conventional pesticides versus alternative non-chemical methods varied among different project scenarios, including water body and the particular weed being targeted. Using conventional pesticides for floating or submerged weeds in Delta water bodies proved most cost effective. A combination of chemical application and mechanical harvesting for milfoil in Big Bear Lake was most cost effective. Mowing was most effective for vegetation in wetlands. The use of alternative or non-chemical methods should be done at the appropriate time in the life cycle of the targeted weed and at the correct pesticide dilution to increase efficiency.

DISCHARGER MONITORING DATA REVIEW

State Water Board staff reviewed the 2003 annual monitoring reports from dischargers under Order No. 2001-12 DWQ and found that water quality in application areas return to background water quality levels when pesticides are applied with the proper label instructions. Results show that acrolein levels are not detectable after 24 hours. Generally, diquat and glyphosate returned to below water quality objective levels five days after application. Copper dissipated within two

weeks when applied in small amounts or percentages. If greater amounts of copper were used, it took up to four weeks for the water to return to levels observed before application.

AQUATIC PESTICIDE PROJECTS

The use of aquatic pesticides by Control Agencies[3] is necessary to manage resources and maintain beneficial uses, such as to ensure the proper operation of municipal and agricultural irrigation water distribution systems, maintain capacity in flood control channels, maintain boating access, and control invasive species. Weed control projects are undertakings necessary to control a specified type of weed to an acceptable level in the treatment area[4] that is being managed. The need for aquatic pesticide application events as part of a project can vary from week to week and from season to season due to such things as temperature and flow of the receiving water. It is a balancing act between managing resources and impairing resources. This General Permit and the other governmental regulatory programs described below provide different pieces to ensure this balancing act is successful.

RELATED AQUATIC PESTICIDE REGULATIONS

Pesticide formulations contain disclosed active ingredients that yield toxic effects on target organisms and may also have toxic effects on non-target organisms. They also contain inactive or inert ingredients, as well as adjuvants. Adjuvants are compounds chosen by the discharger and added to aquatic pesticides during an application event to increase the effectiveness of the aquatic pesticides on target organisms. Inactive ingredients and adjuvants are trade secrets and have not been publicly disclosed.

According to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), USEPA has sole jurisdiction of pesticide label language. Label language and any changes thereto must be approved by USEPA before the product can be sold in this country. As part of the labeling process, USEPA evaluates data submitted by registrants to ensure that a product used according to label instructions will cause no harm (or "adverse impact") on non-target organism that cannot be reduced (or "mitigated") with protective measures or use restrictions. Registrants are required to submit data on the effects of pesticides on target pests (efficacy) as well as effects on non-target pests. Data on non-target effects include plant effects (phytotoxicity), fish and wildlife hazards (ecotoxicity), impacts on endangered species, effects on the environment, environmental fate, breakdown products, leachability, and persistence; however, FIFRA is not necessarily as protective of water quality as the Clean Water Act (CWA).

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[3] The Control Agency is the permitted discharger authorized by this General Permit. It is the agency responsible for controlling the weeds or pests. In some cases, such as irrigation districts, the Control Agency may own the conveyance system. In other cases, such as application to Delta waters, the Control Agency may not own the water body or conveyance system into which aquatic pesticides are applied. Additionally, the Control Agency may be the pesticide applicator, but it may also contract with a separate entity that does the actual pesticide application. In either case, however, the Control Agency must ensure that the discharge is in compliance with this General Permit.

[4] The treatment area is the area being treated by the aquatic pesticide to control weeds and therefore, the area being targeted to receive lethal doses of aquatic pesticides. It is the responsibility of the discharger to define the treatment area for each specific location that it discharges to.

Department of Pesticide Regulation (DPR) is responsible for reviewing the toxic effects of aquatic pesticide formulations and determining whether a pesticide is suitable for use in California's waters through a registration process. To do this, DPR also reviews data submitted by the registrants. While DPR cannot require manufacturers to make changes in labels, DPR can refuse to register products in California unless manufacturers address unmitigated hazards by amending the pesticide label. Consequently, requirements that are specific for use in California are included in many pesticide labels that are approved by USEPA.

DPR also licenses applicators of pesticides designated as a "restricted material"[5]. To legally apply these pesticides, the applicator must be a holder of a Qualified Applicator Certificate or work under the supervision of someone who is certified. For aquatic pesticides, the qualified Applicator Certificate must have the category "aquatic."

State regulations require that the County Agricultural Commissioners (CACs) determine if a substantial adverse environmental impact will result from the proposed use of a restricted material. The CAC implements this by issuing Use Permits for the application of pesticides considered as restricted materials. In evaluating local conditions, CACs may use information supplied by DPR, which suggests permit conditions that reflect minimum measures necessary to protect people and the environment. State regulations require that specific types of information be provided in an application to the CACs for a pesticide use permit. The CACs review the application to ensure that appropriate alternatives were considered and that any potential adverse effects are mitigated. The CACs also conduct pre-project inspections on at least five percent of projects.

ADDITION OF NEWLY REGISTERED AQUATIC PESTICIDES

Finding 31 of this Order states that it may be reopened to add coverage of aquatic pesticides that have been newly registered by DPR. On August 30, 2005, DPR registered imazapyr for aquatic application.

Imazapyr is a herbicide used to control floating and emergent aquatic vegetation, including shoreline grass, broadleaf weeds, brush species, and perennials. It does not control submerged or mostly submerged foliage. Imazapyr is a slow-acting amino acid synthesis inhibitor. It has an average water half-life of four days with photodegradation as the primary form of degradation in water.

Imazapyr acts quicker and is less toxic than other low-volume herbicides. According to the San Francisco Estuary Invasive Spartina Project's May 4, 2005 report titled *Use of Imazapyr Herbicide to Control Invasive Cordgrass (Spartina spp.) in the San Francisco Estuary*, imazapyr in water rapidly degrades via photolysis. The report further states that a number of field studies demonstrated that imazapyr rapidly dissipated from water within several days, no detectable residues of imazapyr were found

[5] DPR designates a pesticide as a restricted material in California if it poses hazards to public health, farm workers, domestic animals, honeybees, the environment, wildlife, or crops other than those being treated ("Regulating Pesticides: A Guide to Pesticide Regulation in California," October 2001, DPR).

in either water or sediment within two months; and in estuarine systems, dilution of imazapyr with the incoming tides contributes to its rapid dissipation suggesting that imazapyr is not environmentally persistent in the estuarine environment and does not result in significant impacts to water quality. The report concludes that imazapyr herbicides can be a safe, highly effective treatment for control and eradication of non-native *Spartina* species in the San Francisco Estuary and offers an improved risk scenario over the existing treatment regime with glyphosate herbicides.

PERMIT COVERAGE/NOTIFICATION REQUIREMENTS

This General Permit addresses the discharge of aquatic pesticides related to the application of 2,4-D, acrolein, copper, diquat, endothall, fluridone, glyphosate, imazapyr, and triclopyr-based aquatic pesticides to surface waters for the control of aquatic weeds. Aquatic pesticides that are applied to application areas[6] within waters of the United States in accordance with FIFRA label requirements and Use Permit restrictions are not considered pollutants. However, pollutants associated with aquatic pesticide application require coverage under this General Permit. These include over-applied or misdirected pesticide products and pesticide residues. Residues are any pesticide byproduct, or breakdown product, or pesticide product that is present after the use of the pesticide to kill or control the target weed.

This General Permit does not cover agricultural storm water discharges or return flows from irrigated agriculture because these discharges are not defined as "point sources" and do not require coverage under an NPDES permit. This General Permit also does not cover other indirect or nonpoint source discharges from applications of pesticides, including discharges of pesticides to land that may be conveyed in storm water or irrigation runoff. This General Permit does not cover the discharge of pollutants related to applications of pesticides other than 2,4-D, acrolein, copper, diquat, endothall, fluridone, glyphosate, imazapyr, and triclopyr based pesticides; however, this General Permit includes a re-opener statement specifying that the permit may be reopened for the specific purpose of modifying the list of pesticides whose associated discharge is authorized by this General Permit.

The basic requirements of this General Permit include:

1. The applicator must follow all pesticide label instructions and any Use Permits issued by a CAC;

2. The discharger must be licensed by DPR or work under the supervision of someone who is licensed if the aquatic pesticide is considered a restricted material;

3. The discharger must comply with effluent limitations including developing and implementing an Aquatic Pesticide Application Plan (APAP);

4. The discharger must comply with applicable receiving water limitations; and

[6] The application area is the area to which aquatic pesticides are directly applied.

5. The discharger must comply with monitoring and reporting requirements.

To obtain coverage under this General Permit, a discharger must submit a completed Notice of Intent to Comply with the Terms of this General Permit (Notice of Intent, NOI), a vicinity map, and the first annual fee to the appropriate Regional Water Quality Control Board (Regional Water Board). These items constitute a complete application package, the submittal of which authorizes the discharge of pollutants associated with the application of aquatic pesticides in compliance with this General Permit, unless the Regional Water Board requests additional information necessary to determine the applicability of the discharge to this General Permit.

Each enrollment will cover all discharges occurring within the boundaries of that Regional Water Board. Separate NOIs are required for discharges located within more than one Regional Water Board's boundary, as defined in section 13200 of the California Water Code (CWC). Only one annual fee is required for all applicable discharges from one entity.

Authorization to discharge under this General Permit is terminated upon receipt by the discharger, from the appropriate Regional Water Board(s), of a Notice of Exclusion (NOE),[7] or upon the adoption of either an individual or other general NPDES permit covering the discharge. Alternatively, the discharger may initiate termination under this General Permit by submitting a letter to the appropriate Regional Water Board explaining why coverage under the General Permit is no longer necessary.

WATERS OF THE UNITED STATES

This General Permit regulates the discharge of pollutants associated with the application of aquatic pesticides to waters of the United States. "Waters of the United States" include all waters currently used, used in the past, or susceptible to use in interstate commerce; all interstate waters; all other waters the use, degradation, or destruction of which would or could affect interstate or foreign commerce. Waters of the United States include waters used by interstate or foreign travelers for recreation, waters from which fish or shellfish are taken and sold in interstate or foreign commerce, impoundments[8] of and tributaries to waters of the United States, and wetlands adjacent to waters of the United States. Waters of the United States include, but are not limited to, irrigation and flood control channels that exchange water with waters of the United States.

WATER QUALITY STANDARDS

The CWA defines Water Quality Standards as 'Provisions of state or federal law which consist of designated uses for the waters of the United States, water quality criteria for waters based

[7] An NOE is a one-page notice that indicates that the discharger or proposed discharger is not eligible for coverage under this General Permit and states the reason why. This justification can include, but is not limited to, necessity to comply with a total maximum daily load or to protect sensitive water bodies.

[8] Surface water impoundments include, but are not limited to, drinking water reservoirs, ornamental lakes and ponds, and impoundments used to store irrigation water.

upon such uses, and antidegradation policies. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the Act." [40 Code of Federal Regulations (CFR) section 131.3(i)].

In California, *Water Quality Control Plans* designate the beneficial uses of waters of the State and water quality objectives (WQOs) to protect those uses. The *Water Quality Control Plans* are adopted by the State and Regional Water Boards through a formal administrative rulemaking process, and, upon approval by USEPA, the WQOs for waters of the United States (generally surface waters) become State water quality standards.

USEPA has established water quality criteria in California for priority pollutants in the National Toxics Rule and the California Toxics Rule (CTR). The CTR criteria are also water quality standards.

EFFLUENT LIMITATIONS

NPDES permits for discharges to surface waters must meet all applicable provisions of sections 301 and 402 of the CWA. These provisions require controls that utilize best available technology economically achievable (BAT), best conventional pollutant control technology (BCT), and any more stringent controls necessary to reduce pollutant discharge and meet water quality standards.

Title 40, CFR section 122.44 states that if a discharge causes, has the reasonable potential to cause, or contributes to an excursion (Reasonable Potential) of a numeric or narrative water quality criterion, the permitting authority must develop effluent limits as necessary to meet water quality standards. Title 40, CFR section 122.44(k)(3) allows these effluent limits to be requirements to implement BMPs if numeric effluent limits are infeasible. It is infeasible for the State Water Board to establish numeric effluent limitations in this General Permit because:

1. The application of aquatic pesticides is not necessarily considered a discharge of pollutants according to the Talent decision. The regulated discharge is the discharge of pollutants associated with the application of aquatic pesticides. These include over-applied and misdirected pesticide product and pesticide residue. At what point the pesticide becomes a residue is not precisely known and varies depending on such things as target weed, water chemistry, and flow. Therefore, in the application of aquatic pesticides, the exact effluent is unknown;

2. It would be impractical to treat the numerous short duration intermittent pesticide releases to surface waters from many different locations; and

3. Treatment, in many cases, may render the pesticide useless for aquatic weed control.

Therefore, the effluent limitations contained in this General Permit are narrative and include requirements to develop and implement an APAP that describes appropriate BMPs, including compliance with all pesticide label instructions, and to comply with receiving water limitations.

The BMPs required herein constitute BAT and BCT and will be implemented to minimize the area and duration of impacts caused by the discharge of aquatic pesticides in the treatment area and to allow for restoration of water quality and protection of beneficial uses of the receiving waters to pre-application quality following completion of a treatment event.

APAP

An APAP is a comprehensive plan developed by the discharger that describes the project, the need for the project, what will be done to reduce water quality impacts, and how those impacts will be monitored. Specifically, the APAP must contain the following elements:

1. Description of the water body(ies) or water body systems being controlled;

2. Description of what weed(s) are being controlled and why;

3. Discussion of control tolerances (i.e., how much growth can occur before action is necessary);

4. Discussion of the factors influencing the decision to use aquatic pesticides in regards to those tolerances (pros and cons);

5. Type(s) of aquatic pesticides used[9], the method in which they are applied, and the adjuvants used;

6. Description of the application area and the treatment area in the system;

7. Other control methods used (alternatives) and what their limitations are;

8. How much product is needed and how this is determined;

9. Monitoring plan (See Attachment C), including the location of representative site(s);

10. If applicable, list the gates or control structures and inspection schedule of those gates or control structures to ensure that they are not leaking;

11. If the Control Agency has been granted a section 5.3 exception, describe the exception period. If weeds are also controlled outside of this period, describe how is it ensured that receiving water criteria are not exceeded;

12. Description of the BMPs to be implemented; and

13. Evaluation of other available BMPs to determine feasible alternatives to the selected aquatic pesticide application project that could reduce potential water quality impacts.

[9] List the types and the names of aquatic pesticides used or anticipated to be used. If additional or alternative pesticides are used during the year, amend the APAP and note this in the annual report.

The development of BMPs provides the flexibility necessary to establish controls to minimize the area and duration of impacts caused by the discharge of aquatic pesticides. This flexibility allows dischargers to implement different BMPs for different types of applications and different types of waters.

RECEIVING WATER LIMITATIONS

Once an aquatic pesticide has been applied to an application area, the pesticide product can actively treat the target species within the treatment area. During the treatment event, the aquatic pesticide is at a sufficient concentration to actively kill or control target weeds. When active ingredient concentrations are below this effective concentration, the aquatic pesticide becomes a residue. The minimum effective concentration, and the time required to reach it, vary due to site specific conditions, such as flow, target species, and water chemistry. The Receiving Water Limitations require that an application event does not result in an exceedance of water quality standards in the receiving water. The receiving water includes:

1. Anywhere outside of the treatment area at any time, and

2. Anywhere inside the treatment area after completion of the treatment event.

In recognition of the variability in the temporal extent of a treatment event, this General Permit does not require it to be discretely defined. Instead, post-event monitoring of the water is required no more than a week from the time of aquatic pesticide application.

For those dischargers that have been granted a section 5.3 exception, the event may result in "short-term or seasonal" exceedance of water quality standards for priority pollutants in the receiving water. Again, there is no discrete definition of short-term but the intent is to allow the exception to apply for some period of time, such as the summer months (June, July, and August) and in some years extending through September due to weather. The exception is not intended to apply all year.

The discharger may apply aquatic pesticides longer than would be considered short-term or seasonal. However, it must demonstrate that exceedances of priority pollutant standards occur only during the defined short-term or season. It is up to the discharger to make this demonstration. The justification must be incorporated into the APAP and it must be confirmed through monitoring, if necessary.

To protect all designated beneficial uses of the receiving water, the most protective (lowest) and appropriate (to implement the CTR criteria and WQOs in the *Water Quality Control Plans*) limit should be selected as the water quality limit for a particular water body and constituent. In many cases, water quality standards include narrative, rather than numerical, water quality objectives. In such cases, numeric water quality limits from the literature or publicly available information may be used to ascertain compliance with these standards.

For acrolein and copper, the freshwater aquatic life protection objective (in *Water Quality Control Plans*) and criterion (from CTR) are applicable. For 2,4-D, diquat, endothall, fluridone, and glyphosate, the most protective limits are those for the protection of the MUN beneficial use. The resulting numeric limits shall be used to assess impacts from pollutants associated with aquatic pesticide application on the quality of waters of the State and the beneficial uses that they are able to support. The absence of WARM or COLD criteria for a constituent does not mean that those beneficial uses or other beneficial uses are absent in the receiving water. It simply means that there are no State or USEPA-based numeric water quality objectives or criteria to implement those beneficial uses. This is the case for 2,4-D, diquat, fluridone, and glyphosate.

Below are brief descriptions of the active ingredients covered by this General Permit. The surfactant (a type of adjuvant) nonylphenol is also discussed.

2,4-D

Applications of 2,4-D-based aquatic pesticides are used to control broad-leaved aquatic weeds, as well as water hyacinth. It is applied using a spray nozzle.

The California Department of Health Services (DHS) and USEPA have promulgated a Primary Maximum Contaminant Level (MCL) of 70 µg/L for 2,4-D that is applicable for drinking water sources, or water bodies with a domestic or municipal supply (MUN) designation. This General Permit requires compliance with the Primary MCL for discharges to water bodies with MUN designation. The receiving water limitation for discharge of 2,4-D to water bodies with MUN designation is 70 µg/L.

Acrolein

Acrolein-based aquatic pesticides are used to control submerged and floating vegetation. Application is accomplished by directly injecting the acrolein-based pesticides into flowing water.

Acrolein is a priority pollutant, and its criteria are specified in Table (b)(1) of the CTR. Criteria are established for human consumption of water and organisms (320 µg/L)[10] and only organisms (780 µg/L).[11] The maximum recommended concentration of acrolein for the control of submerged or surface dwelling target species[12] is 15,000 µg/L.

[10] These criteria apply to waters of the Sacramento-San Joaquin Delta and other waters of the State defined as inland waters that include a municipal use (MUN) use designation.
[11] These criteria apply to waters of the State defined as bays and estuaries including San Francisco Bay upstream to and including Suisun Bay and the Sacramento-San Joaquin Delta; and waters of the State defined as inland waters without and MUN use designation.
[12] Acrolein safety manual.

Acrolein is recommended to be applied at a concentration that is greater than the CTR criteria or applicable WQOs[13]. Therefore, there would be a Reasonable Potential for aquatic pesticide applications to cause residue concentrations to exceed the CTR criteria or WQOs.

All Regional Water Board Basin Plans contain narrative criteria prohibiting discharges from causing toxicity in receiving waters. USEPA found acute and chronic toxic effects to freshwater organisms at 68 µg/L and 21 µg/L, respectively.[14] The Lowest Observed Effect Levels (LOELs) of 68 mg/L and 21 µg/L were determined from toxicity testing to freshwater organisms. Therefore, in order to protect freshwater aquatic life from toxic effects resulting from acrolein-based aquatic pesticide residue, this General Permit requires that receiving water residue of acrolein be less than the chronic 21 µg/L LOEL.

This General Permit requires that:

1. Acrolein residue, resulting from applications to inland surface waters, bays, and estuaries with uses of water that support warm and cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates (designation WARM and COLD), be less than 21 µg/L;

2. Acrolein residue, resulting from applications to inland surface waters, bays, and estuaries with a MUN designation, be less than 320 µg/L; and

3. Acrolein residue, resulting from applications to inland surface waters, bays, and estuaries without a MUN or warm and cold designation, be less than 780 µg/L.

Copper

Copper-based aquatic pesticides are used to control algal and aquatic plant growth. There are many different formulations, and application methods vary from pitching water-soluble tablets to direct injection of copper-based liquid products.

Copper-based aquatic pesticide labels recommend applications of copper can be up to 1,000 µg/L or more. Applicable water quality criteria for fresh and salt water, discussed below, are less than 1,000 µg/L. As described above for acrolein, limitations are required for discharges that have the Reasonable Potential to cause an exceedance of applicable criteria or WQOs.

Copper is a priority pollutant and the criteria for dissolved copper are specified in Table (b)(1) of the CTR. Criteria are established for maximum and continuous discharges in fresh and salt water. Conversion factors were also used to convert dissolved copper limitations to the total copper limitations assigned in this General Permit. The continuous or chronic criterion has been chosen in this case because it is the most protective considering that in many cases aquatic pesticides are applied several times per season and the limitation is for pesticide residue in receiving waters.

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[13] Acrolein could be applied in concentrations much higher that CTR criteria or WQOs, which could in turn cause residue concentrations to exceed the criteria.
[14] USEPA Goldbook, 1986.

Freshwater copper criteria need to be adjusted for water hardness and may significantly differ from one irrigation system to another. Water hardness shall be determined by the calculation[7] or titration method. It is necessary to specify a range of total copper limitations in this General Permit because of the possible variations in freshwater hardness statewide. The total copper limitation will be calculated using the following equation:

$$\text{Maximum Residual Total Copper Concentration} = \exp[0.8545(\ln(hardness)-1.702)]$$

For example, for application in water with a hardness of 325 mg/L, in order to be in compliance with this General Permit, the copper concentration in the receiving water must be less than 32.7 µg/L.

Diquat

Diquat-based aquatic pesticides are used to control aquatic weeds. Diquat is a quick-acting contact pesticide, causing injury only to the parts of the plant to which it is applied.

All Regional Water Board Basin Plans contain narrative criteria prohibiting discharges from causing toxicity in receiving waters. USEPA has established an MCL of 20 µg/L for diquat that is applicable for drinking water sources or water bodies with an MUN designation. Therefore, to prevent receiving waters with an MUN designation from toxicity due to the use of diquat-based aquatic pesticides, this General Permit requires compliance with USEPA's MCL of 20 µg/L. The receiving water limitation for discharges of diquat to water bodies with MUN designation is 20 µg/L.

Endothall

Endothall-based aquatic pesticides are used to control a variety of aquatic weeds. USEPA has promulgated a Primary MCL of 100 µg/L for endothall that is applicable for drinking water sources or water bodies with an MUN designation. This General Permit requires compliance with USEPA Primary MCLs for discharges to water bodies with MUN designation. Therefore, the receiving water limitation for discharge of endothall to water bodies with MUN designation is 100 µg/L.

Fluridone

Fluridone is a systemic herbicide that kills the entire plant and is generally non-selective, which means most submersed plants and some floating leaved plants will be killed by fluridone during the treatment. USEPA has a reference dose as a drinking water level of 560 µg/L. This General Permit requires compliance with USEPA's reference dose of 560 µg/L for discharges to water bodies with MUN designation. Therefore, the receiving water limitations for discharge of fluridone to water bodies with MUN designation is 560 µg/L.

[7] Hardness, mg equivalent $CaCO_3$ mg/L = 2.497[Ca, mg/L] + 4.118[Mg, mg/L].

Glyphosate

Glyphosate-based aquatic pesticides are used to control emergent foliage of aquatic weeds. Glyphosate-based aquatic pesticides are ineffective on submerged or mostly submerged foliage. USEPA has promulgated a Primary MCL of 700 µg/L for glyphosate that is applicable for drinking water sources or water bodies with an MUN designation. This General Permit requires compliance with USEPA Primary MCLs for discharges to water bodies with MUN designation. Therefore, the receiving water limitation for discharge of glyphosate to water bodies with MUN designation is 700 µg/L.

Imazapyr

Currently, there are no State or USEPA-based numeric objectives or criteria for imazapyr. Therefore, this General Permit does not have receiving water limitations for imazapyr. However, it requires dischargers who use imazapyr to monitor their applications.

Nonylphenol

Nonylphenol is soluble in water and moderately resistant to natural degradation in water. Because of its chemical properties and widespread use as a chemical intermediate (surfactant), concerns have been raised over the risks it poses to both freshwater and saltwater organisms. Currently, there are no State or USEPA-based numeric objectives or criteria for nonylphenol. However, this General Permit requires monitoring for nonylphenol when this type of adjuvant is used.

Triclopyr

Triclopyr is an herbicide used for the control of perennial broadleaf weeds. Triclopyr has little tendency to hydrolyze, and photolysis is the main degradation pathway in natural water. In river water, the half-life of triclopyr was determined to be 1.3 days in artificial and natural light. Currently, there are no State or USEPA-based numeric objectives or criteria for triclopyr. However, this General Permit requires dischargers who use triclopyr to monitor their applications.

CEQA EXEMPTION

Pursuant to CWC section 13389, Regional Water Boards are exempt from the requirement to comply with Chapter 3, Division 13 of the Public Resources Code (PRC) when adopting NPDES permits. While adoption of this General Permit is exempt from preparation of a CEQA document, public entities receiving exceptions pursuant to section 5.3 of the Policy were required to prepare a CEQA document, as discussed below.

POLICY EXCEPTION

The Policy contains implementation provisions for water quality standards. The Policy provides that categorical exceptions may be granted to allow short-term or seasonal exceptions from meeting the priority pollutant criteria/objectives if 'necessary to implement control measures ... for resource or pest management... conducted by public entities to fulfill statutory requirements." The Policy specifically refers to vector or weed control, and pest and fishery management as bases for categorical exceptions. The exceptions are available only to public entities that have adequately provided the following, as listed in the Policy:

1. CEQA documentation including notifying potentially affected public and government agencies;

2. A detailed description of the proposed action which includes the proposed method of completing the action;

3. A time schedule;

4. A discharge and receiving water monitoring plan that specifies monitoring prior to application events, during application events, and after completion with the appropriate quality control procedures; and

5. Any necessary contingency plans.

The State Water Board requested in a letter dated August 6, 2003 that aquatic pesticide users who seek exceptions provide the above information. All the above information must have been submitted to the State Water Board prior to the adoption of this General Permit for public entities to obtain a section 5.3 exception.

The public entities listed in Attachment E have prepared Initial Studies, Negative Declarations (ND), and Notices of Determination or Mitigated Negative Declarations (MND) for the discharge of aquatic pesticides in accordance with CEQA (PRC §21000 et seq.) to comply with the exception requirements of section 5.3 of the Policy. The boards of each public entity, as the lead agencies under CEQA, approved the Final ND/MND and determined that the discharge of aquatic pesticides in their respective projects would not have significant effect on the environment. Those public entities have determined that the water quality or related water quality impacts identified in the environmental assessments of the ND/MND are less than significant. The boards of each public entity, as the lead agencies under CEQA, approved the Final ND/MND and are not required to meet priority pollutant criteria until after completion of the application event.

As required in section 15096 of the CEQA Guidelines, the State Water Board, as Responsible Agency under CEQA, considered the ND/MND approved by the board of each public entity and finds that the projects will have less than significant water quality impact if the waste discharge requirements in this General permit are followed. Accordingly, the public entities listed in Attachment E are hereby granted an exception pursuant to section 5.3 of the policy.
Aquatic pesticide users not listed in Attachment E are required to meet all applicable priority pollutant criteria in receiving waters, consistent with applicable federal and State regulations.

Several lawsuits have been filed which challenge the Negative Declarations adopted by various applicants for this General Permit. Pursuant to section 15233 of the CEQA Guidelines, the State Water Board must treat the Negative Declarations at issue as if they comply with CEQA and must continue to process the applications according to the time limits for responsible agency action contained in Government Code section 65952. Accordingly, the following applicants are granted a conditional exception under section 5.3 of the Policy: Merced Irrigation District, Modesto Irrigation District, Oakdale Irrigation District, South San Joaquin Irrigation District, and Turlock Irrigation District. The conditional exceptions granted by this General Permit only provide permission to proceed with the project at the applicant's risk. An applicant's conditional exception shall automatically be withdrawn in the event that a court enters a final decision finding that the applicant's Negative Declaration was inadequate.

The California Department of Food and Agriculture (CDFA) has determined that its ongoing projects to eradicate hydrilla are exempt from the requirements of CEQA because the activities are necessary to prevent or mitigate an emergency pursuant to PRC section 21080 (b)(4). The bases for this determination are that the CDFA Hydrilla Program is mandated under sections 403 and 6048 of the Food and Agriculture Code and the Governor and/or the CDFA Secretary has declared that an emergency situation existed as each eradication project began. Although CDFA has determined the CDFA Hydrilla Program is exempt form CEQA, CDFA will coordinate all eradication activities with federal, state and local regulatory agencies to ensure no long-term significant environmental impacts occur.
As required in section 15096 of the CEQA Guidelines, the State Water Board, as a Responsible Agency under CEQA, considered the exemption claimed by CDFA and finds that the projects will have less than significant water quality impact if the waste discharge requirements in this General Permit are followed. Accordingly, CDFA is hereby granted an exception pursuant to section 5.3 of the Policy, as long as the Governor or the CDFA Secretary has declared that an emergency situation exists prior to project implementation.

MONITORING REQUIREMENTS

This General Permit requires that dischargers comply with the Monitoring and Reporting Program (MRP), Attachment C of this General Permit. The goals of the MRP are to:

1. Determine compliance with the receiving water limitations and other requirements specified in this General Permit;

2. Measure and improve the effectiveness of the APAP;

3. Support the development, implementation, and effectiveness of BMPs;

4. Assess the chemical, physical, and biological impacts on receiving waters resulting from aquatic pesticide applications;

5. Assess the overall health and evaluate long-term trends in receiving water quality;

6. Demonstrate that water quality of the receiving waters following completion of resource or weed management projects are equivalent to pre-application conditions;

7. Identify and characterize aquatic pesticide application projects conducted by the discharger; and

8. Ensure that projects that are monitored are representative of all pesticides and application methods used by the discharger.

The MRP provided by this General Permit is considered baseline monitoring. Monitoring plans proposed by entities receiving a section 5.3. exception as a mitigation measure must also comply with that monitoring plan proposed in their CEQA document where the two plans differ.

The APMP, conducted by SFEI as an outcome of the settlement agreement, evaluated the toxicity of the 2,4-D, acrolein, copper, diquat, fluridone, glyphosate, and triclopyr. The APMP report states that no toxicity was found with the use of 2,4-D, glyphosate, and triclopyr; toxicity testing is difficult for acrolein due to its rapid breakdown and volatility; results were inconclusive for diquat and fluridone; and toxicity in copper-based applications was confirmed. Additionally, during the prior permit term, there were no incidents to suggest that toxicity testing is warranted.

The purpose of toxicity testing is to determine if the aquatic pesticide applications cause toxicity in the receiving water. Since the active ingredients, surfactants, and breakdown products used in these aquatic pesticides are known and have receiving water limitations and/or are analyzed for in the MRP, toxicity testing is not necessary. This General Permit specifies receiving water limitations for each active ingredient that has State or USEPA-based water quality objectives or criteria and when available for their breakdown products and surfactants. These limitations are adequate to protect the beneficial uses of the receiving waters.

In order to meet the MRP's monitoring goals, dischargers are required to provide for all application sites a map and information on surface area and/or volume of treatment area and any other information used to calculate dosage and quantity of each pesticide used. In addition, dischargers are required to conduct visual monitoring at all application sites during each application event. Furthermore, dischargers are also required to conduct water quality monitoring at 10 percent of all its application sites during each application event. Ten percent is used as a standard quality control protocol in sample analysis methodology to ensure that the process stays within acceptable criteria. The MRP requires sampling a minimum of two representative sites for a discharger with 20 application sites or less and 10 percent of all application sites for a discharger with more than 20 application sites. Sampling 10 percent of all the application sites is adequate to obtain information necessary to evaluate the effects of all the applications.

Additionally, specific monitoring and requirements are also provided for irrigation canals or similar systems that have reasonable control over treated water.

PERMIT RE-OPENERS

This General Permit contains a re-opener provision that allows the General Permit to be re-opened for the specific purpose of granting exceptions to agencies that have adequately met the section 5.3 exception criteria. Alternatively, dischargers may request an individual permit with the appropriate Regional Water Board.

The re-opener provision also allows for additional aquatic pesticides to be added to those authorized by this General Permit or to revise the monitoring and reporting program to allow for group or regional monitoring.

STATE WATER RESOURCES CONTROL BOARD

WASTE DISCHARGE REQUIREMENTS

WATER QUALITY ORDER NO. 2004-0009-DWQ

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL IN WATERS OF THE UNITED STATES GENERAL PERMIT NO. CAG990005

The State Water Resources Control Board (hereafter State Water Board) finds that:

1. States may request authority to issue general National Pollutant Discharger Elimination System (NPDES) permits pursuant to Title 40, Code of Federal Regulations (CFR) section 122.28. On June 8, 1989, the State Water Board submitted an application to the U.S. Environmental Protection Agency (USEPA) requesting revisions to its NPDES program in accordance with 40 CFR sections 122.28, 123.62, and 403.10. The application included a request to add general permit authority to its approved NPDES program. On September 22, 1989, the USEPA, Region 9, approved the State Water Board's request and granted authorization for the State to issue general NPDES permits.

2. Federal regulation at 40 CFR section 122.28(a)(1) allows NPDES permits to be written to cover a category of discharges within State political boundaries.

3. According to section 301(a) of the federal Clean Water Act (CWA), discharges of pollutants from point sources to waters of the United States are prohibited unless they are in compliance with an NPDES permit.

4. In order to manage resources and protect beneficial uses, many agencies use aquatic pesticides to control aquatic weeds.

5. On March 12, 2001, the Ninth Circuit Court of Appeals held that discharges of pollutants from the use of aquatic pesticides in waters of the United States require coverage under an NPDES permit (Headwaters, Inc. v. Talent Irrigation District[1]).

6. Because of the serious public health, safety, and economic implications of delaying pesticide applications, in 2001 the State Water Board adopted Water Quality Order (Order) No. 2001-12-DWQ, Statewide General NPDES Permit for Discharges of Aquatic Pesticides to Waters of the United States, on an emergency basis to provide immediate NPDES permit coverage for broad categories of aquatic pesticide use in California.

7. In August 2001, Waterkeepers Northern California (Waterkeepers) filed a lawsuit against the State Water Board challenging several aspects of Order No. 2001-12-DWQ. Major aspects of the challenge included the emergency adoption of the Order without compliance with the

[1] Headwaters, Inc. v. Talent Irrigation District, (9th Cir. 2001) 243 F.3d 526.

California Environmental Quality Act (CEQA) and other exception requirements of the State Water Board's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (Policy); failure to address cumulative impacts; and failure to comply with the California Toxics Rule (CTR).

8. In a settlement of the Waterkeepers' lawsuit, the State Water Board agreed to fund a comprehensive aquatic pesticide monitoring program (APMP) that would assess receiving water toxicity caused by aquatic pesticide residues. Available data from the APMP were used to develop the terms and conditions of this General Permit.

9. The results of the APMP show that no toxicity was found with the use of 2,4-D, glyphosate, and triclopyr; toxicity testing is difficult for acrolein due to its rapid breakdown and volatilization; toxicity effects were inconclusive for diquat and fluridone; and toxicity in copper-based applications was confirmed.

10. Pesticide formulations may include "active ingredients"[2] and "inert ingredients"[3]. Adjuvants[4] or surfactants may be added to the active ingredients in the application equipment that is used in the delivery of the pesticide.

11. Pollutants associated with aquatic pesticide application include over- applied and misdirected pesticide product and pesticide residues. Pesticide residues are pesticide byproducts, breakdown products, or pesticide products that are present after the use of the pesticide for controlling the target weed.

12. This General Permit is intended to cover the discharge of pollutants associated with the application of 2,4-D, acrolein, copper, diquat, endothall, fluridone, glyphosate, and triclopyr-based aquatic pesticides to surface waters associated with controlling aquatic weeds.

13. On August 30, 2005, the California Department of Pesticide Regulation (DPR) registered imazapyr for aquatic application. On September 7, 2005, this General Permit was modified to allow the discharge of pollutants associated with the application of imazapyr-based aquatic pesticides to surface waters for aquatic weed control.

14. The aquatic pesticides covered by this General Permit are applied directly into the water body and/or directly to organisms in the water or on the water surface with the intent of killing or controlling the target aquatic organisms. The impacts of these chemicals may not be limited to the target organisms–other plants and aquatic life in the treatment area[5] may be

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[2] Active ingredients are manufacturer disclosed ingredients that yield toxic effects on target organisms.
[3] Inert ingredients are additional ingredients that are not toxic to target organisms. These ingredients are often trade secrets and therefore not always disclosed by the manufacturer.
[4] Adjuvants are ingredients that are added to aquatic pesticides during a treatment event. These ingredients are chosen by the discharger, based on site characteristics, and typically increase the effectiveness of aquatic pesticides on target organisms.
[5] The treatment area is the area that is treated by the aquatic pesticide to control weeds and therefore, the area being targeted to receive lethal doses of aquatic pesticides. It is the responsibility of the discharger to define the treatment area for each specific location that it discharges to.

impacted. Due to water movement at the treatment locations, residual pesticides can be carried to adjacent areas while concentrations in the water are still high enough to cause adverse impacts not only to aquatic organisms but also to other beneficial uses such as irrigation, municipal water supplies, and recreation (such as swimming).

15. As part of the pesticide registration process of pesticides for use in California, USEPA and the Department of Pesticide Regulation (DPR) evaluate data submitted by registrants to ensure that a product used according to label instructions will cause no harm or adverse impact on non-target organisms that cannot be reduced or mitigated with protective measures or use restrictions. While DPR conducts these tests it does not require or conduct Compliance Monitoring.

16. DPR and the County Agricultural Commissioners (CACs) regulate the sale and use of pesticides in California. The use of pesticides must be consistent with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) pesticide label instructions. If applying a pesticide designated as a restricted material, applicators must either be licensed by DPR with a Qualified Applicator Certificate or work under the supervision of someone who is licensed and obtain Use Permits from CACs. For the use of aquatic pesticides, a Qualified Applicator Certificate with the category "aquatic" is required, and their use must be reported to the CACs where required by law or by agreement with DPR.

17. DPR regulates the use of pesticide-treated commodities and sites where needed to ensure that pesticide residues do not pose a hazard to human health or the environment. DPR also regulates the use of pesticides to reduce the release of residues from treated sites. This includes regulation of wastes generated by applications not in accordance with all laws and regulations, including drift from applications.

18. Under this General Permit, aquatic pesticide discharges require minimal or no treatment systems to meet limits and pose no significant threat to water quality. As such, they are eligible for Category 3 in section 2200(b)(9) of Title 23, California Code of Regulations (CCR). This category is appropriate because aquatic pesticide applications incorporate best management practices (BMPs) to control potential impacts to beneficial uses, and this General Permit prohibits pollutant discharge associated with aquatic pesticide application from causing exceedance of CTR criteria or water quality objectives. The annual fee associated with this rating can be found in section 2200(b)(9) of Title 23, CCR.

19. Section 122.44(k)(3) of 40 CFR allows effluent limits to be in the form of BMP requirements, if numeric effluent limits are infeasible. Numeric effluent limits for pollutant discharges associated with the application of aquatic pesticides are infeasible. Therefore, this General Permit requires the implementation of BMPs. The BMPs are identified in the discharger's Aquatic Pesticides Application Plan (APAP) to control and abate the discharge of pollutants associated with aquatic pesticide applications. In addition, where State or USEPA-based water quality objectives or criteria are available, this General Permit includes numeric receiving water limitations.

20. This General Permit requires submittal of a Notice of Intent to Comply with the Terms of this General Permit (NOI) to obtain permit coverage.

21. If the area of aquatic pesticide application extends beyond a Regional Water Quality Control Board (Regional Water Board) boundary, discharges in each Regional Water Board shall be covered by a separate NOI under this General Permit. Only one annual fee must be submitted to the State Water Board.

22. Although a discharge may be eligible for coverage under this General Permit, the appropriate Regional Water Board may determine that the discharge must be regulated under an individual permit or a different general NPDES permit. If an individual or another general NPDES permit is issued for a discharge, then the applicability of this General Permit to the discharge is immediately terminated on the effective date of the other permit.

23. The State Water Board has considered antidegradation pursuant to 40 CFR section 131.12 and State Water Board Resolution No. 68-16. Discharges must be consistent with both State and federal antidegradation policies. The conditions of this General Permit require aquatic pesticide discharges to meet applicable water quality objectives. Waters of exceptional quality may be degraded due to the application of aquatic pesticides, however, it would only be temporary and in the best interest of the people of the State. The nature of aquatic pesticides is to be toxic in order to protect beneficial uses such as municipal and agricultural supply, recreation, and human health (preventing floods by maintaining capacity in flood control channels). However, compliance with receiving water limitations must be maintained. Therefore, this General Permit is consistent with State and federal antidegradation policies.

24. There may be other non-toxic or less toxic control measures available to minimize the discharge of wastes to waters of the United States. This General Permit requires dischargers to evaluate BMPs that may include alternative control options, procedures to determine that water quality impacts have been minimized, and a determination that there are no feasible alternatives to the selected resource or weed management measures.

25. The State Water Board, in establishing the requirements contained herein, considered factors including, but not limited to, the following:

    a. Beneficial uses to be protected and the water quality objectives reasonably required for that purpose;
    b. Other waste discharges;
    c. Past, present, and probable future beneficial uses of the waters under consideration;
    d. Environmental characteristics of the waters under consideration;
    e. Economic considerations;
    f. The need to maintain conveyance facilities to provide water supplies for municipal, irrigation, and industrial purposes; and
    g. Seasonal and weather conditions that require timely implementation of control measures.

26. The designated beneficial uses of surface waters throughout the State may include domestic or municipal, industrial, and agricultural supply; water contact and non-contact recreation; navigation; ground water recharge; fresh water replenishment; hydropower generation; wildlife habitat; cold freshwater and warm freshwater habitat; fish migration and fish spawning; marine habitat; estuarine habitat; shellfish harvesting; ocean commercial and sport fishing; preservation of areas of special biological significance; and preservation of rare and endangered species. To the extent that the applicable State or Regional Water Board *Water Quality Control Plan* designates additional or different beneficial uses, the *Water Quality Control Plan* shall govern.

27. USEPA establishes water quality criteria for priority pollutants in the National Toxics Rule and the CTR, and water quality objectives are established in *Water Quality Control Plans*. The State Water Board's Policy went into effect on May 22, 2000 and generally requires limitations for all constituents that will cause, have the reasonable potential to cause, or contribute to toxicity in receiving waters.

28. Section 5.3 of the Policy provides that the State Water Board may allow short-term or seasonal categorical exceptions from meeting the priority pollutant criteria/objectives if it is determined to be necessary to implement control measures for resource or pest management conducted by public entities to fulfill statutory requirements, including, but not limited to, those in the California Fish and Game, Food and Agriculture, Health and Safety, and Harbors and Navigation codes. Section 5.3 requires that the provisions of CEQA are satisfied and, dischargers provide specific discharge information before an exception may be granted.

29. Because of the emergency nature of Order No. 2001-12-DWQ, many of the actions that would normally occur prior to issuance of a permit granting a section 5.3 categorical exception to priority pollutant objectives/criteria had not yet occurred. Therefore, Order No. 2001-12-DWQ was issued as a limited-term permit, which expired on January 31, 2004. During the term of the Order No. 2001-12-DWQ, the public entities seeking an exception to the CTR during the term of this General Permit were directed to complete necessary CEQA documents and prepare other submittals to satisfy the criteria for the categorical exception.

30. The State Water Board has received CEQA documentation and all other information required for a section 5.3 exception from public entities listed in Attachment E to this General Permit. This General Permit grants the public entities listed in Attachment E a section 5.3 categorical exception from meeting priority pollutant criteria for short-term or seasonal time frames. This General Permit does not grant remaining enrollees a section 5.3 exception of the Policy.

31. Several lawsuits have been filed which challenge the Negative Declarations adopted by various applicants for this General Permit. Pursuant to section 15233 of the CEQA Guidelines, the State Water Board must treat the Negative Declarations at issue as if they comply with CEQA and must continue to process the applications according to the time limits for responsible agency action contained in Government Code section 65952. Accordingly, the following applicants are granted a conditional exception under section 5.3 of the Policy: Merced Irrigation District, Modesto Irrigation District, Oakdale Irrigation District, South San Joaquin Irrigation District, and Turlock Irrigation District. The

conditional exceptions granted by this General Permit only provide permission to proceed with the project at the applicant's risk. An applicant's conditional exception shall automatically be withdrawn in the event that a court enters a final decision finding that the applicant's Negative Declaration was inadequate.

32. This General Permit may be re-opened to modify Attachment E if additional entities qualify for a section 5.3 exception. This General Permit may also be re-opened if additional aquatic pesticides are registered by DPR or to revise the monitoring and reporting program to allow for group or regional monitoring.

33. This General Permit does not authorize any take of endangered species. The discharge is prohibited from adversely impacting biologically sensitive or critical habitats, including, but not limited to, habitat of species listed under federal or State endangered species laws. To ensure that endangered species issues are raised to the responsible agencies, the State Water Board has notified the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the California Department of Fish and Game of this General Permit.

34. The action to adopt an NPDES permit is exempt from the provisions of Chapter 3 of CEQA (Public Resources Code section 21100, et seq.), in accordance with section 13389 of the California Water Code (CWC).

35. The State Water Board has notified interested agencies and persons of its intent to prescribe waste discharge requirements in this General Permit and has provided them with an opportunity to submit comments.

36. The State Water Board, in a public hearing, heard and considered all comments pertaining to the discharges to be regulated by this General Permit.

37. This Order shall serve as an NPDES permit pursuant to section 402 of the Clean Water Act and amendments thereto and shall take effect upon the date of adoption.

IT IS HEREBY ORDERED that all dischargers subject to this General Permit shall comply with the following:

A. Application Requirements:

In order to obtain coverage, the discharger must submit the following to the appropriate Regional Water Board(s)[6]. Dischargers that apply 2,4-D, acrolein, copper, diquat, endothall, fluridone, glyphosate, imazapyr, and triclopyr -based aquatic pesticides to waters of the United States are eligible for coverage under this General Permit provided:

1. An NOI (Attachment A) signed in accordance with the signatory requirements of Standard Provision B;

[6] The discharger must submit an NOI to each applicable Regional Water Board it discharges within. However, only one application fee is required for each discharger, regardless of the number of NOIs submitted.

2. A vicinity map; and
3. An annual fee (for first-time enrollees).

Regional Water Boards may require additional information in order to determine whether a discharge is appropriately covered by this General Permit. Additionally, the Regional Water Board may issue a Notice of Exclusion, which either terminates permit coverage or requires submittal of an application for an individual permit or alternative general permit.

B. Effluent Limitations:

1. The discharge of wastes other than as described in this General Permit is prohibited, unless authorized by a separate NPDES permit.

2. The discharge of wastes shall not cause or contribute to conditions of nuisance or pollution.

3. The discharge shall not cause or contribute to long-term adverse impacts on beneficial uses of waters of the United States.

4. The discharger shall apply pesticides in accordance with the developed APAP, as described in section D.4.

C. Receiving Water Limitations:

1. Discharges shall not cause or contribute to an exceedence of the following in the receiving water.

Constituent/ Parameter	BENEFICIAL USE			
	MUN	WARM or COLD	Other than MUN, WARM, or COLD	All Designations
2,4-D	70 µg/L			
Acrolein[7]	320 µg/L	21 µg/L	780 µg/L	
Copper[8]				Maximum Copper Concentration = exp[0.8545 (ln(hardness))-1.702]
Diquat	20 µg/L			
Endothall	100 µg/L			
Fluridone	560 µg/L			
Glyphosate	700 µg/L			
Toxicity				Applications shall not cause or contribute to toxicity

[7] Public entities listed in Attachment E are not required to meet this limitation in receiving waters during the Exception period, as described in the APAP in accordance with Aquatic Pesticide Requirement D.5.k.
[8] Public entities listed in Attachment E are not required to meet this limitation in receiving waters during the Exception period, as described in the APAP in accordance with Aquatic Pesticide Requirement D.5.k.

The most restrictive (smallest) receiving water limit shall apply when discharges are to water bodies that have multiple limits listed above.

2. Discharges shall not cause or contribute to an exceedance of any CTR criteria or applicable water quality objective in a State or Regional Water Board *Water Quality Control Plan* in the receiving water.

D. Aquatic Pesticide Use Requirements:

1. **License Requirements.** Dischargers must be licensed by DPR if such licensing is required for the aquatic pesticide application project.[9]

2. **Application Requirements.** The pesticide use must be consistent with FIFRA pesticide label instructions and any Use Permits issued by CACs.

3. **Application Schedule.** When requested, the discharger shall provide a phone number to persons who request the discharger's application schedule. The discharger shall provide the requester with the most current application schedule and inform the requester if the schedule is subject to change. Information may be made available by electronic means.

4. **Public Notice Requirements.** Every calendar year, prior to the first application of aquatic pesticides, the discharger shall notify potentially affected governmental agencies. The notification shall include the following information:

    a. A statement of the discharger's intent to apply aquatic pesticide(s);
    b. Name of pesticide(s);
    c. Purpose of use;
    d. General time period and locations of expected use;
    e. Any water use restrictions or precautions during treatment; and
    f. A phone number that interested persons may call to obtain additional information from the discharger.

5. **Aquatic Pesticides Application Plan (APAP).** The discharger shall develop an APAP that contains the following elements:

    a. Description of the water system to which aquatic pesticides are being applied;

    b. Description of what weed(s) are being controlled and why;

    c. Discussion of control tolerances (i.e., how much growth can occur before action is necessary);

[9] A license is required for application of restricted material, as defined by DPR.

d. Discussion of the factors influencing the decision to use aquatic pesticides in regards to those tolerances (pros and cons);

e. Type(s) of aquatic pesticides used[10], the method in which they are applied, and the adjuvants used;

f. Description of the application area and the treatment area in the system;

g. Other control methods used (alternatives) and what their limitations are;

h. How much product is needed and how this is determined;

i. Monitoring plan (see Attachment C), including the location of representative site(s);

j. If applicable, list the gates or control structures and provide an inspection schedule of those gates or control structures to ensure they are not leaking;

k. If the Control Agency has been granted an exception, describe the exception period. If weeds are also controlled outside of this period, how is it ensured that receiving water criteria are not exceeded;

l. Evaluation of other available BMPs to determine if there are feasible alternatives to the selected aquatic pesticide application project that could reduce potential water quality impacts; and

m. Description of the BMPs to be implemented.

6. **Pesticide Application Log.** The discharger shall maintain a log for each aquatic pesticide application. The application log shall contain, at a minimum, the following information:

a. Date of application;
b. Location of application;
c. Name of applicator;
d. List of gates or control structures in the treatment area that may discharge to surface waters, if applicable;
e. Time of gate or control structure closure and reopening, include any calculations used to determine closure and reopening times, if applicable;
f. Application details, such as water temperature, flow or level of water body, time application started and stopped, and aquatic pesticide application rate and concentration;
g. Visual monitoring assessment; and

[10] List the types and the names of the aquatic pesticides most often used or anticipated to be used. If additional or alternative pesticides are used during the year, amend the APAP and note this in the annual report.

h. Certification that applicator(s) followed the APAP.

E. Provisions:

1. **Permit Compliance.** The discharger must comply with all conditions of this General Permit including timely submittal of technical and monitoring reports as directed by the appropriate Regional Water Board' s Executive Officer.

2. **Alternatives.** In accordance with APAP D.5.m, the discharger shall implement the identified alternative measures to the selected aquatic pesticide application project that could reduce potential water quality impacts.

3. **Monitoring and Reporting.** The discharger shall comply with the provisions of the attached Monitoring and Reporting Program (MRP) contained in Attachment C to this General Permit and any revision thereto.

4. **Standard Provisions.** The discharger shall comply with all the applicable items of the Standard Provisions and Reporting for Waste Discharge Requirements (Standard Provisions), which are part of this General Permit (Attachment D).

5. **General Permit Reference.** A copy of this General Permit shall be kept where key operating personnel can refer to the document. Key operating and site management personnel shall be familiar with its contents.

6. **Monitoring Reports to USEPA.** When requested by USEPA, the discharger shall also submit Discharge Monitoring Reports to USEPA.

7. **Change of Control Agency.** In the event of any change in the Control Agency that sought coverage under this Genera Permit, the original Control Agency shall notify the succeeding Control Agency of the existence of this General Permit by letter, a copy of which shall be immediately forwarded to the appropriate Regional Water Board. Upon receipt of the letter, Regional Water Board staff shall terminate coverage of the original Control Agency under this General Permit. The new Control Agency shall complete and submit to the Regional Water Board a revised NOI form (Attachment A) in accordance with Application A.1.

8. **Qualified Biologist Certification Following Project Completion.** Upon completion of an aquatic pesticide project, public entities listed in Attachment E to this General Permit shall provide certification by a qualified biologist that beneficial uses of receiving waters accepting aquatic pesticides have been restored.

9. **Submittal of APAP.** Dischargers that apply for this General Permit before August 1, 2004 shall submit their APAP to the appropriate Regional Water Board by August 1, 2004; those dischargers that apply for this General Permit after August 1, 2004 shall submit their APAP to the appropriate Regional Water Board with their NOI application.

WASTE DISCHARGE REQUIREMENTS
WATER QUALITY ORDER NO. 2004-0009-DWQ

CERTIFICATION

The undersigned, Clerk to the Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on May 20, 2004.

AYE:	Arthur G. Baggett, Jr. Peter S. Silva Richard Katz Gary M. Carlton Nancy H. Sutley
NO:	None
ABSENT:	None
ABSTAIN:	None

Original signed by _____
Debbie Irvin
Clerk to the Board

Alan C. Lloyd, Ph.D.
Agency Secretary

State Water Resources Control Board

Arnold Schwarzenegger
Governor

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
FAX (916) 341-5463 • Internet Address: http://www.waterboards.ca.gov

ATTACHMENT A

NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF WATER QUALITY ORDER NO. 2004-0009-DWQ STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL IN WATERS OF THE UNITED STATES GENERAL PERMIT NO. CAG990005

I. NOTICE OF INTENT STATUS (see instructions)

MARK ONLY ONE ITEM	A. ☐ New Applicator	B. ☐ Change of Information for WDID#

II. CONTROL AGENCY INFORMATION

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip

G. Contact Person	H. Title	I. Phone

III. RECEIVING WATER INFORMATION

A. Do wastes and pesticide residues discharge to (check all that apply):

1. ☐ Canals, ditches, or other constructed conveyance facilities owned and controlled by Control Agency?
   Name of the conveyance system: _____

2. ☐ Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Control Agency
   Owner's name: _____
   Name of the conveyance system: _____

3. ☐ Directly to river, lake, creek, stream, bay, ocean, etc.?
   Name of water body: _____

B. Regional Water Quality Control Board(s) where application sites are located (REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9):
   REGION _____
   (List all regions where pesticide application is proposed.)

NOTICE OF INTENT
WATER QUALITY ORDER NO. 2004-0009-DWQ

IV. PESTICIDE APPLICATION INFORMATION

A. Target Organism: ____Algae _____Aquatic Weeds (surface) _____Aquatic Weeds (submerged)

____OTHER (identify): _____

B. Aquatic Pesticides Used: List Name and Active ingredients

_____

C. Period of Application: Start Date _____ End Date_____

D. Types of Adjuvants Used:

V. AQUATIC PESTICIDES APPLICATION PLAN

Has Aquatic Pesticides Application Plan been prepared and is the applicator familiar with its contents? Yes ☐ No ☐
If not, when will it be prepared? _____

VI. NOTIFICATION

Have potentially affected public and governmental agencies been notified? Yes ☐ No ☐

VII. VICINITY MAP AND FEE

A. Have you included vicinity map(s) with this submittal? ..... YES ☐ NO ☐
Separate vicinity maps must be submitted for each Region where a proposed discharge will occur.

B. Have you included payment of the filing fee (for first-time enrollees only) with this submittal? ... YES ☐ NO ☐ NA ☐

VIII. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordan ce with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the permit, including developing and implementing a monitoring program, will be complied with."

A. Printed Name:_____

B. Signature: _____ **Date:** _____

C. Title: _____

INSTRUCTIONS
FOR COMPLETING THE NOI

WATER QUALITY ORDER NO. 2004-0009-DWQ
STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT FOR DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL
IN WATERS OF THE UNITED STATES
GENERAL PERMIT NO. CAG990005

These instructions are intended to help you, the discharger, complete the Notice of Intent (NOI) form for the general National Pollutant Discharge Elimination System (NPDES) permit. **Please type or print clearly when completing the NOI form and vicinity map(s).**

Send the completed and signed form along with the filing fee, supporting documentation, and vicinity map(s) to the appropriate Regional Water Board. One NOI should be submitted by appropriate discharger to cover all proposed discharges within the boundaries of each Regional Water Quality Control Board (Regional Water Board). If proposed discharges will occur in more than one Region, submit extra copies of the NOI and maps for each Region where a discharge will occur. Only one annual fee is required for each discharger.

Section I – Notice of Intent Status

Please mark whether this is the first time coverage under this General Permit is being requested or if this is a change of information for a discharge already covered under this General Permit. If this is a change of information, please supply the eleven-digit Waste Discharge Identification (WDID) number for the discharge.

Section II – Control Agency Information

A. Enter the name of the Control Agency.
B. Enter the street number and street name where mail and correspondence should be sent (P.O. Box is acceptable).
C. Enter the city that applies to the mailing address given.
D. Enter the county that applies to the mailing address given.
E. Enter the state that applies to the mailing address given.
F. Enter the zip code that applies to the mailing address given.
G. Enter the name (first and last) of the contact person for the Control Agency listed above.
H. Enter the contact person's title.
I. Enter the contact person's daytime telephone number.

Section III – Receiving Water Information

A. Check all boxes that apply. At least one box must be checked.

1. Check this box if the application site is a canal, ditch, or other constructed conveyance system owned and controlled by the Control Agency. Print the name of the conveyance system.
2. Check this box if the application site is a canal, ditch, or other constructed conveyance system owned and controlled by a different person or entity other than the Control Agency. Clearly print the name and the owner of the conveyance system.

3. Check this box if the application site is not a constructed conveyance system (including application to river, lake, creek, stream, bay, ocean) and enter the name of the water body.

B. List all Region numbers where pesticide application is proposed. Regional Water Board boundaries are defined in section 13200 of the California Water Code. The numbers for each Region are given below and a map is attached.

1- North Coast
2- San Francisco Bay
3- Central Coast
4- Los Angeles
5- Central Valley (Sacramento, Fresno, Redding)
6- Lahontan (South Lake Tahoe, Victorville)
7- Colorado River Basin
8- Santa Ana
9- San Diego

Section IV – Pesticide Application Information

A. Check the appropriate target organism. If the target organism is not listed, check OTHER, and list the name or type of target organism in the space provided.
B. List the name and active ingredients of each pesticide to be used.
C. List the start and end date of proposed pesticide application season.
D. List the name(s) and type(s) of adjuvants that will be used.

Section V – Aquatic Pesticides Application Plan (APAP)

An APAP must be prepared and the applicator familiar with its contents before aquatic pesticide application is authorized under this General Permit. If an APAP is not complete at the time of application, enter the date by which it will be completed.

Section VI – Notification

Have you notified potentially affected governmental agencies, as required by Provision D.4 of the General Permit?

Section VII – Vicinity Map and Fee

A. If you have included vicinity map(s) with your Form A submittal, check the YES box if you have not included the vicinity map(s), check the NO box. **NOTE:** Vicinity map(s) of the proposed pesticide application site must be received before you can be covered by this General Permit. You must submit separate vicinity map(s) for each Regional Water Board service area where a discharge is proposed. If applying for coverage under Region 5, please send in two additional copies of the required map, if applying for coverage under Region 6, please send in one additional copy of the required map.

B. Check the YES box if you have included payment of the annual fee for a Category 3 discharge specified in Title 23, California Code of Regulations, section 2200(b)(9) with your submittal. Check the NO box if you have not included this payment.

NOTICE OF INTENT INSTRUCTIONS
WATER QUALITY ORDER NO. 2004-0009-DWQ

NOTES:

1. Payment of this fee is not necessary if you have paid an annual fee within the last year for coverage under the previous order, Order No. 2001-12-DWQ.
2. You will be billed annually and payment is required to continue coverage.

Section VIII

A. Print the name of the appropriate official. For a municipality, State, federal, or other public agency, this would be a principal executive officer, ranking elected official, or duly authorized representative. The principal executive officer of a federal agency includes the chief executive officer of the agency or the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrator of USEPA).

B. The person whose name is printed above must sign and date the NOI.

C. Enter the title of the person signing the NOI.

ATTACHMENT B
WATER QUALITY ORDER NO. 2004-0009-DWQ
STATE WATER RESOURCES CONTROL BOARD

Division of Water Quality
P.O. Box 100
Sacramento, CA 95812-0100
Web Page: http://www.waterboards.ca.gov

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

NORTH COAST REGION (1)
5550 Skylane Blvd, Ste. A
Santa Rose, CA 95403
(707) 576-2220 FAX: (707)523-0135
Web Page:
http://www.waterboards.ca.gov/northcoast/

SAN FRANCISCO BAY REGION (2)
1515 Clay Street, Ste. 1400
Oakland, CA 94612
(510) 622-2300 FAX: (510) 622-2640
Web Page:
http://www.waterboards.ca.gov/sanfranciscobay/

CENTRAL COAST REGION (3)
895 Aerovista Place, Ste 101
San Luis Obispo, CA 93401
(805) 549-3147 FAX: (805) 543-0397
Web Page:
http://www.waterboards.ca.gov/centralcoast/

LOS ANGELES REGION (4)
320 W. 4th Street, Ste. 200
Los Angeles, CA 90013
(213) 576-6600 FAX: (213) 576-6640
Web Page:
http://www.waterboards.ca.gov/losangeles/

CENTRAL VALLEY REGION (5S)
11020 Sun Center Dr., #200
Rancho Cordova, CA 95670-6114
(916) 464-3291 FAX: (916) 464-4645
Web Page:
http:www.waterboards.ca.gov/centralvalley/

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LAHONTAN REGION (6 SLT)
2501 Lake Tahoe Blvd.
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(530) 542-5400 FAX: (530) 544-2271
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VICTORVILLE OFFICE (6V)
14440 Civic Drive, Suite 200
Victorville, CA 92392-2383
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COLORADO RIVER BASIN REGION (7)
73-720 Fred Waring Dr., Ste. 100
Palm Desert, CA 92260
(760) 346-7491 FAX: (760) 341-6820
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SANTA ANA REGION (8)
California Tower
3737 Main Street, Ste. 500
Riverside, CA 92501-3339
Web Page:
http://www.waterboards.ca.gov/santaana/

SAN DIEGO REGION (9)
9174 Sky Park Court, Ste. 100
San Diego, CA 92123-4340
(858) 467-2952 FAX: (858) 571-6972
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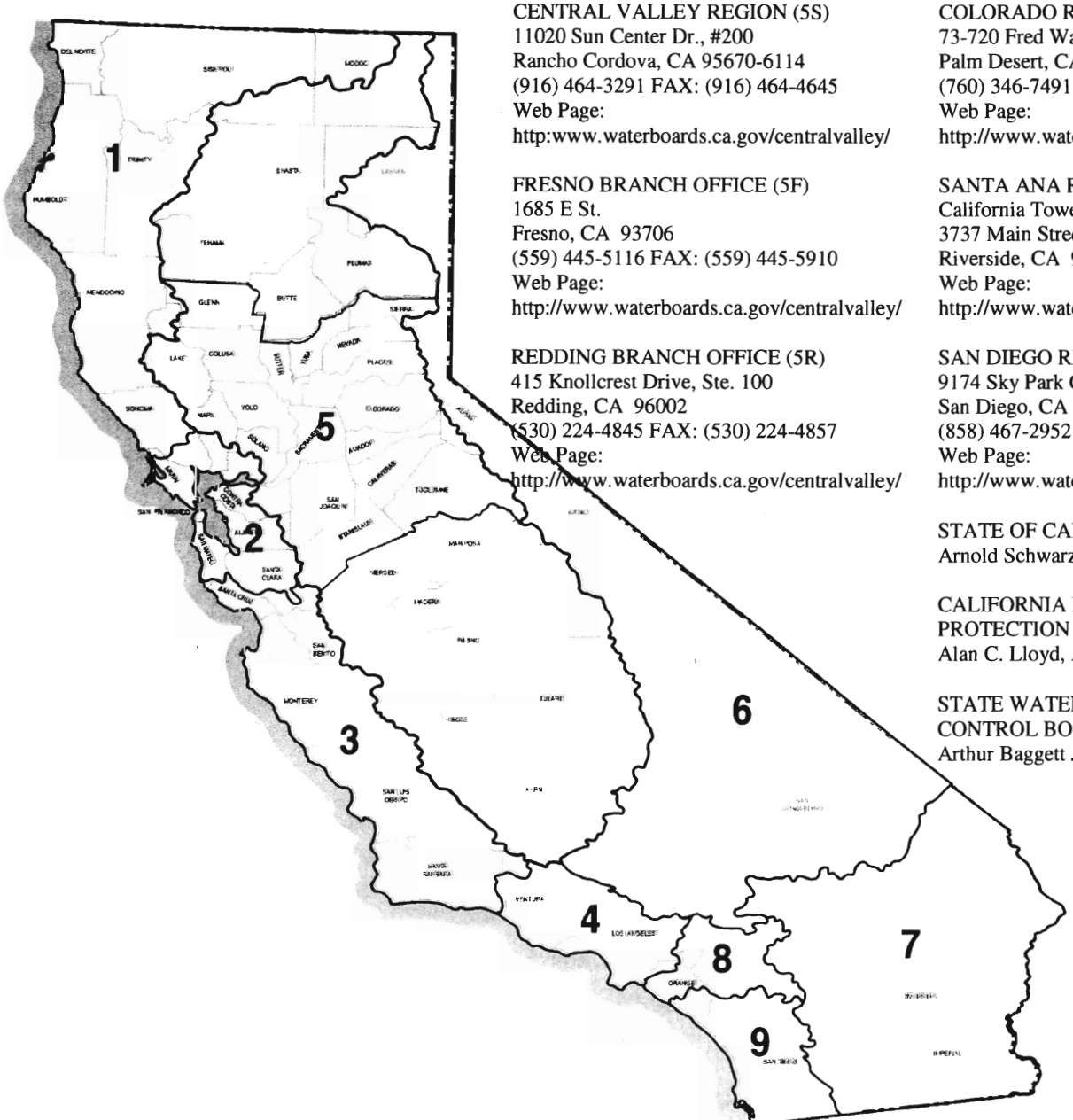


STATE OF CALIFORNIA
Arnold Schwarzenegger, Governor

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
Alan C. Lloyd, Agency Secretary

STATE WATER RESOURCES CONTROL BOARD
Arthur Baggett Jr., Chairman

ATTACHMENT C

STATE WATER RESOURCES CONTROL BOARD
MONITORING AND REPORTING PROGRAM (MRP)

WATER QUALITY ORDER NO. 2004-0009-DWQ
STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL IN WATERS OF THE UNITED STATES
GENERAL PERMIT NO. CAG990005

A. MONITORING PROVISIONS

1. **Sampling Analysis.** All laboratory analyses shall be conducted at a laboratory certified for such analyses by the California Department of Health Services. All analyses shall be conducted in accordance with the latest edition of 'Guidelines Establishing Test Procedures for Analysis of Pollutants" (Guidelines), promulgated by the U.S. Environmental Protection Agency (USEPA) (Title 40 Code of Federal Regulations part 136), except nonylphenol analysis. Nonylphenol shall be analyzed using USEPA Method 3535/Ligquid Chromatograph-Fluorescence. Hardness shall be determined by the calculation[1] or titration method.

2. **Sampling Procedures.** Samples shall be collected using sampling procedures, which minimize loss of monitored constituents during sample collection and analysis and maintain sample integrity.

3. **Monitoring Frequency.** If the discharger monitors any constituent required to be monitored under this General Permit more frequently than specified, the monitoring results shall be submitted to the appropriate Regional Water Board.

4. **Retention of Records.** The discharger shall retain records of all monitoring information including all calibration and maintenance records, copies of all reports required by this General Permit, and records of all data used to complete the application for this General Permit. Records shall be maintained for a minimum of three years from the date of the sampling, measurement, or report. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the appropriate Regional Water Board Executive Officer.

5. **Monitoring Records.** Records of monitoring information shall include the following:

   a. The date, exact place, and time of sampling or measurements;

   b. The individuals who performed the sampling or measurements;

   c. The dates analyses were performed;

   d. The individuals who performed the analyses;

---

[1] Hardness, mg equivalent $CaCO_3$ mg/L = 2.497[Ca, mg/L] + 4.118[Mg, mg/L]

e. The analytical techniques or method used; and

f. The results of such analyses.

6. **Device Calibration and Maintenance.** All monitoring instruments and devices that are used by the discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy.

B. RECEIVING WATER MONITORING

1. For each application at each site, the discharger shall prepare a map with a convenient scale showing the application area, treatment area, immediately adjacent untreated areas (if entire water body is not treated), and water bodies receiving treated water. The discharger shall also provide information on surface area and/or volume of application area and treatment area and any other information used to calculate dosage and quantity of each pesticide used at each application site. For acrolein applications, the map shall also show the acrolein injection points and locations of major canals, spillways, or gates that may flow to natural waters.

   Discharger shall also identify sampling locations described in B.3 through B.5 below and provide global positioning systems (GPS) coordinates for each sampling site.

2. Dischargers who operate canals, ditches, ponds, or other systems that allow dischargers reasonable control over their treated water through gates, weirs, locks, etc. shall inspect the integrity of their systems prior to every application within the system to ascertain that treated water does not unintentionally get discharged to streams, rivers, lakes, or other natural waterways.

3. The dischargers shall collect samples at 10 percent of all application sites for each type of aquatic pesticide used for each type of site. The 10 percent sampling sites shall be representative sites.

4. A discharger with 20 application sites or less shall collect samples at a minimum of two sites[2]. A discharger with greater than 20 sites shall collect samples at 10 percent of all the sites. The number of representative sites shall be rounded to the nearest whole number using scientific number protocol. For example, if the number of sites is 25, the discharger must sample three representative sites.

5. The following monitoring is required for each sampling:

   a. **Background Monitoring**
   Background samples shall be collected upstream at the time of the application event, or they may be collected at the treatment area, just prior (up to 24-hours in advance of application) to the application event.

[2] If the discharger only applies aquatic pesticides at one site, samples are required from that site only.

b. **Event Monitoring**
Event monitoring samples shall be collected immediately downstream of the treatment area in flowing waters or adjacent to the treatment area in non-flowing waters, immediately after the application event or shortly after application, but after sufficient time has elapsed such that treated water will have entered the adjacent or downstream area.

c. **Post-Event Monitoring**
Post-event samples shall be collected within the treatment area and immediately downstream of the treatment area in flowing waters or adjacent to the treatment area in non-flowing waters within one-week after the application event.

6. The following parameters shall be analyzed for:

TABLE 1 - MONITORING PARAMETERS

SAMPLE TYPE	CONSTITUENT/ PARAMETER	SAMPLE METHOD	LABORATORY METHOD	FREQUENCY
Visual	1. Site description (pond, lake, open waterway, channel, estimate of percent covered by vegetation, etc.) 2. Appearance of waterway (sheen, color, clarity, etc.) 3. Weather conditions (fog, rain, wind, etc.)	Visual Observation	Not Applicable	All applications at all sites
Physical	1. Temperature[3] 2. Turbidity[4] 3. Electrical conductivity/salinity[4]	Grab[5]	See USEPA Guidelines	All applications at 10 percent of all sites
Chemical	1. Active Ingredient 2. Nonylphenol[6] 3. pH[4] 4. Dissolved Oxygen[4] 5. Hardness ($CaCO_3$)[7]	Grab[5]	See USEPA Guidelines	All applications at 10 percent of all sites

C. ADDITIONAL MONITORING

Dischargers that propose monitoring as part of their CEQA compliance must also comply with that monitoring plan where the two plans differ.

[3] Field testing.
[4] Field or laboratory testing.
[5] Samples shall be collected at three feet below the surface, or mid-depth if water body is less than six feet deep.
[6] Required when nonylphenol is used.
[7] Required for copper applications only.

D. REPORTING

1. All reports shall be submitted to the appropriate Regional Water Board. All reports submitted in response to this Order must comply with the provisions stated in "Standard Provisions and Reporting for Waste Discharge Requirements (NPDES)" (Attachment D), section B, Monitoring and Reporting Requirements.

2. Annual reports shall contain the following information:

   a. An Executive Summary discussing General Permit compliance or violation and the effectiveness of the APAP to reduce or prevent the discharge of pollutants associated with aquatic pesticide applications;

   b. A summary of monitoring data, including the identification of water quality improvements or degradation, and recommendations for improvements to the APAP (including proposed BMPs) based on the monitoring results. All receiving water monitoring data shall be compared to applicable water quality standards;

   c. Identification of BMPs and a discussion of their effectiveness in meeting this General Permit requirements;

   d. A discussion of BMP modifications addressing violations of this General Permit;

   e. A map showing the location of each application and treatment area;

   f. Types and amounts of aquatic pesticides used at each application event during each application;

   g. Information on surface area and/or volume of treatment area and any other information used to calculate dosage and quantity of each pesticide used;

   h. List of gates in the treatment area that may discharge to surface waters; time of gate closure and reopening, include any calculations used to determine closure and reopening times, if applicable;

   i. Sampling results for all required monitoring under section B of this MRP and any additional sampling conducted in compliance with section A.3 of this MRP. Sampling results shall indicate the name of the sampling agency or organization, detailed sampling location information (including latitude and longitude or township/range/section if available), detailed map or description of each sampling site (i.e., address, cross roads, etc.), collection date, name of constituent/parameter and its concentration detected, minimum levels, method detection limits for each constituent analysis, name or description of water body sampled, and a comparison with applicable water quality standards, description of analytical QA/quality control plan. Sampling results shall be tabulated so that they are readily discernible;

j. Recommendations to improve the monitoring program, BMPs, and APAP to ascertain compliance with this General Permit; and

k. Proposed changes to the APAP and monitoring program.

E. REPORT SCHEDULE

Monitoring reports shall be submitted to the Regional Water Board Executive Officer in accordance with the following schedule:

Reporting Frequency	Reporting Period	Report Due
Annual	January 1-December 31	March 1

ATTACHMENT D

STATE WATER RESOURCES CONTROL BOARD

STANDARD PROVISIONS AND REPORTING FOR WASTE DISCHARGE REQUIREMENTS

WATER QUALITY ORDER NO. 2004-0009-DWQ
STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL IN WATERS OF THE UNITED STATES
GENERAL PERMIT NO. CAG 990005

A. General Provisions

1. **Duty to Comply** [Title 40, Code of Federal Regulations (CFR) 122.41(a)][California Water Code (CWC) 133811]

   a. The Discharger must comply with all of the conditions of this General Permit. Any General Permit noncompliance constitutes a violation of the Clean Water Act and the Porter-Cologne Water Quality Control Act and is grounds for enforcement action, for permit termination, revocation and reissuance or modification, or for denial of a permit renewal application.

   b. The Discharger shall comply with effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the Clean Water Act within the time provided in the regulations that establish these standards or prohibitions, even if this General Permit has not been modified to incorporate the requirement.

2. **Duty to Mitigate** [40 CFR 122.41(d)]

   The Discharger shall take all reasonable steps to minimize or prevent any discharge in violation of this General Permit, which has a reasonable likelihood of adversely affecting human health or the environment.

3. **Proper Operation and Maintenance** [40 CFR 122.41(e)],

   The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Discharger to achieve compliance with this General Permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems, which are installed by a Discharger only when necessary to achieve compliance with the conditions of this General Permit.

4. **Permit Actions** [40 CFR 122.41(f)][CWC 13263(e)][40 CFR 122.44(b)(1)]

   a. This General Permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Discharger for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

   b. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge, and that standard or prohibition is more stringent than any limitation on the pollutant in this General Permit, this General Permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the Discharger so notified.

5. **Property Rights** [40 CFR 122.41(g)][CWC 13263(g)]

   a. This General Permit does not convey any property rights of any sort, or any exclusive privileges.

   b. All discharges of waste into water of the State are privileges, not rights.

6. **Duty to Provide Information** [40 CFR 122.41(h)]

   The Discharger shall furnish the Regional Water Quality Control Board (Regional Water Board), the State Water Resources Control Board (State Water Board), or the U.S. Environmental Protection Agency (USEPA), within a reasonable time, any information which the Regional Water Board, State Water Board, or USEPA may request to determine compliance with this General Permit. Upon request, the Discharger shall also furnish to the Regional Water Board, State Water Board, or USEPA copies of records required by this General Permit to be kept.

7. **Inspection and Entry** [40 CFR 122.41(h)]

   The Discharger shall allow the Regional Water Board, State Water Board, USEPA, and/or their authorized representatives (including an authorized contractor acting as their representative), upon the presentation of credentials and other documents as may be required by law, to:

   a. Enter upon the Discharger' s premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this General Permit; and

   b. Inspect and photograph, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this General Permit; and

   c. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this General Permit; and

d. Sample or monitor, at reasonable times, for the purposes of ensuring permit compliance or as otherwise authorized by the Clean Water Act or the Porter-Cologne Water Quality Control Act, any substances or parameters at any location.

8. **Bypass and Upset** [40 CFR 122.41(m)] [40 CFR 122.41(n)]

a. Definitions.

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities that causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

(3) "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Discharger. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. Prohibition of Bypass.

(1) Bypass is prohibited, and the Regional Water Board may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted notices as required under 40 CFR 122.41(m)(3).

c. Conditions necessary for a demonstration of upset.

A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated;

(3) The permittee submitted notice of the upset as required in 24-Hour Reporting; and

(4) The permittee complied with any remedial measures required under 40 CFR 122.41(d).

d. Burden of proof.

In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

9. **Transfers** [40 CFR 122.41(L)(3)] [CWC 133771] [40 CFR 122.61(a)(b)]

This General Permit is not transferable to any person except after notice to the Regional Water Board. The Regional Water Board may require modification or reissuance of the permit conditions to change the name of the Discharger and incorporate such other requirements as may be necessary under the Clean Water Act and the Porter-Cologne Water Quality Control Act.

10. **Severability**

The provisions of this General Permit are severable and, if any provision of this General Permit or the application of any of its provisions to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this General Permit shall not be affected thereby.

11. **Pollution, Contamination, or Nuisance** [CWC 13050]

Neither the treatment nor the discharge shall create a condition of pollution, contamination, or nuisance.

B. Monitoring and Reporting Requirements

1. **Signatory Requirements** [40 CFR 122-41(k)] [40 CFR 122.221]

a. All permit applications or Notices of Intent (NOIs) submitted to the Regional Water Board, State Water Board, or USEPA shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this provision, a responsible corporate officer means: a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this provision, a principal executive officer of a federal agency includes: the chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of USEPA).

b. All reports required by this General Permit and other information requested by the Regional Water Board, State Water Board, or USEPA shall be signed by a person described in paragraph (a) of this provision or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in paragraph (a) of this provision;

(2) The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company (a duly authorized representative may thus be either a named individual or any individual occupying a named position); and

(3) The written authorization is submitted to the Regional Water Board, State Water Board, or USEPA.

c. If an authorization under paragraph (b) of this provision is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph (b) of this provision must be submitted to the Regional Water Board, State Water Board, or USEPA together with any reports, information, applications, or NOIs to be signed by an authorized representative.

d. Any person signing a document under paragraphs (a) or (b) of this provision shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. **Monitoring Reports** [40 CFR 122.41(l) (4)]

   a. Monitoring results shall be reported at the intervals specified in this General Permit.
   b. Monitoring results must be reported on a Discharge Monitoring Report (DMR) form or forms approved by the Regional Water Board or State Water Board for reporting results of monitoring of pollutants and sludge use or disposal practices.

   c. Calculations for all limitations, which require averaging of measurements, shall utilize an arithmetic mean unless otherwise specified in this General Permit.

3. **Compliance Schedules** [40 CFR 122.41(l) (5)]

   Reports of compliance or noncompliance with interim and final requirements contained in any compliance schedule of this General Permit shall be submitted no later than 14 days following each schedule date.

4. **Twenty-Four Hour Reporting** [40 CFR 122.41(l) (6)]

   a. The Discharger shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the Discharger becomes aware of the circumstances. A written submission shall also be provided within five days of the time the Discharger becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times and, if the noncompliance has not been corrected, the anticipated time it is expected to continue, and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

   b. The following shall be included as information that must be reported within 24 hours under this paragraph:

      (1) Any bypass which exceeds any effluent limitation in this General Permit.

      (2) Any upset which exceeds any effluent limitation in this General Permit.

      (3) Violation of a maximum daily discharge limitation for any of the pollutants listed in this General Permit is to be reported within 24 hours. The Regional Water Board may waive the above required written report under this provision on a case-by-case basis if an oral report has been received within 24 hours.

5. **Other Noncompliance** [40 CFR 122.41(1)(7)]

   The Discharger shall report all instances of noncompliance not reported under Provisions (B.3) and (B.4) at the time monitoring reports are submitted. The reports shall contain the information listed in Provision (B.4).

6. **Other Information** [40 CFR 122.41(l) (8)]

When the Discharger becomes aware that it failed to submit any relevant facts in a permit application or NOI, or submitted incorrect information in a permit application, NOI or in any report to the Regional Water Board, State Water Board, or USEPA, the Discharger shall promptly submit such facts or information.

7. **Planned Changes** [40 CFR 122 41(l)(1)]

The Discharger shall give notice to the Regional Water Board as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required under this provision only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b); or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the General Permit nor to notification requirements under 40 CFR Part 122.42 (a) (1); or

c. The alteration or addition results in a significant change in the Discharger' s sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application/NOI process or not reported pursuant to an approved land application plan.

8. **Anticipated Noncompliance** [40 CFR 122.41(l)(2)]

The Discharger shall give advance notice to the Regional Water Board or State Water Board of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

9. **Discharge Monitoring Quality Assurance (DMQA) Program** [State Water Board/USEPA 106 Partnership Agreement]

The Discharger shall conduct appropriate analyses on any sample provided by USEPA as part of the DMQA program. The results of such analyses shall be submitted to USEPA' s DMQA manager.

C. Enforcement Provisions

1. The Clean Water Act provides that any person who violates a permit condition implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $25,000 per day of violation. Any person who negligently violates permit conditions implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a fine of not less than $2,500 or more than $25,000 per day for each violation, or by imprisonment of not more than one year, or both. Higher penalties may be imposed for knowing violations and for repeat offenders. The Porter-Cologne Water Quality

Control Act provides for civil and criminal penalties comparable to and in some cases greater than those provided under the Clean Water Act. [40 CFR 122.41(a)(2)][CWC sections 13385 and 13387].

2. The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this General Permit including monitoring reports or reports of compliance or noncompliance shall be punished upon conviction by a fine of not more than $10,000 per violation or by imprisonment for not more than six months per violation, or by both. [40 CFR 122-41(k)(2)].

3. The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this General Permit shall, upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than two years, or both. Higher penalties may be imposed for repeat offenders. [40 CFR 122.41(j)(5)].

ATTACHMENT E
WATER QUALITY ORDER NO. 2004-0009-DWQ

STATE WATER RESOURCES CONTROL BOARD

LIST OF PUBLIC ENTITIES GRANTED AN EXCEPTION PURSUANT TO STATE WATER RESOURCES CONTROL BOARD POLICY FOR IMPLEMENTATION OF TOXICS STANDARDS FOR INLAND SURFACE WATERS, ENCLOSED BAYS, AND ESTUARIES OF CALIFORNIA (POLICY)

WATER QUALITY ORDER NO. 2004-0009-DWQ
STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL IN WATERS OF THE UNITED STATES
GENERAL PERMIT NO. CAG990005

The public entities listed herein have prepared Initial Studies, Negative Declarations (ND), and Notices of Determination or Mitigated Negative Declarations (MND) for the discharge of aquatic pesticides in accordance with the California Environmental Quality Act [CEQA (Public Resources Code Section 21000 et seq.)] to comply with the exception requirements of section 5.3 of the Policy. The boards of each public entity, as the lead agencies under CEQA, approved the Final ND/MND and determined that the discharge of aquatic pesticides in their respective projects would not have a significant effect on the environment. These public entities have determined that the water quality or related water quality impacts identified in the environmental assessments of the ND/MND are less than significant. In addition to submitting the CEQA documentation, these public entities have also complied with the other exception requirements of section 5.3 of the Policy.

As required in Section 15096 of the CEQA Guidelines, the State Water Resources Control Board (State Water Board), as a Responsible Agency under CEQA, considered the ND/MND approved by the board of each public entity and finds that the projects will have less than significant water quality impact if the waste discharge requirements in this General Permit are followed. Accordingly, the public entities listed herein are hereby granted an exception pursuant to section 5.3 of the Policy.

The California Department of Food and Agriculture (CDFA) has determined that its ongoing projects to eradicate hydrilla are exempt from the requirements of CEQA because the activities are necessary to prevent or mitigate an emergency pursuant to Public Resources Code Section 21080 (b)(4). The bases for this determination are that the CDFA Hydrilla Program is mandated under sections 403 and 6048 of the Food and Agriculture Code and the Governor of California and/or the CDFA Secretary has declared that an emergency situation existed as each eradication project began. Although CDFA has determined the CDFA Hydrilla Program is exempt form CEQA, CDFA will coordinate all eradication activities with federal, state and local regulatory agencies to ensure no long-term significant environmental impacts occur.

As required in Section 15096 of the CEQA Guidelines, the State Water Board, as a Responsible Agency under CEQA, considered the exemption claimed by CDFA and finds that the projects will have less than significant water quality impact if the waste discharge requirements in this General Permit are followed. Accordingly, CDFA is hereby granted an exception pursuant to section 5.3 of the Policy, as long as the Governor or the CDFA Secretary has declared that an emergency situation exists prior to project implementation.

ATTACHMENT E
WATER QUALITY ORDER NO. 2004-0009-DWQ

Public Entities with Policy Section 5.3 Exception

1. Byron-Bethany Irrigation District
2. City of Antioch Department of Public Works
3. Contra Costa Water District
4. Contra Costa County Flood Control and Water Conservation District
5. Department of Food and Agriculture
6. Department of Water Resources
7. Friant Water Users Authority
8. Maine Prairie Water District
9. Marin Municipal Water District
10. Metropolitan Water District of Southern California
11. Modesto Irrigation District
12. Nevada Irrigation District
13. North Marin Water District
14. Oakdale Irrigation District
15. Placer County Water Agency
16. Princeton-Cordora-Glenn Irrigation District
17. Provident Irrigation District
18. Reclamation District 1004
19. Santa Cruz Water Department
20. Solano Irrigation District
21. South Feather Water and Power Agency
22. South Sutter Water District
23. Tehama Colusa Canal Authority
24. Woodbridge Irrigation District
25. Yolo County Flood Control and Water Conservation District

ATTACHMENT F
WATER QUALITY ORDER NO. 2004-0009-DWQ

Definition of Terms

1. **Application Area** – The application area is the area to which aquatic pesticides are directly applied. (See Figure 1.)

2. **Application Event** – The application event is the time that introduction of the aquatic pesticide to the application area takes place. The application event is the time that the product is applied, not the length of time that it releases pesticide to the environment.

3. **Control Agency** - The Control Agency is the permitted discharger authorized by this General Permit. It is the agency responsible for controlling weeds. In some cases, such as irrigation districts, the Control Agency may own the conveyance system. In other cases, such as application to Delta waters, the Control Agency may not own the water body or conveyance system into which aquatic pesticides are applied. Additionally, the Control Agency may be the pesticide applicator, but it may also contract with a separate entity that does the actual pesticide application. In either case, however, the Control Agency must ensure that the discharge is in compliance with this General Permit.

4. **Pollutants Associated with Aquatic Pesticide Application** – Pollutants associated with aquatic pesticide application are the pollutants being regulated by this General Permit. They include aquatic pesticide residue, as well as misdirected and over-applied aquatic pesticides.

5. **Policy** – Policy is an abbreviation for the State Water Board's *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California*. It establishes procedures for implementing water quality standards for priority pollutants.

6. **Priority Pollutants** - Priority pollutants are listed in 40 Code of Federal Regulations, section 131.38(b)(1), and include acrolein and copper. Limits are set for priority pollutants in the California Toxics Rule.

7. **Project** –Projects are undertakings necessary to control a specified type of weed to an acceptable level in the treatment area that is being managed.

8. **Representative Site** – A site within and near the treatment area that is typical of the hydrologic and vegetative conditions present at the treatment area.

9. **Residues** – Residues are any pesticide byproduct, or breakdown product, or pesticide product that is present after the use of the pesticide to kill or control the target weed.

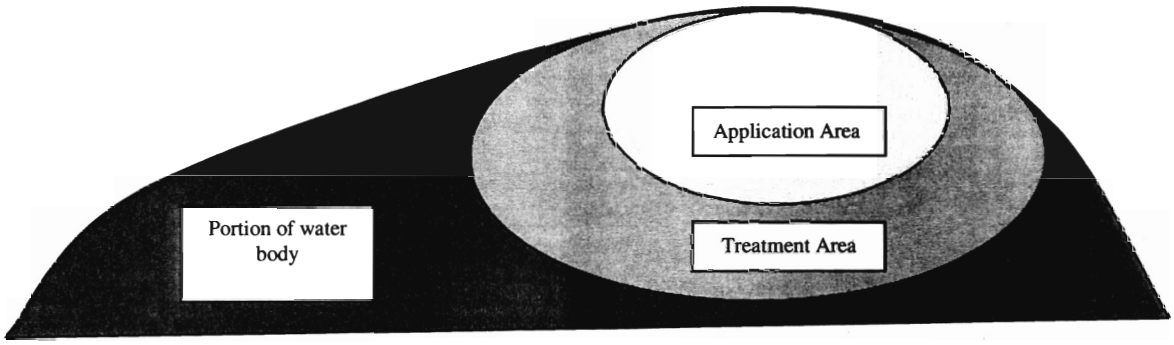
10. **Section 5.3 Exception** – Section 5.3 exception refers to a variance that dischargers may be granted, in accordance with section 5.3 of the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California*. The variance allows dischargers to exceed water quality criteria for priority pollutants, as set by the California Toxics Rule.

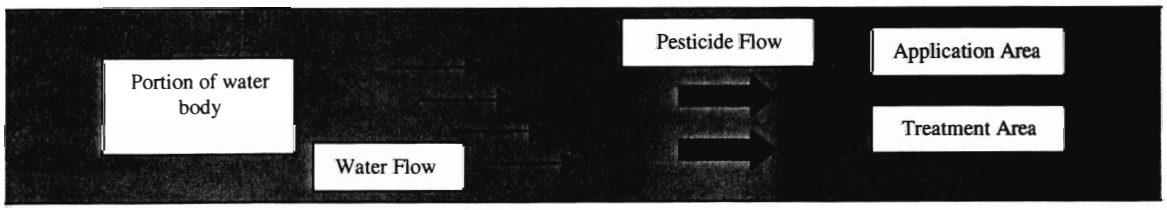
11. **Treatment Area** – The treatment area is the area that is treated by the aquatic pesticide to control weeds. It is the responsibility of the Control Agency to define the treatment area. (See Figure 1.)

12. **Treatment Event** – The treatment event is the period during which the aquatic application is actively killing or controlling weeds within the treatment area. It starts upon initiation of the application event and proceeds until the concentration of the aquatic pesticide is below that which can kill the target weed.

ATTACHMENT F
WATER QUALITY ORDER NO. 2004-0009-DWQ

Figure 1





WHCP Permits

USFWS Biological Opinion (1-1-04-F-0149)

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:
1-1-04-F-0149

MAY 2 1 2004

Dr. Lars W. J. Anderson
Lead Scientist
United States Department of Agriculture
Agricultural Research Service
Weed Science Program
University of California
One Shields Avenue
Davis, California 95616

Subject: Reinitiation of Formal Endangered Species Consultation on the Proposed Water Hyacinth Control Program in the Sacramento-San Joaquin Delta in Nine Counties, California

Dear Dr. Anderson:

This is in response to the U.S. Department of Agriculture's (USDA) February 20, 2004, request for reinitiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed State of California Department of Boating and Waterways (DBW) Water Hyacinth Control Program (WHCP) and chemical control of *Eichhornia crassipes* (Water Hyacinth) in the Sacramento-San Joaquin Delta and its tributaries. Your request was received in our office on February 23, 2004.

On June 1, 2001, the Service issued a biological opinion for the WHCP (Service file No. 1-1-01-F-0050). This biological opinion was subsequently amended three times (Service file No.'s 1-1-02-F-0157, 1-1-03-F-0114, and 1-1-04-F-0113). Your letter stated that the toxicology studies required by the Service's June 1, 2001, biological opinion, as amended, have been completed. You requested that the Service's June 1, 2001, biological opinion, as amended, be modified to reflect the new information on the toxicity of the herbicides and adjuvants used in the WHCP.

The new information on the toxicology of the herbicides and adjuvants used in the WHCP constitutes a substantial change to the project description and effects sections of the Service's June 1, 2001, biological opinion, as amended. In addition, the Sacramento splittail (*Pogonichthys macrolepidotus*) is no longer listed under the Act. Therefore, the Service has determined that a new biological opinion is required to fully account for all of these changes.

TAKE PRIDE IN AMERICA

This document hereby represents the Service's biological opinion on the effects of the State of California Department of Boating and Waterways (DBW) Water Hyacinth Control Program (WHCP) and chemical control of *Eichhornia crassipes* (Water Hyacinth) in the Sacramento-San Joaquin Delta and its tributaries on the federally threatened delta smelt (*Hypomesus transpacificus*) and its critical habitat, giant garter snake (*Thamnophis gigas*), and valley elderberry longhorn beetle *(Desmocerus californicus dimorphus*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). This biological opinion supersedes the Service's June 1, 2001, biological opinion (Service file No. 1-1-01-F-0050) and its amendments (Service file No.'s 1-1-02-F-0157, 1-1-03-F-0114, and 1-1-04-F-0113).

This biological opinion is based on the following information: 1) the Service's June 1, 2001, biological opinion (Service file No. 1-1-01-F-0050) and its amendments (Service file No.'s 1-1-02-F-0157, 1-1-03-F-0114, and 1-1-04-F-0113); 2) The DBW's WHCP 2003 Annual Report, dated January 2004; 3) the USDA's letter reinitiation of formal consultation, dated February 20, 2004; 4) the summary of aquatic acute toxicity data for five spray adjuvants, dated February 4, 2004; 5) the California Department of Fish and Game's (DFG's) study "Acute Oral and Dermal Toxicology of Aquatic Herbicides and a Surfacant to Garter Snakes," dated February 23, 2004; 6) the DFG's draft study "Acute Toxicities of Herbicides Used to Control Water Hyacinth and Brazilian Elodea on Larval Delta Smelt and Sacramento Spilttail," received on April 30, 2004; 7) numerous electronic mails, phone conversations, and meetings between the DBW, USDA and Mike Nepstad of the Service. A complete administrative record of this consultation is on file at the Sacramento Fish and Wildlife Office.

CONSULTATION HISTORY

On February 20, 2004, USDA requested reinitiation of formal consultation.

BIOLOGICAL OPINION

Description of the proposed Action

The DBW, with the assistance of USDA, works to control the non-native Water Hyacinth through the use of herbicides within the waterways of the Delta and its upland tributaries (see Attachment A, project area). The WHCP, approved by the Services June 1, 2001, biological opinion, is an on-going program that intends to control the growth and spread of Water Hyacinth through the use of chemical control methods. The WHCP treats Water Hyacinth using three different herbicides (Weedar ®64, Reward®, and Rodeo®) and three different adjuvants (Placement®, R-11®, and Agri-dex®). The majority of herbicide application would continue to be done from boats using a hand held spray gun; however some application would be done by land in locations not accessible by boat.

The purpose of the WHCP is to control and limit growth and spread of Water Hyacinth in the Delta and its tributaries, improve boat and vessel navigation in the Delta, and improve shallow-water habitat and water quality for native species. The WHCP proposes to use the most efficacious methods available with the least environmental impacts, employ a combination of control methods to allow for maximum flexibility, monitor results to fully understand impacts on the environment, reduce control efforts as efficacy of Water Hyacinth treatment is realized, and minimize use of methods that may cause adverse environmental impacts.

WHCP activities affect waterways, channels, and channel banks in the Delta and its tributaries. The environment affected by the WHCP and associated with the Delta and its tributaries includes three types of waterways: tidal delta, riverine, and dead-end slough. The habitats types include emergent herbaceous wetland vegetation (cattail, bulrush, pennywort), and riparian woodland vegetation (oaks, sycamore, willow, cottonwood, elderberry) associated with the waterways and levee banks of the Delta and tributaries. The majority of the waterways in the Delta have been channelized, are rip-rapped and constrained by levees.

The WHCP has divided the project area into numbered treatment sites varying in size between one and two miles in length depending on the amount of Water Hyacinth infestation, location, and waterbody type (*e.g.* tidal delta, riverine, dead-end slough). Treatment sites vary in size from year to year depending on Water Hyacinth distribution. Not all sites are treated each year. The WHCP is an adaptative program with control methods, treatment sites, and amount of herbicides used being reduced as the Water Hyacinth is effectively reduced. Should the treatment sites or methods need to change than the DBW and USDA have proposed to re-initiate consultation under the Act.

The protocols for the WHCP use five two-person crews each assigned to specific sites within the project area. The sites are prioritized as to greatest impact to navigation, Water Hyacinth nursery areas, and sites close to pumps or other structures. Typically, the five crews will spray about one to three sites each day, totaling 25 acres per day for the group. The maximum amount treated may be as high as 50 acres/day in summer when crews work overtime and weather conditions are conducive to treatment. The majority of the herbicide will be applied from boats with a smaller percentage being applied from land in areas where water access is impractical. Staging areas for the WHCP will be at developed launch sites. Access to sites from land would require disturbance of vegetation along waterways and levee banks. Staging areas would be limited to developed roadways for land operations.

The have maximum effectiveness, the WHCP needs to begin spraying as soon as possible in the spring, when the water hyacinth is small and rapidly growing. The crews check each site in their region throughout the season to evaluate the success of previous treatments and to inspect for any new plant growth.

The WHCP includes a water quality monitoring program. The monitoring program includes sampling for pre-treatment and post-treatment of dissolved oxygen and chemical residues and other monitoring parameters outlined below.

The WHCP assists in the implementation of several recovery actions outlined in the "Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes" (Delta Recovery Plan) (Service 1996) and the "Draft Recovery Plan for the Giant Garter Snake" (GGS Recovery Plan) (Service 1999a). The WHCP also assists in implementing Delta Recovery Plan recovery action #1121 (Develop Delta habitat and vegetation zones), Delta Recovery Plan recovery action #132 (eliminate loss of shallow water habitat) by removing the competition from the non-native macrophytes. The monitoring plan assists in implementing Delta Recovery Plan recovery action #53 (conduct toxicological investigations), and the GGS Recovery Plan recovery task #4.7 (study the effects of contaminants on giant garter snake).

Background

Water Hyacinth (*Eichhornia crassipes*) is a member of the pickerelweed family (Pontederiaceae). Water Hyacinth originated in tropical South America, but has become naturalized in many warm areas of the world including North America (California and southern states), Central America, Africa, India, Asia, Australia, and New Zealand. The plants vary in size from a few centimeters to over a meter in height. The glossy green, leathery leaf blades are up to 20 cm long and 5-15 cm wide and are attached to petioles that are spongy, inflated, and bulb-like. Numerous dark, branched, fibrous roots dangle in the water from the underside of the plant. The inflorescence is a loose terminal spike with showy light-blue to violet flowers (flowers occasionally white). The fruit is a three-celled capsule containing many minute, ribbed seeds.

Water Hyacinth has rapidly spread throughout inland and coastal freshwater bays, lakes, and marshes in the United States and in other countries. New plant populations often form from rooted parent plants and wind movements and currents help contribute to their wide distribution. Linked plants form dense rafts in the water and mud.

The typical Water Hyacinth life cycle in the United States begins when the spring overwintering plants (old stem bases) initiate growth by producing daughter plants. These plants slowly increase in number and size during the spring and summer until the maximum biomass is reached in the late summer. Water Hyacinths are in full bloom in late summer and early fall. Seeds form in the submerged, withered flower. By late fall some of the old leaves start dying and by January most plants have gone into senescence. Colonization of a new site begins with small plants at low plant densities. These plants increase in number and density without increasing in size until they produce a new mat. As a mature dense mat is formed, individual plant size continues to increase, but density decreases as the result of intraspecific competition. Water Hyacinth reproduces sexually by seeds and vegetatively by budding and stolen production. Daughter plants sprout from the stolons and doubling times have been reported of 6-18 days. The seeds can germinate in a few days or remain dormant for 15-20 years. They usually sink and remain dormant until periods of stress (droughts). Upon reflooding, the seeds often germinate and renew the growth cycle.

Aquatic plants often play a beneficial role in the function and "health" of waterbodies in a variety of ways such as: producing dissolved oxygen (DO), cycling nutrients, driving the food chain, dampening wave action and currents, lowering water turbidity, and providing habitat for fish and

wildlife. However, the excessive growth of aquatic vegetation (from exotic weed species such as Eurasian water milfoil, Brazilian Elodea (*Egeria densa*), Hydrilla, and Water Hyacinth, etc.) can result in undesirable impacts to aquatic ecosystems. For instance, the normal nighttime respiration of an overabundance of submersed vegetation can severely deplete DO levels, particularly during summer months or other periods of elevated water temperatures. In addition, thick plant stands reduce light penetration and restrict water circulation patterns to the point of producing extreme temperature, pH and nutrient stratification in the affected water column. These major and other more subtle consequences of excessive plants can have deleterious effects on the full range of aquatic organisms - fish, invertebrates, plants, *etc.* The result is often a reduction in the biodiversity of waterbodies (U.S. Army Corps of Engineers, 1998).

Water Hyacinth forms dense mats that interfere with navigation, recreation, irrigation, power generation, and native aquatic flora and fauna. These mats competitively exclude native submersed and floating-leaved plants which are part of the habitat used by listed species and their forage base. Low oxygen conditions develop beneath Water Hyacinth mats and the dense floating mats impede water flow and create good breeding conditions for mosquitoes (CALFED, ERP Vol. 1, 2000).

Water Hyacinth has also been shown to alter population dynamics and community structure of native ecosystems. As compared to native pennywort (*Hydrocotyle umbellata*), an aquatic plant found in the Delta, Water Hyacinth mats had lesser densities of marcoinvertibrates. Pennywort also attracted greater concentrations of the native amphipod *Hyalella azteca*, which is heavily preyed upon by fish.

Biological Control Methods

This biological opinion does not include the biological control of Water Hyacinth.

Mechanical Control Methods

Herding and handpicking of water hyacinth is used in sensitive areas and/or during time periods where herbicide applications are restricted or impractical, such as Site 20 in Jackson Slough, where there is dense population of elderberry shrubs (*Sambucus* sp.). This biological opinion does not cover the use of mechanical shredders.

Chemical Control Methods

The WHCP proposes to treat Water Hyacinth using three different herbicides, Weedar ®64, Reward®, and Rodeo®, and three adjuvants, Placement®, R-11®, and Agri-dex®. Adjuvants (also called surfactants) help effectiveness of herbicides in a number of manners. The WHCP uses adjuvants to reduce drift, spread the herbicides evenly on to the plants, and facilitate plant uptake. All three herbicides and adjuvants have been approved by EPA and Pesticide Regulators for use in aquatic systems in California. Other chemicals with the same active ingredients may be substituted for the above name-brand chemicals in the WHCP by the DBW.

Herbicides Used in the WHCP

Weedar ®64 (the active ingredient is 2,4-D Dimethylene Salt):
Weedar ®64 is a systemic herbicide specific to broadleaf plants. The active ingredient in this phenoxy herbicide is 2, 4-Dichlorophenoxyacetic acid dimethylamine salt (2, 4-D). Weedar ®64 is soluble in water and chemically stable. Weedar ®64 is absorbed through the leaves and takes approximately four to six hours to enter the phloem of the plant where is mimics plant regulating hormones leading to abnormal growth patterns and death of the plant. 2, 4-D has a relatively short half-life and is rather immobile in the soil. In 35 recent studies across the U.S., the average lowest depth detected ranged from 6 to 12 inches in soils of the southern United States to 16 to 24 inches in low organic soils. Soils were sampled to a depth of 48 inches. Its average half-life in soils ranged from 6.4 days in southern soils to 8.3 days in high organic matter soils. The average half-life in grass was 6.1 days and 6.9 days in thatch. The half-life in natural water was two to four weeks, although in areas such as a treated rice paddy, the half-life was as short as one day. The acid form of 2, 4-D, as well as the amine and ester chemical groups, metabolized to compounds of non-toxicological significance, and ultimately to forms of carbon. Thus, 2, 4-D is considered a biodegradable compound. Under normal conditions, 2, 4-D residues are not persistent in soil, water, or vegetation.

Breakdown in soil and groundwater: 2, 4-D has low soil persistence. The half-life in soil is less than 7 days (Wauchope *et al.* 1992). Soil microbes are primarily responsible for its disappearance (Howard 1991). Despite its short half-life in soil and in aquatic environments, the compound has been detected in groundwater supplies in at least five States and in Canada (Howard 1991). Very low concentrations have also been detected in surface waters throughout the U.S. (EPA 1992a).

Breakdown in water: In aquatic environments, microorganisms readily degrade 2, 4-D. Rates of breakdown increase with increased nutrients, sediment load, and dissolved organic carbon. Under oxygenated conditions the half-life is 1 week to several weeks (Howard 1991).

The effects of 2, 4-D on aquatic organisms: Some formulations of 2, 4-D are highly toxic to fish while others are less so. For example, the LC50 ranges between 1.0 and 100 mg/L in cutthroat trout, depending on the formulation used. Channel catfish had less than 10% mortality when exposed to 10 mg/L for 48 hours (Stevens and Sumner 1991 and EPA 1992b). Green sunfish, when exposed to 110 mg/L for 41 hours, showed no effect on swimming response. Limited studies indicate a half-life of less than 2 days in fish and oysters (National Research Council Canada 1978). Concentrations of 10 mg/L for 85 days did not adversely affect the survival of adult Dungeness crabs. For immature crabs, the 96-hour LC50 is greater than 10 mg/L, indicating that 2, 4-D is only slightly toxic. Brown shrimp showed a small increase in mortality at exposures of 2 mg/L for 48 hours (U.S. National Library of Medicine 1995 and Howard 1991).

The effects of 2, 4-D on delta smelt: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®64) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the delta smelt, acute toxicity tests were conducted by the DFG-Aquatic Toxicology Laboratory

(2004) on larval delta smelt. The adjuvant R-11® was more toxic than the herbicides, and Reward® was the most toxic herbicide. Exposure levels of the herbicides and adjuvant in the Sacramento-San Joaquin Delta are several orders of magnitude less than the 96-hour LC50 values with the exception of Reward®. Therefore, they determined that Weedar®64 is not causing toxicity at its application rates.

The effects of 2, 4-D on garter snakes: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®64) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the giant garter snake, toxicity tests were conducted by the DFG-Pesticide Investigations Unit (2004) with two sympatric, closely related species of garter snakes. Common garter snakes (*Thamnophis sirtalis*) and western terrestrial garter snakes (*Thamnophis elegans*) were orally and dermally dosed with solutions of the herbicides, adjuvant, and herbicide/adjuvant mixtures. Tank mix concentrations of WHCP herbicides and adjuvant were tested. No acute adverse effects were observed.

The maximum concentrations of 2, 4-D used by the WHCP would be approximately 1.5 to 3.1 mg/L with lesser concentrations reaching the water column. This herbicide can be used without an adjuvant, but often more than one treatment is needed to have the same effect.

Reward® (the active ingredient is Diquat):

Reward®, a non-selective contact herbicide, needs direct contact with the plant tissue to effectively control the plant's growth. Diquat dibromide, which is the active ingredient in Reward®, kills the plant tissue by destroying the plant's membranes. Diquat is fast acting and quickly absorbed into the plant tissue. However, diquat easily binds with organic particles and therefore its effectiveness is diminished in turbid waters. Because it quickly binds to particles and becomes biologically unavailable, its persistence in the waters of the Delta is limited. Reward® was used as the primary herbicide for the WHCP 2002-2003 spraying season.

Diquat dibromide is a non-selective, quick-acting herbicide and plant growth regulator, causing injury only to the parts of the plant to which it is applied. Diquat dibromide is referred to as a desiccant because it causes a leaf or an entire plant to dry out quickly. It is used to desiccate potato vines and seed crops, to control flowering of sugarcane, and for industrial and aquatic weed control. It is not residual; that is, it does not leave any trace of herbicide on or in plants, soil, or water.

Breakdown in soil and groundwater: Diquat dibromide is highly persistent, with reported field half-lives of greater than 1000 days (Wauchope *et al.* 1992). It is very well absorbed by soil organic matter and clay (Wauchope *et al.* 1992). Although it is water soluble (Wauchope *et al.* 1992), its capacity for strong adsorption to soil particles suggest that it will not easily leach through the soil, be taken up by plants or soil microbes, or broken down by sunlight (photochemical degradation). Field and laboratory tests show that diquat usually remains in the top inch of soil for long periods of time after it is applied (Tucker 1980).

Breakdown in water: Studies on the erosion of diquat-treated soils near bodies of water indicate

that diquat dibromide stays bound to soil particles, remaining biologically inactive in surface waters, such as lakes, rivers, and ponds (Gillett 1970). When diquat dibromide is applied to open water, it disappears rapidly because it binds to suspended particles in the water (Gillett 1970). Diquat dibromide's half-life is less than 48 hours in the water column, and may be on the order of 160 days in sediments due to its low bioavailability (Tucker 1980 and Gillett 1970). Microbial degradation and sunlight play roles in the breakdown of the compound (Gillett 1970). At 22 days after a weed infested artificial lake was treated, only 1% of the applied diquat dibromide remained in the water and 19% was adsorbed to sediments (Howard 1991).

Breakdown in vegetation: Diquat dibromide is rapidly absorbed into the leaves of plants, but usually kills the plant tissues necessary for translocation too quickly to allow movement to other parts of the plant. The herbicide interferes with cell respiration, the process by which plants produce energy. Diquat dibromide is broken down on the plant surface by photochemical degradation (Weed Science Society 1994). It is rapidly absorbed by aquatic weeds from the surrounding water and concentrated in the plant tissue (U.S. National Library of Medicine 1995). Thus, even low concentrations of the herbicide can control aquatic weeds (U.S. National Library of Medicine 1995).

The effects of diquat on aquatic organisms: Diquat dibromide is moderately to practically nontoxic to fish and aquatic invertebrates. The 8-hour LC50 for diquat dibromide is 12.3 mg/L in rainbow trout and 28.5 mg/L in Chinook salmon (Pimentel 1971). The 96-hour LC50 is 16 mg/L in northern pike, 20.4 mg/L in fingerling trout, 245 mg/L in bluegill, 60 mg/L in yellow perch, and 170 mg/L in black bullhead (Johnson and Finley 1980 and Simonin and Skea 1977). Research indicates that yellow perch suffer significant respiratory stress when herbicide concentrations in the water are similar to those normally present during aquatic vegetation control programs (Bimber 1976). There is little or no bioconcentration of diquat dibromide in fish (U.S. National Library of Medicine 1995).

The effects of 2, 4-D on delta smelt: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the delta smelt, acute toxicity tests were conducted by the DFG-Aquatic Toxicology Laboratory (2004) on larval delta smelt. The adjuvant R-11® was more toxic than the herbicides, and Reward® was the most toxic herbicide. Exposure levels of the herbicides and adjuvant in the Sacramento-San Joaquin Delta are several orders of magnitude less than the 96-hour LC50 values with the exception of Reward®. Therefore, they determined that Reward® is causing toxicity at its application rates, and cannot be used without killing larval fish, if present in the application area.

The effects of diquat on garter snakes: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the giant garter snake, toxicity tests were conducted by the DFG-Pesticide Investigations Unit (2004) with two sympatric, closely related species of garter snakes. Common garter snakes (*Thamnophis sirtalis*) and western terrestrial garter snakes (*Thamnophis elegans*) were orally and dermally dosed with solutions of the herbicides, adjuvant, and herbicide/adjuvant mixtures.

Tank mix concentrations of WHCP herbicides and adjuvant were tested. No acute adverse effects were observed.

The maximum concentrations of diquat used by the WHCP would be approximately 0.37mg/L, with lesser concentrations reaching the water column

Rodeo® (the active ingredient is Glyphosate):

Rodeo® is a non-selective contact herbicide. The active ingredient is glyphosate isopropylamine salt. It is water soluble and mixes readily with water and non-ionic surfactants. Glyphosate moves through the plant from the foliage to the root system. Glyphosate prevents the synthesis of certain amino acids essential for plant survival. Visible effects on the plant occur within 3 or more weeks and include gradual wilting and yellowing of the plant, advancing to complete browning.

Environmental Fate: Breakdown in soil and groundwater: Glyphosate is moderately persistent in soil, with an estimated average half-life of 47 days (Weed Science Society 1994 and Wauchope *et al.* 1992). Reported field half-life range from 1 to 174 days (Wauchope *et al.* 1992). It is strongly adsorbed to most soils, even those with lower organic and clay content (Wauchope *et al.* 1992 and Weed Science Society 1994). Thus, even though it is highly soluble in water, field and laboratory studies show it does not leach appreciably, and has low potential for runoff (except as adsorbed to colloidal matter) (Wauchope *et al.* 1992). One estimate indicated that less than 2% of the applied chemical is lost to runoff (Malik *et al.* 1989). Microbes are primarily responsible for the breakdown of the product, and volatilization or photodegradation losses will be negligible (Weed Science Society 1994).

Breakdown in water: In water, glyphosate is strongly adsorbed to suspended organic and mineral matter and is broken down primarily by microorganisms (USDA 1984). Its half-life in pond water ranges from 12 days to 10 weeks (EPA 1992a).

Breakdown in vegetation: Glyphosate may be translocated throughout the plant, including to the roots. It is extensively metabolized by some plants, while remaining intact in others (Kidd and James 1991).

The effects of Glyphosate on aquatic organisms: Technical glyphosate acid is practically nontoxic to fish and may be slightly toxic to aquatic invertebrates. The 96-hour LC50 (dose required to kill 50% of a given test population) is 120 mg/L in bluegill sunfish, 168 mg/L in harlequin, and 86 mg/L in rainbow trout (Weed Science Society 1994). The reported 96-hour LC50 values for other aquatic species include greater than 10 mg/L in Atlantic oysters, 934 mg/L in fiddler crab, and 281 mg/L in shrimp (Weed Science Society 1994). The 48-hour LC50 for glyphosate in Daphnia (water flea), an important food source for freshwater fish, is 780 mg/L (Weed Science Society 1994). Some formulations of glyphosate may be more toxic to fish and aquatic species due to differences in toxicity between the salts and the parent acid or to surfactants used in the formulation (Weed Science Society 1994). There is a very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms

(Monsanto 1985).

The effects of 2, 4-D on delta smelt: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the delta smelt, acute toxicity tests were conducted by the DFG-Aquatic Toxicology Laboratory (2004) on larval delta smelt. The adjuvant R-11® was more toxic than the herbicides, and Reward® was the most toxic herbicide. Exposure levels of the herbicides and adjuvant in the Sacramento-San Joaquin Delta are several orders of magnitude less than the 96-hour LC50 values with the exception of Reward®. Therefore, they determined that Rodeo® is not causing toxicity at its application rates.

The effects of Glyphosate on garter snakes: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the giant garter snake, toxicity tests were conducted by the DFG-Pesticide Investigations Unit (2004) with two sympatric, closely related species of garter snakes. Common garter snakes (*Thamnophis sirtalis*) and western terrestrial garter snakes (*Thamnophis elegans*) were orally and dermally dosed with solutions of the herbicides, adjuvant, and herbicide/adjuvant mixtures. Tank mix concentrations of WHCP herbicides and adjuvant were tested. No acute adverse effects were observed.

The maximum concentrations of glyphosate used by the WHCP would be approximately 2.3 to 3.1 mg/L with lesser concentrations reaching the water column. This herbicide can only be used with an adjuvant.

Adjuvants used in the WHCP

Placement® (the active ingredients are Amine Salts, Aromatic Acid, and Petroleum Distillates):

Placement® is a deposition and retention agent that reduces evaporation and drift of chemicals while increasing coverage and adherence on the target area. The active ingredients are Amine Salts of Organic Acids, Aromatic Acid, and Aromatic and Aliphatic Petroleum Distillates. Placement® is used as a surfactant with all three herbicides at a rate of one part placement to four parts herbicide.

The effects of Placement® on aquatic organisms and garter snakes has not been studied in depth, however, preliminary lab work conducted by the DFG-Aquatic Toxicology Lab showed Placement® to be the most toxic of the three adjuvants in the WHCP. Based on this information, DBW ceased the use of Placement® for the WHCP.

R-11® (the active ingredients are Alkyl Aryl Polyethoxylates/Compounded Silicone/Linear Alcohol):

The R-11® adjuvant is a combined spreader-activator for increasing the efficiency of agricultural chemicals. R-11® is used where quick wetting and uniform coverage of herbicide is required.

R-11® increases absorption and translocation, as well as inhibits rust and corrosion in equipment. It will be used with all three herbicides at a rate of 2 quarts per 100 gallons of spray solution. R-11® was used as the adjuvant for the WHCP 2002-2003 spraying season.

The effects of R-11® on aquatic organisms: Researchers have published new data on R-11® indicating that it may be an endrocrine disruptor. In August 2003, NOAA Fisheries directed DBW to discontinue the use of R-11® and to use only Agri-dex® for the WHCP.

The effects of 2, 4-D on delta smelt: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the delta smelt, acute toxicity tests were conducted by the DFG-Aquatic Toxicology Laboratory (2004) on larval delta smelt. The adjuvant R-11® was more toxic than the herbicides, and Reward® was the most toxic herbicide. Exposure levels of the herbicides and adjuvant in the Sacramento-San Joaquin Delta are several orders of magnitude less than the 96-hour LC50 values with the exception of Reward®. Therefore, they determined that R-11® could cause toxicity at its application rates, but that this could be avoided by ensuring that the spray is applied to the water hyacinth and not in the water column.

The effects of R-11® on garter snakes: To determine if exposure to aquatic herbicides (Reward®, Rodeo®, Weedar®) and/or adjuvant (R-11®) used by the WHCP posed an acute threat to the giant garter snake, toxicity tests were conducted by the DFG-Pesticide Investigations Unit (2004) with two sympatric, closely related species of garter snakes. Common garter snakes (*Thamnophis sirtalis*) and western terrestrial garter snakes (*Thamnophis elegans*) were orally and dermally dosed with solutions of the herbicides, adjuvant, and herbicide/adjuvant mixtures. Tank mix concentrations of WHCP herbicides and adjuvant were tested. No acute adverse effects were observed.

Agri-dex® (the active ingredients are Paraffin Base Petroleum Oil/Polyoxyethylate Polyol Fatty Acid Esters):

Agri-Dex® is a nonionic blend of surfactants and spray oil that is designed for use with a broad range of pesticides where oil concentrate adjuvant is recommended. Agri-Dex® improves pesticide application by modifying the wetting and deposition characteristics of the spray solution, resulting in a more even and uniform spray deposit. It will be used with all three herbicides at a rate of approximately one to four pints per 100 gallons.

The effects of Agri-Dex® on aquatic organisms and garter snakes has not been studied in depth, however, aquatic acute toxicity studies by the Washington State University have indicated that Agri-Dex® is practically non-toxic and is less toxic to fish and aquatic invertebrates than R-11®. Agri-Dex® was also shown to be less toxic to fish and aquatic invertebrates than R-11® in some preliminary lab work conducted by the DFG-Aquatic Toxicology Lab.

WHCP Monitoring Program

The DBW, with assistance from USDA and CDFA , has been monitoring pre-treatment and post-treatment levels of 2,4-D, Diquat, and Glyphosate since the inception of the WHCP. Historic sampling by DBW, USDA, and CDFA, since 1983, have shown levels of 2,4-D well below allowable State criteria. There have been no recorded fish kills resulting from activities associated with the WHCP since the start of the program. The DBW has been monitoring three fixed locations along with random site location sampling since initiating the WHCP.

The DBW will continue to implement a representative monitoring program for the WHCP. The monitoring program would include monitoring preselected locations where herbicide applications traditionally occur on an annual basis. These sites have associated with them representative samples of delta smelt, giant garter snake, and valley elderberry longhorn beetle habitats. Monitoring sites will include samples from each of the three water types in the WHCP (tidal delta, riverine, and dead-end slough). The monitoring program includes at a minimum of two (2) locations for each species. In years where herbicide application does not occur on the designated sites additional back-up sites will be evaluated so the minimum number of sites are monitored each year. Each site will be monitored a minimum of three times per year.

Chemical Residue Monitoring

The monitoring program includes a daily log with site specifics (*e.g.* location, wind, chemicals used, location of listed species/species habitat), dissolved oxygen levels (DO), pH, and pre-treatment and post-treatment levels of chemical residues.

NPDES Permit Monitoring Requirements

The DBW will follow an approved Central Valley Regional Water Quality Control Board water quality monitoring plan. The DBW will provide copies of the monitoring reports to the Service.

Elderberry Monitoring

The DBW monitors the effects of the WHCP herbicide application on elderberry shrubs which are adjacent (within levee banks or 250 feet which ever is less) to waterways being treated as described in their protocols and standards for elderberry shrub monitoring. Elderberry shrubs will be identified and shrubs health status documented pre-treatment and post-treatment of herbicides following Service guidelines. Any loss of elderberry shrubs with stems greater than 1" attributed to the WHCP shall be compensated for using approved compensation guidelines (U.S. Fish and Wildlife 1999b).

Intertidal Vegetation Monitoring

The DBW monitors the loss of intertidal vegetation as described in their protocols and standards for intertidal vegetation monitoring and will review treatment protocol should significant loss occur.

Dissolved Oxygen Monitoring

The DBW monitors the dissolved oxygen concentration of the treatment areas and would avoid treatment should dissolved oxygen levels fall below certain predetermined levels. Areas which are infested by Water Hyacinth (especially in areas of little water movement) tend to have DO levels which are unsuitable for aquatic life. A review committee comprised of the DBW, USDA, Service, NOAA Fisheries, and DFG will be established to review the ongoing DO monitoring and propose ways to further minimize impacts should monitoring indicate problems.

Treatment Schedule and Data Reporting

DBW submits to the Service an annual treatment schedule and herbicide use report by January 31st of each year. In addition a progress report would be submitted by June 1st of each year detailing the expected amount and area of chemical application for the WHCP. The Service shall review the reports and any available data regarding the monitoring of the WHCP and notify the DBW of any concerns about the WHCP.

WHCP Treatment Restrictions

The DBW has incorporated several treatment restriction on use of chemical herbicides. They are as follows:

1) The maximum size for any treatment site would be no more than 3 contiguous acres. A buffer zone will be created around all treatment sites to ensure that impacts will be spread out and not segregated to one larger area. This will help maintain higher DO levels and provide refugia for smaller fish and invertebrates. The DBW will treat no more than 3 contiguous acres, after which at least one adjacent site will be skipped to create a buffer zone between treatment areas. Buffer zones will be at least equal size of the previously treated site. Crews will not treat skipped sites until two tidal changes have occurred, or in non-tidal areas, until 24 hours after treatment.

2) For completely infested dead-end sloughs greater than one acre, no more than ½ the area at one time would be treated to allow for fish passage.

3) No treatment if winds are greater than 10 MPH.

4) The DBW shall use drift control agents as recommended by chemical label, and change nozzle type and spray pressures whenever conditions warrant, limiting the amount of herbicide which may inadvertently contact non-target plant species.

5) No treatment will occur within 250 feet of elderberry shrubs known to be inhabited by the valley elderberry longhorn beetle.

6) The WHCP will operate from July 1st through November 30th. The WHCP will operate

earlier only if the Service determines that one or more of their herbicides and adjuvants are non-toxic and therefore acceptable for earlier usage.

Action Area

The action area of the WHCP covers a nine-county region encompassing much of the Sacramento-San Joaquin Delta and several of its tributaries, including the San Joaquin River, the Merced River, and the Tuolumne River. The nine counties are: Contra Costa, Merced, Solano, Fresno, Sacramento, Stanislaus, Madera, San Joaquin, and Yolo. The WHCP action area is considered to be the waterways of the Delta and upland tributaries, within the following general geographic boundaries:

1) West up to and including Sherman Island, near the confluence of the Sacramento and San Joaquin Rivers.

2) 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.

3) North to the northern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel , plus waters within Lake Natoma.

4) South along the San Joaquin River and Kings River to Mendota, just east of the City of Fresno.

5) East along the San Joaquin River to Friant Dam on Millerton Lake.

6) East along the Tuolumne River to La Grange Reservoir, below Don Pedro Reservoir.

7) East along the Merced River to Merced Falls, below Lake McClure.

All of the WHCP treatment sites are within the range of the giant garter snake and valley elderberry longhorn beetle. WHCP treatment sites 1-132, 173-176, 241-289, 300-309, and 600 are within the range of the delta smelt and are within its designated critical habitat. WHCP treatment sites 200-239 occur in the Stone Lakes Basin, which is outside the range of the delta smelt but is within its designated critical habitat. WHCP treatment sites 310-325, 401-427, 500-537, 700-718, and 900-929 are outside of the range of the delta smelt and are outside of its designated critical habitat. None of the WHCP treatment sites are within the valley elderberry longhorn beetle's designated critical habitat.

Status of the Species

Delta smelt

Delta smelt was federally listed as a threatened species on March 5, 1993, (58 **FR** 12854) (Service 1993). Critical habitat for delta smelt was designated on December 19, 1994 (59 FR 65256) (Service 1994a). The Sacramento-San Joaquin Delta Native Fishes Recovery Plan was completed in 1996 (Service 1996). The Five Year Status Review for the delta smelt was completed on March 31, 2004 (Service 2004).

Description: Delta smelt are slender-bodied fish that typically reach 60-70 mm standard length (measured from tip of the snout to origin of the caudal fin), although a few may reach 120 mm standard length. The mouth is small, with a maxilla that does not extend past the midpoint of the eye. The eyes are relatively large, with the orbit width contained approximately 3.5-4 times in the head length. Small, pointed teeth are present on the upper and lower jaws. The first gill arch has 27-33 gill rakers and there are 7 branchiostegal rays (paired structures on either side and below the jaw that protect the gills). Counts of branchiostegal rays are used by taxonomists to identify fish. The pectoral fins reach less than two-thirds of the way to the bases of the pelvic fins. There are 9-10 dorsal fin rays, 8 pelvic fin rays, 10-12 pectoral fin rays, and 15-17 anal fin rays. The lateral line is incomplete and has 53-60 scales along it. There are 4-5 pyloric caeca. Live fish are nearly translucent and have a steely-blue sheen to their sides. Occasionally there may be one chromatophore (cellular organelle containing pigment) between the mandibles, but usually there is none. Delta smelt belong to the family Osmeridae, a more ancestral member of the order Salmoniformes which also includes the family Salmonidae (salmon, trout, whitefish, and graylings) (Molye and Cech 1988).

Distribution: Delta smelt are endemic to the upper Sacramento-San Joaquin estuary. They occur in the Delta primarily below Isleton on the Sacramento River, below Mossdale on the San Joaquin River, and in Suisun Bay. They move into freshwater when spawning (ranging from January to July) and can occur in: (1) the Sacramento River as high as Sacramento, (2) the Mokelumne River system, (3) the Cache Slough region, (4) the Delta, and, (5) Montezuma Slough, (6) Suisun Bay, (7) Suisun Marsh, (8) Carquinez Strait, (9) Napa River, and (10) San Pablo Bay. It is not known if delta smelt in San Pablo Bay are a permanent population or if they are washed into the Bay during high outflow periods. Since 1982, the center of delta smelt abundance has been the northwestern Delta in the channel of the Sacramento River. In any month, two or more life stages (adult, larvae, and juveniles) of delta smelt have the potential to be present in Suisun Bay (Department of Water Resources (DWR) and the Bureau of Reclamation (Reclamation) 1994; Molye 1976; and Wang 1991). Delta smelt are also captured seasonally in Suisun Marsh.

Habitat Requirements: Delta smelt are euryhaline (a species that tolerates a wide range of salinities) fish that generally occur in water with less than 10-12 parts per thousand (ppt) salinity. However, delta smelt have been collected in the Carquinez Strait at 13.8 ppt and in San Pablo Bay at 18.5 ppt (DFG 2000). In recent history, they have been most abundant in shallow areas

where early spring salinities are around 2 ppt. However, prior to the 1800's before the construction of levees that created the Delta Islands, a vast fluvial marsh existed in the Delta and the delta smelt probably reared in these upstream areas. During the recent drought (1987-92), delta smelt were concentrated in deep areas in the lower Sacramento River near Emmaton, where average salinity ranged from 0.36 to 3.6 ppt for much of the year (DWR and Reclamation 1994). During years with wet springs (such as 1993), delta smelt may continue to be abundant in Suisun Bay during summer even after the 2 ppt isohaline (an artificial line denoting changes in salinity in a body of water) has retreated upstream (Sweetnam and Stevens 1993). Fall abundance of delta smelt is generally highest in years when salinities of 2 ppt are in the shallows of Suisun Bay during the preceding spring ($p < 0.05$, $r = 0.50$) (Herbold 1994) (p is a statistical abbreviation for the probability of an analysis showing differences between variables, r is a statistical abbreviation for the correlation coefficient, a measure of the linear relationship of two variables). Herbold (1994) found a significant relationship between number of days when 2 parts per thousand was in Suisun Bay during April with subsequent delta smelt abundance ($p < 0.05$, $r = 0.49$) (Figure 2.2), but noted that autocorrelations (interactions among measurements that make relationships between measurements difficult to understand) in time and space reduce the reliability of any analysis that compares parts of years or small geographical areas. It should also be noted that the point in the estuary where the 2 ppt isohaline is located (X2) does not necessarily regulate delta smelt distribution in all years. In wet years, when abundance levels are high, their distribution is normally very broad. In late 1993 and early 1994, delta smelt were found in Suisun Bay region despite the fact that X2 was located far upstream. In this case, food availability may have influenced delta smelt distribution, as evidenced by the *Eurytemora* found in this area by DFG. In Suisun Marsh, delta smelt larvae occur in both large sloughs and small dead end sloughs. New studies are under way to test the hypothesis that adult fall abundance is dependent upon geographic distribution of juvenile delta smelt.

Life History: Wang (1986) reported spawning taking place in fresh water at temperatures of about 7º-15º Celsius (C). However, ripe delta smelt and recently hatched larvae have been collected in recent years at temperatures of 15º-22º C, so it is likely that spawning can take place over the entire 7º-22º C range. Temperatures that are optimal for survival of embryos and larvae have not yet been determined, although R. Mager, UCD, (unpublished data) found low hatching success and embryo survival from spawns of captive fish collected at higher temperatures. Delta smelt of all sizes are found in the main channels of the Delta and Suisun Marsh and the open waters of Suisun Bay where the waters are well oxygenated and temperatures relatively cool, usually less than 20º-22º C in summer. When not spawning, they tend to be concentrated near the zone where incoming salt water and out flowing freshwater mix (mixing zone). This area has the highest primary productivity and is where zooplankton populations (on which delta smelt feed) are usually most dense (Knutson and Orsi 1983; Orsi and Mecum 1986). At all life stages delta smelt are found in greatest abundance in the top 2 m of the water column and usually not in close association with the shoreline.

Delta smelt inhabit open, surface waters of the Delta and Suisun Bay, where they presumably school. In most years, spawning occurs in shallow water habitats in the Delta. Shortly before spawning, adult smelt migrate upstream from the brackish-water habitat associated with the mixing zone to disperse widely into river channels and tidally-influenced backwater sloughs

(Radtke 1966, Moyle 1976, Wang 1991). Migrating adults with nearly mature eggs were taken at the Central Valley Projects's (CVP) Tracy Pumping Plant, located in the south Delta, from late December 1990 to April 1991 (Wang 1991). In February 2000, gravid adults were found at both CVP and the State Water Projects' (SWP) fish facilities in the south Delta. Spawning locations appear to vary widely from year to year (DWR and Reclamation 1993). Sampling of larval smelt in the Delta suggests spawning has occurred in the Sacramento River, Barker, Lindsey, Cache, Georgiana, Prospect, Beaver, Hog, and Sycamore sloughs, in the San Joaquin River off Bradford Island including Fisherman's Cut, False River along the shore zone between Frank's and Webb tracts, and possibly other areas (Wang 1991). In years of moderate to high Delta outflow, smelt larvae are often most abundant in Suisun Bay and sloughs of Suisun Marsh, but it is not clear the degree to which these larvae are produced by locally spawning fish and the degree to which they originate upstream and are transported by river currents to the bay and marsh. Some spawning probably occurs in shallow water habitats in Suisun Bay and Suisun Marsh during wetter years (Sweetnam 1999 and Wang 1991). Spawning has also been recorded in Montezuma Slough near Suisun Bay (Wang 1986) and also may occur in Suisun Slough in Suisun Marsh (P. Moyle, UCD, unpublished data).

The spawning season varies from year to year, and may occur from late winter (December) to early summer (July). Pre-spawning adults are found in Suisun Bay and the western delta as early as September (DWR and Reclamation 1994). Moyle (1976) collected gravid adults from December to April, although ripe delta smelt were common in February and March. In 1989 and 1990, Wang (1991) estimated that spawning had taken place from mid-February to late June or early July, with peak spawning occurring in late April and early May. A recent study of delta smelt eggs and larvae (Wang and Brown 1993 as cited in Water Resources and Reclamation 1994) confirmed that spawning may occur from February through June, with a peak in April and May. Spawning has been reported to occur at water temperatures of about 7° to 15° C. Results from a University of California at Davis (UCD) study (Swanson and Cech 1995) indicate that although delta smelt tolerate a wide range of temperatures (<8° C to >25° C), warmer water temperatures restrict their distribution more than colder water temperatures.

Delta smelt spawn in shallow, fresh, or slightly brackish water upstream of the mixing zone (Wang 1991). Most spawning occurs in tidally-influenced backwater sloughs and channel edgewaters (Moyle 1976; Wang 1986, 1991; Moyle *et al.* 1992). Although delta smelt spawning behavior has not been observed in the wild (Moyle *et al.* 1992), some researchers believe the adhesive, demersal eggs attach to substrates such as cattails, tules, tree roots, and submerged branches in shallow waters (Moyle 1976, Wang 1991).

Laboratory observations have indicated that delta smelt are broadcast spawners (DWR and Reclamation 1994) and eggs are demersal (sinks to the bottom) and adhesive, sticking to hard substrates such as: rock, gravel, tree roots or submerged branches, and submerged vegetation (Moyle 1976; Wang 1986). At 14º-16º C, embryonic development to hatching takes 9 -14 days and feeding begins 4-5 days later (R. Mager, UCD, unpublished data). Newly hatched delta smelt have a large oil globule that makes them semi-buoyant, allowing them to maintain themselves just off the bottom (R. Mager, UCD, unpublished data), where they feed on rotifers (microscopic crustaceans used by fish for food) and other microscopic prey. Once the

swimbladder (a gas-filled organ that allows fish to maintain neutral buoyancy) develops, larvae become more buoyant and rise up higher into the water column. At this stage, 16-18 mm total length, most are presumably washed downstream until they reach the mixing zone or the area immediately upstream of it. Growth is rapid and juvenile fish are 40-50 mm long by early August (Erkkila *et al.* 1950; Ganssle 1966; Radtke 1966). By this time, young-of-year fish dominate trawl catches of delta smelt, and adults become rare. Delta smelt reach 55-70 mm standard length in 7-9 months (Moyle 1976). Growth during the next 3 months slows down considerably (only 3-9 mm total), presumably because most of the energy ingested is being directed towards gonadal development (Erkkila *et al.* 1950; Radtke 1966). There is no correlation between size and fecundity, and females between 59-70 mm standard lengths lay 1,200 to 2,600 eggs (Moyle *et al.* 1992). The abrupt change from a single-age, adult cohort during spawning in spring to a population dominated by juveniles in summer suggests strongly that most adults die after they spawn (Radtke 1966 and Moyle 1976). However, in El Nino years when temperatures rise above 18º C before all adults have spawned, some fraction of the unspawned population may also hold over as two-year-old fish and spawn in the subsequent year. These two-year-old adults may enhance reproductive success in years following El Nino events.

In a near-annual fish like delta smelt, a strong relationship would be expected between number of spawners present in one year and number of recruits to the population the following year. Instead, the stock-recruit relationship for delta smelt is weak, accounting for about a quarter of the variability in recruitment (Sweetnam and Stevens 1993). This relationship does indicate, however, that factors affecting numbers of spawning adults (*e.g.*, entrainment, toxics, and predation) can have an effect on delta smelt numbers the following year.

Delta smelt feed primarily on (1) planktonic copepods (small crustaceans used by fish for food), (2) cladocerans (small crustaceans used by fish for food), (3) amphipods (small crustaceans used by fish for food) and, to a lesser extent, (4) on insect larvae. Larger fish may also feed on the opossum shrimp, *Neomysis mercedis*. The most important food organism for all sizes seems to be the euryhaline copepod, *Eurytemora affinis*, although in recent years the exotic species, *Pseudodiaptomus forbesi*, has become a major part of the diet (Moyle *et al.* 1992). Delta smelt are a minor prey item of juvenile and subadult striped bass, *Morone saxatilis*, in the Sacramento-San Joaquin Delta (Stevens 1966). They also have been reported from the stomach contents of white catfish, *Ameiurus catus*, (Turner 1966 *in* Turner and Kelley (eds) 1966) and black crappie, *Pomoxis nigromaculatus*, (Turner 1966 *in* Turner and Kelley 1966) in the Delta.

Abundance: The smelt is endemic to Suisun Bay upstream of San Francisco Bay and throughout the Delta, in Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties, California. Historically, the smelt is thought to have occurred from Suisun Bay and Montezuma Slough, upstream to at least Verona on the Sacramento River, and Mossdale on the San Joaquin River (Moyle *et al.* 1992, Sweetnam and Stevens 1993).

Since the 1850s, however, the amount and extent of suitable habitat for the delta smelt has declined dramatically. The advent in 1853 of hydraulic mining in the Sacramento and San Joaquin rivers led to an increase in siltation and the alteration of the circulation patterns of the Estuary (Nichols *et al.* 1986, Monroe and Kelly 1992). The reclamation of Merritt Island for

agricultural purposes, in the same year, marked the beginning of the present-day cumulative loss of 94% of the Estuary's tidal marshes (Nichols *et al.* 1986, Monroe and Kelly 1992). The extensive levee system in the Delta has led to a loss of seasonally flooded habitat and significantly changed the hydrology of the Delta ecosystem, restricting the ability of suitable habitat substrates to re-vegetate.

Delta smelt were once one of the most common pelagic (living in open water away from the bottom) fish in the upper Sacramento-San Joaquin estuary, as indicated by its abundance in DFG trawl catches (Erkkila *et al.* 1950; Radtke 1966; Stevens and Miller 1983). Delta smelt abundance from year to year has fluctuated greatly in the past, but between 1982 and 1992 their population was consistently low. The decline became precipitous in 1982 and 1983 due to extremely high outflows and continued through the drought years 1987-1992 (Moyle *et al.* 1992). In 1993, numbers increased considerably, apparently in response to a wet winter and spring. During the period 1982-1992, most of the population was confined to the Sacramento River channel between Collinsville and Rio Vista (D. Sweetnam, DFG unpublished data). This was still an area of high abundance in 1993, but delta smelt were also abundant in Suisun Bay. The actual size of the delta smelt population is not known. However, the pelagic life style of delta smelt, short life span, spawning habits, and relatively low fecundity indicate that a fairly substantial population probably is necessary to keep the species from becoming extinct.

Recreation in the Delta has resulted in the presence and propagation of predatory non-native fish such as striped bass (*Morone saxatilis*). Additionally, recreational boat traffic has led to a loss of habitat from the building of docks and an increase in the rate of erosion resulting from boat wakes. In addition to the loss of habitat, erosion reduces the water quality and retards the production of phytoplankton in the Delta.

In addition to the degradation and loss of estuarine habitat, delta smelt have been increasingly subject to entrainment, upstream or reverse flows of waters in the Delta and San Joaquin River, and constriction of low salinity habitat to deep-water river channels of the interior Delta (Moyle *et al.* 1992). These adverse conditions are primarily a result of the steadily increasing proportion of river flow being diverted from the Delta by the Projects, and occasional droughts (Monroe and Kelly 1992).

Reduced water quality from agricultural runoff, effluent discharge and boat effluent has the potential to harm the pelagic larvae and reduce the availability of the planktonic food source. When the mixing zone is located in Suisun Bay where there is extensive shallow water habitat within the euphotic zone (depths less than four meters), high densities of phytoplankton and zooplankton may accumulate (Arthur and Ball 1978, 1979, 1980). The introduction of the Asian clam (*Potamocorbula amurensis)*, a highly efficient filter feeder, presently reduces the concentration of phytoplankton in this area.

According to seven abundance indices which provide information on the status of the delta smelt, this species was consistently at low population levels through the 1980's (Stevens *et al.* 1990). These same indices also showed a pronounced decline from historical levels of abundance (Stevens *et al.* 1990).

For a large part of its annual life span, this species is associated with the freshwater edge of the mixing zone, where the salinity is approximately 2 ppt. (Ganssle 1966, Moyle *et al.* 1992, Sweetnam and Stevens 1993). The relationship between the portion of the smelt population west of the Delta as sampled in the summer townet survey and the natural logarithm of Delta outflow from 1959 to 1988, indicates the summer townet index increased dramatically when outflow was between 34,000 and 48,000 cubic feet per second, placing X2 between Chipps and Roe islands (DWR and Reclamation 1994).

Specifically, the summer townet abundance index constitutes one of the more representative indices because the data have been collected over a wide geographic area (from San Pablo Bay upstream through most of the Delta) for the longest period of time (since 1959) (DFG 2001). The summer townet abundance index measures the abundance and distribution of juvenile delta smelt and provides data on the recruitment potential of the species (DFG 2001). Since 1983, (except for 1986, 1993, and 1994), this index has remained at consistently lower levels than previously found (DFG 2001). These consistently lower levels correlate with the 1983 to 1992 mean location of X2 upstream of the confluence (DFG 2001).

The final summer townet index for 2000 was 8.0, a decline from the 11.9 index for the 1999 summer townet (DFG 2001). Both of these indices represent an increase from the 1998 index of 3.3. However, both 1999 and 2000 indices are still below the pre-decline average of 20.4 (1959-1981, no sampling in 1966-1968) (DFG 2001).

The second longest running survey (since 1967), the fall midwater trawl survey (FMWT), measures the abundance and distribution of late juveniles and adult delta smelt in a large geographic area from San Pablo Bay upstream to Rio Vista on the Sacramento River and Stockton on the San Joaquin River (Stevens *et al.* 1990, DFG 1999). The FMWT indicates the abundance of the adult population just prior to upstream spawning migration (DFG 1999). The index calculated from the FMWT uses numbers of sampled fish multiplied by a factor related to the volume of the area sampled (DFG 1999). Until recently, except for 1991, this index has declined irregularly over the past 20 years (DFG 1999). Since 1983, the delta smelt population has exhibited more low FMWT abundance indices, for more consecutive years, than previously recorded (DFG 1999). The 1994 FMWT index of 101.2 was a continuation of this trend (DFG 1999). This occurred despite the high 1994 summer townet index for reasons unknown (DFG 1999). The low 1995 summer townet index value of 3.3 was followed by a high FMWT index of 839 reflecting the benefits of higher flows due to an extremely wet year (DFG 1999, 2001).

The 1999 FMWT index of 717, which is an increase from 1998's index (417.6), is the third highest since the start of decline of delta smelt abundance in 1982 (DFG 1999). The FMWT abundance index (127) for 1996 represented the fourth lowest on record (DFG 1999). The 1997 abundance index (360.8) almost tripled since the 1996 survey, despite the low summer townet index (4.0) (DFG 1999, 2001).

Both 2001 TNS and FMWT abundance indices for delta smelt decreased from 2000 (Souza and Bryant 2002, DFG 1999 and 2001). The 2001 TNS delta smelt index (3.5) is less than 1999 (11.9) and 2000 (8.0) but comparable to recent years (1995, 1997, and 1998) when the index

ranged from 3.2 to 4.0 (Souza and Bryant 2002, DFG 2001). The 2001 FMWT delta smelt index (603) decreased by 20% from 2000 (756) (Souza and Bryant 2002, DFG 2001). Both surveys exhibited an overall trend of decline in the last three years, but this decline seems more pronounced in the TNS where the 2001 delta smelt index is 95% lower than the greatest index of record (62.5) in 1978 (Souza and Bryant 2002, DFG 2001).

Swimming Behavior: Observations of delta smelt swimming in a swimming flume and in a large tank show that these fish are unsteady, intermittent, slow speed swimmers (Swanson and Cech 1995). At low velocities in the swimming flume (<3 body lengths per second), and during spontaneous, unrestricted swimming in a 1 m tank, smelt consistently swam with a "stroke and glide" behavior. This type of swimming is very efficient; Weihs (1974) predicted energy savings of about 50% for "stroke and glide" swimming compared to steady swimming. However, the maximum speed smelt are able to achieve using this mode of swimming is less than 3 body lengths per second, and the fish did not readily or spontaneously swim at this or higher speeds (Swanson and Cech 1995). Although juvenile delta smelt appear to be stronger swimmers than adults, forced swimming at 3 body lengths per second in a swimming flume was apparently stressful; the smelt were prone to swimming failure and extremely vulnerable to impingement (Swanson and Cech 1995). Delta smelt swimming performance was limited by behavioral rather than physiological or metabolic constraints (Brett 1976).

Summary of the Five Year Review: In summary, the threats of the destruction, modification, or curtailment of its habitat or range resulting from extreme outflow conditions, the operations of the State and Federal water projects, and other water diversions as described in the original listing remain. The only new information concerning the delta smelt's population size and extinction probability indicates that the population is at risk of falling below an effective population size and therefore in danger of becoming extinct. Although VAMP and Environmental Water Account have helped to ameliorate these threats, it is unclear how effective these will continue to be over time based on available funding and future demands for water. In addition, there are increased water demands outside the CVP and the SWP, which could also impact delta smelt. The increases in water demands are likely to result in less suitable rearing conditions for delta smelt in Suisun Marsh, increased vulnerability to entrainment, and less water available for maintaining the position of X2. The importance of exposure to toxic chemicals on the population of delta smelt is highly uncertain. Therefore, a recommendation to delist the delta smelt is inappropriate.

In addition, many potential threats have not been sufficiently studied to determine their effects, such as predation, disease, competition, and hybridization. Therefore, a recommendation of a change in classification to endangered is premature.

In his August 24, 2003, letter, the foremost delta smelt expert, Dr. Peter B. Moyle, stated that the delta smelt should continue to be listed as a threatened species (Moyle 2003). In addition, in their January 23, 2004, letter, DFG fully supported that the delta smelt should retain its threatened status under the Act (DFG 2004).

Delta Smelt Critical Habitat

In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR §424.12(b)).

The Service is required to list the known primary constituent elements together with the critical habitat description. Such physical and biological features include, but are not limited to, the following:

1. space for individual and population growth, and for normal behavior;

2. food, water, air, light, minerals, or other nutritional or physiological requirements;

3. cover or shelter;

4. sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and

5. generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

In designating critical habitat for the delta smelt, the Service identified the following primary constituent elements essential to the conservation of the species: physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration. Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay.

Larval and juvenile transport. Adequate river flow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay and to ensure that rearing habitat is maintained in Suisun Bay. To ensure this, X2 must be located westward of the confluence of the Sacramento-San Joaquin Rivers, located near Collinsville (Confluence), during the period when larvae or juveniles are being transported, according to historical salinity conditions. X2 is important because the "entrapment zone" or zone where particles, nutrients, and plankton are "trapped," leading to an area of high productivity, is associated with its location. Habitat conditions suitable for transport of larvae and juveniles may be needed by the species as early as February 1 and as late as August 31, because the spawning season varies from year to year and may start as early as December and extend until July.

Rearing habitat. An area extending eastward from Carquinez Strait, including Suisun, Grizzly, and Honker bays, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Three

Mile Slough represents the approximate location of the most upstream extent of historical tidal incursion. Rearing habitat is vulnerable to impacts of export pumping and salinity intrusion from the beginning of February to the end of August.

Adult migration. Adequate flow and suitable water quality is needed to attract migrating adults in the Sacramento and San Joaquin river channels and their associated tributaries, including Cache and Montezuma sloughs and their tributaries. These areas are vulnerable to physical disturbance and flow disruption during migratory periods.

The Service's 1994 and 1995 biological opinions on the operations of the CVP and SWP provided for adequate larval and juvenile transport flows, rearing habitat, and protection from entrainment for upstream migrating adults (Service 1994b, 1995). Please refer to 59 FR 65255 for additional information on delta smelt critical habitat.

Giant Garter Snake

The giant garter snake was listed as a threatened species on October 20, 1993 (58 FR 54053) (Service 1993b). A draft recovery plan for the giant garter snake was completed in 1999 (Service 1999a).

Description - The giant garter snake is one of the largest garter snakes and may reach a total length of at least 64 inches (160 centimeters). Females tend to be slightly longer and proportionately heavier than males. The weight of adult female giant garter snakes is typically 1.1-1.5 pounds (500-700 grams). Dorsal background coloration varies from brownish to olive with a checkered pattern of black spots, separated by a yellow dorsal stripe and two light colored lateral stripes. Background coloration and prominence of black checkered pattern and the three yellow stripes are geographically and individually variable (Hansen 1980). The ventral surface is cream to olive or brown and sometimes infused with orange, especially in northern populations.

Historical and current range - Fitch (1941) described the historical range of the species as extending from the vicinity of Sacramento and Contra Costa Counties southward to Buena Vista Lake, near Bakersfield, in Kern County. Prior to 1970, the giant garter snake was recorded historically from 17 localities (Hansen and Brode 1980). Five of these localities were clustered in and around Los Banos, Merced County. The paucity of information makes it difficult to determine precisely the species' former range. Nonetheless, these records coincide with the historical distribution of large flood basins, fresh water marshes, and tributary streams. Reclamation of wetlands for agriculture and other purposes apparently extirpated the species from the southern one-third of its range by the 1940s -1950s, including the former Buena Vista Lake and Kern Lake in Kern County, and the historic Tulare Lake and other wetlands in Kings and Tulare Counties (Hansen and Brode 1980, Hansen 1980). Surveys over the last two decades have located the giant garter snake as far north as the Butte Basin in the Sacramento Valley.

As recently as the 1970s, the range of the giant garter snake extended from near Burrel, Fresno County (Hansen and Brode 1980), northward to the vicinity of Chico, Butte County (Rossman and Stewart 1987). DFG studies (Hansen 1988) indicate that giant garter snake populations

currently are distributed in portions of the rice production zones of Sacramento, Sutter, Butte, Colusa, and Glenn Counties; along the western border of the Yolo Bypass in Yolo County; and along the eastern fringes of the Sacramento-San Joaquin River delta from the Laguna Creek-Elk Grove region of central Sacramento County southward to the Stockton area of San Joaquin County. This distribution largely corresponds with agricultural land uses throughout the Central Valley.

Essential habitat components - Endemic to wetlands in the Sacramento and San Joaquin valleys, the giant garter snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways and agricultural wetlands, such as irrigation and drainage canals and rice fields, and the adjacent uplands. Giant garter snakes feed on small fishes, tadpoles, and frogs (Fitch 1941, Hansen 1980, Hansen 1988). Essential habitat components consist of: (1) adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) upland habitat with grassy banks and openings in waterside vegetation for basking; and (4) higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter (Hansen 1980).

Foraging ecology - Giant garter snakes are extremely aquatic, are rarely found away from water, forage in the water for food, and will retreat to water to escape predators and disturbance. This species occupies a niche similar to some eastern water snakes (*Nerodia* spp). Giant garter snakes are active foragers, feeding primarily on aquatic prey such as fish and amphibians. Historically, prey likely consisted of Sacramento blackfish (*Orthodon microlepidotus*), thick-tailed chub (*Gila crassicauda*), and red-legged frog (*Rana aurora*). Because these species are no longer available (chub extinct, red-legged frog extirpated from the Central Valley, blackfish declining/in low numbers), the predominant food items are now introduced species such as carp (*Cyprinus carpio*), mosquito-fish (*Gambusia affinis*), bullfrogs (*Rana catesbiana*), and Pacific chorus frog (*Pseudacris regilla*) (Fitch 1941, Rossman *et al*, 1996).

Reproductive ecology - The breeding season extends through March and April, and females give birth to live young from late July through early September (Hansen and Hansen 1990). Brood size is variable, ranging from 10 to 46 young, with a mean of 23 (Hansen and Hansen 1990). At birth young average about 20.6 cm snout-vent length and 3-5 g. Young immediately scatter into dense cover and absorb their yolk sacs, after which they begin feeding on their own. Although growth rates are variable, young typically more than double in size by one year of age (Service 1999a). Sexual maturity averages three years in males and 5 years for females (Service 1999a).

Movements and habitat use - The giant garter snake typically inhabits small mammal burrows and other soil crevices throughout its winter dormancy period (*i.e.*, November to mid-March). Although these areas are generally thought to be above prevailing flood elevations, snakes may not always utilize high ground during their winter dormancy period. The Biological Resources Division (BRD) has documented giant garter snakes at the Colusa National Wildlife Refuge overwintering in areas with few high ground retreat sites (Wylie et al. 1997). Giant garter snakes in another study population at Gilsizer Slough overwintered in a low elevation wetland area, even though higher ground was present nearby. Both of these populations survived flooding and were

not displaced from the area. Giant garter snakes also use burrows as refuge from extreme heat during their active period. The BRD (Wylie *et al.* 1997) has documented giant garter snakes using burrows in the summer as much as 165 feet (50 meters) away from the marsh edge. Overwintering giant garter snakes have been documented using burrows as far as 820 feet (250 meters) from the edge of marsh habitat.

During radio-telemetry studies conducted by the BRD giant garter snakes typically moved little from day to day. However, total activity varied widely between individuals. Snakes have been documented moving up to 5 miles (8 kilometers) over the period of a few days (Wylie *et al.* 1997). In agricultural areas, giant garter snakes were documented using rice fields in 19-20 percent of the observations, marsh habitat in 20-23 percent of observations, and canal and agricultural waterway habitats in 50-56 percent of the observations (Wylie *et al.* 1997).

The current distribution and abundance of the giant garter snake is much reduced from former times. Agricultural and flood control activities have extirpated the giant garter snake from the southern one third of its range in former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds. These lakebeds once supported vast expanses of ideal giant garter snake habitat, consisting of cattail and bulrush dominated marshes. Vast expanses of bulrush and cattail floodplain habitat also typified much of the Sacramento Valley historically (Hinds 1952). Prior to reclamation activities beginning in the mid to late 1800s, about 60 percent of the Sacramento Valley was subject to seasonal overflow flooding in broad, shallow flood basins that provided expansive areas of giant garter snake habitat (Hinds 1952). Valley floor wetlands are subject to the cumulative effects of upstream watershed modifications, water storage and diversion projects, as well as urban and agricultural development; all natural habitats have been lost and an unquantifiably small percentage of seminatural wetlands remain extant. Only a small percentage of extant wetlands currently provides habitat suitable for the giant garter snake.

The giant garter snake currently is only known from a small number of populations. The status of these populations and the threats to these snakes and their habitats are detailed in the final rule that listed the giant garter snake as threatened (58 FR 54053). A number of land use practices and other human activities currently threaten the survival of the giant garter snake throughout the remainder of its range. Although some giant garter snake populations have persisted at low levels in artificial wetlands associated with agricultural and flood control activities, many of these altered wetlands are now threatened with urban development. Cities within the current range of the giant garter snake that are rapidly expanding include: (1) Chico, (2) Yuba City, (3) Sacramento, (4) Galt, (5) Stockton, (6) Gustine, and (7) Los Banos. Ongoing maintenance of aquatic habitats for flood control and agricultural purposes eliminate or prevent the establishment of habitat characteristics required by giant garter snakes and can fragment and isolate available habitat, prevent dispersal of snakes among habitat units, and adversely affect the availability of the garter snake's food items (Hansen 1988, Brode and Hansen 1992). Livestock grazing along the edges of water sources degrades habitat quality in a number of ways: (1) eating and trampling aquatic and riparian vegetation needed for cover from predators, (2) changes in plant species composition, (3) trampling snakes, (4) water pollution, (5) and reducing or eliminating fish and amphibian prey populations. Overall, grazing has contributed to the elimination and reduction of the quality of available habitat at four known locations (Hansen 1980, 1988).

In many areas, the restriction of suitable habitat to water canals bordered by roadways and levee tops renders giant garter snakes vulnerable to vehicular mortality. Fluctuation in rice and agricultural production affects stability and availability of habitat. Recreational activities, such as fishing, may disturb snakes and disrupt basking and foraging activities. Non-native predators, including introduced predatory gamefish, bullfrogs, and domestic cats also threaten giant garter snake populations. While large areas of seemingly suitable giant garter snake habitat exist in the form of duck clubs and waterfowl management areas, water management of these areas typically does not provide summer water needed by giant garter snakes.

Although giant garter snakes on national wildlife refuges are relatively protected from many of the threats to the species, degraded water quality continues to be a threat to the species both on and off refuges.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle is dependent on its host plant, elderberry, which is a locally common component of the remaining riparian forests and savannah areas and, to a lesser extent, the mixed chaparral-foothill woodlands of the Central Valley. Use of the elderberry shrubs by the animal, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the shrub's use by the beetle is an exit hole created by the larva just prior to the pupal stage. Observations made within elderberry shrubs along the Consumes River and in the Folsom Lake area indicate that larval galleries can be found in elderberry stems with no evidence of exit holes; the larvae either succumb prior to constructing an exit hole or are not far enough along in the developmental process to construct an exit hole. Larvae appear to be distributed in stems which are 1.0 inch or greater in diameter at ground level. The *Valley Elderberry Longhorn Beetle Recovery Plan* (Service 1984) and Barr (1991) contain further details on the beetle's life history.

Population densities of the beetle are probably naturally low (Service 1984); and it has been suggested, based on the spatial distribution of occupied shrubs (Barr 1991), that the beetle is a poor disperser. Low density and limited dispersal capability cause the beetle to be vulnerable to the negative effects of the isolation of small subpopulations due to habitat fragmentation.

When the beetle was listed, the species was known from less than 10 localities along the American River, the Merced River, and Putah Creek. By the time the *Valley Elderberry Longhorn Beetle Recovery Plan* was prepared in 1984, additional species localities had been found along the American River and Putah Creek. As of 1998, the California Natural Diversity Database (CNDDB) included 181 occurrences for this species in 44 drainages throughout the Central Valley, from a location along the Sacramento River in Shasta County, southward to an area along Caliente Creek in Kern County (CNDDB 1998). The beetle continues to be threatened by habitat loss and fragmentation, invasion by Argentine ants (*Linepithema humile*), and possibly other factors such as pesticide drift, exotic plant invasion, and grazing.

The following paragraphs analyze the effects of past and ongoing factors leading to the current status of the species, its habitat and ecosystem, throughout the species' range. It includes an analysis of impacts from projects that have received incidental take authorization for the beetle

since the species was listed, and an evaluation of conservation efforts aimed at minimizing these impacts, based on the best available information. The purpose of this analysis is to provide a baseline with which to compare in determining whether implementation of the programmatic conservation strategy would jeopardize the continued existence of the species, and whether the strategy would provide for the species' long-term survivability.

Habitat loss has been ranked as the single greatest threat to biodiversity in the United States (Wilcove *et al.* 1998). In the 1980 final rule to list the beetle as threatened, habitat destruction was cited as the primary factor contributing to the need to federally list the species (Service 1980). As stated in the final rule, by the time the species was listed its habitat had largely disappeared throughout much of its former range due to agricultural conversion, levee construction, and stream channelization. The 1984 recovery plan reiterated that the primary threat to the beetle was loss and alteration of habitat by agricultural conversion, grazing, levee construction, stream and river channelization, removal of riparian vegetation, riprapping of shoreline, plus recreational, industrial and urban development (Service 1984).

Riparian forests, the primary habitat for the beetle, have been severely depleted throughout the Central Valley over the last two centuries as a result of expansive agricultural and urban development (Katibah 1984, Thompson 1961, Roberts *et al.* 1977). Since colonization, these forests have been "...modified with a rapidity and completeness matched in few parts of the United States" (Thompson 1961). As of 1849, the rivers and larger streams of the Central Valley were largely undisturbed. They supported continuous bands of riparian woodland four to five miles in width along some major drainages such as the lower Sacramento River, and generally about two miles wide along the lesser streams (Thompson 1961). Most of the riverine floodplains supported riparian vegetation to about the 100-year flood line (Katibah 1984). A large human population influx occurred after 1849, however, and much of the Central Valley riparian habitat was rapidly converted to agriculture and used as a source of wood for fuel and construction to serve a wide area (Thompson 1961). By as early as 1868, riparian woodland had been severely impacted in the Central Valley, as evidenced by the following excerpt:

> This fine growth of timber which once graced our river [Sacramento], tempered the atmosphere, and gave protection to the adjoining plains from the sweeping winds, has entirely disappeared - the woodchopper's axe has stripped the river farms of nearly all the hard wood timber, and the owners are now obliged to rely upon the growth of willows for firewood. (Cronise 1868, *in* Thompson 1961).

The clearing of riparian forests for fuel and construction made this land available for agriculture (Thompson 1977). Natural levees bordering the rivers, once supporting vast tracts of riparian habitat, became prime agricultural land (Thompson 1961, 1977). As agriculture expanded in the Central Valley, needs for increased water supply and flood protection spurred water development and reclamation projects. Artificial levees, river channelization, dam building, water diversion, and heavy groundwater pumping further reduced riparian habitat to small, isolated fragments (Katibah 1984). In recent decades, these riparian areas have continued to decline as a result of ongoing agricultural conversion as well and urban development and stream channelization. As of 1989, there were over 100 dams within the Central Valley drainage basin, as well as thousands

of miles of water delivery canals and streambank flood control projects for irrigation, municipal and industrial water supplies, hydroelectric power, flood control, navigation, and recreation (Frayer *et al.* 1989). Riparian forests in the Central Valley have dwindled to discontinuous strips of widths currently measurable in yards rather than miles.

Some accounts state that the Sacramento Valley supported approximately 775,000 to 800,000 acres of riparian forest as of approximately 1848, just prior to statehood (Smith 1977, Katibah 1984). No comparable estimates are available for the San Joaquin Valley. Based on early soil maps, however, more than 921,000 acres of riparian habitat are believed to have been present throughout the Central Valley under pre-settlement conditions (Katibah 1984). Another source estimates that of approximately five million acres of wetlands in the Central Valley in the 1850s, approximately 1,600,000 acres were riparian wetlands (Warner *et al.* 1985, Frayer *et al.* 1989).

Based on a DFG riparian vegetation distribution map, there were approximately 102,000 acres of riparian vegetation remaining in the Central Valley by 1979. This represents a decline in acreage of approximately 89% as of 1979 (Katibah 1984). More extreme figures were given by Frayer *et al.* (1989), who reported that woody riparian forests in the Central Valley had declined to 34,600 acres by the mid-1980s (from 65,400 acres in 1939). Although these studies have differing findings in terms of the number of acres lost (most likely explained by differing methodologies), they attest to a dramatic historic loss of riparian habitat in the Central Valley. As there is no reason to believe that riparian habitat suitable to the beetle (*i.e.* occupied by elderberry shrubs) would be destroyed at a different rate than other riparian habitat, we can assume that the rate of loss for beetle habitat in riparian areas has been equally dramatic.

A number of studies have focused on riparian loss along the Sacramento River, which supports some of the densest known populations of the beetle. Approximately 98% of the middle Sacramento River's historic riparian vegetation was believed to have been extirpated by 1977 (DWR 1979). The State Department of Water Resources estimated that native riparian habitat along the Sacramento River from Redding to Colusa decreased from 27,720 acres to 18,360 acres (34%) between 1952 and 1972 (McGill 1975, Conrad *et al.* 1977). The average rate of riparian loss on the middle Sacramento River was 430 acres per year from 1952 to 1972, and 410 acres per year from 1972 to 1977. In 1987, riparian areas as large as 180 acres were observed converted to orchards along this river (McCarten and Patterson 1987).

Barr (1991) examined 79 sites in the Central Valley supporting beetle habitat. When 72 of these sites were re-examined by researchers in 1997, seven no longer supported beetle habitat. This represents a decrease in the number of sites with beetle habitat by approximately nine percent in six years.

There is no comparable information on the historic loss of non-riparian beetle habitat such as elderberry savanna and other vegetation communities where elderberry occurs (oak or mixed chaparral-woodland, or grasslands adjacent to riparian habitat). However, all natural habitats throughout the Central Valley have been heavily impacted within the last 200 years (Thompson 1961), and we can therefore assume that non-riparian beetle habitat also has suffered a widespread decline. This analysis focuses on loss of riparian habitat because the beetle is

primarily dependent upon riparian habitat. Adjacent upland areas are also likely to be important for the species (Huxel pers. comm. 2000), but this upland habitat typically consist of oak woodland or elderberry savanna bordering willow riparian habitat (Barr 1991). The riparian acreage figures given by Frayer *et al.* (1989) and Katibah (1984) included the oak woodlands concentrated along major drainages in the Central Valley, and therefore probably included lands we would classify as upland habitat for the beetle adjacent to riparian drainages.

Between 1980 and 1995, the human population in the Central Valley grew by 50%, while the rest of California grew by 37%. The Central Valley's population was 4.7 million by 1999, and it is expected to more than double by 2040. The American Farmland Trust estimates that by 2040 more than 1 million cultivated acres will be lost and 2.5 million more put at risk (Ritter 2000). With this growing population in the Central Valley, increased development pressure is likely to result in continuing loss of riparian habitat.

While habitat loss is clearly a large factor leading to the species' decline, other factors are likely to pose significant threats to the long term survival of the beetle. Only approximately 20% of riparian sites with elderberry observed by Barr (1991) and Collinge *et al.* (2001) support beetle populations (Barr 1991, Collinge *et al.* 2001). Jones and Stokes (1988) found 65% of 4,800 riparian acres on the Sacramento River to have evidence of beetle presence. The fact that a large percentage of apparently suitable habitat is unoccupied suggests that the valley elderberry longhorn beetle is limited by factors other than habitat availability, such as habitat quality or limited dispersal ability.

Destruction of riparian habitat in central California has resulted not only in a loss of acreage, but also in habitat fragmentation. Fahrig (1997) states that habitat fragmentation is only important for habitats that have suffered greater than 80% loss. Riparian habitat in the Central Valley, which has experienced greater than 90% loss by most estimates, would meet this criterion as habitat vulnerable to effects of fragmentation. Existing data suggests that beetle populations, specifically, are affected by habitat fragmentation. Barr (1991) found that small, isolated habitat remnants were less likely to be occupied by beetles than larger patches, indicating that beetle subpopulations are extirpated from small habitat fragments. Barr (1991) and Collinge *et al.* (2001) consistently found beetle exit holes occurring in clumps of elderberry bushes rather than isolated bushes, suggesting that isolated shrubs do not typically provide long-term viable habitat for this species. Local populations of organisms often undergo periodic colonization and extinction, while the metapopulation (set of spatially separated groups of a species) may persist (Collinge 1996).

Habitat fragmentation can be an important factor contributing to species declines because (1) it divides a large population into two or more small populations that become more vulnerable to direct loss, inbreeding depression, genetic drift, and other problems associated with small populations, (2) it limits a species' potential for dispersal and colonization, and (3) it makes habitat more vulnerable to outside influences by increasing the edge:interior ratio (Primack 1998). These factors, as they relate to the beetle, are discussed below.

Small, isolated subpopulations are susceptible to extirpation from random demographic, environmental, and/or genetic events (Shaffer 1981, Lande 1988, Primack 1998). While a large area may support a single large population, the smaller subpopulations that result from habitat fragmentation may not be large enough to persist over a long time period. As a population becomes smaller, it tends to lose genetic variability through genetic drift, leading to inbreeding depression and a lack of adaptive flexibility. Smaller populations also become more vulnerable to random fluctuations in reproductive and mortality rates, and are more likely to be extirpated by random environmental factors.

Species that characteristically have small population sizes, such as large predators or habitat specialists, are more likely to become extinct than species that typically have large populations (Primack 1998). Also, a species with low population density (few individuals per unit area) tends to have only small populations remaining if its habitat is fragmented. Populations of species that naturally occur at lower density become extinct more rapidly than do those of more abundant species (Bolger *et al.* 1991). The species may be unable to persist within each fragment, and gradually die out across the landscape.

The valley elderberry longhorn beetle, a specialist on elderberry plants, tends to have small population sizes, and to occur in low densities (Barr 1991, Collinge *et al.* 2001). Collinge *et al.* (2001) compared resource use and density of exit holes between the valley elderberry longhorn beetle and a related subspecies, the California elderberry longhorn beetle (*Desmocerus californicus californicus*). The valley elderberry longhorn beetle tended to occur in areas with higher elderberry densities, but had lower exit hole densities than the California elderberry longhorn beetle. With extensive riparian habitat loss and fragmentation, these naturally small populations are broken into even smaller, isolated populations. Once a small population has been extirpated from an isolated habitat patch, the species may be unable to re-colonize this patch if it is unable to disperse from nearby occupied habitat. Insects with limited dispersal and colonization abilities may persist better in large habitat patches than small patches because small fragments may be insufficient to maintain viable populations and the insects may be unable to disperse to more suitable habitat (Collinge 1996).

Studies suggest that the beetle is unable to re-colonize drainages where the species has been extirpated, because of its limited dispersal ability (Huxel 2000, Barr 1991; Collinge *et al.* 2001). Huxel (2000) used computer simulations of colonization and extinction patterns for the beetle based on differing dispersal distances, and found that the short dispersal simulations best matched the 1997 census data in terms of site occupancy. This suggests that in the natural system dispersal and thus colonization is limited to nearby sites. At spatial scales greater than 10 kilometers (km.), such as across drainages, beetle occupancy appears to be strongly influenced by regional extinction and colonization processes, and colonization is constrained by limited dispersal (Collinge *et al.* 2001). Except for one occasion, drainages examined by Barr that were occupied in 1991 remained occupied in 1997 (Collinge *et al.* 2001). The one exception was Stoney Creek, which was occupied in 1991 but not in 1997. All drainages found by Barr (1991) to be unoccupied in 1991 were also unoccupied in 1997. This data suggests that drainages unoccupied by the beetle remain so and that colonizing is slow.

Habitat fragmentation not only isolates small populations, but also increases the interface between habitat and urban or agricultural land, increasing negative edge effects such as the invasion of non-native species (Huxel 2000, Soule 1990) and pesticide contamination (Barr 1991). There are several edge effect-related factors that may be related to the decline of the beetle.

Recent evidence indicates that the invasive Argentine ant poses a risk to the long-term survival of the beetle. Surveys along Putah Creek found beetle presence where Argentine ants were not present or had recently colonized, and beetle absence from otherwise suitable sites where Argentine ants had become established (Huxel 2000). The Argentine ant has negatively impacted populations of other native arthropod species (Holway 1998; Ward 1987). Predation on eggs, larvae, and pupae are the most likely impacts these ants have on the beetle. In Portugal, Argentine ants have been found to be significant egg predators on the eucalyptus borer (*Phorocantha semipunctata*), a cerambycid like the valley elderberry longhorn beetle. Egg predation on the beetle could lead to local extirpations, as indicated by a population viability study suggesting that egg and juvenile mortality are significant factors affecting probability of extinction for the beetle (Huxel and Collinge, in prep.). The Argentine ant has been expanding its range throughout California since its introduction around 1907, especially in riparian woodlands associated with perennial streams (Holway 1998, Ward 1987). Huxel (2000) states that, given the potential for Argentine ants to spread with the aid of human activities such as movement of plant nursery stock and agricultural products, this species may come to infest most drainages in the Central Valley along the valley floor, where the beetle is found.

Direct spraying and drift of pesticide, including herbicides and/or insecticides, in or near riparian areas (which is done to control mosquitos, crop diseases, invasive and/or undesirable plants, or other pests) is likely to adversely affect the beetle and its habitat. Although there have been no studies specifically focusing on the effects of pesticides on the beetle, evidence suggests that the species is likely to be affected by pesticides. As of 1980, the prevalent land use adjacent to riparian habitat in the Sacramento Valley was agriculture, even in regions where agriculture was not generally the most common land use (Katibah 1984), therefore the species is likely vulnerable to pesticide contamination from adjacent agricultural practices. Recent studies of major rivers and streams documented that 96% of all fish, 100% of all surface water samples and 33% of major aquifers contained one or more pesticides at detectable levels (Gilliom 1999). Pesticides were identified as one of the 15 leading causes of impairment for streams included on the Federal Water Pollution Control Act, as amended (Clean Water Act), section 303(d) lists of impaired waters. As the beetle occurs primarily in riparian habitat, the contamination of rivers and streams affects this species and its habitat. Pesticides have been identified as one of a number of potential causes of pollinator species' declines and declines of other insects beneficial to agriculture (Ingraham *et al.* 1996), therefore it is likely that the beetle, typically occurring adjacent to agricultural lands, has suffered a decline due to pesticides.

Grazing by livestock damages or destroys elderberry plants and inhibits regeneration of seedlings. Cattle readily forage on new growth of elderberry, which may explain the absence of beetles at manicured elderberry stands (Service 1984). Habitat fragmentation exacerbates problems related to exotic species invasion and cattle grazing by increasing the edge to interior ratio of habitat patches, facilitating the penetration of these influences.

Environmental Baseline

Delta Smelt

Adult delta smelt spawn in central Delta sloughs from February through August in shallow water areas having submersed aquatic plants and other suitable substrates and refugia. These shallow water areas have been identified in the Delta Native Fishes Recovery Plan (Recovery Plan) (Service 1996) as essential to the long-term survival and recovery of delta smelt and other resident fish. A no net loss strategy of delta smelt population and habitat is proposed in this Recovery Plan.

The delta smelt is adapted to living in the highly productive Estuary where salinity varies spatially and temporally according to tidal cycles and the amount of freshwater inflow. Despite this tremendously variable environment, the historical Estuary probably offered relatively consistent spring transport flows that moved delta smelt juveniles and larvae downstream to the mixing zone (Peter Moyle, U.C. Davis pers. comm.). Since the 1850's, however, the amount and extent of suitable habitat for the delta smelt has declined dramatically. The advent in 1853 of hydraulic mining in the Sacramento and San Joaquin rivers led to increased siltation and alteration of the circulation patterns of the Estuary (Nichols et al. 1986, Monroe and Kelly 1992). The reclamation of Merritt Island for agricultural purposes, in the same year, marked the beginning of the present-day cumulative loss of 94 percent of the Estuary's tidal marshes (Nichols *et al.* 1986, Monroe and Kelly 1992).

In addition to the degradation and loss of estuarine habitat, the delta smelt has been increasingly subject to entrainment, upstream or reverse flows of waters in the Delta and San Joaquin River, and constriction of low salinity habitat to deep-water river channels of the interior Delta (Moyle et al. 1992). These adverse conditions are primarily a result of drought and the steadily increasing proportion of river flow being diverted from the Delta by the CVP and SWP (Monroe and Kelly 1992). The relationship between the portion of the delta smelt population west of the Delta as sampled in the summer townet survey and the natural logarithm of Delta outflow from 1959 to 1988 (Department and Reclamation 1994). This relationship indicates that the summer townet index increased dramatically when outflow was between 34,000 and 48,000 cfs which placed X2 between Chipps and Roe islands. Placement of X2 downstream of the Confluence, Chipps and Roe islands provides delta smelt with low salinity and protection from entrainment, allowing for productive rearing habitat that increases both smelt abundance and distribution.

The results of seven surveys conducted by the Interagency Ecological Program (IEP) corroborate the dramatic decline in delta smelt. Existing baseline conditions, as mandated for delta smelt under the Service's consultations on CVP operations (Service 1994b, 1995), provide sufficient

Delta outflows from February 1 through June 30 to transport larval and juvenile delta smelt out of the "zone of influence" of the CVP and SWP pumps, and provide them low salinity, productive rearing habitat. This zone of influence has been delineated by DWR's Particle Tracking Model and expands or contracts with CVP and SWP combined pumping increases or decreases, respectively (Department and Reclamation 1993). With tidal effects contributing additional movement, the influence of the pumps may entrain larvae and juveniles as far west as the Confluence.

According to seven abundance indices designed to record trends in the status of the delta smelt, this species was consistently at low population levels during the last ten years (Stevens *et al.* 1990). These same indices also show a pronounced decline from historical levels of abundance (Stevens *et al.* 1990). The summer townet abundance index constitutes one of the more representative indices because the data have been collected over a wide geographic area (from San Pablo Bay upstream through most of the Delta) for the longest period of time (since 1959). The summer townet abundance index measures the abundance and distribution of juvenile delta smelt and provides data on the recruitment potential of the species. Except for three years since 1983 (1986, 1993, and 1994), this index has remained at consistently lower levels than experienced previously. As indicated, these consistently lower levels correlate with the 1983 to 1992 mean location of X2 upstream of the Confluence, Chipps and Roe islands.

The second longest running survey (since 1967), the fall midwater trawl survey (FMWT), measures the abundance and distribution of late juveniles and adult delta smelt in a large geographic area from San Pablo Bay upstream to Rio Vista on the Sacramento River and Stockton on the San Joaquin River (Stevens *et al.* 1990). The fall midwater trawl provides an indication of the abundance of the adult population just prior to upstream spawning migration. The index that is calculated from the FMWT survey uses numbers of sampled fish multiplied by a factor related to the volume of the area sampled. Until recently, except for 1991, this index has declined irregularly over the past 20 years. Since 1983, the delta smelt population has exhibited more low fall midwater trawl abundance indices, for more consecutive years, than previously recorded. The 1994 FMWT index of 101.7 is a continuation of this trend. This occurred despite the high 1994 summer townet index for reasons unknown. The 1995 summer townet was a low index value of 319 but resulted in a high FMWT index of 898.7 reflecting the benefits of large transport and habitat maintenance flows with the Bay-Delta Accord in place and a wet year. The abundance index of 128.3 for 1996 represented the fourth lowest on record. The abundance index of 305.6 for 1997 demonstrated that the relative abundance of delta smelt almost tripled over last years results, and delta smelt abundance continued to rise, peaking in 1999 to an abundance index of 863, only to fall back down to the low abundance indexes of 139 for 2002 and 213 for 2003.

Delta Smelt Critical Habitat

Delta smelt critical habitat has been affected by activities that destroy spawning and refugial areas and change hydrology patterns in Delta waterways. Critical habitat also has been affected by diversions that have shifted the position of X2 upstream of the confluence of the Sacramento and San Joaquin rivers. This shift has caused a decreased abundance of smelt. Existing baseline

conditions and implementation of the Service's 1994 and 1995 biological opinions concerning the operation of the Central Valley Project and the State Water Project, provide a substantial part of the necessary positive riverine flows and estuarine outflows to transport smelt larvae downstream to suitable rearing habitat in Suisun Bay outside the influence of marinas, agricultural diversions, and Federal and State pumping plants.

The demands on surface water resources in the Central Valley have increased. The proposed Freeport Regional Water Project would divert up to 185,000 acre-feet(af)/year of water from a point of diversion north of the delta at Freeport (Freeport Regional Water Authority 2003). The proposed expansion of Los Vaqueros Reservoir would entail an additional 400,000 af of off-stream storage, diverted from the delta using existing facilities as well as new facilities located at Old River and/or Middle River (CALFED 2003a and Reclamation 2003). Reclamation and DWR have proposed to increase pumping capacity at the SWP Banks pumping plant from 6,680 cubic feet per second (cfs) to 8,500 cfs and eventually to 10,300 cfs (CALFED 2002, 2003b). Reclamation and CDWR have also proposed construction of a 400 cfs intertie connecting their aqueducts, which would allow Reclamation to increase the pumping at their Tracy Pumping Plant from 4,200 cfs to 4,600 cfs. The CALFED Bay-Delta Program proposes to expand surface water storage capacity at existing reservoirs and strategically located off-stream sites by 3.5 million af (including the 400,000 af at Los Vaqueros) by: 1) north of the delta off stream storage; 2) Shasta enlargement; 3) Los Vaqueros Expansion; 4) in-delta storage; and 5) additional storage in the Upper San Joaquin (Friant) (CALFED 2002 and Reclamation 2003). Finally, the City of Stockton proposes to construct a new intake at the southwestern tip of Empire Tract on the San Joaquin River with an ultimate diversion capacity of 371 cfs (Environmental Science Associates 2003). The diversions would likely result in lower delta outflows and increased entrainment.

Giant Garter Snake

Surveys over the last two decades have located the giant garter snake as far north as the Butte Basin in the Sacramento Valley. Currently, the Service recognizes 13 separate populations of giant garter snake, with each population representing a cluster of discrete locality records (Service 1993b). The 13 extant population clusters largely coincide with historical riverine flood basins and tributary streams throughout the Central Valley (Hansen 1980, Brode and Hansen 1992): (1) Butte Basin, (2) Colusa Basin, (3) Sutter Basin, (4) American Basin, (5) Yolo Basin-Willow Slough, (6) Yolo Basin-Liberty Farms, (7) Sacramento Basin, (8) Badger Creek-Willow Creek, (9) Caldoni Marsh, (10) East Stockton-Diverting Canal and Duck Creek, (11) North and South Grasslands, (12) Mendota, and (13) Burrell-Lanare. These populations span the Central Valley from just southwest of Fresno (Burrell-Lanare) north to Chico (Hamilton Slough). The 11 counties where the giant garter snake is still presumed to occur are: Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter and Yolo.

Since April of 1995, the BRD has further documented occurrences of giant garter snakes within some of the 13 populations identified in the final rule. The BRD has studied populations of giant garter snakes at the Sacramento and Colusa National Wildlife Refuges within the Colusa Basin, at Gilsizer Slough within the Sutter Basin, and at the Badger Creek area of the Cosumnes River Preserve within the Badger Creek-Willow Creek area. These populations, along with the

American Basin population of giant garter snakes represent the largest extant populations. With the exception of the American Basin, these populations are largely protected from many of the threats to the species. Outside of these protected areas, giant garter snakes in these population clusters are still subject to all threats identified in the final rule. The remaining nine population clusters identified in the final rule are distributed discontinuously in small isolated patches and are vulnerable to extirpation by stochastic environmental, demographic, and genetic processes. All 13 population clusters are isolated from each other with no protected dispersal corridors. Opportunities for recolonization of small populations which may become extirpated is unlikely given the isolation from larger populations and lack of dispersal corridors between them.

The current distribution and abundance of the giant garter snake is much reduced from former times. Agricultural and flood control activities have extirpated the giant garter snake from the southern one third of its range in former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds. These lakebeds once supported vast expanses of ideal giant garter snake habitat, consisting of cattail and bulrush dominated marshes. Vast expanses of bulrush and cattail floodplain habitat also typified much of the Sacramento Valley historically (Hinds 1952). Prior to reclamation activities beginning in the mid to late 1800s, about 60 percent of the Sacramento Valley was subject to seasonal overflow flooding in broad, shallow flood basins that provided expansive areas of giant garter snake habitat (Hinds 1952). Valley floor wetlands are subject to the cumulative effects of upstream watershed modifications, water storage and diversion projects, as well as urban and agricultural development; all natural habitats have been lost and an unquantifiably small percentage of seminatural wetlands remain extant. Only a small percentage of extant wetlands currently provides habitat suitable for the giant garter snake.

The giant garter snake currently is only known from a small number of populations. The status of these populations and the threats to these snakes and their habitats are detailed in the final rule that listed the giant garter snake as threatened (58 FR 54053). A number of land use practices and other human activities currently threaten the survival of the giant garter snake throughout the remainder of its range.

The draft recovery plan for the snake subdivided the giant garter snake's historic range into four recovery units (Service 1999a). These are: (1) the Sacramento Valley unit, extending from the vicinity of Red Bluff south to the confluence of the Sacramento and Feather Rivers; (2) the Mid-Valley unit, extending from the American and Yolo Basins south to Duck Creek near the City of Stockton; (3) the San Joaquin Valley unit, extending south from Duck Creek to the Kings River; and (4) the South Valley unit, extending south of the Kings River to the Kern River Basin. Portions of the Mid-Valley and San Joaquin recovery units are within the action area for the WHCP.

The Mid-Valley Recovery Unit includes seven populations of the snake: American Basin, Yolo Basin–Willow Slough, Yolo Basin–Liberty Farms, Sacramento Area, Badger Creek/Willow Creek, Caldoni Marsh/White Slough, and East Stockton. The status of the seven snake populations in the Mid-Valley Recovery Unit is very uncertain. The East Stockton population may be extirpated, and is not considered recoverable as a result of urban encroachment into habitat (Service 1999a). Five of the remaining six populations within the recovery unit are very

small, highly fragmented and isolated, and, except for the Badger Creek/Willow Slough population, are also threatened by urbanization. This latter population is within a small isolated area. Within the Mid-Valley unit, only the American Basin population supports a sizeable snake population which is dependent largely upon rice lands. The American Basin population, although threatened by urban development, receives protection from the Natomas Basin Habitat Conservation Plan (HCP), which has a goal of maintaining a viable snake population in the basin.

The remaining two recovery units are located to the south in the San Joaquin Valley, where the best available data indicate that the snake's status is precarious. The San Joaquin Valley Recovery Unit contains three historic snake populations: North and South Grasslands; Mendota Area; and Burrel/Lanare Area (Service 1999a). This recovery unit formerly supported large snake populations, but numbers have declined severely in recent decades, and recent survey efforts indicate numbers are very low compared to Sacramento Valley populations.

The draft recovery criteria require multiple, stable populations within each of the four recovery units, with subpopulations well-connected by corridors of suitable habitat. Currently, only the Sacramento Valley Recovery Unit, at the northern end of the species' range, is known to support relatively large, stable populations. Habitat corridors connecting populations or subpopulations, even for the Sacramento Valley Recovery Unit, are not present and/or protected.

Further descriptions of the three subpopulations located in the project area that may be affected by the WHCP are provided below:

Yolo Basin/Liberty Farms: Two CNDDB records from an irrigation canal network, combined with an absence of suitable, natural habitat in the area, suggest this population is restricted entirely to degraded, artificial habitat. Livestock grazing appears to be a primary threat. Based on habitat scarcity and an associated small population size, threats are imminent and severe, similar to those at Willow Slough, absent the threat of urban development.

Water sources for this area are primarily the agricultural waterways associated with the Delta. The Yolo Bypass and the upstream sources described in the Yolo Basin - Willow Slough subpopulations also are potential sources of water.

Sacramento Basin: Seven CNDDB locality records are known for the Sacramento Basin subpopulations. These records date 1992 and prior. These locality records include Beach Lake, Snodgrass Slough, Stone Lakes NWR, and Laguna, Morrison and Elk Grove Creeks. Surveys conducted by the BRD during the summer of 1997 did not detect snakes on Stone Lakes NWR (G. Wylie pers. comm.). Because the Stone Lakes NWR has little upland refugia, Dr. Wylie concluded that snake populations in the area may have been severely reduced by the prolonged flooding during January 1997, and that snake populations have not had sufficient time to recover. However, Stone Lakes NWR contains suitable supporting habitat. Numerous development projects have been constructed in or near snake habitat in this rapidly urbanizing area. Any remaining populations are vulnerable to secondary effects of urbanization, such as increased predation by house cats and increased vehicular mortality. Most documented localities have been

adversely impacted by development, including freeway construction, flood control projects, and commercial development. Several former localities are known to have been lost and/or depleted to the extent that continued viability is in question (Brode and Hansen 1992).

The scarcity of remaining suitable habitat, flooding, stochastic processes, and continued threats of habitat loss pose a severe, imminent threat to this population.

Stone Lakes NWR is the largest remaining parcel of snake habitat in this subpopulation. Currently, the refuge receives water from Morrison and Laguna Creeks and from the Delta via Snodgrass Slough.

White Slough/Caldoni Marsh: Four CNDDB locality records are known from the Caldoni Marsh area. Also known as White Slough Wildlife Area, only about 50 acres of suitable habitat remains, the most valuable portion situated on private land. Approximately 280 acres of habitat was eliminated during the construction of Interstate 5 around 1978 to 1979. Restricted to such a small patch size of remaining habitat, this population is highly vulnerable to extinction from stochastic processes. A locality record along Eight Mile Road possibly connected with this population apparently has been extirpated due to habitat loss (J. Brode, CDFG, pers. comm. 1992; G. Hansen, *in litt.*, 1992). Several snakes were observed in the Caldoni Marsh area during 1995 surveys (G. Hansen, pers. comm. 1996).

White Slough is on the eastern periphery of and is hydrologically a part of the Delta. The Delta hydrology could significantly affect contaminants distribution within the Caldoni Marsh - White Slough area. Contaminants distribution in this area would depend on predominant flow. Location within the San Joaquin Valley combined with Delta hydrology could produce high concentrations of contaminants, particularly selenium, in this area.

The draft recovery criteria require multiple, stable populations within each of the four recovery units, with subpopulations well-connected by corridors of suitable habitat. Currently, only the Sacramento Valley Recovery Unit, at the northern end of the species' range, is known to support relatively large, stable populations. Habitat corridors connecting populations or subpopulations, even for the Sacramento Valley Recovery Unit, are not present and/or protected.

Since April of 1995, the BRD has further documented occurrences of snakes within some of the 13 populations identified in the final rule. The BRD has studied populations of snakes at the Sacramento and Colusa National Wildlife Refuges within the Colusa Basin, at Gilsizer Slough within the Sutter Basin, at the Badger Creek area of the Cosumnes River Preserve within the Badger Creek-Willow Creek area, and in the Natomas Basin within the American Basin. These populations of snakes represent the largest extant populations. With the exception of the American Basin, these populations are largely protected from many of the threats to the species. Outside of protected areas, snakes in these population clusters are still subject to all threats identified in the final rule. The remaining nine population clusters identified in the final rule are distributed discontinuously in small isolated patches and are vulnerable to extirpation by stochastic environmental, demographic, and genetic processes. Recent surveys conducted by CDFG in cooperation with BRD in the Grasslands Area in the San Joaquin Valley have detected

snakes, but in numbers much lower than those found in the Sacramento Valley populations. All 13 population clusters are isolated from each other with no protected dispersal corridors. Opportunities for recolonization of small populations which may become extirpated is unlikely given the isolation from larger populations and lack of dispersal corridors between them.

The environmental baseline for the snake includes aquatic and terrestrial habitat within the boundaries of the Delta, including sloughs, irrigation canals, wetlands and fields that may be affected by projects proposed for completion under the EDCP.

Valley Elderberry Longhorn Beetle

Extensive destruction of California's Central Valley riparian forests has occurred during the last 150 years due to agricultural and urban development (Katibah 1984, Katibah *et al.* 1984, Smith 1977, Thompson 1961). Based on a 1979 aerial survey, only about 102,000 acres out of an estimated 922,000 acres of Central Valley riparian forest remain (Katibah *et al.* 1981). More extreme figures were given by Frayer *et al.* (1989), who reported that approximately 85 percent of all wetland acreage in the Central Valley was lost before 1939; and that from 1939 to the mid-1980's, the acreage of wetlands dominated by forests and other woody vegetation declined from 65,400 acres to 34,600 acres. Differences in methodology may explain the differences between the studies. In any case, the historical loss of riparian habitat in the Central Valley strongly suggests that the range of the beetle has been reduced and its distribution greatly fragmented. Loss of non-riparian habitat where elderberry occurs (*e.g.*, savanna and grassland adjacent to riparian habitat, oak woodland, mixed chaparral-woodland), and where the beetle has been recorded (Barr 1991), suggests further reduction of the beetle's range and increased fragmentation of its upland habitat. In Sacramento County, some riparian forest along the American River corridor is protected as parks and open space, but elderberries in savanna and streamside riparian habitats in the southern portion of the County are vulnerable to expansion of residential and commercial developments.

The beetle's current distribution is patchy throughout the remaining habitat of the Central Valley from Redding to Bakersfield. Surveys conducted in 1991 (Barr 1991) found evidence of beetle activity at 28 percent of the 230 sites with elderberry. The beetle appears to be only locally common, *i.e.*, found in population clusters which are not evenly distributed across available elderberry shrubs. Frequently only particular clumps or trees in the study areas were found to harbor the beetle.

Habitat fragmentation not only isolates small populations, but also increases the interface between habitat and urban or agricultural land, increasing negative edge effects such as the invasion of non-native species (Huxel in prep., Soule 1990) and pesticide contamination (Barr 1991). There are several edge effect-related factors that may be related to the decline of the beetle. Recent evidence indicates that the invasive Argentine ant poses a risk to the long-term survival of the beetle. Surveys along Putah Creek found beetle presence where Argentine ants were not present or had recently colonized, and beetle absence from otherwise suitable sites where Argentine ants had become established (Huxel in prep.). The Argentine ant has negatively impacted populations of other native arthropod species (Holway 1998; Ward 1987). Predation

on eggs, larvae, and pupae are the most likely impacts these ants have on the beetle. In Portugal, Argentine ants have been found to be significant egg predators on the eucalyptus borer (*Phorocantha semicincta*), a cerambycid like the valley elderberry longhorn beetle. Egg predation on the beetle could lead to local extirpations, as indicated by a population viability study suggesting that egg and juvenile mortality are significant factors affecting probability of extinction for the beetle (Huxel and Collinge, in prep.). The Argentine ant has been expanding its range throughout California since its introduction around 1907, especially in riparian woodlands associated with perennial streams (Ward 1987). Huxel (*in prep.*) states that, given the potential for Argentine ants to spread with the aid of human activities such as movement of plant nursery stock and agricultural products, this species may come to infest most drainages in the Central Valley along the valley floor, where the beetle is found.

Direct spraying and drift of pesticide, including herbicides and/or insecticides, in or near riparian areas (which is done to control mosquitos, crop diseases, invasive and/or undesirable plants, or other pests) is likely to adversely affect the beetle and its habitat. Although there have been no studies specifically focusing on the effects of pesticides on the beetle, evidence suggests that the species is likely to be affected by pesticides. As of 1980, the prevalent land use adjacent to riparian habitat in the Sacramento Valley was agriculture, even in regions where agriculture was not generally the most common land use (Katibah *et al.* 1984), therefore the species is likely vulnerable to pesticide contamination from adjacent agricultural practices. Recent studies of major rivers and streams documented that 96% of all fish, 100% of all surface water samples and 33% of major aquifers contained one or more pesticides at detectable levels (Gilliom 1999). Pesticides were identified as one of the 15 leading causes of impairment for streams included on the Federal Water Pollution Control Act, as amended (Clean Water Act), section 303(d) lists of impaired waters. As the beetle occurs primarily in riparian habitat, the contamination of rivers and streams affects this species and its habitat. Pesticides have been identified as one of a number of potential causes of pollinator species' declines and declines of other insects beneficial to agriculture (Ingraham *et al.* 1996), therefore it is likely that the beetle, typically occurring adjacent to agricultural lands, has suffered a decline due to pesticides.

Effects of the Proposed Action

Delta Smelt and its Critical Habitat

Acute toxicology studies performed by DFG-Aquatic Toxicology Laboratory (2004) determined that Weedar ®64 (the active ingredient is 2,4-D Dimethylene Salt) and Rodeo® (the active ingredient is Glyphosate) are non-toxic to larval delta smelt at the levels used by the WHCP.

Acute toxicology studies performed by DFG-Aquatic Toxicology Laboratory (2004) determined that Reward® (the active ingredient is Diquat) is toxic to larval delta smelt at the levels used by the WHCP and its use would result in delta smelt mortality if used when larval delta smelt are present. Therefore the use of Reward® when delta smelt are present would result in the harm, harassment and mortality of delta smelt. This effect is minimized by the WHCP treatment restrictions, which limit the WHCP to operate from July 1st through November 30th, unless the Service determines that one or more of their herbicides and adjuvants are non-toxic and therefore

acceptable for earlier usage. Most delta smelt will be out of the Delta by July 1st. This effect can be minimized by restricting the usage of Reward® until August 1st, when all delta smelt are expected to be outside of the delta.

Acute toxicology studies performed by DFG-Aquatic Toxicology Laboratory (2004) determined that R-11® (the active ingredients are Alkyl Aryl Polyethoxylates/Compounded Silicone/Linear Alcohol) could cause toxicity at its application rates, but that this could be avoided by ensuring that the spray is applied to the water hyacinth and not in the water column. They noted that throughout the 2002-2003 season, R-11® was only detected within the water column once and at only one treatment site. Therefore the improper use of R-11® when delta smelt are present would result in the harm, harassment and mortality of delta smelt. This effect is minimized by the WHCP treatment restrictions, which limit the WHCP to operate from July 1st through November 30th, unless the Service determines that one or more of their herbicides and adjuvants are non-toxic and therefore acceptable for earlier usage. Most delta smelt will be out of the Delta by July 1st. This effect can be minimized by restricting the usage of R-11® until August 1st, when all delta smelt are expected to be outside of the delta.

Preliminary lab work conducted by the DFG-Aquatic Toxicology Lab showed Placement® (the active ingredients are Amine Salts, Aromatic Acid, and Petroleum Distillates) to be the most toxic of the three adjuvants in the WHCP. This effect is minimized by the WHCP treatment restrictions, which limit the WHCP to operate from July 1st through November 30th, unless the Service determines that one or more of their herbicides and adjuvants are non-toxic and therefore acceptable for earlier usage. Most delta smelt will be out of the Delta by July 1st. This effect can be minimized by restricting the usage of Placement® until August 1st, when all delta smelt are expected to be outside of the delta.

Acute toxicity studies by the Washington State University have indicated that Agri-Dex® (the active ingredients are Paraffin Base Petroleum Oil/Polyoxyethylate Polyol Fatty Acid Esters) is practically non-toxic and is less toxic to fish and aquatic invertebrates than R-11®. Agri-Dex® was also shown to be less toxic to fish and aquatic invertebrates than R-11® in some preliminary lab work conducted by the DFG-Aquatic Toxicology Lab.

No permanent effects to delta smelt critical habitat will occur as a result of the WHCP. Temporary indirect effects to critical habitat include habitat loss, decreased dissolved oxygen levels (due to decaying water hyacinth), and decreases in the abundance of aquatic invertebrates that form the prey base of the delta smelt.

The WHCP will assist in the implementation of several recovery actions outlined in the "Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes" (Delta Recovery Plan) (Service 1996). The WHCP will assist in developing native Delta habitat and vegetation zones (recovery action #1121), and eliminate loss of shallow water habitat by removing the competition from the non-native macrophyte (recovery action #132). The monitoring plan and toxicological investigations being proposed will assist in implementing recovery action #53. Other potential beneficial effects of the proposed WHCP include: reduction in the amount of an invasive non-native aquatic macrophyte in the Delta and its tributaries, an increase in DO levels in slow

moving or dead-end sloughs, and a potential increase in the amount and distribution of native aquatic plants and animal species associated with them. This increase in native flora and fauna could potentially increase the forage base for listed species.

Giant Garter Snake

Acute toxicology studies performed by DFG-Pesticide Investigation Unit (2004) determined that none of the proposed herbicides or adjuvants would have an acute effect on garter snakes at the levels used for the WHCP.

The primary effects to giant garter snake as a result of the WHCP include temporary destruction of habitat, loss of prey base after pesticide application, and reduced water quality. Direct impact caused by boating and vehicle activity may result in harm to the giant garter snake. Use of the herbicides in the WHCP could result in a loss of intertidal wetland vegetation, such as tules and cattails. The snake needs a component of herbaceous wetland vegetation, such as cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.) for escape cover and foraging habitat (Draft Recovery Plan for the Giant Garter Snake, Service 1999). Loss of giant garter snake prey base may result from application of herbicides.

Temporary indirect effects to the snake could also occur due to loss of intertidal wetland vegetation following herbicide use, disturbance due to staging or maneuvering of boats or vehicles in the implementation of the WHCP. Additional indirect effects include mortality from predatory fish and birds, vehicular traffic, agricultural practices, and maintenance of water channels.

The proposed WHCP will assist in implementing recovery task #4.7 (study the effects of contaminants on giant garter snake) outlined in the "Draft Recovery Plan for the Giant Garter Snake" (Service 1999).

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle may be effected by the WHCP if herbicides, derivatives, or dispersants come in contact with nearby elderberry shrubs (*Sambucus* sp.) either by direct or indirect (drift, treated water inundation) contact. No information is available on the direct effects of herbicide application on the valley elderberry longhorn beetle, however the proposed chemicals may kill or greatly affect valley elderberry longhorn beetle habitat. The increase in habitat loss for the valley elderberry longhorn beetle may result in increased location fragmentation and harm to the valley elderberry longhorn beetle. The effects of the herbicide application may weaken elderberry health and result in other animal species colonizing the shrub and displacing the valley elderberry longhorn beetle.

Cumulative Effects

Delta Smelt and its Critical Habitat

Cumulative effects on the delta and its designated critical habitat include the impacts of point and non-point source chemical contaminant discharges. These contaminants include selenium and numerous pesticides and herbicides associated with discharges related to agricultural and urban activities. Implicated as potential sources of mortality for delta smelt, these contaminants may adversely affect delta smelt reproductive success and survival rates. Spawning habitat may also be affected if submersed aquatic plants used as substrates for adhesive egg attachment are lost due to toxic substances.

Additional cumulative effects may result from any continuing or future non-Federal diversions of water that may entrain adult or larval fish or that may decrease outflows incrementally, thus shifting the position of the delta smelt's preferred habitat upstream. Water diversions through intakes serving numerous small, private agricultural lands and duck clubs in the Delta, upstream of the Delta, and in Suisun Bay contribute to these cumulative effects. These diversions also include municipal and industrial uses, as well as providing water for power plants. State or local levee maintenance may also destroy or adversely modify critical habitat by disturbing spawning or rearing habitat and release contaminants into the water.

The introduction of exotic species may occur when levees are breached or when separate creeks or river systems are reconnected during various projects. Several exotic species may adversely affect the smelt and splittail, including the Asian clam (*Potamocorbula amurensis*) and three non-native species of euryhaline copepods. The Asian clam could potentially play an important role in affecting the phytoplankton dynamics. The exotic copepods may displace native species and at least one species of copepods (*Sinocalanus doerri*) is difficult for larval fishes to catch because of its fast swimming and effective escape response. Reduced feeding efficiency and ingestion rates weaken and slow the growth of young and make them more vulnerable to starvation and predation.

Other cumulative effects include: wave action in water channels caused by boats may degrade riparian and wetland habitat and erode banks; the dumping of domestic and industrial waste may present hazards to the fish because they could become trapped in the debris, injure themselves, or ingest the debris; golf courses may reduce habitat and introduce pesticides and herbicides into the environment; oil and gas development and production remove habitat and may introduce pollutants into the delta; agricultural uses on levees may reduce riparian and wetland habitats; residential or agricultural land use can fragment and reduce wildlife habitat and corridors; unscreened agricultural diversions throughout the delta divert all life stages of the fish (Service 1995); and grazing activities may degrade or reduce suitable habitat and increase erosion and sedimentation.

Giant Garter Snake

Cumulative effects that may affect giant garter snakes throughout their range include: unpredictable fluctuations in aquatic habitat due to water management; dredging and clearing vegetation from irrigation canals; discing, mowing, ornamental cultivation, and routine grounds maintenance of upland habitat; increased vehicular traffic on access roads adjacent to aquatic habitat; increased boat use and access into giant garter snake habitat; use of burrow fumigants on

levees and other potential upland refugia; and contaminated runoff from agriculture and urbanization. Introduced bullfrogs also pose a great threat to a variety of aquatic species, including snakes, fish, and other frog species. Adult bullfrogs are accomplished predators which can populate an area quickly and out compete the natives.

An additional threat to some populations of giant garter snakes include proposed urban development. Many remaining populations are vulnerable to secondary effects of urbanization, such as increased predation by house cats and vehicular mortality. Some documented localities have been adversely impacted by development, including freeway construction, flood control projects, and commercial development. Incidental disturbance from human activity may also cause disruption of normal foraging and reproductive activities.

Valley Elderberry Longhorn Beetle

Cumulative effects on the beetle throughout its range include continuing loss and alteration of riparian habitat and other habitats where elderberry plants and the beetle live, to the extent that this habitat loss is not subject to Federal jurisdiction. Elderberry shrubs and associated riparian habitat may be destroyed by agricultural conversion, removal of riparian vegetation, and recreational, industrial, and urban development. Levee construction and maintenance, channelization of streams and rivers, and riprapping of shoreline can destroy elderberry plants at construction sites and alter river hydraulics to cause additional erosion of riparian habitat downstream. Competition from invasive exotic plants such as Chinese tree-of-heaven (*Ailanthus altissima*) and black locust (*Robinia pseudoacacia*) may negatively affect elderberries. Grazing by livestock may damage or destroy elderberry plants and inhibit regeneration of seedlings. Direct spraying or drift of herbicide or insecticide in or near riparian areas (which may be done to control mosquitos, crop diseases, or other pests) will continue to adversely affect the beetle and its habitat. The increased human population growth in the Central Valley and other parts of California is expected to drive further development of agriculture, cities, industry, transportation, and water resources in the foreseeable future, and these cumulative effects are expected to continue.

Conclusion

After reviewing the current status of the delta smelt, giant garter snake, valley elderberry longhorn beetle, the environmental baseline, the effects of the proposed WHCP, and the cumulative effects, it is the Service's biological opinion that the proposed WHCP is not likely to jeopardize the continued existence of the delta smelt, giant garter snake, valley elderberry longhorn beetle, or result in the destruction or adverse modification of critical habitat for Delta smelt. We base this determination on the temporary nature of the effects, proposed WHCP treatment restrictions, and the non-toxicity of Weedar®64, Rodeo®, and Agri-dex® at the levels used in the WHCP. Critical habitat has been designated for the valley elderberry longhorn beetle on the American River in Sacramento County; however, this action is not expected to affect that area and no destruction or adverse modification of valley elderberry longhorn beetle critical habitat is anticipated. Critical habitat has not been designated for the giant garter snake, therefore none will be adversely modified or destroyed.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary for listed species in this opinion and must be implemented by USDA so they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. USDA has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Federal agency (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Delta Smelt

The Service anticipates as much as 1,733 acres of delta smelt critical habitat could be temporarily impacted annually as a result of the chemical control of Water Hyacinth. The Service anticipates that incidental take of delta smelt will occur. However, the Service anticipates that any take of delta smelt will be difficult to detect and quantify for a number of reasons: they have a relatively small body size; they are relatively secretive; their presence in the delta coincides with relatively turbid conditions, which makes their detection difficult; and additionally, their presence in aquatic vegetation makes them difficult to detect. Therefore, it is not possible to provide precise numbers of delta smelt that could be injured, harassed, harmed, or killed from the WHCP. Accordingly, the Service is quantifying take incidental to the project as the acreage of Delta and upland tributaries under chemical treatment for Water Hyacinth. The Service anticipates that annually from December 1 through June 30, all delta smelt inhabiting up to 1,733 acres of delta smelt habitat may be harmed and/or harassed by the temporary modification and degradation of habitat as a result of the WHCP. The Service also anticipates that annually from July 1 through November 30, all delta smelt inhabiting up to 1,733 acres of delta smelt habitat delta smelt

habitat may be harmed, harassed, injured, or killed by acute toxicity and temporary modification and degradation of habitat as a result of the WHCP. Because the species is wide-ranging and its distribution varies from one year to the next, take may vary from year to year. Additionally, losses of the species may be masked by seasonal fluctuations in numbers. Upon implementation of the following reasonable and prudent measures, incidental take associated with the WHCP in the form of harm, harassment, injury, or mortality to delta smelt, the USDA and DBW will become exempt from the prohibitions described under section 9 of the Act.

Giant Garter Snake

The Service anticipates incidental take of giant garter snakes will occur. Giant garter snakes are secretive and notoriously sensitive to human activities. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. It is not possible to make an accurate estimate of the number of snakes that will be harassed, harmed or killed during WHCP activities. In instances when take is difficult to detect, the Service estimates take in numbers of species per acre of habitat lost as a result of the action. Therefore, the Service anticipates that annually all giant garter snakes inhabiting the WHCP treatment area may be harmed and/or harassed by temporary modification and degradation of habitat as a result of the WHCP. The Service also estimates that approximately 1 snake may be injured or killed annually by upland activities and temporary modification and degradation of habitat as a result of the WHCP. Should the number of snakes harassed, harmed, or killed as a result of WHCP operations be greater than those outlined above the USDA and DBW shall contact the Service to discuss further avoidance measures. Upon implementation of the following reasonable and prudent measures, incidental take associated with the WHCP in the form of harm, harassment, injury, or mortality to the giant garter snake, the USDA and DBW will become exempt from the prohibitions described under section 9 of the Act.

Valley Elderberry Longhorn Beetle

The Service expects that incidental take of beetle larvae will be difficult to detect or quantify because of the secretive nature of the species and because the early stages occur within the elderberry bushes. Due to the difficulty in quantifying the number of individuals that will be injured or killed, the Service is quantifying incidental take as the number of elderberry stems over 1 inch in diameter at ground level that will become unsuitable or damaged as a result of the action. The Service has determined that incidental take will be in the form of killing, harming, or harassing individuals resulting from the loss of an undetermined number of elderberry shrubs and stems of suitable size to be potential habitat for the beetle. Take in the form of harm and harassment will occur in locations where elderberry shrubs exist on lands surrounding the project area of the WHCP. Therefore, the Service estimates that up to 40 elderberry stems will become unsuitable for use by the beetle as a result of the WHCP. Upon implementation of the following reasonable and prudent measures, incidental take associated with the WHCP in the form of harm, harassment, injury, or mortality to valley elderberry longhorn beetle, the USDA and DBW will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the delta smelt, valley elderberry longhorn beetle, or giant garter snake. We base this determination on the temporary nature of the effects, proposed WHCP treatment restrictions, and the non-toxicity of Weedar®64, Rodeo®, and Agri-dex® at the levels used in the WHCP. The critical habitat for the smelt and valley elderberry longhorn beetle will not be adversely modified or destroyed by the proposed action. Critical habitat has not been proposed or designated for the giant garter snake; therefore, none will be adversely modified or destroyed.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impact of incidental take on the delta smelt, valley elderberry longhorn beetle and giant garter snake:

> The potential for harassment, harm, or kill of delta smelt, giant garter snake, valley elderberry longhorn beetles and elderberry shrubs (habitat) shall be minimized

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the USDA and DBW must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. The WHCP shall be implemented as described in this biological opinion.

2. The USDA and DBW shall submit to the Service an annual project review and monitoring report by January 31st of each year. The annual report shall detail the previous periods sites treated, amount of chemical used, acreages treated, whether listed species or its habitat were present, treatment methods, monitoring results, and times of treatment.

3. Chemical treatment shall be restricted as follows:

   a. To minimize take of delta smelt, the herbicide Reward® (the active ingredient is Diquat) and the adjuvants R-11® (the active ingredients are Alkyl Aryl Polyethoxylates/Compounded Silicone/Linear Alcohol) and Placement® (the active ingredients are Amine Salts, Aromatic Acid, and Petroleum Distillates), can only be used from August 1st through November 30th in WHCP treatment sites 1-132, 173-176, 241-289, 300-309, and 600.

   b. At WHCP treatment sites 200-239, 310-325, 401-427, 500-537, 700-718, and 900-929, the usage of the herbicide Reward® (the active ingredient is Diquat) and the adjuvants R-11® (the active ingredients are Alkyl Aryl

Polyethoxylates/Compounded Silicone/Linear Alcohol) and Placement® (the active ingredients are Amine Salts, Aromatic Acid, and Petroleum Distillates), are not restricted to a period of time.

c. At all WHCP treatment sites, the usage of the herbicides Weedar ®64 (the active ingredient is 2,4-D Dimethylene Salt) and Rodeo® (the active ingredient is Glyphosate) and the adjuvant Agri-Dex® (the active ingredients are Paraffin Base Petroleum Oil/Polyoxyethylate Polyol Fatty Acid Esters), are not restricted to a period of time.

4. The USDA and the DBW shall insure that any other agencies, county governments, or contractors who are under contract with the USDA or DBW to implement the WHCP are briefed on and comply with the conditions of this Biological Opinion.

5. Personnel involved in this project will receive Service-approved worker environmental awareness training. Under this program, personnel will be informed about the presence of giant garter snakes and habitat associated with the species and that unlawful take of the animal or destruction of its habitat is a violation of the Act. Prior to chemical application activities, a qualified biologist approved by the Service will instruct all operators about: 1) the life history of the giant garter snake; 2) the importance of irrigation canals, marshes/wetlands, and seasonally flooded areas, to the giant garter snake; and 3) the terms and conditions of the biological opinion. Proof of this instruction will be submitted in writing to the SFWO two weeks prior to implementation of the WHCP operations, attention: Endangered Species Division, fax number: (916) 414-6712, and should reference the number of this biological opinion.

6. All disturbance of upland giant garter snake habitat shall be conducted between May 1 and October 1. This is the "active season" for giant garter snakes and direct impacts are lessened, because giant garter snakes are actively moving and avoiding danger.

7. The clearing of vegetation for land based spraying will be to the minimal amount necessary to facilitate WHCP operations. Clearing will not be allowed in areas designated as environmentally sensitive for the giant garter snake.

8. If the USDA and DBW discover any valley elderberry longhorn beetle habitat that has been directly or indirectly damaged or destroyed as a result of chemical treatments associated with the WHCP, the USDA and DBW shall compensate for any impacts to valley elderberry longhorn beetle habitat following the Service July 9, 1999, *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* and approved on by the Service.

9. To minimize impacts to valley elderberry longhorn beetle habitat, herbicide application will occur away from and down wind of elderberry shrubs. In situations where treatment cannot occur away from habitat, a maximum of one half of the area may be treated at one time. If elderberry shrubs are present 100 feet of the outside

edge of the perimeter of the treatment area, herbicide application shall occur during low tide.

10. Personnel involved in this project will receive Service-approved worker environmental awareness training. Under this program, personnel will be informed about the presence of the valley elderberry longhorn beetle and habitat associated with the species and that unlawful take of the animal or destruction of its habitat is a violation of the Act. Prior to chemical application activities, a qualified biologist approved by the Service will instruct all operators about: 1) the life history of the valley elderberry longhorn beetle; 2) the importance of elderberry shrubs and associated riparian habitats, to the valley elderberry longhorn beetle; and 3) the terms and conditions of the biological opinion. Proof of this instruction will be submitted in writing to the SFWO two weeks prior to implementation of the WHCP operations, attention: Endangered Species Division, fax number: (916) 414-6712, and should reference the number of this biological opinion.

Reporting Requirements

The Service is to be notified immediately of the finding of any listed species or any unanticipated take or suspected take of species addressed in this opinion. Notification must include the date, time, and precise location of the incident/specimen(s) and any other pertinent information. The Service contact person for this is Mike Nepstad (916) 414-6625.

Any salvaged giant garter snake, delta smelt, or valley elderberry longhorn beetle specimens taken shall be properly preserved in accordance with the Natural History Museum of Los Angeles County's policy of accessioning (10% formalin in a quart jar or freezing). Information concerning how the specimen was taken, length of the interval between death and preservation, the environmental conditions, the incidental take permit number (1-1-04-F-0149), and any other relevant information shall be written on 100% rag content paper, with indelible ink, and included in the container with the specimen. Preserved specimens shall be delivered to the Service's Division of Law Enforcement at 2800 Cottage Way, Room W-2928, Sacramento, California 95825 (telephone: 916/414-6660).

All observations of delta smelt, giant garter snakes, valley elderberry longhorn beetles (live, injured, or dead– or fresh beetle exit holes) shall be recorded on California Natural Diversity Data Base (NDDB) field sheets and sent to the Department of Fish and Game, Wildlife Habitat Data Analysis Branch, 1416 Ninth Street, Sacramento, California 95814.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species

habitat, implementation of recovery actions, or development of information and data bases.

1. The Service recommends DBW and USDA enhance and restore aquatic and wetland habitat in the Sacramento-San Joaquin River estuary as part of the CALFED program.

2. The Service recommends DBW and USDA work to increase public awareness of potential threats to proper ecosystem function by exotic species introductions such as water hyacinth and increase public awareness of the importance of native flora and fauna of the Delta and its tributaries.

3. The Service recommends DBW and USDA work to assist the Service in implementing recovery actions identified in the recovery plans for the valley elderberry longhorn beetle, giant garter snake, and Sacramento-San Joaquin Delta native fishes.

To be kept informed of actions minimizing or avoiding adverse effects or benefiting listed and proposed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation with USDA on the proposed mechanical and chemical control of the exotic and invasive aquatic plant Water Hyacinth. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the proposed action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion; or (4) a new species or critical habitat is designated that may be affected by the proposed action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

If you have any questions regarding this biological opinion on the WHCP, please contact Mike Nepstad or Dan Buford of the Sacramento Fish and Wildlife Office at (916) 414-6625.

Sincerely,

Cay C. Goude

Cay C. Goude
Acting Field Supervisor

cc:
ARD (ES), Portland, OR
California Department of Boating and Waterways, Sacramento CA (Attn: Marcia Carlock)

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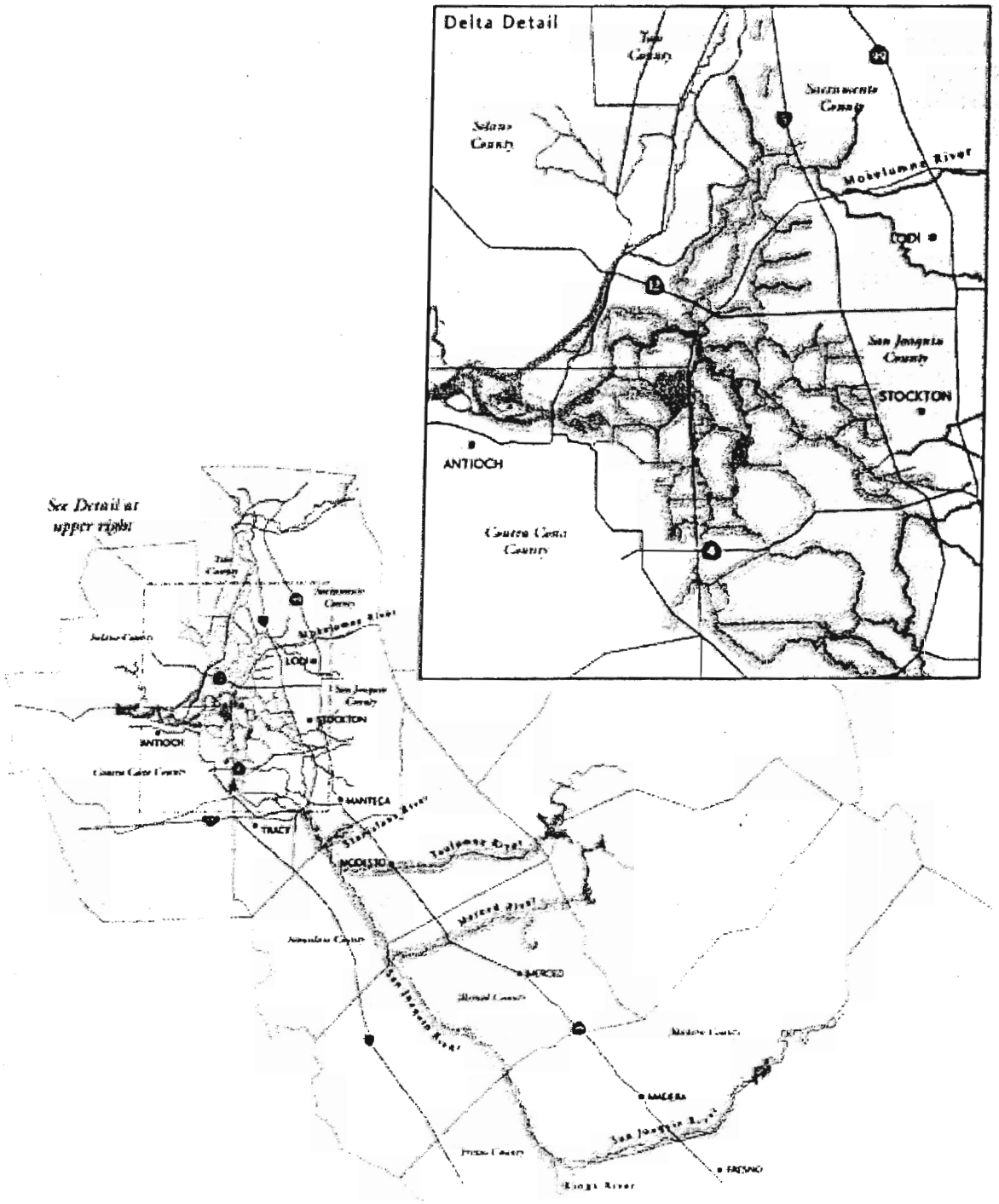
Attachment A



WHCP Permits

NOAA-Fisheries Biological Opinion (151422SWR2005SA00681:JSS)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

In Response Refer To:
151422SWR2005SA00681:JSS

APR 04 2006

James N. Seiber
Director
United States Department of Agriculture
Pacific West Area, Western Regional Research Center
Agricultural Research Service
800 Buchanan Street
Albany, California 94710-1105

Dear Director Seiber:

This letter transmits NOAA's National Marine Fisheries Service's (NMFS) biological and conference opinion (Enclosure 1) based on our review of the proposed Water Hyacinth Control Program (WHCP) in the Sacramento-San Joaquin Delta (Delta) in the state of California, and its effects on Federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), proposed threatened southern distinct population segment (DPS) of North American green sturgeon (*Acipenser medirostris*), and designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your September 9, 2005, request for formal consultation was received on September 14, 2005. A response was sent on October 19, 2005, indicating that NMFS would require additional information from the U.S. Department of Agriculture-Agricultural Research Services (USDA-ARS) in order to initiate the consultation process. A complete biological assessment was received from the USDA-ARS via the California Department of Boating and Waterways (DBW) that fulfilled the request for additional information on November 14, 2005.

This biological and conference opinion (Enclosure 1) is based on information provided from the annual reports for the WHCP from 2003, 2004, 2005, the September 9, 2005 request letter, the November 14, 2005 biological assessment, and the September 28, and November 4, 2005 meetings between staff from NMFS, the USDA-ARS, and DBW for the proposed WHCP project. A complete administrative record of this consultation is on file at the Sacramento, California, field office of NMFS.

Based on the best available scientific and commercial information, the biological and conference opinion concludes that the WHCP, as proposed by the USDA-ARS and DBW, is not likely to jeopardize the continued existence of the listed or proposed species or adversely modify designated critical habitat. NMFS also has included an incidental

take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take associated with the project. The conference opinion concerning the proposed listing of green sturgeon does not take the place of consultation under section 7(a) 2 of the ESA. The conference opinion may be adopted as a biological opinion when the proposed listing for the southern DPS of North American green sturgeon becomes final if no significant new information is developed, and no significant changes to the project are made that would alter the contents of this opinion.

This letter also transmits NMFS' Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon (*O. tshawytscha*), starry flounder (*Platichthys stellatus*) and English sole (*Parophrys vetulus*) as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*; Enclosure 2). The document concludes that the WHCP will adversely affect the EFH of Pacific salmon, starry flounder, and English sole in the action area and adopts certain terms and conditions of the incidental take statement and the ESA conservation recommendations of the biological and conference opinion as the EFH conservation recommendations.

The USDA-ARS has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a detailed response in writing to NMFS within 30 days of receipt of these conservation Recommendations that includes a description of the measures proposed for avoiding, mitigating, or offsetting the impact of the activity on EFH (50 CFR 600.920 (j)). If unable to complete a final response within 30 days, the Corps should provide an interim written response within 30 days before submitting its final response.

Please contact Mr. Jeffrey Stuart in our Sacramento Area Office at (916) 930-3607 or via e-mail at J.Stuart@noaa.gov if you have any questions regarding this response or require additional information.

Sincerely,

for Rodney R. McInnis
Regional Administrator

Enclosures (2)

cc:

NOAA Fisheries-PRD, Long Beach, CA
Stephen A. Meyer, ASAC, NOAA Fisheries, Sacramento, CA
USDA-ARS, Lars Anderson, Weed Science Program, UC-Davis - One Shields Avenue, Davis, CA 95616

DBW, Marcia Carlock, 2000 Evergreen Street, Suite 100, Sacramento, CA 95815

U.S. Fish and Wildlife Service, Ryan Olah, 2800 Cottage Way, Suite W-2605, Sacramento, CA 95825

James Starr, California Department of Fish and Game, 4001 North Wilson Way, Stockton, CA 94205

California Regional Water Quality Control Board, Emily Alejandro, 3443 Routier Road, Suite A, Sacramento, CA 95827

APR 0 4 2006

BIOLOGICAL AND CONFERENCE OPINION

ACTION AGENCY: U.S. Department of Agriculture-Agricultural Research Service

ACTIVITY: Water Hyacinth Control Program

CONSULTATION CONDUCTED BY: Southwest Region, National Marine Fisheries Service

FILE NUMBER: 151422SWR2005SA00681:JSS

I. CONSULTATION HISTORY

Previous consultations by NOAA's National Marine Fisheries Service (NMFS) addressing the effects of the Water Hyacinth Control Program (WHCP) on listed salmonids resulted in the issuance of biological opinions on June 8, 2001; June 11, 2002; and August 11, 2003. These biological opinions respectively concluded that the WHCP was not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook salmon (*O. tshawytscha*), and Central Valley steelhead (*O. mykiss*), or adversely modify designated critical habitat for the 2001, 2002, and 2003 through 2005 application seasons.

On September 14, 2005, NMFS received the U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) request for initiation of formal section 7 consultation under the Endangered Species Act (ESA) for the WHCP covering application seasons 2006 through 2010.

On September 28, 2005, a meeting was held at NMFS' Sacramento offices between staff from the USDA-ARS, the California Department of Boating and Waterways (DBW) and NMFS to discuss the WHCP consultation and the necessary information to be included in the project's biological assessment (BA).

On October 19, 2005, NMFS formally responded to the USDA-ARS' request for formal section 7 consultation regarding the WHCP with a letter indicating that the information provided in the initiation package was incomplete and that further detailed information was necessary to continue the consultation. The information requested by NMFS had been discussed in the September 28, 2005 meeting between agency staff.

On November 4, 2005, a second meeting was held at NMFS' Sacramento offices between staff from the aforementioned agencies to discuss the progress of the BA.

On November 14, 2005, a copy of the final BA for the WHCP was delivered to the offices of NMFS in Sacramento by staff from the DBW and formal consultation was initiated for the project.

II. DESCRIPTION OF THE PROPOSED PROJECT

The DBW, through their Federal sponsor, the USDA-ARS, is proposing a continuation of their ongoing WHCP in the affected waters of the Central Valley of California for the next five years (2006-2010). The WHCP is an ongoing program that is designed to control the growth and spread of the invasive, non-native aquatic plant *Eichhornia crassipes* (water hyacinth) in the Sacramento – San Joaquin Delta (Delta), several tributaries that flow into the delta (*i.e.* Morrison Creek, and the Merced, Mokelumne, Tuolumne, and San Joaquin Rivers) as well as several sloughs that feed into the Delta. Tables and figures mentioned in text will be given in appendix A and B, respectively, at the end of the document. Please see Appendix B, Figure 1 for a map of the project action area.

A. Project objectives

The primary purpose of the WHCP is to prevent the growth and spread of water hyacinth in the affected areas of the Delta and its adjoining waters (DBW 2005b). The DBW has been charged with preventing degradation of the beneficial uses of the Delta waters by the infestation of the water hyacinth and thus seeks to minimize the negative impacts of the water hyacinth on navigation, recreation, and agricultural activities (diversions) in the affected waterways of the Delta. DBW will clear and maintain adequate navigation channels for Delta boaters and clear infested waters surrounding marinas, boat launching ramps, agricultural diversions, and domestic water pumping intakes. In addition to these stated primary objectives, DBW seeks to improve the Delta's aquatic habitat by removing the non-native water hyacinth and creating opportunities for native plants to recolonize the infested areas. The DBW has identified a total of ten specific objectives to be achieved by the WHCP and their associated performance measures that will be used to evaluate the success of the WHCP (Table 1).

Table 1: WHCP Objectives and Performance Measures (from DBW 2005)

Objectives	
1.	Limit future growth and spread of water hyacinth in the Delta.
2.	Improve boat and vessel navigation in the Delta.
3.	Utilize the most efficacious methods available with the least environmental impacts.
4.	Prioritize sites so that the WHCP activities are focused on sites with a high degree of infestation, as well as navigational, agricultural, or recreational significance.
5.	Employ a combination of control methods to allow maximum flexibility.
6.	Improve the WHCP as more information becomes available on control methods used in the Delta.
7.	Monitor results of the WHCP to fully understand impacts of the WHCP on the environment of the Delta.
8.	Improve shallow water habitats for native species by controlling water hyacinth.
9.	Decrease WHCP control efforts, when and if sufficient efficacy of water hyacinth control is realized.
10.	Minimize use of methods that could cause adverse environmental impacts.

Performance Measures
• Reduce total acres of water surface infested with water hyacinth
• Reduce water hyacinth biomass at high priority navigation sites currently infested with water hyacinth
• Reduce water hyacinth biomass at nursery sites.
• Prevent infestation of new sites.
• Produce fewer incidents of boat navigation, agricultural, and recreation problems related to water hyacinth.
• Prepare reports for regulatory agencies
• Increase the total efficacy level of the WHCP, and each control method over time.
• Increase the number of shallow-water sites suitable for native species.
• Limit the number and significance of environmental impacts resulting from the WHCP.
• Limit the number of acres treated with methods that have the potential for adverse environmental impacts.
• Reduce the quantity of herbicides applied to the Delta over time.

B. Project Activities

The WHCP is a program intended to control water hyacinth, an invasive, non-native aquatic weed in the Delta. The Federal nexus for this activity is the USDA-ARS, which has the responsibility to conduct research and provide technical input into the control of nuisance weeds and agricultural pests. The DBW is the state lead for this project, with whom the USDA-ARS has contracted with to conduct the application of the program.

1. Chemical Control

Currently, the primary WHCP treatment methods utilize chemical herbicides in conjunction with adjuvents. The chemical compounds available to the DBW for application to infested waters during the 2006-2010 treatment seasons include:

a. *Herbicides*

1. Reward® (active ingredient: diquat dibromide, Environmental Protection Agency (EPA) Registration Number 10182-404)

2. Weedar 64® (active ingredient: 2,4-Dichlorophenoxyacetic acid (2,4-D), dimethylamine salt). EPA Registration Number 71368-264.

3. Rodeo® and Aquamaster (active ingredient glyphosate). EPA Registration Number 524-00343.

b. *Adjuvants*

1. R-11® Spreader-Activator (active ingredients: alkyl aryl polyethoxylates, compounded silicone, and linear alcohol). California State Registration 2935-50142-AA.

2. Agri-Dex® (active ingredients: paraffin base petroleum oil and polyoxyethylate polyol fatty acid esters). California State Registration 5905-50017-AA.

Of the three aquatic herbicides selected for use in the program, only two have been used regularly, 2,4-D and glyphosate. These will remain the two preferred herbicides for use during the 2006 to 2010 application seasons. The compound 2,4-D accounted for between 75 percent and 90 percent of the herbicides applied in the past three treatment seasons for the WHCP and glyphosate has accounted for the remainder. DBW has not determined whether the herbicide diquat dibromide will be used during the next five application seasons.

In addition to the herbicides, two different adjuvants have been used in the application program during the period from 2003 to 2005. They are: (1) R-11®, a combined spreading-activating compound for increasing the efficiency of action for agricultural chemicals where quick wetting and uniform coverage are required and (2) Agri-Dex®, a nonionic compound that improves pesticide application by modifying the wetting and deposition characteristics of the application solution.

Agri-Dex® will be the primary adjuvant used in the WHCP. R-11 has been deemed unsuitable for the majority of applications in the waters of the Delta. R-11 can, however, be used in portions of the Stone/Beach Lakes complex where contact with listed fish species is unlikely to occur.

Please see Table 2 (Appendix A) for an accounting of chemical usage and acreage treated for the 2003 through 2005 application seasons (DBW 2004, 2005a, 2006).

2. Biological Control

The USDA-ARS and DBW are conferring with the California Department of Food and Agriculture (DFA) to develop and implement biological control methods for the WHCP. The DBW has contracted with the DFA to search for populations of weevils belonging to the genus *Neochetina* within the Delta. These weevils are a naturally occurring consumer of the water hyacinth, endemic to the plant's native South American habitat. This genus of weevils was previously released into the Delta several decades ago, but had not established a large enough population to achieve control of the water hyacinth infestation. Remnant populations of these earlier releases still remain in the Delta, but are scattered and small in size. If populations of these weevils are found, DFA will determine if they are infected with a microsporidian disease that could interfere with biological control efforts. DBW intends to utilize these weevils to colonize water hyacinth nurseries and establish self-sustaining populations of the insect as an ongoing control of water hyacinth infestation in these locales. Pending the results of the DFA investigations, DBW intends to submit a final biological control study proposal to NMFS to be

included as an amendment to this or future biological opinions, which will fulfill earlier requirements to establish an integrated pest management program for water hyacinth in the Delta as described in the project's biological assessment (DBW 2005b). Therefore, biological control operations will not be addressed further in this biological opinion.

3. Mechanical and Physical Removal

The DBW has received concurrence under a separate consultation (SWR-03-SA-8373:JSS) to implement a manual and mechanical removal of water hyacinth infestations from Delta waterways during the non-spraying season. This period is typically from the end of the herbicide spraying season in mid October (October 15) to the beginning of the permitted herbicide spray application season in spring (date varies depending on location). Personnel from the DBW will manually remove small infestations of water hyacinth with rakes in critical areas and deposit the vegetation on adjacent levee banks where the plants will desiccate naturally and perish. Mechanical removal will require DBW personnel to use motorized water-craft to "herd" mats of water hyacinth out into the main channels of the Delta where they will be carried by currents out of the Delta system and eventually perish in the higher salinity of Suisun Bay. Mechanical and physical removal operations will not be further addressed in this biological opinion.

4. Daily Protocol

The proposed WHCP treatment season would extend from approximately April 1 through October 15. Five crews, each consisting of a Specialist and a Technician, would carry out the spraying of herbicides in an assigned region of the Delta. Spraying would be conducted five days a week, with each team spraying about 25 acres per day in total, at one to three sites in a given day. The maximum area that could be treated in a day could range as high as 50 acres a day in the summer, when crews work overtime and weather and tidal conditions are conducive to treatment. A Field Supervisor would manage daily operations from the DBW Field Office in Stockton, California, and would be responsible for determining daily spraying needs and assign teams to sites based on local conditions, available personnel, and equipment resources. The Field Supervisor will also assure that the Notice of Intent (NOI) requirements are met by reporting the locations of the treatment sites to the respective county Agricultural Commissioner no later than the Friday prior to the week of treatment. Each boat crew will document herbicide applications on a daily basis, make sure that application rates are compliant with label instructions for each respective chemical product, are applied at designated treatment sites only, are performed in a manner consistent with the WHCP protocols and use permits, and overseen by the Project Supervisor. The application of herbicides will be conducted with hand held sprayers operated from 19 to 21-foot aluminum air or outboard boats. The boats are equipped for direct metering of herbicides, adjuvants and water into the pump system of the spraying unit. The herbicide/adjuvant mixture will be sprayed directly onto the floating mats of water hyacinth. Waste products, including both active and inert components of the herbicidal mixtures, degraded components of the herbicidal mixtures, and dead and decaying vegetable matter, would be left to sink to the bottom or be carried downstream by the river and tidal currents. Operating protocols will prohibit treatments when wind conditions exceed a maximum threshold (10 mph) or when water flow or wave action is excessive.

The DBW will follow the California Department of Pesticide Regulation procedures for pesticide application. Restricted Use Permits from the relevant county agriculture commissioners will be obtained prior to the initiation of the spraying program. Monitoring protocols for water quality and pesticide concentrations in treated water bodies will be strictly adhered to in compliance with the water quality monitoring protocols approved by the Central Valley Regional Water Quality Board (Regional Board) per the criteria set forth in the General Permit.

C. Proposed Conservation Measures

The DBW was initially covered under the Individual Permit issued by the Regional Board on March 7, 2001 for the application of herbicides in conjunction with the WHCP. This order expires March 7, 2006. On April 12, 2002, the USDA-ARS and DBW applied for a General Permit under the "emergency basis" resulting from the Headwaters, Inc. v. Talent Irrigation District (Talent Decision) issued in 2001 by the Ninth Circuit Court of Appeals. As a requirement of the General Permit, the DBW would follow monitoring protocol terms imposed by the Regional Board. The general goals of the monitoring plan are to:

1. Document compliance with the requirements of the General Permit

2. Support the development, implementation, and effectiveness of the implementation of Best Management Procedures (BMPs)

3. Demonstrate the full recovery of water quality and protection of beneficial uses of the receiving waters following completion of resource or pest management projects

4. Identify and characterize aquatic pesticide application projects conducted by the DBW

5. Assure that the Monitoring Plan provides for monitoring of projects that are representative of all pesticides and application methods used by the DBW.

The General Permit does not specify numeric limits for water quality criteria, but rather gives narrative guidelines for dischargers to follow. The General Permit allows for temporary excursions above the numeric criteria listed in the California Toxics Rule (CTR) and EPA water quality criteria, as long as full restoration of water quality and beneficial uses of the receiving waters are returned to pre-treatment levels following completion of the action. However, DBW anticipates following both the EPA aquatic species toxicity limits and drinking water standards that follow:

- Diquat--the maximum-labeled rate for water column concentration is 370 parts per billion (ppb). The EPA drinking water concentration standard (Maximum Contaminant Level, or MCL) is 20 ppb. EPA lists the protective criteria for freshwater life as 0.5 ppb. The DBW anticipates treating within the labeled rates the day of treatment and returning to EPA criteria within 24 hours after treatment.

- Glyphosate--application rates will be limited to ensure a MCL that does not exceed 700 ppb in water bodies designated as municipal and domestic water supplies. The DBW anticipates treating within the labeled rates the day of treatment and returning to EPA criteria within 24 hours after treatment.

- 2,4-D--the application rate will be limited to ensure a MCL that does not exceed 70 ppb in water bodies designated as municipal or domestic water supplies. Regional Board has further restricted the level of permissible 2,4-D concentrations in receiving waters to 20 ppb in the individual National Pollution Discharge Elimination System (NPDES) permit (Section A-14, Receiving Water Limitations). The DBW anticipates treating within the labeled rates the day of treatment and returning to EPA criteria within 24 hours after treatment.

In order to fulfill the requirements of the General Permit, the DBW has implemented pre-treatment and post-treatment monitoring for biological, chemical, and physical indicators associated with each form of WHCP treatment. These elements are required according to the terms of the monitoring plan associated with the General Permit (Attachment B of the General Permit). The objectives of the program's monitoring are to: (1) determine if environmental conditions are conducive to chemical or mechanical treatment; (2) collect data for environmental baseline conditions, for assessment of environmental impacts and treatment efficacy, and (3) determine if treatment protocols need to be modified to reduce environmental impacts.

Pre-treatment monitoring involves taking measurements of physical and chemical parameters, including water temperature, water flow rate, turbidity, dissolved oxygen (DO), pH, and concentrations of aquatic herbicides prior to treatment. Post-treatment monitoring consists of taking measurements of DO, pH, and aquatic herbicides concentrations. Water hyacinth biomass and coverage are quantified before and after treatment to determine overall efficacy of the WHCP and possible modifications to the treatment protocol. Specific mitigation measures for the water hyacinth control program are proposed by the DBW to avoid or minimize potential impacts where available. Consultation with various state and federal agencies regarding impacts and mitigation measures for future revisions or additions to the mitigation measures will be on going.

1. Environmental Monitoring

The monitoring program includes a daily log with site specifics (*e.g.* location, wind, chemicals used, location of listed species/species habitat), DO levels, pH, and pre-treatment and post-treatment levels of chemical residues. Three times each year, replicated (n=2) monitoring of pre-treatment and post-treatment chemical residue concentrations will be conducted in each of the water type categories (tidal, slow-moving, fast-flowing, dead-end slough). Each type of herbicide applied will have a complete set of residue determinations performed.

2. Pre-Treatment

One hour prior to treatment, readings of the ambient DO, temperature, and turbidity will be taken in the treatment area at the midpoint of the water column or at a depth of 5 feet, whichever is

closer to the surface. An ambient chemical residue sample will also be taken in the treatment area at the midpoint of the water column or at a depth of 5 feet, whichever is closer to the surface, and within 3 feet of the water hyacinth mat, if possible, at the same location.

3. Post-Treatment

Upon completion of the chemical application, DBW will take ambient DO, temperature and turbidity readings at the mid-point of the water column or at a depth of 5 feet; whichever is closer to the surface, at the following three locations:

1. 100 feet up current of the treatment area.
2. Within the treatment area at the same location as the pre-treatment sample; and
3. 25 feet down-current of the treatment area

These DO, temperature and turbidity readings will continue until dead plants are no longer observable and the DO readings within and 25 feet down-current of the treatment area are within 0.5 mg/L of the readings 100 feet up-current of the treatment area.

Chemical residue and toxicity samples:

- Direction of water flow will be determined prior to the initiation of spraying. After the initial water sample has been taken, the spray crew will flag the starting point and spray in a down-current direction, traveling with the current.

- When the spray crew has passed the initial sampling location, the monitoring crew will take the first post-treatment sample 100 feet upstream of the flagged starting point.

- The monitoring crew will then take the second sample at the initial sample location for chemical residue and toxicity studies. The monitoring crew will contact the spraying crew to stop at this point, and the spraying crew will flag the end point of the application area.

- The monitoring crew will sample water 25 feet down-current from the flagged stopping point.

The time, latitude, and longitude of the sampling location for each set of samples will be recorded for later incorporation into a GIS database.

The DBW has Memoranda of Understanding (MOUs) with regional water agencies outlining application restrictions. Prior to any future work within close proximity of drinking water intakes, the DBW will develop a protocol for sampling post-treatment chemical residue around the intakes. Currently, label recommendations for Reward® concentration cannot exceed 20 ppb in drinking water.

Other monitoring protocols being carried out by DBW and relevant to listed salmonid species includes field observations for any dead fish and native vegetation; visual assessment of water

quality and photo documentation of native vegetation present at treatment sites before and after chemical control applications.

The WHCP technical crew is trained in fish species identification and recognition of fish habitat in the Delta and associated waterways by the DBW environmental scientist assigned to the program.

4. WHCP Adaptive Management

The DBW proposes to employ an adaptive management strategy for conducting the WHCP. This strategy will allow the DBW to re-evaluate its project protocol as new data and information becomes available that enhances the efficiency of the program or minimizes its environmental impact. The proposed adaptive management strategies include:

- Evaluating the need for control measures on a site by site basis;
- Selecting appropriate indicators for pre-treatment environmental monitoring;
- Monitoring indicators following treatment and evaluating data to determine program efficacy and environmental impacts;
- Support ongoing research to explore the impacts of the WHCP and alternative control methodologies;
- Report findings from monitoring evaluations and research to regulatory agencies and stakeholders;
- Adjust program actions, as necessary, in response to recommendations and evaluations by regulatory agencies and stakeholders.

5. Temporal and Spatial Restrictions to Herbicide Applications

The application of herbicides in the waters of the action area has been modified by DBW, in response to on-going consultations with NMFS, to minimize or avoid potential adverse effects upon listed salmonids and North American green sturgeon. DBW has indicated that the following temporal and spatial limitations and restrictions will be incorporated into their application protocols for the WHCP and become part of the project description:

1. The following sites may be treated from April 1 to November 30 under the following specified conditions:

    a. The San Joaquin River upstream of the confluence with the Merced River (Hills Ferry) and associated sloughs and canals in Merced and Fresno counties south of the confluence of the Merced and San Joaquin Rivers;

b. The Stone/Beach Lakes complex in Sacramento County (except for site 220, which will only be treated April 1 through October 15).

2. The following sites may be treated April 1 through October 15 of each application season. Treated sections will start at the inner margin of the infested water body and move progressively outwards towards the main channel as practicable:

    a. Sloughs on the east side of the Delta which have minimal current and unsuitable salmonid habitat:
        i. Fourteen Mile Slough east of Shima Tract
        ii. Pixley Slough
        iii. Rio Blanco Tract
        iv. White and Disappointment Sloughs, east of Honker Cut
        v. Sycamore Slough
        vi. Hog Slough
        vii. Beaver Slough
        viii. Lost Slough
        ix. Snodgrass Slough above the Delta Cross Channel

3. Areas available to herbicide treatment from April 15 through October 15 are portions of the south Delta that are within the region bounded by the placement of the four south Delta temporary barriers. Herbicide applications may commence once the barriers are in place and the Head of Old River Barrier is closed. These waterways include portions of Old River, Middle River, Paradise Cut, Salmon Cut, Tom Paine Slough, Sugar Slough, Grant Line, Fabian and Bell Canals. Additionally, off channel sites along the Merced River that have no hydrological connectivity to the mainstem Merced River may also be treated as early as April 15.

4. Treatment may occur as early as May 15 (but continue no later than October 15) in the Merced River, Tuolumne River and the mainstem San Joaquin River upstream of the confluence with the Stanislaus River to the confluence with the Merced River depending on water temperatures, with the stipulation that water temperatures must be 21 °C (69.8 °F) or greater for one week prior to the application of herbicides in each prospective area.

5. The remainder of the project area may be treated after June 1, or when Interagency Ecological Program (IEP) data indicates that the pulse of migrating salmon have moved through the Delta. If IEP data shows that fish are still present in these reaches, spraying activities may be suspended upon the discretion of NMFS personnel.

6. Between July 1 and October 15, there are no restrictions for areas to be sprayed within the project area.

D. Action Area

The WHCP includes portions of nine counties that encompass much of the Sacramento-San Joaquin Delta and its upland tributaries. The nine counties are: Contra Costa, Fresno, Madera, Merced, Sacramento, San Joaquin, Stanislaus, and Yolo. Merced and Fresno counties will be treated by the agricultural commissions of those counties under the direction of the DBW. The DBW will conduct the program in the other seven counties. 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 the Sacramento River Deep Water Ship Channel (SDWSC);
- North to the northern confluence of the Sacramento River and the SDWSC, plus waters of Lake Natoma;
- South along the San Joaquin River and Kings River to Mendota, just west of Fresno;
- East along the San Joaquin River to Friant Dam on Millerton Lake;
- East along the Tuolumne River to La Grange Reservoir; below Don Pedro Reservoir; and
- East along the Merced River to Merced Falls, below Lake McClure.

Within the project area are 367 possible treatment sites which average between one and two miles in length (see Table 3, Appendix A). These sites include those that were listed in the 2002 WHCP, sites that were omitted from the action area in 2002, and additional sites that have been added to the WHCP since 2003. Each year, sites will be prioritized after DBW crews complete a spring survey. High priority sites will generally have the greatest impacts to navigation, create extensive obstructions to pumping facilities, or have high levels of infestation.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following Federally listed and proposed species (Evolutionarily Significant Units [ESUs] or Distinct Population Segments [DPSs]) and designated critical habitat occur in the action area and may be affected by the proposed project:

Sacramento River winter-run Chinook salmon ESU
endangered (June 28, 2005, 70 FR 37160)

Sacramento River winter-run Chinook salmon critical habitat
(June 16, 1993, 58 FR 33212)

Central Valley spring-run Chinook salmon ESU
threatened (June 28, 2005, 70 FR 37160)

Central Valley spring-run Chinook salmon critical habitat
(September 2, 2005, 70 FR 52488)

Central Valley steelhead DPS
Threatened (January 5, 2006 71 FR 834)

Central Valley steelhead designated critical habitat
(September 2, 2005, 70 FR 52488)

Southern DPS of North American green sturgeon (*Acipenser medirostris*)
proposed threatened (April 6, 2005, 70 FR 17386)

The designated critical habitat of Sacramento River winter-run Chinook salmon occurs along the main channel of the Sacramento River downstream to Chipps Island and includes Sutter, Steamboat, and Cache Sloughs as well as the lower segments of the San Joaquin River adjacent to Kimball, Browns and Winter Islands near RM 4 of the San Joaquin River. Critical habitat is inclusive of the aquatic habitat below the ordinary high water mark surrounding these islands and along the river and slough channels. Designated critical habitat for Central Valley steelhead occurs throughout the waters of the Delta and within the eastside tributaries below the first impassable barrier (Calaveras, Mokelumne, Stanislaus, Tuolumne, and Merced Rivers). Critical habitat extends up the lower section of the San Joaquin River to Hills Ferry, located at the confluence of the Merced River. Critical habitat lies below the ordinary high water mark in these waters. Designated critical habitat for Central Valley spring-run Chinook salmon borders the northern edge of the San Joaquin River from the confluence of the Mokelumne River west to the boundaries of the Suisun Bay and Sacramento Delta hydrologic sub units at approximately RM 4 of the San Joaquin River. This would include the waters of Three Mile Slough and New York Slough. Critical habitat for spring-run Chinook salmon in the action area includes the Sacramento River from Sherman Island upriver to the City of Sacramento, and would include the waters of Steamboat, Sutter, Miner, and Elk Sloughs. Individuals of both Chinook salmon ESUs can occupy waters within the action area during their migratory or rearing phases.

A. Species and Critical Habitat Listing Status

NMFS has recently completed an updated status review of 16 salmon ESUs, including Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon, and concluded the species' status should remain as previously listed (70 FR 37160). On January 5, 2006, NMFS published a final listing determination for ten steelhead DPSs, including Central Valley steelhead and concludes that Central Valley steelhead will remain listed as threatened (71 FR 834).

Sacramento River winter-run Chinook salmon were originally listed as threatened in August 1989, under emergency provisions of the ESA, and formally listed as threatened in November 1990 (55 FR 46515). The ESU consists of only one population that is confined to the upper

Sacramento River in California's Central Valley. The Livingston Stone National Fish Hatchery population has been included in the listed Sacramento River winter-run Chinook salmon population as of June 28, 2005 (70 FR 37160). NMFS designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212). The ESU was reclassified as endangered on January 4, 1994 (59 FR 440), due to increased variability of run sizes, expected weak returns as a result of two small year classes in 1991 and 1993, and a 99 percent decline between 1966 and 1991. Critical habitat was delineated as the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) at the westward margin of the Delta, including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge. The critical habitat designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration and protection. Within the Sacramento River this includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing. In the areas west of Chipps Island, including San Francisco Bay to the Golden Gate Bridge, this designation includes the estuarine water column, essential foraging habitat, and food resources utilized by winter-run Chinook salmon as part of their juvenile outmigration or adult spawning migrations.

Central Valley spring-run Chinook salmon were listed as threatened on September 16, 1999 (50 FR 50394). This ESU consists of spring-run Chinook salmon occurring in the Sacramento River basin. The Feather River Hatchery (FRH) spring-run Chinook salmon population has been included as part of the Central Valley spring-run Chinook salmon ESU as of June 28, 2005 (70 FR 37160). Critical habitat was designated for spring-run Chinook salmon in the Central Valley on September 2, 2005 (70 FR 52488). Critical habitat includes the stream channels to the ordinary high water line within designated stream reaches such as those of the Feather and Yuba Rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear Creeks, and the Sacramento River and Delta.

Central Valley steelhead were listed as threatened under the ESA on March 19, 1998 (63 FR 13347). This DPS consists of steelhead populations in the Sacramento and San Joaquin River (inclusive of and downstream of the Merced River) basins in California's Central Valley. The Coleman National Fish Hatchery and FRH steelhead populations have been included in the listed population of steelhead as of January 5, 2006 (71 FR 834). These populations were previously included in the DPS but were not deemed essential for conservation and thus not part of the listed steelhead population. Critical habitat was designated for steelhead in the Central Valley on September 2, 2005 (70 FR 52488). Critical habitat includes the stream channels to the ordinary high water line within designated stream reaches such as those of the American, Feather, and Yuba Rivers, and Deer, Mill, Battle, Antelope, and Clear Creeks in the Sacramento River basin; the Calaveras, Mokelumne, Stanislaus, and Tuolumne Rivers in the San Joaquin River basin; and, the Sacramento and San Joaquin Rivers and Delta.

The southern DPS of North American green sturgeon was proposed for listing as threatened on April 6, 2005 (70 FR 17386). The southern DPS presently contains only a single spawning

population in the Sacramento River; individuals may occur in the action area. No critical habitat has been designated or proposed for the southern DPS of North American green sturgeon.

B. Species Life History, Population Dynamics, and Likelihood of Survival and Recovery

1. Chinook Salmon

a. *General Life History*

Chinook salmon exhibit two generalized freshwater life history types (Healey 1991). "Stream-type" Chinook salmon, enter freshwater months before spawning and reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon spawn soon after entering freshwater and migrate to the ocean as fry or parr within their first year. Spring-run Chinook salmon exhibit a stream-type life history. Adults enter freshwater in the spring, hold over summer, spawn in fall, and the juveniles typically spend a year or more in freshwater before emigrating. Winter-run Chinook salmon are somewhat anomalous in that they have characteristics of both stream- and ocean-type races (Healey 1991). Adults enter freshwater in winter or early spring, and delay spawning until spring or early summer (stream-type). However, juvenile winter-run Chinook salmon migrate to sea after only 4 to 7 months of river life (ocean-type). Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over-summering by adults and/or juveniles.

Chinook salmon typically mature between 2 and 6 years of age (Myers *et al.* 1998). Freshwater entry and spawning timing generally are thought to be related to local water temperature and flow regimes. Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime, and flow characteristics of their spawning site, and the actual time of spawning (Myers *et al.* 1998). Both spring-run and winter-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 °F to 56 °F (Bell 1991, California Department of Fish and Game (CDFG) 1998). Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past Red Bluff Diversion Dam (RBDD) from mid-December through early August (NMFS 1997). The majority of the run passes RBDD from January through May, with the peak passage occurring in mid-March (Hallock and Fisher 1985). The timing of migration may vary somewhat due to changes in river flows, dam operations, and water year type. Adult spring-run Chinook salmon enter the Delta from the Pacific Ocean beginning in January and enter natal streams from March to July (Myers *et al.*

1998). In Mill Creek, Van Woert (1964) noted that of 18,290 spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30. Typically, spring-run Chinook salmon utilize mid- to high elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature.

Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs, and suitable water temperatures, depths, and velocities for redd construction and adequate oxygenation of incubating eggs. Chinook salmon spawning typically occurs in gravel beds that are located at the tails of holding pools (U.S. Fish and Wildlife Service (FWS) 1995). The range of water depths and velocities in spawning beds that Chinook salmon find acceptable is very broad. Bell (1991) identifies the preferred water temperature for adult spring-run Chinook salmon migration as 38 °F to 56 °F. Boles (1988) recommends water temperatures below 65 °F for adult Chinook salmon migration, and Lindley *et al.* (2004) report that adult migration is blocked when temperatures reach 70 °F, and that fish can become stressed as temperatures approach 70 °F. The Bureau of Reclamation (Reclamation) reports that spring-run Chinook salmon holding in upper watershed locations prefer water temperatures below 60 °F; although, salmon can tolerate temperatures up to 65 °F before they experience an increased susceptibility to disease. The upper preferred water temperature for spawning Chinook salmon is 55 °F to 57 °F (Chambers 1956, Bjornn and Reiser 1995). Winter-run Chinook salmon spawning occurs primarily from mid-April to mid-August, with the peak activity occurring in May and June in the Sacramento River reach between Keswick dam and RBDD (Vogel and Marine 1991). The majority of winter-run Chinook salmon spawners are 3-years old. Physical Habitat Simulation Model (PHABSIM) results (FWS 2003a) indicate winter-run Chinook salmon suitable spawning velocities in the upper Sacramento River are between 1.54 feet per second (ft/s) and 4.10 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter. Initial habitat suitability curves (HSCs) show spawning suitability rapidly decreases for water depths greater than 3.13 feet (FWS 2003a). Spring-run Chinook salmon spawning occurs between September and October depending on water temperatures. Between 56 and 87 percent of adult spring-run Chinook salmon that enter the Sacramento River basin to spawn are 3 years old (Calkins *et al.* 1940, Fisher 1994). PHABSIM results indicate spring-run Chinook salmon suitable spawning velocities in Butte Creek are between 0.8 ft/s and 3.22 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter (FWS 2004). The initial HSC showed suitability rapidly decreasing for depths greater than 1.0 feet, but this effect was most likely due to the low availability of deeper water in Butte Creek with suitable velocities and substrates rather than a selection by spring-run Chinook salmon of only shallow depths for spawning (FWS 2004).

The optimal water temperature for egg incubation is 44 °F to 54 °F (Rich 1997). Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel percolation, and poor water quality. Studies of Chinook salmon egg survival to hatching conducted by Shelton (1995) indicated 87 percent of fry emerged successfully from large gravel with adequate subgravel flow. The length of time required for eggs to develop and hatch is dependent on water temperature and is quite variable. Alderdice and Velsen (1978) found that

the upper and lower temperatures resulting in 50 percent pre-hatch mortality were 61 °F and 37 °F, respectively, when the incubation temperature was held constant.

Winter-run Chinook salmon fry begin to emerge from the gravel in late June to early July and continue through October (Fisher 1994), with emergence generally occurring at night. Spring-run Chinook salmon fry emerge from the gravel from November to March and spend about 3 to 15 months in freshwater habitats prior to emigrating to the ocean (Kjelson *et al.* 1981). Post-emergent fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris. They then begin feeding on small insects and crustaceans.

When juvenile Chinook salmon reach a length of 50 to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures. In the mainstems of larger rivers, juveniles tend to migrate along the margins and avoid the elevated water velocities found in the thalweg of the channel. When the channel of the river is greater than 9 to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Stream flow and/or turbidity increases in the upper Sacramento River basin are thought to stimulate emigration. Emigration of juvenile winter-run Chinook salmon past RBDD may begin as early as mid-July, typically peaks in September, and can continue through March in dry years (Vogel and Marine 1991, NMFS 1997). From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001). The emigration timing of Central Valley spring-run Chinook salmon is highly variable (CDFG 1998). Some fish may begin emigrating soon after emergence from the gravel, whereas others over-summer and emigrate as yearlings with the onset of intense fall storms (CDFG 1998). The emigration period for spring-run Chinook salmon extends from November to early May, with up to 69 percent of the young-of-the-year fish outmigrating through the lower Sacramento River and Delta during this period (CDFG 1998).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, the Delta, and their tributaries. In addition, Central Valley spring-run Chinook salmon juveniles have been observed rearing in the lower reaches of non-natal tributaries and intermittent streams in the Sacramento Valley during the winter months (Maslin *et al.* 1997, Snider 2001). Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960, Dunford 1975). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson *et al.* 1982, Sommer *et al.* 2001, MacFarlane and Norton 2002). Shallow water habitats are more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer *et al.* 2001). Optimal water temperatures for the growth of juvenile Chinook salmon in the Delta are between 54 °F to 57 °F (Brett 1952). In Suisun and San Pablo Bays water temperatures reach 54 °F by February in a typical year. Other portions of the Delta (*i.e.*, South Delta and Central Delta) can reach 70 °F by February in a dry year. However, cooler temperatures are usually the norm until after the spring runoff has ended.

As Chinook salmon fry and fingerlings mature, they prefer to rear further downstream where ambient salinity is up to 1.5 to 2.5 parts per thousand (Healy 1980, 1982; Levings *et al.* 1986). Juvenile winter-run Chinook salmon occur in the Delta from October through early May based on data collected from trawls, beach seines, and salvage records at the Central Valley Project (CVP) and State Water Project (SWP) pumping facilities (CDFG 1998). The peak of listed juvenile salmon arrivals in the Delta generally occurs from January to April, but may extend into June. Upon arrival in the Delta, winter-run Chinook salmon spend the first 2 months rearing in the more upstream, freshwater portions of the Delta (Kjelson *et al.* 1981, 1982). Data from the CVP and SWP salvage records indicate that most spring-run Chinook salmon smolts are present in the Delta from mid-March through mid-May depending on flow conditions (CDFG 2000).

Within the estuarine habitat, juvenile Chinook salmon movements are dictated by the tidal cycles, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levy and Northcote 1982, Levings 1982, Healey 1991). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed (Allen and Hassler 1986). In Suisun Marsh, Moyle *et al.* (1986) reported that Chinook salmon fry tend to remain close to the banks and vegetation, near protective cover, and in dead-end tidal channels. Kjelson *et al.* (1982) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to nearshore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. During the night, juveniles were distributed randomly in the water column, but would school up during the day into the upper 3 meters of the water column. Available data indicates that juvenile Chinook salmon use Suisun Marsh extensively both as a migratory pathway and rearing area as they move downstream to the Pacific Ocean. Winter-run Chinook salmon fry remain in the estuary (Delta/Bay) until they reach a fork length of about 118 mm (*i.e.*, 5 to 10 months of age) and then begin emigrating to the ocean perhaps as early as November and continuing through May (Fisher 1994, Myers *et al.* 1998). Little is known about estuarine residence time of spring-run Chinook salmon. Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (MacFarlane and Norton 2002). Based on the mainly ocean-type life history observed (*i.e.*, fall-run Chinook salmon) MacFarlane and Norton (2002) concluded that unlike other salmonid populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry. Spring-run yearlings are larger in size than fall-run yearlings and are ready to smolt upon entering the Delta; therefore, they are believed to spend little time rearing in the Delta.

b. *Population Trend – Sacramento River Winter-run Chinook Salmon*

The distribution of winter-run Chinook salmon spawning and rearing historically was limited to the upper Sacramento River and its tributaries, where spring-fed streams allowed for spawning, egg incubation, and rearing in cold water (Slater 1963, Yoshiyama *et al.* 1998). The headwaters of the McCloud, Pit, and Little Sacramento Rivers, and Hat and Battle Creeks, historically provided clean, loose gravel; cold, well-oxygenated water; and, optimal stream flows in riffle habitats for spawning and incubation. These areas also provided the cold, productive waters

necessary for egg and fry development and survival, and juvenile rearing over the summer. The construction of Shasta Dam in 1943 blocked access to all of these waters except Battle Creek, which has its own impediments to upstream migration (*i.e.*, the fish weir at the Coleman National Fish Hatchery and other small hydroelectric facilities situated upstream of the weir) (Moyle *et al.* 1989; NMFS 1997, 1998). Approximately, 299 miles of tributary spawning habitat in the upper Sacramento River is now inaccessible to winter-run Chinook salmon. Yoshiyama *et al.* (2001) estimated that in 1938, the Upper Sacramento had a "potential spawning capacity" of 14,303 redds. Most components of the winter-run Chinook salmon life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River.

Following the construction of Shasta Dam, the number of winter-run Chinook salmon initially declined but recovered during the 1960s. The initial recovery was followed by a steady decline from 1969 through the late 1980s following the construction of the RBDD. Since 1967, the estimated adult winter-run Chinook salmon population ranged from 117,808 in 1969, to 186 in 1994 (FWS 2001a, b; CDFG 2002b). The population declined from an average of 86,000 adults in 1967 to 1969 to only 1,900 in 1987 to 1989, and continued to remain low, with an average of 2,500 fish for the period from 1998 to 2000 (see Appendix B: Figure 2). Between the time Shasta Dam was built and the listing of winter-run Chinook salmon as endangered, major impacts to the population occurred from warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Delta, acid mine drainage from Iron Mountain Mine, and entrainment at a large number of unscreened or poorly-screened water diversions (NMFS 1997, 1998).

Population estimates in 2001 (8,224), 2002 (7,441), 2003 (8,218), and 2004 (7,701) show a recent increase in the escapement of winter-run Chinook salmon. The 2003 run was the highest since the listing. Winter-run Chinook salmon abundance estimates and cohort replacement rates since 1986 are shown in Table 3. The population estimates from the RBDD counts have increased since 1986 (CDFG 2004a), there is an increasing trend in the 5-year moving average (491 from 1990-1994 to 5,451 from 1999-2003); and, the 5-year moving average of cohort replacement rates has increased and appears to have stabilized over the same period (Table 3).

Table 4. Winter-run Chinook salmon population estimates from RBDD counts, and corresponding cohort replacement rates for the years since 1986 (CDFG 2004a, Grand Tab CDFG February 2005).

Year	Population Estimate (RBDD)	5-Year Moving Average of Population Estimate	Cohort Replacement Rate	5-Year Moving Average of Cohort Replacement Rate	NMFS Calculated Juvenile Production Estimate (JPE)[a]
1986	2,596	-	-	-	
1987	2,186	-	-	-	
1988	2,885	-	-	-	
1989	696	-	0.27	-	
1990	433	1,759	0.20	-	
1991	211	1,282	0.07	-	40,100
1992	1,240	1,092	1.78	-	273,100

1993	387	593	0.90	0.64	90,500
1994	186	491	0.88	0.77	74,500
1995	1,297	664	1.05	0.94	338,107
1996	1,337	889	3.45	1.61	165,069
1997	880	817	4.73	2.20	138,316
1998	3,002	1,340	2.31	2.48	454,792
1999	3,288	1,961	2.46	2.80	289,724
2000	1,352	1,972	1.54	2.90	370,221
2001	8,224	3,349	2.74	2.76	1,864,802
2002	7,441	4,661	2.26	2.22	2,136,747
2003	8,218	5,705	6.08	3.02	1,896,649
2004	7,701	6,587	0.94	2.71	881,719
2005	15,730	9,463	2.11	2.83	3,831,286
median	1,769	1,550	1.78	2.49	338,107

[a]JPE estimates were derived from NMFS calculations utilizing RBDD winter-run counts through 2001, and carcass counts thereafter for deriving adult escapement numbers.

c. *Status - Sacramento River Winter-run Chinook Salmon*

Numerous factors have contributed to the decline of winter-run Chinook salmon through degradation of spawning, rearing, and migration habitats. The primary impacts include blockage of historical habitat by Shasta and Keswick Dams, warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Delta, heavy metal contamination from Iron Mountain Mine, high ocean harvest rates, and entrainment in a large number of unscreened or poorly screened water diversions within the Central Valley. Secondary factors include smaller water manipulation facilities and dams, loss of rearing habitat in the lower Sacramento River and Delta from levee construction, marshland reclamation, and interactions with, and predation by, introduced non-native species (NMFS 1997, 1998).

Since the listing of winter-run Chinook salmon, several habitat problems that led to the decline of the species have been addressed and improved through restoration and conservation actions. The impetus for initiating restoration actions stems primarily from the following: (1) ESA section 7 consultation Reasonable and Prudent Alternatives (RPAs) on temperature, flow, and operations of the CVP and SWP; (2) Regional Board decisions requiring compliance with Sacramento River water temperatures objectives which resulted in the installation of the Shasta Temperature Control Device in 1998; (3) a 1992 amendment to the authority of the CVP through the Central Valley Project Improvement Act (CVPIA) to give fish and wildlife equal priority with other CVP objectives; (4) fiscal support of habitat improvement projects from the California Bay Delta Authority (CALFED) Bay-Delta Program (*e.g.*, installation of a fish screen on the Glenn-Colusa Irrigation District (GCID) diversion); (5) establishment of the CALFED Environmental Water Account (EWA); (6) EPA actions to control acid mine runoff from Iron Mountain Mine; and, (7) ocean harvest restrictions implemented in 1995.

The susceptibility of winter-run Chinook salmon to extinction remains linked to the elimination of access to most of their historical spawning grounds and the reduction of their population structure to a small population size. Recent trends in winter-run Chinook salmon abundance and cohort replacement are positive and may indicate some recovery since the listing. Although NMFS recently proposed that this ESU be upgraded from endangered to threatened status, it made the decision in its Final Listing Determination (June 28, 2005, 70 FR 37160) to continue to list the Sacramento River winter-run Chinook salmon ESU as endangered. This population remains below the recovery goals established for the run (NMFS 1997, 1998) and the naturally-spawned component of the ESU is dependent on one extant population in the Sacramento River. In general, the recovery criteria for winter-run Chinook salmon include a mean annual spawning abundance over any 13 consecutive years of at least 10,000 females with a concurrent geometric mean of the cohort replacement rate greater than 1.0.

d. *Population Trend – Central Valley Spring-run Chinook Salmon*

Historically, the predominant salmon run in the Central Valley was the spring-run Chinook salmon, which occupied the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit Rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). Before the construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River alone (Fry 1961). Construction of other low elevation dams in the foothills of the Sierras on the American, Mokelumne, Stanislaus, Tuolumne, and Merced Rivers extirpated Central Valley spring-run Chinook salmon from these watersheds. Naturally-spawning populations of Central Valley spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (CDFG 1998).

On the Feather River, significant numbers of spring-run Chinook salmon, as identified by run timing, return to the FRH. In 2002, the FRH reported 4,189 returning spring-run Chinook salmon, which is 22 percent below the 10-year average of 4,727 fish. However, coded-wire tag (CWT) information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run Chinook salmon populations within the Feather River system due to hatchery practices. Because Chinook salmon are not temporally separated in the hatchery, spring-run and fall-run Chinook salmon are spawned together, thus compromising the genetic integrity of the spring-run Chinook salmon stock. The number of naturally-spawning spring-run Chinook salmon in the Feather River has been estimated only periodically since the 1960s, with estimates ranging from 2 fish in 1978 to 2,908 in 1964. However, the genetic integrity of this population is questionable because of the significant temporal and spatial overlap between spawning populations of spring-run and fall-run Chinook salmon (Good *et al.* 2005). For the reasons discussed above, the Feather River spring-run Chinook population numbers are not included in the following discussion of ESU abundance.

Since 1969, the Central Valley spring-run Chinook salmon ESU (excluding Feather River fish) has displayed broad fluctuations in abundance ranging from 25,890 in 1982 to 1,403 in 1993

(CDFG unpublished data). Even though the abundance of fish may increase from one year to the next, the overall average population trend has a negative slope during this time period (see Appendix B: Figure 3). The average abundance for the ESU was 12,499 for the period of 1969 to 1979, 12,981 for the period of 1980 to 1990, and 6,542 for the period of 1991 to 2001. In 2002 and 2003, total run size for the ESU was 13,218 and 8,775 adults respectively, well above the 1991 to 2001 average.

Evaluating the ESU as a whole masks significant changes that are occurring among basin metapopulations. For example, while the mainstem Sacramento River population has undergone a significant decline, the tributary populations have demonstrated substantial increases. The average population abundance of Sacramento River mainstem spring-run Chinook salmon has recently declined from a high of 12,107 fish for the period 1980 to 1990, to a low of 609 for the period between 1991 and 2001, while the average abundance of Sacramento River tributary populations increased from a low of 1,227 to a high of 5,925 over the same period. Although tributaries such as Mill and Deer Creeks have shown positive escapement trends since 1991, recent escapements to Butte Creek, including 20,259 in 1998, 9,605 in 2001, and 8,785 in 2002, are responsible for the overall increase in tributary abundance (CDFG 2002a, 2004b; CDFG, unpublished data). The Butte Creek estimates, which account for the majority of this ESU, do not include prespawning mortality. In the last several years as the Butte Creek population has increased, mortality of adult spawners has increased from 21 percent in 2002 to 60 percent in 2003 due to over-crowding and diseases associated with high water temperatures. This trend may indicate that the population in Butte Creek may have reached its carrying capacity (Ward *et al.* 2003) or has reached historical population levels (*i.e.*, Deer and Mill creeks). Table 4 shows the population trends from the three tributaries since 1986, including the 5-year moving average, cohort replacement rate, and estimated JPE.

Table 5. Spring-run Chinook salmon population estimates from CDFG Grand Tab (February 2005) with corresponding cohort replacement rates for years since 1986.

Year	Sacramento River Basin Escapement Run Size	5-Year Moving Average of Population Estimate	Cohort Replacement Rate	5-Year Moving Average of Cohort Replacement Rate	NMFS Calculated JPE[a]
1986	24,263	-	-	-	4,396,998
1987	12,675	-	-	-	2,296,993
1988	12,100	-	-	-	2,192,790
1989	7,085	-	0.29	-	1,283,960
1990	5,790	12,383	0.46	-	1,049,277
1991	1,623	7,855	0.13	-	294,124
1992	1,547	5,629	0.22	-	280,351
1993	1,403	3,490	0.24	0.27	254,255
1994	2,546	2,582	1.57	0.52	461,392
1995	9,824	3,389	6.35	1.70	1,780,328
1996	2,701	3,604	1.93	2.06	489,482
1997	1,431	3,581	0.56	2.13	259,329
1998	24,725	8,245	2.52	2.58	4,480,722

1999	6,069	8,950	2.25	2.72	1,099,838
2000	5,457	8,077	3.81	2.21	988,930
2001	13,326	10,202	0.54	1.94	2,414,969
2002	13,218	12,559	2.18	2.26	2,395,397
2003	8,902	9,394	1.63	2.08	1,613,241
2004	9,872	10,155	0.74	1.78	1,789,027
2005	14,312	11,926	1.08	1.23	2,593,654
median	7,994	9,172	1.33	1.74	1,448,601

[a]NMFS calculated the spring-run JPE using returning adult escapement numbers to the Sacramento River basin prior to the opening of the RBDD for spring-run migration, and then escapement to Mill, Deer, and Butte Creeks for the remaining period, and assuming a female to male ratio of 6:4 and prespawning mortality of 25 percent. NMFS utilized the female fecundity values in Fisher (1994) for spring-run Chinook salmon (4,900 eggs/female). The remaining survival estimates used the winter-run values for calculating JPE.

The extent of spring-run Chinook salmon spawning in the mainstem of the upper Sacramento River is unclear. Very few spring-run Chinook salmon redds (less than 15 per year) were observed from 1989 through 1993, and none in 1994, during aerial redd counts (FWS 2003a). Recently, the number of redds in September has varied from 29 to 105 during 2001 though 2003 depending on the number of survey flights (CDFG, unpublished data). In 2002, based on RBDD ladder counts, 485 spring-run Chinook salmon adults may have spawned in the mainstem Sacramento River or entered upstream tributaries such as Clear or Battle Creek (CDFG 2004b). In 2003, no adult spring-run Chinook salmon were believed to have spawned in the mainstem Sacramento River. Due to geographic overlap of ESU and resultant hybridization since the construction of Shasta Dam, Chinook salmon that spawn in the mainstem Sacramento River during September are more likely to be identified as early fall-run rather than spring-run Chinook salmon.

e. *Status of Spring-run Chinook Salmon*

The initial factors that led to the decline of spring-run Chinook salmon in the Central Valley were related to the loss of upstream habitat behind impassable dams. Since this initial loss of habitat, other factors have contributed to the instability of the spring-run Chinook salmon population and have negatively affected the ESU's ability to recover. These factors include a combination of physical, biological, and management factors such as climatic variation, water management activities, hybridization with fall-run Chinook salmon, predation, and over-harvesting (CDFG 1998). Since spring-run Chinook salmon adults must hold over for months in small tributaries before spawning, they are much more susceptible to the effects of high water temperatures.

During the drought from 1986 to 1992, Central Valley spring-run Chinook salmon populations declined substantially. Reduced flows resulted in warm water temperatures that impacted adults, eggs, and juveniles. For adult spring-run Chinook salmon, reduced instream flows delayed or completely blocked access to holding and spawning habitats. Water management operations (*i.e.*, reservoir release schedules and volumes) and the unscreened and poorly screened diversions in the Sacramento River, Delta, and tributaries compounded drought-related problems

by reducing river flows, elevating river temperatures, and entraining juveniles into the diversions.

Several actions have been taken to improve habitat conditions for spring-run Chinook salmon, including: improved management of Central Valley water (*e.g.*, through use of CALFED EWA and CVPIA (b)(2) water accounts); implementing new and improved screen and ladder designs at major water diversions along the mainstem Sacramento River and tributaries; and, changes in ocean and inland fishing regulations to minimize harvest. Although protective measures likely have contributed to recent increases in spring-run Chinook salmon abundance, the ESU is still below levels observed from the 1960s through 1990. Threats from hatchery production (*i.e.*, competition for food between naturally-spawned and hatchery fish, run hybridization and genomic homogenization), climatic variation, high temperatures, predation, and water diversions still persist. Because the Central Valley spring-run Chinook salmon ESU is confined to relatively few remaining watersheds and continues to display broad fluctuations in abundance, the population is at a moderate risk of extinction.

2. Steelhead

a. *General Life History*

Steelhead can be divided into two life history types, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration, stream-maturing and ocean-maturing. Stream-maturing steelhead enter freshwater in a sexually immature condition and require several months to mature and spawn, whereas ocean-maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two life history types are more commonly referred to by their season of freshwater entry (*i.e.*, summer (stream-maturing) and winter (ocean-maturing) steelhead). Only winter steelhead currently are found in Central Valley rivers and streams (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento river system prior to the commencement of large-scale dam construction in the 1940s (Interagency Ecological Program [IEP] Steelhead Project Work Team 1999). At present, summer steelhead are found only in North Coast drainages, mostly in tributaries of the Eel, Klamath, and Trinity River systems (McEwan and Jackson 1996).

Winter steelhead generally leave the ocean from August through April, and spawn between December and May (Busby *et al.* 1996). Timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. In general, the preferred water temperature for adult steelhead migration is 46 °F to 52 °F (McEwan and Jackson 1996, Myrick 1998, Myrick and Cech 2000). Thermal stress may occur at temperatures beginning at 66 °F and mortality has been demonstrated at temperatures beginning at 70 °F, although some races of steelhead may have higher or lower temperature tolerances depending upon their evolutionary history. Lower latitudes and elevations would tend to favor fish tolerant of higher ambient temperatures (see Matthews and Berg (1997) for discussion of *O. mykiss* from Sespe Creek in Southern California). The preferred water temperature for steelhead spawning is 39 °F to 52 °F, and the preferred water temperature for steelhead egg incubation is 48 °F to 52 °F (McEwan and Jackson 1996, Myrick 1998, Myrick and Cech 2000). The

minimum stream depth necessary for successful upstream migration is 13 cm (Thompson 1972). Preferred water velocity for upstream migration is in the range of 40-90 cm/s, with a maximum velocity, beyond which upstream migration is not likely to occur, of 240 cm/s (Thompson 1972, Smith 1973).

Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Nickelson *et al.* 1992, Busby *et al.* 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Most steelhead spawning takes place from late December through April, with peaks from January though March (Hallock *et al.* 1961). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity, and may spawn in intermittent streams as well (Everest 1973, Barnhart 1986).

The length of the incubation period for steelhead eggs is dependent on water temperature, DO concentration, and substrate composition. In late spring, following yolk sac absorption, fry emerge from the gravel and actively begin feeding in shallow water along stream banks (Nickelson *et al.* 1992).

Steelhead rearing during the summer takes place primarily in higher velocity areas in pools, although young-of-the-year also are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody debris. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Shirvell 1990, Meehan and Bjornn 1991). Some older juveniles move downstream to rear in large tributaries and mainstem rivers (Nickelson *et al.* 1992). Juveniles feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and older juveniles sometimes prey upon emerging fry.

Steelhead generally spend 2 years in freshwater before emigrating downstream (Hallock *et al.* 1961, Hallock 1989). Rearing steelhead juveniles prefer water temperatures of 45 °F to 58 °F and have an upper lethal limit of 75 °F. They can survive up to 81 °F with saturated DO conditions and a plentiful food supply. Reiser and Bjornn (1979) recommended that DO concentrations remain at or near saturation levels with temporary reductions no lower than 5.0 mg/l for successful rearing of juvenile steelhead. During rearing, suspended and deposited fine sediments can directly affect salmonids by abrading and clogging gills, and indirectly cause reduced feeding, avoidance reactions, destruction of food supplies, reduced egg and alevin survival, and changed rearing habitat (Reiser and Bjornn 1979). Bell (1973) found that silt loads of less than 25 mg/l permit good rearing conditions for juvenile salmonids.

Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows. Emigrating Central Valley steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Some may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas

for short periods prior to their final emigration to the sea. Barnhart (1986) reported that steelhead smolts in California range in size from 140 to 210 mm (fork length). Hallock *et al.* (1961) found that juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall.

b. *Population Trend – Central Valley Steelhead*

Steelhead historically were well-distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al.* 1996). Steelhead were found from the upper Sacramento and Pit River systems (now inaccessable due to Shasta and Keswick Dams) south to the Kings and possibly the Kern River systems (now inaccessible due to extensive alterations from numerous water diversion projects) and in both east and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles currently. Historically, steelhead probably ascended Clear Creek past the French Gulch area, but access to the upper basin was blocked by Whiskeytown Dam in 1964 (Yoshiyama *et al.* 1996).

Historic Central Valley steelhead run sizes are difficult to estimate given the paucity of data, but may have approached 1 to 2 million adults annually (McEwan 2001). By the early 1960s the steelhead run size had declined to about 40,000 adults (McEwan 2001). Over the past 30 years, the naturally-spawned steelhead populations in the upper Sacramento River have declined substantially (see Appendix B: Figure 4). Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River. Steelhead counts at the RBDD declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations.

Nobriga and Cadrett (2003) compared CWT and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998 through 2001 to estimate that about 100,000 to 300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the draft *Updated Status Review of West Coast Salmon and Steelhead* (NMFS 2003), the Biological Review Team (BRT) made the following conclusion based on the Chipps Island data:

> "If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s".

The only consistent data available on steelhead numbers in the San Joaquin River basin come from CDFG mid-water trawling samples collected on the lower San Joaquin River at Mossdale.

These data (see Appendix B, Figure 5) indicate a decline in steelhead numbers in the early 1990s, which have remained low through 2002 (CDFG 2003). In 2003, a total of 12 steelhead smolts were collected at Mossdale (CDFG, unpublished data).

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996).

Recent snorkel surveys (1999 to 2002) indicate that steelhead are present in Clear Creek (J. Newton, FWS, pers. comm. 2002, as reported in Good *et al.* 2005). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Until recently, steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self-sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, and other streams previously thought to be devoid of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (Demko *et al.* 2000). After 3 years of operating a fish counting weir on the Stanislaus River only two adult steelhead have been observed moving upstream, although several large rainbow trout (*O. mykiss*) have washed up on the weir in late winter (S.P. Cramer 2005). It is possible that naturally-spawning populations exist in many other streams but are undetected due to lack of monitoring programs (IEP Steelhead Project Work Team 1999). Incidental catches and observations of steelhead juveniles also have occurred on the Tuolumne and Merced Rivers during fall-run Chinook salmon monitoring activities, indicating that steelhead are widespread, if not abundant, throughout accessible streams and rivers in the Central Valley (Good *et al.* 2005).

c. *Status - Central Valley Steelhead*

Both the BRT (Good *et al.* 2005) and the Artificial Propagation Evaluation Workshop (69 FR 33102) concluded that the Central Valley steelhead DPS presently is "in danger of extinction". Steelhead have been extirpated from most of their historical range in this region. Habitat concerns in this DPS focus on the widespread degradation, destruction, and blockage of freshwater habitat within the region, and water allocation problems. Widespread hatchery steelhead production within this DPS also raises concerns about the potential ecological interactions between introduced stocks and native stocks. Because the Central Valley steelhead population has been fragmented into smaller isolated tributaries without any large source population and the remaining habitat continues to be degraded by water diversions, the population remains at an elevated risk for future population declines.

3. Southern Distinct Population Segment of North American Green Sturgeon

a. *General Life History*

(1) ***Adult Distribution and Feeding***. In North America, spawning populations of the anadromous green sturgeon currently are found in only three river systems, the Sacramento and

Klamath Rivers in California and the Rogue River in southern Oregon. Spawning has only been reported in one Asian river, the Tumin River in eastern Asia. Green sturgeon are known to range from Baja California to the Bering Sea along the North American continental shelf. Data from commercial trawl fisheries and tagging studies indicate that the green sturgeon occupy waters within the 110 meter contour (NMFS 2005a). During the late summer and early fall, subadults and nonspawning adult green sturgeon frequently can be found aggregating in estuaries along the Pacific coast (Emmett *et al.* 1991). Particularly large concentrations occur in the Columbia River estuary, Willapa Bay, and Grays Harbor, with smaller aggregations in San Francisco and San Pablo Bays (Emmett *et* al 1991, Moyle *et al.* 1992, Beamesderfer *et al.* 2004). Recent acoustical tagging studies on the Rogue River (Erickson *et al.* 2002) have shown that adult green sturgeon will hold for as long as 6 months in deep (> 5m), low gradient reaches, off channel sloughs or coves of the river during summer months when water temperatures were between 15 °C and 23 °C. When ambient temperatures in the river dropped in autumn and early winter (< 10 °C) and flows increased, fish moved downstream and into the ocean.

Adult green sturgeon are believed to feed primarily upon benthic invertebrates such as clams, mysid and grass shrimp, and amphipods (Radtke 1966, J. Stuart, NMFS, pers. obs., unpublished data). Adult sturgeon caught in Washington state waters were found to have fed on Pacific sand lance (*Ammodytes hexapterus*) and callianassid shrimp (Moyle *et al.* 1992).

(2) ***Spawning***. Adult green sturgeon are believed to spawn every 3 to 5 years and reach sexual maturity only after several years of growth (10 to 15 years based on sympatric white sturgeon (*A. transmontanus*) sexual maturity). Adult female green sturgeon produce between 60,000 and 140,000 eggs, depending on body size, with a mean egg diameter of 4.3 mm (Moyle *et al.* 1992, Van Eenennaam *et al.* 2001). They have the largest egg size of any sturgeon, and the volume of yolk ensures an ample supply of energy for the developing embryo. The eggs are less adhesive and more dense than than those of white sturgeon (Kynard *et al.* 2005). Green sturgeon adults begin their upstream spawning migrations into freshwater in late February with spawning occuring between March and July. Peak spawning is believed to occur between April and June in deep, turbulent, mainstem channels over large cobble and rocky substrates with crevices and interstices. Females broadcast spawn their eggs over this substrate, and the fertilized eggs sink into the interstices of the substrate where they develop further (Kynard *et al.* 2005).

(3) ***Egg Development.*** Green sturgeon larvae hatched from fertilized eggs after approximately 169 hours at a water temperature of 15 °C (Van Eenennaam *et al.* 2001, Deng *et al.* 2002), which is similar to the sympatric white sturgeon development rate (176 hours). Van Eenennaam *et al.* (2005) indicated that an optimum range of water temperature for egg development ranged between 14 °C and 17 °C. Temperatures over 23 °C resulted in 100 percent mortality of fertilized eggs before hatching. Eggs incubated at water temperatures between 17.5 °C and 22 °C resulted in elevated mortalities and an increased occurrence of morphological abnormalities in those eggs that did hatch. At incubation temperatures below 14 °C, hatching mortality also increased significantly, and morphological abnormalities increased slightly, but not statistically so.

(4) ***Early Development.*** Newly hatched green sturgeon are approximately 12.5 to 14.5 mm in length and have a large ovoid yolk sac that supplies nutritional energy until exogenous feeding

occurs. The larvae are less developed in their morphology than older juveniles and external morphology resembles a "tadpole" with a continuous fin fold on both the dorsal and ventral sides of the caudal trunk. The eyes are well developed with differentiated lenses and pigmentation. Olfactory and auditory vesicles are present while the mouth and respiratory structures are only shallow clefts on the head. At 10 days of age, the yolk sac has become greatly reduced in size and the larvae initiates exogenous feeding through a functional mouth. The fin folds have become more developed and formation of fin rays begins to occur in all fin tissues. By 45 days of age, the green sturgeon larvae have completed their metamorphosis, which is characterized by the development of dorsal, lateral, and ventral scutes, elongation of the barbels, rostrum, and caudal peduncle, reabsorption of the caudal and ventral fin folds, and the development of fin rays. The juvenile fish resembles the adult form, including the dark olive coloring, with a dark mid-ventral stripe (Deng *et al.* 2002).

Green sturgeon larvae do not exhibit the initial pelagic swim-up behavior characteristic of other *Acipenseridae*. They are strongly oriented to the bottom and exhibit nocturnal activity patterns. After 6 days, the larvae exhibit nocturnal swim-up activity (Deng *et al.* 2002) and nocturnal downstream migrational movements (Kynard *et al.* 2005). Juvenile fish continue to exhibit nocturnal behavioral beyond the metamorphosis from larvae to juvenile stages. Kynard *et al.*'s (2005) laboratory studies indicated that juvenile fish continued to migrate downstream at night for the first 6 months of life. When ambient water temperatures reached 8 °C, downstream migrational behavior diminished and holding behavior increased. This data suggests that 9- to 10- month old fish would hold over in their natal rivers during the ensuing winter following hatching, but at a location downstream of their spawning grounds.

Green sturgeon juveniles tested under laboratory conditions had optimal bioenergetic performance (*i.e.*, growth, food conversion, swimming ability) between 15 °C and 19 °C under either full or reduced rations (Mayfield and Cech 2004). This temperature range overlaps the egg incubation temperature range for peak hatching success previously discussed. Ambient water temperature conditions in the Rogue and Klamath River systems range from 4 °C to approximately 24 °C. The Sacramento River has similar temperature profiles, and, like the Rogue and Klamath Rivers, is a regulated system with several dams controlling flows on its mainstem (Shasta and Keswick Dams), and its tributaries (Whiskeytown, Oroville, Folsom, and Nimbus Dams).

Larval and juvenile green sturgeon are subject to predation by both native and introduced fish species. Smallmouth bass (*Micropterus dolomieui*) have been recorded on the Rogue River as preying on juvenile green sturgeon, and prickly sculpin (*Cottus asper*) have been shown to be an effective predator on the larvae of sympatric white sturgeon (Gadomski and Parsley 2005). This latter study also indicated that the lowered turbidity found in tailwater streams and rivers due to dams increased the effectiveness of sculpin predation on sturgeon larvae under laboratory conditions.

b. *Population Trend –Southern Distinct Population Segment of North American Green Sturgeon*

Based on the distribution of sturgeon eggs, larvae, and juveniles the in the Sacramento River, CDFG (2002c) indicated that southern DPS of green sturgeon spawn in late-spring and early-

summer above Hamilton City possibly to Keswick Dam. Young green sturgeon appear to rear for the first 1 to 2 months in the Sacramento River between Keswick Dam and Hamilton City (CDFG 2002c). Juvenile green sturgeon first appear in FWS sampling efforts at RBDD in June and July at lengths ranging in fork length from 24 to 31 mm (CDFG 2002c). Sampling efforts at Glen Colusa Irrigation District on the Sacramento River yield green sturgeons averaging approximately 29 mm in length with a peak abundance occurring in July (Adams *et al.* 2002). Since 1980, trawling studies in the San Francisco Bay estuary and Delta have taken a total of 61 juvenile green sturgeon ranging in size from 20 to 112 cm total length and although most juveniles are captured between April and October, they have been captured in nearly every month of the year (CDFG 2002c, IEP Relational Database search May 31, 2005). Juveniles spend between 1 and 4 years in fresh and estuarine waters and enter the marine environment at lengths of approximately 300 mm (Adams *et al.* 2002).

Spawning in the Feather River is suspected to have occurred in the past due to the continued presence of adult green sturgeon in the river below Oroville Dam. This continued presence of adults below the dam suggests that fish are trying to migrate upstream to spawning areas now blocked by the dam, which was constructed in 1968. Due to the extreme longevity of green sturgeon (and sturgeon in general), it is possible that these adults represent adults which have previously spawned in the Feather River system prior to the construction of the dam.

Spawning in the San Joaquin River system has not been recorded, but alterations of the San Joaquin River tributaries (Stanislaus, Tuolumne, and Merced Rivers) and its mainstem occurred early in the European settlement of the region. During the later half of the 1800s impassable barriers were built on these tributaries where the water courses left the foothills and entered the valley floor. Therefore, these low elevation dams have blocked potentially suitable spawning habitats located further upstream for over a century. Additional destruction of riparian and stream channel habitat by industrialized gold dredging further disturbed any valley floor habitat that was still available for sturgeon spawning. It is likely that both white and green sturgeon utilized the San Joaquin River basin for spawning prior to the onset of European influence, based on past use of the region by populations of Central Valley spring-run Chinook salmon and Central Valley steelhead. These two populations of salmonids have either been extirpated or greatly diminished in their use of the San Joaquin River basin over the past two centuries.

Population abundance information concerning the southern DPS of North American green sturgeon is scant as described in the status review (Adams 2002). Limited population abundance information comes from incidental captures of green sturgeon from the white sturgeon monitoring program by the CDFG sturgeon tagging program (CDFG 2002c). CDFG (2002c) utilizes a multiple-census or Peterson mark-recapture method to estimate the legal population of white sturgeon captures in trammel nets. By comparing ratios of white sturgeon to green sturgeon captures, CDFG provides estimates of adult and sub-adult green sturgeon abundance. Estimated abundance between 1954 and 2001 ranged from 175 fish to more than 8,000 per year and averaged 1,509 fish per year. Unfortunately, there are many biases and errors associated with these data, and CDFG does not consider these estimates reliable. Fish monitoring efforts at RBDD and GCID on the upper Sacramento River have captured between 0 and 2,068 juvenile green sturgeon per year, mostly between June and July (Adams 2002). The only existing information regarding changes in the abundance of the southern DPS of green sturgeon includes

changes in their abundance at the John Skinner Fish Protection Facility between 1968 and 2001 (SWP facility). The estimated number of green sturgeon taken at the SWP facility prior to 1986 was 732; since 1986, the average number has dropped to 47 (70 FR 17386). For the Tracy Fish Collection Facility (CVP facility), the average number prior to 1986 was 889; from 1986 to 2001 the average has dropped to 32 (70 FR 17386). In light of the increased volume of water exports, particularly during the previous 10 years, it is apparent that green sturgeon population abundance is dropping. Catches of sub-adult and adult green sturgeon by the IEP between 1996 and 2004 ranged from 1 to 212 green sturgeon per year (212 occurred in 2001), however, the proportion of the southern DPS of North American green sturgeon is unknown due to the comingling of the Northern and Southern population segments in San Pablo Bay. Additional analysis of green and white sturgeon taken at the SWP and CVP facilities indicates that take of both green and white sturgeon per acre-foot of water exported has decreased substantially since the 1960s (70 FR 17386).

c. *Status –Southern Distinct Population Segment of North American Green Sturgeon*

The southern DPS of North American green sturgeon historically was smaller than the sympatric population of white sturgeon in the San Francisco Bay estuary and its associated tributaries. The population has apparently been declining over the past several decades based on harvest numbers from sport and commercial fisheries and the entrainment rates at the CVP and SWP. The principle factor for this decline is the reduction of green sturgeon spawning habitat to a limited area below Keswick Dam on the Sacramento River. The construction of impassable barriers, particularly large dams, has greatly reduced the access of green sturgeon to their historical spawning areas. Reduced flows have corresponded with weakened year class recruitment in the sympatric white sturgeon population and it is believed to have the same effect upon green sturgeon recruitment. In addition to the adverse effects of impassable barriers, numerous agricultural water diversions exist in the Sacramento River and the Delta along the migratory route of larval and juvenile sturgeon. Entrainment, or, if equipped with a fish screen, impingement are considered serious threats to sturgeon during their downstream migration. Fish screens have not been designed with criteria that address sturgeon behavior or swimming capabilities. The benthic oriented sturgeon are also more susceptible to contaminated sediments through dermal contact and through their feeding behavior of ingesting prey along with contaminated sediments before winnowing out the sediment. Their long life spans allow them to accumulate high body burdens of contaminants, that potentially will reach concentrations with deleterious physiological effects. All of the above threats have been identified by the BRT as potentially affecting the continued existence of the southern DPS of North American green strurgeon (70 FR 17386).

C. Factors Affecting the Species and Critical Habitat

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley. For example, NMFS prepared range-wide status reviews for West coast Chinook salmon (Myers *et al.* 1998), steelhead (Busby *et al.* 1996) and green sturgeon (Adams *et al.* 2002, NMFS 2005a). Also, the NMFS BRT published a draft updated status review for West coast Chinook salmon and steelhead in November 2003 (NMFS 2003) and a final review in June 2005 (Good *et*

al. 2005). Information also is available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (*e.g.*, 58 FR 33212, 59 FR 440, 62 FR 24588, 62 FR 43937, 63 FR 13347, 64 FR 24049, 64 FR 50394, 65 FR 7764). The Final Programmatic Environmental Impact Statement/Report (EIS/EIR) for the CALFED Bay-Delta Program (CALFED 1999), and the Final Programmatic EIS for the CVPIA (Department of Interior (DOI) 1999), provide an excellent summary of historical and recent environmental conditions for salmon and steelhead in the Central Valley.

The following general description of the factors affecting Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, the southern DPS of North American green sturgeon, and their habitat is based on a summary of these documents.

In general, the human activities that have affected listed anadromous salmonids, proposed North American green sturgeon, or their habitats consist of: (1) dam construction that blocks previously accessible habitat; (2) water development and management activities that affect water quantity, flow timing, quality, and stream function; (3) land use activities such as agriculture, flood control, urban development, mining, road construction, and logging that degrade aquatic and riparian habitat; (4) hatchery operation and practices; (5) harvest activities; and, (6) ecosystem restoration actions.

1. Habitat Blockage

Hydropower, flood control, and water supply dams of the CVP, SWP, and other municipal and private entities permanently have blocked or hindered salmonid access to historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 linear miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 linear miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today.

In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and the Delta block salmon and steelhead access to the upper portions of their respective watersheds. On the Sacramento River, Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud, and Pit Rivers. Whiskeytown Dam blocks access to the upper watershed of Clear Creek. Oroville Dam and associated facilities block passage to the upper Feather River watershed. Nimbus Dam blocks access to most of the American River basin. Friant Dam construction in the mid-1940s has been associated with the elimination of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River (Department of Interior [DOI] 1999). On the Stanislaus River, construction of Goodwin Dam (1912), Tulloch Dam (1957), and New Melones Dam (1979) blocked both spring- and fall-run Chinook salmon (CDFG 2001) as well as Central Valley steelhead. Similarly, La Grange Dam (1893) and New Don Pedro Dam (1971) blocked upstream access to salmonids on the Tuolumne River. Upstream migration on the Merced River was blocked in 1910 by the construction of Merced Falls and Crocker-Huffman Dams and later New Exchequer Dam (1967) and McSwain Dam (1967). These dams also had the potential to block any spawning populations of green sturgeon in these tributaries.

As a result of the dams, winter-run Chinook salmon, spring-run Chinook salmon, and steelhead populations on these rivers have been confined to lower elevation mainstems that historically only were used for migration. Population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat. Higher temperatures at these lower elevations during late-summer and fall are a major stressor to adults and juvenile salmonids. Green sturgeon populations would be similarly affected by these barriers and alterations to the natural hydrology.

The Suisun Marsh Salinity Control Gates (SMSCG), located on Montezuma Slough, were installed in 1988, and are operated with gates and flashboards to decrease the salinity levels of managed wetlands in Suisun Marsh. The SMSCG have delayed or blocked passage of adult Chinook salmon migrating upstream (Edwards *et al.* 1996, Tillman *et al.* 1996, California Department of Water Resources (DWR) 2002). The effects of the SMSCG on sturgeon are unknown at this time.

2. Water Development

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted streamflows and altered the natural cycles by which juvenile and adult salmonids base their migrations. As much as 60 percent of the natural historical inflow to Central Valley watersheds and the Delta has been diverted for human uses. Depleted flows have contributed to higher temperatures, lower DO levels, and decreased recruitment of gravel and large woody debris (LWD). More uniform flows year-round have resulted in diminished natural channel formation, altered foodweb processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement (Mount 1995, Ayers 2001), caused spawning gravels to become embedded, and decreased channel widths due to channel incision, all of which has decreased the available spawning and rearing habitat below dams.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Hundreds of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, and their tributaries. Although efforts have been made in recent years to screen some of these diversions, many remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile salmonids. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). Most of the 370 water diversions operating in Suisun Marsh are unscreened (FWS 2003b).

Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmonid survival has been reduced by the following: (1) water diversion from the mainstem Sacramento River into the Central Delta via the Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay; and, (4) increased exposure to introduced, non-native predators such as striped bass (*Morone saxatilis*), largemouth bass

(*Micropterus salmoides*), and sunfishes (*Centrarchidae* spp.). Entrainment of green sturgeon at the CVP/SWP export facility is known to occur as well.

3. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley watershed. Until about 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for 4 or 5 miles (California Resources Agency 1989). By 1979, riparian habitat along the Sacramento River diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The degradation and fragmentation of riparian habitat had resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture. Removal of snags and driftwood in the Sacramento and San Joaquin River basins has reduced sources of LWD needed to form and maintain stream habitat that salmon depend on for various life stages.

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation (NMFS 1996). Sedimentation can adversely affect salmonids during all freshwater life stages by: clogging or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961), burying eggs or alevins, scouring and filling in pools and riffles, reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affecting intergravel permeability and DO levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through the alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and, removal of riparian vegetation, resulting in increased streambank erosion (Meehan 1991). Urban stormwater and agricultural runoff may be contaminated with herbicides and pesticides, petroleum products, sediment, *etc.* Agricultural practices in the Central Valley have eliminated large trees and logs and other woody debris that would otherwise be recruited into the stream channel (NMFS 1998). LWD influences stream morphology by affecting channel pattern, position, and geometry, as well as pool formation (Keller and Swanson 1979, Bilby 1984, Robison and Beschta 1990).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipps Island, respectively (Conomos *et al.* 1985, Nichols *et al.* 1986, Wright and Phillips 1988, Monroe *et al.* 1992, Goals Project 1999). Prior to 1850, approximately 1400 km^2 of freshwater marsh surrounded the confluence of the Sacramento and San Joaquin Rivers, and another 800 km^2 of saltwater marsh fringed San Francisco Bay's margins. Of the original 2,200 km^2 of tidally influenced marsh, only about 125 km^2 of undiked marsh remains today. In Suisun Marsh, saltwater intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for

duck clubs, which first were established in the 1870s in western Suisun Marsh (Goals Project 1999).

Dredging of river channels to enhance inland maritime trade and to provide raw material for levee construction has significantly and detrimentally altered the natural hydrology and function of the river systems in the Central Valley.

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by DWR on water quality in the Delta over the last 30 years have shown a steady decline in the food sources available for juvenile salmonids and sturgeon and an increase in the clarity of the water due to a decline in the phytoplankton and zooplankton abundance. These conditions have contributed to increased mortality of juvenile Chinook salmon, steelhead, and sturgeon as they move through the Delta.

4. Water Quality

The water quality of the Delta has been negatively impacted over the last 150 years. Increased water temperatures, decreased DO levels, and increased turbidity and contaminant loads have degraded the quality of the aquatic habitat for the rearing and migration of salmonids. The Regional Board, in its 1998 Clean Water Act §303(d) list characterized the Delta as an impaired waterbody having elevated levels of chlorpyrifos, dichlorodiphenyltrichlor (*i.e.* DDT), diazinon, electrical conductivity, Group A pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane (including lindane), endosulfan and toxaphene), mercury, low DO, organic enrichment, and unknown toxicities (Regional Board 1998, 2001).

In general, water degradation or contamination can lead to either acute toxicity, resulting in death when concentrations are sufficiently elevated, or more typically, when concentrations are lower, to chronic or sublethal effects that reduce the physical health of the organism, and lessens its survival over an extended period of time. Mortality may become a secondary effect due to compromised physiology or behavioral changes that lessen the organism's ability to carry out its normal activities. For example, increased levels of heavy metals are detrimental to the health of an organism because they: interfere with metabolic functions by inhibiting key enzyme activity in metabolic pathways; decrease neurological function; degrade cardiovascular output; and act as mutagens, teratogens or carcinogens in exposed organisms (Rand *et al.* 1995, Goyer 1996). For listed species, these effects may occur directly to the listed fish or to its prey base, which reduces the forage base available to the listed species.

Sediments can either act as a sink or as a source of contamination depending on hydrological conditions and the type of habitat the sediment occurs in. Sediment provides habitat for many aquatic organisms and is a major repository for many of the more persistent chemicals that are introduced into the surface waters. In the aquatic environment, most anthropogenic chemicals and waste materials including toxic organic and inorganic chemicals eventually accumulate in sediment (Ingersoll 1995).

Direct exposure to contaminated sediments may cause deleterious effects to listed salmonids or the proposed threatened green sturgeon. This may occur if a fish swims through a plume of the resuspended sediments or rests on contaminated substrate and absorbs the toxic compounds through one of several routes: dermal contact, ingestion, or uptake across the gills. Elevated contaminant levels may be found in localized "hot spots" where discharge occurs or where river currents deposit sediment loads. Sediment contaminant levels can thus be significantly higher than the overlying water column concentrations (EPA 1994). However, the more likely route of exposure to salmonids or sturgeon is through the food chain, when the fish feed on organisms that are contaminated with toxic compounds. Prey species become contaminated either by feeding on the detritus associated with the sediments or dwelling in the sediment itself. Therefore, the degree of exposure to the salmonids depends on their trophic level and the amount of contaminated forage base they consume. Response of salmonids to contaminated sediments is similar to water borne exposures.

5. Hatchery Operations and Practices

Five hatcheries currently produce Chinook salmon in the Central Valley and four of these also produce steelhead. Releasing large numbers of hatchery fish can pose a threat to wild Chinook salmon and steelhead stocks through genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels (DOI 1999). For example, Nimbus Hatchery on the American River rears Eel River steelhead stock and releases these fish in the Sacramento River basin. One of the recommendations in the Joint Hatchery Review Report (NMFS and CDFG 2001) was to identify and designate new sources of steelhead brood stock to replace the current Eel River origin brood stock.

Hatchery practices as well as spatial and temporal overlaps of habitat use and spawning activity between spring- and fall-run fish have led to the hybridization and homogenization of some subpopulations (CDFG 1998). As early as the 1960s, Slater (1963) observed that early fall- and spring-run Chinook salmon were competing for spawning sites in the Sacramento River below Keswick Dam, and speculated that the two runs may have hybridized. The FRH spring-run Chinook salmon have been documented as straying throughout the Central Valley for many years (CDFG 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon, an indication that FRH spring-run Chinook salmon may exhibit fall-run life history characteristics. Although the degree of hybridization has not been comprehensively determined, it is clear that the populations of spring-run Chinook salmon spawning in the Feather River and counted at RBDD contain hybridized fish.

The management of hatcheries, such as Nimbus Hatchery and FRH, can directly impact spring-run Chinook salmon and steelhead populations by oversaturating the natural carrying capacity of the limited habitat available below dams. In the case of the Feather River, significant redd superimposition occurs in-river due to hatchery overproduction and the inability to physically

separate spring- and fall-run Chinook salmon adults. This concurrent spawning has led to hybridization between the spring- and fall-run Chinook salmon in the Feather River. At Nimbus Hatchery, operating Folsom Dam to meet temperature requirements for returning hatchery fall-run Chinook salmon often limits the amount if water available for steelhead spawning and rearing the rest of the year.

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally produced fish in the 1950s (McEwan 2001) to an estimated 23 to 37 percent naturally produced fish currently (Nobriga and Cadrett 2001). The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NMFS and CDFG 2001). Thus, the ability of natural populations to successfully reproduce and continue their genetic integrity likely has been diminished.

The relatively low number of spawners needed to sustain a hatchery population can result in high harvest-to-escapements ratios in waters where fishing regulations are set according to hatchery population. This can lead to over-exploitation and reduction in the size of wild populations existing in the same system as hatchery populations due to incidental bycatch (McEwan 2001).

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown to be effective in bolstering the numbers of naturally spawning fish in the short term under specific scenarios, artificial propagation programs can also aid in conserving genetic resources and guarding against catastrophic loss of naturally-spawned populations at critically low abundance levels, as was the case with the Sacramento River winter-run Chinook salmon population during the 1990s. However, relative abundance is only one component of a viable salmonid population.

6. Commercial and Sport Harvest

a. *Ocean Harvest*

(1) ***Chinook salmon.*** Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon and steelhead. Ocean harvest of Central Valley Chinook salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement. CWT returns indicate that Sacramento River salmon congregate off the California coast between Point Arena and Morro Bay.

Since 1970, the CVI for winter-run Chinook salmon generally has ranged between 0.50 and 0.80. In 1990, when ocean harvest of winter-run Chinook salmon was first evaluated by NMFS and the Pacific Fisheries Management Council (PFMC), the CVI harvest rate was near the highest recorded level at 0.79. NMFS determined in a 1991 biological opinion that continuance of the 1990 ocean harvest rate would not prevent the recovery of winter-run Chinook salmon. Through the early 1990s, the ocean harvest index was below the 1990 level (*i.e.*, 0.71 in 1991 and 1992, 0.72 in 1993, 0.74 in 1994, 0.78 in 1995, and 0.64 in 1996). In 1996 and 1997, NMFS issued a

biological opinion which concluded that incidental ocean harvest of winter-run Chinook salmon represented a significant source of mortality to the endangered population, even though ocean harvest was not a key factor leading to the decline of the population. As a result of these opinions, measures were developed and implemented by the PFMC, NMFS, and CDFG to reduce ocean harvest by approximately 50 percent.

Ocean fisheries have affected the age structure of spring-run Chinook salmon through targeting large fish for many years and reducing the numbers of 4- and 5-year-old fish (CDFG 1998). There are limited data on spring-run Chinook salmon ocean harvest rates. An analysis of 6 tagged groups of FRH spring-run Chinook salmon by Cramer and Demko (1997) indicated that harvest rates of 3-year-old fish ranged from 18 percent to 22 percent, 4-year-old fish ranged from 57 percent to 84 percent, and 5-year-olds ranged from 97 percent to 100 percent. The almost complete removal of 5-year-olds from the population effectively reduces the age structure of the species, which reduces its resiliency to factors that may impact a particular year class (*e.g.*, prespawning mortality from lethal instream water temperatures).

(2) *Steelhead.* There is essentially no ocean harvest of steelhead.

(3) *Green sturgeon.* Ocean harvest for green sturgeon occurs primarily along the Oregon and Washington coasts and within their coastal estuaries. A commercial fishery for sturgeon still exists within the Columbia River, where they are caught in gill nets along with the more commercially valuable white sturgeon. Green sturgeon are also caught by recreational fisherman, and it is the primary bottomfish landed in Willapa Bay. Within the San Francisco Bay estuary, green sturgeon are captured by sport fisherman targeting the more desirable white sturgeon, particularly in San Pablo and Suisun Bays (Emmett *et al.* 1991).

b. *Freshwater Sport Harvest*

(1) *Chinook salmon.* Historically in California, almost half of the river sportfishing effort was in the Sacramento-San Joaquin River system, particularly upstream from the city of Sacramento (Emmett *et al.* 1991). Since 1987, the Fish and Game Commission has adopted increasingly stringent regulations to reduce and virtually eliminate the in-river sport fishery for winter-run Chinook salmon. Present regulations include a year-round closure to Chinook salmon fishing between Keswick Dam and the Deschutes Road Bridge and a rolling closure to Chinook salmon fishing on the Sacramento River between the Deschutes River Bridge and the Carquinez Bridge. The rolling closure spans the months that migrating adult winter-run Chinook salmon are ascending the Sacramento River to their spawning grounds. These closures have virtually eliminated impacts on winter-run Chinook salmon caused by recreational angling in freshwater.

In 1992, the California Fish and Game Commission adopted gear restrictions (all hooks must be barbless and a maximum of 5.7 cm in length) to minimize hooking injury and mortality of winter-run Chinook salmon caused by trout anglers. That same year, the Commission also adopted regulations which prohibited any salmon from being removed from the water to further reduce the potential for injury and mortality.

In-river recreational fisheries historically have taken spring-run Chinook salmon throughout the species' range. During the summer, holding adult spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown. Specific regulations for the protection of spring-run Chinook salmon in Mill, Deer, Butte, and Big Chico creeks were added to the existing CDFG regulations in 1994. The current regulations, including those developed for winter-run Chinook salmon, provide some level of protection for spring-run fish (CDFG 1998).

(2) *Steelhead*. There is little information on steelhead harvest rates in California. Hallock *et al.* (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-1954 through 1958-1959 seasons ranged from 25.1 percent to 45.6 percent assuming a 20 percent non-return rate of tags. Staley (1975) estimated the harvest rate in the American River during the 1971-1972 and 1973-1974 seasons to be 27 percent. The average annual harvest rate of adult steelhead above RBDD for the 3-year period from 1991-1992 through 1993-1994 was 16 percent (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose fin clip allowing anglers to distinguish hatchery and wild steelhead. Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams (CDFG 2004c). Overall, this regulation has greatly increased protection of naturally produced adult steelhead.

(3) *Green sturgeon.* Green sturgeon are caught incidentally by sport fisherman targeting the more highly desired white sturgeon within the Delta waterways and the Sacramento River. Due to slot limits imposed on the sport fishery by the CDFG, only sturgeon between 46 and 72 inches may be retained by sport fisherman with a daily bag limit of 1 fish in possession. This protects both fish that are sexually immature and have not yet had an opportunity to spawn, and those larger females that have the greatest reproductive value to the population.

7. Predation

Accelerated predation also may be a factor in the decline of winter-run Chinook salmon and spring-run Chinook salmon, and to a lesser degree steelhead. Human-induced habitat changes such as alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile salmonids and attract predators (Stevens 1961, Decato 1978, Vogel *et al.* 1988, Garcia 1989).

On the mainstem Sacramento River, high rates of predation are known to occur at the RBDD, Anderson Cottonwood Irrigation District's diversion dam, GCID's diversion dam, areas where rock revetment has replaced natural riverbank vegetation, and at south Delta water diversion structures (*e.*g., Clifton Court Forebay; CDFG 1998). Predation at RBDD on juvenile winter-run Chinook salmon is believed to be higher than normal due to factors such as water quality and flow dynamics associated with the operation of this structure. Due to their small size, early emigrating winter-run Chinook salmon may be very susceptible to predation in Lake Red Bluff when the RBDD gates remain closed in summer and early fall (Vogel *et al.* 1988). In passing the dam, juveniles are subject to conditions which greatly disorient them, making them highly

susceptible to predation by fish or birds. Sacramento pikeminnow (*Ptychocheilus grandis*) and striped bass congregate below the dam and prey on juvenile salmon in the tail waters.

FWS found that more predatory fish were found at rock revetment bank protection sites between Chico Landing and Red Bluff than at sites with naturally eroding banks (Michny and Hampton 1984). From October 1976 to November 1993, CDFG conducted 10 mark/recapture studies at the SWP's Clifton Court Forebay to estimate pre-screen losses using hatchery-reared juvenile Chinook salmon. Pre-screen losses ranged from 69 percent to 99 percent. Predation by striped bass is thought to be the primary cause of the loss (Gingras 1997).

Other locations in the Central Valley where predation is of concern include flood bypasses, post-release sites for salmonids salvaged at the State and Federal fish facilities, and the SMSCG. Predation on salmon by striped bass and pikeminnow at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967, Pickard *et al.* 1982); however, accurate predation rates at these sites are difficult to determine. CDFG conducted predation studies from 1987 to 1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the SMSCG was striped bass, and the remains of juvenile Chinook salmon were identified in their stomach contents (NMFS 1997).

8. Environmental Variation

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Hare *et al.* 1999, Mantua and Hare 2002). This phenomenon has been referred to as the Pacific Decadal Oscillation. In addition, large-scale climatic regime shifts, such as the El Niño condition, appear to change productivity levels over large expanses of the Pacific Ocean. A further confounding effect is the fluctuation between drought and wet conditions in the basins of the American west. During the first part of the 1990s, much of the Pacific Coast was subject to a series of very dry years, which reduced inflows to watersheds up and down the west coast.

A key factor affecting many West Coast stocks has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. It is presumed that survival in the ocean is driven largely by events occurring between ocean entry and recruitment to a subadult life stage.

Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Predation rates on juvenile and adult green sturgeon have not been adequately studied to date. Ocean predation may also contribute to significant natural mortality, although it is not known to what extent. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations following their protection under the Marine Mammal Protection Act of 1972 has increased the number of salmonid deaths.

Unusual drought conditions may warrant additional consideration in California. Flows in 2001 were among the lowest flow conditions on record in the Central Valley. The available water in the Sacramento watershed and San Joaquin watershed was 70 percent and 66 percent of normal, according to the Sacramento River Index and the San Joaquin River Index, respectively. Back-to-back drought years could be catastrophic to small populations of listed salmonids that are dependent upon reservoir releases for their success (*e.g.*, Sacramento River winter-run Chinook salmon). Therefore, reservoir carryover storage (usually referred to as end-of-September storage) is a key element in providing adequate reserves to protect salmon and steelhead during extended drought periods. In order to buffer the effect of drought conditions and over allocation of resources, NMFS in the past has recommended that minimum carryover storage be maintained in Shasta and other reservoirs to help alleviate critical flow and temperature conditions in the fall. Green sturgeon's need for appropriate water temperatures would also benefit from river operations that maintain a suitable temperature profile for this species.

The future effects of global warming are of key interest to salmonid and green sturgeon survival. It is predicted that Sierra snow packs will dwindle with global warming and that the majority of runoff in California will be from rainfall in the winter rather than from melting snow pack in the mountains. This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/summer snowmelt dominated system to a winter rain dominated system. It can be rationally hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This should truncate the period of time that suitable cold-water conditions exist below existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold-water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids (*i.e.*, Sacramento River winter-run Chinook salmon and Central Valley steelhead) that must hold below the dam over the summer and fall periods. Similar, although potentially to a lesser degree, declines in green sturgeon populations are anticipated with reduced cold-water flows. Green sturgeon egg and larval development are optimized at water temperatures that are only slightly higher than those for salmonids. Lethal temperatures are similar to salmonids, although slightly higher than those for salmonids.

9. Ecosystem Restoration

a. *California Bay-Delta Authority*

Two programs included under CALFED; the Ecosystem Restoration Program (ERP) and the EWA, were created to improve conditions for fish, including listed salmonids, in the Central Valley. Restoration actions implemented by the ERP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these actions address key factors affecting listed salmonids and emphasis has been placed in tributary drainages with high potential for steelhead and spring-run Chinook salmon production. Additional ongoing actions include new efforts to enhance fisheries monitoring and directly support salmonid production through hatchery releases. Recent habitat

restoration initiatives sponsored and funded primarily by the CALFED-ERP Program have resulted in plans to restore ecological function to 9,543 acres of shallow-water tidal and marsh habitats within the Delta. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids. Similar habitat restoration is imminent adjacent to Suisun Marsh (*i.e.*, at the confluence of Montezuma Slough and the Sacramento River) as part of the Montezuma Wetlands project, which is intended to provide for commercial disposal of material dredged from San Francisco Bay in conjunction with tidal wetland restoration.

A sub-program of the ERP called the Environmental Water Program (EWP) has been established to support ERP projects through enhancement of instream flows that are biologically and ecologically significant. This program is in the development stage and the benefits to listed salmonids are not yet clear. Clear Creek is one of five watersheds in the Central Valley that has been targeted for action during Phase I of the EWP.

The EWA is designed to provide water at critical times to meet ESA requirements and incidental take limits without water supply impacts to other users. In early 2001, the EWA released 290 thousand acre feet of water from San Luis Reservoir at key times to offset reductions in south Delta pumping implemented to protect winter-run Chinook salmon, delta smelt, and splittail. However, the benefit derived by this action to winter-run Chinook salmon in terms of number of fish saved was very small. The anticipated benefits to other Delta fisheries from the use of the EWA water are much higher than those benefits ascribed to listed salmonids by the EWA release.

b. *Central Valley Project Improvement Act*

The CVPIA, implemented in 1992, requires that fish and wildlife get equal consideration with other demands for water allocations derived from the CVP. From this act arose several programs that have benefited listed salmonids: the Anadromous Fish Restoration Program (AFRP), the Anadromous Fish Screen Program (AFSP), and the Water Acquisition Program (WAP). The AFRP is engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The AFSP combines Federal funding with State and private funds to prioritize and construct fish screens on major water diversions mainly in the upper Sacramento River. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the DOI's ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for spring-run Chinook salmon and steelhead by maintaining or increasing instream flows in Butte and Mill Creeks and the San Joaquin River at critical times.

c. *Iron Mountain Mine Remediation*

EPA's Iron Mountain Mine remediation involves the removal of toxic metals in acidic mine drainage from the Spring Creek Watershed with a state-of-the-art lime neutralization plant.

Contaminant loading into the Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990s (see Appendix J, Reclamation 2004). Decreasing the heavy metal contaminants that enter the Sacramento River should increase the survival of salmonid eggs and juveniles. However, during periods of heavy rainfall upstream of the Iron Mountain Mine, Reclamation substantially increases Sacramento River flows in order to dilute heavy metal contaminants being spilled from the Spring Creek debris dam. This rapid change in flows can cause juvenile salmonids to become stranded or isolated in side channels below Keswick Dam.

d. *State Water Project Delta Pumping Plant Fish Protection Agreement (Four-Pumps Agreement)*

The Four-Pumps Agreement Program has approved about $49 million for projects that benefit salmon and steelhead production in the Sacramento-San Joaquin basins and Delta since the agreement inception in 1986. Four-Pumps projects that benefit spring-run Chinook salmon and steelhead include water exchange programs on Mill and Deer Creeks; enhanced law enforcement efforts from San Francisco Bay upstream to the Sacramento and San Joaquin Rivers and their tributaries; design and construction of fish screens and ladders on Butte Creek; and, screening of diversions in Suisun Marsh and San Joaquin tributaries. Predator habitat isolation and removal, and spawning habitat enhancement projects on the San Joaquin tributaries benefit steelhead (see Chapter 15, Reclamation 2004).

The Spring-run Salmon Increased Protection Project provides overtime wages for CDFG wardens to focus on reducing illegal take and illegal water diversions on upper Sacramento River tributaries and adult holding areas, where the fish are vulnerable to poaching. This project covers Mill, Deer, Antelope, Butte, Big Chico, Cottonwood, and Battle Creeks, and has been in effect since 1996. Through the Delta-Bay Enhanced Enforcement Program, initiated in 1994, a team of 10 wardens focus their enforcement efforts on salmon, steelhead, and other species of concern from the San Francisco Bay Estuary upstream into the Sacramento and San Joaquin River basins. These two enhanced enforcement programs have had significant, but unquantified benefits to spring-run Chinook salmon attributed to CDFG (see Chapter 15, Reclamation 2004).

The Mill and Deer Creek Water Exchange projects are designed to provide new wells that enable diverters to bank groundwater in place of stream flow, thus leaving water in the stream during critical migration periods. On Mill Creek several agreements between Los Molinos Mutual Water Company (LMMWC), Orange Cove Irrigation District (OCID), CDFG, and DWR allows DWR to pump groundwater from two wells into the LMMWC canals to pay back LMMWC water rights for surface water released downstream for fish. Although the Mill Creek Water Exchange project was initiated in 1990 and the agreement allows for a well capacity of 25 cubic feet per second (cfs), only 12 cfs has been developed to date (Reclamation and OCID 1999). In addition, it has been determined that a base flow of greater than 25 cfs is needed during the April through June period for upstream passage of adult spring-run Chinook salmon in Mill Creek (Reclamation and OCID 1999). In some years, water diversions from the creek are curtailed by amounts sufficient to provide for passage of upstream migrating adult spring-run Chinook salmon and downstream migrating juvenile steelhead and spring-run Chinook salmon. However, the current arrangement does not ensure adequate flow conditions will be maintained in all years. DWR, CDFG, and FWS have developed the Mill Creek Adaptive Management Enhancement

Plan to address the instream flow issues. A pilot project using 1 of the 10 pumps originally proposed for Deer Creek was tested in summer 2003. Future testing is planned with implementation to follow.

10. Non-native Invasive Species

As currently seen in the San Francisco estuary, non-native invasive species (NIS) can alter the natural food webs that existed prior to their introduction. Perhaps the most significant example is illustrated by the Asiatic freshwater clams *Corbicula fluminea* and *Potamocorbula amurensis*. The arrival of these clams in the estuary disrupted the normal benthic community structure and depressed phytoplankton levels in the estuary due to the highly efficient filter feeding of the introduced clams (Cohen and Moyle 2004). The decline in the levels of phytoplankton reduces the population levels of zooplankton that feed upon them, and hence reduces the forage base available to salmonids transiting the Delta and San Francisco estuary which feed either upon the zooplankton directly or their mature forms. This lack of forage base can adversely impact the health and physiological condition of these salmonids as they emigrate through the Delta region to the Pacific Ocean.

Attempts to control the NIS also can adversely impact the health and well-being of salmonids within the affected water systems. For example, the control programs for the invasive water hyacinth and *Egeria densa* plants in the Delta must balance the toxicity of the herbicides applied to control the plants to the probability of exposure to listed salmonids during herbicide application. In addition, the control of the nuisance plants has certain physical parameters that must be accounted for in the treatment protocols, particularly the decrease in DO resulting from the decomposing vegetable matter left by plants that have died.

11. Summary

Land-use activities such as road construction, urban development, logging, mining, agriculture, and recreation are pervasive and have significantly altered fish habitat quantity and quality for Chinook salmon and steelhead through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and, removal of riparian vegetation resulting in increased streambank erosion. Human-induced habitat changes, such as: alteration of natural flow regimes; installation of bank revetment; and, building structures such as dams, bridges, water diversions, piers, and wharves, often provide conditions that both disorient juvenile salmonids and attract predators. Harvest activities, ocean productivity, and drought conditions provide added stressors to listed salmonid populations. In contrast, various ecosystem restoration activities have contributed to improved conditions for listed salmonids (*e.g.*, various fish screens). However, some important restoration activities (*e.g.*, Battle Creek) have not yet been initiated. Benefits to listed salmonids from the EWA have been smaller than anticipated.

D. Critical Habitat Condition and Function for Species' Conservation

The freshwater habitat of salmon, steelhead, and sturgeon in the Sacramento River, San Joaquin River, and Suisun Marsh watershed drainages varies in function depending on location. Spawning areas are located in accessible, upstream reaches of the Sacramento or San Joaquin Rivers and their watersheds where viable spawning gravels and water quality are found. Spawning habitat condition is strongly affected by water flow and quality, especially the primary constituent elements (PCEs) of temperature, DO, and silt load, all of which can greatly affect the survival of eggs and larvae. High quality spawning habitat is now inaccessible behind large dams in these watersheds, which limits salmonids to spawning in marginal tailwater habitat below the dams. Despite often intensive management efforts, the existing spawning habitat below dams is highly susceptible to inadequate flows and high temperatures due to competing demands for water, which impairs the habitat function.

Migratory corridors are downstream of the spawning area and include the Delta and Suisun Marsh. These corridors allow the upstream passage of adults and the downstream emigration of juveniles. Migratory habitat conditions are impaired in each of these drainages by the presence of barriers, which can include seasonal dams, unscreened or poorly-screened diversions, inadequate water flows, and degraded water quality.

Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing by salmonids, but such use has not been documented for sturgeon. Rearing habitat condition is strongly affected by PCEs such as habitat complexity, food supply, and presence of predators of juvenile salmonids and sturgeon. Some complex, productive habitats with floodplains remain in the Sacramento and San Joaquin River systems (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees (*i.e.*, primarily located upstream of the City of Colusa) and the Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Delta and Suisun Marsh systems typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators.

IV. ENVIRONMENTAL BASELINE

A. Factors Affecting the Species and Habitat in the Action Area

Starting in the mid-1800s, the U.S. Army Corps of Engineers (Corps) and other private consortiums began straightening river channels and artificially deepening them to enhance shipping commerce. This has led to declines in the natural meandering of river channels and the formation of pool and riffle segments. The deepening of channels beyond their natural depth also has led to a significant alteration in the transport of bedload in the riverine system as well as the local flow velocity in the channel (Mount 1995). The Sacramento Flood Control Project at the turn of the nineteenth century ushered in the start of large scale Corps actions in the Delta and along the rivers of California for reclamation and flood control. The creation of levees and the Sacramento and San Joaquin deep water ship channels (DWSCs) reduced the natural tendency of the San Joaquin and Sacramento Rivers to create floodplains along their banks with seasonal inundations during the wet winter season and the spring snow melt periods. These

annual inundations provided necessary habitat for rearing and foraging of juvenile native fish that evolved with this flooding process. The armored riprapped levee banks and active maintenance actions of reclamation districts precluded the establishment of ecologically important riparian vegetation, introduction of valuable LWD from these riparian corridors, and the productive intertidal mudflats characteristic of the undisturbed Delta habitat.

Low DO levels frequently are observed in the portion of the DWSC extending from Channel Point, downstream to Turner and Columbia Cuts. Over a 5-year period, starting in August 2000, a DO meter has recorded channel DO levels at Rough and Ready Island (Dock 20 of the Port of Stockton, West Complex). Over the course of this time period, there have been 297 days in which violations of the 5 mg/l DO criteria for the protection of aquatic life in the San Joaquin River between Channel Point and Turner and Columbia Cuts have occurred during the September through May migratory period for salmonids in the San Joaquin River. The data derived from the California Data Exchange Center files indicate that DO depressions occur during all migratory months, with significant events occurring from November through March when listed Central Valley steelhead adults and smolts would be utilizing this portion of the San Joaquin River as a migratory corridor (see Appendix A, Table 6).

Potential factors that contribute to these DO depressions are reduced river flows through the ship channel, released ammonia from the City of Stockton Wastewater Treatment Plant, upstream contributions of organic materials (*e.g.*, algal loads, nutrients, agricultural discharges) and the increased volume of the dredged ship channel. During the winter and early spring emigration period, increased ammonia concentrations in the discharges from the City of Stockton Waste Water Treatment Facility lowers the DO in the adjacent DWSC near the West Complex. In addition to the adverse effects of the lowered DO on salmonid physiology, ammonia is in itself toxic to salmonids at low concentrations. Likewise, adult fish migrating upstream will encounter lowered DO in the DWSC as they move upstream in the fall and early winter due to low flows and excessive algal and nutrient loads coming downstream from the upper San Joaquin River watershed. Levels of DO below 5 mg/L have been reported as delaying or blocking fall-run Chinook salmon in studies conducted by Hallock *et al.* (1970). As the river water and its constituents move downstream from the San Joaquin River channel to the DWSC, the channel depth increases from approximately 8 to 10 feet to over 35 feet. The water column is no longer mixed adequately to prevent DO from decreasing as it is consumed by biotic and abiotic factors. This is due to the increased amount of time the water spends away from the air-water interface where equilibration with atmospheric oxygen can occur. Photosynthesis by suspended algae is diminished by increased turbidity and circulation below the photosynthetic compensation depth. This is the depth to which light penetrates with adequate intensity to carry on photosynthesis in excess of the oxygen demands of cellular respiration. As the oxygen demand from respiration, defined as biological oxygen demand, exceeds the rate at which oxygen can be produced by photosynthesis and mixing, then the level of DO in the water column will decrease. Additional demands on oxygen are also exerted in non-biological chemical reactions in which compounds consume oxygen in an oxidation-reduction reaction.

NMFS completed consultation on the Port of Stockton (Port), West Complex Dredging project on July 19, 2005 (NMFS Project No. 151422SWR2003SA9009;9010JSS; NMFS 2005b). The Port is situated on the San Joaquin River between RM 37.5 and RM 41. The proposed Port of

Stockton, West Complex Dredging project will involve dredging approximately 576,000 cy of material from the waters of the San Joaquin River, adjacent to the Port's wharves at the West Complex. Disposal of this material will occur at the dredge material placement (DMP) site on Roberts Island, which also will be used to facilitate dredge material disposal associated with the project that is the focus of the present consultation. The dredging activities are anticipated to exacerbate the low DO conditions in the DWSC. However, the Port of Stockton, West Complex Dredging project is a part of a much larger action, called the West Complex Redevelopment project as described in the Port's draft EIR for the project (Environmental Science Associates 2003). Interrelated and interdependent activities include upland development of the former naval facilities on Rough and Ready Island with the intent of accommodating larger ships compared to those that currently use the DWSC. This development will result in an approximate doubling of ship traffic in the San Joaquin River. Hence, these activities will affect that portion of the action area for the current project that encompasses the waters adjacent to the Stockton DWSC.

In addition to the adverse effects of dredging and release of effluent from the DMP site, the Port of Stockton, West Complex Dredging project is expected to adversely affect Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead transiting the action area through increased shipping impacts including, but not limited to, propeller entrainment and changes in channel hydrodynamics (*e.g.*, creation of shear forces and turbulent mixing created by vessel passage).

The total incidental take associated with the Port of Stockton, West Complex Dredging project was estimated by NMFS as follows:

Species	Number Juveniles	Percentage of ESU/DPS	Number Adults	Percentage of ESU/DPS
Sacramento River winter-run Chinook salmon	2,500	0.80	0	0
Central Valley spring-run Chinook salmon	5000	0.32	0	0
Central Valley Steelhead	280	0.15	3	0.15

NMFS's biological opinion on the Port of Stockton, West Complex Dredging project (NMFS 2005b) did not assess the project's effects on the southern DPS of North American green sturgeon. However, NMFS (2005b) states the following:

> Recent discussions with CDFG staff have indicated that adult sturgeon have been recovered with obvious propeller scars, some resulting in death, during fish monitoring surveys (Gingras 2005). These incidents occurred immediately following the passage of large ocean going ships in the San Joaquin River channel.

The expected increase in shipping notwithstanding, this statement suggests that the ongoing impact of shipping at present levels likely is adversely affecting listed and proposed species.

B. Presence of Listed Salmonids in the Action Area

The action area for the WHCP includes the entire legal Delta as well as the eastside tributaries feeding the Delta and the San Joaquin River upstream to Friant Dam. All of the listed Central Valley steelhead in the San Joaquin River watershed originating from the Calaveras, Stanislaus, Tuolumne, or Merced Rivers must pass through the Delta on both their downstream emigration to the ocean as smolts and on their upstream spawning migrations as adults. Those few adults that survive to spawn a second time would also pass through this portion of the action area again. Those fish with origins in the Sacramento River watershed must pass through the northern treatment areas of the WHCP in the north Delta on the way to the ocean.

Based on fish monitoring studies, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead juveniles and smolts from the Sacramento River watershed frequently enter into the San Joaquin River system based on river flows and SWP and CVP pumping rates. Fish from the Sacramento River can access the San Joaquin River from several points, the Delta Cross Channel via the North and South Forks of the Mokelumne River, Georgiana Slough, Three Mile Slough, and the mouth of the San Joaquin River near Antioch and Sherman Island.

C. Presence of North American Green Sturgeon in the Action Area

Both adult and juvenile North American green sturgeon are known to occur within the lower reaches of the San Joaquin River, the south Delta, the waterways of the north Delta and Sacramento River itself within the action area. Juveniles have been captured in the vicinity of Santa Clara Shoals and Brannan Island State Recreation Area, and in the channels of the south Delta (Moyle *et al.* 1992, Beamesderfer *et al.* 2004). Green sturgeon also have been recovered at both the SWP and CVP pumping facilities on Old River near Tracy, indicating that they must have transited through one of the many channels of the south Delta to reach that location. Both adult and juvenile green sturgeon may use the Delta as a migratory, resting, or rearing habitat. Green sturgeon presence in the Delta could occur in any month, as juveniles may reside there during their first few years of growth. Adults are likely to be present in the winter and early spring as they move through the Delta towards their spawning grounds in the upper Sacramento River watershed. Following spawning, the fish will pass through the Delta again on their way back to the ocean, but the duration and timing of this event is not well understood in the Sacramento River system.

V. EFFECTS OF THE ACTION

Pursuant to section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. This biological and conference opinion assesses the effects of the USDA-ARS' WHCP on endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, proposed threatened southern DPS of North American green sturgeon, and their designated critical habitats. The proposed action is likely to adversely affect listed salmonids, North American green sturgeon, and their habitat primarily through the

application of herbicides and adjuvants to floating water hyacinth in infested areas, changes in water quality parameters associated with the application of herbicides and the decomposition of the treated plant material, and the collateral alterations of the plant communities in response to the application of herbicides to the non-native invasive water hyacinth. In the *Description of the Proposed Action* section of this opinion, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this opinion, NMFS provided an overview of the threatened and endangered species and critical habitats that are likely to be adversely affected by the activity under consultation.

Regulations that implement section 7(a)(2) of the ESA require that biological opinions evaluate the direct and indirect effects of Federal actions and actions that are interrelated with or interdependent to the Federal action to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. §1536, 50 CFR §402.02).

NMFS generally approaches "jeopardy" analyses in a series of steps. First, NMFS evaluates the available evidence to identify direct and indirect physical, chemical, and biotic effects of the proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or a sound). Once NMFS has identified the effects of the action, the available evidence is evaluated to identify a species' probable response, including behavioral reactions, to these effects. These responses then will be assessed to determine if they can reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). The available evidence is then used to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

The regulatory definition of adverse modification has been invalidated by the courts. Until a new definition is adopted, NMFS will evaluate destruction or adverse modification of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species.

A. Approach to Assessment

1. Information Available for the Assessment

To conduct the assessment, NMFS examined an extensive amount of evidence from a variety of sources. Detailed background information on the status of these species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, governmental and non-governmental reports, scientific meetings, and environmental reports submitted by the project proponents. Additional information investigating

the effects of the project's actions on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was obtained from the aforementioned resources.

2. Assumptions Underlying This Assessment

In the absence of definitive data or conclusive evidence, NMFS must make a logical series of assumptions to overcome the limits of the available information. These assumptions will be made using sound, scientific reasoning that can be logically derived from the available information. The progression of the reasoning will be stated for each assumption, and supporting evidence cited.

Exposure potential and risk assessment of listed species to herbicides is predicated on having a detailed understanding of the multiple avenues of physiological and behavioral interactions associated with the exposure in the natural environment. Although there is considerable information available concerning the herbicide concentrations required for acute mortality in fish and other aquatic organisms in controlled laboratory settings, specific data concerning listed salmonids and green sturgeon is lacking in most instances, and particularly so for natural systems. Furthermore, studies that are designed to investigate the sublethal effects of herbicide exposure are still rare, and even rarer are studies looking at the effects of herbicide exposure in complicated natural systems, with multiple stressors and contaminants present. In order to account for these unknowns, NMFS must apply the precautionary principle and err on the side of the species when assessing impacts of the project's actions.

B. Assessment

1. Natural History of Water Hyacinth

Water hyacinth is a non-native invasive free-floating aquatic macrophyte belonging to the South American pickerelweed family (*Pontederiacea*). It is considered to be one of the most invasive species worldwide, having been reported in 56 countries worldwide (Holm *et al.* 1977, Gopal and Sharma 1981).

Water hyacinth was first reported in California in a Yolo County slough in 1904 (Prokopovich *et al.* 1985). The plant gradually spread through the Delta and by the late 1970s had covered nearly 1,000 acres and 150 miles of the 700 miles of waterways in the Delta (U.S. Army Corps of Engineers 1985). The spread of water hyacinth in the Delta was probably inhibited by the cool winters and occasional freezes that occur in the Central Valley, which can kill or severely retard growth of the water hyacinth (Holm *et al.* 1977).

Water hyacinth grows in wetlands, marshes, shallow water bodies, slow moving waterways, lakes, reservoirs, and rivers. The plants often form large, thick mats that are monospecific in nature. Mats can reach dimensions that can block waterways and impede navigation, agricultural practices, and pursuit of recreational activities. Dense mats can also serve as breeding grounds for mosquitoes, which can increase the possibility of vector born diseases in surrounding areas (Savage *et al.* 1990, Meyers 1992, Rodriguez *et al.* 1993, and Manguin *et al.* 1996). During high

wind or river flow conditions, small floats of water hyacinth often break off from the larger mats and colonize new areas. Water hyacinths are tolerant of fluctuations in water levels, seasonal flow velocities, and extremes of nutrient availability, pH, toxicants, and temperatures. However, the plants are susceptible to even low levels of salinity, and perish in these environments.

The water hyacinth growth cycle starts in spring when over-wintering plants (old stem bases) initiate new growth by producing daughter plants. The minimum growth temperature is 54 °F, optimal growth temperatures are reached at 77-86 °F and maximum growth temperature is reached at 92-95 °F. The daughter plants increase in number during spring and summer until the maximum biomass is reached in September. When the density of the mats has reached its maximum, individual plants begin to increase in size, crowding out smaller plants. This decreases the overall number of plants in the mats, while still maintaining high biomass. Water hyacinth grows faster than any other tested plant (Wolverton and McDonald 1979) and can double its numbers in as little as 6 days (Mitchell 1976). During late summer and early fall, the plants reach their full bloom. By late fall, the flowers and leaves begin to die back, and by January most of the plants have gone dormant. Water hyacinths are not very tolerant to freezing conditions, and cold climates limit their northern range. Leaves can regrow after moderate freezing, but plants do not survive hard freezes or ice conditions.

2. Problems Associated with Water Hyacinth Infestation

Typically, aquatic vegetation plays an important, beneficial role in the functioning of an aquatic ecosystem. Aquatic vegetation produces oxygen through photosynthesis that leads to an elevation of ambient DO levels in the water column. Macrophytes provide shelter and habitat for invertebrates and juvenile fish whether they are rooted in the substrate or are free floating. Macrophytes also provide substrate for periphyton (algae, fungus, and microflora) to grow on which in turn provides food resources for grazing invertebrates. These invertebrates then provide the basis for the food resources of higher trophic levels, such as fish. Aquatic plants also enhance the cycling of nutrients and minerals in the aquatic ecosystems of which they are part. This is done by incorporating them into the plant tissue, which then serves as a nutritional substrate for herbivores or as a nutrient source for bacteria and fungi during their decay. Native aquatic plants are co-evolved with the other flora and fauna in their ecosystems and thus are in equilibrium with the other components of the ecosystem.

Non-native invasive species are those plants or organisms which have been introduced into an ecosystem in which they have not evolved. These species do not have the checks and balances on their numbers and range that native species have and are likely to adversely affect native species in the invaded ecosystem. Water hyacinth is such a species. The infestation of the Delta with water hyacinth has resulted in several negative impacts on this ecosystem. The increased biomass of water hyacinth has resulted in nighttime depletion of DO through increased levels of plant respiration, particularly during periods of elevated water temperatures. The extensive coverage of water hyacinth mats have excluded numerous species of submerged native plants by shading-out these plants or smothering emergent plants that become surrounded by the mats. Likewise, the extensive mats have created zones of hypoxic or anoxic water conditions due to extensive plant respiration and lack of water-air interface mixing. These conditions have altered the normal assemblages of invertebrate and vertebrate species normally found in ecosystems

without the water hyacinth (Baily and Litterick 1993, Toft 2000, CALFED 2000). Water hyacinths can also lead to abiotic changes in the ecosystem such as accretion of sediment and organic detritus under the mats due to reductions of water flows through the infested sites. Likewise, the ability of the water hyacinth to absorb vast amounts of nutrients and minerals through its extensive root structure can lead to the formation of nutrient sinks in the infested zones. These sinks essentially remove these nutrients from the ecosystem due to the inability of native organisms to feed on the water hyacinth, or survive in the conditions created by the water hyacinth.

3. Physio-chemical Properties of Program Herbicides and Adjuvants

The mode-of-action is the overall manner in which an herbicide affects a plant at the tissue or cellular level. Herbicides can be organized into those which are applied to foliage, and those which are applied almost strictly to soil. The foliar groups are further divided into three categories according to movement through the plant:

- Symplastically translocated (source to sink, capable of downward movement in plant),
- Apoplastcially translocated (capable of upward movement in plant), and
- Those which do not move appreciably and kill very quickly on contact.

Plants are complex organisms with well-defined structures and numerous biochemical processes that are necessary for life. Some of these vital metabolic pathways include photosynthesis, amino acid and protein synthesis, fat synthesis, pigment synthesis, nucleic acid synthesis, oxidative respiration for energy, and maintenance of cellular membrane integrity. Other essential processes include growth and differentiation, mitosis (cell division) in plant meristems, meiosis (sexual gamete production- pollen and seeds), uptake of ions and molecules, translocation of ions and compounds across cellular membranes, and transpiration. One or more of these essential processes must be disrupted in order for an herbicide to kill a plant (Ross and Childs 1996).

Foliar applied herbicides are either downwardly mobile, contact (non-translocated), or upwardly mobile in their mode-of–action. Downwardly mobile herbicides can be further divided into auxin growth regulators (2,4-D), aromatic amino acid synthesis inhibitors (glyphosate), branched chain amino acid inhibitors, chlorophyll/carotenoid pigment inhibitors, or lipid synthesis inhibitors (meristem membranes). Contact herbicides destroy by disrupting the cellular membranes of plants. Diquat belongs to this class of herbicides and functions by producing peroxides and free radicals in the cytoplasm upon exposure to light, which then destroy the lipid membranes of the cells almost immediately. Upwardly mobile herbicides move with the transpiration stream in the plant's xylem from the bottom to the top of the plant. This group of herbicides inhibits the photosynthetic pathways of metabolism. Soil applied herbicides inhibit cellular division in the roots, new shoots or both (Ross and Childs 1996).

Weedar ® 64, a dimethylamine salt formulation of 2,4-Dichlorophenoxyacetic acid (46.8 percent active ingredient) is an auxin growth regulator. This type of herbicide is applied to the foliage of plants, which almost immediately results in a bending and twisting of the leaves and stems. Delayed symptoms include root formation on dicot stems, misshapened leaves, stems, and

flowers and abnormal roots. The amine salt form has been shown to be less toxic to fish than the ester forms of the herbicide, while invertebrates show a higher sensitivity to both the ester and amine forms of the compound than fish. The half-life of Weedar ® in aquatic environments can be short, from several days to several weeks (Extoxnet 2001). Rates of breakdown increase with increased levels of nutrients, sediments, and dissolved organic carbon. Maximum concentrations in surface waters are reached in one day, and then dissipate rapidly, especially in moving water (USDA 2002). Microorganisms readily breakdown 2,4-D along two separate metabolic pathways, metabolizing the compound into either pyruvate or 3-oxo-adipate. These intermediate metabolites serve as precursors to other metabolic pathways in the degrading microorganisms (Hill *et al.* 2002). The manufacturer's Material Safety Data Sheet (MSDS, Rhône-Poulenc) indicates that this product is "for use in ponds, lakes, reservoirs, marshes, bayous, drainage ditches, canals, rivers, and streams that are quiescent or slow moving." It further stipulates that "to avoid fish kills from the decaying plant material consuming oxygen, buffer strips of at least 100 feet wide should be left, and that treatment of these strips should be delayed for 4 to 5 weeks or until the dead vegetation has decomposed". This will be the primary compound used for water hyacinth control by the DBW, accounting for more than 75 percent of chemical usage in the last three years. Concentrations of 2,4-D in the receiving waters shall not exceed 20 µg/L following application.

Rodeo®, an isopropylamine salt formulation of glyphosate (53.8 percent active ingredients) is a non-selective, slow acting systemic herbicide that inhibits aromatic amino acid synthesis. This type of herbicide is sprayed on the foliage due to its rapid degradation by microbes. Symptoms include yellowing of new growth and death of treated plants in days to weeks (Ross and Childs 1996). Glyphosate inhibits an essential enzyme pathway, the shikimic acid pathway. This inhibition prevents plants from synthesizing three key aromatic amino acids, phenylalanine, tyrosine, and tryptophan. These enzymes are essential for the normal growth and survival of most plants. Plants are inefficient at metabolizing glyphosate; therefore, the compound readily disseminates throughout the target plant and provides a more effective herbicide (Hartzler 2001). Animals do not synthesize either phenylalanine or tryptophan, and thus require them in their diets to survive (essential amino acids). Glyphosate rapidly degrades in aquatic systems either by photodegradation (≈28 days) or by microbial degradation into sarcosine or formaldehyde, which then enters the intermediate single carbon metabolism of the bacteria. Glyphosate is also strongly adsorbed to soil particles and suspended particulate matter in the water column, rendering it "biologically unavailable" to most aquatic organisms. Toxicological data indicates that the parent compound, glyphosate, is relatively benign to fish at expected acute field concentrations. Increased toxicity has been shown to occur when the parent compound is mixed with spray adjuvants and the inert portions of the manufacturer's formulation. The manufacture's MSDS (Monsanto) states that the product may be "applied to emergent weeds in all bodies of fresh and brackish water which may include flowing, non-flowing, and transient waters." Rodeo® does not effectively treat plants which are completely submerged or have the majority of their foliage under water. Restrictions also apply to the application of Rodeo® near potable water intakes. As with 2,4-D, hypoxic conditions may be formed in the water column due to excessive weed decay from previous treatments, thereby causing fish to suffocate from a lack of DO. It is recommended that treating the area in strips may avoid this problem. This will be the least used compound for water hyacinth control by the DBW. Concentrations of glyphosate in the receiving waters shall not exceed 700 µg/L following application.

Reward®, which contains 36.4 percent diquat dibromide as an active ingredient, is a "broad spectrum" contact herbicide that destroys lipid membranes and disrupts photosynthetic organelles. Diquat is readily absorbed through the plant cuticle and passes into the cytosol of the plant. It then forms superoxide free radicals that are subsequently converted into hydrogen peroxides by the enzyme superoxide dismutase. The hydrogen peroxide and superoxide anion can attack polyunsaturated lipids present in the cellular membranes to produce lipid hydroperoxides which, in turn, can react with unsaturated lipids to form more lipid free radicals, thereby perpetuating the system (Ecobichon in Klassen 1996). Diquat rapidly adsorbs to soil particles and suspended particles in water. It thus becomes relatively biologically unavailable to most aquatic organisms. Diquat dibromide's half-life is less than 48 hours in the water column, and may be on the order of 160 days in sediments due to its low bioavailability. Microbial degradation or sunlight may play roles in the degradation of the compound. Plants can absorb diquat from the water and concentrate it in the plant's tissues. Thus, low concentrations are effective for controlling aquatic weeds. Diquat is considered slightly toxic to fish and aquatic invertebrates. It has been reported to be less toxic in hard waters. There is little or no bioconcentration of diquat in fish due to its limited absorption from the gastrointestinal tract (Extoxnet 1993, 1996). One research paper indicated that yellow perch (*Perca flavescens*) exhibited respiratory difficulties when herbicide concentrations were similar to those present during aquatic vegetation control programs (Bimber 1976). The manufacturer's MSDS for Reward® (Zeneca) indicates that the herbicide may be applied to aquatic weeds. In public waters, the herbicide may be applied to still, slow-moving, or other quiescent bodies of water and that if warning signs are required by state law they must be posted within the restricted area (1600 feet downstream of the treatment site). Due to the likelihood of hypoxic or anoxic conditions resulting from the decay of dead plant material, the MSDS requires that only one third to one half of the water body be treated at any one time, especially if dense weeds are present, and to wait 24 hours between treatments. Diquat has not been used in the WHCP for the last three seasons (2003 through 2005) although DBW has retained it in its herbicide usage protocol for the next five years as described in the BA for the current consultation (DBW 2005). Concentrations of diquat in the receiving waters shall not exceed 0.5µg/L following application as directed by the current NPDES permit for the WHCP.

4. Effects of Herbicidal Application on Salmonids

The application of herbicides to waters of the Delta and the San Joaquin River Basin under the USDA-ARS' and DBW's WHCP actions from 2006 to 2010 potentially may affect Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and the Central Valley steelhead in both direct and indirect ways.

a. *Dissolved Oxygen Levels*

Juvenile salmonids may be directly affected through the reduction in DO levels resulting from the decomposition of plants killed from the herbicide application. Low DO levels (< 3 mg/L) can result in fish kills if fish are unable to move out of the zone of hypoxic or anoxic waters. Low DO levels are particularly harmful to salmonids, which have a high metabolic requirement for DO (Bjornn and Reiser 1991). Studies have shown that DO levels below 5 mg/L have a

significant negative effect on growth, food conversion efficiency, and swimming performance. High water temperatures, which result in reduced oxygen solubility, can compound the stress on fish caused by marginal DO concentrations (Bjornn and Reiser 1991). Stress from low DO can make juvenile salmonids more susceptible to predation and disease, and less likely to smolt due to insufficient energy reserves. Adult salmonids may experience delayed migration through Delta waters if DO is below concentrations needed for survival. Delay in upstream migration can have a negative impact on the maturation of gonadal tissue, particularly if ambient water temperatures in the Delta are also elevated. Salmonids exposed to elevated temperatures during gonadal maturation have reduced fertility and lower numbers of viable eggs (CALFED 2000). Previous studies have shown that levels of DO under water hyacinth mats can be hypoxic or even anoxic (Bailey and Litterick 1993, Toft 2000) having values that are less than 5 mg/L. Fish exposed to extended dissolved oxygen levels below 5 mg/L are usually compromised in their growth and survival (Piper *et al.* 1982). NMFS expects that fish and mobile invertebrates generally will avoid areas with large mats of water hyacinth due to the decreased ambient levels of DO in the water column. The applications of herbicides are expected to initially decrease DO levels even further in areas treated for the plant. This results from the decomposition of the dead vegetable matter and an increase in biological oxygen demand. This effect is expected to be transitory as the decaying vegetation is dispersed by tidal and river currents from the treatment area. Areas of higher tidal and river current exposure will be flushed faster than areas of low water body exchange, such as dead end sloughs and restricted peripheral channels. Additional parameters affecting the DO levels are the rate of decay for the treated vegetation which is dependent on ambient water temperature and microbial activity. Higher water temperatures should theoretically result in higher microbial activity, thus resulting in a faster decline in the DO levels. However, the duration of the depressed DO levels should be shorter than in a cooler temperature profile due to the vegetative biomass being metabolized at a faster rate. Conversely, a cooler ambient temperature would result in a prolonged DO depression, although perhaps not to the hypoxic levels reached in a warmer water profile.

b. *Narcosis*

Fish, which are exposed to elevated concentrations of polar and non-polar organic compounds, such as the herbicides used in the WHCP, can become narcotized. Narcosis is a generalized non-selective toxicity that is the result of a general disruption of cell membrane function. The process of narcosis is poorly understood, but is thought to involve either a "critical volume" change in cellular membranes due to the toxicant dissolving into the lipid membrane and altering its function, or by the "protein binding" process in which hydrophobic portions of receptor proteins in the lipid membrane are bound by the toxicant molecules, thus changing the receptor protein's function (Rand 1995). Exposure to elevated concentrations of the herbicides would occur in the very upper most portions of the water column, directly beneath the fringe of the water hyacinth mat. A fish with narcosis would be susceptible to predation as a result of a loss of equilibrium, a reduction in swimming ability or a lack of predator avoidance behavior. Furthermore, a fish with narcosis would also have difficulty maintaining its position in the water column, and potentially could be carried by water currents into areas of sub-optimal water quality where conditions may be lethal to salmonids (hypoxic regions underneath water hyacinth mats).

c. *Sublethal Effects on Salmonids*

In contrast to the acute lethality endpoints utilized by the WHCP, nonlethal or sublethal endpoints are more appropriate to the levels of exposure likely to be seen in the herbicide application protocol employed in the program. Sublethal or nonlethal endpoints do not require that mortality be absent; rather it indicates that death is not the primary toxic endpoint being examined. Rand (1995) states that the most common sublethal endpoints in aquatic organisms are behavioral (*e.g.*, swimming, feeding, attraction-avoidance, and predator-prey interactions), physiological (*e.g.*, growth, reproduction, and development), biochemical (*e.g.*, blood enzyme and ion levels), and histological changes. Some sublethal effects may indirectly result in mortality. Changes in certain behaviors, such as swimming or olfactory responses, may diminish the ability of the salmonids to find food or escape from predators and may ultimately result in death. Some sublethal effects may have little or no long-term consequences to the fish because they are rapidly reversible or diminish and cease with time. Individual fish of the same species may exhibit different responses to the same concentration of toxicant. The individual condition of the fish can significantly influence the outcome of the toxicant exposure. Fish with greater energy stores will be better able to survive a temporary decline in foraging ability, or have sufficient metabolic stores to swim to areas with better environmental conditions. Fish that are already stressed are more susceptible to the deleterious effects of contaminants, and may succumb to toxicant levels that are considered sublethal to a healthy fish.

Exposure of fish to the aromatic hydrocarbons typical of many families of pesticides, results in the biotransformation of these compounds by various detoxifying enzyme systems in the fish. Most organic contaminants are lipophilic, a property that makes these compounds readily absorbed across the lipid membranes of the gill, skin, and gastrointestinal tract. Following absorption, compounds that are susceptible to biotransformation are converted to more water soluble metabolites that are easier to excrete than the parent compound. Compounds that are resistant to metabolism are often sequestered in the lipid-rich tissues of the body. Although biotransformation is often considered a positive event in the detoxification of the contaminant, the parent compound of some contaminants are actually less toxic than the metabolites formed. These reactive intermediate metabolites can cause significant problems in other metabolic pathways, including alterations in the synthesis of DNA and RNA, redox cycling of reactive compounds, and induction of enzymatic systems that could lead to altered metabolism of environmentally encountered contaminants (Di Giulo *et al.* in Rand 1995). Within the Delta, mixtures of contaminants, particularly organophosphate pesticides are common. Induction of the biotransforming enzymatic pathways, particularly the P450 monooxygenases, may actually increase the sensitivity of a fish to environmental contaminants. Organophosphate insecticides are often activated by the mono-oxygenase system (Murty 1986, Dr. M.J. Lydy. Southern Illinois University, Carbondale, personal communication 2003), thus the higher the activity of the mono-oxygenase system, the higher the potential for the formation of reactive metabolites.

d. *Indirect Effects*

Indirect effects may result from temporary reductions in primary productivity and invertebrate populations in treated reaches, increased water temperatures in previously shaded habitats, and exposure to predation resulting from a loss of cover as a result of exposure to the chemical

compounds used in the WHCP. Invertebrate populations may be reduced either by direct toxic exposure to herbicides in the water column or indirectly by drifting decaying vegetation smothering the benthic substrate they inhabit. Either avenue would diminish the forage base needed by juvenile salmonids utilizing the Delta as a rearing habitat or within the natal rivers of the San Joaquin Basin where fry and fingerlings are present. Juvenile salmonids would then be forced to enlarge their forage area to successfully ingest the necessary caloric intake for survival. The rate of survival for juvenile salmonids would be a balance between the amounts of metabolic energy expended in swimming during foraging behavior versus the amount of caloric intake achieved from the prey captured during foraging. Caloric intake needs to exceed the metabolic cost of swimming in order for the juvenile fish to have sufficient energy reserves for growth and other metabolic needs. An additional indirect effect is the increase in monitoring for the status of listed fish (*i.e.* delta smelt), where listed fish other than the target species are caught as bycatch in the sampling procedures. This bycatch often results in the loss of the listed salmonids. Finally, operation of the program's vessels in the project area may result in direct and indirect effects due to wake turbulence, sediment resuspension, physical impact with propellers, and discharge of pollutants from the motor's exhaust and lubrication systems.

e. *Beneficial Effects*

Reductions in the percentage of water hyacinth infested waterways theoretically will result in better flows through these waterways, re-establishment of native aquatic vegetation, and recolonization of habitats with native invertebrate species. These changes should result in positive effects on the suitability of the Delta waterways for salmonid rearing and migration. Although these benefits are stated in the DBW BA, definitive data was not given to support this claim and hence must be taken as potential benefits rather than actual benefits.

f. *Potential Extent of Exposure*

The proposed spraying seasons for the WHCP (2006 - 2010) is the 8-month period from April through November in the action area (Delta plus San Joaquin River areas). This treatment period would overlap at least 1 month of adult winter-run Chinook salmon migration through the Delta (22 percent) and at least 2 months of the juvenile winter-run Chinook salmon emigration (29 percent); a majority of the spring-run Chinook salmon adult migration (66 percent) and some juvenile spring-run Chinook salmon emigration (16 percent), 2 months (33 percent) of the juvenile Central Valley steelhead migration through the Delta and 100 percent of the adult Central Valley steelhead emigration. During juvenile out-migration, the winter-run Chinook salmon are at the sub-yearling stage (age zero), spring-run Chinook salmon are at the yearling stage (age 1), and Central Valley steelhead smolts are post-yearlings (age 1.5 – 2 years).

Segments of the North American green sturgeon southern population are expected to be in the waters of the Delta year round. NMFS anticipates that juvenile green sturgeon may be rearing in the channels of the Delta for the first few years of their life before migrating to marine waters as young adults. Adult green sturgeon must transit the Delta in late winter and early spring on their way upstream to spawning grounds in the upper Sacramento River and return through the Delta after spawning is completed in July. The length of time spent in the Delta during these

migrations is unclear at this time, but may span several weeks to months and will likely occur during the eight-month period of the WHCP application season.

5. Toxicity of WHCP Herbicides

Water hyacinth is a floating macrophyte, thus the herbicides are applied by spraying the foliage of the plant above the surface of the water. A conservative estimate of the amount of herbicide entering the water column under normal conditions is approximately 10 to 20 percent of the sprayed volume (Anderson 1982).

a. *Weedar®*

Under the WHCP, Weedar® (2,4-D) will be applied at the rate of 2 to 4 quarts per acre (or 4 pounds equivalent per acre) with an instantaneous concentration of 1,200 to 9,600 parts per million (ppm) from the sprayer unit nozzle (actual concentration of active ingredient is 46.8 percent therefore 560 ppm to 4,800 ppm). Instantaneous field concentrations for the herbicide were calculated by DBW to be 1.50 mg/L to 3.10 mg/L in 1 acre-foot of water, and 150 µg/L to 310 µg/L per 10 acre-feet of water if all of the herbicide were to enter the water and complete mixing were to occur. However, actual field concentrations are likely to be much different. Less than 10 to 20 percent of the herbicide enters the water column from the overlying water hyacinth mat, but mixing is neither instantaneous nor homogenous. In addition, complete mixing will only occur after an appreciable time lag, and herbicide concentrations may be substantially higher in the microzone near the surface of the water directly beneath the treated vegetation.

The typical Weedar® concentrations found in the field are expected to be much less than the expected acute toxicity levels (LC_{50}) for 96-hour exposure studies. The 96-hour LC_{50} for 2,4-D for rainbow trout (*O. mykiss*) ranges from ~100 mg/L (Johnson and Finley 1980) to more than 1000 mg/L (Doe *et al.* 1988). The formulation of 2,4-D has been shown to affect toxicity, with the acid and amine forms considerably less toxic to different species of salmonids than the ester formulations (Meehan *et al.* 1974). The levels of toxicity of 2,4-D have been shown to be affected by ambient environmental pH, with the toxicity of the compound decreasing with increasing pH. This is due to the degree of dissociation of the acidic herbicide (Doe *et al.* 1988). Water hardness has also been implicated as a factor in affecting 2,4-D toxicity to salmonids. Hard water was shown to reduce the toxicity of the 2,4-D to different species of salmonids (Wan *et al.* 1991). Invertebrates have been shown to have differing sensitivities to 2,4-D (George *et al.* 1982, Sarkar 1991, and Abdelghani *et al.* 1997) and are frequently more sensitive to 2,4-D than fish.

Physiological and morphological alterations have been seen in fish exposed to 2,4-D. Common changes seen in physiological parameters are changes in enzyme activity levels (Nešković *et al.*, 1994). Exposure to 2,4-D has also been shown to cause morphological changes in gill epithelium in carp. These changes include lifting of the gill epithelium and clubbing of gill filaments, but are considered non-lethal if the fish is removed to clean water for recovery (Nešković *et al.* 1994). In field conditions this would be equivalent to swimming to an untreated area or the herbicide concentration falling off to negligible levels. Carpenter and Eaton (1983) investigated the metabolism of 2,4-D in rainbow trout after injection, and found that almost 99

percent of the compound is excreted in the urine as unchanged 2,4-D, with a half-life of only 2.4 hours. Less than 1 percent was found in the bile of treated fish, presumably as a conjugated metabolite. Similar results were shown for metabolic studies in channel catfish (*Ictalurus punctatus*) where 2,4-D was administered orally (Plakas *et al.* 1992). The responses described in the references above all occurred at considerably higher exposure concentrations than are expected to be seen in the WHCP applications in the Delta.

NMFS has queried the EPA's toxicology database and has not found any citations for sturgeon exposure to 2,4-D. Therefore, NMFS will assume that green sturgeon will be protected by the most sensitive LC_{50} values found in the database for fish exposures to 2,4-D.

Assuming a worst case situation, using the highest predicted environmental concentration (3.1 mg/L) and the lowest LC_{50} for salmonids (100 mg/L), the ambient environmental concentration of 2,4-D at the time of application is still approximately 32 times lower than the 96-hour LC_{50} for salmonids. Furthermore, the concentration of 2,4-D is expected to decrease through dilution and mixing by local water movement. Weedar® is also readily degraded in aquatic systems; its decomposition is enhanced with increased levels of nutrients, sediment loads, and dissolved organic carbon levels. Under field conditions, Weedar® is expected to have a half-life of several days to several weeks (Extoxnet 2001). The environmental fate characteristics of 2,4-D and the application rates used in the WHCP would indicate that the concentration levels of the herbicide achieved in Delta waters should be significantly below the acute toxicity levels of listed salmonids (and presumably green sturgeon) which would lead to death immediately following herbicide applications.

However, sublethal effects are of concern. As mentioned previously, these are the category of effects that are most likely to occur during this program. Sublethal effects are characterized as those that occur at concentrations that are below those that lead directly to death. Sublethal effects produce less obvious effects on behavior, biochemical and/or physiological functions and the histology of the fish. In addition, potential narcosis in exposed fish can lead to negative effects including increased predation and death as described above. Degradation of critical habitat is expected to occur due to decreases in DO, decreases in the invertebrate standing population which reduces the forage base available to the juvenile salmonids and changes in water quality, particularly ambient water temperature due to a decrease in vegetated cover. In addition, changes in the sensitivities of fish to other contaminants, particularly pesticides and other aromatic hydrocarbons, may increase the mortality of exposed fish. Furthermore, recent medical studies in humans have shown correlations with the usage of herbicides, particularly phenoxy acetic acid herbicides (*e.g.* 2,4- D) to increases in spontaneous abortions (Arbuckle *et al.* 2001) in Ontario farm populations, presence of phenoxy residues in Ontario farmers' sperm (Arbuckle *et al.* 1999), parkinsonism from glyphosate exposure (Barbosa *et al.* 2001), short term decreases in immunological indices in farmers exposed to phenoxy herbicides (Faustini *et al.* 1996) and an increased risk of non-Hodgkin lymphoma from herbicide and pesticide exposures (Lynge 1998, Hardell and Eriksson 1999, McDuffie *et al.* 2001). The epidemiological data for humans exposed to herbicides would indicate that there is sufficient concern to warrant restricted usage of the compounds in aquatic environmental settings until more extensive physiological research is conducted.

b. *Rodeo®*

Under the WHCP, Rodeo® will be applied at the rate of 0.75 to 1.0 gallon of herbicide per 100 gallons of water with an instantaneous concentration of 7,200 to 9,600 ppm from the sprayer unit nozzle (actual concentration of active ingredient is 53.8 percent therefore 3,900 ppm to 5,200 ppm). Instantaneous field concentrations for the herbicide were calculated by DBW to be 2.3 mg/L to 3.10 mg/L in 1 acre-foot of water, and 230 µg/L to 310 µg/L per 10 acre-feet of water if all of the herbicide were to enter the water and complete mixing were to occur. However, actual field concentrations are likely to be different than the theoretical concentrations. DBW believes that only 10 to 20 percent of the herbicide enters the water column after spraying the exposed foliage of the floating water hyacinth mats. The volume of herbicide that does enter the water column will only have complete mixing after an appreciable time lag as water current movements disperse the herbicides within the treatment area. Thus, herbicide concentrations may be substantially higher in the microzone near the surface of the water following the initial movement of the herbicides from the overlying water hyacinth mat into the water body beneath them.

Typical field concentrations of Rodeo® are expected to be less than the acute 96-hour LC_{50} for glyphosate, the active ingredient of the herbicide Rodeo®. However the acute toxicity levels for the formulated mixture found in Rodeo® are higher than that for glyphosate alone. This has been attributed to the addition of surfactants to the mixture. The 96-hour LC_{50} for Rodeo®, calculated as the glyphosate acid for rainbow trout and Chinook salmon ranges from 130 mg/L to 140 mg/l in soft water to 210 mg/L to 290 mg/L in hard water for rainbow trout and Chinook salmon respectively (Mitchell *et al.* 1987a). Wan *et al.* (1989) also found a correlation between water hardness and toxicity for five species of salmonids (coho, chum, Chinook, and pink salmons and rainbow trout [*Oncoryhnchus* spp]). In soft water, Chinook salmon and rainbow trout had similar sensitivities to the herbicide, 19 mg/L to 10 mg/L respectively as glyphosate, and 33 mg/L as Roundup® (a terrestrial formulation of the aquatic herbicide Rodeo® with different surfactants). However in hard water, the LC_{50} for glyphosate was 197 mg/L and 211 mg/L for rainbow trout and Chinook salmon, respectively, considerably less toxic than in soft water. Conversely, the Roundup® formulation was more toxic in hard water, with an LC_{50} equal to 14 mg/l and 17 mg/L for trout and salmon respectively. Folmar *et al.* (1979) found the 96-hour LC_{50} for several different invertebrate and fish species, including rainbow trout. Acute toxicities to rainbow trout were 8.3 mg/L for Roundup® and 140 mg/L for technical glyphosate. The toxicity for the surfactant alone was similar to that of Roundup®, 2.0 mg/L versus 8.3 mg/L for Roundup®.

Folmar *et al.* (1979) also investigated the effects of glyphosate on the reproductive success and behavior of rainbow trout. No significant effects were detected between the control fish and those exposed to the glyphosate in either their gonadal somatic index or fecundity when exposed to 2 mg/L of glyphosate for 12 hours followed by a 30-day recovery period in freshwater. The data found in Folmar *et al.* (1979) indicates that eggs of rainbow trout are less sensitive to the toxicity of Roundup® than other life stages. This is an expected result as the water hardening of the egg's chorion prevents large molecules from crossing into the interior of the egg. After hatching, toxicity increased at the yolk-sac stage and early swim up stages, but decreased in the fingerling stage, as fish grew larger. The values for the 96-hour LC_{50} exposures are as follows:

eyed eggs – 16 mg/L; sac-fry –3.4 mg/L; swim-up fry – 2.4 mg/L; fingerling (1.0 g) - 1.3 mg/L; and fingerling (2.0 g) – 8.3 mg/L. Rainbow trout also did not avoid concentrations of the isopropylamine salt of glyphosate up to 10 mg/L (Folmar 1976, Folmar *et al.* 1979). Morgan *et al.* (1991) found similar reactions of rainbow trout fry exposed to Vision®, a glyphosate based formulation with either 10 percent or 15 percent proprietary surfactant with similar function and use to Roundup®. The nominal concentration that elicited a threshold avoidance reaction from the test fish were 54 ppm for Vision-15 and 150 ppm for Vision-10, roughly two times the LC_{50} for the fish. Threshold effects for alterations in the fish's behavior where observed at 13.5 ppm for Vision-15, and 37.5 ppm for Vision-10 following 24 hours of exposure. These changes were characterized by erratic, gyrating swimming at 24 hours, with the fish eventually becoming moribund at 48 hours.

Physiological studies conducted by Mitchell *et al.* (1987b) on coho salmon showed no apparent adverse effects of exposure of up to 2.3 mg/L of Roundup® in the seawater adaptation of the fish. There were no significant differences in the biochemical and morphological parameters measured in this study between control and treated fish (hematocrit, condition factor, length or weight, or ionoregulatory gill enzymes). Similar findings were made by Janz *et al.* (1991) using the glyphosate herbicide Vision®. Their studies reported that four-hour exposures to sublethal concentrations of Vision did not appear physiologically stressful to juvenile coho salmon, as indicated by secondary stress responses (*i.e.* increased oxygen consumption, plasma glucose and lactate levels, hematocrit and leukocrit). Rainbow trout exposed for two months at concentrations up to 100 g/L of Vision® exhibited no significant effects in foraging behavior, growth, liver tumors, or gill lesions (Morgan and Kiceniuk 1992). However one study did show immunotoxicity to sublethal levels of glyphosate. At concentrations of 2.8 mg/L, El-Gendy *et al.* (1998) showed that exposure for 96-hours could significantly alter lymphocyte proliferation, humoral and cell mediated immunity and protein synthesis in tilapia for up to four weeks after exposure. It should be noted that these responses are rather gross physiological indicators and that few studies have examined cellular or molecular indices of toxicological effects.

NMFS has queried the EPA's toxicology database and has not found any citations for sturgeon exposure to glyphosate based herbicides. Therefore, NMFS will assume that green sturgeon will be protected by the most sensitive LC_{50} values found in the database for fish exposures to glyphosate based herbicides.

Assuming the worst case scenario, the highest instantaneous concentration (3.10 mg/L) and the lowest salmonid LC_{50} for Rodeo® (130 mg/L to 210 mg/L; soft water, hard water), the ambient environmental concentration of Rodeo® at the time of application is still approximately 42 to 68 times lower than the 96-hour LC_{50} for Rodeo® exposure to salmonids. Furthermore, the concentration of glyphosate is expected to decrease due to mixing and dilution in Delta waters after application (but see above also). Glyphosate will also be adsorbed to particulate matter suspended in the water and onto sediments on the bottom of the treated waterways. Bacterial degradation will remove glyphosate from the system and metabolize it to simple carbon compounds. The half-life for glyphosate in aquatic environments is on the order of days to weeks (Extoxnet 2001). The environmental fate characteristics of Rodeo® and the application rates used in the WHCP would indicate that the concentration levels of the herbicide achieved in Delta waters should be significantly below the acutely lethal toxicity levels for listed salmonids

(and presumably green sturgeon) which would lead to death immediately following herbicide applications.

As previously stated for the herbicide 2,4-D, the sublethal effects of glyphosate and the surfactants used to enhance its penetration of the plant cuticle are the most likely toxicological endpoints that will be demonstrated by salmonids and green sturgeon exposed to this herbicide application. The appearance of acute lethality following herbicide application under the WHCP is unlikely, but long term health and behavioral effects can not be ruled out based on the human medical data.

c. *Reward®*

The estimated instantaneous environmental concentration of Reward® at the application rate used in the WHCP (2.8 lbs. per acre) will be approximately 0.37 ppm diquat. The 96-hour LC_{50} for rainbow trout ranges from 11.2 mg/L (Gilderhus 1967) to 21 mg/L (Worthington and Hance 1991). The 8-hour LC_{50} for diquat dibromide is 12.3 mg/L for rainbow trout and 28.5 mg/L for Chinook salmon (Pimental 1971). However, studies by Paul *et al.* (1994) found that diquat was toxic to larval fish as low as 0.74 ppm (96-hour exposure) and would indicate that early life stages may be much more sensitive to diquat than older fish. Folmar's studies (1976) indicated that rainbow trout did not avoid diquat at concentrations up to 10 mg/L (highest concentration tested), nearly the lethal concentration for this species. The concentration of diquat in the Delta waters is expected to decrease rapidly after initial application due to the extensive adsorption of the compound to suspended particulate matter in the water column and sediment on the bottom. The half-life for diquat dibromide can be as little as 48 hours in water (Extoxnet 2001). However, diquat dibromide may persist for longer periods in the bottom sediments. Diquat residues were found 21 days after application in an artificial lake, 1 percent in the water and 19 percent adsorbed to sediments (Extoxnet 2001). Diquat that is adsorbed to particulate matter is purportedly biologically unavailable to aquatic organisms.

Assuming the worst case scenario, using the highest predicted environmental concentration (0.37 ppm) and the most sensitive LC_{50} (0.74 ppm), the instantaneous diquat concentration is still two times lower than the most sensitive LC_{50} values which are for larval fish. The instantaneous concentration is almost 77 times lower than the published LC_{50} values for Chinook and 31 times lower than those for rainbow trout are. The environmental fate characteristics of Reward® and the application rates used in the WHCP would indicate that the concentration levels of the herbicide achieved in Delta waters should be significantly below the acute toxicity levels of listed salmonids.

As mentioned previously, sublethal effects are of concern. Oxidative stress in exposed fish can be expected from the application of diquat dibromide. This reactive compound is subject to redox cycling in which highly reactive oxygen radicals are formed during the regeneration of the parent compound from the reactive intermediate metabolite. Either the reactive intermediate metabolite of the parent diquat compound, or the reactive oxygen radicals can cause deleterious effects on the organism via covalent binding to DNA or proteins thus forming adducts or oxidation of DNA, lipids or proteins within the organism (Schlenk and Di Giulio 2002). The degree to which the stress will manifest itself in the exposed organism depends on the status of

the organisms protective pathways (super oxide dismutase, glutathione reductase and catalase) and their ability to convert the reactive oxygen radicals to less potent forms.

d. *Surfactants*

Surfactants are frequently toxic in their own right. The surfactant R-11 has a 96-hour LC_{50} of 3.8 ppm for rainbow trout, making it considerably more toxic than the glyphosate it is commonly mixed with (Diamond and Durkin 1997). Curran *et al.* (2003) found that R-11 was significantly more toxic to smaller rainbow trout (0.39 g) than it was to larger fish (15.46 g) when the LC_{50} of each size was compared (5.19 ppm v. 6.57 ppm) and that EPA test criterion size (<3g) indicates that differences in fish size may cause differences in the 96-hour LC_{50} as great as 200 percent. Experimental data indicates that the surfactant Agri-Dex is approximately 300 times less toxic than R-11 (3.8 ppm v. >1000 ppm) when their 96-hour LC_{50} values are compared (Diamond and Durkin 1997). Furthermore, the surfactant R-11 has been implicated as causing endocrine disruption in fish and amphibians as one of its constituents is a nonylphenol polyethoxylate (NPE). Nonylphenols are weakly estrogenic, and have been shown to cause endocrine disruption under laboratory conditions at low doses (20 ppb) (United Kingdom Marine Special Areas of Conservation Project 2003). Exposure of male fish to these compounds, nonylphenols and octylphenols, has induced the formation of the lipoprotein vitellogenin (Jobling *et. al.* 1996, Blackburn *et. al.* 1999). Vitellogenin is a lipoprotein normally produced by females and found in the yolk of the eggs. These compounds are lipophilic and have the potential to accumulate in fatty tissues of aquatic organisms. However, the same lipophilic characteristics will also cause the compounds to be absorbed into organic biofilms surrounding particulate matter. These alkylphenols will tend to partition on to particulate matter and, to a large extent, be incorporated into the underlying sediments (Blackburn *et al.* 1999). Chronic toxicity values (No Observed Effects Concentrations) for NPEs and their metabolites have been shown to occur as low as 6 ppb in fish and 3.9 ppb for aquatic invertebrates (Environment Canada 2003). In comparison to the project's herbicides, the surfactant R-11 is more toxic and has a range of effects that present themselves in the low parts per billion concentration range.

As described in the previous sections concerning the herbicides, sublethal effects from the surfactants used in the WHCP may ultimately increase the likelihood of mortality of salmon and steelhead. Sublethal effects are characterized as those that occur at concentrations that are below those that lead directly to death. Sublethal effects may impact the fish's behavior, biochemical, and/or physiological functions, and create histological alterations of the fish's anatomy. In addition, changes in the sensitivities of fish to other contaminants (*i.e.*, chemical synergism), particularly pesticides and other aromatic hydrocarbons, may increase the mortality of exposed fish. Degradation of habitat is expected to occur due to decreases in DO level due to water hyacinth decomposition, decreases in native vegetative cover, decreases in the invertebrate standing population which reduces the forage base available to juvenile salmonids, and changes in ambient water temperature due to changes in the amount of vegetative cover.

e. Bioaccumulation of Herbicides

The high water solubility of Weedar® indicates that the active ingredient (2,4-D) is not likely to bioaccumulate in fish tissues, or undergo maternal transfer into developing ovaries and

associated eggs. Bluegills and channel catfish absorbed only 0.5 percent of radio-labeled 2,4-D during exposures to 2mg/L of the compound in laboratory studies. The amount of 2,4-D absorbed was maximal after 24 hours of exposure, and did not change significantly for the next 7 days. Bluegills administered 2,4-D via intraperitoneal injection, excreted 90 percent of the dose within 6 hours of treatment (Sikka *et al.* 1977). Rainbow trout excrete almost 99 percent of injected 2,4-D in their urine as the unchanged compound, with a half-life of 2.4 hours (Carpenter and Eaton 1983).

There is very low potential for glyphosate (Rodeo®) to bioaccumulate in the tissues of aquatic organisms due to its high water solubility. Furthermore, glyphosate is broken down by microbial actions fairly rapidly, and is subject to photodegradation in the water column. Like Weedar®, Rodeo® strongly adsorbs to particulate matter in the water column and to sediments on the bottom.

There is little bioconcentration of diquat dibromide in fish (Extoxnet 2001). A study on the metabolism and toxicokinetics of diquat dibromide in channel catfish estimated the half-life for diquat to be 35.8 hours (Schultz *et al.* 1995), indicating fairly rapid elimination, and little potential for bioaccumulation.

The nature of salmonid life history in the Delta also diminishes the likelihood of bioaccumulation of the herbicides applied in the WHCP. Listed species of salmonids are transitory in their use of the Delta, residing for only a few weeks to months in the Delta before emigrating to the ocean.

f. Removal of Native Submerged and Emergent Aquatic Vegetation

Native submerged and emergent vegetation may be harmed by the application of herbicides during the WHCP. However, NMFS believes that the harm to native vegetation will be temporary, as new colonizing plants take hold in the treated area. Removal of the thick mats of water hyacinth will allow light penetration to submerged plants in areas previously shaded by these mats. Likewise, the floating mats of water hyacinth will not crowd out emergent plants, which smother and abrade the native plants. Treated areas will also allow the native plants the opportunity to re-colonize these areas without competing with the water hyacinth for space and resources. During periods of juvenile salmonid migration, treated areas may not provide the necessary vegetative cover or food resources needed by the fish. Treatment protocols could possibly magnify this impact as adjacent areas could be treated within 48 hours, thereby increasing the areas devoid of aquatic vegetation or having compromised water quality. NMFS believes that these localized effects will reduce the probability of survival of juveniles emigrating through or rearing in the treatment area. Adjacent untreated acreage could be available to provide shelter and foraging for the juvenile salmonids as they move out of the treated area. However, expenditures of valuable metabolic reserves will have to be utilized for swimming to these new areas, making these reserves unavailable for other physiological needs like growth or smoltification. This shift in the utilization of metabolic energy stores has the potential to decrease the health and hence the survivability of the juvenile salmonid.

g. Declines in the Abundance of Invertebrate Food Resources

The chemical compounds proposed for use in the WHCP should not reach levels toxic to invertebrates if they are applied at the labeled rates. Regions of low DO caused by drifting mats of decaying vegetation or smothering of benthic substrate may cause a localized decrease in populations and diversity of invertebrates. This would temporarily affect salmonid and green sturgeon foraging success in treated areas. Invertebrates have limited ability to migrate out of the treatment area, and thus are more susceptible to the effects of the DO levels. Following treatment, new populations of invertebrates will re-establish themselves through larval re-colonization of the area as soon as habitat conditions are suitable for their growth. Therefore, as a result of the WHCP, portions of the critical habitats for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead will be negatively impacted until water quality is re-established in the treated areas and the native invertebrate species can re-establish themselves in sustainable populations.

VI. CUMULATIVE EFFECTS

For purposes of the ESA, cumulative effects are defined as the effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR §402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultations pursuant to section 7 of the ESA.

Non-Federal actions that may affect the action area include ongoing agricultural activities and increased urbanization. Agricultural practices in the Delta may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow in stream channels flowing into the Delta. Unscreened agricultural diversions throughout the Delta entrain fish including juvenile salmonids. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the Delta. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect salmonid reproductive success and survival rates (Dubrovsky *et al.* 1998, 2000, Daughton 2003).

The Delta and East Bay regions, which include portions of Contra Costa, Alameda, Sacramento, San Joaquin, Solano, Stanislaus, and Yolo Counties, are expected to increase in population by nearly 3 million people by the year 2020 (California Commercial, Industrial, and Residential Real Estate Services Directory 2002). Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. The project site is within the region controlled by San Joaquin County Council of Governments, and the cities of Brentwood, Antioch, Oakley, Lathrop, Modesto, Turlock, Merced, Fresno, and Sacramento. The General Plans for the cities of Stockton, Brentwood, Antioch, Oakley and their surrounding communities anticipate rapid growth for several decades to come, as do the other more established communities. The anticipated growth will occur along both the I-5 and US-99 transit corridors in the east, and Highway 4 in the west.

Increased urbanization also is expected to result in increased wave action and propeller wash in Delta waterways due to increased recreational boating activity. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially resuspending contaminated sediments and degrading areas of submerged vegetation. This in turn would reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids. Increased recreational boat operation in the Delta is anticipated to result in more contamination from the operation of engines on powered craft entering the water bodies of the Delta. In addition to recreational boating, commercial vessel traffic is expected to increase with the redevelopment plans of the Port. Portions of this redevelopment plan have already been analyzed by NMFS for the West Complex (formerly Rough and Ready Island) but the redevelopment of the East Complex, which currently does not have a Federal action associated with it, will also increase vessel traffic as the Port becomes more modernized. Commercial vessel traffic is expected to create substantial entrainment of aquatic organisms through ship propellers as the vessels transit the shipping channel from Suisun Bay to the Port and back again. In addition, the hydrodynamics of the vessel traffic in the confines of the channel will create sediment resuspension, and localized zones of high turbulence and shear forces. These physical effects are expected to adversely affect aquatic organisms, including both listed salmonids and North American green sturgeon resulting in death or injury.

VII. INTEGRATION AND SYNTHESIS

The degree to which Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead may be impacted by the WHCP is a function of their presence within the action area. The proposed period of implementation of the WHCP is from April 1 through November 30, which will overlap with more than half of the migration periods for the two Chinook salmon listed ESUs and the Central Valley steelhead DPS. The period of greatest overlap with the presence of listed juvenile salmonids in the Delta is during the higher flow periods of spring (*e.g.*, from April through June) and fall (*e.g.*, October 1 through November 30). North American green sturgeon are anticipated to be year round residents within the Delta portion of the action area and therefore will be present for the entire application season in the Delta region (April through October 15). The upstream reaches of the San Joaquin River from Mossdale to Hills Ferry are expected to potentially have listed Central Valley steelhead present during the April through June period, based on water temperature profiles and emigration patterns. The upper reaches of the Tuolumne and Merced Rivers above their confluences with the San Joaquin River but below the first impassable barrier (La Grange Dam or Merced Falls Dam respectively) may have juvenile Central Valley steelhead present year round based on the cooler temperatures available below the dams and the life history of steelhead. However, water conditions that favor steelhead residency (*i.e.* faster flows and cooler water temperatures) do not favor water hyacinth infestations. Infestations in these reaches are typically off channel sloughs or isolated water bodies set off from the main channel by receding water levels.

Based on the foregoing analysis, NMFS anticipates that applications of Reward®, Weedar®, or Rodeo® to the waters of the Delta and its tributaries during the WHCP treatment seasons in an

effort to control water hyacinth will not result in acute lethal effects to listed salmonids, unless fish are present in the immediate area during or immediately after the herbicide is applied. Nonetheless, there is a potential for loss of a certain fraction of the migrating population that is exposed to the toxicants. Although fish should not be present in the cores of water hyacinth mats, they may be present along the periphery of the mats, utilizing them for cover from overhead predators. Thus, fish may be exposed to lethal or sublethal concentrations of herbicides that are applied to the margins of the mat or to herbicides present in the water column directly below the mat or flowing out of the area of application.

The most important impacts of the WHCP are expected to occur to juvenile salmonids and green sturgeon, and include sublethal effects and effects to habitat. As stated in Rand (1995), sublethal effects to listed salmonids can be expected to take the form of behavioral, physiological, biochemical, or histological changes in the exposed fish. These changes may not be immediately lethal, but can cause fish to exhibit impaired behaviors (*e.g.*, narcosis) or eventually develop a lesser level of physical health, thus reducing their chances of survival as compared to unexposed fish. Possible consequences include loss of equilibrium, reduced swimming ability, and impaired predator avoidance behavior, which could lead to increased predation risk or reduced foraging ability. Chemical synergism between the WHCP herbicides and other contaminants in the Delta could occur and exacerbate these effects.

The WHCP is expected to result in several temporary degraded habitat conditions. These are expected to include physical disturbance, elevation of water temperature caused by reduced shading, reduction of DO levels resulting from decaying water hyacinth, reduction in the invertebrate forage base for juvenile salmonids and green sturgeon, and reduction of native vegetation which juvenile salmonids may utilize for cover. Even though juvenile salmonids should be able to leave or avoid areas of degraded habitat, they may need to expend valuable metabolic energy to do so. This could result in depleted energy stores that could have been used for other physiological needs, such as growth or smoltification.

As stated previously in the project description, the WHCP proposes to treat 367 possible sites for water hyacinth infestation (see Table 3). These sites range between one to two miles in length. Treatment sites are located throughout the Delta, including portions of the Sacramento River, Steamboat Slough, and Sutter Slough, as well as most of the San Joaquin River watershed between the first dam on each tributary and its confluence downstream with the mainstem of the San Joaquin River and then north along the mainstem of the river to the Delta. Over the last 3 years approximately 2,500 acres were treated annually. The geographical coverage of the WHCP overlaps with the known migration corridors for all three listed salmonids as well as the fall/late fall run of Chinook salmon in the Central Valley. However, DBW has a limited number of spray boats (*i.e.*, in 2002, four full time and three part time crews and boats were used) that can be active on any given weekday. Therefore, only a fraction of the 367 sites can be treated in any given day, and not all sites treated may be within areas expected to support salmonids. Each crew is capable of treating at a maximum 50 acres per a day if conditions are optimal and they work overtime. However, due to environmental and logistical constraints, the treatment acreage is frequently less. In addition to the low number and area of coverage of daily sites for the treatment program, only the waters near the periphery of the water hyacinth mat will have elevated herbicide concentrations capable of having toxicological effects on the fish. Even

though the interior of the mat will have similar elevated concentrations of herbicides following treatment, it is unlikely that any salmonids will be present within the interior due to its low ambient DO levels. Therefore the total area of Delta waters likely to have negative effects on fish during the period of elevated concentrations is far smaller than 50 acres on any given treatment day. As a result, NMFS reasons that very few listed salmonids will be present within areas of toxicological effect. The duration of elevated herbicidal concentrations in the peripheral waters will depend on the rate of mixing that occurs and the subsequent dilution of the herbicide applied to the mat as well as other physical conditions such as adsorption to suspended matter in the water column and water hardness. The dilution of applied herbicides will occur over a period of minutes to hours, dependent on current velocity, tidal stage, and local water quality. These parameters will invariably change on both a spatial and temporal scale in the described action area. Therefore, NMFS expects that areas with elevated herbicide concentrations will be both small and transient in nature, resulting in low levels of exposure to salmonids migrating through the action area and transitory impacts on critical habitat. Degraded habitat conditions eventually will be attenuated as DO levels increase and invertebrates recolonize treated areas. In addition, the removal of water hyacinth eventually may improve habitat conditions for juvenile salmonids if water flow improves and native vegetation colonizes the treated areas, creating shaded habitat. Similarly, it is not anticipated that individual green sturgeons will congregate in application areas in high enough numbers to represent a significant proportion of the population, but rather will be dispersed throughout the channels of the Delta.

NMFS, in previous consultations with DBW and the USDA-ARS, has given guidance for avoidance of listed fish based on temporal and spatial parameters. NMFS has concluded that certain sections of the project area can be treated with minimal potential for exposing listed salmonids and the proposed green sturgeon starting as early as April 1 of the treatment season. These early start dates allow boat crews from DBW to start control measures early in the water hyacinth's growth cycle. The sections that were chosen by NMFS for early start dates have habitats that are unsuitable for salmonids either due to a lack of circulation (eastside sloughs) or physical barriers to prevent salmonid migration into the application area (South Delta region between temporary barriers after the installation of the Head of Old River Barrier). Early applications in the San Joaquin River watershed are based on hydrologic connections between off channel sloughs and ponds and the main channel and the ambient water temperatures in the system. When there is a lack of hydrologic connection between the off channel water bodies and the main water channel, then NMFS believes that any hyporheic flow between the two bodies will be insufficient to carry herbicides between the two water bodies through the gravel and underlying substrate. When water temperatures have become sufficiently elevated to preclude the presence of listed salmonids (greater than 70 °F for seven consecutive days and after May 15) then herbicide treatments may be applied in the main channels of the San Joaquin River and its tributaries. DBW has incorporated these guidelines into its application protocol as described in the project description (see section II (C)(5) of this biological opinion).

While there will be negative impacts to a proportion of the listed salmonid populations that are within the immediate vicinity of a herbicidal application at the moment of application or immediately following it, the exact proportion of each ESU affected by the application is difficult to determine since the density of migrating fish and the timing of migration can vary annually and within seasons based on a myriad of factors. However, as discussed above, only a

small segment of each listed salmonid race is expected to be actually exposed to concentrations sufficiently elevated to have a negative impact on the individual fish. Effects of primary concern are sublethal, as few or no fish are likely to be directly killed during herbicide application. Sublethal effects such as behavioral changes (*e.g.*, swimming, feeding, attraction, avoidance, and predator-prey interactions), physiological changes (*e.g.*, growth, reproduction, and development), biochemical changes (*e.g.*, blood enzyme and ion levels), and histological changes (*e.g.*, degenerative necrosis of the liver, kidneys, and gill lamellae) are expected in the fish that are exposed to areas of elevated herbicide and surfactant concentrations. However, based on the low likelihood of fish exposure to these levels and the small numbers of salmonids likely affected, this level of impact is not expected to detectably reduce the numbers, reproduction, or distribution of the cohorts affected during each year of treatment. Likewise, green sturgeon are not anticipated to spend any length of time in the localized areas of herbicide applications for water hyacinth control. Green sturgeon are expected to rear primarily in the deeper channels and holes of the Delta with transient foraging movements onto the shallow flats during favorable tides. As previously stated, NMFS could not find any data on herbicide exposure to sturgeon species in the EPA database. Therefore, NMFS will assume that the sturgeon will be no more sensitive than the most sensitive fish species available in the database and based on the current analysis would not show signs of acute toxicity from the herbicide concentrations present in the WHCP.

Critical habitat for Sacramento River winter-run Chinook salmon in the project area is not expected to be adversely modified. The majority of the critical habitat in the project area for this ESU is in the Sacramento River, Steamboat, Cache, and Sutter Sloughs. Although some treatment areas will be in the Sacramento River side of the Delta, WHCP operations will be primarily to the south of these waterways in the central and south Delta regions as well as in the San Joaquin River watershed. Critical habitat for the Central Valley spring-run Chinook salmon ESU includes waterways in the central Delta (North Fork Mokelumne River and Georgiana Slough) and waterways in the northern portion of the Delta. The critical habitat for the Central Valley steelhead DPS includes all waters of the Delta that are accessible to anadromous fish, and habitat below the high water line (*i.e.* tidal flats, commonly inundated riparian zones, *etc.*). Critical habitats for Sacramento River winter-run and Central Valley spring-run Chinook salmon and Central Valley steelhead are not expected to be permanently affected in an adverse manner, but rather on a temporary basis following herbicide treatment. The degraded habitat conditions eventually will be attenuated as DO levels increase and invertebrates recolonize treated areas. The removal of water hyacinth eventually may improve habitat conditions for juvenile salmonids if water flow improves and native vegetation colonizes the treated areas, creating shaded habitat and diverse foraging opportunities for juvenile salmon. Therefore, the EDCP is not expected to appreciably reduce the conservation value of designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead. No critical habitat has been proposed for green sturgeon at this time.

VIII. CONCLUSION

A. Formal Consultation

After reviewing the best available scientific and commercial information, the current status of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead, the environmental baseline, the effects of the proposed WHCP, and the cumulative effects, it is NMFS' biological opinion that the WHCP, as proposed, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead, or result in the destruction or adverse modification of the designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead.

B. Conference Consultation

After reviewing the best available scientific and commercial information, the current status of the southern DPS of North American green sturgeon, the environmental baseline, the effects of the proposed WHCP, and the cumulative effects, it is NMFS' biological opinion that the WHCP, as proposed, is not likely to jeopardize the continued existence of the southern DPS of North American green sturgeon.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement (ITS).

The measures described below are non-discretionary and must be undertaken by the USDA-ARS so that they become binding conditions of any grant or permit issued to DBW or their agents, as appropriate, for the exemption in section 7(o)(2) to apply. The USDA-ARS has a continuing duty to regulate the activity covered in this ITS. If the USDA-ARS: (1) fails to assume and implement the terms and conditions of the ITS; and/or (2) fails to require the DBW or its agents to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USDA-ARS and its agents must report the progress of the action and its impact on the species to NMFS as specified in this ITS (50 CFR §402.14[i][3]).

While some measures described below are expected and intended to avoid, minimize, or monitor the take of North American green sturgeon, the prohibitions against taking of listed species in section 9 of the ESA do not apply to proposed North American green sturgeon unless and until

the species is listed. However, NMFS advises the USDA-ARS to consider implementing the following reasonable and prudent measures for proposed North American green sturgeon. If this conference opinion for North American green sturgeon is adopted as a biological opinion following a listing, the measures for North American green sturgeon, with their implementing terms and conditions, will be nondiscretionary.

A. Amount or Extent of Take

NMFS anticipates that the proposed WHCP will result in the incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and North American green sturgeon.

The incidental take is expected to be in the form of death, injury, harassment, and harm from sources such as herbicide exposure, behavioral modifications, increased susceptibility to contaminants in the aquatic system, and depleted DO. Direct take of salmonids from the DBW's activities (*e.g.*, exposure to herbicide applications) is expected to occur primarily to listed salmonids and only during the months of April and May, when listed salmonids are most likely to be present in the Delta. Take from extended changes to the action area (*e.g.*, reductions in forage base species and changes in plant communities) are expected to affect listed salmonids from November 1 through May 31, which includes the entire period when individuals from one or more of the listed ESUs or DPSs may be expected to occur in the action area.

North American green sturgeon are known to spawn only in the Sacramento River drainage. Therefore, NMFS assumes that adverse effects to green sturgeon are most likely to occur in the lowermost portions of the Sacramento and San Joaquin River channels during the application season. Green sturgeon are expected to occur in the action area year-round, although it is anticipated that the highest densities will occur from April through October. Therefore, take from project activities is most likely to occur from April through October during the proposed work window. The occupation of benthic habitat by green sturgeon is expected to increase their vulnerability to water quality changes due to decaying vegetation as compared to listed salmonids.

The numbers of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and North American green sturgeon taken will be difficult to quantify because dead, injured, or impaired individuals will be difficult to detect and recover. Take is expected to include:

1. All Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead fry and juveniles, as well as all North American green sturgeon killed from exposure to lethal and sublethal concentrations of diquat, glyphosate, 2,4-D or surfactants applied to waters of the Delta and the San Joaquin River basins.

2. All Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead fry and juveniles, as well as all North American green sturgeon harmed, harassed, or killed from altered habitat conditions, increased

predation levels, and reductions in health as a result of chemical herbicide exposure or activities resulting from the implementation of the WHCP.

B. Effect of the Take

In the accompanying biological and conference opinion, NMFS determined that the level of anticipated take will not result in jeopardy to the species or destruction or adverse modification of designated or proposed critical habitat.

C. Reasonable and Prudent Measures

Reasonable and Prudent Measures (RPMs) are non-discretionary measures to minimize take that may or may not already be part of the description of the proposed action. They must be implemented as binding conditions for the exemption in section 7(o)(2) to apply. The USDA-ARS has the continuing duty to regulate the activities covered in this incidental take statement. If the USDA-ARS fails to adhere to the terms and conditions of the incidental take statement, or fails to retain the oversight of its contractor(s) to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

NMFS believes that the following RPMs are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead resulting from implementation of the action. These reasonable and prudent measures would also minimize adverse effects on designated critical habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Implementation of these actions will also serve to avoid or minimize adverse effects upon North American green sturgeon, should they be eventually listed, by the actions of the WHCP.

1. Measures shall be taken to reduce impacts to juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and North American green sturgeon from chemical control treatment and/or monitoring activities.

2. Measures shall be taken to reduce the impact of DBW's WHCP boating operations on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central valley steelhead, and North American green sturgeon.

3. Measures shall be taken by DBW to monitor the operations of the WHCP and the ambient Delta hydrologic conditions.

4. Pending the listing of the southern population of North American green sturgeon, the USDA-ARS and their agents will implement additional measures to avoid, minimize, and monitor incidental take of North American green sturgeon from the actions of the WHCP.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the USDA-ARS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. **Measures shall be taken to reduce impacts to juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and North American green sturgeon from chemical control treatment and/or monitoring activities.**

   a. Restrictions to the timing and places of herbicide applications shall comply with the guidelines indicated in the project description for the WHCP as presented in section II (C)(5) of this biological opinion.

   b. Any winter-run Chinook salmon, spring-run Chinook salmon, and steelhead trout mortalities found at or in the vicinity of a treatment site (*i.e.*, within 400 meters) shall be collected, fork length measured and the body placed in a whirl-pak bag. The bag will be labeled with the time, date, location of capture, and a description of the near-shore habitat type and water conditions and frozen. NMFS, Sacramento office shall be notified as soon as possible of any mortalities at 916-930-3600 and a representative of NMFS will collect the frozen specimen.

   c. DBW staff and their assigned agents must follow all Federal and State laws applicable to the use of the herbicides and any adjuvants and apply them in a manner consistent with the product labeling, the current NPDES General Permit if granted, the Description of the Proposed Action, and determinations from the California Department of Pesticide Regulation.

   d. The use of the adjuvant R-11 shall be reduced to minimize its toxic effects on aquatic organisms where practicable. The less toxic adjuvant, Agri-Dex, shall be used in its place. R-11 may be used in the following defined areas during the appropriate application windows. Within the sites on the San Joaquin River south of the intersection of Merced, Madera, and Fresno Counties (sites 900 to 929), R-11 may be used as an adjuvant between June 1 and October 15. Within the Stone Lakes/Beach Lakes area (sites 221-239), R-11 may be used as an adjuvant between June 1 and October 15. R-11 may not be used as an adjuvant elsewhere in the WHCP application areas.

   e. Fish passage shall not be blocked within treatment areas. Protocols shall be followed to ensure that WHCP operations do not inhibit passage of fish in each area scheduled for treatment or exceed limitations on contiguous treated acreage.

   f. The DBW will provide a copy of each week's Notice of Intent to Jeffrey Stuart, Fishery Biologist, Protected Resources Division, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814, by the Friday prior to the treatment week. This

notification will include the sites scheduled for treatment and a contact person for those sites.

g. Jeffrey Stuart will be the appointed NMFS representative on the Water Hyacinth Task Force (Task Force), and provide technical assistance to the Task Force along with carrying out the duties of a Task Force member. As part of the WHCP Task Force, the NMFS representative will be active in guiding decisions on prioritizing treatment sites in regards to the presence of salmonids.

2. **Measures shall be taken to reduce the impact of DBW's WHCP boating operations on the designated critical habitat of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead.**

a. USDA-ARS and DBW shall comply with the receiving water limitations of the General Permit issued for the WHCP in regards to oils, greases, waxes, floating material, or suspended material derived from the operation of program vessels or application activities.

b. The USDA-ARS and DBW shall ensure that any mixing of chemicals, or disinfecting and cleaning of any equipment shall be done in strict accordance with the operational protocols of the WHCP and that all equipment is in working order prior to engaging in application activities, including the operation of the program's vessels.

c. Operation of program vessels in shallow water habitats shall be done in a manner that causes the least amount of disturbance to the habitat. Operational procedures for vessels in these habitats should minimize boat wakes and propeller wash.

d. Operation of program vessels shall avoid or minimize to the greatest practicable extent dislodging portions of existing water hyacinth mats that can drift into other areas. This will avoid or minimize new infestations of the weed due to drifting fragments.

3. **Measures shall be taken by DBW to monitor the operations of the WHCP and the ambient Delta hydrologic conditions.**

a. The USDA-ARS shall ensure that the DBW follows a comprehensive monitoring plan designed to collect project operational information. The monitoring plan shall adhere to the requirements of the General Permit and have at a minimum those water quality criteria stated in Attachment B of the permit, *i.e.* data on water temperatures, DO, pH, turbidity, water hardness, electrical conductivity, and chemical concentrations in the application areas as well as other criteria stated in the attachment. Chemical concentrations (including both herbicides and adjuvants) shall have at a minimum, a pre- and post-application water sample taken at the furthest down current site of the application zone. Additional tests, if required by other Federal and State agencies, shall be conducted and the

information made available to NMFS. The results of this monitoring program will be used to determine if the DBW is affecting Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead to an extent not previously considered.

b. The USDA-ARS, in coordination with the DBW, shall provide bimonthly (*i.e.*, every other month) monitoring reports of the hydrologic conditions and the amounts of chemical discharges to Jeffrey Stuart, NMFS, Sacramento Field Office. These reports shall also include information on the following parameters:

i. Pre-treatment and post-treatment measurements on chemical residues, pH and turbidity levels as well as water temperatures and DO concentrations at selected sites in the Delta. These sites shall be reflective of the different water types found in the range of application sites and will be determined by DBW as part of their NPDES permit conditions.

ii. Receiving water temperatures and DO levels and resultant changes in those conditions resulting from WHCP operations during each month.

iii. Amounts, types, and dates of application of herbicides and adjuvants applied at each site.

iv. Visual assessment of pre- and post-treatment conditions of treated sites to determine the efficacy of treatment and any effects of chemical drift on downstream habitats immediately adjacent to the treated sites.

v. Operational status of equipment and vessels, including repairs and spraying equipment calibrations as needed.

c. The USDA-ARS, in coordination with the DBW, shall summarize the above bimonthly reports into an annual report of the DBW project operations, monitoring measurements and Delta hydrological conditions for the previous treatment year for submission to NMFS by January 31 of each year. The annual report of DBW operations shall also include:

i. A description of the total number of winter-run and spring-run chinook salmon or steelhead observed taken, the manner of take, and the dates and locations of take, the condition of the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead taken, the disposition of fish taken in the event of mortality and a brief narrative of the circumstances surrounding the take of the fish. This report shall be sent to the address given below.

ii. Listed salmonids or other fish species that are observed to be behaving in an erratic manner shall be reported (see Appendix A).

d. All bimonthly reports and the annual report shall be submitted by mail or Fax to:

NMFS Sacramento Field Office
Attn: Supervisor
650 Capitol Mall, Suite 8-300
Sacramento, California 95814
Fax: (916)930-3629

4. **Pending the listing of the southern population of North American green sturgeon, the USDA-ARS and their agents will implement additional measures to avoid, minimize, and monitor incidental take of North American green sturgeon from the actions of the WHCP.**

a. The USDA-ARS will monitor the take of green sturgeon, and record such information for their reports to NMFS required under term and condition 3(C), above.

b. If necessary, USDA-ARS and DBW will coordinate with NMFS to alter herbicide application plans to avoid or minimize take of green sturgeon if field observations indicate that take is occurring.

X. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of pertinent information.

1. The USDA-ARS and DBW should support anadromous salmonid monitoring programs throughout the Delta to improve the understanding of migration and habitat utilization by salmonids in the Delta region.

2. The USDA-ARS and DBW should support and promote aquatic and riparian habitat restoration within the Delta region, and encourage practices that avoid or minimize negative impacts to salmon and steelhead.

3. NMFS recommends that the USDA-ARS encourage alternate non-chemical controls of water hyacinth and other non-native invasive vegetation in the Delta and its tributaries, in conjunction with a re-vegetation program with native plants in the Delta.

4. NMFS recommends that the USDA-ARS and DBW increase public awareness of the potential threats to proper ecosystem function by exotic species introductions such as water hyacinth.

5. NMFS recommends that the USDA-ARS and DBW pro-actively promote state legislation that takes steps to curb the importation and marketing of water hyacinth, and prevent future exotic species introductions into the state.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the actions outlined in the November 14, 2005 BA from the USDA-ARS and the DBW. This biological opinion is valid for the project described for the years 2006 through 2010. As provided for in 50 CFR§402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in any incidental take statement is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an affect to the listed species that was not considered in the biological opinion; or, (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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Appendix A: Tables

Table 2:
Chemical Usage and Acreage Treated during the 2003 through 2005 Treatment Seasons

2003	2,4 - D		Glyphosate		R-11	Agri-dex
Month	Gallons	Acres	Gallons	Acres	Gallons	
April	0	0	0	0	0	0
May	42.69	42.69	90.7	121.16	40.33	0
June	78.08	80.61	105.91	141.96	55.32	0
July	430.45	433.18	38.73	51.83	124.8	0
August	428.75	430.78	46.63	63.19	111.34	0
September	479.78	481.45	49.02	66.64	126.51	0
October	259.37	259.87	35.81	47.74	60.57	0
November	0	0	0	0	0	0
Total	1719.12	1728.58	366.8	492.52	518.87	0

2004	2,4 - D		Glyphosate		R-11	Agri-dex
Month	Gallons	Acres	Gallons	Acres	Gallons	
April	20.5	20.5	136.7	183.65	0	39.77
May	24.86	24.86	109.84	147.17	0	38.14
June	65.77	67.44	92.3	124.37	0	48.01
July	464.12	471.12	47.45	66.17	0	154.78
August	577.57	585.09	36.03	49.15	0	181.91
September	572.31	579.21	53.38	72.88	0	178
October	323.05	328.32	36.85	49.75	0	103.29
November	14.25	14.92	4.28	5.92	0	7.03
Total	2062.43	2091.46	516.83	699.06	0	750.93

2005	2,4 - D		Glyphosate		R-11	Agri-dex
Month	Gallons	Acres	Gallons	Acres	Gallons	
April	26.5	26.5	49.3	65.44	0	24.8
May	17.25	17.25	44.5	59.23	0	23
June	68	68	62.13	82.69	0	50.13
July	549.16	553.56	0.76	0.97	0	188.16
August	600.93	604.93	44.15	58.82	0	229.04
September	401.03	403.03	17.6	23.41	0	143.99
October	240.5	243.83	0.1	0.13	0	77.1
November	0	0	0	0	0	0
Total	1903.37	1917.1	218.54	290.69	0	736.22

Table 3: WHCP Treatment Sites

County	Location	Site Number(s)	Water Type
San Joaquin	San Joaquin River	1,2,3,4,5,	Tidal
San Joaquin	French Camp Slouogh, Walker Slough	6	Tidal
San Joaquin	San Joaquin River	7	Tidal
San Joaquin	Mormon Slough, San Joaquin River Deep Water Ship Channel	8	Tidal
San Joaquin	Burns Cutoff	9	Tidal
San Joaquin	Buckley Cove, San Joaquin River Deep Water Ship Channel	10	Tidal
San Joaquin	Black Slough, Black Slough Landing, 14 Mile Slough, San Joaquin River	11	Tidal
San Joaquin	Turner Cut	12	Tidal
San Joaquin	Heypress Reach, Hog Island Cut, San Joaquin River Deep Water Ship Channel, 21 Mile Slough	13	Tidal
San Joaquin	San Joaquin River	14	Tidal
San Joaquin	Empire Tract Slough	15	Tidal
San Joaquin	Mandeville Cut, Mandeville Reach, San Joaquin River Deep Water Ship Channel, 3 River Reach, Venice Cut, Venice Reach	16	Tidal
San Joaquin	Potato Slough	17	Tidal
San Joaquin	Mokelumne River	18	Tidal
Contra Costa	San Joaquin River	19	Tidal
Sacramento	San Joaquin River, 7-Mile Cut	20	Tidal
Contra Costa	San Joaquin River	21	Tidal
Sacramento	Sacramento River, 3-Mile Slough	22	Tidal
Sacramento	Lake Natoma	none	Slow Moving
Contra Costa, Sacramento	False River, San Joaquin River	23	Tidal
Contra Costa, Sacramento	San Joaquin River	24	Tidal
San Joaquin	14 Mile Slough	25	Tidal
San Joaquin	14 Mile Slough	26,28,29	Tidal
San Joaquin	5 Mile Slough	27	Tidal
San Joaquin	Mosher Slough	30	Tidal
San Joaquin	Bear Creek, Disappointment Slough, Pixley Slough	31	Tidal
San Joaquin	Disappointment Slough	32,33	Tidal
San Joaquin	Bishop Cut	34	Tidal
San Joaquin	Telephone Cut	35	Tidal
San Joaquin	White Slough	36,37,39	Tidal
San Joaquin	Bishop Cut	38	Tidal
San Joaquin	Little Potato Slough	40,41	Tidal
San Joaquin	Little Connection Slough	42	Tidal
San Joaquin	Potato Slough	43,44	Tidal
San Joaquin	Middle River	45,46,47,48,49,52,53,56,58,59,66,67,68	Tidal
San Joaquin	North Canal, Victoria Canal	50,51	Tidal
San Joaquin	North Victoria Canal, Woodard Canal	54,55	Tidal
San Joaquin	Railroad Cut	57	Tidal
San Joaquin	Empire Cut	60	Tidal

County	Location	Site Number(s)	Water Type
San Joaquin	Whiskey Slough	61,62,63	Tidal
San Joaquin	Trapper Slough	64	Tidal
San Joaquin	Latham Slough	65	Tidal
San Joaquin	Connection Slough, Middle River	69	Tidal
San Joaquin	Old River	70,71	Tidal
San Joaquin	Old River, Paradise Cut	72	Tidal
San Joaquin	Old River, Paradise Cut, Salmon Slough	73	Tidal
San Joaquin	Sugar Cut, Tom Paine Slough	74	Tidal
San Joaquin	Old River	75,76,77,78,79,83,84,85,87,89,90,91,92,98,99	Tidal
San Joaquin	Fabian & Bell Canal, Grant Line Canal	80,81,82	Tidal
Contra Costa	Italian Slough	88	Tidal
Contra Costa	Indian Slough	93	Tidal
Contra Costa	Warner Dredge Cut	94,95,96	Tidal
Contra Costa	Rock Slough	97	Tidal
San Joaquin	Connection Slough, Old River	100	Tidal
San Joaquin	Old River	101	Tidal
Contra Costa	Sheep Slough	102	Tidal
Contra Costa, San Joaquin	Old River	103,104	Tidal
Contra Costa	False River,	105	Tidal
Contra Costa	Fisherman's Cut	106	Tidal
Contra Costa	Piper Slough	107	Tidal
Contra Costa	Roosevelt Cut, Sand Mound Slough	108	Tidal
Contra Costa	Sand Mound Slough	109	Tidal
Contra Costa	Taylor Slough	110,111	Tidal
Contra Costa	Dutch Slough, Emerson Slough	112	Tidal
Contra Costa	Dutch Slough	113, 114	Tidal
Contra Costa	Big Break	115,116,117,118	Tidal
Contra Costa, Sacramento	San Joaquin River	119,120,121	Tidal
Sacramento	Sherman Lake	**132**	Tidal
Contra Costa	Frank's Tract	**173, 174, 175**	Tidal
Solano	Sacramento River, Decker Isalnd	176	Tidal
San Joaquin	South Mokelumne River	200, 201, 202, 204, 206, 208	Tidal
San Joaquin	Sycamore Slough	203	Tidal
San Joaquin	Hog Slough	205	Tidal
San Joaquin	Beaver Slough	207	Tidal
Sacramento, San Joaquin	North Mokelumne River	209, 210,211,2113	Tidal
Sacramento, San Joaquin	Snodgrass Slough, Delta Cross Channel	**212**	To Be Determined
Sacramento	Snodgrass Slough	214, 215, 216,217, 218, 219	Tidal
Sacramento	Stone Lakes	220, 221, 222, 223, 224, 225, 226, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239	Tidal

Table 3: WHCP Treatment Sites

County	Location	Site Number(s)	Water Type
Sacramento, Solano	Sacramento River	**240**	To Be Determined
Sacramento	Sacramento River	**241, 242, 243, 244, 245**	To Be Determined
Sacramento, Yolo	Sacramento River	**246, 247, 248, 249, 250**	To Be Determined
Sacramento, Solano	Steamboat Slough	**251, 252, 253**	To Be Determined
Sacramento	Steamboat Slough	**254, 255**	To Be Determined
Sacramento, Solano	Sutter Slough	**256, 257**	To Be Determined
Sacramento	Sutter Slough	**258,259**	To Be Determined
Soalno, Sacramento	Cache Slough	**260**	To Be Determined
Solano	Cache Slough	**261, 272, 277, 278, 280**	To Be Determined
Solano	Miner Slough	**262, 263,264, 265, 266**	To Be Determined
Solano	Prospect Lsough	**267**	To Be Determined
Solano, Yolo	Sacramento Deep Water Ship Channel	**268**	To Be Determined
Solano	Tox Drain, Liberty	**270**	To Be Determined
Solano, Yolo	Tox Drain, Liberty	**271**	To Be Determined
Solano	Shag Slough	**273, 274**	To Be Determined
Solano, Yolo	Shag Slough	**275, 276**	To Be Determined
Solano	Hass Slough, Duck Slough	**279**	To Be Determined
Solano	Lindsey Slough	**281, 282, 283, 284**	To Be Determined
Sacramento	Georgiana Slough	**285, 286, 287, 288, 289**	To Be Determined
San Joaquin	San Joaquin River	300, 302, 303, 304, 305, 306, 307, 308, 309	Fast or Slow Moving
San Joaquin	Wethall Slough	301	Fast or Slow Moving
Stanislaus	San Joaquin River	310, 313, 314, 316, 318, 319, 320, 321, 322, 323	Fast or Slow Moving
Stanislaus	Brush Lake	316	Fast or Slow Moving
Stanislaus	Finnegan Cut, San Joaquin River	311, 312	Fast or Slow Moving
Stanislaus	Laird Slough	315	Fast or Slow Moving
Stanislaus	Del Puerto Creek, San Joaquin River	317	Fast or Slow Moving
Stanislaus	Lake Ramona	320	Fast or Slow Moving
Merced, Stanislaus	San Joaquin River	324, 325	Fast or Slow Moving

Table 3: WHCP Treatment Sites

County	Location	Site Number(s)	Water Type
Merced	San Joaquin River	401, 403, 414, 415, 417, 418, 419, 421,422, 423, 424, 425, 426, 427	Fast or Slow Moving
Merced	Snag Slough, San Joaquin River	402	Fast or Slow Moving
Merced	Salt Slough	405, 406, 407, 408, 409, 410, 412, 413	Fast or Slow Moving
Merced	Poso Slough	414A	Fast or Slow Moving
Merced	Mud Slough	411	Fast or Slow Moving
Merced	Bear Creek, Bravel Slough	416	Fast or Slow Moving
Merced	San Joaquin River	**420**	To Be Determined
Merced	Merced River	500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 517, 518, 519, 520, 521, 522, 523, 524, 526, 527, 530, 532	Fast or Slow Moving
Merced	Ingalsbe Slough, Hope Town Slough	516	Fast or Slow Moving
Merced	Ingalsbe Slough	525	Fast or Slow Moving
Merced	Merced River, North Canal	528, 529	Fast or Slow Moving
Merced	Main Canal	531, 533, 537	Fast or Slow Moving
Merced	Main Canal, Canal Creek	534, 535	Fast or Slow Moving
Merced	Main Canal, Parkinson Creek	536	Fast or Slow Moving
Stanislaus	Stanislaus River	600	Fast or Slow Moving
Stanislaus	Toulumne River	700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718	Fast or Slow Moving
Fresno	San Joaquin River	900, 901, 902, 903, 904, 905, 909, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929	Fast or Slow Moving
Fresno, Madera	Firebaugh	**906, 907, 908**	To Be Determined
Fresno	San Joaquin River, Mendota Pool	910	Fast or Slow Moving
Fresno	Fresno Slough	910A, 910B	Fast or Slow Moving

Table 3: WHCP Treatment Sites

Bold Numbers are new treatment sites as of 2003.

Table 6:

Monthly Occurrences of Dissolved Oxygen Depressions below the 5mg/L Criteria in the Stockton Deepwater Ship Channel (Rough and Ready Island DO monitoring site) Water Years 2000 to 2004

	Water Year					
Month	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**Monthly Sum**
September	0	26**	30**	16**	30**	102
October	0	0	7	0	4	11
November	0	0	12	0	3	15
December	6	4*	13	2	13	38
January	3	4	19	7	0	33
February	0	25	28	13	0	66
March	0	7	9	0	0	16
April	0	4	4	0	0	8
May	2*	0	2	4	0	8
Yearly Sum	11	70	124	42	50	**Total=297**

* = Suspect Data – potentially faulty DO meter readings

** = Wind driven and photosynthetic daily variations in DO level; very low night-time DO levels, high late afternoon levels

Table 7. Salmon and Steelhead monitoring programs in the Sacramento - San Joaquin River basins, and Suisun Marsh.

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
Central Valley	***Chinook salmon, Steelhead***	Sacramento River	Scale and otolith collection	Coleman National Hatchery, Sacramento River and tributaries	Scale and otolith microstructure analysis	Year-round	CDFG
		Sacramento River and San Joaquin River	Central Valley angler survey	Sacramento and San Joaquin rivers and tributaries downstream to Carquinez	In-river harvest	8 or 9 times per month, year-round	CDFG
		Sacramento River	Rotary screw trap	Upper Sacramento River at Balls Ferry and Deschutes Road Bridge	Juvenile emigration timing and abundance	Year round	CDFG
		Sacramento River	Rotary screw trap	Upper Sacramento River at RBDD	Juvenile emigration timing and abundance	Year round	FWS
		Sacramento River	Ladder counts	Upper Sacramento River at RBDD	Escapement estimates, population size	Variable, May - Jul	FWS
		Sacramento River	Beach seining	Sacramento River, Caldwell Park to Delta	Spatial and temporal distribution	Bi-weekly or monthly, year-round	FWS
		Sacramento River	Beach seining, snorkel survey, habitat mapping	Upper Sacramento River from Battle Creek to Caldwell Park	Evaluate rearing habitat	Random, year-round	CDFG
		Sacramento River	Rotary screw trap	Lower Sacramento River at Knight's Landing	Juvenile emigration and post-spawner adult steelhead migration	Year-round	CDFG
		Sacramento-San Joaquin basin	Kodiak/Midwater trawling	Sacramento River at Sacramento, Chipps Island, San Joaquin River at Mossdale	Juvenile outmigration	Variable, year-round	FWS
		Sacramento-San Joaquin Delta	Kodiak trawling	Various locations in the Delta	Presence and movement of juvenile salmonids	Daily, Apr - Jun	IEP
		Sacramento-San Joaquin Delta	Kodiak trawling	Jersey Point	Mark and recapture studies on juvenile salmonids	Daily, Apr - Jun	Hanson Environmental Consultants
Central Valley	***Chinook salmon, Steelhead, Continued***	Sacramento-San Joaquin Delta	Salvage sampling	CVP and SWP south Delta pumps	Estimate salvage and loss of juvenile salmonids	Daily	USBR/CDFG

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
		Battle Creek	Rotary screw trap	Above and below Coleman Hatchery barrier	Juvenile emigration	Daily, year-round	FWS
		Battle Creek	Weir trap, carcass counts, snorkel/ kayak survey	Battle Creek	Escapement, migration patterns, demographics	Variable, year-round	FWS
		Clear Creek	Rotary screw trap	Lower Clear Creek	Juvenile emigration	Daily, mid Dec- Jun	FWS
		Feather River	Rotary screw trap, Beach seining, Snorkel survey	Feather River	Juvenile emigration and rearing, population estimates	Daily, Dec - Jun	DWR
		Yuba River	Rotary screw trap	lower Yuba River	Life history evaluation, juvenile abundance, timing of emergence and migration, health index	Daily, Oct - Jun	CDFG
		Feather River	Ladder at hatchery	FRH	Survival and spawning success of hatchery fish (spring-run Chinook salmon), determine wild vs. hatchery adults (steelhead)	Variable, Apr - Jun	DWR, CDFG
		Mokelumne River	Habitat typing	Lower Mokelumne River between Camanche Dam and Cosumnes River confluence	Habitat use evaluation as part of limiting factors analysis	Various, when river conditions allow	EBMUD
		Mokelumne River	Redd surveys	Lower Mokelumne River between Camanche Dam and Hwy 26 bridge	Escapement estimate	Twice monthly, Oct 1- Jan 1	EBMUD
		Mokelumne River	Rotary screw trap, mark/recapture	Mokelumne River, below Woodbridge Dam	Juvenile emigration and survival	Daily, Dec- Jul	EBMUD
		Mokelumne River	Angler survey	Lower Mokelumne River below Camanche Dam to Lake Lodi	In-river harvest rates	Various, year-round	EBMUD
Central Valley	***Chinook salmon, Steelhead, Continued***	Mokelumne River	Beach seining, electrofishing	Lower Mokelumne	Distribution and habitat use	Various locations at various times throughout the year	EBMUD
		Mokelumne River	Video monitoring	Woodbridge Dam	Adult migration timing, population estimates	Daily, Aug - Mar	EBMUD

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
		Calaveras River	Adult weir, snorkel survey, electrofishing	Lower Calaveras River	Population estimate, migration timing, emigration timing	Variable, year-round	Fishery Foundation
		Stanislaus River	Rotary screw trap	lower Stanislaus River at Oakdale and Caswell State Park	Juvenile outmigration	Daily, Jan - Jun, dependent on flow	S.P. Cramer
		San Joaquin River basin	Fyke nets, snorkel surveys, hook and line survey, beach seining, electrofishing	Stanislaus, Tuolumne, Merced, and mainstem San Joaquin rivers	Presence and distribution, habitat use, and abundance	Variable, Mar- Jul	CDFG
	Central Valley Steelhead	Sacramento River	Angler Survey	RBDD to Redding	In-river harvest	Random Days, Jul 15 - Mar 15	CDFG
		Battle Creek	Hatchery counts	CNFH	Returns to hatchery	Daily, Jul 1 - Mar 31	FWS
		Clear Creek	Snorkel survey, redd counts	Clear Creek	Juvenile and spawning adult habitat use	Variable, dependent on river conditions	FWS
		Mill Creek, Antelope Creek, Beegum Creek	Spawning survey - snorkel and foot	Upper Mill, Antelope, and Beegum Creeks	Spawning habitat availability and use	Random days when conditions allow, Feb - Apr	CDFG
		Mill Creek, Deer Creek, Antelope Creek	Physical habitat survey	Upper Mill, Deer, and Antelope Creeks	Physical habitat conditions	Variable	USFS
		Dry Creek	Rotary screw trap	Miner and Secret Ravine's confluence	Downstream movement of emigrating juveniles and post-spawner adults	Daily, Nov- Apr	CDFG
		Dry Creek	Habitat survey, snorkel survey, PIT tagging study	Dry Creek, Miner and Secret Ravine's	Habitat availability and use	Variable	CDFG
Central Valley	***Central Valley Steelhead Continued***	Battle Creek	Otolith analysis	CNFH	Determine anadromy or freshwater residency of fish returning to hatchery	Variable, dependent on return timing	FWS
		Feather River	Hatchery coded wire tagging	FRH	Return rate, straying rate, and survival	Daily, Jul - Apr	DWR

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
		Feather River	Snorkel survey	Feather River	Escapement estimates	Monthly, Mar to Aug (upper river), once annually (entire river)	DWR
		Yuba River	Adult trap	lower Yuba River	Life history, run composition, origin, age determination	Year-round	Jones and Stokes
		American River	Rotary screw trap	Lower American River, Watt Ave. Bridge	Juvenile emigration	Daily, Oct- Jun	CDFG
		American River	Beach seine, snorkel survey, electrofishing	American River, Nimbus Dam to Paradise Beach	Emergence timing, juvenile habitat use, population estimates	Variable	CDFG
		American River	Redd surveys	American River, Nimbus Dam to Paradise Beach	Escapement estimates	Once, Feb - Mar	CDFG, BOR
		Mokelumne River	Electrofishing, gastric lavage	Lower Mokelumne River	Diet analysis as part of limiting factor analysis	Variable	EBMUD
		Mokelumne River	Electrofishing, hatchery returns	Lower Mokelumne River, Mokelumne River hatchery	O. Mykiss genetic analysis to compare hatchery returning steelhead to residents	Variable	EBMUD
		Calaveras River	Rotary screw trap, pit tagging, beach seining, electrofishing	lower Calaveras River	Population estimate, migration patterns, life history	Variable, year-round	S.P. Cramer
		San Joaquin River basin	Fyke nets, snorkel survey, hook and line survey, beach seining, electrofishing, fish traps/weirs	Stanislaus, Tuolumne, Merced, and mainstem San Joaquin rivers	Presence, origin, distribution, habitat use, migration timing, and abundance	Variable, Jun - Apr	CDFG
		Merced River	Rotary screw trap	Lower Merced River	Juvenile oumigration	Variable, Jan-Jun	Natural Resource Scientists, Inc.
Central Valley	***Central Valley Steelhead Continued***	Central Valley-wide	Carcass survey, hook and line survey, electrofishing, traps, nets	Upper Sacramento, Yuba, Mokelumne, Calaveras, Tuolumne, Feather, Cosumnes, and Stanislaus Rivers, and Mill, Deer, Battle, and Clear Creeks	Occurrence and distribution of *O. Mykiss*	Variable, year-round	CDFG

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
		Central Valley - wide	Scale and otolith sampling	Coleman NFH, Feather, Nimbus, Mokelumne River hatcheries	Stock identification, juvenile residence time, adult age structure, hatchery contribution	Variable upon availability	CDFG
		Central Valley - wide	Hatchery marking	All Central Valley Hatcheries	Hatchery contribution	Variable	FWS, CDFG
	Sacramento River Winter-run Chinook salmon	Sacramento River	Aerial redd counts	Keswick Dam to Princeton	Number and proportion of reds above and below RBDD	Weekly, May 1-July 15	CDFG
		Sacramento River	Carcass survey	Keswick Dam to RBDD	In-river spawning escapement	Weekly, Apr 15-Aug 15	FWS, CDFG
		Battle Creek	Hatchery marking	Colemen National Fish Hatchery	Hatchery contribution	Variable	FWS, CDFG
		Sacramento River	Ladder counts	RBDD	Run-size above RBDD	Daily, Mar 30- Jun 30	FWS
		Pacific Ocean	Ocean Harvest	California ports south of Point Arena	Ocean landings	May 1- Sept 30 (commercial), Feb 15 - Nov 15 (sport)	CDFG
	Central Valley Spring-run Chinook salmon	Mill, Deer, Antelope, Cottonwood, Butte, Big Chico Creeks	Rotary screw trap, snorkel survey, electrofishing, beach seining	upper Mill, Deer, Antelope, Cottonwood, Butte, and Big Chico creeks	Life history assessment, presence, adult escapement estimates	Variable, year-round	CDFG
		Feather River	Fyke trapping, angling, radio tagging	Feather River	Adult migration and holding behavior	Variable, Apr-June	DWR
		Yuba River	Fish trap	lower Yuba River, Daguerre Point Dam	Timing and duration of migration, population estimate	Daily, Jan - Dec	CDFG
<u>Suisun Marsh</u>	***Chinook salmon***	Suisun Marsh	Otter trawling, beach seining	Suisun Marsh	Relative population estimates and habitat use	Monthly, year-round	UC Davis
		Suisun Marsh	Gill netting	Suisun Marsh Salinity Control Gates	Fish passage	Variable, Jun - Dec	CDFG

Appendix B: Figures

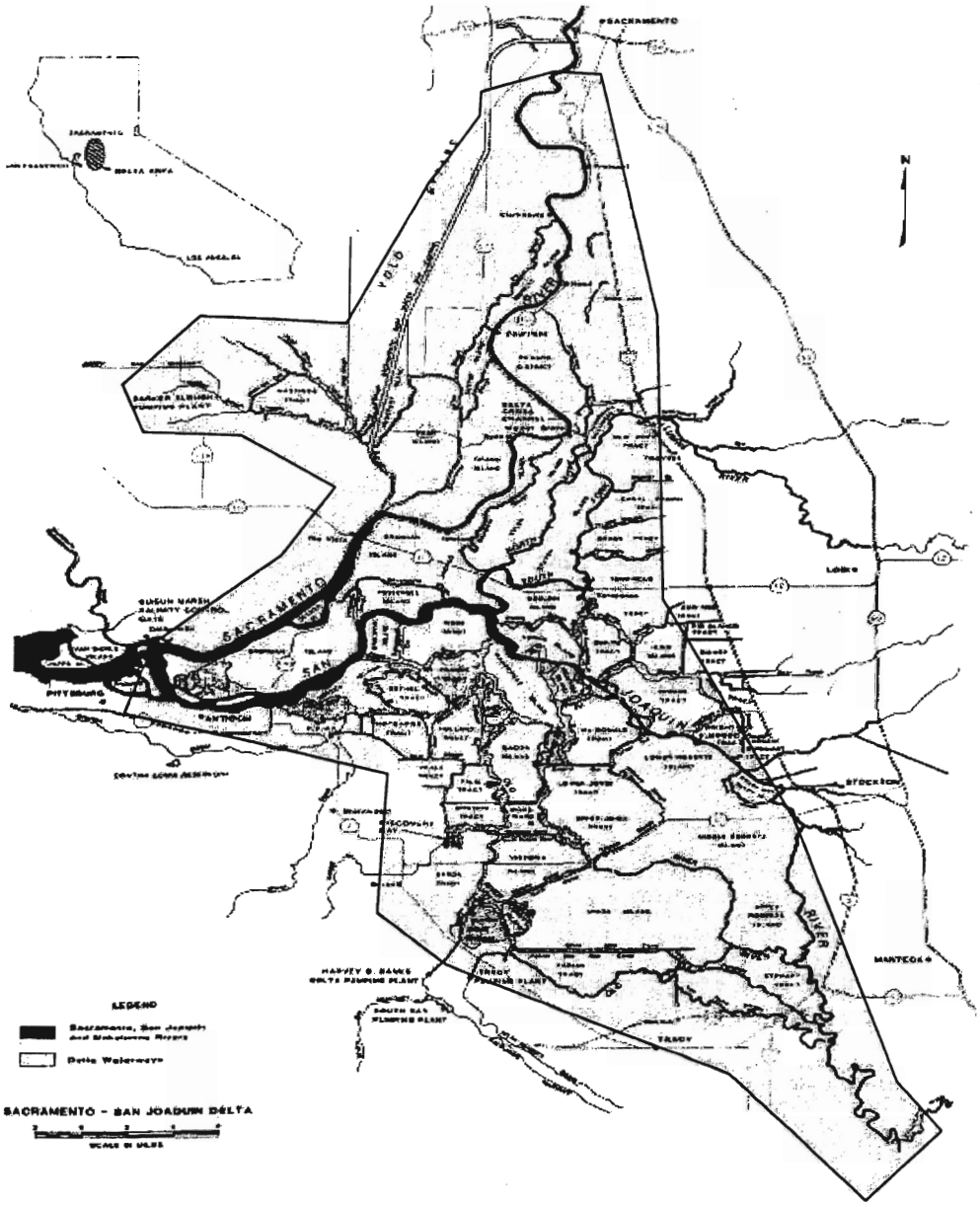
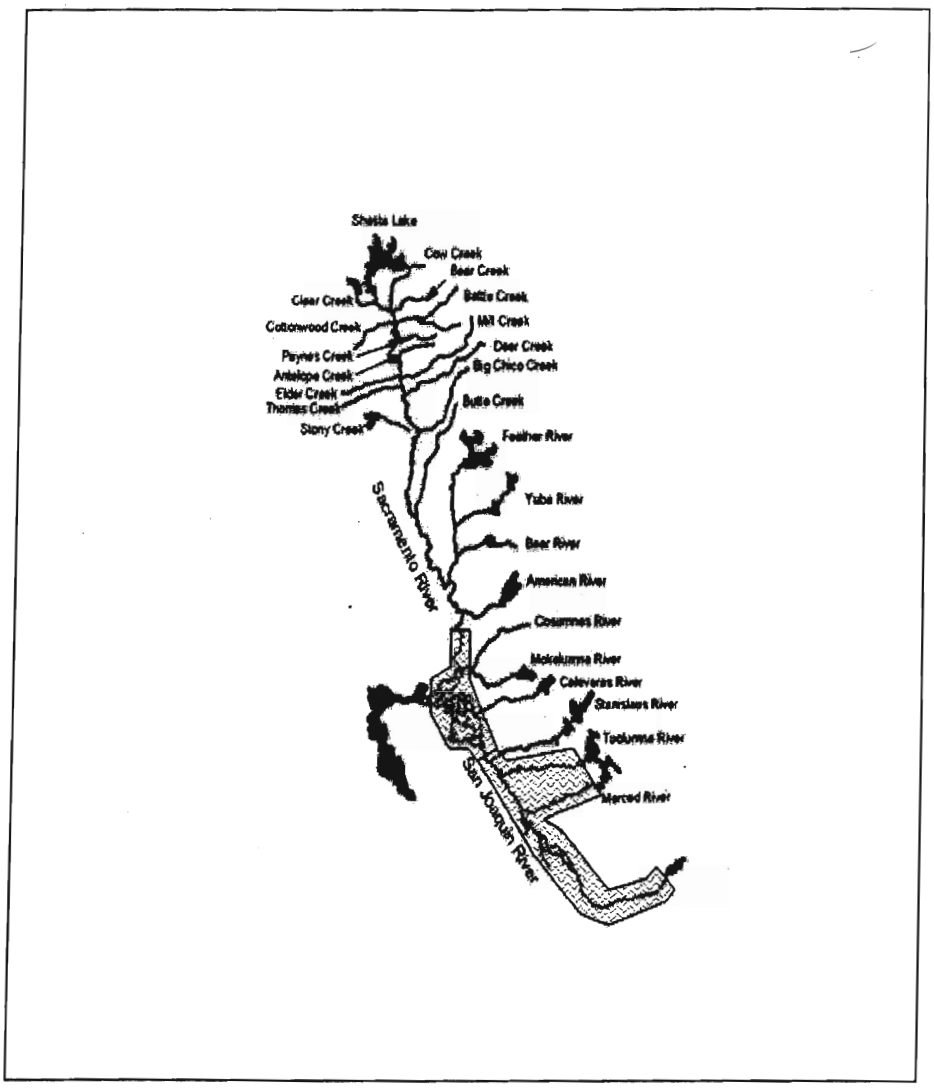


Figure 1A: Generalized Water Hyacinth Treatment Boundaries in the Legal Delta. Treatment boundaries are not to exact geographic locale.

Figure 1b: Generalized Water Hyacinth Boundaries in the San Joaquin Valley



Shaded areas indicate generalized areas of herbicide applications for the WHCP.

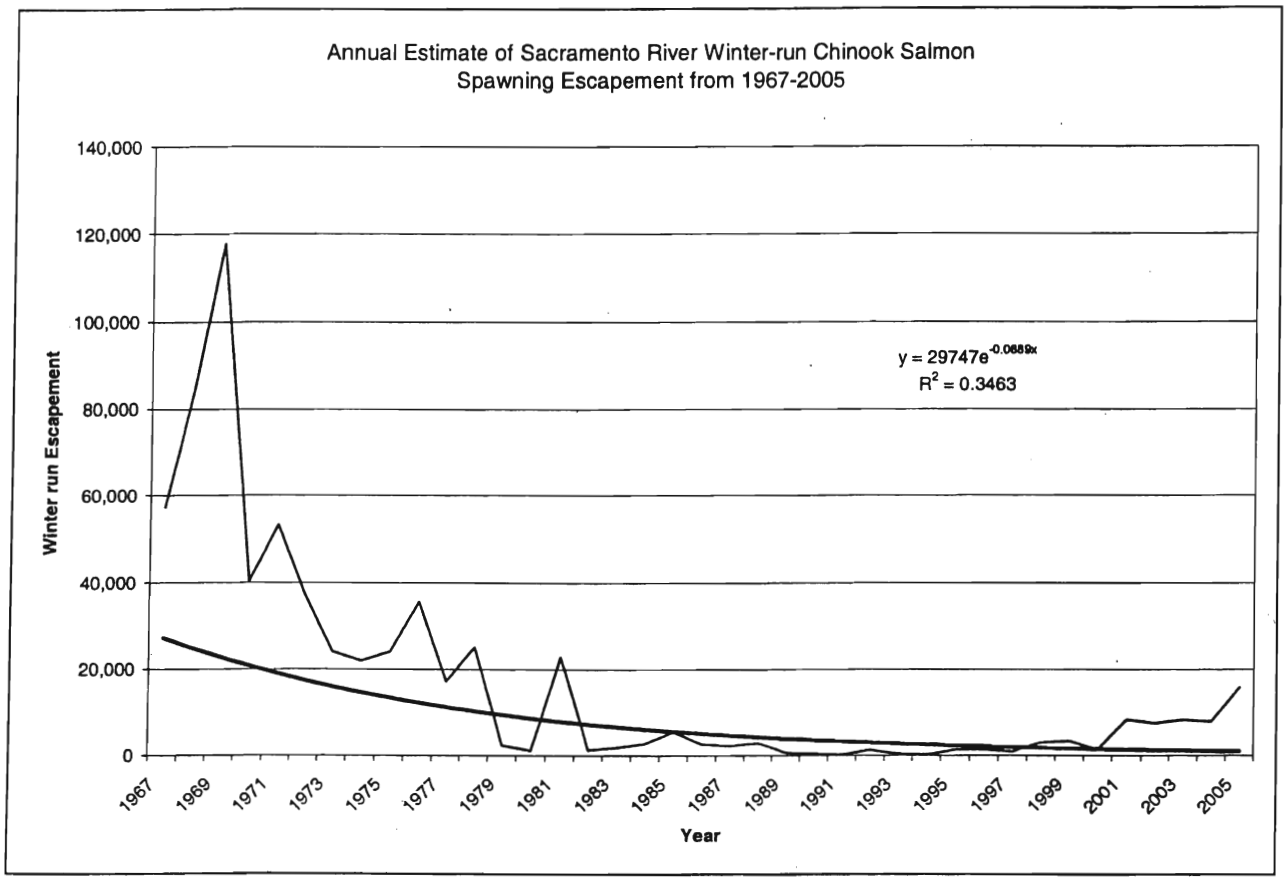


Figure 2:
Annual estimated Sacramento River winter-run Chinook salmon escapement population.
Sources: PFMC 2002, DFG 2004a, NMFS 1997
Trendline for figure 2 is an exponential function: $Y=29{,}747e^{-0.0889x}$, $R^2=0.3463$.

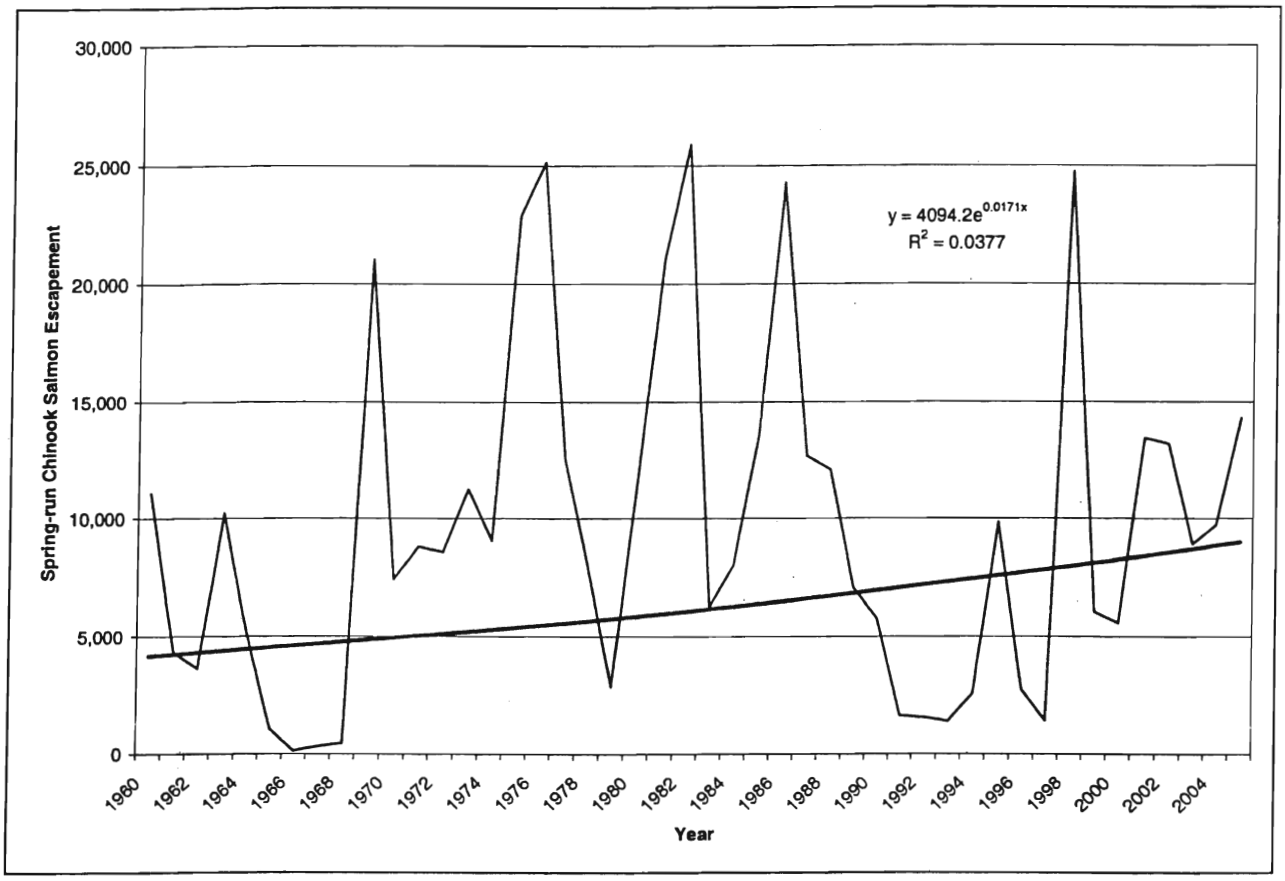
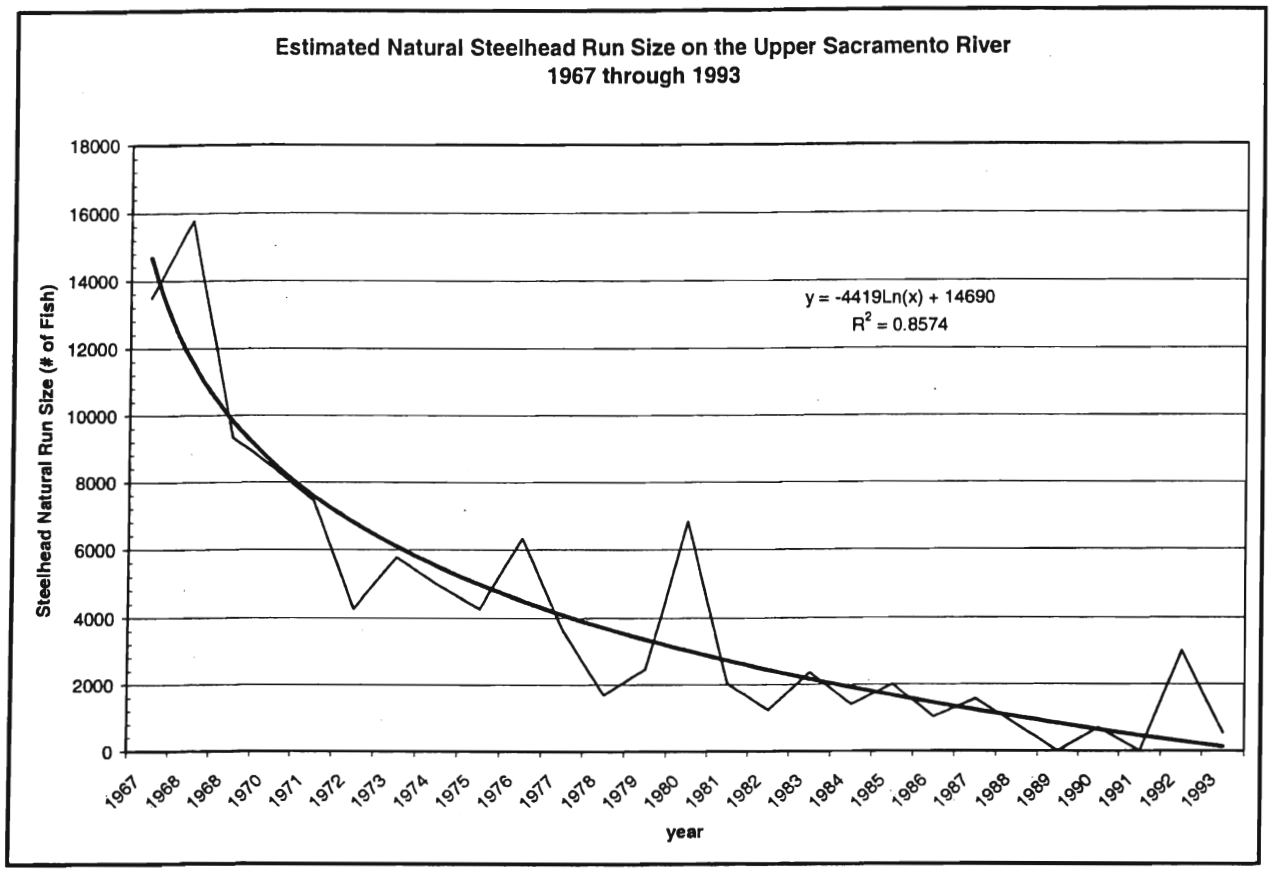


Figure 3:
Annual estimated Central Valley spring-run Chinook salmon escapement population for the Sacramento River watershed for years 1967 through 2003.
Sources: PFMC 2002, DFG 2004b, Yoshiyama 1998.
Trendline for figure 3 is an exponential function: $Y = 4094.2\ e^{0.0171}$, $R^2 = 0.0377$.



Note: Steelhead escapement surveys at RBDD ended in 1993

Figure 4:
Estimated Central Valley natural steelhead escapement population in the upper Sacramento River based on RBDD counts.
Source: McEwan and Jackson 1996.
Trendline for Figure 4 is a logarithmic function: $Y= -4419 \ln(x) + 14690$ $R^2= 0.8574$

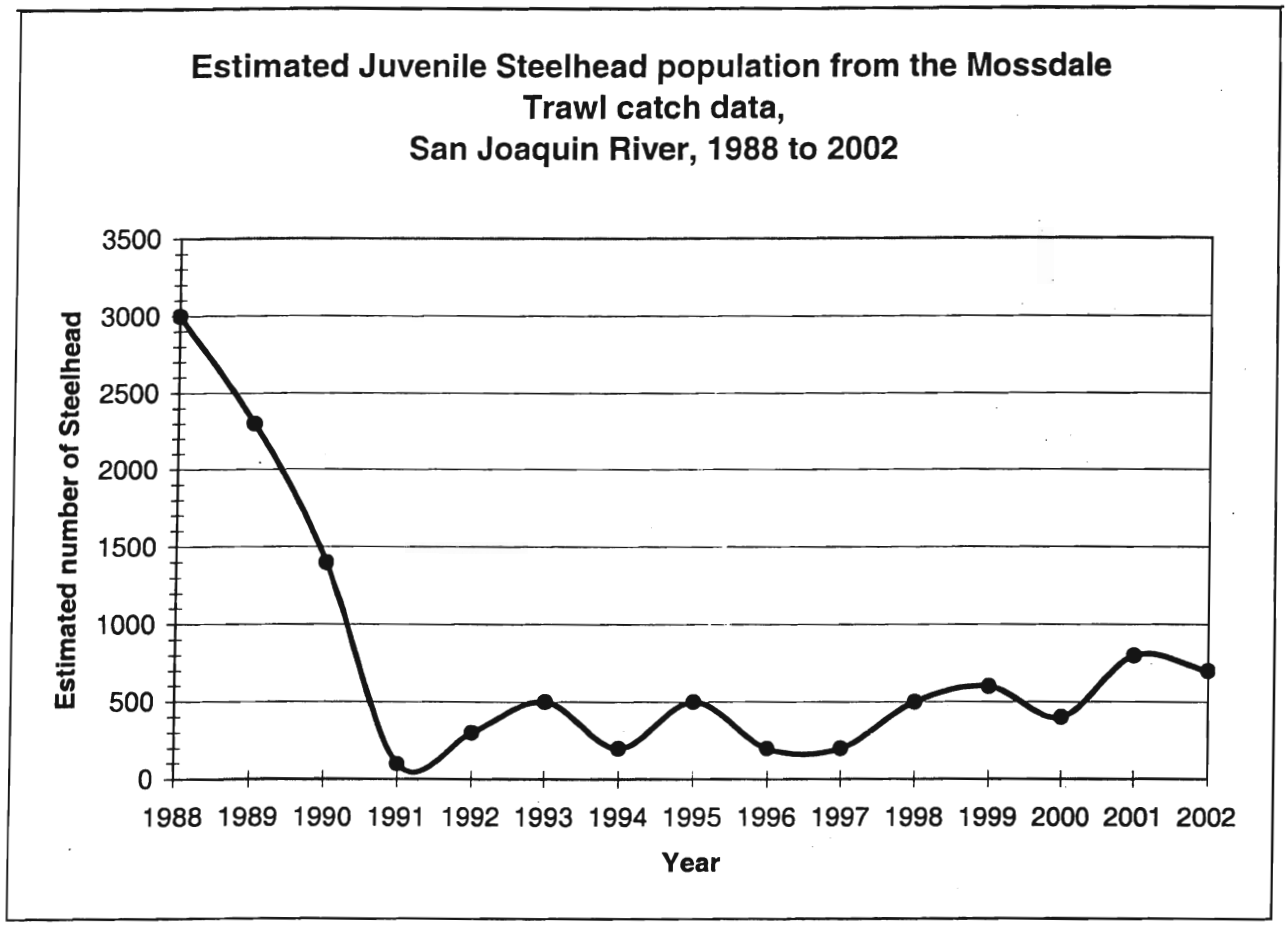


Figure 5:
Estimated number of juvenile Central Valley steelhead derived from the Mossdale trawl surveys on the San Joaquin River from 1988 to 2002.
Source: Marston (DFG), 2003.

Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended (U.S.C. 180 *et seq.*), requires that Essential Fish Habitat (EFH) be identified and described in Federal fishery management plans (FMPs). Federal action agencies must consult with NOAA's National Marine Fisheries Service (NMFS) on any activity which they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purposes of interpreting the definition of EFH, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and, "spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle. The proposed project site is within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon FMP and for starry flounder (*Platichthys stellatus*) and English sole (*Parophrys vetulus*) in Amendment 11 to the Pacific Coast Groundfish FMP.

The Pacific Fishery Management Council (PFMC) has identified and described EFH, Adverse Impacts and Recommended Conservation Measures for salmon in Amendment 14 to the Pacific Coast Salmon FMP (PFMC 1999). Freshwater EFH for Pacific salmon in the California Central Valley includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers *et al.* (1998), and includes the San Joaquin Delta (Delta) hydrologic unit (*i.e.*, number 18040003), Suisun Bay hydrologic unit (18050001) and the Lower Sacramento hydrologic unit (18020109). Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook salmon (*O. tshawytscha*), and Central Valley fall-/late fall-run Chinook salmon (*O. tshawytscha*) are species managed under the Salmon Plan that occur in the Delta, Suisun Bay, and Lower Sacramento units.

Factors limiting salmon populations in the Delta include periodic reversed flows due to high water exports (drawing juveniles into large diversion pumps), loss of fish into unscreened agricultural diversions, predation by introduced species, and reduction in the quality and quantity of rearing habitat due to channelization, pollution, riprapping, *etc.* (Dettman *et al.* 1987;

California Advisory Committee on Salmon and Steelhead Trout 1988, Kondolf *et al.* 1996a, 1996b). Factors affecting salmon populations in Suisun Bay include heavy industrialization within its watershed and discharge of wastewater effluents into the bay. Loss of vital wetland habitat along the fringes of the bay reduce rearing habitat and diminish the functional processes that wetlands provide for the bay ecosystem.

A. Life History and Habitat Requirements

1. Pacific Salmon

General life history information for Central Valley Chinook salmon is summarized below. Information on Sacramento River winter-run and Central Valley spring-run Chinook salmon life histories is summarized in the preceding biological opinion for the proposed project (Enclosure 1). Further detailed information on Chinook salmon Evolutionarily Significant Units (ESU) are available in the NMFS status review of Chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998), and the NMFS proposed rule for listing several ESU of Chinook salmon (63 FR 11482).

Adult Central Valley fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from July through December and spawn from October through December while adult Central Valley late fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from October to April and spawn from January to April (U.S. Fish and Wildlife Service [FWS] 1998). Chinook salmon spawning generally occurs in clean loose gravel in swift, relatively shallow riffles or along the edges of fast runs (NMFS 1997).

Egg incubation occurs from October through March (Reynolds *et al.* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and into the San Francisco Bay and its estuarine waters (Kjelson *et al.* 1982). The remaining fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, aquatic and riparian vegetation, logs, and undercut banks provide habitat for food organisms, shade, and protect juveniles and smolts from predation. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean. Whether entering the Delta or estuary as fry or juveniles, Central Valley Chinook salmon depend on passage through the Delta for access to the ocean.

2. Starry Flounder

The starry flounder is a flatfish found throughout the eastern Pacific Ocean, from the Santa Ynez River in California to the Bering and Chukchi Seas in Alaska, and eastwards to Bathurst inlet in Arctic Canada. Adults are found in marine waters to a depth of 375 meters. Spawning takes place during the fall and winter months in marine to polyhaline waters. The adults spawn in

shallow coastal waters near river mouths and sloughs, and the juveniles are found almost exclusively in estuaries. The juveniles often migrate up freshwater rivers, but are estuarine dependent. Eggs are broadcast spawned and the buoyant eggs drift with wind and tidal currents. Juveniles gradually settle to the bottom after undergoing metamorphosis from a pelagic larva to a demersal juvenile by the end of April. Juveniles feed mainly on small crustaceans, barnacle larvae, cladocerans, clams and dipteran larvae. Juveniles are extremely dependent on the condition of the estuary for their health. Polluted estuaries and wetlands decrease the survival rate for juvenile starry flounder. Juvenile starry flounder also have a tendency to accumulate many of the anthropogenic contaminants found in the environment.

3. English Sole

The English sole is a flatfish found from Mexico to Alaska. It is the most abundant flatfish in Puget Sound, Washington and is abundant in the San Francisco Bay estuary system. Adults are found in nearshore environments. English sole generally spawn during late fall to early spring at depths of 50 to 70 meters over soft mud bottoms. Eggs are initially buoyant, then begin to sink just prior to hatching. Incubation may last only a couple of days to a week depending on temperature. Newly hatched larvae are bilaterally symmetrical and float near the surface. Wind and tidal currents carry the larvae into bays and estuaries where the larvae undergo metamorphosis into the demersal juvenile. The young depend heavily on the intertidal areas, estuaries, and shallow near-shore waters for food and shelter. Juvenile English sole primarily feed on small crustaceans (*i.e.* copepods and amphipods) and on polychaete worms in these rearing areas. Polluted estuaries and wetlands decrease the survival rate for juvenile English soles. The juveniles also have a tendency to accumulate many of the contaminants found in their environment and this exposure manifests itself as tumors, sores, and reproductive failures.

II. PROPOSED ACTION

The proposed action is described in section II (*Description of the Proposed Action*) of the preceding biological opinion for endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and Central Valley steelhead (*O. mykiss*), the proposed threatened southern population of North American green sturgeon, and critical habitat for winter-run Chinook salmon, spring-run Chinook salmon, and Central Valley steelhead (Enclosure 1).

III. EFFECTS OF THE PROJECT ACTION

The effects of the proposed action on salmonid habitat (*i.e.,* for winter, spring and fall/late fall-run Chinook salmon) are described at length in section V (*Effects of the Action*) of the preceding biological opinion, and generally are expected to apply to Pacific salmon EFH. The general contaminant effects on the quality of EFH for the two species of flatfish are expected to be similar to those for green sturgeon due to their benthic life history. Benthic dwelling flatfish will have direct contact with contaminated sediment and will ingest sediment as well as benthic

invertebrates during their foraging activities. Both the starry flounder and the English sole will spend more time as juveniles rearing in the action area than the Chinook salmon smolts. Therefore, these fish species will have a greater duration of exposure to the contaminants of concern than the juvenile Chinook salmon, leading to greater levels of adverse effects to the individual organisms.

IV. CONCLUSION

Based on the best available information, NMFS believes that the proposed Water Hyacinth Control Program may adversely affect EFH for Pacific salmon and groundfish during its five year term of operations (2006 to 2010).

V. EFH CONSERVATION RECOMMENDATIONS

NMFS recommends that the reasonable and prudent measures 1, 2, and 3 from the biological opinion, with their associated terms and conditions, be adopted as EFH Conservation Recommendations for EFH in the action area. In addition, certain other conservation measures need to be implemented in the project area, as addressed in Appendix A of Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). NMFS anticipates that implementing those conservation measures intended to minimize disturbance and sediment and pollutant inputs to waterways would benefit groundfish as well.

Riparian Habitat Management–In order to prevent adverse effects to riparian corridors, the U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS) should:

- Maintain riparian management zones of appropriate width in the San Joaquin River system and Delta that influence EFH;
- Reduce erosion and runoff into waterways within the project area; and
- Minimize the use of chemical treatments within the riparian management zone to manage nuisance vegetation along the levee banks and reclamation district's irrigation drain.

Bank Stabilization–The installation of riprap or other streambank stabilization devices can reduce or eliminate the development of side channels, functioning riparian and floodplain areas and off channel sloughs. In order to minimize these impacts, the USDA-ARS should:

- Use vegetative methods of bank erosion control whenever feasible. Hard bank protection should be a last resort when all other options have been explored and deemed unacceptable;
- Determine the cumulative effects of existing and proposed bio-engineered or bank hardening projects on salmon EFH, including prey species before planning new bank stabilization projects; and

- Develop plans that minimize alterations or disturbance of the bank and existing riparian vegetation.

Conservation Measures for Construction/Urbanization–Activities associated with urbanization (*e.g.*, building construction, utility installation, road and bridge building, and storm water discharge) can significantly alter the land surface, soil, vegetation, and hydrology and subsequently adversely impact salmon EFH through habitat loss or modification. In order to minimize these impacts, the USDA-ARS and the applicant should:

- Plan development sites to minimize clearing and grading;

- Use Best Management Practices in building as well as road construction and maintenance operations such as avoiding ground disturbing activities during the wet season, minimizing the time disturbed lands are left exposed, using erosion prevention and sediment control methods, minimizing vegetation disturbance, maintaining buffers of vegetation around wetlands, streams and drainage ways, and avoid building activities in areas of steep slopes with highly erodible soils. Use methods such as sediment ponds, sediment traps, or other facilities designed to slow water runoff and trap sediment and nutrients; and

- Where feasible, reduce impervious surfaces.

Wastewater/Pollutant Discharges–Water quality essential to salmon and their habitat can be altered when pollutants are introduced through surface runoff, through direct discharges of pollutants into the water, when deposited pollutants are resuspended (*e.g.*, from dredging or ship traffic), and when flow is altered. Indirect sources of water pollution in salmon habitat includes run-off from streets, yards, and construction sites. In order to minimize these impacts, the USDA-ARS and the applicant should:

- Monitor water quality discharge following National Pollution Discharge Elimination System requirements from all discharge points;

- For those waters that are listed under Clean Water Act section 303 (d) criteria (*e.g.*, the Delta), work with State and Federal agencies to establish total maximum daily loads and develop appropriate management plans to attain management goals; and

- Establish and update, as necessary, pollution prevention plans, spill control practices, and spill control equipment for the handling and transport of toxic substances in salmon EFH (*e.g.*, oil and fuel, organic solvents, raw cement residue, sanitary wastes, *etc.*). Consider bonds or other damage compensation mechanisms to cover clean-up, restoration, and mitigation costs.

VI. STATUTORY REQUIREMENTS

Section 305 (b) 4(B) of the MSA requires that the Federal lead agency provide NMFS with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by the lead agency for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR §600.920[j]). In the case of a response that is inconsistent with our recommendations, the Corps must explain its reasons for not following the recommendations, including the scientific justification for any disagreement with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

VII. LITERATURE CITED

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Appendix B

WHCP Herbicide Labels and Material Safety Data Sheets

Appendix B. WHCP Herbicide Labels and Material Safety Data Sheets (MSDS)

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Competitor® Label B-56

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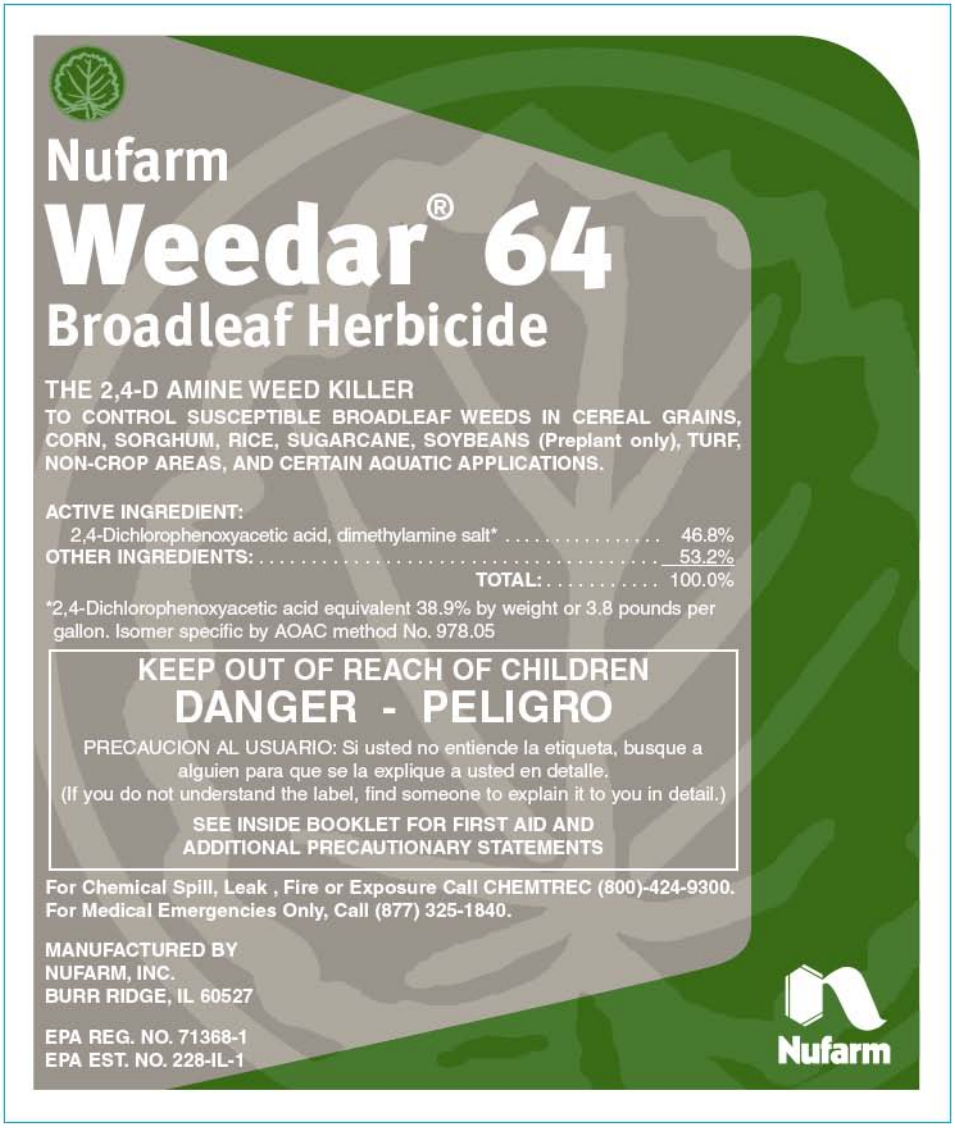

Nufarm

Weedar® 64

Broadleaf Herbicide

THE 2,4-D AMINE WEED KILLER

TO CONTROL SUSCEPTIBLE BROADLEAF WEEDS IN CEREAL GRAINS, CORN, SORGHUM, RICE, SUGARCANE, SOYBEANS (Preplant only), TURF, NON-CROP AREAS, AND CERTAIN AQUATIC APPLICATIONS.

ACTIVE INGREDIENT:

2,4-Dichlorophenoxyacetic acid, dimethylamine salt*	46.8%
OTHER INGREDIENTS:	53.2%
TOTAL:	100.0%

*2,4-Dichlorophenoxyacetic acid equivalent 38.9% by weight or 3.8 pounds per gallon. Isomer specific by AOAC method No. 978.05

KEEP OUT OF REACH OF CHILDREN

DANGER - PELIGRO

PRECAUCION AL USUARIO: Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)

SEE INSIDE BOOKLET FOR FIRST AID AND ADDITIONAL PRECAUTIONARY STATEMENTS

For Chemical Spill, Leak , Fire or Exposure Call CHEMTREC (800)-424-9300.
For Medical Emergencies Only, Call (877) 325-1840.

MANUFACTURED BY
NUFARM, INC.
BURR RIDGE, IL 60527

EPA REG. NO. 71368-1
EPA EST. NO. 228-IL-1

Nufarm

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER - PELIGRO

Corrosive. Causes irreversible eye damage. Harmful if swallowed. May be fatal if absorbed through the skin. Avoid breathing vapors or spray mist. Do not get in eyes, on skin or on clothing.

PERSONAL PROTECTIVE EQUIPMENT (PPE):

Some of the materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category A on an EPA chemical-resistance category selection chart.

Applicators and other handlers must wear: coveralls over short-sleeved shirt and short pants, chemical resistant gloves made of any waterproof material such as polyethylene or polyvinyl chloride, chemical-resistant footwear plus socks, chemical-resistant headgear for overhead exposure and protective eye wear. A chemical-resistant apron should also be worn when cleaning equipment, mixing or loading.

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. After each day of use, clothing or PPE must not be reused until it has been cleaned.

ENGINEERING CONTROL STATEMENTS:

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d) (4-6)], the handler PPE (personal protective equipment) may be reduced or modified as specified in the WPS.

For containers over 1 gallon but less than 5 gallons, mixers and loaders who do not use a mechanical system (probe and pump) to transfer the contents of this container must wear coveralls or a chemical-resistant apron in addition to the other required PPE.

For containers of 5 gallons or more, a mechanical transfer system (probe and pump) must be used for transferring the contents of the container. If the contents of non-refillable pesticide containers are emptied, the probe must be rinsed before removal. If the mechanical system is used in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(4)] the handler PPE requirements may be reduced or modified as specified in the WPS.

USER SAFETY RECOMMENDATIONS

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

FIRST AID

IF IN EYES	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
IF SWALLOWED	• Call poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
IF ON SKIN OR CLOTHING	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or a doctor for treatment advice.
IF INHALED	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. • Call a poison control center or doctor for treatment advice.

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FIRST AID *(continued)*

HOTLINE NUMBER

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-877-325-1840 for emergency medical treatment information.

NOTE TO PHYSICIAN

This product contains a phenoxy herbicidal chemical. There is no specific antidote. All treatments should be based on observed signs and symptoms of distress in the patient. Overexposure to materials other than this product may have occurred.

ENVIRONMENTAL HAZARDS

This product is toxic to aquatic invertebrates. Drift or runoff may adversely affect aquatic invertebrates and non-target plants. For terrestrial uses, do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. Do not apply when weather conditions favor drift from treated areas. Do not use the same spray equipment for other purposes unless thoroughly cleaned.

Do not contaminate water used for irrigation or domestic purposes (except as specifically recommended on this label) especially in areas where grapes, cotton, tomatoes or other susceptible plants are grown.

Do not treat irrigation ditches in areas where water will be used to overhead (sprinkler) irrigate susceptible crops especially grapes, tomatoes, tobacco, and cotton.

Do not apply WEEDAR® 64 Broadleaf Herbicide directly to, or permit to drift onto cotton, okra, grapes, tomatoes, fruit trees, vegetables, flowers or other desirable crop or ornamental plants which are susceptible to 2,4-D herbicide. Do not apply near susceptible plants since very small quantities of the 2,4-D will cause severe injury during the growing or dormant periods. Crops contacted by WEEDAR 64 sprays or spray drift may be killed or suffer significant stand loss with extensive quality and yield reduction.

Do not apply when a temperature air inversion exists. Such a condition is characterized by little or no air movement and an increase in air temperature with an increase in height. In humid regions, a fog or mist may form. An inversion may be detected by producing a smoke column and checking for a layering effect. If questions exist pertaining to the existence of an inversion, consult with local weather services before making an application.

Use coarse sprays to minimize drift. Do not apply with hollow cone-type insecticide or other nozzles that produce fine spray droplets. Drift from aerial or ground application may be reduced by: (1) applying as near to the target as possible in order to obtain coverage; (2) by increasing the volume of spray mix per acre; (3) by decreasing the pounds of pressure at the nozzle tips; and (4) by using nozzles which produce a coarse spray pattern; (5) by not applying when wind is blowing toward susceptible crops or valuable plants.

MIXING AND LOADING: Most cases of ground water contamination involving phenoxy herbicides such as 2,4-D have been associated with mixing/loading and disposal sites. Caution should be exercised when handling 2,4-D pesticides at such sites to prevent contamination of ground water supplies. Use of closed systems for mixing or transferring this pesticide will reduce the probability of spills. Placement of the mixing/loading equipment on an impervious pad to contain spills will help prevent ground water contamination.

DIRECTIONS FOR USE

It Is A Violation Of Federal Law To Use This Product In A Manner Inconsistent With Its Labeling.

Read entire label before using this product.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow entry into treated areas during the restricted entry interval (REI) of 48 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated such as plants, soil or water is: coveralls over short-sleeved shirt and short pants, chemical-resistant gloves made of any waterproof material, chemical-resistant footwear plus socks, chemical-resistant headgear for overhead exposure and protective eyewear.

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NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries or greenhouses.

For ornamental turf uses (golf courses, cemeteries, parks and other turf grass areas), do not enter treatment areas until sprays have dried. Do not allow people (other than applicator) or pets on treatment area during application.

GENERAL PRECAUTIONS AND RESTRICTIONS

Do not apply WEEDAR 64 through any type of irrigation system. Do not use in or near a greenhouse.

GENERAL INFORMATION

INJURY TO CROPS FROM THIS HERBICIDE MAY OCCUR. IF YOU ARE NOT PREPARED TO ACCEPT SOME DEGREE OF CROP INJURY DO NOT USE THIS PRODUCT.

Crop varieties vary in response to 2,4-D and some are easily injured. Apply WEEDAR 64 only to varieties known to be tolerant to 2,4-D. If you are uncertain concerning tolerant varieties or local use situations that may affect crop tolerance to 2,4-D, consult your seed company, State Agricultural Extension Service or qualified crop consultant for advice.

Be sure that use of this product conforms to all applicable laws, rules and regulations. Certain states have restrictions pertaining to application distances from susceptible crops. The applicator should become familiar with these laws, rules or regulations and follow them exactly.

MIXING INSTRUCTIONS

Add about one-half the water to the mixing tank, then add WEEDAR 64 with agitation and finally the rest of water with continuing agitation.

NOTE: Adding oil, wetting agent, or other surfactants to the spray may increase effectiveness on weeds but also may reduce selectivity to crops, resulting in crop damage.

COMPATIBILITY

If WEEDAR 64 is to be tank mixed with fertilizers or with other pesticides, compatibility should be tested prior to mixing. To test for compatibility, use a small container and mix a small amount (0.5 to 1 quart) of spray, combining all ingredients in the same ratio as the anticipated use. If any indications of physical incompatibility develop, do not use this mixture for spraying. Indications of incompatibility usually will appear within 5 to 15 minutes after mixing.

Read and follow all directions and precautions on this label and on the labels of any products for which a tank mixture is being considered.

APPLICATION PROCEDURES

Apply by air or ground equipment in sufficient gallonage to obtain adequate coverage, except as otherwise directed on this label. Use 2 or more gallons of water per acre for aerial application and 10 or more gallons of water per acre for ground application.

SMALL QUANTITY DILUTION TABLE

To spray small areas use the following dilution table.

If Dosage on Label shows Following Rate Per Acre:	Use this Amount for each Gallon of Water Per 1,000 Square Feet
2 pints (1 quart)	3/4 ounces (4 teaspoons)
3 pints (1-1/2 quarts)	1-1/4 ounces (2-1/2 Tablespoons)
4 pints (2 quarts)	1-1/2 ounces (3 Tablespoons)
6 pints (3 quarts)	2-1/4 ounces (4-1/2 Tablespoons)

GENERAL WEED LIST

Annual and Biennial Weeds

*Beggarticks	Jimsonweed	**Pigweeds (*Amaranthus* spp.)	Sunflower
Bullthistle	*Knotweed	Prickly lettuce	*Vervains
Coffeeweed	*Mallow (venice or little)	Ragweed (common or giant)	Vetches
Common cocklebur	Marshelder	Rough fleabane	Wild carrot
Common burdock	Morningglory (common, ivy, woolly)	*Russian thistle	Wild lettuce
Common evening primrose	*Musk thistle (**)	Salsify (western or common)	Wild parsnips
Common lambsquarters	Mustards (except blue mustard)	*Smartweeds (annual species)	
Hairy galinsoga	Pepper weeds (except perennial)	Sowthistles (annual or spiny)	

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Perennial Weeds

*Bindweed (hedge, field, European)	Dandelion	*Hoary cress	Plantains
	*Docks	*Ironweed	Sowthistle (perennial)
Blue lettuce	*Dogbanes	Jerusalem artichoke	*Vervains
*Canada thistle	*Goldenrod	Many flowered aster	*Wild garlic
Catnip	*Ground ivy	*Nettles (including stinging)	*Wild onion
Chicory	Healall	*Orange hawkweed	

*These species may require repeated applications and/or use of the higher rate recommended on this product label even under ideal conditions for application.

**Control of pigweeds in the High Plains area of Texas and Oklahoma may not be satisfactory with this product.

***Not registered for control of musk thistle in California.

SPECIFIC USE DIRECTIONS

APPLES, PEARS, STONE FRUIT AND NUT ORCHARDS

WEEDS IN CROPS	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Annual broadleaf weeds	3 pints	For control of weeds on the orchard floor, apply using coarse sprays and low pressure in sufficient volume of water to obtain thorough wetting of weeds. Treat when weeds are small and actively growing. Do not use on light, sandy soil. **DO NOT USE IN CALIFORNIA.**

RESTRICTIONS AND LIMITATIONS FOR USE IN APPLES, PEARS, STONE FRUIT AND NUT ORCHARDS

- Do not apply to bare ground as injury may result.
- Do not apply immediately before irrigation and withhold irrigation for 2 days before and for 3 days after treatment.
- Do not allow spray to drift onto or contact foliage, fruit, stems, trunks of trees or exposed roots as injury may result.
- Do not apply to newly established or young orchards. Trees must be at least 1 year old and in vigorous condition.
- Do not apply during bloom.
- Do not graze or feed cover crops from treated orchards.
- Do not make more than 2 applications per year.
- Do not harvest stone fruit within 40 days of application.
- Do not harvest nuts within 60 days of application.
- Do not harvest apples or pears within 14 days of application.
- For apples and pears, allow at least 75 days between applications.

CEREAL GRAINS

Barley, Millet, Oats, Rye, Triticale, Wheat

WEEDS IN CROP	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Not underseeded with legumes Postemergence		Apply after grain is fully tillered (usually about 4 to 8 inches high) but not forming joints in the stem. **Do not spray grain in the boot to dough stage.**
Annual and biennial broadleaf weeds	1/2 to 2 pints*	
Perennial broadleaf weeds	1 to 2 pints*	
Underseeded with legumes	1/4 to 1/2 pint*	Apply after grain is 8 inches tall. **Do not spray grain in boot to dough stage.** Do not spray alfalfa or sweet clover unless the infestation is severe and injury to these legumes can be tolerated.

(continued)

CEREAL GRAINS *(continued)*

WEEDS IN CROP	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Emergency weed control in Triticale, Wheat, Perennial broadleaf weeds	3 pints	Apply when weeds are approaching bud stage, after the grain dough stage. **Do not spray during the boot to dough stage.** The 3 pints per acre application can produce injury to wheat. Balance the severity of your weed problem against the possibility of crop damage. Where perennial weeds are scattered, spot treatment is suggested to minimize the extent of crop injury.

*Use the lower rate if small annual and biennial weeds are the major problem. Use the higher rate if perennial weeds or annual and biennial weeds are present which are in the hard-to-kill categories as determined by local experience. The higher rates increase the risk of grain injury and should be used only where the weed control problem justifies the grain damage risk. Do not apply WEEDAR 64 to grain in the seedling stage.

RESTRICTIONS AND LIMITATIONS FOR USE ON CEREAL GRAINS

- For aerial application on grain, apply WEEDAR 64 in 3 to 10 gallons of water per acre.
- For ground application a minimum of 10 to 15 gallons of water per acre is recommended for proper spray coverage.
- Do not permit dairy animals or meat animals being finished for slaughter to forage treated grain fields within 2 weeks after treatment.
- Do not feed treated straw to livestock if an emergency treatment as described above is applied.

CORN AND SORGHUM

WEEDS IN CROP	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
CORN (Field and Sweet) Preplant	1 to 2 pints	To control emerged broadleaf weed seedlings or existing cover crops prior to planting corn, apply 7 to 14 days before planting. Do not use on light, sandy soil, or where soil moisture is inadequate for normal weed growth. Use high rate for less susceptible weeds or cover crops such as alfalfa.
Preemergence	2 to 3 pints	Apply 3 to 5 days after planting but before corn emerges. Do not use on light, sandy soils or where soil moisture is low.
Postemergence Annual broadleaf weeds	1/2 to 1 pint	Apply when weeds are small and corn is less than 8 inches tall (to top of canopy). When corn is over 8 inches tall, use drop nozzles and keep spray off foliage. Treat perennial weeds when they are in the bud to bloom stage. **Do not spray corn in the tassel to dough stage.** Corn treated with 2,4-D may become temporarily brittle. Winds or cultivation may cause stalk breakage during the period of time when the corn is brittle.
Perennial broadleaf weeds	1 to 1-1/2 pints	
Grain Sorghum (Milo) Postemergence	1 pint	Apply when sorghum is 6 to 15 inches tall. If sorghum is taller than 8 inches to top of the canopy, use drop nozzles and keep spray off the foliage. **Do not treat during the boot, flowering or dough stage.**

RESTRICTIONS AND LIMITATIONS FOR USE ON CORN AND SORGHUM

- Do not forage or feed fodder for 7 days following application.

RICE

WEEDS IN CROP	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Preplant	1 to 2 pints	Apply four or more weeks prior to planting rice. **DO NOT USE IN CALIFORNIA.**
Postemergence	1 to 2-1/2 pints	Apply when rice is in the late tillering stage of development at the time of first joint development. Do not apply after panicle initiation, after rice internodes exceed one-half inch, at early seedling, early panicle, boot or heading stages. Consult local university or Agricultural Extension Service specialists for more specific information on rates and timing of application. **DO NOT USE IN CALIFORNIA.**

(continued)

RESTRICTIONS AND LIMITATIONS FOR USE IN RICE
- Do not apply more than a total of 2-1/2 pints of WEEDAR 64 to rice per growing season
- Do not use on rice in California without an approved Supplemental Label allowing the use.

SOYBEANS* (Preplant Only)

WEEDS IN CROP	AMOUNT OF WEEDAR® 64 PER ACRE	DIRECTIONS
Postemergence	3/4 to 1 pint	Apply not less than 15 days prior to planting soybeans, when weeds are small and actively growing. Use the higher rate on larger weeds and when perennials are present.
	>1 to 2 pints	Apply not less than 30 days prior to planting soybeans, when weeds are actively growing.
		In addition to those weeds found on the GENERAL WEED LIST, WEEDAR 64 will suppress or control the following broadleaf weeds frequently encountered in reduced tillage soybean production systems: alfalfa*, bullnettle, smallflowered bittercress, Carolina geranium, smallflowered buttercup, common and rough cinquefoil, red clover*, horseweed or marestail, mousetail, wild mustard, field pennycress, cutleaf evening primrose, common purslane, speedwell, velvetleaf, and Virginia copperleaf. * These weeds are only partially controlled. Apply no more than 2.0 pints of WEEDAR 64 in one season prior to planting soybeans. After applying, plant soybean seed as deep as practical or at least 1-1/2 to 2 inches deep. Adjust the planter press wheel, if necessary, to ensure that planted seed is completely covered. If desired, WEEDAR 64 may be applied pre-plant to soybeans in tank mixtures with other herbicides such as Poast®, Poast Plus®, Roundup®, Roundup D-Pak®, Honcho®, Gramoxone Extra®, Prowl®, Pursuit Plus®, Scepter®, Scepter 70 DG, Squadron® and others that are registered for pre-plant soybean use. **NOTE:** Unacceptable injury to soybeans planted in fields previously treated with WEEDAR 64 may occur and the extent of injury will depend on weather and agronomic factors such as the amount of weed vegetation and previous crop residue present that may be in effect between the time of application and the emergence of the soybean plant.

RESTRICTIONS AND LIMITATIONS FOR USE IN SOYBEANS (PREPLANT)
- Do not apply WEEDAR 64 when weather conditions such as temperature, air inversions, or wind favor drift from treated areas to susceptible plants.
- Apply no more than 2.0 pints of WEEDAR 64 per acre in one season prior to planting soybeans.
- Only one application per growing season, regardless of the application rate used, is allowed.
- Do not apply WEEDAR 64 prior to planting soybeans if you are not prepared to accept the results of soybean injury including possible loss of stand and yield.
- Do not replant fields treated with WEEDAR 64 in the same growing season with crops other than those labeled for 2,4-D pre-plant use.
- Do not mow or cultivate weeds prior to treating with WEEDAR 64 as poor control may result.
- Do not cut for feed treated hay, forage, or fodder or graze treated soybeans to livestock.
- Do not apply WEEDAR 64 preplant to soybeans in fields having a coarse-textured soil where the percent organic matter is <1.0%.
- Only one application of WEEDAR 64 may be made prior to planting soybeans per growing season.
- Do not feed treated hay, forage, or fodder. Livestock should be restricted from feeding/grazing of treated cover crops.

***Not currently registered for use in California.**

SUGARCANE

WEEDS IN CROP	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Preemergence	4 pints	Apply before canes appear for control of emerged broadleaf weeds. **DO NOT USE IN CALIFORNIA.**
Postemergence	1-1/2 to 4 pints	Apply after cane emerges and through lay-by. **DO NOT USE IN CALIFORNIA.**

RESTRICTIONS AND LIMITATIONS FOR USE IN SUGARCANE
- Do not apply more than a total of 8 pints of WEEDAR 64 to sugarcane per acre per growing season.

CONSERVATION RESERVE PROGRAM AREAS

WEEDS	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Annual broadleaf weeds In young grasses In established grasses	 1/2 to 1 pint 1/2 to 2 pints	Apply to actively growing annual broadleaf weeds. Use 1/2 to 1 pint when weeds are small; use higher rates on older weeds. Do not apply to young grasses with fewer than 6 leaves or prior to tillering, as excessive injury may result. Do not apply more than 1 pint until grasses are well established as excessive injury may result.
Biennial and perennial broadleaf weeds In established grasses	2 to 4 pints	Treat when biennial weeds are in the seedling to rosette stage and before flower stalks become apparent. Treat perennial weeds in the bud to bloom stage. Apply to actively growing weeds.

RESTRICTIONS AND LIMITATIONS FOR USE ON CONSERVATION RESERVE PROGRAM AREAS
- Use at least 2 gallons of water per acre by air and 5 gallons of water per acre by ground.
- Do not harvest or graze treated Conservation Reserve Program areas.
- Do not apply to grasses in the boot to dough stage if grass seed production is desired.

ESTABLISHED GRASS PASTURES, RANGELAND, AND CONSERVATION RESERVE PROGRAM AREAS

WEEDS	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Annual broadleaf weeds **Biennial and perennial broadleaf weeds**	2 pints 2 to 4 pints	Apply when weeds are small and actively growing and prior to bud stage. Spray while musk thistles or other biennial species are in the seedling to rosette stage and before flower stalks become apparent. The lower rate can be used in the spring during rosette stage. Use the highest rate in the fall or after flower stalks have developed. Do not apply to newly seeded areas until grass is well established. Do not apply to grass in the early boot through milk stage if grass seed production is desired. Bentgrass and legumes may be injured by this treatment.

RESTRICTIONS AND LIMITATIONS FOR USE IN PASTURES AND RANGELANDS
- Do not graze (dairy) cattle in treated areas for 7 days after application.
- Do not cut forage for hay within 30 days of application.
- Do not permit dairy animals or meat animals being finished for slaughter to forage treated fields within 3 days of slaughter.

FALLOWLAND AND CROP STUBBLE

WEEDS	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Annual broadleaf weeds	1 to 2 pints	Use the lower rate when weeds are small (2 to 3 inches tall) and actively growing. Use the higher rate on older and drought-stressed plants.
Biennial broadleaf weeds	2 to 4 pint	Spray when musk thistles or other biennial species are in the seedling to rosette stage and before flower stalks become apparent. The lower rate can be used in the spring during rosette stage. Use the highest rate in the fall or after flower stalks have developed.
Perennial broadleaf weeds	2 to 6 pints	Spray weed in the bud to bloom stage or while in good vegetative growth. Do not disturb treated areas for at least 2 weeks after treatment, or until tops are dead.
Wild garlic and onion in crop stubble	4 to 6 pints	Apply to new regrowth of wild garlic or onion which occurs in the fall following harvest of small grains, corn or grain sorghum.

RESTRICTIONS AND LIMITATIONS FOR USE IN FALLOWLAND AND CROP STUBBLE
- Do not plant any crop for 3 months after treatment or until chemical has disappeared from the soil.

GRASSES FOR SEED PRODUCTION

WEEDS	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Annual and perennial broadleaf weeds	2 to 4 pints	Apply to established stands in spring from tiller to early boot stage. **Do not spray in boot stage.** New spring seedings may be treated with the lower rate after grass seedlings have at least 5 leaves. Perennial weed regrowth may be treated in the fall.

RESTRICTIONS AND LIMITATIONS FOR USE ON GRASSES FOR SEED PRODUCTION
- Do not graze dairy animals or cut forage for hay within 7 days of application.

NON-CROPLAND

Such as Fencerows, Hedgerows, Roadsides, Drainage Ditches, Rights-of-Way, Utility Power Lines, Railroads and Other Non-Crop Areas

WEEDS	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Annual broadleaf weeds	2 to 4 pints	Treat when weeds are young and actively growing. Perennial weeds should be near the bud stage, but not flowering at application. Do not use on susceptible southern grasses such as St. Augustine. Do not apply to newly seeded areas until grass is well established. Bentgrass, clover, legumes and dichondria may be injured by this treatment.
Biennial and perennial broadleaf weeds	4 to 8 pints	

RESTRICTIONS AND LIMITATIONS FOR USE ON NON-CROPLAND
- Do not graze dairy animals for 7 days following application.
- Use sufficient gallonage for thorough and uniform coverage.

SPOT TREATMENT IN NON-CROP AREAS

Mix 2 to 3 fluid ounces of WEEDAR 64 in 3 gallons of water. Wet all weeds and stems thoroughly. For best results, treat when weeds are actively growing.

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ORNAMENTAL TURF AREAS

Golf Courses, Cemeteries, Parks, Turfgrass, and Other Grass Areas

WEEDS	AMOUNT OF WEEDAR 64 PER ACRE	DIRECTIONS
Annual broadleaf weeds	2 to 4 pints	Treat when weeds are young and actively growing. Perennial weeds should be near the bud stage, but not flowering at application. Do not use on susceptible southern grasses such as St. Augustine. Do not apply to newly seeded areas until grass is well established. Bentgrass, clover, legumes and dichondria may be injured by this treatment.
Biennial and perennial broadleaf weeds	4 pints	

RESTRICTIONS AND LIMITATIONS FOR USE ON ORNAMENTAL TURF AREAS

- Use sufficient gallonage for thorough and uniform coverage.
- Do not apply more than 2 broadcast applications per year per treatment site. This does not exclude spot treatments.
- Do not allow people (other than applicator) or pets on treatment area during application.
- Do not enter treatment areas until sprays have dried.

POPLAR/COTTONWOOD TREES GROWN FOR PULP BROADLEAF WEED CONTROL

WEEDAR 64 may be applied through wick applicators or conventional ground sprayers. (Excluding irrigation systems) Do not allow WEEDAR 64 to contact leaves or green bark of the tree. Use 1/2 pint to 3 pints per acre in enough water to provide uniform coverage prior to or after planting of Poplar/Cottonwood trees. Application during warm weather is preferred. Apply when weeds are actively growing, preferably before bud stage. Repeat treatment may be necessary for less susceptible weeds; re-apply as needed. Accord® may be mixed with WEEDAR 64 to increase weed control. Follow both labels to determine correct rates. Two quarts or more of a spreader - activator per 100 gallons of spray solution may be added to improve herbicide performance.

FORESTRY - TREE INJECTION

For Controlling Species Such as Alder, Aspen, Birch, Blackgum, Cherry, Oak, Sweetgum, and Tulip Poplar

Make injections as near to the root collar as possible, using one injection per inch of trunk dbh (4-1/2 feet). For resistant species such as hickory, injections should overlap. For best results, injections should be made during the growing season, May 15th through October 15th.

For Dilute Injection

Mix 1 gallon of WEEDAR 64 in 19 gallons of water for dilute injections.

For Concentrate Injections

Use 1 to 2 ml of concentrate WEEDAR 64 per injection. The injection bit must penetrate the inner bark.

WEEDS AND BRUSH ON IRRIGATION CANAL DITCHBANKS

(Seventeen Western States: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, Nevada, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah,Washington, and Wyoming)

For Control of Annual and Perennial Broadleaf Weeds

Apply 1 to 2 quarts of WEEDAR 64 per acre in approximately 20 to 100 gallons per acre. Treat when weeds are young and actively growing before the bud or early bloom stage. For harder-to-control weeds, a repeat spray after 3 to 4 weeks using the same rates may be needed for maximum results. Apply no more than two treatments per season.

For Woody Brush and Patches of Perennial Broadleaf Weeds

Mix 1 gallon of WEEDAR 64 in 150 gallons of water.Wet foliage thoroughly using about 1 gallon of solution per square rod.

Spraying Instructions

Apply with low pressure (10 to 40 psi) power spray equipment mounted on a truck, tractor, or boat. Apply while traveling upstream to avoid accidental concentration of chemical into water. Spray when the air is fairly calm, 5 mph or less. Do not use on small canals (less than 10 cfs) where water will be used for drinking purposes.

Boom spraying onto water surface must be held to a minimum and no cross-stream spraying to opposite banks should be permitted. When spraying shoreline weeds, allow no more than 2 foot overspray onto water with an average of less than 1 foot overspray to prevent introduction of greater than negligible amounts of chemical into the water.

RESTRICTIONS AND LIMITATIONS FOR USE ON IRRIGATION CANAL DITCHBANKS
Do not allow dairy animals to graze on treated areas for at least 7 days after spraying.
Water within treated banks should not be fished.

AQUATIC WEED CONTROL

For Use in Ponds, Lakes, Reservoirs, Marshes, Bayous, Drainage Ditches, Canals, Rivers and Streams that are Quiescent or Slow Moving.

NOTICE TO APPLICATORS
State and Local Coordination

Before application, coordination and approval of local and state authorities may be required, either by letter of agreement or issuance of special permits for such use.

Fish Toxicity - Oxygen Ratio: Fish breathe oxygen in the water and a water - oxygen ratio must be maintained. Decaying weeds use up oxygen.To avoid fish kill from decaying plant material do not treat more than one half the lake or pond at one time. For large bodies of weed infested waters leave buffer strips of at least 100 feet wide and delay treatment of these strips for 4 to 5 weeks or until the dead vegetation has decomposed.

Wind Velocity - Ground or Surface Application: Do not apply when wind speeds are at or above 10 mph. Air Application: Do not apply when wind speeds are at or above 5 mph. The restrictions do not apply to subsurface applications used in weed control programs.

Irrigation: Delay the use of treated waters for irrigation for three weeks after treatment unless an approved assay shows that the water does not contain more than 0.1 ppm 2,4-D acid. Do not treat irrigation ditches in areas where water will be used to overhead sprinkler irrigate susceptible crops especially grapes, tomatoes and cotton.

Potable Water: Delay the use of treated water for domestic purposes for a period of three weeks or until such time as an approved assay shows that the water contains no more than 0.1 ppm 2,4-D acid.

WATER HYACINTH *(Eichornia crasipe)* - Directions For Use

WEEDAR 64 will control water hyacinth with surface and air applications.

Amounts to Use: 2 to 4 quarts (4 lb. acid equivalent per gallon) per acre. **Spray the weed mass only.** Use 4 quarts when plants are matured or when the weed mass is dense.

When To Apply: Spray when water hyacinth plants are actively growing. Repeat as necessary to kill regrowth and hyacinth plants missed in the previous operation.

How To Use - Surface Application: Use power sprayers operated with a boom or spray gun mounted on a boat, tractor or truck. Thorough wetting of foliage is essential for maximum control. Use 100 to 400 gal. per acre of spray mixture. Special precautions such as the use of low pressure, large nozzles and thickening agents should be taken to avoid spray drift in areas of sensitive crops. For DIRECTA-SPRA™ operation use WEEDAR 64 with 1 pint of drift control agent in 50 to 100 gallons of water. For other applications, follow the drift control agent label for mixing directions.

Air Application: Use drift control spray equipment or thickening agents mixed into the spray solution. Apply 1.0 gallon per acre of WEEDAR 64 through standard boom systems with a minimum of 5 gallons of spray mix per acre. For MICROFOIL® drift control spray systems, apply WEEDAR 64 in 12 to 15 gallons spray mix per acre.

2,4-D Acid Equivalent	1/2 pound	1 pound	2 pounds	3 pounds	4 pounds
WEEDAR 64	1 pint	2 pints	2 quarts	3 quarts	4 quarts

WATER MILFOIL *(Myriophyllum spicatum)* - Directions For Use

For Eurasian Water Milfoil in programs conducted by the Tennessee Valley Authority in dams and reservoirs of the TVA system.

WEEDAR 64 will control water milfoil with surface, subsurface and air applications.

How To Use: To control water milfoil when less than 5 gallons of concentrate per acre is recommended, dilute the concentrate with water to apply a minimum of 5 gallons of spray mix per acre. Do not treat within 1/2 mile of potable water intakes. Shoreline areas should be treated by sub-surface injection applied by boat to avoid aerial drift. Do not apply when weather conditions favor drift from target area. Do not contaminate water by cleaning of equipment washwaters.

Open Water Areas: To reduce contamination and prevent undue exposure to fish and other aquatic organisms, do not treat water areas that are not infested with aquatic weeds.

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Amounts To Use: Apply 2.5 to 10 gallons of WEEDAR 64 per acre. The higher rate is used in areas of greater water exchange. These areas may require a repeat application.

When To Apply: For best results, apply in spring or early summer when milfoil starts to grow. This timing can be checked by sampling the lake bottom in areas heavily infested with weeds the year before.

Subsurface Application: Apply 2.5 to 10 gallons of WEEDAR 64 per acre as a concentrate directly into the water through boat mounted distribution systems.

Surface Application: Apply 2.5 to 10 gallons of WEEDAR 64 per acre in a minimum spray volume of 5 gallons mix per acre.

Air Application: Use drift control spray equipment or thickening agents mixed into the spray solution. Apply 2.5 to 10 gallons per acre of WEEDAR 64 through standard boom systems with a minimum of 5 gallons of spray mix per acre. For MICROFOIL® drift control spray systems apply WEEDAR 64 in 12 to 15 gallons spray mix per acre.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a dry, secured storage area. Keep container tightly closed when not in use. Store at temperature above 32°F. If allowed to freeze, warm to at least 40°F and remix before using. Freezing does not alter this product.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law and may contaminate ground water. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL -- NONRETURNABLE PLASTIC: Triple rinse or (equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

RETURNABLE -- REFILLABLE CONTAINERS: After use, return the container to the point of purchase or designated locations. This container must only be refilled with WEEDAR 64. DO NOT REUSE THE CONTAINER FOR ANY OTHER PURPOSE. Prior to refilling, inspect thoroughly for damage such as cracks, punctures, abrasions and damaged or worn out threads on closure devices. Do not refill or transport damaged or leaking containers. Check for leaks after refilling and before transportation. If the container is not being refilled, return it to the point of purchase.

LIMITED WARRANTY AND DISCLAIMER

The manufacturer warrants that this product conforms to the chemical description on the label; that this product is reasonably fit for the purposes set forth in the directions for use when it is used in accordance with such directions; and that the directions, warnings and other statements on this label are based upon responsible experts' evaluation of reasonable tests of effectiveness, of toxicity to laboratory animals and to plants, and of residues on food crops, and upon reports of field experience. Tests have not been made on all varieties or in all states or under all conditions. THE MANUFACTURER NEITHER MAKES NOR INTENDS, NOR DOES IT AUTHORIZE ANY AGENT OR REPRESENTATIVE TO MAKE, ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND IT EXPRESSLY EXCLUDES AND DISCLAIMS ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY DOES NOT EXTEND TO, AND THE BUYER SHALL BE SOLELY RESPONSIBLE FOR, ANY AND ALL LOSS OR DAMAGE WHICH RESULTS FROM THE USE OF THIS PRODUCT IN ANY MANNER WHICH IS INCONSISTENT WITH THE LABEL DIRECTIONS, WARNINGS OR CAUTIONS.

BUYER'S EXCLUSIVE REMEDY AND MANUFACTURER'S OR SELLER'S EXCLUSIVE LIABILITY FOR ANY AND ALL CLAIMS, LOSSES, DAMAGES, OR INJURIES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT, WHETHER OR NOT BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY IN TORT OR OTHERWISE SHALL BE LIMITED, AT THE MANUFACTURER'S OPTION, TO REPLACEMENT OF, OR THE REPAYMENT OF THE PURCHASE PRICE FOR, THE QUANTITY OF PRODUCT WITH RESPECT TO WHICH DAMAGES ARE CLAIMED. IN NO EVENT SHALL MANUFACTURER OR SELLER BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT.

NOTICE TO BUYER

Purchase of this material does not confer any rights under patents governing this product or the use thereof in countries outside of the United States.
Weedar is a Registered Trademark of Nufarm, Inc.
Directa-Spray and Microfoil are Registered Trademarks of Aventis.
Poast, Poast Plus, Prowl, Pursuit Plus, Scepter and Squadron are Registered Trademarks of BASF Corporation.
Accord and Garlon are Registered Trademark s of Dow AgroSciences.
Honcho, Roundup, and Roundup D-Pak are Registered Trademarks of Monsanto Co.
Gramoxone Extra is a Registered Trademark of Syngenta Crop Protection

Extended Text® INSEAL™ U.S. Pat. No. 4488922.
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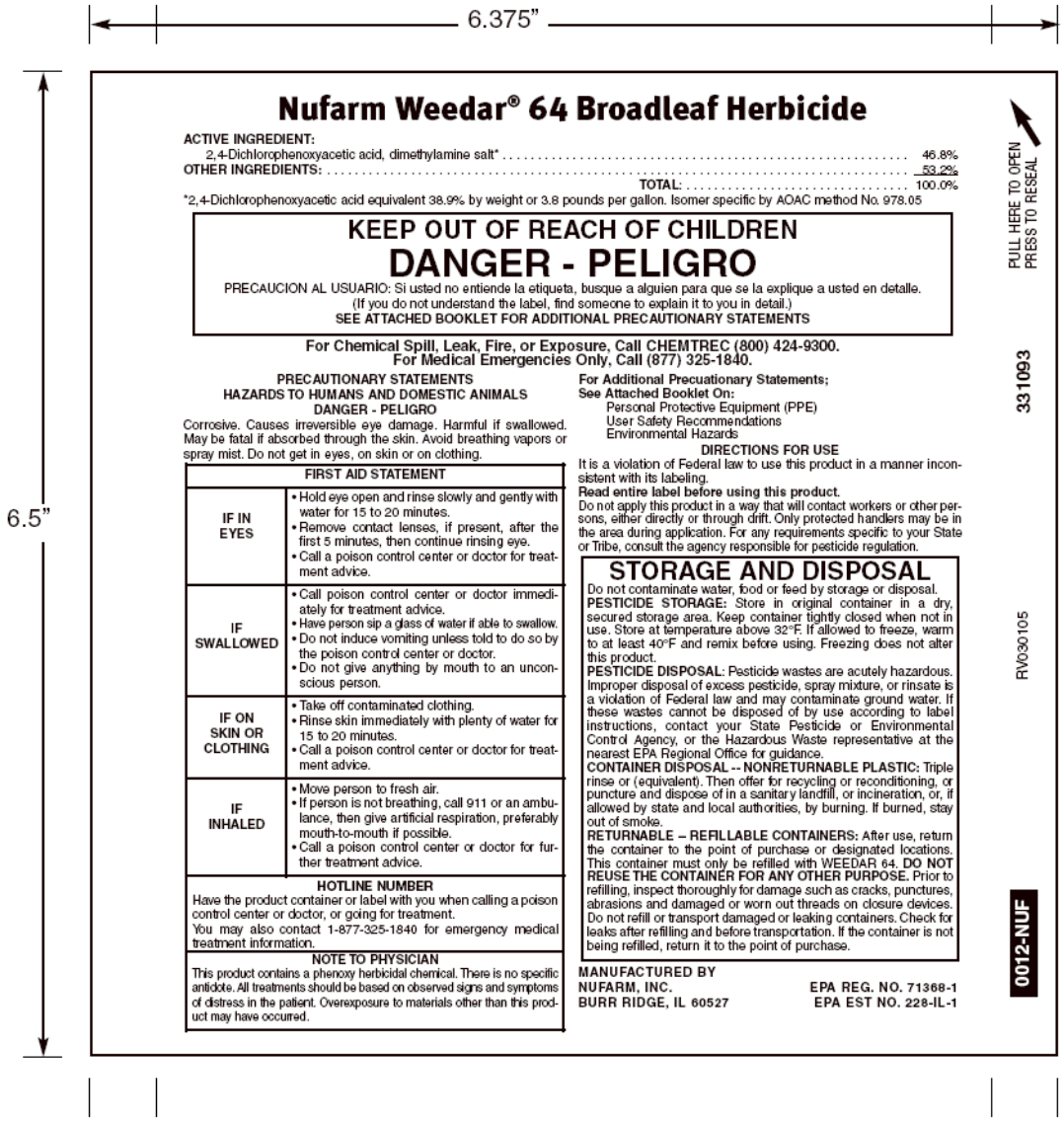

Nufarm Weedar® 64 Broadleaf Herbicide

ACTIVE INGREDIENT:
2,4-Dichlorophenoxyacetic acid, dimethylamine salt* 46.8%
OTHER INGREDIENTS: 53.2%
TOTAL: 100.0%

*2,4-Dichlorophenoxyacetic acid equivalent 38.9% by weight or 3.8 pounds per gallon. Isomer specific by AOAC method No. 978.05

KEEP OUT OF REACH OF CHILDREN

DANGER - PELIGRO

PRECAUCION AL USUARIO: Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)
SEE ATTACHED BOOKLET FOR ADDITIONAL PRECAUTIONARY STATEMENTS

For Chemical Spill, Leak, Fire, or Exposure, Call CHEMTREC (800) 424-9300.
For Medical Emergencies Only, Call (877) 325-1840.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER - PELIGRO

Corrosive. Causes irreversible eye damage. Harmful if swallowed. May be fatal if absorbed through the skin. Avoid breathing vapors or spray mist. Do not get in eyes, on skin or on clothing.

FIRST AID STATEMENT	
IF IN EYES	• Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
IF SWALLOWED	• Call poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
IF ON SKIN OR CLOTHING	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 to 20 minutes. • Call a poison control center or doctor for treatment advice.
IF INHALED	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. • Call a poison control center or doctor for further treatment advice.

HOTLINE NUMBER
Have the product container or label with you when calling a poison control center or doctor, or going for treatment.
You may also contact 1-877-325-1840 for emergency medical treatment information.

NOTE TO PHYSICIAN
This product contains a phenoxy herbicidal chemical. There is no specific antidote. All treatments should be based on observed signs and symptoms of distress in the patient. Overexposure to materials other than this product may have occurred.

For Additional Precautionary Statements;
See Attached Booklet On:
Personal Protective Equipment (PPE)
User Safety Recommendations
Environmental Hazards

DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
Read entire label before using this product.
Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
PESTICIDE STORAGE: Store in original container in a dry, secured storage area. Keep container tightly closed when not in use. Store at temperature above 32°F. If allowed to freeze, warm to at least 40°F and remix before using. Freezing does not alter this product.
PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law and may contaminate ground water. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.
CONTAINER DISPOSAL -- NONRETURNABLE PLASTIC: Triple rinse or (equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.
RETURNABLE – REFILLABLE CONTAINERS: After use, return the container to the point of purchase or designated locations. This container must only be refilled with WEEDAR 64. **DO NOT REUSE THE CONTAINER FOR ANY OTHER PURPOSE.** Prior to refilling, inspect thoroughly for damage such as cracks, punctures, abrasions and damaged or worn out threads on closure devices. Do not refill or transport damaged or leaking containers. Check for leaks after refilling and before transportation. If the container is not being refilled, return it to the point of purchase.

MANUFACTURED BY
NUFARM, INC.
BURR RIDGE, IL 60527

EPA REG. NO. 71368-1
EPA EST NO. 228-IL-1

PULL HERE TO OPEN
PRESS TO RESEAL

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RV030105

0012-NUF

Nufarm

For Chemical Emergency, Spill, Leak, Fire, Exposure, or Accident,
Call CHEMTREC Day or Night: 1-800-424-9300.
For Medical Emergencies Only, Call 1-877-325-1840.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Weedar® 64 Broadleaf Herbicide
Synonyms: 2,4-D DMA; 2,4-Dichlorophenoxyacetic acid, dimethylamine salt
EPA Reg. No.: 71368-1

Company Name: Nufarm, Inc.
150 Harvester Drive, Suite 200
Burr Ridge, IL 60527

Date of Issue: November 14, 2006 **Supersedes:** March 12, 2002
Sections Revised: New or updated information all sections

2. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance and Odor: Clear, pale yellow liquid with a phenolic-amine odor.
Warning Statements: Keep out of reach of children. DANGER. Corrosive. Causes irreversible eye damage. Harmful if swallowed. May be fatal if absorbed through the skin. Avoid breathing vapors or spray mist. Do not get in eyes, on skin or on clothing.

Potential Health Effects:
Likely Routes of Exposure: Inhalation, eye and skin contact.
Eye Contact: Causes corneal opacity, irreversible eye damage. Vapors and mist can cause irritation.
Skin Contact: May cause slight transient irritation. Overexposure by skin absorption may cause symptoms similar to those for ingestion.
Ingestion: Harmful if swallowed. May cause nausea, vomiting, abdominal pain, decreased blood pressure, muscle weakness, muscle spasms.
Inhalation: Harmful if inhaled. May cause upper respiratory tract irritation and symptoms similar to those from ingestion.
Medical Conditions Aggravated by Exposure: Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema or bronchitis. Skin contact may aggravate existing skin disease.

See Section 11: TOXICOLOGICAL INFORMATION for more information.

Potential Environmental Effects:
This product is toxic to aquatic invertebrates. Drift or runoff may adversely affect aquatic invertebrates and non-target plants.

See Section 12: ECOLOGICAL INFORMATION for more information.

3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS NO.	% BY WEIGHT
Dimethylamine Salt of 2,4-Dichlorophenoxyacetic Acid	2008-39-1	46.8
Inert Ingredients		53.2

4. FIRST AID MEASURES

If in Eyes: Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.
If Swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.
If on Skin: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes. Call a poison control center or doctor for treatment advice.
If Inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.
Note to Physician: This product contains a phenoxy herbicidal chemical. There is no specific antidote. All treatments should be based on observed signs and symptoms of distress in the patient. Overexposure to materials other than this product may have occurred.

5. FIRE FIGHTING MEASURES

Flash Point: >212°F (100°C) Pensky-Martens closed cup
Autoignition Temperature: Not determined **Flammability Limits:** Not determined

Extinguishing Media: Recommended for large fires: foam or water spray. Recommended for small fires: dry chemical or carbon dioxide.
Special Fire Fighting Procedures: Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full fire-fighting turn out gear. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.
Unusual Fire and Explosion Hazards: Containers will burst from internal pressure under extreme fire conditions. If water is used to fight fire or cool containers, dike to prevent runoff contamination of municipal sewers and waterways.
Hazardous Decomposition Materials (Under Fire Conditions): May produce gases such as hydrogen chloride and oxides of carbon and nitrogen.

National Fire Protection Association (NFPA) Hazard Rating:
Rating for this product: Health: 2 **Flammability:** 1 **Reactivity:** 0
Hazards Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Wear appropriate protective gear for the situation. See Personal Protection information in Section 8.
Environmental Precautions: Prevent material from entering public sewer systems or any waterways. Do not flush to drain. Large spills to soil or similar surfaces may necessitate removal of topsoil. The affected area should be removed and placed in an appropriate container for disposal.
Methods for Containment: Dike spill using absorbent or impervious materials such as earth, sand or clay. Collect and contain contaminated absorbent and dike material for disposal.
Methods for Cleanup and Disposal: Pump any free liquid into an appropriate closed container. Collect washings for disposal. Decontaminate tools and equipment following cleanup. See Section 13: DISPOSAL CONSIDERATIONS for more information. See Section 13: DISPOSAL CONSIDERATIONS for more information.
Other Information: Large spills may be reportable to the National Response Center (800-424-8802) and to state and/or local agencies.

7. HANDLING AND STORAGE

Handling:
Avoid breathing vapors or spray mist. Do not get in eyes, on skin or on clothing. Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Remove Personal Protective Equipment (PPE) immediately after handling this product. Wash outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

If the container is over one gallon and less than five gallons, mixers and loaders who do not use a mechanical system (probe and pump) to transfer the contents of this container must wear coveralls or a chemical-resistant apron in addition to the other required PPE. If the container is five gallons or more in capacity, do not open pour product from the container. A mechanical system (such as a probe and pump or spigot) must be used for transferring the contents of the container. If the contents of a non-refillable pesticide container are emptied, the probe must be rinsed before removal.

Storage:
Store in original container in a dry, secured storage area. Keep container tightly closed when not in use. Store at temperatures above 32°F. If allowed to freeze, warm to at least 40°F and remix before using. Freezing does not alter the product. Do not contaminate water, food or feed by storage or disposal.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls:
Where engineering controls are indicated by specific use conditions or a potential for excessive exposure, use local exhaust ventilation at the point of generation.

Personal Protective Equipment:
Eye/Face Protection: To avoid contact with eyes, wear face shield, goggles or safety glasses with front, brow and temple protection. An emergency eyewash or water supply should be readily accessible to the work area.
Skin Protection: To avoid contact with skin, wear coveralls over short-sleeved shirt and short pants, chemical-resistant footwear plus socks and chemical-resistant made of any waterproof material such as polyethylene or polyvinyl chloride. For overhead exposure, wear chemical-resistant headgear. Wear a chemical-resistant apron when cleaning equipment, mixing, or loading. An emergency shower or water supply should be readily accessible to the work area.
Respiratory Protection: Not normally required. If vapors or mists exceed acceptable levels, wear NIOSH approved air-purifying respirator with cartridges/canisters approved for use against pesticides.
General Hygiene Considerations: Personal hygiene is an important work practice exposure control measure and the following general measures should be taken when working with or handling this material: 1) do not store, use and/or consume foods, beverages, tobacco products, or cosmetics in areas where this material is stored; 2) wash hands and face carefully before eating, drinking, using tobacco, applying cosmetics or using the toilet.

Exposure Guidelines:

	OSHA		ACGIH		
Component	TWA	STEL	TWA	STEL	Unit
DMA Salt of 2,4-D	10*	NE	10*	NE	mg/m^3

*Based on adopted limit for 2,4-D NE = Not Established

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: Clear, pale yellow liquid with a phenolic-amine odor.

Boiling Point:	Not determined	**Solubility in Water:**	Soluble
Density:	9.65 pounds/gallon	**Specific Gravity:**	1.158 @ 20°C
Evaporation Rate:	Not determined	**Vapor Density:**	Not determined
Freezing Point:	Not determined	**Vapor Pressure:**	Not determined
pH:	8.3 – 8.7	**Viscosity:**	Not determined

Note: Physical data are typical values, but may vary from sample to sample. A typical value should not be construed as a guaranteed analysis or as a specification.

10. STABILITY AND REACTIVITY

Chemical Stability: This material is stable under normal handling and storage conditions.
Conditions to Avoid: Excessive heat. Do not store near heat or flame.
Incompatible Materials: Strong oxidizing agents: bases and acids.
Hazardous Decomposition Products: Under fire conditions may produce gases such as hydrogen chloride and oxides of carbon and nitrogen.
Hazardous Reactions: Hazardous polymerization will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological Data:
Except as noted, data from laboratory studies conducted on this product are summarized below:
Oral: Rat LD_{50}: 1,161 mg/kg
Dermal: Rabbit LD_{50}: 1,544 mg/kg
Inhalation: Rat 4-hr LC_{50}: >3.5 mg/l (data on similar product)
Eye Irritation: Rabbit: Severely irritating
Skin Irritation: Rabbit: Minimally irritating
Skin Sensitization: Not a contact sensitizer in guinea pigs following repeated skin exposure.

Subchronic (Target Organ) Effects: Repeated overexposure to phenoxy herbicides may cause effects to liver, kidneys, blood chemistry, and gross motor function. Rare cases of peripheral nerve damage have been reported, but extensive animal studies have failed to substantiate these observations, even at high doses for prolonged periods.
Carcinogenicity / Chronic Health Effects: Prolonged overexposure can cause liver, kidney and muscle damage. The International Agency for Research on Cancer (IARC) lists exposure to chlorophenoxy herbicides as a class 2B carcinogen, the category for limited evidence for carcinogenicity in humans. However, more current 2,4-D lifetime feeding studies in rats and mice did not show carcinogenic potential. The U.S. EPA has given 2,4-D a Class D classification (not classifiable as to human carcinogenicity).
Reproductive Toxicity: No impairment of reproductive function attributable to 2,4-D has been noted in laboratory animal studies.
Developmental Toxicity: Studies in laboratory animals with 2,4-D have shown decreased fetal body weights and delayed development in the offspring at doses toxic to mother animals.
Genotoxicity: There have been some positive and some negative studies, but the weight of evidence is that 2,4-D is not mutagenic.

Assessment Carcinogenicity:
This product contains substances that are considered to be probable or suspected human carcinogens as follows:

	Regulatory Agency Listing As Carcinogen			
Component	**ACGIH**	**IARC**	**NTP**	**OSHA**
Chlorophenoxy Herbicides	No	2B	No	No

See Section 2: HAZARDS IDENTIFICATION for more information.

12. ECOLOGICAL INFORMATION

Ecotoxicity:

Data on 2,4-D Dimethylamine Salt:

96-hour LC_{50} Bluegill:	524 mg/l	Bobwhite Quail Oral LD_{50}:	500 mg/kg
96-hour LC_{50} Rainbow Trout:	250 mg/l	Mallard Duck 8-day Dietary LC_{50}:	>5,620 ppm
48-hour EC_{50} Daphnia:	184 mg/l		

Environmental Fate:

In laboratory and field studies, 2,4-D DMA salt rapidly dissociated to parent acid in the environment. The typical half-life of the resultant 2,4-D acid ranged from a few days to a few weeks.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Handling and Disposal:

Plastic Bottles and Non-Returnable Plastic Drums: Do not reuse empty container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

Returnable/Refillable Containers: After use, return the container to the point of purchase or designated locations. The container must only be refilled with this product. DO NOT REUSE THE CONTAINER FOR ANY OTHER PURPOSE. Prior to refilling, inspect thoroughly for damage such as cracks, punctures, abrasions and damaged or worn out threads on closure devices. Do not refill or transport damaged or leaking containers. Check for leaks after refilling and before transportation. If the container is not being refilled, return it to the point of purchase.

14. TRANSPORTATION INFORMATION

Follow the precautions indicated in Section 7: HANDLING AND STORAGE of this MSDS.

DOT

< 25 gallons per complete package
Non Regulated

> 25 gallons per complete package
RQ ENVIRONMENTALLY HAZARDOUS SUBSTANCES,
LIQUID, N.O.S. (2,4-D SALT), 9, UN3082, III

See 49 CFR 173.132(b)(3) & 172.101 Appendix A

IMDG

Non Regulated – See IMDG 2.6.2.1.3

IATA
Non Regulated – See IATA 3.6.1.5.3

15. REGULATORY INFORMATION

U.S. Federal Regulations:

TSCA Inventory: This product is exempted from TSCA because it is solely for FIFRA regulated use.

SARA Hazard Notification/Reporting:
Hazard Categories Under Criteria of SARA Title III Rules (40 CFR Part 370):
Immediate, Delayed

Section 313 Toxic Chemical(s):
Acetic Acid, (2,4-Dichlorophenoxy)- (CAS No. 94-75-7), 38.9% equivalent by weight in product

Reportable Quantity (RQ) under U.S. CERCLA:
Acetic Acid, (2,4-Dichlorophenoxy)- (CAS No. 94-75-7) 100 pounds

RCRA Waste Code:
Acetic Acid, (2,4-Dichlorophenoxy)- (CAS No. 94-75-7) U240

State Information:
Other state regulations may apply. Check individual state requirements.

California Proposition 65: Not Listed

16. OTHER INFORMATION

This Material Safety Data Sheet (MSDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-ACCEPTED PRODUCT LABELING (attached to and accompanying the product container). This MSDS provides important health, safety and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course.

Use, storage and disposal of pesticide products are regulated by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) through the product labeling, and all necessary and appropriate precautionary, use, storage, and disposal information is set forth on that labeling. It is a violation of Federal law to use a pesticide product in any manner not prescribed on the EPA-accepted label.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, Nufarm Americas Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Nufarm Americas Inc. be responsible for damages of any nature whatsoever resulting from the use of or reliance upon Information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

Weedar is a registered trademark of Nufarm Americas Inc.

ATTENTION:

This specimen label is provided for general information only.

- This pesticide product may not yet be available or approved for sale or use in your area.
- It is your responsibility to follow all federal, state and local laws and regulations regarding the use of pesticides.
- Before using any pesticide, be sure the intended use is approved in your state or locality.
- Your state or locality may require additional precautions and instructions for use of this product that are not included here.
- Monsanto does not guarantee the completeness or accuracy of this specimen label. The information found in this label may differ from the information found on the product label. You must have the EPA approved labeling with you at the time of use and must read and follow all label directions.
- You should not base any use of a similar product on the precautions, instructions for use or other information you find here.
- Always follow the precautions and instructions for use on the label of the pesticide you are using.

21195F3-25

AQUAMASTER®

Herbicide by Monsanto

Complete Directions for Use in Aquatic and Other Non-Crop Sites.

EPA Reg. No. 524-343

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

2006-1

Read the entire label before using this product.

Use only according to label instructions.

Not all products recommended on this label are registered for use in California. Check the registration status of each product in California before using.

Read the "LIMIT OF WARRANTY AND LIABILITY" statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.

THIS IS AN END-USE PRODUCT. MONSANTO DOES NOT INTEND AND HAS NOT REGISTERED IT FOR REFORMULATION OR REPACKAGING. SEE INDIVIDUAL CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

1.0 INGREDIENTS

ACTIVE INGREDIENT:	
*Glyphosate, N-(phosphonomethyl)glycine, in the form of its isopropylamine salt	53.8%
OTHER INGREDIENTS:	46.2%
	100.0%

*Contains 648 grams per liter or 5.4 pounds per U.S. gallon of the active ingredient glyphosate, in the form of its isopropylamine salt. Equivalent to 480 grams per liter or 4.0 pounds per U.S. gallon of the acid, glyphosate.

No license granted under any non-U.S. patent(s).

2.0 IMPORTANT PHONE NUMBERS

1. FOR PRODUCT INFORMATION OR ASSISTANCE IN USING THIS PRODUCT, CALL TOLL-FREE, 1-800-332-3111.
2. IN CASE OF AN EMERGENCY INVOLVING THIS PRODUCT, OR FOR MEDICAL ASSISTANCE, CALL COLLECT, DAY OR NIGHT, (314)-694-4000.

3.0 PRECAUTIONARY STATEMENTS

3.1 Hazards to Humans and Domestic Animals

Keep out of reach of children.

CAUTION!

Remove contaminated clothing and wash clothing before reuse. Wash thoroughly with soap and water after handling.

3.2 Environmental Hazards

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation.

In case of: SPILL or LEAK, soak up and remove to a landfill.

3.3 Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied using only stainless steel, aluminum, fiberglass, plastic or plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in any manner inconsistent with its labeling. This product can only be used in accordance with the Directions for Use on this label or in separately published Monsanto Supplemental Labeling. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulations.

4.0 STORAGE AND DISPOSAL

Do not contaminate water, foodstuffs, feed or seed by storage or disposal.

Keep container closed to prevent spills and contamination.

PESTICIDE STORAGE: STORE ABOVE 5°F (-15°C) TO KEEP PRODUCT FROM CRYSTALLIZING. Crystals will settle to the bottom. If allowed to crystallize, place in a warm area 68°F (20°C) for several days to redissolve and roll or shake container or recirculate in mini-bulk containers to mix well before using.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticide disposal or in accordance with applicable Federal, state, or local procedures.

CONTAINER DISPOSAL: Emptied container retains vapor and product residue. Observe all labeled safeguards until container is cleaned, reconditioned, or destroyed.

FOR PLASTIC ONE-WAY CONTAINERS & BOTTLES: Do not reuse container. Triple rinse container, then puncture and dispose of in a sanitary landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

FOR ONE-WAY DRUMS: Do not reuse container. Return container per the Monsanto container return program. If not returned, triple rinse container,

then puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

FOR REFILLABLE PORTABLE (MINI-BULK) CONTAINERS: This container must only be refilled with pesticide product. **Do not reuse this container for any other purpose.**

Final disposal must be in compliance with state and local regulations. If not refilled, returned, or recycled, triple rinse or pressure rinse, puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

Do not transport this container if it is damaged or leaking. If the container is damaged, leaking or obsolete, or to obtain information about recycling portable refillable containers, contact Monsanto Company at 800-768-6387.

Users: When the container is empty, replace the cap and seal all openings that have been made during usage, and return the container to the point of purchase, or to an alternate location designated by the manufacturer at the time of purchase of this product. If not returned, triple rinse or pressure rinse the empty container and offer it for recycling if available.

Refillers: Do not reuse this mini-bulk container except for refill in accordance with a valid Monsanto Repackaging or Toll Repackaging Agreement. Prior to refilling, inspect carefully for damage such as cracks, punctures, abrasions, worn-out threads and closure devices. Check for leaks after refilling and before transporting.

FOR REFILLABLE STATIONARY BULK CONTAINERS: This container must only be refilled with pesticide product. **Do not reuse this container for any other purpose.**

Prior to refilling, inspect carefully for damage such as cracks, punctures, abrasions, worn-out threads and closure devices.

Final disposal must be in compliance with state and local regulations. If not refilled, triple rinse or pressure rinse container and offer for recycling or reconditioning if possible. If burned, stay out of smoke.

5.0 GENERAL INFORMATION (How This Product Works)

Product Description: This product is a postemergent, systemic herbicide with no soil residual activity. It gives broad-spectrum control of many annual weeds, perennial weeds, woody brush and trees.

Time to Symptoms: This product moves through the plant from the point of foliage contact to and into the root system. Visible effects on most annual weeds occur within 2 to 4 days, but on most perennial weeds may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow activity of this product and delay development of visual symptoms. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts.

Mode of Action in Plants: The active ingredient in this product inhibits an enzyme found only in plants and microorganisms that is essential to formation of specific amino acids.

Cultural Considerations: Reduced control may result when applications are made to annual or perennial weeds that have been mowed, grazed or cut, and have not been allowed to regrow to the recommended stage for treatment.

Rainfastness: Heavy rainfall soon after application may wash this product off of the foliage and a repeat application may be required for adequate control.

No Soil Activity: Weeds must be emerged at the time of application to be controlled by this product. Weeds germinating from seed after application will not be controlled. Unemerged plants arising from unattached underground rhizomes or rootstocks of perennials will not be affected by the herbicide and will continue to grow.

Tank Mixing: This product does not provide residual weed control. For subsequent residual weed control, follow a label-approved herbicide program. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive label directions for each product in the mixture.

When this label recommends a tank mixture with a generic active ingredient such as diuron, 2,4-D or dicamba, the user is responsible for ensuring that the mixture product's label allows the specific application.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product with herbicides or other materials that are not expressly recommended in this label. Mixing this product with herbicides or other materials not recommended on this label may result in reduced performance.

Annual Maximum Use Rate: The combined total of all treatments must not exceed 8 quarts of this product per acre per year in terrestrial sites. Any single broadcast application made over water must not exceed 7.5 pints per acre. The maximum use rates stated throughout this product's labeling apply to this product combined with the use of all other herbicides containing glyphosate or sulfosate as the active ingredient, whether applied as mixtures or separately. Calculate the application rates and ensure that the total use of this and other glyphosate or sulfosate containing products does not exceed stated maximum use rates.

ATTENTION

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, GREEN STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended. The likelihood of injury occurring from the use of this product increases when winds are gusty, as wind velocity increases, when wind direction is constantly changing or when there are other meteorological conditions that favor spray drift. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) that are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

NOTE: Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences.

6.0 MIXING

Clean sprayer parts immediately after using this product by thoroughly flushing with water.

NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, SUCH AS VISIBLY MUDDY WATER OR WATER FROM PONDS AND DITCHES THAT IS NOT CLEAR.

6.1 Mixing with Water

This product mixes readily with water. Mix spray solutions of this product as follows: Fill the mixing or spray tank with the required amount of water. Add the recommended amount of this product near the end of the filling process and mix well. Use caution to avoid siphoning back into the carrier source. Use approved anti-back-siphoning devices where required by state or local regulations. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, terminate by-pass and return lines at the bottom of the tank and, if needed, use an approved anti-foam or defoaming agent.

6.2 Surfactant

This product requires the use of a nonionic surfactant. When using this product, mix 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution. Increasing the rate of surfactant may enhance performance. Examples of when to use the higher surfactant rate include, but are not limited to: hard-to-control woody brush, trees and vines, high water volumes, adverse environmental conditions, tough-to-control weeds, weeds under stress, surfactants with less than 70 percent active ingredient, tank mixes, etc. These surfactants should not be used in excess of 1 quart per acre when making broadcast applications.

Always read and follow the manufacturer's surfactant label recommendations for best results. Carefully observe all cautionary statements and other information appearing in the surfactant label.

When applied as recommended under the conditions described, this product controls annual and perennial weeds listed in the label booklet. Do not reduce rates of this product when adding surfactant.

6.3 Tank Mixing Procedure

Mix labeled tank mixtures of this product with water as follows:

1. Place a 20- to 35-mesh screen or wetting basket over filling port.
2. Through the screen, fill the spray tank one-half full with water and start agitation.
3. If a wettable powder is used, make a slurry with the water carrier, and add it SLOWLY through the screen into the tank. Continue agitation.
4. If a flowable formulation is used, premix one part flowable with one part water. Add diluted mixture SLOWLY through the screen into the tank. Continue agitation.
5. If an emulsifiable concentrate formulation is used, premix one part emulsifiable concentrate with two parts water. Add diluted mixture slowly through the screen into the tank. Continue agitation.
6. Continue filling the spray tank with water and add the required amount of this product near the end of the filling process.

7. Add nonionic surfactant to the spray tank before completing the filling process.
8. Add individual formulations to the spray tank as follows: wettable powder, flowable, emulsifiable concentrate, drift control additive, water soluble liquid and nonionic surfactant.

Maintain good agitation at all times until the contents of the tank are sprayed. If the spray mixture is allowed to settle, thorough agitation is required to resuspend the mixture before spraying is resumed.

Keep by-pass line on or near the bottom of the tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50-mesh.

Always predetermine the compatibility of labeled tank mixtures of this product with water carrier by mixing small proportional quantities in advance. Ensure that the specific tank mixture product is registered for application at the desired site.

Refer to the "**Tank Mixing**" section of "GENERAL INFORMATION" for additional precautions.

6.4 Mixing Percent Solutions

Prepare the desired volume of spray solution by mixing the amount of this product in water as shown in the following table:

Spray Solution

DESIRED VOLUME	Amount of AquaMaster Herbicide					
	0.5%	0.75%	1%	1.5%	4%	8%
1 gal	2/3 oz	1 oz	1.3 oz	2 oz	5 oz	10 oz
25 gal	1 pt	1.5 pt	1 qt	1.5 qt	4 qt	2 gal
100 gal	2 qt	3 qt	1 gal	1.5 gal	4 gal	8 gal

2 tablespoons = 1 fluid ounce

For use in backpack, knapsack or pump-up sprayers, it is suggested that the recommended amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution.

6.5 Colorants or Dyes

Agriculturally approved colorants or marking dyes may be added to this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilution. Use colorants or dyes according to the manufacturer's recommendations.

6.6 Drift Reduction Additives

Drift reduction additives may be used with all equipment types, except wiper applicators, and sponge bars. When a drift reduction additive is used, read and carefully observe the cautionary statements and all other information appearing on the additive label. The use of drift reduction additives can affect spray coverage which may result in reduced performance.

7.0 APPLICATION EQUIPMENT AND TECHNIQUES

Do not apply this product through any type of irrigation system.

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES.

SPRAY DRIFT MANAGEMENT

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment- and weather-related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

7.1 Aerial Equipment

DO NOT APPLY THIS PRODUCT USING AERIAL SPRAY EQUIPMENT EXCEPT UNDER CONDITIONS AS SPECIFIED WITHIN THIS LABEL.

FOR AERIAL APPLICATION IN CALIFORNIA, REFER TO THE FEDERAL SUPPLEMENTAL LABEL FOR AERIAL APPLICATIONS IN THAT STATE FOR SPECIFIC INSTRUCTIONS, RESTRICTIONS AND REQUIREMENTS.

This product plus Oust, 2,4-D or dicamba tank mixtures may not be applied by air in California.

TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Avoid direct application to any body of water.

Use the recommended rates of this herbicide in 3 to 25 gallons of water per acre.

Ensure uniform application—To avoid streaked, uneven or overlapped application, use appropriate marking devices.

AERIAL SPRAY DRIFT MANAGEMENT

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications to agricultural field crops. These requirements do not apply to public health uses.

1. The distance of the outermost nozzles on the boom must not exceed 3/4 the length of the wingspan or rotor.
2. Nozzles must always point backward parallel with the air- stream and never be pointed downwards more than 45 degrees. Where states have more stringent regulations, they should be observed.

Importance of Droplet Size

The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see the **"Wind"**, **"Temperature and Humidity"** and **"Temperature Inversions"** sections of this label).

Controlling Droplet Size

- **Volume:** Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with the higher rated flows produce larger droplets.
- **Pressure:** Use the lower spray pressures recommended for the nozzle. Higher pressure reduces droplet size and does not improve canopy penetration. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of nozzles:** Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle orientation:** Orienting nozzles so that the spray is released backwards, parallel to the airstream, will produce larger droplets than other orientations. Significant deflection from the horizontal will reduce droplet size and increase drift potential.
- **Nozzle type:** Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low- drift nozzles. Solid stream nozzles oriented straight back produce larger droplets than other nozzle types.
- **Boom length:** For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.
- **Application height:** Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces the exposure of the droplets to evaporation and wind.

Swath Adjustment

When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller droplets, etc.).

Wind

Drift potential is lowest between wind speeds of 2 to 10 miles per hour. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 miles per hour due to variable wind direction and high inversion potential. **NOTE:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect drift.

Temperature and Humidity

When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions

Applications should not occur during a temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion,

while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

Sensitive Areas

This product should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

Aircraft Maintenance

PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion. To prevent corrosion of exposed parts, thoroughly wash aircraft after each day of spraying to remove residues of this product accumulated during spraying or from spills. Landing gear is most susceptible.

7.2 Ground Broadcast Equipment

When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label. Use the recommended rates of this product in 3 to 40 gallons of water per acre as a broadcast spray unless otherwise specified. As density of weeds increases, spray volume should be increased within the recommended range to ensure complete coverage. Carefully select proper nozzles to avoid spraying a fine mist. For best results with ground application equipment, use flat-fan nozzles. Check for even distribution of spray droplets.

7.3 Hand-Held Equipment

Apply to foliage of vegetation to be controlled. For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff. Use coarse sprays only.

For low-volume directed spray applications, use a 4- to 8-percent solution of this product for control or partial control of annual weeds, perennial weeds, or woody brush and trees. Spray coverage should be uniform with at least 50 to 75 percent of the foliage contacted. Coverage of the top one-half of the plant is important for best results. If a straight stream nozzle is used, start the application at the top of the targeted vegetation and spray from top to bottom in a lateral zig-zag motion. For flat-fan and cone nozzles and with hand-directed mist blowers, mist the application over the foliage of the targeted vegetation. To ensure adequate spray coverage, spray both sides of large or tall woody brush and trees, when foliage is thick and dense, or where there are multiple sprouts. For best results, apply to actively growing woody brush and trees after full leaf expansion and before fall color and leaf drop.

Unless otherwise specified, use the recommended rates listed in the following "**Application Rates**" table for various methods of foliar application using high-volume, backpack, knapsack and similar types of hand-held equipment. When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label.

APPLICATION RATES

APPLICATION	AQUAMASTER	SPRAY VOLUME GALLONS/ACRE
SPRAY-TO-WET		
Handgun or Backpack	0.5 to 1.5% by volume	spray-to-wet*
LOW-VOLUME DIRECTED SPRAY		
Backpack	4 to 8% by volume	15 to 25**
Modified High-Volume	1.5 to 3% by volume	40 to 60**

*For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff.

**Low-volume directed applications with backpacks work best when treating weeds and brush less than 10 feet tall. For taller weeds and brush, high-volume handguns can be modified by reducing nozzle size and spray pressure to produce a low-volume directed spray.

7.4 Selective Equipment

This product may be applied through shielded applicators, hooded sprayers, wiper applicators or sponge bars, after dilution and thorough mixing with water, to listed weeds growing in any aquatic or non-crop site specified on this label.

AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION, AS SERIOUS INJURY OR DEATH IS LIKELY TO OCCUR.

Applicators used above desired vegetation should be adjusted so that the lowest spray stream or wiper contact point is at least 2 inches above the desirable vegetation. Droplets, mist, foam or splatter of the herbicide solution settling on desirable vegetation is likely to result in discoloration, stunting or destruction.

Better results may be obtained when more of the weed is exposed to the herbicide solution. Weeds not contacted by the herbicide solution will not be affected. This may occur in dense clumps, severe infestations or when the height of the weeds varies so that not all weeds are contacted. In these instances, repeat treatment may be necessary.

Shielded and Hooded Applicators

A shielded or hooded applicator directs the herbicide solution onto weeds, while shielding desirable vegetation from the herbicide. Use nozzles that provide uniform coverage within the treated area. Keep shields on these sprayers adjusted to protect desirable vegetation. EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION.

Wiper Applicators and Sponge Bars

Wiper applicators are devices that physically wipe appropriate amounts of this product directly onto the weed.

Equipment must be designed, maintained and operated to prevent the herbicide solution from contacting desirable vegetation. Operate this equipment at ground speeds no greater than 5 miles per hour. Performance may be improved by reducing speed in areas of heavy weed infestations to ensure adequate wiper saturation. Better results may be obtained if 2 applications are made in opposite directions.

Avoid leakage or dripping onto desirable vegetation. Adjust height of applicator to ensure adequate contact with weeds. Keep wiping surfaces clean. Be aware that, on sloping ground, the herbicide solution may migrate, causing dripping on the lower end and drying of the wicks on the upper end of a wiper applicator.

Do not use wiper equipment when weeds are wet.

Mix only the amount of solution to be used during a 1-day period, as reduced activity may result from use of leftover solutions. Clean wiper parts immediately after using this product by thoroughly flushing with water.

Nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended with all wiper applications.

For Rope or Sponge Wick Applicators—Solutions ranging from 33 to 75 percent of this product in water may be used.

For Panel Applicators—Solutions ranging from 33 to 100 percent of this product in water may be used in panel wiper applicators.

8.0 SITE AND USE INSTRUCTIONS

Unless otherwise specified, applications may be made to control any weeds listed in the "**Annual Weeds**", "**Perennial Weeds**" and "**Woody Brush and Trees**" rate tables. Refer also to the "**Selective Equipment**" section.

8.1 Aquatic Sites

This product may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, wastewater treatment facilities, wildlife habitat restoration and management areas.

This product may also be used to control the labeled weeds, woody brush and trees growing in other terrestrial non-crop sites listed on this label or in aquatic sites within these areas.

If aquatic sites are present in a non-crop area and are part of the intended treatment, read and observe the following directions:

This product does not control plants which are completely submerged or have a majority of their foliage under water.

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

NOTE: Do not apply this product **directly to water** within 0.5 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 0.5 mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within 0.5 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after the application. The water intake may be turned on prior to 48 hours if the glyphosate level in the intake water is below 0.7 parts per million as determined by laboratory analysis. These aquatic applications may be made ONLY in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable

water intake for a minimum period of 48 hours after the applications. This restriction does **NOT** apply to intermittent inadvertent overspray of water in terrestrial use sites.

For treatments after drawdown of water or in dry ditches, allow 7 or more days after treatment before reintroduction of water to achieve maximum weed control. Apply this product within 1 day after drawdown to ensure application to actively growing weeds.

Floating mats of vegetation may require retreatment. Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash or by rainfall within 6 hours of application. Do not retreat within 24 hours following the initial treatment.

Applications made to moving bodies of water must be made while traveling upstream to prevent concentration of this herbicide in water. When making any bankside applications, do not overlap more than 1 foot into open water. Do not spray in bodies of water where weeds do not exist. The maximum application rate of 7.5 pints per acre must not be exceeded in any single broadcast application that is being made over water.

When emerged infestations require treatment of the total surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in fish kill.

Tank Mixtures

Tank mixtures of this product plus 2,4-D amine may be used to increase the spectrum of vegetation controlled in aquatic sites. Use 1.5 to 2 pints of this product plus 2 to 4 pints of 2,4-D amine (4 pounds active ingredient per gallon, labeled for aquatic sites) for control of annual weeds. Use 3 to 7.5 pints of this product plus 2 to 4 quarts of 2,4-D amine (4 pounds per gallon, labeled for aquatic sites) for control or partial control of perennial weeds, woody brush and trees.

When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Mix in the following sequence: Fill sprayer tank one-half full with water, add AquaMaster herbicide, then 2,4-D amine and finally surfactant. Fill sprayer tank to final volume of water.

NOTE: DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE CONCENTRATES WITHOUT WATER CARRIER. DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE IN BYPASS INJECTOR-TYPE SPRAY EQUIPMENT.

8.2 Cut Stump

Cut stump treatments may be made on any site listed on this label. This product will control many types of woody brush and tree species. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut trees or resprouts close to the soil surface. Apply a 50- to 100-percent solution of this product to the freshly-cut surface **immediately after** cutting. Delays in application may result in reduced performance. For best results, applications should be made during periods of active growth and full leaf expansion.

For control of *Ailanthus altissima* (Tree-of-heaven) make a cut stump treatment according to the directions in this section using a spray mixture of 50 percent AquaMaster herbicide and 10 percent Arsenal.

DO NOT MAKE CUT STUMP APPLICATIONS WHEN THE ROOTS OF DESIRABLE WOODY BRUSH OR TREES MAY BE GRAFTED TO THE ROOTS OF THE CUT STUMP. Some sprouts, stems, or trees may share the same root system. Adjacent trees having a similar age, height and spacing may signal shared roots. Whether grafted or shared, injury is likely to occur to non-treated stems/trees when one or more trees sharing common roots are treated.

8.3 General Non-Crop Areas and Industrial Sites

Use in areas such as airports, apartment complexes, commercial sites, ditch banks, driveways, dry ditches, dry canals, fencerows, golf courses, greenhouses, industrial sites, lumber yards, manufacturing sites, municipal sites, natural areas, office complexes, ornamentals, parking areas, parks, pastures, petroleum tank farms and pumping installations, railroads, rangeland, recreational areas, residential areas, rights-of-way, roadsides, schools, sod or turf seed farms, sports complexes, storage areas, substations, utility sites, warehouse areas, other public areas, and wildlife management areas.

General Weed Control, Trim-and-Edge and Bare Ground

This product may be used in general non-crop areas. It may be applied with any application equipment described in this label. This product may be used to trim-and-edge around objects in non-crop sites, for spot treatment of unwanted vegetation and to eliminate unwanted weeds growing in established shrub beds or ornamental plantings. This product may be used prior to planting an area to ornamentals, flowers, turfgrass (sod or seed), or prior to laying asphalt or beginning construction projects.

Repeated applications of this product may be used, as weeds emerge, to maintain bare ground.

TANK MIXTURES: This product may be tank-mixed with the following products. Refer to these products' labels for approved non-crop sites and application rates.

Arsenal®	Outrider®
Barricade® 65WG	Pendulum® 3.3 EC
Certainty®	Pendulum WDG
diuron	Plateau®
Endurance®	Princep® DF
Escort®	Princep Liquid
Garlon® 3A	Ronstar® 50 WP
Garlon 4	Sahara®
Hyvar® X	simazine
Karmex® DF	Surflan®
Krovar® I DF	Telar®
Oust®	2,4-D

This product plus dicamba tank mixtures may not be applied by air in California.

Brush Control Tank Mixtures

TANK MIXTURES: Tank mixtures of this product may be used to increase the spectrum of control for herbaceous weeds, woody brush and trees. When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Any recommended rate of this product may be used in a tank mix.

For control of herbaceous weeds, use the lower recommended tank mixture rates. For control of dense stands or tough-to-control woody brush and trees, use the higher recommended rates.

NOTE: For side trimming treatments, it is recommended that this product be used alone or in tank mixture with Garlon 4.

PRODUCT	BROADCAST RATE
Arsenal	6 to 32 fluid ounces per acre
Escort	1 to 2 ounces per acre
Garlon 3A*, Garlon 4	1 to 4 quarts per acre

PRODUCT	SPRAY-TO-WET RATES
Arsenal	0.06 to 0.12% by volume
Escort	1 to 2 ounces per acre

PRODUCT	LOW-VOLUME DIRECTED SPRAY RATES
Arsenal	0.1 to 0.5% by volume
Escort	1 to 2 ounces per acre

* Ensure that Garlon 3A is thoroughly mixed with water according to label directions before adding this product. Have spray mixture agitating at the time this product is added to avoid spray compatibility problems.

8.4 Habitat Management

Habitat Restoration and Management

This product may be used to control exotic and other undesirable vegetation in habitat management and natural areas, including riparian and estuarine areas, rangeland and wildlife refuges. Applications can be made to allow recovery of native plant species, prior to planting desirable native species, and for similar broad-spectrum vegetation control requirements. Spot treatments can be made to selectively remove unwanted plants for habitat management and enhancement.

Wildlife Food Plots

This product may be used as a site preparation treatment prior to planting wildlife food plots. Any wildlife food species may be planted after applying this product, or native species may be allowed to repopulate the area. If tillage is needed to prepare a seedbed, wait 7 days after application before tillage to allow translocation into underground plant parts.

8.5 Injection and Frill (Woody Brush and Trees)

This product may be used to control woody brush and trees by injection or frill applications. Apply this product using suitable equipment that must penetrate into the living tissue. Apply the equivalent of 1/25 fluid ounce (1 milliliter) of this product per each 2 to 3 inches of trunk diameter at breast height (DBH). This is best achieved by applying a 50- to 100-percent concentration of this product either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying diluted material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frilled or cut areas in species that exude sap freely. In species such as this, make the frill or cuts at an oblique angle to produce a cupping effect and use a

100-percent concentration of this product. For best results, application should be made during periods of active growth and after full leaf expansion.

8.6 Roadsides

All of the instructions in the "**General Non-Crop Areas and Industrial Sites**" section apply to roadsides.

Shoulder Treatments

This product may be used on road shoulders. It may be applied with boom sprayers, shielded boom sprayers, high-volume off-center nozzles, hand-held equipment, and similar equipment.

Guardrails and Other Obstacles to Mowing

This product may be used to control weeds growing under guardrails and around signposts and other objects along the roadside.

Spot Treatment

This product may be used as a spot treatment to control unwanted vegetation growing along roadsides.

TANK MIXTURES: This product may be tank-mixed with the following products for shoulder, guardrail, spot and bare ground treatments, provided that the specific tank mixture product is labeled for this site:

diuron	Princep DF
Endurance	Princep Liquid
Escort	Ronstar 50 WP
Garlon 4	Sahara
Krovar I DF	simazine
Oust	Surflan
Outrider	Telar
Pendulum 3.3 EC	2,4-D
Pendulum WDG	

See the "MIXING" section of this label for general instructions for tank mixing.

Release of Bermudagrass or Bahiagrass

Dormant Applications

This product may be used to control or partially control many winter annual weeds and tall fescue for effective release of dormant Bermudagrass or bahiagrass. Treat only when turf is dormant and prior to spring greenup. This product may also be tank mixed with Outrider herbicide or Oust for residual control. Tank mixtures of this product with Oust may delay greenup.

For best results on winter annuals, treat when plants are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is at or beyond the 4- to 6-leaf stage.

Apply 6 to 48 fluid ounces of this product in a tank mixture with 0.75 to 1.33 ounces Outrider herbicide per acre. Read and follow all label directions for Outrider herbicide.

TANK MIXTURES: Apply 6 to 48 fluid ounces of this product per acre alone or in a tank mixture with 0.25 to 1 ounce per acre of Oust. Apply the recommended rates in 10 to 40 gallons of water per acre. Use only in areas where Bermudagrass or bahiagrass are desirable ground covers and where some temporary injury or discoloration can be tolerated. To avoid delays in greenup and minimize injury, add no more than 1 ounce of Oust per acre on Bermudagrass and no more than 0.5 ounce of Oust per acre on bahiagrass and avoid treatments when these grasses are in a semi-dormant condition.

Actively Growing Bermudagrass

This product may be used to control or partially control many annual and perennial weeds for effective release of actively growing Bermudagrass. Apply 12 to 36 fluid ounces of this product in 10 to 40 gallons of spray solution per acre. Use the lower rate when treating annual weeds below 6 inches in height (or runner length). Use the higher rate as weeds increase in size or as they approach flower or seedhead formation. These rates will also provide partial control of the following perennial species:

Bahiagrass	Johnsongrass
Bluestem, silver	Trumpetcreeper
Fescue, tall	Vaseygrass

This product may be tank-mixed with Outrider herbicide for control or partial control of Johnsongrass and other weeds listed in the Outrider herbicide label. Use 6 to 24 ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide per acre. Use the higher rates of both products for control of perennial weeds or annual weeds greater than 6 inches in height.

TANK MIXTURES: This product may be tank-mixed with Oust. If tank-mixed, use no more than 12 to 24 fluid ounces of this product with 1 to 2 ounces of Oust per acre. Use the lower rates of each product to control annual weeds less than 6 inches in height or runner length that are listed in this label and the Oust label. Use the higher rates as annual weeds increase in size and approach the flower or seedhead stages. These rates will also provide partial control of the following perennial weeds:

Bahiagrass	Fescue, tall
Bluestem, silver	Johnsongrass
Broomsedge	Poorjoe
Dallisgrass	Trumpetcreeper
Dock, curly	Vaseygrass
Dogfennel	Vervain, blue

Use only on well-established Bermudagrass. Bermudagrass injury may result from the treatment, but regrowth will occur under moist conditions. Repeat applications of the tank mix in the same season are not recommended, since severe injury may occur.

Actively Growing Bahiagrass

For suppression of vegetative growth and seedhead inhibition of bahiagrass for approximately 45 days, apply 4 fluid ounces of this product in 10 to 40 gallons of water per acre. Apply 1 to 2 weeks after full greenup or after mowing to a uniform height of 3 to 4 inches. This application must be made prior to seedhead emergence.

For suppression up to 120 days, apply 3 fluid ounces of this product per acre, followed by an application of 2 to 3 fluid ounces per acre about 45 days later. Make no more than 2 applications per year.

This product may be used for control or partial control of Johnsongrass and other weeds listed on the Outrider herbicide label in actively growing bahiagrass. Apply 1.5 to 3.5 fluid ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide per acre. Use the higher rates for control of perennial weeds or annual weeds greater than 6 inches in height. Use only on well established bahiagrass.

TANK MIXTURES: A tank mixture of this product plus Oust may be used. Apply 4 fluid ounces of this product plus 0.25 ounce of Oust per acre 1 to 2 weeks following an initial spring mowing. Make only one application per year.

9.0 WEEDS CONTROLLED

Always use the higher rate of this product per acre within the recommended range when weed growth is heavy or dense or weeds are growing in an undisturbed (noncultivated) area.

Reduced results may occur when treating weeds heavily covered with dust. For weeds that have been mowed, grazed or cut, allow regrowth to occur prior to treatment.

Refer to the following label sections for recommended rates for the control of annual and perennial weeds and woody brush and trees. For difficult to control perennial weeds and woody brush and trees, where plants are growing under stressed conditions, or where infestations are dense, this product may be used at 4.5 to 8 quarts per acre for enhanced results.

9.1 Annual Weeds

Apply to actively growing annual grasses and broadleaf weeds.

Allow at least 3 days after application before disturbing treated vegetation. After this period the weeds may be mowed, tilled or burned. See the "GENERAL INFORMATION", "MIXING", and "APPLICATION EQUIPMENT AND TECHNIQUES" sections for labeled uses and specific application instructions.

Use 1.5 pints per acre if weeds are less than 6 inches in height or runner length and 1 to 4 quarts per acre if weeds are over 6 inches in height or runner length or when weeds are growing under stressed conditions.

For spray-to-wet applications, apply a 0.5-percent solution of this product to weeds less than 6 inches in height or runner length. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds. For annual weeds over 6 inches tall, or for smaller weeds growing under stressed conditions, use a 0.75- to 1.5-percent solution. Use the higher rate for tough-to-control species or for weeds over 24 inches tall.

WEED SPECIES

Anoda, spurred	Cheeseweed
Balsamapple* *	*(Malva parviflora)*
Barley*	Chervil*
Barnyardgrass*	Chickweed*
Bittercress*	Cocklebur*
Black nightshade*	Copperleaf, hophornbeam
Bluegrass, annual*	Corn*
Bluegrass, bulbous*	Corn speedwell*
Bassia, fivehook	Crabgrass*
Brome, downy*	Dwarfdandelion*
Brome, Japanese*	Eastern mannagrass*
Broomsedge	Eclipta*
Browntop panicum*	Fall panicum*
Buttercup*	Falsedandelion*
Carolina foxtail*	Falseflax, smallseed*
Carolina geranium	Fiddleneck
Castor bean	Field pennycress*
Cheatgrass*	Filaree

WEED SPECIES (Cont'd)

Fleabane, annual*	Ragweed, common*
Fleabane, hairy *(Conyza bonariensis)**	Ragweed, giant
	Red rice
Fleabane, rough*	Russian thistle
Florida pusley	Rye*
Foxtail*	Ryegrass*
Goatgrass, jointed*	Sandbur, field*
Goosegrass	Shattercane*
Grain sorghum (milo)*	Shepherd's-purse*
Groundsel, common*	Sicklepod
Hemp sesbania	Signalgrass, broadleaf*
Henbit	Smartweed, ladysthumb*
Horseweed/Marestail *(Conyza canadensis)*	Smartweed, Pennsylvania*
	Sowthistle, annual
Itchgrass*	Spanishneedles***
Johnsongrass, seedling	Speedwell, purslane*
Junglerice	Sprangletop*
Knotweed	Spurge, annual
Kochia	Spurge, prostrate*
Lamb's-quarters*	Spurge, spotted*
Little barley*	Spurry, umbrella*
London rocket*	Starthistle, yellow
Mayweed	Stinkgrass*
Medusahead*	Sunflower*
Morningglory *(Ipomoea spp.)*	Teaweed/Prickly sida
	Texas panicum*
Mustard, blue*	Velvetleaf
Mustard, tansy*	Virginia copperleaf
Mustard, tumble*	Virginia pepperweed*
Mustard, wild*	Wheat*
Oats	Wild oats*
Pigweed*	Witchgrass*
Plains/Tickseed coreopsis*	Woolly cupgrass*
Prickly lettuce*	Yellow rocket
Puncturevine	
Purslane, common	

*When using field broadcast equipment (aerial applications or boom sprayers using flat-fan nozzles) these species will be controlled or partially controlled using 12 fluid ounces of this product per acre. Applications must be made using 3 to 10 gallons of carrier volume per acre. Use nozzles that ensure thorough coverage of foliage and treat when weeds are in an early growth stage.

** Apply with hand-held equipment only.

***Apply 3 pints of this product per acre.

9.2 Perennial Weeds

Best results are obtained when perennial weeds are treated after they reach the reproductive stage of growth (seedhead initiation in grasses and bud formation in broadleaves). For non-flowering plants, best results are obtained when the plants reach a mature stage of growth. In many situations treatments are required prior to these growth stages. Under these conditions, use the higher application rate within the recommended range.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed spot treatments, apply a 4- to 8-percent solution of this product.

Allow 7 or more days after application before tillage. If weeds have been mowed or tilled, do not treat until regrowth has reached the recommended stages. Fall treatments must be applied before a killing frost.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed.

WEED SPECIES	RATE (QT/A)	HAND-HELD % SOLUTION
Alfalfa*	0.7	1.5
Alligatorweed*	3.0	1.3
Anise (fennel)	1.5 - 3.0	1.0 - 1.5
Bahiagrass	2.3 - 3.75	1.5
Beachgrass, European *(Ammophila arenaria)*	—	3.5
Bentgrass*	1.0	1.5
Bermudagrass	4.0	1.5
Bermudagrass, water (knotgrass)	1.0	1.5
Bindweed, field	3.0 - 3.75	1.5
Bluegrass, Kentucky	1.5 - 2.3	0.75
Blueweed, Texas	3.0 - 3.75	1.5
Brackenfern	2.3 - 3.0	0.75 - 1.0
Bromegrass, smooth	1.5 - 2.3	0.75
Bursage, woolly-leaf	—	1.5
Canarygrass, reed	1.5 - 2.3	0.75
Cattail	2.3 - 3.75	0.75
Clover; red, white	2.3 - 3.75	1.5
Cogongrass	2.3 - 3.75	1.5
Cordgrass	2.3 - 3.75	1.0 - 2.0
Cutgrass, giant	3.0	1.0
Dallisgrass	2.3 - 3.75	1.5
Dandelion	2.3 - 3.75	1.5
Dock, curly	2.3 - 3.75	1.5
Dogbane, hemp	3.0	1.5
Fescue (except tall)	2.3 - 3.75	1.5
Fescue, tall	2.3	1.0
Guineagrass	2.3	0.75
Horsenettle	2.3 - 3.75	1.5
Horseradish	3.0	1.5
Iceplant	1.5	1.5
Ivy; German, cape	1.5 - 3.0	0.75 - 1.5
Jerusalem artichoke	2.3 - 3.75	1.5
Johnsongrass	1.5 - 2.3	0.75
Kikuyugrass	1.5 - 2.3	0.75
Knapweed	3.0	1.5
Lantana	—	0.75 - 1.0
Lespedeza	2.3 - 3.75	1.5
Loosestrife, purple	2.0	1.0 - 1.5
Lotus, American	2.0	0.75
Maidencane	3.0	0.75
Milkweed, common	2.3	1.5
Muhly, wirestem	1.5 - 2.3	0.75
Mullein, common	2.3 - 3.75	1.5
Napiergrass	2.3 - 3.75	1.5
Nightshade, silverleaf	3.0 - 3.75	1.5
Nutsedge; purple, yellow	2.3	0.75
Orchardgrass	1.5 - 2.3	0.75
Pampasgrass	2.3 - 3.75	1.5
Paragrass	3.0	0.75
Pepperweed, perennial	3.0	1.5
Phragmites*	2.0 - 3.75	0.75 - 1.5
Poison hemlock	1.5 - 3.0	0.75 - 1.5
Quackgrass	1.5 - 2.3	0.75
Redvine*	1.5	1.5
Reed, giant *(Arundo donax)*	3.0 - 3.75	1.5
Ryegrass, perennial	1.5 - 2.3	0.75
Salvinia, *(spp.)*	—	2.0
Smartweed, swamp	2.3 - 3.75	1.5
Spatterdock	3.0	0.75
Spurge, leafy*	—	1.5
Starthistle, Yellow	—	1.5
Sweet potato, wild*	—	1.5
Thistle, artichoke	1.5 - 2.3	2.0
Thistle, Canada	1.5 - 2.3	1.5
Timothy	1.5 - 2.3	1.5
Torpedograss*	3.0 - 3.75	0.75 - 1.5
Trumpetcreeper*	1.5 - 2.3	1.5
Tules, common	—	1.5
Vaseygrass	2.3 - 3.75	1.5
Velvetgrass	2.3 - 3.75	1.5
Waterhyacinth	2.5 - 3.0	0.75 - 1.0
Waterlettuce	—	0.75 - 1.0
Waterprimrose	—	0.75
Wheatgrass, western	1.5 - 2.3	0.75

*Partial control

Alligatorweed—Apply 6 pints of this product per acre as a broadcast spray or as a 1.3-percent solution with hand-held equipment to provide partial control of alligatorweed. Apply when most of the target plants are in bloom. Repeat applications will be required to maintain such control.

Beachgrass, European—Apply an 8-percent solution of this products plus 0.5- to 1.5-percent nonionic surfactant on a low-volume spray-to-wet basis. Best results are obtained when applications are made when European beachgrass is actively growing through the boot to the full heading stages of growth. Make applications prior to the loss of more than 50 percent green leaf color in the fall. Do not treat when weeds are under drought stress. Repeat applications may be necessary.

Bermudagrass—Apply 7.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and when seedheads appear.

Bindweed, field / Silverleaf Nightshade / Texas Blueweed—Apply 6 to 7.5 pints of this product per acre as a broadcast spray west of the Mississippi River and 4.5 to 6 pints of this product per acre east of the Mississippi River. With hand-held equipment, use a 1.5-percent solution. Apply when target plants are actively growing and are at or beyond full bloom. For silverleaf nightshade, best results can be obtained when appli-

cation is made after berries are formed. Do not treat when weeds are under drought stress. New leaf development indicates active growth. For best results apply in late summer or fall.

Brackenfern—Apply 4.5 to 6 pints of this product per acre as a broadcast spray or as a 0.75- to 1-percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.

Cattail—Apply 4.5 to 6 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the early-to-full bloom stage of growth. Best results are achieved when application is made during the summer or fall months.

Cogongrass—Apply 4.5 to 7.5 pints of this product per acre as a broadcast spray. Apply when cogongrass is at least 18 inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.

Cordgrass—Apply 4.5 to 7.5 pints of this product per acre as a broadcast spray or as a 1- to 2-percent solution with hand-held equipment. Schedule applications in order to allow 6 hours before treated plants are covered by tidewater. The presence of debris and silt on the cordgrass plants will reduce performance. It may be necessary to wash targeted plants prior to application to improve uptake of this product into the plant.

Cutgrass, giant—Apply 6 pints of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment to provide partial control of giant cutgrass. Repeat applications will be required to maintain such control, especially where vegetation is partially submerged in water. Allow for substantial regrowth to the 7- to 10-leaf stage prior to retreatment.

Dogbane, hemp / Knapweed / Horseradish—Apply 6 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth. For best results, apply in late summer or fall.

Fescue, tall—Apply 4.5 pints of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained.

Guineagrass—Apply 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and when most have reached at least the 7-leaf stage of growth.

Johnsongrass / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western—Apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained. In the fall, apply before plants have turned brown.

Lantana—Apply this product as a 0.75- to 1-percent solution with hand-held equipment. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.

Loosestrife, purple—Apply 4 pints of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution using hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost.

Lotus, American—Apply 4 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost. Repeat treatments may be necessary to control regrowth from underground parts and seeds.

Maidencane / Paragrass—Apply 6 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Repeat treatments will be required, especially to vegetation partially submerged in water. Under these conditions, allow for regrowth to the 7- to 10-leaf stage prior to retreatment.

Milkweed, common—Apply 4.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth.

Nutsedge; purple, yellow—Apply 4.5 pints of this product per acre as a broadcast spray, or as a 0.75-percent solution with hand-held equipment to control existing nutsedge plants and immature nutlets attached to treated plants. Apply when target plants are in flower or when new nutlets can be found at rhizome tips. Nutlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.

Pampasgrass—Apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing.

Phragmites—For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 7.5 pints per acre as a broadcast spray or apply a 1.5-percent solution with hand-held equipment. In other areas of the U.S., apply 4 to 6 pints per acre as a broadcast spray or apply a 0.75-percent solution with hand-held equipment for partial control. For best results, treat during late summer or fall months when plants are actively growing and in full bloom. Due to the dense nature of the vegetation, which may prevent good spray coverage and uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.

Quackgrass / Kikuyugrass / Muhly, wirestem—Apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment when most quackgrass or wirestem muhly is at least 8 inches in height (3- to 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.

Reed, giant / Ice Plant—For control of giant reed and ice plant, apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing. For giant reed, best results are obtained when applications are made in late summer to fall.

Spatterdock—Apply 6 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.

Sweet potato, wild—Apply this product as a 1.5-percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the recommended stage of growth before retreatment.

Thistle; Canada, artichoke—Apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment for Canada thistle. To control artichoke thistle, apply a 2-percent solution as a spray-to-wet application. Apply when target plants are actively growing and are at or beyond the bud stage of growth.

Torpedograss—Apply 6 to 7.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment to provide partial control of torpedograss. Use the lower rates under terrestrial conditions, and the higher rates under partially submerged or a floating mat condition. Repeat treatments will be required to maintain such control.

Tules, common—Apply this product as a 1.5-percent solution with hand-held equipment. Apply to actively growing plants at or beyond the seedhead stage of growth. After application, visual symptoms will be slow to appear and may not occur for 3 or more weeks.

Waterhyacinth—Apply 5 to 6 pints of this product per acre as a broadcast spray or apply a 0.75- to 1-percent solution with hand-held equipment. Apply when target plants are actively growing and at or beyond the early bloom stage of growth. After application, visual symptoms may require 3 or more weeks to appear with complete necrosis and decomposition usually occurring within 60 to 90 days. Use the higher rates when more rapid visual effects are desired.

Waterlettuce—For control, apply a 0.75- to 1-percent solution of this product with hand-held equipment to actively growing plants. Use higher rates where infestations are heavy. Best results are obtained from mid-summer through winter applications. Spring applications may require retreatment.

Waterprimrose—Apply this product as a 0.75-percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.

Other perennials listed on this label—Apply 4.5 to 7.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached early head or early bud stage of growth.

9.3 Woody Brush and Trees

Apply this product after full leaf expansion, unless otherwise directed. Use the higher rate for larger plants and/or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when applications are made in the spring to early summer when brush species are at high moisture content and are flowering.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed-spray spot treatments, apply a 4- to 8-percent solution of this product.

Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

WEED SPECIES	BROADCAST RATE (QT/A)	HAND-HELD SPRAY-TO-WET % SOLUTION
Alder	2.3 - 3.0	0.75 - 1.2
Ash*	1.5 - 3.75	0.75 - 1.5
Aspen, quaking	1.5 - 2.3	0.75 - 1.2
Bearclover (Bearmat)*	1.5 - 3.75	0.75 - 1.5
Beech*	1.5 - 3.75	0.75 - 1.5
Birch	1.5	0.75
Blackberry	2.3 - 3.0	0.75 - 1.2
Blackgum	1.5 - 3.75	0.75 - 1.5
Bracken	1.5 - 3.75	0.75 - 1.5
Broom; French, Scotch	1.5 - 3.75	1.2 - 1.5
Buckwheat, California*	1.5 - 3.0	0.75 - 1.5
Cascara*	1.5 - 3.75	0.75 - 1.5
Castor bean	—	1.5
Catsclaw*	—	1.2 - 1.5
Ceanothus*	1.5 - 3.75	0.75 - 1.5
Chamise*	1.5 - 3.75	0.75
Cherry; bitter, black, pin	1.5 - 3.75	1.0 - 1.5
Cottonwood, eastern	1.5 - 3.75	0.75 - 1.5
Coyote brush	2.3 - 3.0	1.2 - 1.5
Cypress; swamp, bald	1.5 - 3.75	0.75 - 1.5
Deerweed	1.5 - 3.75	0.75 - 1.5
Dewberry	2.3 - 3.0	0.75 - 1.2
Dogwood*	3.0 - 3.75	1.0 - 2.0
Elderberry	1.5	0.75
Elm*	1.5 - 3.75	0.75 - 1.5
Eucalyptus	—	1.5
Gallberry	1.5 - 3.75	0.75 - 1.5
Gorse*	1.5 - 3.75	0.75 - 1.5
Hackberry, western	1.5 - 3.75	0.75 - 1.5
Hasardia*	1.5 - 3.0	0.75 - 1.5
Hawthorn	1.5 - 2.3	0.75 - 1.2
Hazel	1.5	0.75
Hickory*	3.0 - 3.75	1.0 - 2.0
Honeysuckle	2.3 - 3.0	0.75 - 1.2
Hornbeam, American*	1.5 - 3.75	0.75 - 1.5
Huckleberry	1.5 - 3.75	0.75 - 1.5
Knotweed; Japanese, Giant**	—	—
Kudzu	3.0	1.5
Locust, black*	1.5 - 3.0	0.75 - 1.5
Madrone resprouts*	—	1.5
Magnolia, sweetbay	1.5 - 3.75	0.75 - 1.5
Manzanita*	1.5 - 3.75	0.75 - 1.5
Maple, red	1.0 - 3.75	0.75 - 1.2
Maple, sugar	—	0.75 - 1.2
Maple, vine*	1.5 - 3.75	0.75 - 1.5
Monkey flower*	1.5 - 3.0	0.75 - 1.5
Oak; black, white*	1.5 - 3.0	0.75 - 1.5
Oak, northern pin	1.5 - 3.0	0.75 - 1.2
Oak, post	2.3 - 3.0	0.75 - 1.2
Oak, red	—	0.75 - 1.2
Oak, Scrub*	1.5 - 3.0	0.75 - 1.5
Oak, southern red	1.5 - 3.75	1.0 - 1.5
Orange, Osage	1.5 - 3.75	0.75 - 1.5
Peppertree, Brazilian (Florida holly)*	1.5 - 3.75	1.5
Persimmon*	1.5 - 3.75	0.75 - 1.5
Pine	1.5 - 3.75	0.75 - 1.5
Poison ivy	3.0 - 3.75	1.5
Poison oak	3.0 - 3.75	1.5
Poplar, yellow*	1.5 - 3.75	0.75 - 1.5
Prunus	1.5 - 3.75	1.0 - 1.5
Raspberry	2.3 - 3.0	0.75 - 1.2
Redbud, eastern	1.5 - 3.75	0.75 - 1.5
Redcedar, eastern	1.5 - 3.75	0.75 - 1.5
Rose, multiflora	1.5	0.75
Russian olive*	1.5 - 3.75	0.75 - 1.5
Sage, black	1.5 - 3.0	0.75
Sage, white*	1.5 - 3.0	0.75 - 1.5
Sage brush, California	1.5 - 3.0	0.75
Salmonberry	1.5	0.75
Saltbush	—	1.0
Saltcedar**	1.5 - 3.75	0.75 - 1.5
Sassafras*	1.5 - 3.75	0.75 - 1.5
Sea Myrtle	—	1.0
Sourwood*	1.5 - 3.75	0.75 - 1.5
Sumac; laurel, poison, smooth, sugarbush, winged*	1.5 - 3.0	0.75 - 1.5
Sweetgum	1.5 - 2.3	0.75 - 1.5
Swordfern*	1.5 - 3.75	0.75 - 1.5
Tallowtree, Chinese	—	0.75
Tan oak resprouts*	—	1.5
Thimbleberry	1.5	0.75
Tobacco, tree*	1.5 - 3.0	0.75 - 1.5
Toyon*	—	1.5
Trumpetcreeper	1.5 - 2.3	0.75 - 1.2
Vine maple*	1.5 - 3.75	0.75 - 1.5
Virginia creeper	1.5 - 3.75	0.75 - 1.5
Waxmyrtle, southern*	1.5 - 3.75	1.5
Willow	2.3	0.75
Yerba Santa*	—	1.5

*Partial control
**Refer to specific instructions below

Alder / Blackberry / Dewberry / Honeysuckle / Oak, post / Raspberry—For control, apply 4.5 to 6 pints per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

Aspen, quaking / Hawthorn / Trumpetcreeper—For control, apply 3 to 4.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

Birch / Elderberry / Hazel / Salmonberry / Thimbleberry—For control, apply 3 pints per acre of this product as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

Broom; French, Scotch—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment.

Buckwheat, California / Hasardia / Monkey flower / Tobacco, tree—For partial control of these species, apply a 0.75- to 1.5-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Castor bean—For control, apply a 1.5-percent solution of this product with hand-held equipment.

Catsclaw—For partial control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Cherry; bitter, black, pin / Oak, southern red / Sweetgum / Prunus—For control, apply 3 to 7.5 pints of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution with hand-held equipment.

Coyote brush—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Dogwood / Hickory—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 6 to 7.5 pints per acre as a broadcast spray.

Eucalyptus, bluegum—For control of eucalyptus resprouts, apply a 1.5-percent solution of this product with hand-held equipment when resprouts are 6- to 12-feet tall. Ensure complete coverage. Apply when plants are actively growing. Avoid application to drought-stressed plants.

Knotweed; Japanese, Giant *(Polygonum cuspidatum and P. sachalinense)*

Stem Injection. Apply 0.18 fluid ounce (5 milliliters) of this product injected below the 2nd node above the ground of each stem in the clump. Use suitable equipment that must penetrate into the internode region.

Cut Stem. Cut stems cleanly just below the 2nd or 3rd node above the ground. Immediately apply 0.36 fluid ounce (10 milliliter) of a 50-percent solution of this product into the 'well' or remaining internode. Ensure that removed upper plant material is carefully gathered and discarded so that it will not contact soil and regenerate plants from sprouting buds. Use of a bio-barrier such as cardboard, plywood or plastic sheeting is recommended.

The combined total for all treatments must not exceed 8 quarts per acre. At 5 milliliters per stem, 8 quarts should treat about 1500 stems

Kudzu—For control, apply 6 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications will be required to maintain control.

Maple, red—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 2 to 7.5 pints of this product per acre as a broadcast spray.

Maple, sugar / Oak, northern pin, red—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Peppertree, Brazilian (holly, Florida) / Waxmyrtle, southern—For partial control, apply this product as a 1.5-percent solution with hand-held equipment.

Poison ivy / Poison oak—For control, apply 6 to 7.5 pints of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.

Rose, multiflora—For control, apply 3 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.

Sage, black / Sage brush, California / Chamise / Tallowtree, Chinese—For control of these species, apply a 0.75-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Saltbush, Sea Myrtle—For control, apply this product as a 1-percent solution with hand-held equipment.

Saltcedar—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 6 to 7.5 pints per acre as a broadcast spray. For control, apply a 1- to 2-percent solution of this product mixed with 0.25-percent Arsenal with hand-held equipment. For control using broadcast applications, apply 3 pints of this product in a tank mix with 1 pint of Arsenal to plants less than 6 feet tall. To control saltcedar greater than 6 feet tall using broadcast applications, apply 6 pints of this product in a tank mix with 2 pints of Arsenal.

Willow—For control, apply 4.5 pints of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

Other woody brush and trees listed in this label—For partial control, apply 3 to 7.5 pints of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment.

10.0 LIMIT OF WARRANTY AND LIABILITY

Monsanto Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet ("Directions") when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS WARRANTY OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this Company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

To the fullest extent permitted by law, buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this Company, including, but not limited to, incompatibility with products other than those set forth in the Directions, application to or contact with desirable vegetation, unusual weather, weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied, as well as weather conditions which are outside the application ranges set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil, crop or treated vegetation.

This Company does not warrant any product reformulated or repackaged from this product except in accordance with this Company's stewardship requirements and with express written permission from this Company.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY, OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY. TO THE FULLEST EXTENT PERMITTED BY LAW, IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Upon opening and using this product, buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement. If terms are not acceptable, return at once unopened.

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EPA Reg. No. 524-343

In case of an emergency involving this product,
or for medical assistance,
Call Collect, day or night, (314) 694-4000.

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ST. LOUIS, MISSOURI, 63167 U.S.A.

MONSANTO

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ATENCIÓN:

Esta etiqueta de muestra se entrega únicamente para información general.

- Este producto pesticida puede no estar todavía disponible o aprobado para la venta o utilización en su localidad.
- Usted tiene la responsabilidad de cumplir todas las leyes federales, estatales y locales, así como todas las reglamentaciones relativas a la utilización de pesticidas.
- Antes de utilizar un pesticida, asegúrese de que esté aprobado en su estado o localidad.
- Su estado o localidad puede exigir precauciones adicionales e instrucciones para la utilización de este producto que no están incluidas aquí.
- Monsanto no garantiza el lo completo ni la certeza de esta etiqueta de la espécimen. La información encontró en esta etiqueta puede diferir de la información encontró en la etiqueta del producto. Usted debe tener consigo la etiqueta aprobada por la agencia EPA cuando utilice el producto y debe leer y respetar todas las instrucciones en la etiqueta.
- No debe basarse sobre las precauciones, las instrucciones de utilización y cualquier otra información en esta etiqueta para utilizar algún otro producto similar.
- Siempre siga las precauciones y las instrucciones para el uso en la etiqueta del pesticida que usted utiliza.

AQUAMASTER®

Herbicida de Monsanto

Instrucciones de uso en medios acuáticos y otros sitios no dedicados a cultivos.

Registro en la EPA Nº 524-343

EVITE EL CONTACTO DEL HERBICIDA CON EL FOLLAJE, TALLOS VERDES, RAICES NO LEÑOSAS EXPUESTAS O FRUTOS EXPUESTOS DE LAS COSECHAS, PLANTAS Y ARBOLES DESEABLES. EN CASO CONTRARIO ES PROBABLE QUE SUFRAN GRAVES DAÑOS O SEAN DESTRUIDOS TOTALMENTE.

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Antes de usar este producto, lea la etiqueta en su totalidad.

Uselo solamente de acuerdo con las instrucciones de la etiqueta.

No todos los productos recomendados en esta etiqueta han sido registrados para su uso en California. Verifique el estado de registro de cada producto en California antes de utilizarlo.

Antes de comprar o usar el producto, lea "LIMITES EN LA GARANTIA Y EN LA RESPONSABILIDAD" en la última sección de la etiqueta. Si las condiciones son inaceptables para usted, devuelva el producto inmediatamente sin abrir el recipiente.

ESTE ES UN PRODUCTO PARA USARSE TAL Y COMO ESTA PREPARADO. MONSANTO NO LO HA DISEÑADO NI LO HA REGISTRADO PARA QUE SEA REFORMULADO O LA VOLVER A EMPAQUETAR. VEA LA ETIQUETA DEL ENVASE INDIVIDUAL PARA ENTERARSE DE LAS LIMITACIONES DE REEMPAQUE.

1.0 INGREDIENTES

INGREDIENTE ACTIVO:	
*Glifosato, N-(fosfonometil)glicina, en forma de su sal de isopropilamina	53.8%
OTROS INGREDIENTES:	46.2%
	100.0%

*Contiene 648 gramos por litro o 5.4 libras por galón americano del ingrediente activo glifosato, en forma de su sal de isopropilamina. Equivalente a 480 gramos por litro o 4.0 libras por galón americano del ácido, glifosato.

No se han otorgado licencias bajo ninguna patente que no sea de los Estados Unidos.

2.0 TELEFONOS IMPORTANTES

1. PARA INFORMACION SOBRE EL PRODUCTO O AYUDA PARA UTILIZAR ESTE PRODUCTO, LLAME GRATIS AL 1-800-332-3111.
2. EN CASO DE QUE SE PRESENTE UNA EMERGENCIA RELACIONADA CON ESTE PRODUCTO, O PARA OBTENER AYUDA MEDICA, LLAME POR COBRAR A CUALQUIER HORA DEL DIA O DE LA NOCHE, AL TELEFONO. (314)-694-4000.

3.0 ADVERTENCIAS

3.1 Riesgos para seres humanos y animales domésticos

Manténgase fuera del alcance de los niños.

¡PRECAUCIÓN!

Quítese la ropa contaminada y lávela antes de volver a usarla.

Después de manipular este producto, lávese bien con agua y jabón.

3.2 Riesgos al medio ambiente

No contamine el agua cuando lave los equipos ni cuando elimine las aguas de lavado de los mismos. El tratamiento de malezas acuáticas podría provocar el agotamiento del oxígeno debido a su consumo durante la descomposición de las plantas muertas. Esta pérdida del oxígeno podría provocar, a su vez, la asfixia de los peces.

En caso de DERRAME o FUGA de este producto, recójalo con materiales absorbentes y envíe los residuos a un vertedero.

3.3 Riesgos de orden físico o químico

Para mezclar, almacenar y aplicar la solución de este producto, se deben usar solamente recipientes de acero inoxi-dable, aluminio, fibra de vidrio, plástico o recipientes de acero recubiertos internamente con plástico.

NO MEZCLE, ALMACENE O APLIQUE ESTE PRODUCTO O SUS SOLUCIONES PARA ROCIAR EN RECIPIENTES O TANQUES ROCIADORES DE ACERO GALVANIZADO O DE ACERO NO RECUBIERTO (EXCEPTO SI ES ACERO INOXIDABLE). Este producto o la solución para rociar reaccionan con el material de dichos recipientes y tanques, lo cual produce hidrógeno, que puede formar una mezcla de gases altamente combustibles. Si esta mezcla de gases entra en contacto con llamas, chispas, el soplete de un soldador, un cigarrillo encendido o cualquier otra fuente de encendido, puede inflamarse o explotar y causar heridas graves a personas.

INSTRUCCIONES PARA EL USO

El uso de este producto de cualquier manera que sea inconsistente con las instrucciones dadas en la etiqueta es una violación de las leyes federales. Este producto sólo puede utilizarse de acuerdo a las indicaciones sobre el modo de empleo que figuran en esta etiqueta o en la etiqueta adicional de Monsanto impresa por separado. Para verificar requisitos específicos de su tribu o estado, consulte con la agencia responsable de la regulación del uso de pesticidas.

4.0 ALMACENAMIENTO Y DESECHO

Cuando almacene o deseche el producto no contamine el agua, los productos alimenticios, el alimento para animales o las semillas.

Mantenga los recipientes bien cerrados para evitar derramamientos y contaminación.

ALMACENAMIENTO DE PESTICIDAS: ALMACENE POR ENCIMA DE 5°F (-15°C) PARA EVITAR QUE EL PRODUCTO SE CRISTALICE. Los cristales se depositarán en el fondo. Si se permite la cristalización, coloque en un ambiente cálido a 68°F (20°C) durante varios días para que vuelva a disolverse y haga rodar el recipiente de agitación o recicle en recipientes de granel mínimo para mezclar bien antes de usar.

DESECHO DE PESTICIDAS: Los desechos que resulten del uso de este producto que no puedan utilizarse o reprocesarse químicamente deben eliminarse en un vertedero de basura aprobado para la eliminación de

pesticidas o de acuerdo con los procedimientos locales, estatales y federales aplicables.

ENVASE DE PESTICIDA: El recipiente vacio retiene vapores y residuos del producto. Observe todas las precauciones de la etiqueta hasta que el recipiente esté limpio, reacondicionado, o destruido.

PARA RECIPIENTES Y BOTELLAS PLÁSTICAS DE UNA VÍA: No reutilice el recipiente. Enjuague tres veces el recipiente, luego perfórelo y deséchelo en un vertedero de basura sanitario o por incineración, ó, si lo permiten las autoridades estatales y locales, quemándolos. Si se queman, permanezca lejos del humo.

PARA CONTENEDORES TAMBORES DE UNA SOLA DIRECCIÓN: No reutilice el recipiente. Devuelva el recipiente según el programa de devolución de recipientes de Monsanto. Si no se devuelve, enjuague el recipiente tres veces, luego perfórelo y deséchelo en un vertedero de basura sanitario, o por incineración, ó, si lo permiten las autoridades estatales y locales, quemándolos. Si se queman, permanezca lejos del humo.

PARA RECIPIENTES RECARGABLES PORTÁTILES (MINIGRANEL): Este recipiente se debe recargar sólo con productos pesticidas. No vuelva a utilizar este recipiente para ningún otro propósito.

El desecho final debe efectuarse conforme a las reglamentaciones estatales y locales. Si no recarga, devuelve o recicla el recipiente, enjuáguelo tres veces o a presión, perfórelo y deséchelo en un vertedero sanitario, incinerándolo o bien, si las autoridades del estado y la localidad lo permiten, quemándolo. En caso de quemarlo, manténgase lejos del humo.

No lo transporte si el recipiente está dañado o escapandoce. Si el recipiente está dañado, escapandoce o es obsoleto, o bien, si desea informarse sobre cómo reciclar envases recargables portátiles, comuníquese con Monsanto Company al 800-768-6387.

Usuarios: Cuando el recipiente esté vacío, vuelva a taparlo y selle todas las aberturas practicadas cuando lo usó y luego, regréselo al lugar donde lo compró o a un lugar alternativo designado por el fabricante cuando se compró este producto. Si no lo regresa, enjuague el recipiente vacío tres veces o a presión y ofrézcalo para ser reciclado, si este servicio está disponible.

Recargadores: No vuelva a utilizar este recipiente para minigranel salvo para recargarlo conforme a un Acuerdo válido con Monsanto de Reenvasado o Reenvasado con cargo. Antes de recargar el recipiente, inspecciónelo cuidadosamente para asegurarse de que no presente rajaduras, pinchaduras, abrasión o roscas y dispositivos de cierre desgastados. Verifique si hay fugas después de recargarlo y antes de transportarlo.

PARA RECIPIENTES RECARGABLES FIJOS A GRANEL: Este recipiente se debe recargar sólo con productos pesticidas. **No vuelva a utilizar este recipiente para ningún otro propósito.**

Antes de recargar el recipiente, inspecciónelo cuidadosamente para asegurarse de que no presente rajaduras, pinchaduras, abrasión o roscas y dispositivos de cierre desgastados.

El desecho final debe efectuarse conforme a las reglamentaciones estatales y locales. Si no recarga el recipiente, enjuáguelo tres veces o a presión y ofrézcalo para ser reciclado o reacondicionado, si esto es posible. En caso de quemarlo, manténgase lejos del humo.

5.0 INFORMACION GENERAL
(Cómo funciona este producto)

Descripción del producto: Este producto es un herbicida sistémico de aplicación post-emergencia foliar, sin actividad residual en la tierra. Controla un amplio espectro de malezas anuales, malezas perennes, matorrales leñosos y árboles.

Aparición de los síntomas: Este producto se mueve dentro de la planta desde el punto de aplicación sobre el follaje, hasta las raíces. Los efectos visibles en la mayor parte de las malezas anuales se pueden apreciar entre los 2 ó 4 días después de la aplicación, pero en la mayoría de las malezas perennes, los efectos no se ven hasta después de 7 días o más. El frío extremo o el cielo muy nublado después de la aplicación pueden retardar la actividad del producto y hacer que el efecto visual se retarde. Los efectos visibles incluyen que la planta se marchite y se vuelva amarilla en forma gradual, hasta que la parte exterior de ésta se torne completamente color café; mientras tanto, las partes de la planta que están bajo tierra se deterioran completamente.

Modo de acción en las plantas: El ingrediente activo de este producto inhibe una enzima hallada sólo en las plantas y microorganismos que es esencial para la formación de aminoácidos específicos.

Prácticas culturales: Se podrá observar una reducción en el efecto si se aplica el producto a malezas anuales o perennes que hayan sido segadas, que hayan servido de alimento para animales o hayan sido cortadas, y que no hubiesen crecido nuevamente hasta el nivel recomendado para el tratamiento.

Resistencia a la lluvia: La lluvia torrencial poco después de la aplicación lavará el producto del follaje y se requerirá una nueva aplicación para obtener un control adecuado.

No tiene actividad residual sobre la tierra: En el momento de la aplicación, las malezas deben haber emergido para poder ser controladas por este producto. Las malezas que germinen a partir de semillas después de la aplicación no serán controladas. Las plantas de malezas perennes que no hayan emergido y se originen de rizomas o estolones subterráneos que no están unidos, no se verán afectadas por el herbicida y continuarán desarrollándose.

Mezclas de tanque: Este producto no proporciona control residual de malezas. Para lograr un control residual subsecuente, utilice un herbicida que la etiqueta esté aprobado. Lea y siga cuidadosamente todas las precauciones indicadas y toda la información que aparezca en las etiquetas de los herbicidas que use. Uselos según las instrucciones más restrictivas de la etiqueta de cada producto usado en la mezcla.

Cuando en las indicaciones incluidas en la etiqueta de este producto se recomiende una mezcla en tanque con un principio activo genérico como diuron, 2,4-D o dicamba, el usuario es responsable de asegurarse de que la indicación de uso en el rótulo de la mezcla del producto permita la aplicación específica.

El comprador y todos los usuarios son responsables por todas las pérdidas o daños que resulten del uso o manejo de las mezclas de este producto con herbicidas u otros mate-riales que no estén expresamente recomendados en este libreto. La mezcla de este producto con herbicidas u otros materiales que no estén recomendados en este libreto puede reducir la eficacia de este producto.

Proporción anual máxima de uso: El total combinado de todos los tratamientos no debe exceder 2 galones de producto por acre (18.7 L por hectárea) al año en zonas terrestres. Ninguna sola aplicación terrestre hecha sobre agua no debe exceder 7,5 pintas por acre (8.8 L por hectárea). Las proporciones máximas de uso especificadas en esta etiqueta de producto corresponden a este producto combinado con el uso de cualquier otro herbicida que contenga glifosfato o sulfosato como ingrediente activo, ya sea que se apliquen en forma de mezcla o por separado. Calcule las proporciones de aplicación y asegúrese de que el uso total de éste y otros productos que contienen glifosfato o sulfosato no exceda los límites máximos especificados.

ATENCION

EVITE EL CONTACTO DEL HERBICIDA CON EL FOLLAJE, TALLOS VERDES, RAICES NO LEÑOSAS EXPUESTAS O FRUTOS EXPUESTOS DE LAS COSECHAS, PLANTAS Y ARBOLES DESEABLES. EN CASO CONTRARIO ES PROBABLE QUE SUFRAN GRAVES DAÑOS O SEAN DESTRUIDOS TOTALMENTE.

EVITE EL ACARREO. CUANDO EL PRODUCTO SE APLIQUE, SE DEBE TENER MUCHO CUIDADO PARA PREVENIR EL DAÑO A PLANTAS Y CULTIVOS DESEABLES.

No permita que la solución del herbicida se nebulice, gotee, sea acarreada o salpique sobre la vegetación deseable. Una cantidad pequeña puede ser suficiente para causar daños graves o destruir las cosechas, plantas u otras áreas que no se desea tratar. La probabilidad de que ocurran daños por el uso de este producto aumenta cuando hay muchas ráfagas de viento, a medida que aumenta la velocidad del viento, cuando la velocidad del viento cambia constantemente o cuando existen otras condiciones meteorológicas que favorecen la dispersión del rociado. Cuando se esté aplicando el producto con un rociador, evite la combinación de presiones y tipos de boquilla que puedan dar como resultado salpicaduras o partículas finas (niebla), que tienen muchas probabilidades de que el producto sea acarreado. EVITE LA APLICACION A ALTA VELOCIDAD O PRESION EXCESIVAS.

NOTA: El uso de este producto de cualquier manera contraria a las indicaciones contenidas en este libreto, puede resultar en lesiones a personas, animales o cosechas o pueden ocurrir otras consecuencias no deseadas.

6.0 MEZCLA

Limpie las piezas del rociador inmediatamente después de su utilización lavándolas bien con agua.

NOTA: PUEDE OCURRIR UNA DISMINUCION DE LOS RESULTADOS SI SE UTILIZA AGUA QUE CONTENGA TIERRA, TAL COMO AGUA CON BARRO VISIBLE O AGUA DE CHARCAS O ACEQUIAS QUE NO ESTE CLARA.

6.1 Mezcla con agua

Este producto se mezcla fácilmente con agua. La solución para rociar se debe mezclar de la siguiente manera: ponga la cantidad correcta de agua en el tanque en el cual se va a preparar la mezcla. Agregue la cantidad recomendada de este producto cuando ya está cerca de completarse el llenado con agua y mezcle bien. Tenga cuidado de que el líquido no regrese al recipiente original. Use dispositivos aprobados para evitar que el líquido regrese al recipiente original cuando así lo exijan las reglamentaciones estatales o locales. Es posible que durante la mezcla y rociado, la solución produzca espuma. Para evitar o minimizar la formación de espuma, evite el uso de agitadores mecánicos, cierre las tuberías de derivación y de retorno en el fondo del tanque, y si es necesario, use

compuestos aprobados para evitar la formación de espuma o para eliminar la espuma ya formada.

6.2 Surfactante

Este producto requiere un surfactante no iónico. Al utilizar este producto, mezcle medio galón o más de surfactante no iónico por cada 100 galones de solución de rociado (0.5 litros o más por cada 100 litros). Si aumenta la proporción de surfactante podrá mejorar el rendimiento. Algunos casos en los que debe utilizarse una mayor proporción de surfactante son los siguientes: maleza leñosa, árboles y enredaderas difíciles de controlar, grandes volúmenes de agua, condiciones ambientales adversas, malezas resistentes al control, malezas que sufren estrés, surfactantes con menos de 70 por ciento de ingrediente activo, mezclas de tanque, etc. Estos surfactantes no deben utilizar en proporción mayor de 0.25 galones por acre (2.3 L por hectárea) al realizar aplicaciones difundidas.

Para obtener los mejores resultados, siempre lea y siga las recomendaciones en la etiqueta del fabricante del surfactante. Ponga especial atención a las advertencias y demás información que aparezca en la etiqueta del surfactante.

Este producto, si se aplica conforme a las recomendaciones y en las condiciones descritas, controla la maleza anual y perenne indicada en el folleto de la etiqueta. No reduzca las proporciones de este producto al añadir surfactante.

6.3 Procedimiento para mezclas de tanque

Mezcle las combinaciones para tanque de este producto con agua, como sigue:

1. Coloque una rejilla de malla 20 a 35 o un cesto de humectación sobre el orificio de llenado.
2. Llene el tanque de rociado hasta la mitad con agua a través de la rejilla y comience a agitar.
3. Si utiliza un polvo mojable, forme un lodo con el agua y agréguelo LENTAMENTE al tanque a través de la rejilla. Siga agitando la mezcla.
4. Si utiliza una fórmula fluida, mezcle primero una parte de la fórmula fluida con una parte de agua. Agregue la mezcla diluida LENTAMENTE al tanque a través de la rejilla. Siga agitando la mezcla.
5. Si utiliza una fórmula concentrada emulsionante, mezcle primero una parte del concentrado emulsionante con dos partes de agua. Agregue la mezcla diluida lentamente al tanque a través de la rejilla. Siga agitando la mezcla.
6. Siga llenando el tanque de rociado con agua y agregue la cantidad requerida de este producto hacia el final del proceso de llenado.
7. Agregue el surfactante no iónico al tanque de rociado antes de terminar el proceso de llenado.
8. Agregue las fórmulas individuales al tanque de rociado como sigue: polvo mojable, fórmula fluida, concentrado emulsionante, aditivo de control de deriva, líquido soluble en agua y surfactante no iónico.

Agite continuamente hasta usar totalmente el contenido del tanque. Si se deja que la mezcla para rociar se asiente, agite bien para que la mezcla vuelva a estar en suspensión antes de continuar con el rociado.

A fin de minimizar la formación de espuma, mantenga las tuberías de retorno lo más cerca del fondo del tanque. El tamaño del cernidor en la boquilla o de los cernidores en las tuberías no debe ser menor al número 50.

Siempre determine previamente la compatibilidad de la mezcla de este producto, que viene en tanque rotulado, con agua como vehículo, mezclando cantidades pequeñas proporcionales con anticipación. Asegúrese de que la mezcla en tanque específica esté registrada para su aplicación en el área deseada.

Vea la sección "**Mezclas de Tanque**" de "INFORMACION GENERAL" para las precauciones adicionales.

6.4 Mezcla de soluciones en porcentaje

Prepare la cantidad deseada de la solución para rociar, mezclando las proporciones de este producto con agua, según se muestra en la siguiente tabla:

Solución para rociar

VOLUMEN	Cantidad de Herbicida AquaMaster					
DESEADO	0.5%	0.75%	1%	1.5%	4%	8%
1 gal	2/3 oz	1 oz	1.3 oz	2 oz	5 oz	10 oz
25 gal	1 pt	1.5 pt	1 qt	1.5 qt	4 qt	2 gal
100 gal	2 qt	3 qt	1 gal	1.5 gal	4 gal	8 gal
2 cucharadas = 1 onza fluida						

Cuando se usen rociadores tipo mochila, o para bombeo, se recomienda que este producto se mezcle con agua en un recipiente grande. Llene el rociador con la solución ya lista.

6.5 Colorantes o tinturas

A este producto se le pueden agregar colorantes o tinturas para marcar, que sean aprobados para uso agrícola. Los colorantes o tinturas utilizados en las soluciones de rocío de este producto pueden reducir su rendimiento, especialmente a bajas concentraciones del producto o a bajas diluciones. Para usar los colorantes y tinturas siga las instrucciones del fabricante.

6.6 Aditivos de reducción de deriva

Puede utilizarse aditivos de reducción de deriva con todos los tipos de equipo, excepto aplicadores de enjugador y barras de esponja. Al utilizar un aditivo de reducción de deriva, lea detenidamente y siga al pie de la letra las advertencias y demás información que aparece en la etiqueta del aditivo. El uso de aditivos de reducción de deriva puede afectar la cobertura de rociado y reducir el rendimiento.

7.0 EQUIPOS Y TECNICAS PARA LA APLICACION

No use ningún sistema de irrigación para aplicar este producto.

APLIQUE ESTAS SOLUCIONES PARA ROCIAR UTILIZANDO EQUIPOS DEBIDAMENTE MANTENIDOS Y CALIBRADOS QUE SEAN CAPACES DE ROCIAR EL VOLUMEN DESEADO.

MANEJO DE LA DERIVA POR ROCIADO

EVITE LA DERIVA. DEBE USARSE EXTREMO CUIDADO EN LA APLICACIÓN DE ESTE PRODUCTO PARA EVITAR DAÑOS A PLANTAS Y CULTIVOS DESEADOS.

No permita que la solución del herbicida empañe, gotee, se derive o salpique sobre la vegetación deseada, ya que minúsculas cantidades de este producto pueden causar daños graves o destrucción del cultivo, plantas u otras áreas que no se pretendía tratar.

Es la responsabilidad del aplicador evitar la deriva por rociado en el lugar de aplicación. La interacción de varios factores relacionados con el clima y el equipo determina la posibilidad de deriva por rociado. El aplicador y el cultivador son responsables de considerar todos estos factores al tomar decisiones.

7.1 Equipo aéreo

NO APLIQUE ESTE PRODUCTO CON EQUIPOS AEREOS EXCEPTO BAJO LAS CONDICIONES QUE SE ESPECIFICAN EN ESTE LIBRETO.

PARA LA APLICACION AEREA EN CALIFORNIA, CONSULTE EL SUPLEMENTO FEDERAL PARA APLICACIONES AEREAS EN DICHO ESTADO, PARA CONOCER LAS INSTRUCCIONES, LIMITACIONES Y REQUISITOS ESPECIFICOS. Este producto más las mezclas en tanque de dicamba, Oust, y 2,4-D no se pueden aplicar por pulverización aérea en California.

PARA EVITAR DAÑAR LA VEGETACIÓN DESEADA, SE DEBEN MANTENER ZONAS TAMPÓN ADECUADAS.

Evite la aplicación directa sobre agua.

Use las proporciones recomendadas de este producto con 3 a 25 galones de agua por acre.

Asegúrese de que la aplicación sea uniforme — A fin de evitar que queden áreas sin tratar, que la aplicación no sea uniforme o que las aplicaciones se traslapen, se deben usar marcadores adecuados.

MANEJO DE LA DERIVA POR ROCIADO AÉREO

Deben cumplirse los siguientes requisitos de control de deriva para evitar la deriva fuera del objetivo en las aplicaciones aéreas del producto a campos de cultivo. Estos requisitos no se aplican a usos de salud pública.

1. La distancia del pulverizador más externo en la barra distribuidora no debe exceder 3/4 del largo de la envergadura o rotor.
2. Los pulverizadores deben siempre apuntar hacia atrás, paralelos a la corriente de aire, nunca hacia abajo más de 45 grados. En los estados con reglamentos más estrictos, éstos deben observarse.

Importancia del tamaño de la gotita

La forma más eficaz de reducir la posibilidad de deriva es la aplicación de gotitas grandes. La mejor estrategia de manejo de la deriva es la aplicación de las gotitas más grandes que provean suficiente cobertura y control. La aplicación de gotitas más grandes reduce la posibilidad de deriva, pero no la evitará si las aplicaciones se realizan inadecuadamente o bajo condiciones ambientales desfavorables (vea las secciones de **"Viento"**, **"Temperatura y Humedad"**, e **"Inversión de la Temperatura"** en esta etiqueta).

Control del tamaño de la gotita

- **Volumen:** Use pulverizadores de velocidad de flujo alta para aplicar el mayor volumen de rociado práctico. Los pulverizadores con mayores velocidades de flujo producen gotitas más grandes.

- **Presión:** Use las presiones de rociado más bajas recomendadas para el pulverizador. La presión más alta reduce el tamaño de la gotita y no mejora la penetración del todo. Cuando sean necesarias velocidades de flujo mayores, use pulverizadores con velocidad de flujo mayor en lugar de aumentar la presión.
- **Número de pulverizadores:** Use el número mínimo de pulverizadores que provean cobertura uniforme.
- **Orientación del pulverizador:** Oriente los pulverizadores de modo que el rocío sea liberado hacia atrás, paralelo a la corriente de aire, produzca gotitas más grandes que en otras orientaciones. Una deflexión significativa de la horizontal reducirá el tamaño de la gotita y aumentará la posibilidad de deriva.
- **Tipo de pulverizador:** Use un tipo de pulverizador que esté diseñado para la aplicación prevista. Con la mayoría de los tipos de pulverizadores, los ángulos de rociado más angostos producen gotitas más grandes. Considere el uso de pulverizadores de deriva baja. Los pulverizadores de flujo sólido orientados hacia atrás producen gotitas más grandes que otros tipos de pulverizador.
- **Largo de la barra distribuidora:** Para algunos tipos de uso, la reducción del largo efectivo de la barra distribuidora a menos de 3/4 de la envergadura o el largo del rotor puede reducir más la deriva sin reducir el ancho de la hilera (pasada).
- **Altura de la aplicación:** Las aplicaciones no deben realizarse a una altura mayor que 10 pies por encima de la copa de las plantas más grandes, a menos que se requiera mayor altura por razones de seguridad del aeroplano. La realización de las aplicaciones a la menor altura que sea segura reduce la exposición de las gotitas a la evaporación y el viento.

Ajuste de la hilera (pasada)

Cuando las aplicaciones se lleven a cabo con viento lateral, la banda de aspersión se desplazará a favor del viento. Por ello, en los extremos con o contra el viento del campo, el aplicador debe compensar este desplazamiento ajustando la trayectoria del aeroplano contraria al viento. La distancia de ajuste de la hilera debe aumentar, cuando aumenta la posibilidad de deriva (mayor viento, gotitas más pequeñas, etc.).

Viento

La posibilidad de deriva es menor con velocidades del viento entre 2 y 10 mph. Sin embargo, muchos factores, incluyendo el tamaño de las gotitas y el tipo de equipo determinan la posibilidad de deriva a una velocidad determinada. Debe evitarse la aplicación menos de 2 mph debido a la dirección variable del viento y la posibilidad alta de inversión. **NOTA**: El terreno local puede influir en los patrones de viento. Cada aplicador debe conocer los patrones (vientos) locales y cómo éstos afectan la deriva.

Temperatura y humedad

Cuando se realizan aplicaciones con humedad relativa baja, fije el equipo para que produzca gotitas más grandes para compensar por la evaporación. La evaporación de gotitas es más grave cuando las condiciones son calurosas y secas.

Inversiones de temperatura

No deben realizarse aplicaciones durante una inversión de temperatura debido a que es alta la posibilidad de deriva. Las inversiones de temperatura restringen la mezcla de aire vertical, lo que causa que pequeñas gotitas suspendidas permanezcan en una nube concentrada. Esta nube puede moverse en direcciones no predecibles debido a los vientos variables leves que son comunes durante las inversiones. Las inversiones de temperatura están caracterizadas por temperaturas en aumento con altitud y son comunes en las noches con cobertura de nubes limitada y poco o ningún viento. Comienzan a formarse cuando se mete el sol y a menudo continúan en la mañana. Su presencia puede indicarse por neblina en el suelo; sin embargo, si la neblina no está presente, las inversiones también pueden identificarse por el movimiento del humo desde una fuente del suelo o por el generador de humo de un aeroplano. El humo en capas que se mueve lateralmente en una nube concentrada (bajo condiciones de poco viento) indica una inversión, mientras que el humo que se mueve hacia arriba y se disipa rápidamente indica buena mezcla de aire vertical.

Áreas sensibles

Este producto sólo se debe aplicar cuando la posibilidad de deriva hacia zonas adyacentes susceptibles (como por ejemplo, áreas residenciales, masas de agua, hábitat conocido de especies amenazadas o en peligro de extinción, cultivos que no sean el objetivo) sea mínima, (es decir, cuando el viento sople lejos de las áreas susceptibles).

Mantenimiento de aeronaves

EL CONTACTO PROLONGADO DE ESTE PRODUCTO CON PARTES DE ACERO QUE NO ESTA RECUBIERTO CON ALGUN TIPO DE PROTECCION, PUEDE DAR COMO RESULTADO LA CORROSION Y POSIBLEMENTE QUE LAS PARTES FALLEN. Es posible prevenir la corrosión recubriendo las partes con pintura orgánica, que cumpla con las especificaciones aeroespaciales MIL-C-38413. Al final de cada día de trabajo, para evitar la corrosión de las partes expuestas, lave muy bien el avión a fin de remover los residuos de este producto que se acumulan durante el rociado o por derramamientos. Las partes del tren de aterrizaje son extremadamente susceptibles.

7.2 Equipo de aplicación terrestre

Cuando se usa de acuerdo a las instrucciones de la etiqueta, este producto proporciona el control total o parcial de las malezas herbáceas, de los matorrales leñosos y de los árboles que se indican en la sección "MALEZAS CONTROLADAS" de esta etiqueta. Use las proporciones recomendadas de este producto con 3 a 40 galones de agua por acre para rociar de manera diseminada, a menos que se indique de otra manera en este libreto. A medida que la densidad de las malezas aumenta, el volumen de rociado se debe aumentar también para conseguir una cobertura completa, pero siempre dentro de los límites recomendados. A fin de evitar un rociado muy fino, seleccione la boquilla cuidadosamente. Para obtener mejores resultados con equipo a nivel del terreno, use boquillas tipo abanico plano. Asegúrese de que las gotas del rociado se distribuyan uniformemente.

7.3 Equipo de mano

Aplique el producto al follaje de la vegetación que se desea controlar. En aplicaciones de rociado para mojar, la cobertura del follaje debe ser completa y uniforme. No rocíe hasta el punto en que el producto gotee de la vegetación. Use ro-ciadores gruesos solamente.

En el caso de aplicaciones de rociado directo de bajo volumen, utilice una solución de este producto al 4 u 8 por ciento para el control total o parcial de maleza anual, maleza perenne, arbustos leñosos o árboles. La cobertura de rociado debe ser uniforme y debe tener contacto con un 50 a 75 por ciento del follaje, como mínimo. Para obtener los mejores resultados es importante cubrir la mitad superior de la planta. Si emplea una boquilla de chorro recto, comience la aplicación del producto en la parte superior de la vegetación rocíe de arriba hacia abajo con movimientos laterales de barrido. Al utilizar boquillas con salida en forma de abanico o cono, o al usar nebulizadores de control manual, nebulice el producto al follaje de la vegetación. Para asegurar una cobertura adecuada, rocíe ambos lados de los árboles y los arbustos leñosos grandes o altos, si el follaje es denso o si hay varios retoños. Para obtener los mejores resultados, aplique el producto a los árboles y arbustos leñosos en crecimiento después de la expansión completa de las hojas y antes de que éstas tenga color otoñal y se caigan.

A menos que se especifique de otro modo, use las dosis recomendadas que se indican en el cuadro siguiente de "**Dosis de Aplicación**" para distintos métodos de aplicación foliar utilizando equipo de gran volumen, tipo mochila, y tipos similares de equipo manual. Cuando se usa de acuerdo a las instrucciones de la etiqueta, este producto proporciona el control total o parcial de las malezas herbáceas, los matorrales leñosos y los árboles que se indican en la sección "MALEZAS CONTROLADAS" de esta etiqueta.

DOSIS DE APLICACIÓN

APLICACIÓN	AQUAMASTER	VOLUMEN DE PULVERIZACIÓN GALONES POR ACRE
PULVERIZACIÓN PARA MOJAR		
Pistola manual, o tipo mochila	0.5 a 1.5% en peso	pulverización para mojar*
PULVERIZACIÓN DIRIGIDA DE BAJO VOLUMEN		
Tipo mochila	4 a 8% en peso	15 a 25**
Alto volumen modificado	1.5 a 3% en peso	40 a 60**

*En el caso de efectuar aplicaciones de pulverización para mojar, la cobertura debe ser uniforme y total. No pulverice hasta el punto de escurrimiento.

** Las aplicaciones dirigidas de bajo volumen con equipo tipo mochila dan mejor resultado cuando se tratan malezas y matorrales de menos de 10 pies de altura. En el caso de malezas y matorrales más altos, las pistolas de alto volumen se pueden modificar reduciendo el tamaño de la boquilla y la presión de pulverización para producir una pulverización dirigida de bajo volumen.

7.4 Equipo especializado

Este producto puede aplicarse mediante aplicadores con pantalla, rociadores con campana, aplicadores por frotación o barras de esponja, después de diluirse y mezclarse bien con agua, a la maleza especificada en esta etiqueta que crezca en sitios acuáticos o zonas que no sean de cultivo.

EVITE EL CONTACTO DEL HERBICIDA CON LA VEGETACION DESEABLE YA QUE ES PROBABLE QUE SUFRA GRAVES DAÑOS O SEA DESTRUIDA TOTALMENTE.

Los aplicadores utilizados por encima de la vegetación deseable deben ser calibrados de tal manera que el rociado o el punto de contacto más bajo esté por lo menos a 2 pulgadas arriba de la vegetación deseable. Gotas, niebla, espuma o salpicaduras del herbicida en contacto con la vegetación deseable pueden causar con mucha probabilidad descoloración, atrofia o destrucción.

Se obtienen mejores resultados cuando una mayor cantidad de la maleza entra en contacto con el herbicida. Las malezas que no entran en contacto con la solución herbicida no serán afectadas. Esto puede ocurrir en lugares donde las malezas están muy concentradas, cuando la infestación es grave o donde la altura de las malezas es variada, lo que no permite que todas sean tocadas por el herbicida. En estos casos puede hacerse necesario repetir el tratamiento.

Aplicadores con pantalla y con capucha

Los rociadores con pantalla o con capucha aplican la solución del herbicida directamente sobre las malezas, al mismo tiempo que protegen la vegetación deseable, para que no sea tocada por el herbicida. Use boquillas que aseguren un recubrimiento uniforme en toda el área tratada. En los rociadores con pantalla, mantenga las pantallas debidamente colocadas a fin de proteger la vegetación que no se desee destruir. SE DEBE TENER MUCHO CUIDADO PARA EVITAR EL CONTACTO DEL HERBICIDA CON LA VEGETACION DESEABLE.

Aplicadores por frotación y barras de esponja

Los aplicadores por frotación son dispositivos que aplican cantidades adecuadas de este producto directamente sobre la maleza.

El equipo debe ser diseñado, mantenido y operado de manera que la solución del herbicida no haga contacto con la vegetación deseable. Opere este equipo a velocidades inferiores a las 5 millas por hora. En áreas donde la infestación es grave, se puede mejorar la eficacia reduciendo la velocidad, así se asegura que el frotador esté siempre adecuadamente saturado con la solución del herbicida. Se obtienen mejores resultados si se aplica dos veces en direcciones opuestas.Evite fugas o goteos sobre la vegetación deseable. Ajuste la altura de los aplicadores a fin de asegurar un contacto adecuado con las malezas. Mantenga limpias las superficies de frotación. Tenga presente que en terrenos inclinados, el herbicida puede migrar causando goteos en la parte baja y el secado de las mechas en la parte superior del aplicador por frotación.

No use aplicadores por frotación cuando las malezas estén mojadas.

Mezcle solamente la cantidad de solución que se usará durante el período de un día, debido a que el uso de sobras de días anteriores puede dar como resultado un efecto menos eficiente. Inmediatamente después de usar este producto, lave bien el aplicador usando bastante agua.

En todas las aplicaciones con enjugador se recomienda utilizar un surfactante no iónico en proporción del 10 por ciento por volumen de solución total de herbicida.

Para aplicadores de cordón o de mecha de esponja—Puede emplearse soluciones que oscilan entre 33 y 75 por ciento de este producto en agua.

Aplicadores de panel—En los aplicadores de enjugador de panel pueden utilizarse soluciones de un 33 a un 100 por ciento de producto en agua.

8.0 INSTRUCCIONES SEGUN AREAS Y USO

Salvo que se especifique lo contrario, pueden efectuarse aplicaciones para controlar cualquier tipo de maleza que se indique en las "**Maleza Anuales**", "**Maleza Perenne**" o "**Arbustos Leñosos y Árboles**" mesas de tasa. Consulte también la sección "**Equipo Selectivo**".

8.1 Sitios Acuáticos

Este producto puede aplicarse a las malezas brotadas en todo tipo de masa de agua (dulce o salobre), circulante o no. Esto incluye lagos, ríos, arroyos, estanques, estuarios, diques, manantiales, zanjas de drenaje e irrigación, canales, represas, plantas de tratamiento de aguas y sitios donde desea restaurarse el hábitat de la fauna local.

Este producto también puede usarse para controlar la maleza, arbustos leñosos y árboles indicados en la etiqueta que crezcan en zonas terrestres que no sean de cultivo o en áreas acuáticas de estas zonas.

Si hubiera sitios acuáticos próximos a las zonas no utilizadas para cultivo y que fueran parte del tratamiento a realizarse, lea y cumpla con las siguientes instrucciones:

Este producto no controla plantas que estén completamente sumergidas o que tengan la mayor parte de su follaje bajo agua.

No hay restricciones de ningún tipo en cuanto a la utilización del agua tratada en irrigación, actividades recreativas o uso doméstico.

Antes de aplicar este producto en aguas de uso público, consulte a los organismos estatales locales reguladores de caza y pesca, así como a las autoridades que controlan el uso del agua. Tal vez sea necesario contar con un permiso para tratar tales aguas.

NOTA: No aplique este producto **directamente al agua** dentro de 0.5 milla en contra de la corriente de una fuente activa de agua potable en agua que fluya (es decir, río, corriente, etc.) o dentro de la 0.5 milla de una fuente activa de agua potable en una extensión de agua estancada, tal como un lago, estanque o represa. Para poder efectuar aplicaciones sobre agua próxima o dentro de un radio de media milla de una toma activa de agua potable, la toma de agua deberá desactivarse durante un mínimo de 48 horas luego de la aplicación. La toma de agua puede abrirse antes de las 48 horas si el nivel de glifosato en la misma se encuentra por debajo de 0.7 partes por millón, determinado por un análisis de laboratorio. Estas aplicaciones sobre agua podrán efectuarse ÚNICAMENTE en caso de que exista una fuente de agua alternativa o lagunas de contención que permitan la desactivación temporal de la toma de agua durante un mínimo de 48 horas luego de la aplicación. Esta restricción **NO** se aplica al sobrerociado inadvertido intermitente de agua en sitios de uso terrestre.

Para tratamientos luego de un descenso del nivel de las aguas o en zanjas secas, después del tratamiento deje transcurrir 7 días o más antes de volver a llenar con agua. Así logrará el máximo control de las malezas. Aplique el herbicida de AquaMaster dentro de las 24 horas siguientes al descenso de las aguas, para asegurarse de que el producto está actuando sobre malezas en crecimiento activo.

Tal vez sea necesario volver a tratar la vegetación flotante. Evite que la vegetación a la que se le aplicó el producto, lo pierda por salpicaduras creadas por el bote utilizado para la aplicación o por otros botes que circulen en los alrededores. No efectúe ningún tratamiento si se esperan lluvias dentro de las 6 primeras horas posteriores a la aplicación. No vuelva a aplicar dentro de las 24 horas posteriores al tratamiento inicial.

La aplicación efectuada en las masas de agua en circulación debe realizarse desplazándose corriente arriba, para evitar que el herbicida se concentre en el agua. Cuando se lleve a cabo alguna aplicación en las orillas de un río o arroyo, no superponga las aplicaciones a más de 1 pie en el cauce del río o arroyo. No aplique sobre masas de agua donde no haya maleza. No supere la concentración máxima aplicable (7.5 pintas/acre) en ninguna aplicación diseminada que se efectúe sobre agua.

Cuando haya que tratar toda la superficie de una masa de agua no circulante, el tratamiento de ésta en franjas podría evitar el consumo total del oxígeno debido al proceso de degradación de la vegetación. Este agotamiento del oxígeno podría provocar la muerte de peces.

Mezclas Para Tanque

Pueden usarse mezclas para tanque de este producto con 2,4-D amina para aumentar el espectro de vegetación controlada en zonas acuáticas. Utilice de 1.5 a 2 pintas (0.7 a 0.95 L) de este producto más 2 a 4 pintas (0.95 a 1.9 L) de 2,4-D amina (4 libras de ingrediente activo por galón [480 mg por kg], rotulado para sitios acuáticos) para controlar maleza anual. Utilice de 3 a 7.5 pintas (1.4 a 3.5 L) de este producto más 2 a 4 cuartos de galón de 2,4-D amina (4 libras de ingrediente activo por galón [480 mg por kg], rotulado para sitios acuáticos) para el control total o parcial de maleza perenne, arbustos leñosos y árboles.

Al mezclar en tanque, lea y siga al pie de la letra las reclamaciones, advertencias y demás información en las etiquetas de los producto utilizados. Use la mezcla conforme a las medidas precautorias más estrictas indicadas para cada producto en la mezcla. Mezcle en el siguiente orden: Llene el tanque de rociado a la mitad con agua, agregue el herbicida AquaMaster, luego 2,4-D amina y por último el surfactante. Llene el tanque de rociado con agua.

NOTA: NO MEZCLE EL HERBICIDA AQUAMASTER CON CONCENTRADOS DE 2,4-D AMINA SIN PORTADOR DE AGUA. NO MEZCLE EL HERBICIDA AQUAMASTER CON 2,4-D AMINA EN EQUIPO ROCIADOR CON INYECTOR DE DERIVACIÓN.

8.2 Troncos cortados

El tratamiento de troncos cortados puede hacerse en cualquier área indicada en esta etiqueta. Este producto controla muchas especies de matorrales leñosos y árboles. Aplique este producto usando equipo adecuado para garantizar la cobertura completa del cámbium. Corte los árboles o sus brotes cerca de la superficie de la tierra. Aplique una solución de este producto del 50 al 100 por ciento a la superficie recién cortada, **inmediatamente después** del corte. Demorar la aplicación puede reducir la eficacia del producto. Para obtener mejores resultados, la aplicación deberá hacerse durante los períodos de crecimiento activo y expansión completa de las hojas.

Para controlar *Ailanthus altissima* (Tree-of-heaven) efectúe un tratamiento de tocón cortado de acuerdo con las instrucciones en esta sección utilizando una mezcla de rociado con 50 por ciento de herbicida AquaMaster y 10 por ciento de Arsenal.

NO HAGA LAS APLICACIONES SOBRE TRONCOS CORTADOS CUANDO LAS RAICES DE LOS MATORRALES LEÑOSOS O ARBOLES DESEABLES PUEDEN ESTAR INJERTADAS A LAS RAICES DE LOS TRONCOS CORTADOS. Algunos brotes, tallos o árboles pueden compartir el mismo sistema radicular. Árboles que están contiguos, que tienen la misma edad, altura y separación pueden indicar raíces compartidas. Cuando se trata a uno o más árboles que tienen raíces en común, tanto si están injertados como si comparten el sistema radicular, es probable que se produzca un daño en los brotes/árboles no tratados.

8.3 Areas generales no cultivables y áreas industriales

Utilice en lugares como aeropuertos, complejos de apartamentos, zonas comerciales, bordes de acequias, entradas de autos, zanjas

secas, canales secos, hileras de cercas, canchas de golf, invernaderos, zonas industriales, depósitos de maderas, zonas de fabricación, solares municipales, zonas naturales, complejos de oficinas, cultivos ornamentales, estacionamientos, parques, pasturas, zonas con tanques de petróleo e instalaciones de bombeo, líneas de ferrocarril, praderas, zonas recreativas, zonas residenciales, derechos de paso, bordes de carreteras, escuelas, granjas de tepes o para semillas de césped, complejos deportivos, zonas de almacenamiento, subestaciones, zonas de servicios públicos, zonas de depósito, otros lugares públicos y zonas en las que se realiza gestión de vida silvestre.

Control general de malezas, recortado de bordes y suelo limpio de malezas

Este producto puede usarse en áreas generales no cultivables. Puede aplicarse con cualquiera de los equipos descritos en este libreto. Puede usarse para el recortado de bordes alrededor de objetos en áreas no cultivables, para tratamiento localizado de vegetación no deseable y para eliminar las malezas no deseables que crecen en cuadros de arbustos establecidos y plantaciones ornamentales. Este producto puede usarse antes de plantar un área con plantas ornamentales, flores, césped (tepes o semillas), o antes de colocar asfalto o de comenzar un proyecto de construcción.

Pueden hacerse aplicaciones repetidas de este producto, a medida que emergen las malezas, para mantener el suelo limpio de malezas.

MEZCLAS PARA TANQUE: Este producto se puede mezclar en tanque con los siguientes productos. Consulte los rótulos de estos productos para informarse sobre áreas no cultivables y dosis de aplicación.

Arsenal®	Outrider®
Barricade® 65WG	Pendulum® 3.3 EC
Certainty®	Pendulum WDG
diuron	Plateau®
Endurance®	Princep®DF
Escort®	Princip Liquid
Garlon® 3A	Ronstar® 50 WP
Garlon 4	Sahara®
Hyvar® X	simazine
Karmex® DF	Surflan®
Krovar® I DF	Telar®
Oust®	2,4-D

Este producto más las mezclas en tanque de dicamba, no se pueden aplicar por pulverización aérea en California.

Mezclas en tanque para el control de matorrales

MEZCLAS PARA TANQUE: Las mezclas en tanque de este producto se pueden usar para aumentar el espectro de control de las malezas herbáceas, matorrales leñosos y árboles. Cuando lleve a cabo una mezcla en tanque, lea y cumpla cuidadosamente con todas las recomendaciones y las precauciones que establece la etiqueta, así como también con toda la información incluida en las etiquetas de todos los productos que utilice. Use cada uno de los productos para la mezcla con la mayor de las precauciones. En una mezcla en tanque se puede usar cualquiera de las dosis recomendadas de este producto.

Para el control de malezas herbáceas, emplee las dosis recomendadas más bajas para mezcla en tanque. Para el control de herbaje tupido o de matorrales leñosos y árboles difíciles de controlar, emplee las dosis recomendadas más altas.

NOTA: En tratamientos de corte lateral, se recomienda que este producto se use solo o en mezcla en tanque con Garlon 4.

PRODUCTO	DOSIS POR DISEMINACIÓN
Arsenal	6 a 32 onzas fluidas por acre
Escort	1 a 2 onzas por acre
Garlon 3A*, Garlon 4	1 a 4 cuartos de galón por acre

PRODUCTO	DOSIS DE PULVERIZACIÓN PARA MOJAR
Arsenal	0.06 a 0.12% en volumen
Escort	1 a 2 onzas por acre

PRODUCTO	BAJO VOLUMEN DOSIS DE PULVERIZACIÓN DIRIGIDA
Arsenal	0.1 a 0.5% en volumen
Escort	1 a 2 onzas por acre

* Asegúrese de que Garlon 3A se mezcle bien con agua de acuerdo a las instrucciones de la etiqueta, antes de agregar este producto. Para evitar problemas de compatibilidad, agite la mezcla de pulverización en el momento en que se agregue este producto.

8.4 Manejo de hábitats

Restauración y mantenimiento de hábitats

Este producto puede ser usado para controlar la vegetación exótica y otras plantas indeseables en áreas de manejo de hábitats y en áreas naturales, incluyendo áreas ribereñas y estuarinas, hábitats nativos y refugios para la fauna silvestre. Pueden hacerse aplicaciones para permitir la recuperación de las especies de plantas nativas, antes de plantar dichas especies nativas deseables, y para otros requisitos similares de control de la vegetación de amplia efectividad. A fin de eliminar selectivamente ciertas plantas indeseables, se pueden hacer aplicaciones localizadas para controlar y mejorar el hábitat.

Sitios donde se siembran alimentos para la fauna silvestre

Este producto puede ser usado para preparar el terreno donde se desea sembrar alimentos para la fauna silvestre. Cualquier especie de alimento para la fauna silvestre puede ser sembrada después de aplicar este producto, o también se puede permitir que las especies nativas vuelvan a poblar el área. Si hace falta labrar para preparar el terreno semillas, espere 7 días después de aplicar este producto antes de arar a fin de permitir la absorción adecuada en las partes de la planta que estén bajo tierra.

8.5 Inyección y chorro (matorrales leñosos y árboles)

Los matorrales leñosos y árboles pueden ser controlados aplicando este producto por inyección o chorro. Aplique este producto usando equipo adecuado, que debe ser capaz de penetrar en el tejido viviente. Aplique el equivalente a 1/25 onza fluida (1 ml) de este producto por cada 2 ó 3 pulgadas de diámetro del tronco a la altura del pecho (DBH en inglés). La mejor forma de hacerlo es aplicando una solución del 50 al 100 por ciento, este producto, con un chorro continuo alrededor del árbol o en cortes espaciados uniformemente alrededor del árbol y por debajo del nivel de las ramas. A medida que el diámetro del árbol aumenta, se obtienen mejores resultados con el chorro diluido continuo alrededor del árbol o en cortes espaciados muy cerca entre sí alrededor del árbol. Evite las aplicaciones que permiten el desagüe de material cuando se chorrea alrededor del árbol o sobre los cortes en árboles que tienen la facilidad de exudar savia de los cortes. En especies de este tipo, haga los cortes de manera oblicua a fin de producir el efecto de copa y use el producto sin diluir. Para obtener mejores resultados, la aplicación debe tener lugar durante períodos de crecimiento activo y expansión completa de las hojas.

8.6 Carreteras

Todas las instrucciones de la sección "**Areas Generales No Cultivables y Areas Industriales**" son válidas para las carreteras.

Tratamiento de bordes

Este producto puede ser usado en los bordes de las carreteras. Puede aplicarse con rociadores de aguilón, rociadores de aguilón con pantalla, boquillas descentradas de gran volumen, equipo de mano y equipos similares.

Barandas y otros obstáculos para la siega

Este producto puede ser usado para controlar las malezas que crecen debajo de las barandas y alrededor de los postes de señal y otros objetos en los bordes de las carreteras.

Tratamiento localizado

Este producto puede ser usado como tratamiento localizado para controlar la vegetación indeseable que crece a lo largo de los bordes de las carreteras.

MEZCLAS PARA TANQUE: Este producto puede mezclarse en tanque con los siguientes productos para tratamientos de bordes de carreteras, vallas de seguridad, zonas específicas y áreas sin vegetación, siempre y cuando el producto específico para la mezcla en tanque esté rotulado para el tipo de área:

diuron	Princep DF
Endurance	Princep Liquid
Escort	Ronstar 50 WP
Garlon 4	Sahara
Krovar I DF	simazine
Oust	Surflan
Outrider	Telar
Pendulum 3.3 EC	2,4-D
Pendululm WDG	

Vea las instrucciones generales para mezclas de tanque en la sección "MEZCLA" de este libreto.

Mantenimiento del Bermudagrass y Bahiagrass

Aplicaciones cuando estén latentes (durmientes)

Este producto puede usarse para controlar o controlar parcialmente muchas malezas anuales de invierno y tall fescue para el alivio eficaz de Bermudagrass y bahiagrass latentes. Trate solamente cuando el césped esté latente y antes de su reverdecer primaveral. Este producto también se puede mezclar en tanque con el herbicida Outrider o Oust para el control residual. Las mezclas de tanque de este producto con Oust pueden retrasar el reverdecer.

Para obtener mejores resultados con malezas anuales de invierno, haga el tratamiento cuando las plantas estén en una etapa temprana de su crecimiento (menos de 6 pulgadas de altura) después de que la mayoría haya germinado. Para obtener mejores resultados con tall fescue, haga el tratamiento cuando el fescue esté en o después de su etapa de 4 a 6 hojas.

Aplique de 6 a 48 onzas fluidas de este producto en una mezcla de tanque con .075 a 1.33 de onza de herbicida Outrider por acre. Lea y siga todas las instrucciones de la etiqueta del herbicida Outrider.

MEZCLAS PARA TANQUE: Aplique de 6 a 48 onzas fluidas de este producto por acre, solo o en mezcla de tanque con 0.25 a 1 onza de Oust por acre. Aplique las proporciones recomendadas en 10 a 40 galones de agua por acre. Uselo solamente en áreas donde el Bermudagrass o bahiagrass son deseables y en las que puede tolerarse un poco de daño o decoloración. Para evitar que el reverdecer se retarde y para minimizar el daño, no agregue más de 1 onza de Oust por acre sobre Bermudagrass y no más de 0.5 onzas de Oust por acre sobre bahiagrass, y evite el tratamiento cuando estas hierbas se encuentren en estado semi-latente.

Bermudagrass que esté creciendo activamente

Este producto puede ser usado para controlar total o parcialmente muchas malezas anuales y perennes para el mantenimiento eficaz de Bermudagrass que esté creciendo activamente. Aplique de 12 a 36 onzas fluidas de este producto en 10 a 40 galones de solución para rociar por acre. Para tratar malezas anuales que tengan menos de 6 pulgadas de altura (o el largo de los tallos), use las proporciones más bajas. Use la proporción más alta a medida que las malezas aumenten de tamaño o cuando estén cerca de la floración o de la formación de semillas. Estas proporciones también controlan parcialmente las siguientes especies perennes:

Bahiagrass	Johnsongrass
Bluestem, silver	Trumpetcreeper
Fescue, tall	Vaseygrass

Este producto se puede mezclar en tanque con el herbicida Outrider para el control o el control parcial de Sorghum halepense (Johnsongrass) y otras malas hierbas indicadas en la etiqueta del herbicida Outrider. Use de 6 a 24 onzas fluidas de este producto con 0.75 a 1.33 onzas de herbicida Outrider. Utilice las proporciones más altas de ambos productos para el control de malas hierbas perennes o anuales que tengan una altura superior a 6 pulgadas.

MEZCLAS PARA TANQUE: Este producto puede ser mezclado con Oust. Si se mezcla en tanques, no use más de 12 a 24 onzas fluidas de este producto con 1 a 2 onzas de Oust por acre. Para tratar malezas anuales indicadas en este libreto y en el libreto de Oust, que tengan menos de 6 pulgadas de altura (o el largo de los tallos), use las proporciones más bajas de cada producto. Use la proporción más alta a medida que las malezas aumenten de tamaño o cuando estén cerca de la floración o de la formación de semillas. Estas proporciones también controlan parcialmente las siguientes especies perennes:

Bahiagrass	Fescue, tall
Bluestem, silver	Johnsongrass
Broomsedge	Poorjoe
Dallisgrass	Trumpetcreeper
Dock, curly	Vaseygrass
Dogfennel	Vervain, blue

Uselo solamente en Bermudagrass que esté bien establecido. Como resultado del tratamiento, el Bermudagrass puede sufrir deterioro, pero volverá a crecer si se riega. No se recomienda repetir el tratamiento con la mezcla de tanque en la misma estación, ya que esto puede ocasionar daños graves al Bermudagrass.

Bahiagrass que esté creciendo activamente

Para suprimir el crecimiento vegetativo y la inhibición de la formación de semillas de bahiagrass durante aproximadamente 45 días, aplique 4 onzas fluidas de este producto en 10 a 40 galones de agua por acre. Aplique de 1 a 2 semanas después de reverdecer completo o después de cortar a una altura uniforme de 3 a 4 pulgadas. Esta aplicación debe ser hecha antes de la emergencia de las semillas.

Para la supresión durante un máximo de 120 días, aplique 3 onzas fluidas de este producto por acre, y a continuación una aplicación de 2 a 3 onzas fluidas por acre unos 45 días más tarde. No haga más de 2 aplicaciones al año.

Este producto se puede utilizar para el control o el control parcial de Sorghum halepense (Johnsongrass) y otras malas hierbas indicadas en la etiqueta de Outrider, en Paspalum notatun (bahiagrass) en crecimiento activo. Aplique de 1.5 a 3.5 onzas fluidas de este producto con 0.75 a 1.33 onzas de herbicida Outrider por acre. Utilice las proporciones más altas para el control de malas hierbas perennes o anuales que tengan una altura superior a 6 pulgadas. Utilice sólo en Paspalum notatum (bahiagrass) bien establecido.

MEZCLAS PARA TANQUE: Puede usarse una mezcla de tanque de este producto con Oust. Aplique 4 onzas fluidas de este producto con 0.25 onzas de Oust por acre, 1 a 2 semanas después de la primera siega de la primavera. Haga solamente 1 aplicación al año.

9.0 TIPOS DE MALEZAS CONTROLADAS

Use siempre la proporción más alta de este producto por acre, dentro de las proporciones recomendadas, cuando las malezas son densas o cuando crecen en un área no tocada (no cultivada).

Puede haber una disminución de los resultados cuando se traten malezas cubiertas con mucho polvo. Para las malezas que han sido segadas, pastadas o cortadas, permita que vuelvan a crecer antes del tratamiento.

Vea las secciones siguientes para las proporciones recomendadas para el control de malezas anuales y perennes, matorrales leñosos y árboles. Para las malezas, matorrales leñosos y árboles difíciles de controlar, donde las plantas crecen en condiciones de estrés, o donde la infestación es densa, pueden usarse 4.5 a 8 cuartos de galón por acre de este producto para obtener mejores resultados.

9.1 Malezas anuales

Aplique a las malezas anuales en crecimiento activo y de oja ancha.

Deje transcurrir al menos 3 días luego de la aplicación antes de hacer algo sobre la vegetación tratada. Después del lapso mencionado, podrá cortar, remover o quemar la maleza. En "INFORMACIÓN GENERAL", "MEZCLA", e "EQUIPOS Y TECNICAS PARA LA APLICACION" encontrará instrucciones específicas relativas a la aplicación.

Use 1.5 pintas por acre si las malezas tienen menos de 6 pulgadas de altura o largo de los tallos y 1 cuarto a 4 cuartos de galón por acre si las malezas tienen más de 6 pulgadas de altura o largo de los tallos o cuando las malezas crecen en condiciones de estrés.

Para aplicaciones de rociado para mojar, aplique una solución de 0.5% de este producto a las malezas que tengan menos de 6 pulgadas de altura o largo de los tallos. Haga la aplicación antes de la formación de semillas para la hierba, o la formación de yemas para las malezas de hoja ancha.

Para las malezas anuales que tienen más de 6 pulgadas de altura o las malezas más pequeñas que crecen en condiciones de estrés, use una solución del 0.75- al 1.5-por ciento. Use la dosis más alta para las especies difíciles de controlar o las malezas de más de 24 pulgadas de altura.

ESPECIES DE MALEZAS

Anoda, spurred	Hemp sesbania
Balsamapple**	Henbit
Barley*	Horseweed/Marestail
Barnyardgrass*	*(Conyza canadensis)*
Bittercress*	Itchgrass*
Black nightshade*	Johnsongrass, seedling
Bluegrass, annual*	Junglerice
Bluegrass, bulbous*	Knotweed
Bassia, fivehook	Kochia
Brome, downy*	Lamb's-quarters*
Brome, Japanese*	Little barley*
Broomsedge	London rocket*
Browntop panicum*	Mayweed
Buttercup*	Medusahead*
Carolina foxtail*	Morningglory
Carolina geranium	*(Ipomoea spp.)*
Castor bean	Mustard, blue*
Cheatgrass*	Mustard, tansy*
Cheeseweed	Mustard, tumble*
(Malva parviflora)	Mustard, wild*
Chervil*	Oats
Chickweed*	Pigweed*
Cocklebur*	Plains/Tickseed coreopsis*
Copperleaf, hophornbeam	Prickly lettuce*
Corn*	Puncturevine
Corn speedwell*	Purslane, common
Crabgrass*	Ragweed, common*
Dwarfdandelion*	Ragweed, giant
Eastern mannagrass*	Red rice
Eclipta*	Russian thistle
Fall panicum*	Rye*
Falsedandelion*	Ryegrass*
Falseflax, smallseed*	Sandbur, field*
Fiddleneck	Shattercane*
Field pennycress*	Shepherd's-purse*
Filaree	Sicklepod
Fleabane, annual*	Signalgrass, broadleaf*
Fleabane, hairy	Smartweed, ladysthumb*
*(Conyza bonariensis)**	Smartweed, Pennsylvania*
Fleabane, rough*	Sowthistle, annual
Florida pusley	Spanishneedles***
Foxtail*	Speedwell, purslane*
Goatgrass, jointed*	Sprangletop*
Goosegrass	Spurge, annual
Grain sorghum (milo)*	Spurge, prostrate*
Groundsel, common*	Spurge, spotted*

ESPECIES DE MALEZAS	
Spurry, umbrella*	Virginia copperleaf
Starthistle, yellow	Virginia pepperweed*
Stinkgrass*	Wheat*
Sunflower*	Wild oats*
Teaweed/Prickly sida	Witchgrass*
Texas panicum*	Woolly cupgrass*
Velvetleaf	Yellow rocket

*Cuando use equipos de aplicación diseminada a nivel del terreno (aplicaciones aéreas o rociadores de aguilón con boquillas tipo abanico plano), estas especies serán controladas o controladas parcialmente con 12 onzas fluidas de este producto por acre. Las aplicaciones deben hacerse usando de 3 a 10 galones de volumen por acre. Use boquillas que garanticen una cobertura completa del follaje y haga el tratamiento cuando las malezas estén en su etapa temprana de crecimiento.

**Aplique únicamente con equipo de mano.

***Aplique 3 pintas de herbicida de AquaMaster por acre.

9.2 Malezas perennes

Los mejores resultados se obtienen cuando las malezas perennes son tratadas una vez que han alcanzado la etapa reproductiva de su crecimiento (inicio de las semillas para hierbas y formación de yemas para malezas de hoja ancha). Para las plantas sin flores, los mejores resultados se obtienen cuando las plantas alcanzan el estado de madurez. En muchos casos, se requiere el tratamiento antes de estas etapas del crecimiento. En estos casos, use la proporción más alta dentro de las proporciones recomendadas.

Asegúrese de que la cobertura sea a fondo cuando emplee tratamientos de rociado para mojar con equipo de mano. Cuando se utilice equipo manual para tratamientos puntuales localizados de bajo volumen, aplique una solución de 4- a 8- por ciento de este producto.

Espere 7 días o más después de la aplicación antes de labrar. Si la maleza ha sido podada o labrada, no aplique el tratamiento hasta que la maleza haya crecido a la etapa recomendada. Los tratamientos otoñales deben aplicarse antes de las heladas.

Para controlar malezas que surjan de semillas o partes bajo tierra, deberá repetirse el tratamiento.

Especies de malezas	Proporción (cuartos por acre)	% de solución de mano
Alfalfa*	0.7	1.5
Alligatorweed*	3.0	1.3
Anise (fennel)	1.5 - 3.0	1.0 - 1.5
Bahiagrass	2.3 - 3.75	1.5
Beachgrass, European (*Ammophila arenaria*)	—	3.5
Bentgrass*	1.0	1.5
Bermudagrass	4.0	1.5
Bermudagrass, water (knotgrass)	1.0	1.5
Bindweed, field	3.0 - 3.75	1.5
Bluegrass, Kentucky	1.5 - 2.3	0.75
Blueweed, Texas	3.0 - 3.75	1.5
Brackenfern	2.3 - 3.0	0.75 - 1.0
Bromegrass, smooth	1.5 - 2.3	0.75
Bursage, woolly-leaf	—	1.5
Canarygrass, reed	1.5 - 2.3	0.75
Cattail	2.3 - 3.75	0.75
Clover; red, white	2.3 - 3.75	1.5
Cogongrass	2.3 - 3.75	1.5
Cordgrass	2.3 - 3.75	1.0 - 2.0
Cutgrass, giant	3.0	1.0
Dallisgrass	2.3 - 3.75	1.5
Dandelion	2.3 - 3.75	1.5
Dock, curly	2.3 - 3.75	1.5
Dogbane, hemp	3.0	1.5
Fescue (except tall)	2.3 - 3.75	1.5
Fescue, tall	2.3	1.0
Guineagrass	2.3	0.75
Horsenettle	2.3 - 3.75	1.5
Horseradish	3.0	1.5
Iceplant	1.5	1.5
Ivy; German, cape	1.5 - 3.0	0.75 - 1.5
Jerusalem artichoke	2.3 - 3.75	1.5
Johnsongrass	1.5 - 2.3	0.75
Kikuyugrass	1.5 - 2.3	0.75
Knapweed	3.0	1.5
Lantana	—	0.75 - 1.0
Lespedeza	2.3 - 3.75	1.5
Loosestrife, purple	2.0	1.0 - 1.5
Lotus, American	2.0	0.75
Maidencane	3.0	0.75
Milkweed, common	2.3	1.5
Muhly, wirestem	1.5 - 2.3	0.75
Mullein, common	2.3 - 3.75	1.5
Napiergrass	2.3 - 3.75	1.5
Nightshade, silverleaf	3.0 - 3.75	1.5
Nutsedge; purple, yellow	2.3	0.75
Orchardgrass	1.5 - 2.3	0.75
Pampasgrass	2.3 - 3.75	1.5
Paragrass	3.0	0.75
Pepperweed, perennial	3.0	1.5
Phragmites*	2.0 - 3.75	0.75 - 1.5
Poison hemlock	1.5 - 3.0	0.75 - 1.5
Quackgrass	1.5 - 2.3	0.75
Redvine*	1.5	1.5
Reed, giant (*Arundo donax*)	3.0 - 3.75	1.5
Ryegrass, perennial	1.5 - 2.3	0.75
Salvinia, (*spp.*)	—	2.0
Smartweed, swamp	2.3 - 3.75	1.5
Spatterdock	3.0	0.75
Spurge, leafy*	—	1.5
Starthistle, Yellow	—	1.5
Sweet potato, wild*	—	1.5
Thistle, artichoke	1.5 - 2.3	2.0
Thistle, Canada	1.5 - 2.3	1.5
Timothy	1.5 - 2.3	1.5
Torpedograss*	3.0 - 3.75	0.75 - 1.5
Trumpetcreeper*	1.5 - 2.3	1.5
Tules, common	—	1.5
Vaseygrass	2.3 - 3.75	1.5
Velvetgrass	2.3 - 3.75	1.5
Waterhyacinth	2.5 - 3.0	0.75 - 1.0
Waterlettuce	—	0.75 - 1.0
Waterprimrose	—	0.75
Wheatgrass, western	1.5 - 2.3	0.75

*Control parcial

Alligatorweed (Alternantera)—Aplique 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.3% con equipo de mano para lograr el control parcial de alligatorweed. Aplique cuando la mayoría de las plantas esté en floración. Para mantener el control, deberá repetir la aplicación.

Beachgrass, European; Barrón o grama del norte (Ammophila arenaria)—Aplique una solución de este producto al 8 por ciento más un 0.5 a 1.5 por ciento de surfactante no iónico para rociado o aplicación mojada de bajo volumen. Se obtienen los mejores resultados al efectuar la aplicación cuando el barrón está saliendo de la bota para alcanzar las etapas de desarrollo completo. En el otoño, aplique el producto antes de que el número de hojas verdes se reduzca a menos del 50 por ciento. No aplique el tratamiento cuando la maleza está afectada por sequía. Tal vez sea necesario repetir las aplicaciones.

Bermudagrass (Pasto Bermuda)—Aplique 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.5% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando aparezca la vaina de las semillas.

Bindweed, field / Silverleaf Nightshade (Hierba mora) / Texas Blueweed—Aplique 6 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada al oeste del Río Mississippi y 4.5 a 6 pintas por acre al este de dicho río. Cuando utilice equipo de mano, use una solución al 1.5%. Aplique cuando las plantas estén en pleno crecimiento y estén floreciendo o ya hayan florecido. Para silverleaf nightshade, los mejores resultados se obtienen cuando la aplicación se realiza luego de formadas las bayas. No aplique cuando la maleza esté debilitada por sequía. El desarrollo de nuevas hojas indica que hay un crecimiento activo. Los mejores resultados se obtienen cuando se aplica a fines del verano o durante el otoño.

Brackenfern—Aplique 4.5 a 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75-1% con equipo de mano. Aplique a las frondas crecidas que tengan al menos 18 pulgadas (45 cm) de longitud.

Cattail (Tifa)—Aplique 4.5 a 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando estén floreciendo o ya hayan florecido. Los mejores resultados se obtienen cuando se aplica en el verano o durante el otoño.

Cogongrass (Zacate Fucgo)—Aplique 4.5 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada. Aplique cuando el cogongrass tengan al menos 18 pulgadas (45 cm) de altura y esté en pleno crecimiento a fines del verano o durante el otoño. Luego de la aplicación y antes de remover o cortar las plantas, deje transcurrir 7 días o más. Debido a las distintas etapas de crecimiento y a lo tupido de la vegetación, que impide realizar una cobertura homogénea, para mantener el control podría ser necesario efectuar repetidas aplicaciónes.

Cordgrass (Espartina)—Aplique 4.5 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1-2% con equipo de mano. Programe la aplicación de modo de que transcurran al menos 6 horas desde la aplicación hasta que las plantas tratadas sean cubiertas por la marea.

La presencia de escombro u otros restos sobre las plantas reducirá la efectividad del producto aplicado. Para mejorar la absorción del herbicida sobre las plantas, podría ser necesario lavar éstas antes de proceder a la aplicación.

Cutgrass, giant—Aplique 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1% con equipo de mano para lograr el control parcial de cutgrass. Para mantener el control, deberá repetirse la aplicación, sobre todo en sitios donde la vegetación esté parcialmente sumergida en agua. Antes de repetir la aplicación, deje que las plantas vuelvan a crecer, hasta llegar a la etapa en que poseen 7 a 10 hojas.

Dogbane, hemp / Knapweed / Horseradish—Aplique 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.5% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando la mayoría de ellas haya llegado a la etapa de comienzo del florecimiento. Los mejores resultados se obtienen cuando se aplica a finales del verano o durante el otoño.

Fescue, tall—Aplique 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando la mayoría de ellas haya llegado a la etapa de floración. Cuando se aplica antes de floración, el control no resulta tan efectivo.

Guineagrass (Zacate guinea)—Aplique 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando la mayoría de ellas haya llegado a una etapa donde tenga al menos 7 hojas.

Johnsongrass (Zacate Johnson) / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western—Aplique 3 a 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando la mayoría de ellas haya llegado a la etapa del comienzo de floración. Cuando se aplica antes del comienzo de floración, el control no resulta tan efectivo. En el otoño, aplique antes de que las plantas se tornen marrones.

Lantana—Aplique herbicida de AquaMaster como una solución al 0.75% a 1% con equipo de mano. Aplique a la lantana en crecimiento activo durante o luego del florecimiento. Si las plantas hubieran llegado a la etapa de crecimiento leñoso, utilice la concentración más alta.

Loosestrife, purple—Aplique 4 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1-1.5% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando estén floreciendo o ya hayan florecido. Los mejores resultados se obtienen cuando se aplica en el verano o durante el otoño. El tratamiento en otoño debe efectuarse antes de que se produzcan heladas.

Lotus, American (Lirio)—Aplique 4 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando estén floreciendo o ya hayan florecido. Los mejores resultados se obtienen cuando se aplica en el verano o durante el otoño. El tratamiento en otoño debe efectuarse antes de que se produzcan heladas. Podría ser necesario repetir el tratamiento para controlar el crecimiento a partir de semillas o de partes enterradas de la planta.

Maidencane / Paragrass (Pasto Pará)—Aplique 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Podría ser necesario repetir la aplicación, sobre todo en sitios donde la vegetación esté parcialmente sumergida en agua. En estas condiciones, deje que las plantas vuelvan a crecer hasta que posean 7 a 10 hojas antes de repetir el tratamiento.

Milkweed, common—Aplique 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.5% con equipo de mano. Aplique cuando las plantas estén en pleno crecimiento y cuando la mayoría haya llegado a la etapa de pasaje de capullo a flor.

Nutsedge: purple, yellow (coquito, coyolito)—Aplique 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano para controlar plantas de nutsedge existentes y los frutos inmaduros de éstas. Aplique cuando las plantas estén en flor o cuando se vean nuevos frutos en la punta de los rizomas. Los frutos que aún no hubieran germinado no serán controlados y podrían germinar luego del tratamiento. Para lograr un control a largo plazo, deberán repetirse los tratamientos.

Pampasgrass—Aplique herbicida de AquaMaster como una solución al 1.5% con equipo de mano cuando las plantas estén en crecimiento activo.

Phragmites—Para controlar parsialmente phragmites en Florida y en los condados de otros estados a orillas del Golfo de México, aplique 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.5% con equipo de mano. En otras áreas de los Estados Unidos, el control parcial se logra aplicando 4 a 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Los mejores resultados se obtienen cuando se aplica a finales del verano o durante el otoño, cuando las plantas están creciendo activamente y en pleno florecimiento. Dada la densidad natural de esta vegetación, que podría dificultar una cobertura uniforme del follaje, así como la existencia de plantas en distinto estado de crecimiento, podría ser necesario repetir los tratamientos para mantener el control. Los síntomas de control que se aprecian a simple vista podrían demorar en manifestarse.

Quackgrass / Kikuyugrass (Kikuyo) / Muhly, wirestem—Aplique 3 a 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano cuando la mayoría de las plantas quackgrass y wirestem muhly tengan, como mínimo, 8 pulgadas (20 cm) de altura (3 a 4 hojas) y estén creciendo activamente. Luego de la aplicación y antes de remover las plantas, deje transcurrir 3 días o más.

Reed, giant (Carrizo) / Ice Plant—Aplique herbicida de AquaMaster como una solución al 1.5% con equipo de mano cuando las plantas estén en pleno crecimiento. Para giant reed, los mejores resultados se obtienen cuando se aplica a fines del verano o durante el otoño.

Spatterdock—Aplique 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Aplique cuando la mayoría de las plantas estén floreciendo. Los mejores resultados se obtienen cuando se aplica en el verano o durante el otoño.

Sweet potato, wild (boniato/batata silvestre)—Aplique herbicida de AquaMaster como una solución al 1.5% con equipo de mano cuando las plantas estén en pleno crecimiento, durante o luego del florecimiento. Se necesitarán varias aplicaciones. Antes de repetir el tratamiento, deje que la planta llegue a la etapa de crecimiento recomendada.

Thistle (cardo): Canada, artichoke—Aplique 3 a 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.5% con equipo de mano para el cardo Canada. Para controlar cardo artichoke, aplique una solución al 2% de modo de mojar toda la superficie. Aplique cuando las plantas estén creciendo activamente y tengan capullos o hayan florecido.

Torpedograss—Aplique 6 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75-1.5% con equipo de mano para lograr un control parcial. Use las concentraciones menores si aplica sobre tierra y las concentraciones mayores si aplica sobre plantas parcialmente sumergidas o flotantes. Para mantener el control, deberá repetir los tratamientos.

Tules, common—Aplique herbicida de AquaMaster como una solución al 1.5% con equipo de mano cuando las plantas estén creciendo activamente, durante o luego de la aparición de las vainas. Después de la aplicación, los síntomas del efecto demorarán en aparecer y tal vez no se aprecien hasta transcurridas 3 semanas o más.

Waterhyacinth (Jacinto de agua)—Aplique 5 a 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75-1% con equipo de mano cuando las plantas estén creciendo activamente, durante o luego de las primeras etapas del florecimiento. Después de la aplicación, los síntomas del efecto demorarán 3 semanas o más en aparecer. La necrosis y total descomposición suele ocurrir dentro de los 60 a 90 días posteriores a la aplicación. Si desea que los efectos se aprecien más rápidamente, utilice las concentraciones más altas.

Waterlettuce (Lechuga de agua)—Para control, aplique herbicida de AquaMaster como una solución al 0.75-1% con equipo de mano cuando las plantas estén creciendo activamente. Use concentraciones mayores si el enmalezado fuera grave. Los mejores resultados se obtienen cuando la aplicación se realiza desde mediados de verano hasta el invierno. Si la aplicación se realizara en la primavera, tal vez deba repetirse el tratamiento.

Waterprimrose (Clauito)—Aplique herbicida de AquaMaster como una solución al 0.75% con equipo de mano cuando las plantas estén creciendo activamente, durante o luego de la etapa del florecimiento y antes de que ocurran los cambios de color típicos del otoño. El mejor control se logra cuando la cobertura es completa.

Otras malezas perennes mencionadas en esta etiqueta—Aplique 4.5 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75-1.5% con equipo de mano, cuando las plantas estén creciendo activamente y la mayoría haya llegado a las primeras etapas de florecimiento.

9.3 Matorrales leñosos y árboles

Aplique este producto después de la formación completa de hojas, a menos que se indique de otra manera. Para las plantas más grandes y/o donde la densidad de la vegetación sea alta, use la proporción más alta. En las plantas enredaderas que han alcanzado el estado leñoso de crecimiento, use las proporciones más altas. Los mejores resultados se obtienen cuando se aplica a finales del verano o en el otoño, después de la formación de frutos.

En zonas áridas, se obtienen mejores resultados cuando se aplica en la primavera o a principios del verano cuando las especies que crecen como matorrales tienen alto contenido de humedad y florecen.

Cuando haga tratamientos de rociado para mojar con equipos de mano, asegúrese de que la cobertura sea total.

Cuando use equipos de mano para tratamientos localizados con rociado dirigido de poco volumen, aplique una solución del 4 al 8 por ciento de este producto.

Es posible que los síntomas no aparezcan antes de las heladas o del envejecimiento con tratamientos de otoño.

Permita que pasen 7 o más días después de la aplicación antes de labrar, segar o remover. Es posible que se necesite repetir el tratamiento para tratar plantas que emergen de partes enterradas o de semillas. Un poco de colorido otoñal es aceptable en plantas indeseables que pierden las hojas en el otoño, siempre y cuando no hayan sufrido mayor pérdida de hojas. Si la aplicación de otoño se realiza después de que hayan ocurrido heladas, es posible que se obtengan resultados deficientes.

Especies de malezas	Proporción (cuartos por acre)	% de solución de mano de rociado para mojar
Alder	2.3 - 3.0	0.75 - 1.2
Ash*	1.5 - 3.75	0.75 - 1.5
Aspen, quaking	1.5 - 2.3	0.75 - 1.2
Bearclover (Bearmat)*	1.5 - 3.75	0.75 - 1.5
Beech*	1.5 - 3.75	0.75 - 1.5
Birch	1.5	0.75
Blackberry	2.3 - 3.0	0.75 - 1.2
Blackgum	1.5 - 3.75	0.75 - 1.5
Bracken	1.5 - 3.75	0.75 - 1.5
Broom; French, Scotch	1.5 - 3.75	1.2 - 1.5
Buckwheat, California*	1.5 - 3.0	0.75 - 1.5
Cascara*	1.5 - 3.75	0.75 - 1.5
Castor bean	—	1.5
Catsclaw*	—	1.2 - 1.5
Ceanothus*	1.5 - 3.75	0.75 - 1.5
Chamise*	1.5 - 3.75	0.75
Cherry; bitter, black, pin	1.5 - 3.75	1.0 - 1.5
Cottonwood, eastern	1.5 - 3.75	0.75 - 1.5
Coyote brush	2.3 - 3.0	1.2 - 1.5
Cypress, swamp, bald	1.5 - 3.75	0.75 - 1.5
Deerweed	1.5 - 3.75	0.75 - 1.5
Dewberry	2.3 - 3.0	0.75 - 1.2
Dogwood*	3.0 - 3.75	1.0 - 2.0
Elderberry	1.5	0.75
Elm*	1.5 - 3.75	0.75 - 1.5
Eucalyptus	—	1.5
Gallberry	1.5 - 3.75	0.75 - 1.5
Gorse*	1.5 - 3.75	0.75 - 1.5
Hackberry, western	1.5 - 3.75	0.75 - 1.5
Hasardia*	1.5 - 3.0	0.75 - 1.5
Hawthorn	1.5 - 2.3	0.75 - 1.2
Hazel	1.5	0.75
Hickory*	3.0 - 3.75	1.0 - 2.0
Honeysuckle	2.3 - 3.0	0.75 - 1.2
Hornbeam, American*	1.5 - 3.75	0.75 - 1.5
Huckleberry	1.5 - 3.75	0.75 - 1.5
Knotweed, Japanese and Giant**	—	—
Kudzu	3.0	1.5
Locust, black*	1.5 - 3.0	0.75 - 1.5
Madrone resprouts*	—	1.5
Magnolia, sweetbay	1.5 - 3.75	0.75 - 1.5
Manzanita*	1.5 - 3.75	0.75 - 1.5
Maple, red	1.0 - 3.75	0.75 - 1.2
Maple, sugar	—	0.75 - 1.2
Maple, vine*	1.5 - 3.75	0.75 - 1.5
Monkey flower*	1.5 - 3.0	0.75 - 1.5
Oak; black, white*	1.5 - 3.0	0.75 - 1.5
Oak, northern pin	1.5 - 3.0	0.75 - 1.2
Oak, post	2.3 - 3.0	0.75 - 1.2
Oak, red	—	0.75 - 1.2
Oak, Scrub*	1.5 - 3.0	0.75 - 1.5
Oak, southern red	1.5 - 3.75	1.0 - 1.5
Orange, Osage	1.5 - 3.75	0.75 - 1.5
Peppertree, Brazilian (Florida holly)*	1.5 - 3.75	1.5
Persimmon*	1.5 - 3.75	0.75 - 1.5
Pine	1.5 - 3.75	0.75 - 1.5
Poison ivy	3.0 - 3.75	1.5
Poison oak	3.0 - 3.75	1.5
Poplar, yellow*	1.5 - 3.75	0.75 - 1.5
Prunus	1.5 - 3.75	1.0 - 1.5
Raspberry	2.3 - 3.0	0.75 - 1.2
Redbud, eastern	1.5 - 3.75	0.75 - 1.5
Redcedar, eastern	1.5 - 3.75	0.75 - 1.5
Rose, multiflora	1.5	0.75
Russian olive*	1.5 - 3.75	0.75 - 1.5
Sage, black	1.5 - 3.0	0.75
Sage, white*	1.5 - 3.0	0.75 - 1.5
Sage brush, California	1.5 - 3.0	0.75
Salmonberry	1.5	0.75
Saltbush	—	1.0
Saltcedar**	1.5 - 3.75	0.75 - 1.5
Sassafras*	1.5 - 3.75	0.75 - 1.5
Sea Myrtle	—	1.0
Sourwood*	1.5 - 3.75	0.75 - 1.5
Sumac; laurel, poison, smooth, sugarbush, winged*	1.5 - 3.0	0.75 - 1.5
Sweetgum	1.5 - 2.3	0.75 - 1.5
Swordfern*	1.5 - 3.75	0.75 - 1.5
Tallowtree, Chinese	—	0.75
Tan oak resprouts*	—	1.5
Thimbleberry	1.5	0.75
Tobacco, tree*	1.5 - 3.0	0.75 - 1.5
Toyon*	—	1.5
Trumpetcreeper	1.5 - 2.3	0.75 - 1.2
Vine maple*	1.5 - 3.75	0.75 - 1.5
Virginia creeper	1.5 - 3.75	0.75 - 1.5
Waxmyrtle, southern*	1.5 -3.75	1.5
Willow	2.3	0.75
Yerba Santa*	—	1.5

*Control parcial

**Consulte las instrucciones específicas más adelante

Alder (Aliso) / Blackberry (Zarza) / Dewberry (Zarza) / Honeysuckle (Madreselva) / Oak, post / Raspberry (Frambuesa)—Para control, aplique 4.5 a 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75-1.2% con equipo de mano.

Aspen, quaking (Álamo) / Hawthorn (Espino) / Trumpetcreeper (Trompeta)—Para control, aplique 3 a 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75-1.2% con equipo de mano.

Birch (Abedul) / Elderberry (Saúco) / Hazel (Avellano) / Salmonberry / Thimbleberry—Para control, aplique 3 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano.

Broom (Retama): French, Scotch—Para control, aplique una solución al 1.25-1.5% con equipo de mano.

Buckwheat, California (Alforfón) / Hasardia / Monkey flower / Tobacco, tree (Tobaco, árbol)—Para control parcial de estas especies, aplique una solución al 0.75-1.5% sobre las hojas mediante equipo de mano. Para lograr los mejores resultados es necesario cubrir completamente el follaje.

Castor bean (Semilla de ricino)—Para control, aplique una solución al 1.5 por ciento de este producto con equipo manual.

Catsclaw (Uña de gato)—Para control parcial, aplique una solución al 1.2-1.5% con equipo de mano, cuando al menos el 50% de las hojas nuevas esté totalmente desarrollado.

Cherry (Cerezo); bitter (Amargo), black (Negro), pin / Oak, southern red (Rojo del Sur) / Sweetgum (Liquidambar) / Prunus—Para control, aplique 3 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.0 -1.5% con equipo de mano.

Coyote brush—Para control, aplique una solución al 1.2-1.5% con equipo de mano, cuando al menos el 50% de las hojas nuevas esté totalmente desarrollado.

Dogwood / Hickory (Nogal)—Para control parcial, aplique herbicida de AquaMaster como una solución al 1-2% con equipo de mano o a razón de 6 a 7.5 pintas por acre por aspersión diseminada.

Eucalyptus, (Eucalipto) bluegum—Para controlar los nuevos brotes de eucaliptos, aplique herbicida de AquaMaster como una solución al 1.5% con equipo de mano cuando los brotes tengan 6 a 12 pies (1.8 a 3.6 m) de altura. Verifique que la cobertura sea completa. Aplique cuando las plantas estén creciendo activamente. Evite aplicar cuando las plantas estén debilitadas por sequía.

Knotweed; Japanese, Giant *(Polygonum cuspidatum and P. sachalinense)*—Polígono japonés o (Polygonum cuspidatum) y centinodia de Sakhaline (Polygonum sachalinense)

Inyección en el tallo. Aplique 0.18 onzas líquidas (5 mililitros) de este producto. Inyectado debajo del segundo nodo, que está encima de la tierra de cada tallo en el grupo. Utilice equipo apropiado que penetre en la región internodal.

Tallo cortado. Corte los tallos limpiamente justo debajo del segundo o tercer nodo sobre la superficie de la tierra. Aplique de inmediato 0.36 onzas líquidas (10 mL) de solución de este producto al 50 por ciento en el "pozo" o espacio internodal que queda. Asegurecé que se colecte y deseche todo el material superior de las plantas, para que no tenga contacto con tierra y se regeneren las plantas a partir de los bulbos germinantes. Se recomienda usar una barrera biológica, como cartón, madera terciada o plástico.

El total de los tratamientos combinados no debe exceder 2 galones por acre (18.7 L por hectárea). Con 5 mililitros por el tallo, 8 cuartos de galón pueden tratar acerca de 1500 tallos.

Kudzu (Kudzú)—Para control, aplique 6 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.5% con equipo de mano. Para mantener el control, las aplicaciones deberán repetirse.

Maple (Arce), red (rojo)—Para control, aplique una solución al 0.75-1.2% con equipo de mano cuando las hojas estén totalmente desarrolladas. Para control parcial, aplique 2 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada.

Maple (Arce), sugar (azúcar) / Oak (Roble), northern pin (pino del norte), red (rojo)—Para control, aplique una solución al 0.75-1.2% con equipo de mano, cuando al menos el 50% de las hojas nuevas esté totalmente desarrollado.

Peppertree, Brazilian (Molle, Brasilero) (holly, Florida) / Waxmyrtle, southern—Para control parcial, aplique una solución de herbicida de AquaMaster al 1.5% con equipo de mano.

Poison ivy (Hiedra venenosa) / Poison oak (Zumaque)—Para control, aplique 6 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 1.5% con equipo de mano. Para mantener el control, tal vez sea necesario repetir las aplicaciones. Los tratamientos en otoño deberán efectuarse antes de que las hojas pierdan su color verde.

Rose, multiflora (Rosa)—Para control, aplique 3 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano. Los tratamientos deberán efectuarse antes de que las hojas se deterioren debido a insectos que se alimenten de ellas.

Sage, black / Sage brush, California / Chamise / Tallowtree, Chinese (Arbol de Melissa)—Para control de estas especies, aplique una solución al 0.75% sobre las hojas mediante equipo de mano. Para lograr los mejores resultados es necesario cubrir completamente el follaje.

Saltbush, Sea Myrtle—Para control, aplique una solución de herbicida de AquaMaster al 1% con equipo de mano.

Saltcedar (Pino salado)—Para lograr un control parcial, aplique una solución de este producto al 1 ó 2 por ciento con equipo manual, ó 6 a 7.5 pintas (6.9 a 8,6 L por hectárea) como rociado difundido. Para el control total, aplique una solución de este producto al 1 ó 2 por ciento mezclada con 0.25 por ciento de Arsenal, utilizando equipo manual. Para el control con aplicación difundida, aplique una mezcla en tanque de 3 pintas (1.5 L) de este producto con 1 pinta (0.5 L) de Arsenal a las planta de menos de 6 pies (180 cm) de altura. Para controlar pinos salados de más de 6 pies (180 cm) de altura mediante aplicaciones difundidas, aplique una mezcla en tanque de 6 pintas (2.8 L) de producto con 2 pintas (0.95 L) de Arsenal.

Willow (Sauce)—Para control, aplique 4.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75% con equipo de mano.

Otros arbustos leñosos y árboles que figuran en esta etiqueta—Para control parcial, aplique 3 a 7.5 pintas de herbicida de AquaMaster por acre por aspersión diseminada o como una solución al 0.75 -1.5% con equipo de mano.

10.0 LIMITES EN LA GARANTIA Y EN LA RESPONSABILIDAD

Monsanto Compañia garantiza que este producto concuerda con la descripción química de la etiqueta y es razonablemente adecuado para los propósitos descritos en el libreto titulado Instrucciones Completas para el Uso ("Instrucciones") cuando se usa de acuerdo con dichas Instrucciones y las condiciones que allí se detallan. NO SE HACE NINGUNA OTRA GARANTIA EXPRESA O IMPLICITA ACERCA DE LA IDONEIDAD PARA UN USO PARTICULAR O COMERCIABILIDAD. Esta garantía está sujeta también a las condiciones y limitaciones que aquí se indican.

El comprador y todos los usuarios deberán reportar con prontitud a esta Compañía acerca de cualquier reclamo que se base en un contrato, negligencia, estricta responsabilidad, y otros actos ilícitos.

En la medida que lo permita la ley, el comprador y todos los usuarios son responsables por todas las pérdidas o daños que resultasen por el uso o manipulación en condiciones que estén más allá del control de esta Compañía, incluyendo pero no limitándose a: incompatibilidad con productos que no sean los señalados en las Instrucciones, aplicación o contacto con vegetación que no se quiera destruir, condiciones climáticas inusuales, condiciones de clima que estén fuera de los límites que se consideran normales en el lugar de la aplicación y para el período de tiempo en el cual se aplica, así como condiciones de clima que estén fuera de los límites indicados en las Instrucciones, aplicaciones que no estén explícitamente aconsejadas en las Instrucciones, condiciones de humedad que estén fuera de los límites establecidos en las Instrucciones, o la presencia de productos en la tierra o sobre ella, en las plantas o en la vegetación que se está tratando, diferentes a los indicados en las Instrucciones.

Monsanto compañía no garantiza ninguno de los productos reformulados o reempacados de este producto, excepto de acuerdo a los requisitos de la administración de esta compañía y con el permiso escrito expreso de esta compañía.

LA UNICA Y EXCLUSIVA COMPENSACION AL USUARIO O COMPRADOR Y EL LIMITE DE RESPONSABILIDAD DE ESTA COMPAÑIA O DE CUALQUIER OTRO VENDEDOR POR CUALQUIER PERDIDA O POR TODAS LAS PERDIDAS, PERJUICIOS O DAÑOS QUE RESULTASEN DEL USO O MANEJO DE ESTE PRODUCTO (INCLUYENDO RECLAMOS QUE SE BASEN EN UN CONTRATO, NEGLIGENCIA, ESTRICTA RESPONSABILIDAD Y OTROS ACTOS ILICITOS) SERA EL PRECIO PAGADO POR EL USUARIO O EL COMPRADOR POR LA CANTIDAD INVOLUCRADA DE ESTE PRODUCTO, O A ELECCION DE ESTA COMPAÑIA O DE OTRO VENDEDOR, EL REEMPLAZO DE DICHA CANTIDAD, O SI NO SE OBTUVO MEDIANTE COMPRA SE REEMPLAZARA DICHA CANTIDAD DEL PRODUCTO. EN NINGUN CASO ESTA COMPAÑIA U OTRO VENDEDOR SERAN RESPONSABLES POR DAÑOS INCIDENTALES, CONSECUENTES O ESPECIALES.

En el momento de abrir y usar el producto, se asume que el comprador y todos los usuarios han aceptado las condiciones de los LIMITES EN LA GARANTIA Y EN LA RESPONSABILIDAD que no pueden variar por medio de ningún acuerdo verbal o escrito. Si las condiciones son inaceptables, devuelva el producto inmediatamente sin abrir el recipiente.

AquaMaster, Certainty, Outrider, Monsanto y el Vine symbol, es una marca comercial de la empresa Monsanto Technology LLC.

Todas las otras marcas registradas son la propiedad de sus dueños respectivos.

Registro en la EPA Nº 524-343

En caso de que se presente una emergencia relacionada con este producto, llame por cobrar a cualquier hora del día o de la noche, al teléfono (314)-694-4000.

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ST. LOUIS, MISSOURI, 63167 U.S.A.

MONSANTO

MONSANTO COMPANY

Material Safety Data Sheet
Commercial Product

1. PRODUCT AND COMPANY IDENTIFICATION

Product name
AquaMaster® Herbicide

EPA Reg. No.
524-343
Product use
Herbicide
Chemical name
Not applicable.
Synonyms
None.
Company
MONSANTO COMPANY, 800 N. Lindbergh Blvd., St. Louis, MO, 63167
Telephone: 800-332-3111, **Fax:** 314-694-5557
Emergency numbers
FOR CHEMICAL EMERGENCY, SPILL LEAK, FIRE, EXPOSURE, OR ACCIDENT Call CHEMTREC - Day or Night: 1-800-424-9300 toll free in the continental U.S., Puerto Rico, Canada, or Virgin Islands. For calls originating elsewhere: 703-527-3887 (collect calls accepted).
FOR MEDICAL EMERGENCY - Day or Night: +1 (314) 694-4000 (collect calls accepted).

2. COMPOSITION/INFORMATION ON INGREDIENTS

Active ingredient
Isopropylamine salt of N-(phosphonomethyl)glycine; {Isopropylamine salt of glyphosate}

Composition

COMPONENT	CAS No.	% by weight (approximate)
Isopropylamine salt of glyphosate	38641-94-0	53.8
Water	7732-18-5	46.2

OSHA Status
This product is not hazardous according to the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

3. HAZARDS IDENTIFICATION

Emergency overview
Appearance and odour (colour/form/odour): Colourless - Amber / Liquid, (viscous) / Odourless

CAUTION!

Potential health effects
Likely routes of exposure
Skin contact, eye contact, inhalation
Eye contact, short term
Not expected to produce significant adverse effects when recommended use instructions are followed.
Skin contact, short term
Not expected to produce significant adverse effects when recommended use instructions are followed.
Inhalation, short term

Not expected to produce significant adverse effects when recommended use instructions are followed.

Refer to section 11 for toxicological and section 12 for environmental information.

4. FIRST AID MEASURES

Eye contact
Immediately flush with plenty of water.
If easy to do, remove contact lenses.

Skin contact
Take off contaminated clothing, wristwatch, jewellery.
Wash affected skin with plenty of water.
Wash clothes and clean shoes before re-use.

Inhalation
Remove to fresh air.

Ingestion
Immediately offer water to drink.
Do NOT induce vomiting unless directed by medical personnel.
If symptoms occur, get medical attention.

Advice to doctors
This product is not an inhibitor of cholinesterase.

Antidote
Treatment with atropine and oximes is not indicated.

5. FIRE-FIGHTING MEASURES

Flash point
none

Extinguishing media
Recommended: Water, foam, dry chemical, carbon dioxide (CO2)

Unusual fire and explosion hazards
None.
Environmental precautions: see section 6.

Hazardous products of combustion
Carbon monoxide (CO), phosphorus oxides (PxOy), nitrogen oxides (NOx)

Fire fighting equipment
Self-contained breathing apparatus.
Equipment should be thoroughly decontaminated after use.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protection recommended in section 8.

Environmental precautions
SMALL QUANTITIES:
Low environmental hazard.

LARGE QUANTITIES:
Minimise spread.
Keep out of drains, sewers, ditches and water ways.
Notify authorities.

Methods for cleaning up
SMALL QUANTITIES:
Flush spill area with water.
LARGE QUANTITIES:
Absorb in earth, sand or absorbent material.
Dig up heavily contaminated soil.
Collect in containers for disposal.
Refer to section 7 for types of containers.
Flush residues with small quantities of water.
Minimise use of water to prevent environmental contamination.

Refer to section 13 for disposal of spilled material.

7. HANDLING AND STORAGE

Good industrial practice in housekeeping and personal hygiene should be followed.

Handling
Avoid contact with skin and eyes.
When using do not eat, drink or smoke.
Wash hands thoroughly after handling or contact.
Thoroughly clean equipment after use.
Do not contaminate drains, sewers and water ways when disposing of equipment rinse water.
Refer to section 13 for disposal of rinse water.
Emptied containers retain vapour and product residue.

Storage
Minimum storage temperature: -15 °C
Maximum storage temperature: 50 °C
Compatible materials for storage: stainless steel, aluminium, fibreglass, plastic, glass lining
Incompatible materials for storage: galvanised steel, unlined mild steel, see section 10.
Keep out of reach of children.
Keep away from food, drink and animal feed.
Keep only in the original container.
Partial crystallization may occur on prolonged storage below the minimum storage temperature.
If frozen, place in warm room and shake frequently to put back into solution.
Minimum shelf life: 5 years.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Airborne exposure limits

Components	Exposure Guidelines
Isopropylamine salt of glyphosate	No specific occupational exposure limit has been established.
Water	No specific occupational exposure limit has been established.

Engineering controls
No special requirement when used as recommended.

Eye protection

No special requirement when used as recommended.

Skin protection
No special requirement when used as recommended.

Respiratory protection
No special requirement when used as recommended.

When recommended, consult manufacturer of personal protective equipment for the appropriate type of equipment for a given application.

9. PHYSICAL AND CHEMICAL PROPERTIES

These physical data are typical values based on material tested but may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specifications for the product.

Colour/colour range:	Colourless - Amber
Form:	Liquid, (viscous)
Odour:	Odourless
Flash point:	none
Specific gravity:	1.206 @ 20 °C / 15.6 °C
Solubility:	Water: Completely miscible.
pH:	4.6 - 4.8 @ 63 g/l
Partition coefficient (log Pow):	< 0.000 (active ingredient)

10. STABILITY AND REACTIVITY

Stability
Stable under normal conditions of handling and storage.

Hazardous decomposition
Thermal decomposition: Hazardous products of combustion: see section 5.

Materials to avoid/Reactivity
Reacts with galvanised steel or unlined mild steel to produce hydrogen, a highly flammable gas that could explode.

11. TOXICOLOGICAL INFORMATION

This section is intended for use by toxicologists and other health professionals.

Data obtained on product, similar products and on components are summarized below.

Mutagenicity
Micronucleus test(s):
Not mutagenic.
Ames test(s):
Not mutagenic with and without metabolic activation.

Isopropylamine salt of glyphosate (62%)

Acute oral toxicity
Rat, LD50 (limit test): > 5,000 mg/kg body weight
Practically non-toxic.
FIFRA category IV.
No mortality.

Mouse, LD50 (limit test): > 5,000 mg/kg body weight
Practically non-toxic.
FIFRA category IV.
No mortality.

Acute dermal toxicity
Rabbit, LD50 (limit test): > 5,000 mg/kg body weight
Practically non-toxic.
FIFRA category IV.
No mortality.

Skin irritation
Rabbit, 6 animals, Draize test:
Days to heal: 3
Primary Irritation Index (PII): 0.0/8.0
Essentially non irritating.
FIFRA category IV.

Acute inhalation toxicity
Rat, LC50, 4 hours, aerosol: > 4.24 mg/L
Practically non-toxic.
FIFRA category IV.
No mortality. Maximum attainable concentration.

Skin sensitization
Guinea pig, Buehler test:
Positive incidence: 0 %

N-(phosphonomethyl)glycine; {glyphosate}

Mutagenicity
In vitro and in vivo mutagenicity test(s):
Not mutagenic.

Repeated dose toxicity
Rabbit, dermal, 21 days:
NOAEL toxicity: > 5,000 mg/kg body weight/day
Target organs/systems: none
Other effects: none
Rat, oral, 3 months:
NOAEL toxicity: > 20,000 mg/kg diet
Target organs/systems: none
Other effects: none

Chronic effects/carcinogenicity
Mouse, oral, 24 months:
NOEL tumour: > 30,000 mg/kg diet
NOAEL toxicity: ~ 5,000 mg/kg diet
Tumours: none
Target organs/systems: liver
Other effects: decrease of body weight gain, histopathologic effects
Rat, oral, 24 months:
NOEL tumour: > 20,000 mg/kg diet
NOAEL toxicity: ~ 8,000 mg/kg diet
Tumours: none
Target organs/systems: eyes
Other effects: decrease of body weight gain, histopathologic effects

Toxicity to reproduction/fertility
Rat, oral, 3 generations:
NOAEL toxicity: > 30 mg/kg body weight
NOAEL reproduction: > 30 mg/kg body weight
Target organs/systems in parents: none
Other effects in parents: none

Target organs/systems in pups: none
Other effects in pups: none

Developmental toxicity/teratogenicity

Rat, oral, 6 - 19 days of gestation:
NOAEL toxicity: 1,000 mg/kg body weight
NOAEL development: 1,000 mg/kg body weight
Other effects in mother animal: decrease of body weight gain, decrease of survival
Developmental effects: weight loss, post-implantation loss, delayed ossification
Effects on offspring only observed with maternal toxicity.

Rabbit, oral, 6 - 27 days of gestation:
NOAEL toxicity: 175 mg/kg body weight
NOAEL development: 175 mg/kg body weight
Target organs/systems in mother animal: none
Other effects in mother animal: decrease of survival
Developmental effects: none

12. ECOLOGICAL INFORMATION

This section is intended for use by ecotoxicologists and other environmental specialists.

Data obtained on components are summarized below.

Isopropylamine salt of glyphosate (62%)

Aquatic toxicity, fish

Bluegill sunfish (Lepomis macrochirus):
Acute toxicity, 96 hours, static, LC50: > 1,000 mg/L
Practically non-toxic.

Rainbow trout (Oncorhynchus mykiss):
Acute toxicity, 96 hours, static, LC50: > 1,000 mg/L
Practically non-toxic.

Aquatic toxicity, invertebrates

Water flea (Daphnia magna):
Acute toxicity, 48 hours, static, EC50: 930 mg/L
Practically non-toxic.

Aquatic toxicity, algae/aquatic plants

Green algae (Scenedesmus subspicatus):
Acute toxicity, 72 hours, static, ErC50 (growth rate): 166 mg/L
Practically non-toxic.

Soil organism toxicity, invertebrates

Earthworm (Eisenia foetida):
Acute toxicity, 14 days, LC50: > 5,000 mg/kg dry soil
Practically non-toxic.

N-(phosphonomethyl)glycine; {glyphosate}

Avian toxicity

Bobwhite quail (Colinus virginianus):
Dietary toxicity, 5 days, LC50: > 4,640 mg/kg diet
No more than slightly toxic.

Mallard duck (Anas platyrhynchos):
Dietary toxicity, 5 days, LC50: > 4,640 mg/kg diet
No more than slightly toxic.

Bobwhite quail (Colinus virginianus):
Acute oral toxicity, single dose, LD50: > 3,851 mg/kg body weight
Practically non-toxic.

Arthropod toxicity

Honey bee (Apis mellifera):
Oral, 48 hours, LD50: 100 µg/bee

Honey bee (Apis mellifera):
Contact, 48 hours, LD50: > 100 µg/bee
Practically non-toxic.

Bioaccumulation

Bluegill sunfish (Lepomis macrochirus):
Whole fish: BCF: < 1
No significant bioaccumulation is expected.

Dissipation

Soil, field:
Half life: 2 - 174 days
Koc: 884 - 60,000 L/kg
Adsorbs strongly to soil.

Water, aerobic:
Half life: < 7 days

13. DISPOSAL CONSIDERATIONS

Product

Not classified as hazardous waste by the Resource, Conservation and Recovery Act (RCRA), 40 CFR 261.
Recycle if appropriate facilities/equipment available.
Burn in special, controlled high temperature incinerator.
Keep out of drains, sewers, ditches and water ways.
Follow all local/regional/national/international regulations.
Consult your attorney or appropriate regulatory officials for information on disposal.

Container

Triple or pressure rinse empty containers.
Pour rinse water into spray tank.
Store for collection by approved waste disposal service.
Dispose of as non hazardous industrial waste.
Do NOT re-use containers.
Follow all local/regional/national/international regulations.

14. TRANSPORT INFORMATION

The data provided in this section is for information only. Please apply the appropriate regulations to properly classify your shipment for transportation.

Not hazardous under the applicable DOT, ICAO/IATA, IMO, TDG and Mexican regulations.

15. REGULATORY INFORMATION

TSCA Inventory

All components are on the US EPA's TSCA Inventory

SARA Title III Rules

Section 311/312 Hazard Categories
Not applicable.
Section 302 Extremely Hazardous Substances
Not applicable.
Section 313 Toxic Chemical(s)
Not applicable.

CERCLA Reportable quantity
Not applicable.

16. OTHER INFORMATION

The information given here is not necessarily exhaustive but is representative of relevant, reliable data.
Follow all local/regional/national/international regulations.
Please consult supplier if further information is needed.
For more information refer to product label.
Please consult Monsanto if further information is needed.
In this document the British spelling was applied.
® Registered trademark of Monsanto Company or its subsidiaries.

	Health	Flammability	Instability	Additional Markings
NFPA	0	1	1	

0 = Minimal hazard, 1 = Slight hazard, 2 = Moderate hazard, 3 = Severe hazard, 4 = Extreme hazard

Full denomination of most frequently used acronyms. BCF (Bioconcentration Factor), BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), EC50 (50% effect concentration), ED50 (50% effect dose), I.M. (intramuscular), I.P. (intraperitoneal), I.V. (intravenous), Koc (Soil adsorption coefficient), LC50 (50% lethality concentration), LD50 (50% lethality dose), LDLo (Lower limit of lethal dosage), LEL (Lower Explosion Limit), LOAEC (Lowest Observed Adverse Effect Concentration), LOAEL (Lowest Observed Adverse Effect Level), LOEC (Lowest Observed Effect Concentration), LOEL (Lowest Observed Effect Level), MEL (Maximum Exposure limit), MTD (Maximum Tolerated Dose), NOAEC (No Observed Adverse Effect Concentration), NOAEL (No Observed Adverse Effect Level), NOEC (No Observed Effect Concentration), NOEL (No Observed Effect Level), OEL (Occupational Exposure Limit), PEL (Permissible Exposure Limit), PII (Primary Irritation Index), Pow (Partition coefficient n-octanol/water), S.C. (subcutaneous), STEL (Short-Term Exposure Limit), TLV-C (Threshold Limit Value-Ceiling), TLV-TWA (Threshold Limit Value - Time Weighted Average), UEL (Upper Explosion Limit)

This Material Safety Data Sheet (MSDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-APPROVED PRODUCT LABELING (attached to and accompanying the product container). This MSDS provides important health, safety, and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course. Use, storage and disposal of pesticide products are regulated by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) through the product labeling, and all necessary and appropriate precautionary, use, storage, and disposal information is set forth on that labeling. It is a violation of federal law to use a pesticide product in any manner not prescribed on the EPA-approved label.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, MONSANTO Company makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for the purposes prior to use. In no event will MONSANTO Company be responsible for damages of any nature whatsoever resulting from the use of or reliance upon information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR TO THE PRODUCT TO WHICH INFORMATION REFERS.

000000006108

Agridex®

NON-IONIC SURFACTANT

Active Constituents: **730 g/L PARAFFIN BASE PETROLEUM OIL**
149 g/L POLYOL FATTY ACID ESTERS AND POLYETHOXYLATED POLYOL FATTY ACID ESTER EMULSIFIER

For addition to various pesticides as recommended on their labels

GENERAL INSTRUCTIONS

Mixing
Mix the required quantity of Folicur, Bayfidan or other pesticide with water in the spray tank, then add the required amount of Agridex and stir or agitate thoroughly.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT
DO NOT contaminate streams, rivers or waterways with the chemical or used containers.

STORAGE AND DISPOSAL
Keep out of reach of children. Store in the closed, original container in a cool, well ventilated area. Do not store for prolonged periods in direct sunlight. Triple or preferably pressure rinse container before disposal. Add rinsings to spray tank. Do not dispose of undiluted chemicals on site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush or puncture and bury empty containers in a local authority landfill. If no landfill is available, bury the containers below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots. Empty containers and product should not be burnt.

MATERIAL SAFETY DATA SHEET
Additional information is listed in the Material Safety Data Sheet, which can be obtained from www.bayercropscience.com.au.

EXCLUSION OF LIABILITY
This product must be used strictly as directed, and in accordance with all instructions appearing on the label and in other reference material. So far as it is lawfully able to do so, Bayer CropScience Pty Ltd accepts no liability or responsibility for loss or damage arising from failure to follow such directions and instructions.

Agridex®, Bayfidan® and Folicur® are Trademarks of Bayer

NRA Approval Number 41165/0103

FOR 24 HOUR SPECIALIST ADVICE
IN EMERGENCY ONLY
PHONE 1800 033 111

DIRECTIONS FOR USE

Agridex is a blend of a surfactant and a superior type of agricultural spray oil which enhances the activity of Folicur® 430 SC Fungicide, Bayfidan® 250 EC Fungicide and some other pesticides.
Before using Agridex, read the other pesticide label.

For use with	Crop	Rate of Agridex
Folicur 430 Bayfidan 250	Peanuts Brassica vegetables	1 L/ha 200 mL/ha
Other pesticides - see manufacturer's label		

NOT TO BE USED FOR ANY PURPOSE, OR IN ANY MANNER, CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION

Bayer CropScience

MATERIAL SAFETY DATA SHEET

Date of Issue: December 14, 2004

Bayer CropScience

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product name	**Agridex® Non-Ionic Surfactant**
Other names	None
Product codes and pack sizes	4950223 (20 L)
Chemical group	Paraffins, esters
Recommended use	Surfactant / adjuvant for use with various pesticides
Formulation	Emulsifiable concentrate
Supplier	Bayer CropScience Pty Ltd ABN 87 000 226 022
Address	391 - 393 Tooronga Road, East Hawthorn, Victoria 3123, Australia
Telephone	(03) 9248 6888
Facsimile	(03) 9248 6800
Website	www.bayercropscience.com.au
Contact	Development Manager (03) 9248 6888
Emergency Telephone Number	1800 033 111 – Orica SH&E Shared Services

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
NON-HAZARDOUS SUBSTANCE – NON DANGEROUS GOOD

Hazard classification	Not Hazardous (National Occupational Health and Safety Commission - NOHSC)
Risk phrases	None
Safety phrases	See Sections 4, 5, 6, 7, 8, 10, 12, 13
ADG classification	Not a "Dangerous good" for transport by road or rail according to the Australian Code for the Transport of Dangerous Goods by Road and Rail.
SUSDP classification	Exempt (Standard for the Uniform Scheduling of Drugs and Poisons)

3. COMPOSITION / INFORMATION ON INGREDIENTS

Ingredients	CAS Number	Concentration (g/L)
Paraffin base petroleum oil	[64742-56-9]	730
Polyol fatty acid esters and polyethoxylated polyol fatty acid ester emulsifier	-----	149

4. FIRST AID MEASURES

If poisoning occurs, immediately contact a doctor or Poisons Information Centre (telephone 13 11 26), and follow the advice given. Show this Material Safety Data Sheet to the doctor.

Inhalation If inhaled and symptoms occur, seek immediate medical assistance. If breathing has stopped, start artificial respiration. Call for prompt medical attention.

MATERIAL SAFETY DATA SHEET

Date of Issue: December 14, 2004

Bayer CropScience

4. FIRST AID MEASURES - continued

Skin contact	Carefully remove contaminated clothing. Wash affected areas with soap and water. Seek medical aid if at all worried.
Eye contact	Rinse eyes immediately with clean water for at least 15 minutes. If irritation persists obtain medical aid.
Ingestion	Seek immediate medical attention. Do NOT induce vomiting.
First Aid Facilities	Provide eyewash and safety shower facilities in the workplace.
Medical attention	Low viscosity liquid – if swallowed may enter the lungs and cause lung damage. Excessive exposure may result in eye, skin or respiratory irritation. If this product is aspirated into the lungs it may cause chemical pneumonitis.

5. FIRE FIGHTING MEASURES

Extinguishing media	Carbon dioxide, foam, dry chemical, water fog
Hazards from combustion products	Combustion products may include carbon monoxide, sulphur oxides, aldehydes.
Precautions for fire fighters	Water or foam may cause frothing. Fire fighters should wear full protective gear, including self-contained breathing apparatus (AS/NZS 1715/1716). If possible and without risk, remove intact containers from exposure to fire. Otherwise, spray unopened containers with water to keep cool. Avoid spraying directly into containers. Keep unnecessary people away. Bund area to prevent contamination of water sources. Dispose of fire control water and spillage safely later.
Hazchem code	Not applicable

6. ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled material or contaminated surfaces. The spill may be slippery. Extinguish or remove possible sources of ignition. When dealing with spills do not eat, drink or smoke and wear protective clothing and equipment as described in Section 8 - PERSONAL PROTECTION. Prevent spilled material from entering drains or watercourses. Contain spill and absorb with earth, sand, clay, or other absorbent material. Collect and store in properly labelled, sealed drums for safe disposal. Deal with all spillages immediately. If contamination of drains, streams, watercourses, etc. is unavoidable, warn the local water authority.

7. HANDLING AND STORAGE

Handling	Keep out of reach of children. Avoid contact with eyes and skin. Do not inhale mists.
Storage	Store in the closed, original container in a cool, well ventilated area. Do not store for prolonged periods in direct sunlight. Keep container tightly closed and do not allow water to be introduced to the contents of the container.
Flammability	Class C2 combustible liquid – flashpoint over 150° C

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure standards

NOHSC Occupational Exposure Limits for oil mist: TWA: 5 mg/m³

Definition:
Exposure standard – Time Weighted Average (TWA) means the average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day working week.

Biological limit values

None allocated

Engineering controls

Control process conditions to avoid contact. Use local exhaust ventilation during manufacturing operations. Use in a well-ventilated area only, especially if mists are generated.

Personal Protective Equipment

- Safety goggles if exposure is likely
- Suitable work clothing to prevent skin contact
- Elbow-length PVC gloves
- If inhalation exposure is likely to exceed the exposure level above or ventilation is inadequate, an AS/NZS 1715/1716 approved respirator suitable for organic vapours should be worn.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Light yellow liquid
Odour:	Mild, bland petroleum
pH:	Not available
Vapour pressure:	Low
Vapour density:	> 2.0
Boiling point:	> 316 ° C
Freezing/melting point:	Not available
Solubility:	Emulsifies in water
Density:	Approximately 0.88 g/mL at 20° C
Flash Point:	Approximately 183° C – Cleveland open cup
Flammability (explosive) limits:	Not established
Auto-ignition temperature:	> 260° C
Partition coefficient (octanol/water):	Not available

10. STABILITY AND REACTIVITY

Chemical stability

Stable under normal conditions of use.

Conditions to avoid

Extreme heat and high energy sources of ignition

Incompatible materials

Incompatible with strong acids and oxidising agents.

MATERIAL SAFETY DATA SHEET

Date of Issue: December 14, 2004

Bayer CropScience

10. STABILITY AND REACTIVITY - continued

Hazardous decomposition products	Carbon monoxide, sulphur oxides, aldehydes on combustion.
Hazardous reactions	None known

11. TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

Inhalation	Excessive exposure may result in respiratory irritation.
Skin contact	Prolonged contact may remove natural fats and oils from the skin. Excessive exposure may result in skin irritation.
Eye contact	Excessive exposure may result in eye irritation.
Ingestion	If swallowed, the material may enter the lungs and cause lung damage.

ANIMAL TOXICITY DATA – *SIMILAR PRODUCTS*

Acute:	
Oral toxicity	LD_{50} rat: > 2000 mg/kg
Dermal toxicity	LD_{50} rat: > 2000 mg/kg
Inhalation toxicity	Not available. Similar products showed low inhalation toxicity.
Skin irritation	Practically non-irritating (rabbit)
Eye irritation	Practically non-irritating (rabbit)
Sensitisation	Not expected to be sensitising based on results of tests with similar products.

Chronic:
Repeated or prolonged exposure to this product may cause irritation to the skin, eyes or respiratory tract. Overexposure to oil mist may result in oil droplet deposition and / or granuloma formation. The base oils in this product are not mutagenic or teratogenic. The main ingredient in this product is not listed as a carcinogen in the National Toxicology Program or the International Agency for Research on Cancer databases.

12. ECOLOGICAL INFORMATION

Agridex poses a low a hazard to the environment.
DO NOT contaminate streams, rivers or waterways with Agridex or the used containers.

Ecotoxicity	No data available
Environmental fate, persistence and degradability, mobility	Adsorption to sediment and soil can be expected. This product is expected to be inherently biodegradable. Bioaccumulation is unlikely due to the low water solubility of the product.

13. DISPOSAL CONSIDERATIONS

Triple or preferably pressure rinse containers before disposal. Add rinsings to spray tank. Do not dispose of undiluted chemicals on-site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush or puncture and bury empty containers in a local authority landfill. If no landfill is available, bury the containers below 500 mm in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots. Empty containers or product should not be burnt. Dispose of waste material via a reputable waste disposal contractor.

14. TRANSPORT INFORMATION

UN number	Not applicable
Proper shipping name	Not applicable
Class and Subsidiary Risk	Not applicable
Packing Group	Not applicable
EPG	Not applicable
Hazchem code	Not applicable
Marine Pollutant	No

15. REGULATORY INFORMATION

Registered according to the Agricultural and Veterinary Chemicals Act 1988.
Australian Pesticides and Veterinary Medicines Authority approval number: 41165
See also Section 2.

16. OTHER INFORMATION

Trademark information	Agridex® is a Registered Trademark of Bayer.
Preparation information	Replaces August 1, 2002 MSDS. Reasons for revision: 16 heading format, Ingredients, Physical and Chemical properties, Exposure Standards, Toxicological and Ecological information.

This MSDS summarises our best knowledge of the health and safety hazard information of the product and how to safely handle and use the product in the workplace. Each user should read this MSDS and consider the information in the context of how the product will be handled and used in the workplace including in conjunction with other products.

If clarification or further information is needed to ensure that an appropriate risk assessment can be made, the user should contact this company.

Our responsibility for products sold is subject to our standard terms and conditions, a copy of which is sent to our customers and is also available on request.

END OF MSDS

WILBUR-ELLIS
IDEAS TO GROW WITH®

COMPETITOR®

CPDA Certified

Modified Vegetable Oil

U.S. Patent No. 5,631,205

CA Reg. No. 2935-50173 WA Reg. No. 2935-04001

PRINCIPAL FUNCTIONING AGENTS	% By Wt.
Ethyl Oleate, Sorbitan Alkylpolyethoxylate Ester, Dialkyl Polyoxyethylene Glycol	98%
Constituents Ineffective as spray adjuvant	2%
Total	100%

KEEP OUT REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if swallowed. Avoid breathing vapors or spray mist. Avoid contact with skin, eyes or clothing. Causes eye and skin irritation. Do not get in eyes, on skin or on clothing. Wear proper eye protection to reduce splash exposure. Wear protective gloves and proper personal protective equipment to reduce skin exposure. Wash thoroughly with soap and water after handling. Remove and wash contaminated clothing before reuse. This product may cause an allergic reaction in sensitive individuals.

FIRST AID

IF SWALLOWED, Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person. **IF IN EYES**, Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice. **IF ON SKIN OR CLOTHING**, Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice. **IF INHALED**, Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice.

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH PRECAUTIONARY STATEMENTS AND DIRECTIONS AND WITH APPLICABLE STATE REGULATIONS.

Read label of pesticide carefully. Keep container tightly closed and DO NOT allow water to be introduced to contents of this container.

GENERAL INFORMATION

COMPETITOR is a Modified Vegetable Oil containing a non-ionic emulsifier system. COMPETITOR can be used with products where a modified vegetable oil or crop oil concentrate is recommended.

PREPARATION OF SPRAY MATERIAL

Fill spray tank one-half full of water. Add the required amount of pesticide while agitating. Add remainder of the water. Add the recommended amount of COMPETITOR last and continue agitation until completion of spraying.

DIRECTIONS FOR USE

Aquatics: COMPETITOR may be used as an additive with aquatically labeled pesticides. The use rates for COMPETITOR should follow the recommended adjuvant rate that is specified on the pesticide product label.

If there is no recommended adjuvant rate on the pesticide label, COMPETITOR should be used at the rate of 1 to 2 pints per acre in 5-30 gallons of water. For volumes greater than 30 gallons of water, do not exceed a rate of 1% volume/volume.

For handgun or backpack applications, do not exceed a rate of 5% volume/volume.

Herbicides: Use 1 to 4 pints of COMPETITOR per acre. The addition of a nitrogen fertilizer such as 28%-32% N solution or ammonium sulfate may be required to improve control under extreme environmental conditions or to satisfy certain label requirements. For over-the-Top Application, use caution at the higher application rates when temperatures exceed 85º F on sensitive crops such as seedling alfalfa.

Insecticides: Use 1/2 to 2 pints per 100 gallons of spray mix or use 1/4 to 1 pint per acre in concentrate sprays of 50 gallons or less.

For pesticides/herbicides that permit use of an adjuvant at a higher rate, follow instructions on that pesticide/herbicide label. **HOWEVER, DO NOT ADD THIS PRODUCT AT A RATE WHICH EXCEEDS 5% OF THE FINISHED SPRAY VOLUME, EXCEPT WHEN USED AS A DILUENT IN DORMANT, BASAL, SITE PREPARATION OR OTHER SIMILAR APPLICATIONS, PER LABEL INSTRUCTIONS.**

Use caution at the higher application rates. When applying to a sensitive crop, first treat a small area to determine if there may be adverse effects on the crop.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage, disposal or cleaning of equipment. Open dumping is prohibited.
STORAGE: Keep product in original container. Do not put concentrate or dilute into food or drink containers. For help with any spill, leak, fire or exposure involving this material, call day or night CHEMTREC (800) 424-9300.
PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
CONTAINER DISPOSAL: Triple rinse (or equivalent). Do not reuse container. Offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

NET CONTENTS: _____GALLON(S)

Manufactured by:

WILBUR-ELLIS COMPANY
PO BOX 16458 – FRESNO CA 93755

Continued on page 2 of 2

WARRANTY STATEMENT: WILBUR-ELLIS COMPANY warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of WILBUR-ELLIS COMPANY. In no case shall WILBUR-ELLIS COMPANY be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. The exclusive remedy of any buyer or user of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling or application of this product, whether in contract, warranty, tort, negligence, strict liability or otherwise, shall not exceed the purchase price paid for this product or at WILBUR-ELLIS COMPANY'S election, the replacement of this product. WILBUR-ELLIS COMPANY MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

WILBUR-ELLIS Logo® ,IDEAS TO GROW WITH® and COMPETITOR® are registered trademarks of WILBUR-ELLIS Company.

F-033108

IN CASE OF EMERGENCY,
CALL CHEMTREC: (800) 424-9300

WILBUR-ELLIS
IDEAS TO GROW WITH®

PO BOX 16458 • FRESNO CA 93755

MATERIAL SAFETY DATA SHEET

PRODUCT/TRADE NAME:

COMPETITOR

I. NAME

PRODUCT/TRADE NAME: COMPETITOR
EPA REGISTRATION #: NONE
CHEMICAL NAME/COMMON NAME:
Ethyl Oleate/Ethyloleate

II. HAZARDOUS INGREDIENTS

	CAS#	OSHA PEL	ACGIH TLV
Ethyloleate	111-62-6	NE	NE

III. PHYSICAL DATA

SPECIFIC GRAVITY (H2O = 1): .9
MELTING POINT: NA
VAPOR DENSITY (AIR = 1): NE
% VOLATILES BY VOL.: NE
ODOR: Fatty
APPEARANCE: Amber Liquid
FLASH POINT/METHOD: >150 Deg. C
VAPOR PRESSURE (mmHg): NE
SOLUBILITY IN H2O: Emulsifiable

IV. FIRE & EXPLOSION HAZARD

EXTINGUISHING MEDIA: [ ] Water Fog [X] Foam [ ]Alcohol Foam
[X] CO2 [X] Dry Chemical [ ] Other
FIRE FIGHTING PRECAUTIONS & HAZARDS:
Fight fire upwind. Wear positive pressure self-contained breathing apparatus and full protective clothing. Do not breathe smoke or spray mist. Avoid fallout and runoff. Dike to prevent entering drains, sewers, or water courses. Evacuate people downwind from fire.

V. CARCINOGEN STATUS

[ ] OSHA [ ] NTP [ ] ARC [X] No Listing Type

VI. REACTIVITY

[X] Stable HAZARDOUS POLYMERIZATION
[ ] Unstable [ ] May Occur [X] Will Not Occur
AVOID: Strong oxidizers, organic material
HAZARDOUS DECOMPOSITION PRODUCTS: COx

VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE OF SPILL: Absorb with inert material and sweep or vacuum into disposal container.
DECONTAMINATION: Treat spill area with detergent and water. Absorb with inert material. Place in disposal container and repeat procedure as necessary until area is clean.
ENVIRONMENTAL HAZARDS: Dike to prevent entering drains, sewers or water courses.
DISPOSAL: Dispose of in accordance with Federal, State and local regulations.

VIII. HEALTH PRECAUTION DATA

INGESTION: Do not ingest. Acute Oral LD50 (Rats) >5000 mg/kg (WECO). Wash thoroughly before eating, drinking or smoking.
INHALATION: No PEL/TLV established for this product. Do not inhale mist. Use proper respiratory protective equipment for exposures encountered.
SKIN ABSORPTION: Acute Dermal LD50 (Rabbits) >5000 mg/kg (WECO). May cause moderate skin irritation. Wear proper personal protective equipment to reduce skin exposure.
EYE EXPOSURE: Keep out of eyes. Minimally irriting to eyes. If exposed, flush eyes for a minimum of 15 minutes with water. Wear proper eye protection to reduce splash exposure.
EFFECTS OF OVEREXPOSURE: Material is not toxic or irritating to the skin. No known chronic effects. No known preexisting medical conditions will be aggravated by exposure.
FIRST AID: In all cases, get prompt medical attention. If ingested, give several glasses of water and induce vomiting. Do not induce vomiting if person is unconscious. For skin exposure, remove contaminated clothing and wash with soap and water. For eye contact, irrigate for a minimum of 15 minutes with water. If inhaled, remove victim to fresh air, and administer CPR if necessary.

IX. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Use NIOSH/MSHA - approved respirator for organic vapors for the exposures encountered. Positive pressure self-contained breathing apparatus should be used for confined space entry and excessive exposures.
PERSONAL PROTECTIVE EQUIPMENT: Neoprene or rubber gloves and safety goggles.
VENTILATION: General ventilation.

X. SPECIAL PRECAUTIONS

Keep out of the reach of children. Read and follow all label instructions.

XI. REGULATORY DATA

SARA HAZARD CLASS: [X] Acute [ ] Chronic [ ] Flammable
[ ] Pressure [ ] Reactive [ ] None
SARA 313: [ ] Yes [X] No Chemical:
SARA 302: [ ] Yes [X] No Chemical:
TPQ:
CERCLA: [ ] Yes [X] No Chemical:
RQ:
RCRA: [ ] Yes [X] No

NFPA HAZARD RATING:
Health: [1]
Fire: [1]
Reactivity: [0]
Special: [ ]

NFPA HAZARD RATING SCALE:
0 = Minimal 3 = Serious
1 = Slight 4 = Severe
2 = Moderate

HMIS CODES:
Health: [1]
Fire: [1]
Reactivity: [0]

HMIS HAZARD RATING SCALE:
0 = Minimal 3 = Serious
1 = Slight 4 = Severe
2 = Moderate

DATE PREPARED: October 8, 2003
REVISED DATE: July 22, 2005

Notice: This information was developed from information on the constituent materials. No warranty is expressed or implied regarding the completeness or continuing accuracy of the information contained herein, and Wilbur-Ellis disclaims all liability for reliance thereon. The user should satisfy himself that he has all current data relevant to his particular use.

*Technical Material NE - Not Established NA - Not Applicable

24 Hour Emergency Phone Number
CHEMTREC: (800) 424-9300

WECO MSDS\Competitor.p65

Appendix C

WHCP Operations Management Plan

CALIFORNIA DEPARTMENT OF BOATING AND WATERWAYS

WHCP Operations Management Plan

June 2009

2009 Updated Manual
Dan Darling

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A. INTRODUCTION

Senate Bill 1344 [1982] amended the California Harbors and Navigation Code to designate the Department of Boating and Waterways (DBW) as the lead agency to control water hyacinth (*Eichhornia crassipes*) in the Sacramento-San Joaquin Delta (Delta), and its tributaries. The DBW subsequently initiated the Water Hyacinth Control Program (WHCP), a chemical herbicide treatment program, in 1983.

DBW's Aquatic Weed Unit manages the WHCP. DBW staff assigned to the WHCP include the:

Aquatic Weed Unit Manager and office support staff

Field Supervisor

Assistant Field Supervisor (designee)

Environmental Scientists (ES)

Monitoring Crew

Aquatic Pest Control Specialist (certified)

Aquatic Pest Control Technicians (do not have to be certified).

An application crew is usually made up of a minimum of one Aquatic Pest Control Specialist and one Aquatic Pest Control Technician.

The primary goal of the WHCP is to control the growth and spread of water hyacinth in the Delta while minimizing impacts to non-target species and preventing environmental degradation. For the WHCP, the DBW currently uses the following three herbicides to control water hyacinth:

Herbicides

- 2,4-D, or Weedar® 64 [2,4-Dichlorophenoxyacetic acid, dimethylamine salt], EPA Registration Number 71368-1
- Glyphosate Herbicide: AquaMaster ® [Glyphosate: N-(phosphonmethyl) glycine in the form of isopropylamine salt], EPA Registration Number 524-343

Adjuvants

- Agridex® [active ingredients: paraffin base petroleum oil, polyol fatty acid esters, and polyethoxylated polyol fatty acid ester emulsifier], California State Registration 5905-50094-AA.

This WHCP Protocol and Procedures Manual is generally written for new WHCP staff, but also should be used as a reference for more experienced WHCP staff. The manual explains general program requirements, application protocols, and best management practices. As part of its adaptive management

approach[1], the DBW will revise this manual over time to reflect improvements in WHCP management approach and new permit requirements.

Best management practices (BMPs) are referenced throughout this manual and are included within the body of the text (shown italicized) as well as in appendices. A total of three (3) BMPs are included, numbered sequentially beginning with BMP # WH1. BMPs are separate modules intended to provide the reader with standard, effective, practices related to a particular WHCP operations topic.

Additionally there are a total of 16 appendices to this manual.

B. GENERAL REQUIREMENTS

1. Herbicide Applicator Responsibilities

a. Certification

All DBW application and contracted crews, who apply aquatic herbicides for the WHCP and EDCP, must have at least one person who has obtained a Qualified Applicators Certificate (QAC). The California Department of Pesticide Regulation (DPR) is responsible for examining and licensing QACs. All Aquatic Pest Control specialists must have a QAC. Aquatic Pest Control technicians also are encouraged to work toward obtaining a QAC.

The QAC signifies proficiency in:

- ❑ Reading and understanding pesticide labels
- ❑ Proper methods of mixing and applying pesticides
- ❑ Handling and disposing of pesticides and pesticide containers
- ❑ Recognizing pesticide poisoning symptoms
- ❑ Proper use of protective equipment

To obtain a QAC, an individual must pass the Qualified Applicator Certificate examination, category “F” (Aquatic), administered by the DPR. To assist an applicant with the examination, the DPR website provides suggested study materials and applicable laws and regulations. Information on QAC testing and requirements, see the DPR website at www.cdpr.ca.gov/docs/license/qacinfo.htm.

[1] Adaptive management refers to improving the program over time as new and better information is available about the program.

To pass the Qualified Applicator Certificate examination, category "F" (Aquatic), applicators must demonstrate proficiency in:

Principals of limited area application

Water use situations and potential for downstream effects

Secondary effects caused by incorrect formulations and faulty applications

Competency, practical knowledge, and understanding of pesticide impacts to:

- Plants
- Fish
- Birds
- Beneficial insects
- Other organisms present in aquatic environments.

To retain possession of a QAC, the certificate holder must complete at least 20 hours of continuing education every two years (four hours covering the topic of pesticide laws and regulations). Information on continuing education is provided on the web at http://www.cdpr.ca.gov/docs/license/conted.htm. The DPR accredits, and posts the schedule for, continuing education classes.

The DBW will retain copies of each QAC's card, and continuing education records, on file at the DBW Headquarters' office in Sacramento. These records will be updated yearly prior to the beginning of each spray season.

b. Understanding Herbicide Labels

Application crews are responsible for reading, understanding, and following herbicide label requirements. Management is responsible for providing the training to ensure employees have the tools necessary to achieve these goals. Current copies of herbicide labels and Material Safety Data Sheets (MSDS) are included for the two herbicides and adjuvant currently used: 2,4-D (**Appendix A**), Glyphosate (**Appendix B**), and Agridex (**Appendix C**).

Application crews should use the following guidelines related to understanding herbicide labels:

- ❑ **Consult the Field Supervisor, or Assistant Field Supervisor (designee),** for clarification on herbicide label requirements, use and storage, and safety procedures. Please also feel free to call Department of Pesticide Regulation (DPR) or the local Agricultural Commissioner if further clarification is needed.
- ❑ **Ask questions and obtain clarification on application protocols well before a planned application.**
- ❑ **Ask questions before an application starts** if any part of the application protocol or the Pest Control Recommendation is not completely understood.

- Do not use herbicides of any kind other than those currently authorized for the WHCP by DBW (i.e., 2,4-D, Glyphosate, and Agridex). Especially in situations where use is deemed impractical. i.e. where certain crops occur.

Labels and MSDSs may be revised over time. The DBW Aquatic Weed Unit Manager and Field supervisor shall ensure that this manual is updated to reflect the most current labels and MSDS prior to use by DBW application crews.

c. Proper Herbicide Application Methods

Applications shall be made according to registered herbicide label specifications and California Code of Regulations requirements. Together, these requirements are detailed in the following documents:

- 2,4-D label and MSDS (Appendix A)
- Glyphosate label and MSDS (Appendix B)
- Agridex label and MSDS (Appendix C)
- Pest Control Recommendations (see sample in **Appendix D**).

d. Contracted Applicators

If the DBW uses other agencies or private companies to perform herbicide applications for the WHCP, explicit and formal agreements (i.e., contracts) outlining roles and responsibilities will be made between DBW and the other agency or private company. These agreements will specify, for example, that personnel from contracted agencies or private companies must be QACs or have an advisor's license for recommendations.

e. Environmental Mitigation

Each application crew will be responsible for following environmental protocols required by applicable permits from the following agencies:

- U.S. Fish and Wildlife Service (USFWS), Biological Opinion, including Incidental Fish Take Provision **(Appendix E)**
- National Marine Fisheries Service (NOAA Fisheries), Biological Opinion, including Incidental Fish Take Provision **(Appendix F)**
- Central Valley Regional Water Quality Control Board (CVRWQCB), National Pollutant Discharge Elimination System (NPDES) Permit **(Appendix G)**.

All personnel involved in the WHCP will receive required annual worker environmental awareness training provided by an ES. This training will be provided prior to the start of the treatment season. This training is designed to identify special status species. Each trainee will receive *Species of Concern* identification pages in the OMP. The *Species of Concern* manual includes:

- Detailed color photographs of special status species (**see Appendix R**)

The training also will include a review of avoidance, minimization, and mitigation measures for Federal and State listed threatened and endangered species and the procedures for handling "take" (i.e., a species killed during an application). Trainees also will be provided a "take" kit which includes a:

Whirlpac (to hold species taken)

Blank chain-of-custody form (to record possession of take)

Protocol for collection and notification of take

Telephone list for whom to contact following a take.

Field crew members (i.e., Field Supervisor, Assistant Field Supervisor, ES, Aquatic Pest Control Specialists, and Aquatic Pest Control Technicians) also will receive maps of giant garter snake habitat within the WHCP treatment area.

2. Herbicide Handling Requirements

All field staff (including Field Supervisors, Assistant Field Supervisor, Aquatic Pest Control Specialists, and Aquatic Pest Control Technicians) shall follow requirements for storage, transport, mixing, loading applications, and container disposal. These requirements are described below in **BMP # WH1**.

BMP# WH1 – Herbicide Handling Requirements

All personnel involved with the application of WHCP herbicides will be trained in herbicide handling in accordance with Food and Agriculture Code and Title 3 Code of Regulations pertaining to Pesticides and Pest Control Operations.

Storage

All WHCP herbicides will be stored in a secured warehouse in accordance with the California Food and Agriculture Code and Title 3 Code of Regulations. All herbicides obtained from the storage area will be recorded in the storage area logbook as well as in the individual treatment crew's daily log.

Transport

Herbicides will be delivered by truck or boat to specific treatment sites on the day of treatment. They will be transported in their original containers, securely fastened to the truck or boat, in a manner that will prevent spillage onto or off of the vehicle or vessel.

Mixing, Loading and Applications

DBW staff shall use undiluted herbicides from containers of 5 gallons or less; only the herbicide containers being used will be opened at the application site. All mixing, loading, and application operations will be conducted in

accordance with all label requirements and will be performed by licensed pesticide applicators.

Disposal of Herbicide Containers

Herbicide containers will be triple rinsed and disposed of according to the Food and Agriculture Code.

The Field Supervisor, or an entity designated by the Field Supervisor as qualified will provide herbicide handling training to all field staff in accordance with Title 3, Food and Agriculture, Division 6, of the California Code of Regulations, titled, "Pesticides and Pest Control Operations." Copies of these regulations are included in **Appendix H**. Specifically, the following regulations should be understood and followed by the field staff:

- ❑ Storage, Transportation and Disposal (Chapter 3, Subchapter 2, Article 4)
  - Container control
  - Delivery of pesticide containers
  - Container requirements
  - Transportation
  - Rinse and drain procedures.
- ❑ General Safety Requirements (Chapter 3, Subchapter 3, Article 2)
  - Handler training
  - Emergency medical care
  - Medical supervision (not applicable at this time)
  - Working alone
  - Change area
  - Handler decontamination facilities
  - Coveralls
  - Personal protective equipment
  - Adequate light
  - Safe equipment
  - Equipment maintenance
  - Closed systems.

Each application crew will have a two-way radio and / or a cellular telephone to use to communicate with the Aquatic Weed Unit Manager, Field Supervisors, ES, and to use in case of emergencies. A list of medical emergency telephone numbers, including local hospital contacts, is provided in **Appendix I**. In case of injury, the field crew should immediately contact the hospital within the County that the injury

occurred. Field crew members should assure that these contact telephone numbers are on their possession.

3. Herbicide Application Equipment Calibration Requirements

All field staff shall follow equipment calibration procedures for each type of herbicide. These procedures are provided in **BMP # WH2** below. Calibration will occur at a minimum of once per week, when a pump is changed, or each time a different herbicide is used.

BMP #WH2 – Spray Equipment Maintenance and Calibration

Spray equipment used for the WHCP shall be calibrated on a weekly basis. The date of the last spray equipment calibration is recorded on the Daily Log under "Last Calibration."

The boats used by the DBW have a 30-gallon holding tank on the boat that is used to store Delta water. The boats use a two-pump system. One pump draws water from the Delta into the 30-gallon holding tank. Another pump draws the aqueous chemical from the herbicide container.

A tube from each pump meets at the sprayer where the Delta water and the herbicide are mixed. An orifice on the Walbro or Shureflow pump can be adjusted to vary the application rate.

Operators should calibrate the spray equipment so that it mixes the water from the Delta with the herbicide at the required concentrations. Based on the Pest Control Recommendations, these concentrations are as follows:

2,4-D: 2 to 4 quarts (64 oz. to 128 oz.) Weedar 64 per 200 gallons of water

AquaMaster: 2 ½ to 3 quarts (80 oz. to 96 oz.) AquaMaster per 100 gallons of water.

The spray equipment is calibrated as follows:

1. *Make sure that each of the pumps is primed. To do this the operator should run water through them for approximately two (2) minutes*
2. *The 30-gallon holding tank should be marked at the 25-gallon level (for ease of conversion)*
3. *Fill the 30-gallon holding tank with 25-gallons of water*
4. *Pour the water into a 32-oz. cup. The amount to pour into the 32-oz. cup will vary depending on the herbicide as follows:*
    a. *For 2,4-D, the operator should pour 8 oz. to 16 oz. of water into the 32-oz. cup. The 8 oz. to 16 oz. range per 25 gallons of water is exactly 1/8th of the 64 oz. to 128 oz. per 200 gallons of water requirement noted above.*

b. *For AquaMaster, the operator should pour 20 oz. to 24 oz of water into the 32-oz. cup. The 20 oz. to 24 oz. per 25 gallons of water is exactly 1/4th of the 80 oz. to 96 oz. per 100 gallons of water requirement noted above.*

5. *The operator should turn both pumps on and begin the spray process*
6. *If the spray equipment is properly calibrated the 25-gallons of water in the holding tank and the herbicide in the 32-oz. cup should be completely gone at the same time. If the spray equipment is not properly calibrated either the 25-gallons of water, or the water in the 32-oz. cup, will be gone before the other is*
7. *The operator may need to adjust the orifice size on the pumps to allow the pumps to draw chemical at a slower or faster rate.*
8. *For the adjuvant Agridex, the operator should make sure that the appropriate amount is added per the Pest Control Recommendation. For Agridex, the amount is 1 quart per 100 gallons. The result is that the 2,4-D or AquaMaster is applied using a smooth coating (not droplets or beading). If the application results in beading the operator should add more adjuvant to the mix*.

4. Hazmat and Spill Contingency Requirements

In the event of an aquatic or terrestrial spill, all application crew members shall follow the Spill Contingency Plan outlined in **BMP # WH3** below. This BMP includes procedures for spill prevention, cleanup, and notification.

BMP# WH3 – Spill Contingency Plan

All herbicide spills will be treated as emergencies. Concentrated herbicide spills are more dangerous than herbicides diluted with water, and will be treated seriously and immediately. While spills can occur during transporting, storing, or while using herbicides, the DBW will apply the following preventive measures to reduce the potential for a serious spill:

- *For boats – herbicides will be securely fastened to floats in their original, watertight containers. Each boat shall carry a marker buoy with an attached anchor line with which to mark any herbicide, and water movement from the spill site, in the event of a spill. In case of a spill, materials and tools used for spill cleanup should be transported with the chemical.*

- *For vehicles – herbicides will be transported in their original, watertight containers, in a manner that will prevent spillage onto the vehicles or off the vehicle. In case of a spill, materials and tools used for spill cleanup should be transported with the chemical.*

Only herbicide containers being used at the time of application will be open.

Reporting Spills

The Aquatic Pest Control Specialist will have a cellular phone in his/her possession and the telephone numbers of the California Department of Fish and Game (Office of Spill Prevention and Response), California Regional Water Quality Control Board, State Office of Emergency Services, County Agricultural Commissioners, County Sheriff's Office, the California Highway Patrol, County Health Departments, and DBW management and staff. **Appendix J**, the *Spill Emergency Contact Telephone Numbers, provides a list of emergency telephone numbers to use in case of a spill.*

Large herbicide spills will immediately be reported to the Office of Emergency Services.

Smaller spills not on public roadways, that do not pose a serious threat to the public or the environment, will be reported by the person in charge, at the earliest convenience, to the appropriate agencies on the "Spill Emergency Contact Telephone Number" list. Reporting for these smaller spills may be limited to the County Agricultural Commissioners of the appropriate County. ***The Aquatic Weed Unit manager and Field Supervisor will make the determination as to whether the spill meets this "smaller" criterion.***

Spills on Land

If a spill occurs on a public roadway, the California Highway Patrol, the California Office of Emergency Services and the County Agricultural Commissioner will immediately be notified.

In the event a spill occurs, it is of paramount importance that the discharge is stopped at its source and that the spilled material be contained. DBW and contracted personnel will have access to supersorb or common cat litter that will be used for immediate containment of the spilled material. The following actions will be taken as necessary to contain a spill on ground:

- *Stopping the spill at its source.*
- *Diking in pools as appropriate.*
- *Using materials such as soil, supersorb, or cat litter to absorb pooled material.*

Contaminated soil or absorbent material will be placed in a sealable disposable container suitable for transporting. The container will be labeled with its contents, including herbicide name and signal word. It will then be disposed of in accordance with the label and all applicable laws and regulations.

When possible the spill and its clean up will be documented with photos and the date/time registered. Copies of these photos will be attached to any spill reports filed.

Spills in Water

In the event of a spill in water the following procedures will be employed:

- *The location of the spill will be marked*
- *The Aquatic Weed Unit Manager will be immediately notified*
- *The amount of herbicide spilled will be assessed*
- *The Office of Emergency Services will be immediately notified. The Office of Emergency Services will take charge of coordinating the cleanup and protecting the public.*
- *The County Agricultural Commissioners Office will be notified*
- *All other appropriate agencies on the "Spill Emergency Contact List" will be notified.*

The spill location will be marked with a marker buoy and an approximate bearing with any permanent land markers. A GPS reading will be taken. Photographs of the spill will be taken. DBW personnel, the Office of Emergency Services, and appropriate state and federal agencies will perform an inspection of the spill location to determine the amount of herbicide spilled and the potential environmental impacts. If deemed necessary the area will be monitored for herbicide residues and environmental impacts.

5. County Agricultural Commissioner Notification

Before an application can occur, the DBW Aquatic Weed Unit shall file Pesticide Use Recommendations (PUR) and a Notice of Intent (NOI) with the appropriate County Agricultural Commissioner (CAC) office. If necessary, the DBW Aquatic Weed Unit also shall obtain a Restricted Use Permit (RUP) from all appropriate CACs.

a. Pesticide Use Recommendations (PUR)

For each season, a licensed Pest Control Advisor (PCA) shall write the PURs for all application areas. DBW may have a pesticide manufacturer representative write a PUR as long as the representative is a PCA and the PUR is reviewed and approved by a licensed PCA DBW staff member.

DBW may write PURs for contract applicators that are hired to apply restricted pesticides. Contract applicators will operate under all WHCP permits and this WHCP Protocol and Procedures Manual. Contract applicators also will be responsible for using all equipment and aquatic herbicides legally, and for filing Daily Logs, weekly NOIs, and monthly Pesticide Use Reports with DBW.

Application crews shall:

- **Have a copy of the appropriate PUR with them at time of application.**
- **Understand the PUR before making an application**. If clarification is necessary, the Field Supervisor or Assistant Field Supervisor (designee) should be contacted.
- Follow PUR application rates, hazard and use restrictions, and application protocols.
- Record the PUR application rate on the Daily Log at the time of application.

Sample Pest Control Recommendations are provided in Appendix E.

b. Notice of Intent (NOI)

The NOI"s for each week will be done and submitted by the Aquatic Pest Control Field Supervisor. All sites will be submitted weekly in a manner designated by the Specialist who is assigned to his/her area. It is the Specialist's responsibility to notify the Field Supervisor if any changes are to be made for a designated week. The Specialists will also be responsible for communication with each other to plan for possible overlap in designated treatment zones .The following information will be submitted in a weekly N.O.I.

Application specialist name and program (i.e., WHCP or EDCP)

Site number

Spray dates

County/counties where spraying will occur

Herbicides and adjuvants used

Before NOI'ing application sites, the application crew should consult with the ES to determine if the presence of Endangered Species will prevent a scheduled application. See Section C.4 "Endangered Species Use Restriction Assessment" below to determine when it is necessary to contact the ES about upcoming applications.

Many factors influence whether a site can be treated. As a result, applications potentially can be cancelled up until, and including, the day of treatment. Where possible, alternative sites should be included on the list submitted to the DBW Central Office.

DBW Headquarters Office staff will prepare NOIs, submit them to the appropriate CACs, and send a copy to the field offices (i.e., Oakley and Stockton). A sample copy of a Notice of Intent to Operate Summary is provided in **Appendix K**.

c. Restricted Use Permit (RUP)

The CAC will review NOIs to determine whether the application is for a restricted use pesticide, and thus requires a restricted use permit (RUP). Currently there are no herbicides used for the WHCP that are restricted use pesticides that require a RUP to be carried on board with the applicator. The RUP is on file with the Sacramento office.

If the DBW begins to use a restricted use herbicide, the CAC may place conditions on a proposed application and notify DBW staff if additional provisions will apply to a particular treatment. In the event that a site borders two counties, and the two counties provide conflicting application requirements, the DBW shall use the more restrictive guideline(s).

Application crews shall be aware of, and implement, all RUP provisions. The Field Supervisor or Assistant Field Supervisor (designee) is responsible for communicating RUP provisions to application crews.

C. TREATMENT PLANNING PROTOCOL

Water hyacinth treatments will occur at up to 367 possible treatment sites throughout the Delta, based on where it is observed to be present. **To the best extent possible, water hyacinth treatments will be planned using a combination of current field observations, prior infestation history, and DBW staff knowledge.**

Aquatic Pest Control Specialists and Aquatic Pest Control Technicians will conduct field surveys or provide information on current field conditions prior and at the end of the current application season. These surveys may involve traveling to a site to visually assess the level of water hyacinth infestation and the locations of any drinking water intakes **(no treatment may occur within 1 mile of any drinking water intakes)(see Appendix Q for locations)**.

The DBW has divided the Delta into ten large zones (west, north, central, south). Annually, each application crew will be assigned one of these large areas. These large areas are further divided into “sites.” Sites vary in size, and may be between one and three miles in length.

The Field Supervisor and planning team (i.e., the Aquatic Weed Unit Manager and ES) will work together before each treatment season begins to identify which sites are heaviest in terms of water hyacinth infestation. A map showing the 367 possible treatment sites is provided in **Exhibit 1**.

The Field Supervisor may update, revise, or reprioritize the site list over the course of the treatment year based upon new information about the treatment sites. For example, the DBW receives telephone calls from the public regarding new water hyacinth infestations which may cause a reprioritization of the treatment sites. The

Field Supervisor also may reprioritize treatment sites to maximize efficacy based on new information on patterns of water hyacinth movement in the Delta. It is understood that the Field supervisor will communicate these changes to all parties involved.

Exhibit 1

Treatment date maps for Water hyacinth are located on the wall at HQ in Stockton.

To fulfill USFWS, NOAA Fisheries, and NPDES permit requirements, the DBW must conduct water quality following its WHCP treatments. Prior to conducting actual treatment, the Field Supervisor and ES will discuss which sites will be sampled for the upcoming year. Factors that will be considered when selecting sites for sampling include:

Sites in the top 25 percent of the use areas (as measured by the Pesticide Use Report)

Sites picked in prior years (to create time-series data)

Sites representative of the entire Delta

Sites representative of Delta water types (fast/slow moving, tidal, tidal/dead-end).

Water sampling is an integral part of the WHCP. The ES must plan to conduct its water sampling over the course of the year so that it samples for each of herbicide or herbicide combination in the three water types (fast/slow moving water, tidal, tidal/dead-end). Therefore, the ES must closely coordinate its sampling efforts with each application crew's treatment schedule. If the ES intends to collect water samples at a particular site, the ES will contact the application crew that treats that target site one week in advance of a planned treatment. The Aquatic Pest Control Specialist will make sure that target sites have been NOI'd. The ES also may request that several other sites are NOI'd in case conditions on the day of treatment (e.g., wind) restrict the DBW from treating the target site.

The ES will provide a calendar to the Aquatic Pest Control Specialist at the beginning of the year which shows the tentative schedule for water sampling. This schedule inevitably will be modified during the year to respond to any unforeseen changes in location of water hyacinth, weather conditions, and other factors.

While each application crew is responsible for treating sites in its area, based on permit conditions, some of these sites cannot be treated until a particular date. The ES will provide each application crew with a Delta map that specifies the date when treatment can begin at sites throughout the Delta. This map is provided in Exhibit 1.

The ES also will provide application crews with a map that identifies areas where the giant garter snake may be present. The application crew should use this map as a tool for performing pre-application visual inspections for the presence of giant garter snakes. Do we want to mention that this is available on their tablets too?

The ES and application crew have established a strategy of avoidance of elderberry bushes. To avoid elderberry bushes, the application crew will provide a 250-foot buffer between a treatment site and shoreline elderberry bushes.

The ES will survey a sample of elderberry shrubs, which can be potentially impacted by the WHCP herbicide application activities, at the beginning of the treatment season and at the end of the treatment season. The ES will compare the health of elderberry shrubs at control sites (i.e., with elderberry bushes not located

near sites treated during the year) with elderberry bushes located next to treatment sites treated during the year.

Prior to the treatment season, all application crews will be trained on the use of any new technology that has been integrated into the program for that year. These pieces of equipment may be used to take water quality and location measurements throughout the treatment season. Aquatic Weed Unit office staff is currently assigned the responsibility for this type of training. The application crews are responsible for understanding the technology and applications that are an accepted part of the program. If there are any concerns, field staff should contact office staff before the treatment season begins. Application crews should also contact office staff <u>immediately</u> if there are problems with the monitoring equipment. The problem will be noted on the daily for that day. The Field Supervisor will provide application crews with training on all other equipment.

To minimize potential impacts to sensitive species, the application crew should be familiar with the following:

Delta smelt avoidance (USFWS Biological Opinion, Appendix E)

Chinook salmon avoidance (NOAA Fisheries Biological Opinion, Appendix F)

Giant garter snake and valley elderberry avoidance measures. If the application crew launches a boat from an unimproved location on a levy, the application crew should use the Giant Garter Snake Habitat Evaluation Maps provided by the ES to identify whether the habitat is a giant garter snake habitat and then to visually check the site to identify whether snakes are present.

D. DAY OF TREATMENT BOAT AND HERBICIDE CHECKOUT AND RETURN

On the day of treatment, the application crew should back the truck down to the storage bay where the boat is stored on its trailer. The application crew should attach the boat and trailer to the truck's trailer hitch.

The application crew should review to make sure that the following equipment and gear is in the boat prior to leaving the dock or storage bay:

Personal protective gear

Lifejacket(s)

Coveralls (cotton and Tyvek)

Spray glasses (plus a back up pair)

Gloves (including disposables)

Nextel telephone

2-way radio

Water Resistant Footwear

First Aid Kit

Fire Extinguisher

Tools

Sunscreen

Mosquito Repellent

Waterproof gear bag which includes:

- Permits
- Written recommendations
- Maps

Take Kit

DO Meter and manual

Tablet

Camera

Wind Gauge

On the Daily Log, the application crew should complete the volume data information by first adding the amount of chemical, in gallons, checked out of the DBW warehouse to the amount of chemical, in gallons, remaining in the boat at the beginning of the day.

The application crew should travel to the launch site, launch the boat, and then boat to the site.

At the end of the day, the application crew should bilge the boat and check the bilge for contaminants, perform an overall visual inspection of the boat, check the boat for tightness (i.e., no leaks) and record boat hours for the day.

The application crew should load the boat onto the trailer and return the boat/trailer to the locked storage unit and record truck mileage on the truck log which is located in the glove compartment.

Trucks are left outside the storage unit. At night a “club” should be placed on the steering wheel of the truck to protect the vehicle.

The application crew should perform regular maintenance on the equipment as follows:

Boats

Every 50 hours, change pump oil on the lower unit of the outboard motor including grease in Zurk fittings (i.e. steering, trim plate)

Every 100 hours, replace the motor sparkplugs

Boat trailer

Check “buddy” bearing to make sure that it is grease-filled

Trucks

Every 4,000 miles have engine oil and filter replaced (e.g., at Jiffey Lube or Lube & Tune)

Every 24,000 miles have vehicle tune-up performed.

E. TREATMENT PROTOCOL

1. Pre-Treatment

The application crew will record the following information on the Daily Log:

- ❑ Date
- ❑ Crew (names)
- ❑ Boat number
- ❑ Hour meter (start)
- ❑ Date regular maintenance performed on boat (and answer associated questions in maintenance box)
- ❑ Site number
- ❑ County
- ❑ Hours (beginning time).

The application crew should perform a visual survey for the species of concern and complete the Environmental Observations Checklist. All boxes must be completed on the Environmental Observations Checklist. If no species is observed, the application crew should check "no" in the appropriate box on the form. Application crews will survey and document the applicable species of concern using the provided Species Identification pictures provided This is a brief survey that should normally take about 15 to 20 minutes in a known site. A sample of the Environmental Observations Checklist is provided in **Appendix L**. **If any sensitive species are present at the site, the application crew should not perform the treatment.**

The application crew should utilize the "Hach HQ10" dissolved oxygen monitor/meter to take dissolved oxygen and temperature readings and record the following information on the Daily Log:

Water temperature using the Hach (beginning of treatment)

Dissolved oxygen (DO) level using the Hach (beginning of treatment)

Beginning UTM using the explore iX ® GPS device

Date of last spray equipment calibration (box on bottom left of form).

The application crew should use the wind meter available on each boat to measure the wind speed and record this information in the Daily Log. **If the wind speed is greater than 10 mph or 7 mph in Contra Costa County, the application crew should not perform the treatment at point of application. On days where wind and weather could be a factor in worker safety, and compromises the effectiveness of an application, the Specialist will call the Field supervisor who will call off the application.**

Concurrent with completing the hard copy of the Daily Log, the application crew should also complete electronic data collection using the VESTRA electronic program. This program runs using a handheld computer which is connected to the various electronic equipment devices in the field. The program is based on "pull down" menus, and is used by application crews to record the following information:

Quantity of chemical – beginning of day

Quantity of chemical – end of day

Quantity of chemical used during the day

Date

Site number

Boat number

Personnel names

Herbicide used

Whether the herbicide is recorded in gallons

Herbicide rate and orifice size

UTM data

Coordinates of spray line

Dissolved oxygen

Temperature

Wind speed

Presence of elderberry shrubs

Presence of species of concern

Calibration information

Leak inspection notes,

Based on this pre-treatment data, the application crew should determine whether the application meets applicable NPDES permit conditions for a treatment. **No treatment can be performed when dissolved oxygen is between 3.0 mg/L and the basin plan limit (see D.O. maps).**

The application crew also should ensure that applications will meet applicable conditions specified in Memoranda of Understanding with other water agencies (copies of which are provided in **Appendix M**).

In cases where the treatment requires water sampling, the application crew should travel to the site with the Monitoring Crew. At the site, the Monitoring Crew and application crew should discuss how the site will be treated (based on tidal

factors). The application crew should flag both the start of the application area and the end of the application area. The Monitoring Crew will take a pre-treatment sample. For the WHCP, the application crew will spray the site for at least one hour. The Monitoring Crew will then take post-treatment samples at least one hour following the pre-treatment sample.

2. Treatment

The application crew will calibrate the spray equipment as needed and conduct the treatment. The treatment shall be conducted at labeled rates and consistent with the PUR. **No more than 2.75 acres may be treated at a given site in a given day.** If 3 acres are treated in a site, crews will skip adjacent sites. The application crew shall leave an adequate portion of a waterway open (i.e., without treatment) to allow for fish to pass the site.

3. Post-Treatment

The application crew will record the amount and type(s) of herbicides and adjuvants used during each application on the Daily Log. All application crews will complete a Daily Log at the end of the day that will include the following information:

- ❑ Hour meter (end)
- ❑ Water temperature using the Hach HQ10 LDO (end of treatment)
- ❑ Hours (ending time)
- ❑ Dissolved oxygen (DO) level using the Hach HQ10 LDO (end of treatment)
- ❑ Ending UTM using the Xplore x104C2 device (end of treatment)
- ❑ Total acres treated (each treatment)
- ❑ Amount of herbicide and adjuvant used and rate of application. 2,4-D is recorded in gallons. Glyphosate is recorded in gallons. Agridex is recorded in gallons. Consult each site PUR for rate information. An ounce to gallon conversion table to assist staff is provided in **Appendix N**.
- ❑ Orifice size.

A sample copy of a blank and completed Daily Log is provided in **Appendix O**.

Once the fieldwork is complete the application crews submit Daily Logs to Headquarters office. Headquarters office staff hand key enter the data into a Microsoft Excel file.

Headquarters will regularly (i.e., weekly) download field data collected using the Xplore devices. This data is currently compared with data from the Daily Logs for accuracy and integrity.

The Field Supervisor will assure the integrity and quality of the Daily Log information which is submitted to DBW Headquarters. The Field Supervisor, or the Assistant Field Supervisor, will review Daily Logs to assure all information is included

and the information is accurate and correct. They will sign off verifying that all information is accurate.

DBW Headquarters staff will prepare a Pesticide Use Report to the CAC that includes the amount of herbicide used, acreage, and number of applications. This report is submitted on a monthly basis. A copy of a Pesticide Use Report is provided in **Appendix P.**

Best Management Practices

BMP# WH1 – Herbicide Handling Requirements

All personnel involved with the application of WHCP herbicides will be trained in herbicide handling in accordance with Food and Agriculture Code and Title 3 Code of Regulations pertaining to Pesticides and Pest Control Operations.

Storage

All WHCP herbicides will be stored in a secured warehouse in accordance with the California Food and Agriculture Code and Title 3 Code of Regulations. All herbicides obtained from the storage area will be recorded in the storage area logbook as well as in the individual treatment crew's daily log.

Transport

Herbicides will be delivered by truck or boat to specific treatment sites on the day of treatment. They will be transported in their original containers, securely fastened to the truck or boat, in a manner that will prevent spillage onto or off of the vehicle or vessel. Spill kits and MSDS sheets will be on hand when traveling in **any** vehicle.

Mixing, Loading and Applications

DBW staff shall use undiluted herbicides from containers of 5 gallons or less; only the herbicide containers being used will be opened at the application site. All mixing, loading, and application operations will be conducted in accordance with all label requirements and will be performed by licensed pesticide applicators.

Disposal of Herbicide Containers

Herbicide containers will be triple rinsed and disposed of according to the Food and Agriculture Code.

BMP# WH2 – Spray Equipment Maintenance and Calibration

Spray equipment used for the WHCP shall be calibrated on a weekly basis. The date of the last spay equipment calibration is recorded on the Daily Log under "Last Calibration."

The boats used by the DBW have a 30-gallon holding tank on the boat that is used to store Delta water. The boats use a two-pump system. One pump draws water from the Delta into the 30-gallon holding tank. Another pump draws the aqueous chemical from the herbicide container.

A tube from each pump meets at the sprayer where the Delta water and the herbicide are mixed. An orifice on the sprayer can be adjusted to vary the application rate.

Operators should calibrate the spray equipment so that it mixes the water from the Delta with the herbicide at the required concentrations. Based on the Pest Control Recommendations, these concentrations are as follows:

2,4-D: 2 to 4 quarts (64 oz. to 128 oz.) Weedar 64 per 200 gallons of water

Agridex: 2 ½ to 3 quarts (80 oz. to 96 oz.) Agridex per 100 gallons of water.

The spray equipment is calibrated as follows:

1. Make sure that each of the pumps is primed. To do this the operator should run water through them for approximately two (2) minutes
2. The 30-gallon holding tank should be marked at the 25-gallon level (for ease of conversion)
3. Fill the 30-gallon holding tank with 25-gallons of water
4. Pour the water into a 32-oz. cup. The amount to pour into the 32-oz. cup will vary depending on the herbicide as follows:
   a. For 2,4-D, the operator should pour 8 oz. to 16 oz. of water into the 32-oz. cup. The 8 oz. to 16 oz. range per 25 gallons of water is exactly 1/8th of the 64 oz. to 128 oz. per 200 gallons of water requirement noted above.
   b. For Agridex, the operator should pour 20 oz. to 24 oz of Agridex into the 32-oz. cup. The 20 oz. to 24 oz. per 25 gallons of water is exactly 1/4th of the 80 oz. to 96 oz. per 100 gallons of water requirement noted above.
5. The operator should turn both pumps on and begin the spray process
6. If the spray equipment is properly calibrated the 25-gallons of water in the holding tank and the water in the 32-oz. cup should be completely gone at the same time. If the spray equipment is not properly calibrated either the 25-gallons of water, or the herbicide in the 32-oz. cup, will be gone before the other is

7. The operator may need to adjust the orifice size on the sprayer to allow the sprayer to draw chemical at a slower or faster rate.
8. For the adjuvant Agridex, the operator should make sure that the appropriate amount is added per the Pest Control Recommendation. For Agridex, the amount is 2 quarts per 100 gallons. The result is that the 2,4-D is applied using a smooth coating (not droplets or beading). If the application results in beading, the operator should add more adjuvant.

BMP# WH3 – Spill Contingency Plan

All herbicide spills will be treated as emergencies. Concentrated herbicide spills are more dangerous than herbicides diluted with water, and will be treated seriously and immediately. While spills can occur during transporting, storing, or while using herbicides, the DBW will apply the following preventive measures to reduce the potential for a serious spill:

For boats – herbicides will be securely fastened to floats in their original, watertight containers. Each boat shall carry a marker buoy with an attached anchor line which to mark any herbicide in the event of a spill.

For vehicles – herbicides will be transported in their original, watertight containers, in a manner that will prevent spillage onto the vehicles or off the vehicle. **MSDS labels and spill kits will be carried during transportation.**

Only herbicide containers being used at the time of application will be open.

Reporting Spills

The Aquatic Pest Control Specialist will have a cellular phone in his/her possession and the telephone numbers of the California Department of Fish and Game (Office of Spill Prevention and Response), California Regional Water Quality Control Board, State Office of Emergency Services, County Agricultural Commissioners, County Sheriff's Office, the California Highway Patrol, County Health Departments, and DBW management and staff. **Appendix J**, the Spill Emergency Contact Telephone Numbers, provides a list of emergency telephone numbers to use in case of a spill.

Large herbicide spills will immediately be reported to the Office of Emergency Services.

Smaller spills not occurring on public roadways, that do not pose a serious threat to the public or the environment; will be reported by the person in charge, at the earliest convenience, to the appropriate agencies on the "Spill Emergency Contact Telephone Number" list. Reporting for these smaller spills may be limited to the County Agricultural Commissioners of the appropriate County. The Aquatic Weed Unit Manager and Field Supervisor will make the determination as to whether the spill meets this "smaller" criterion.

Spills on Land

If a spill occurs on a public roadway, the California Highway Patrol, the California Office of Emergency Services and the County Agricultural Commissioner will immediately be notified.

In the event a spill occurs, it is of paramount importance that the discharge is stopped at its source and that the spilled material be contained. DBW and contracted personnel will have access to supersorb or common cat litter that will

be used for immediate containment of the spilled material. The following actions will be taken as necessary to contain a spill on ground:

Stopping the spill at its source.

Diking in pools as appropriate.

Using materials such as soil, supersorb, or cat litter to absorb pooled material.

Contaminated soil or absorbent material will be placed in a sealable disposable container suitable for transporting. The container will be labeled with its contents, including herbicide name and signal word. It will then be disposed of in accordance with the label and all applicable laws and regulations.

When possible the spill and its clean up will be documented with photos and the date/time registered. Copies of these photos will be attached to any spill reports filed.

Spills in Water

In the event of a spill in water the following procedures will be employed:

The location of the spill will be marked

The Aquatic Weed Unit Manager will be immediately notified

The amount of herbicide spilled will be assessed

The Office of Emergency Services will be immediately notified. The Office of Emergency Services will take charge of coordinating the cleanup and protecting the public.

The County Agricultural Commissioners Office will be notified

All other appropriate agencies on the “Spill Emergency Contact List” will be notified.

The spill location will be marked with a marker buoy and an approximate bearing with any permanent land markers. A GPS reading will be taken. Photographs of the spill will be taken. DBW personnel, the Office of Emergency Services, and appropriate state and federal agencies will perform an inspection of the spill location to determine the amount of herbicide spilled and the potential environmental impacts. If deemed necessary, the area will be monitored for herbicide residues and environmental impacts.

Appendices

Appendix A – Weedar 64 (2, 4-D) Label and MSDS

This appendix includes the label and Material Safety Data Sheet (MSDS) for Weedar 64 (2,4-D). This herbicide is manufactured by Nufarm. The EPA registration number is 71368-1. The applicator should read and become familiar with the entire contents of the label and MSDS. The applicator should pay particular attention to the following sections:

Label

User Safety Recommendations
Environmental Hazards
Storage and Disposal
Aquatic Weed Control (Water Hyacinth)

MSDS

Hazards Identification
First Aid Measures
Exposure Controls/Personal Protection.

APPENDIX B – AquaMaster (Glyphosate) Label and MSDS

This appendix includes the label and Material Safety Data Sheet (MSDS) for AquaMaster (Glyphosate). This herbicide is manufactured by Monsanto Company. The EPA registration number is 524-343. The applicator should read and become familiar with the entire contents of the label and MSDS. The applicator should pay particular attention to the following sections:

Label

Storage and Disposal
General Information
Weeds Controlled (Water Hyacinth)

MSDS

Hazards Identification
First Aid Measures
Handling and Storage
Exposure Controls/Personal Protection.

APPENDIX C – Agridex Label and MSDS

This appendix includes the label and Material Safety Data Sheet (MSDS) for Agridex. This adjuvant is manufactured by Helena Chemical Company. This adjuvant is not registered by the EPA. The applicator should read and become familiar with the entire contents of the label and MSDS.

APPENDIX D – Pest Control Recommendations

Pest Control Recommendations are written by a licensed Pest Control Applicator (PCA). Among other factors, Pest Control Recommendations specify:

Sites to be treated

Treatment acreage

Treatment conditions

Surrounding crop hazards

Hazards and restrictions.

Pest Control Recommendations are valid from the signature date until the “Good Until” date identified.

APPENDIX E – U.S. Fish and Wildlife Biological Opinion

This appendix includes relevant portions of the Biological Opinion prepared by the United States Fish and Wildlife Service (USFWS), and subsequent transmittals related to reinitiation of formal consultation with USFWS. The biological opinion is addressed to Dr. Lars Anderson with the United States Department of Agriculture, the DBW's federal nexus to USFWS.

The USFWS biological opinion addresses effects of the WHCP on federally threatened Sacramento splittail, giant garter snake, valley elderberry longhorn beetle, and delta smelt and its designated critical habitat. This appendix includes three letters:

APPENDIX F – National Marine Fisheries Service (NOAA Fisheries) Biological Opinion

The Biological Opinion provides a description of the WHCP, the WHCP monitoring program, the status of the endangered and threatened species, the environmental baseline, the effects of the WHCP on the species, and the incidental take statement, effect of take, reasonable and prudent measures, terms and conditions placed on the WHCP.

The April 4, 2006 NOAA Fisheries Biological Opinion specifies a number of conditions on the WHCP for Chinook salmon and Steelhead avoidance. Key aspects of this permit that field staff needs to be aware of that are not covered elsewhere in this manual are as follows:

1. Measures shall be taken to reduce impacts to juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and North American green sturgeon from chemical control treatment and/or monitoring activities.

a. Restrictions to the timing and places of herbicide applications shall comply with the guidelines indicated in the project description for the WHCP as presented in section II (C)(5) of this biological opinion.

b. Any winter-run Chinook salmon, spring-run Chinook salmon, and steelhead trout mortalities found at or in the vicinity of a treatment site (i.e., within 400 meters) shall be collected, fork length measured and the body placed in a whirl-pak bag. The bag will be labeled with the time, date, location of capture, and a description of the near-shore habitat type and water conditions and frozen. NMFS, Sacramento office shall be notified as soon as possible of any mortalities at (916) 930-3600 and a representative of NMFS will collect the frozen specimen.

c. DBW staff and their assigned agents must follow all Federal and State laws applicable to the use of the herbicides and any adjuvants and apply them in a manner consistent with the product labeling, the current NPDES General Permit if granted, the Description of the Proposed Action, and determinations from the California Department of Pesticide Regulation.

d. The use of the adjuvant R-11 shall be reduced to minimize its toxic effects on aquatic organisms where practicable. The less toxic adjuvant, Agri-Dex, shall be used in its place. R-11 may be used in the following defined areas during the appropriate application windows. Within the sites on the San Joaquin River south of the intersection of Merced, Madera, and Fresno Counties (sites 900 to 929), R11 may be used as an adjuvant between June 1 and October 15. Within the Stone Lakes/Beach Lakes area (sites

221-239), R-11 may be used as an adjuvant between June 1 and October 15. R-11 may not be used as an adjuvant elsewhere in the WHCP application areas.

e. Fish passage shall not be blocked within treatment areas. Protocols shall be followed to ensure that WHCP operations do not inhibit passage of fish in each area scheduled for treatment or exceed limitations on contiguous treated acreage.

f. The DBW will provide a copy of each week's Notice of Intent to Jeffrey Stuart, Fishery Biologist, Protected Resources Division, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814, by the Friday prior to the treatment week. This notification will include the sites scheduled for treatment and a contact person for those sites.

g. Jeffrey Stuart will be the appointed NMFS representative on the Water Hyacinth Task Force (Task Force), and provide technical assistance to the Task Force along with carrying out the duties of a Task Force member. As part of the WHCP Task Force, the NMFS representative will be active in guiding decisions on prioritizing treatment sites in regards to the presence of salmonids.

2. Measures shall be taken to reduce the impact of DBW's WHCP boating operations on the designated critical habitat of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead.

a. USDA-ARS and DBW shall comply with the receiving water limitations of the General Permit issued for the WHCP in regards to oils, greases, waxes, floating material, or suspended material derived from the operation of program vessels or application activities.

b. The USDA-ARS and DBW shall ensure that any mixing of chemicals, or disinfecting and cleaning of any equipment shall be done in strict accordance with the operational protocols of the WHCP and that all equipment is in working order prior to engaging in application activities, including the operation of the program's vessels.

c. Operation of program vessels in shallow water habitats shall be done in a manner that causes the least amount of disturbance to the habitat. Operational procedures for vessels in these habitats should minimize boat wakes and propeller wash.

d. Operation of program vessels shall avoid or minimize to the greatest practicable extent dislodging portions of existing water hyacinth mats that

can drift into other areas. This will avoid or minimize new infestations of the weed due to drifting fragments.

3. Measures shall be taken by DBW to monitor the operations of the WHCP and the ambient Delta hydrologic conditions.

a. The USDA-ARS shall ensure that the DBW follows a comprehensive monitoring plan designed to collect project operational information. The monitoring plan shall adhere to the requirements of the General Permit and have at a minimum those water quality criteria stated in Attachment B of the permit, i.e. data on water temperatures, DO, pH, turbidity, water hardness, electrical conductivity, and chemical concentrations in the application areas as well as other criteria stated in the attachment. Chemical concentrations (including both herbicides and adjuvants) shall have at a minimum, a pre- and post-application water sample taken at the furthest down current site of the application zone. Additional tests, if required by other Federal and State agencies, shall be conducted and the information made available to NMFS. The results of this monitoring program will be used to determine if the DBW is affecting Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead to an extent not previously considered.

b. The USDA-ARS, in coordination with the DBW, shall provide bimonthly (i.e., every other month) monitoring reports of the hydrologic conditions and the amounts of chemical discharges to Jeffrey Stuart, NMFS, Sacramento Field Office. These reports shall also include information on the following parameters:

    i. Pre-treatment and post-treatment measurements on chemical residues, pH and turbidity levels as well as water temperatures and DO concentrations at selected sites in the Delta. These sites shall be reflective of the different water types found in the range of application sites and will be determined by DBW as part of their NPDES permit conditions.

    ii. Receiving water temperatures and DO levels and resultant changes in those conditions resulting from WHCP operations during each month.

    iii. Amounts, types, and dates of application of herbicides and adjuvants applied at each site.

    iv. Visual assessment of pre- and post-treatment conditions of treated sites to determine the efficacy of treatment and any effects of

chemical drift on downstream habitats immediately adjacent to the treated sites.

v. Operational status of equipment and vessels, including repairs and spraying equipment calibrations as needed.

c. The USDA-ARS, in coordination with the DBW, shall summarize the above bimonthly reports into an annual report of the DBW project operations, monitoring measurements and Delta hydrological conditions for the previous treatment year for submission to NMFS by January 31 of each year. The annual report of DBW operations shall also include:

i. A description of the total number of winter-run and spring-run chinook salmon or steelhead observed taken, the manner of take, and the dates and locations of take, the condition of the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead taken, the disposition of fish taken in the event of mortality and a brief narrative of the circumstances surrounding the take of the fish. This report shall be sent to the address given below.

ii. Listed salmonids or other fish species that are observed to be behaving in an erratic manner shall be reported (see Appendix A).

d. All bimonthly reports and the annual report shall be submitted by mail or Fax to:
e. NMFS Sacramento Field Office Attn: Supervisor 650 Capitol Mall, Suite 8-300, Sacramento, California 95814Fax: (916) 930-3629

4. Pending the listing of the southern population of North American green sturgeon, the USDA-ARS and their agents will implement additional measures to avoid, minimize, and monitor incidental take of North American green sturgeon from the actions of the WHCP.

a. The USDA-ARS will monitor the take of green sturgeon, and record such information for their reports to NMFS required under term and condition 3(C), above.

b. If necessary, USDA-ARS and DBW will coordinate with NMFS to alter herbicide application plans to avoid or minimize take of green sturgeon if field observations indicate that take is occurring.

APPENDIX G – National Pollutant Discharge Elimination System (NPDES) Permit

This appendix includes a copy of the National Pollutant Discharge Elimination System (NPDES) permit approved by the State Water Resources Control Board dated March 20, 2006. The NPDES permit specifies.

Compliance with waste discharge requirements, including:

- Receiving water limitations (e.g., dissolved oxygen levels)
- Groundwater limitations
- Other provisions

Use of a monitoring and reporting program

Other information related to the waste discharge requirements.

APPENDIX H – Herbicide Handling Regulations

Division 6 Pesticides and Pest Control Operations
Chapter 3. Pest Control Operations
Subchapter 2. Work Requirements
Article 4. Storage, Transportation and Disposal

6670. Container Control.

Pesticides, emptied containers or parts thereof, or equipment that holds or has held a pesticide, shall not be stored, handled, emptied, disposed of, or left unattended in such a manner or at any place where they may present a hazard to persons, animals (including bees), food, feed, crops or property. The commissioner may take possession of such unattended pesticides or emptied containers to abate such hazard.

NOTE: Authority cited: Sections 11456, 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

6672. Delivery of Pesticide Containers.

(a) No person shall deliver a container that holds, or has held, a pesticide to a property unless he stores it in an enclosure or closure complying with the requirements of this Section or delivers it to a person in charge of the property or his agent, or a pest control operator or his employee. The person receiving the container shall control access to it in accordance with this Section.

(b) Each person who controls the use of any property or premises is responsible for all containers or equipment on the property that holds, or has held, a pesticide. Unless all such containers are under his personal control so as to avoid contact by unauthorized persons, he shall:

(1) Provide a person responsible to him to maintain such control over the containers at all times; or

(2) Store all such containers in a locked enclosure, or in the case of liquid pesticides in a container larger than 55 gallons in capacity, the container shall have a locked closure. Either shall be adequate to prevent unauthorized persons from gaining access to any of the material.

NOTE: Authority cited: Sections 11456, 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

6674. Posting of Pesticide Storage Areas.

Signs visible from any direction of probable approach shall be posted around all storage areas where containers that hold, or have held, pesticides required to be labeled with the signal words "warning" or "danger" is stored. Each sign shall be of such size that it is readable at a distance of 25 feet and be substantially as follows:

DANGER

POISON STORAGE AREA

ALL UNAUTHORIZED PERSONS KEEP OUT

KEEP DOOR LOCKED WHEN NOT IN USE

The notice shall be repeated in an appropriate language other than English when it may reasonably be anticipated that persons who do not understand the English language will come to the enclosure.

NOTE: Authority cited: Sections 11456, 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

6676. Container Requirements.

Except as provided in the Food and Agricultural Code pertaining to service containers, any container that holds, or has held, any pesticide, when stored or transported, shall carry the registrant's label. All lids or closures shall be securely tightened except when the procedure described in Section 6684 has been followed. This Section shall not apply to measuring devices that are not used to store or transport a pesticide.

NOTE: Authority cited: Sections 11456, 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

6678. Service Container Labeling.

Service containers, other than those used by a person engaged in the business of farming when the containers are used on the property the person is farming, shall be labeled with:

(a) The name and address of the person or firm responsible for the container;

(b) The identity of the economic poison in the container; and

(c) The word "Danger," "Warning," or "Caution," in accordance with the label on the original container.

NOTE: Authority cited: Sections 11456, 11502, 12781 and 12859, Food and Agricultural Code.

Reference: Sections 11501 and 12859, Food and Agricultural Code.

6680. Prohibited Containers for Pesticides.

In no case shall a pesticide be placed or kept in any container of a type commonly used for food, drink or household products.

NOTE: Authority cited: Sections 11456, 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

6682. Transportation.

(a) Pesticides shall not be transported in the same compartment with persons, food or feed.

(b) Pesticide containers shall be secured to vehicles during transportation in a manner that will prevent spillage onto the vehicle or off the vehicle. Paper, cardboard, and similar containers shall be covered when necessary to protect them from moisture.

NOTE: Authority cited: Sections 11456, 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

6684. Rinse and Drain Procedures.

(a) Except for containers to be returned to the registrant, each emptied container that has held less than 28 gallons of a liquid pesticide that is diluted for use shall be rinsed and drained by the user at time of use as follows:

(b)(1) Use the following amount of water or other designated spray carrier for each rinse.

Size of container	*Amount of rinse medium*
Less than 5 gallons	1/4 container volume
5 gallons or over	1/5 container volume

(2) Place required minimum amount of rinse medium in the container, replace closure securely, and agitate.

(3) Drain rinse solution from container into tank mix. Allow container to drain 30 seconds after normal emptying.

(4) Repeat (2) and (3) above a minimum of two times so as to provide a total of three rinses; or

(c)(1) Invert the emptied container over a nozzle located in the opening of the mix tank which is capable of rinsing all inner surfaces of the container.

(2) Activate the rinse nozzle allowing the rinse solution to drain into the tank. The rinse shall continue until the rinse solution appears clear and a minimum of one-half of the container volume of rinse medium has been used. A minimum of 15 pounds pressure per square inch shall be used for rinsing; or

(d) Other rinse methods, at least equal in effectiveness to the above, approved by the director.

NOTE: Authority cited: Sections 11456, 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

6686. Exemptions.

(a) Sections 6672, 6674, 6682, and 6684 shall not apply to containers that hold or have held pesticides packaged, labeled, and used for home use when in the possession of a householder on his property.

(b) Sections 6670 and 6672(b) shall not apply to exempt materials specified in Section 6402 except where the commissioner, or the director in any county where there is no commissioner, determines that a hazard to public health and safety exists requiring the control specified in sections 6670 and 6672(b).

(c) Section 6684 shall not apply to outer shipping containers that are not contaminated with a pesticide.

(d) This article shall not apply to sanitizers, disinfectants, or medical sterilants.

NOTE: Authority cited: Sections 12976 and 12981, Food and Agricultural Code.

Reference: Sections 11501, 12981 and 14102, Food and Agricultural Code.

APPENDIX I – Worker and Safety Training

Division 6. Pesticides and Pest Control Operations
Chapter 3. Pest Control Operations
Subchapter 3. Pesticide Worker Safety
Article 2. General Safety Requirements

6720. Safety of Employed Persons.

(a) The requirements of this article shall be complied with by the employer for the safety of employees handling pesticides.

(b) When only vertebrate pest control baits, solid fumigants (including aluminum phosphide, magnesium phosphide, and smoke cartridges), insect monitoring traps or non-insecticidal lures are handled, the employer is exempt from the requirements of Sections 6730 (Working Alone), 6732 (Change Area), and 6736 (Coveralls).

(c) When antimicrobial agents, used only as sanitizers, disinfectants, or medical sterilants or pool and spa chemicals are handled, the employer is exempt from complying with the provisions of this subchapter, provided the employer instead complies with any applicable requirements in the following corresponding provisions of Title 8, California Code of Regulations. Where the word "None" appears in the Title 8 column, the employer does not have to comply with the corresponding regulations specified in the Title 3 column.

Title 3, CCR	*Title 8, CCR*
6700	3200 and 3202
6702	3200 and 3203
6704	None
6706	None
6710	None
6720	As indicated in this Subsection
6723	3203, 3204, and 5194
6724	3203 and 5194
6726	3400
6728	None
6730	None

6732	3367
6734	3363 and 3366
6736	3383
6738	3380 through 3385, and 5144
6740	3317
6742	5141
6744	3203 and 5194
6746	None
Article 3	None
Article 4	None
Article 5	None
Article 6	None

(d) The provisions of Sections 6734 and 6768 (Decontamination), 6726 and 6766 (Emergency Medical Care), 6736 (Coveralls), 6738(b)-(i) (Personal Protective Equipment), and 6770 (Field Reentry) do not apply to licensed agricultural pest control advisers and registered professional foresters, or employees under their direct supervision, while performing, after the application is completed, crop adviser tasks, including field-checking or scouting, making observations of the well-being of the plants, or taking samples provided:

(1) They have been trained equivalent to the requirements of Section 6724 (licensed agricultural pest control advisers are considered trained for the purposes of this exception); and

(2) The licensed agricultural pest control adviser or registered professional forester responsible for the direct supervision has:

(A) Made specific determinations regarding appropriate personal protective equipment, needed decontamination facilities, and how to safely conduct crop adviser tasks;

(B) Informed each employee under his or her direct supervision of the pesticide product and active ingredient(s) applied, method and time of application, the restricted entry interval, and determinations made pursuant to (A) above; and

(C) Instructed each employee under his or her direct supervision regarding which tasks to perform and how to contact him or her if the need arises.

(e) The provisions of this Subchapter do not apply to employees handling consumer products packaged for distribution to, and use by, the general public, provided that employee use of the product is not significantly greater than the typical consumer use of the product.

NOTE: Authority cited: Section 12981, Food and Agricultural Code.

Reference: Sections 11501, 12973, 12980 and 12981, Food and Agricultural Code.

6722. Age.

NOTE: Authority cited: Sections 407 and 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6723. Hazard Communication for Pesticide Handlers.

(a) Before employees are allowed to handle pesticides, the employer shall display a copy of a completed written Hazard Communication Information for Employees Handling Pesticides in Agricultural Settings (Pesticide Safety Information Series leaflet A-8) or Hazard Communication Information for Employees Handling Pesticides in Noncrop Settings (Pesticide Safety Information Series leaflet N-8), as applicable, at a central location in the workplace. Upon request, the employer shall read to the requesting employee, in a language understandable to that employee, Pesticide Information Series leaflet A-8/N-8. Pesticide Information Series leaflet A-8/N-8 shall be written by the Department of Pesticide Regulation in English and Spanish. Pesticide Information Series leaflets is available from the department.

(b) The employer shall maintain, at a central location at the workplace accessible to employees who handle pesticides the following:

(1) Pesticide use records as specified in Section 6624 (b), (c), and (e) for pesticides that have been handled by his or her employees;

(2) Copies of available Pesticide Safety Information Series leaflets which are applicable to the pesticides and handling activities listed in the pesticide use records referred to in subsection (b) (1); and

(3) A Material Safety Data Sheet (MSDS), as specified by Title 8 California Code of Regulations, Section 5194, for each pesticide listed in the pesticide use records referred to in subsection (b) (1). If the MSDS is not provided by the registrant of a pesticide, the employer shall:

(A) Within seven working days of a request for a MSDS from an employee, employee representative or employee's physician, make written inquiry to the registrant of the pesticide, asking that a MSDS be

sent to the employer. If the employer has made written inquiry within the last twelve months as to whether the pesticide is subject to the requirement for a MSDS or the employer has made a written inquiry within the last six months requesting new, revised or later information on the MSDS, the employer need not make additional written inquiry. A copy of the written inquiry shall immediately be sent to the person requesting the MSDS;

(B) Notify the requester of the availability of the MSDS or provide a copy of the MSDS to the requester within fifteen days of receipt of the MSDS from the registrant; and

(C) If a response has not been received from the registrant within twenty-five working days of the date the inquiry was made; send the department a copy of the inquiry with a notation that no response has been received. The employer is not precluded from obtaining and providing the MSDS utilizing other more expedient methods in lieu of those provided in this subsection.

(c) The employer shall inform employees, before they are allowed to handle pesticides and at least annually thereafter, of the location and availability of the records and other documents listed in this Section or relating to employee training, monitoring, and potential exposure. If the location of the records and other documents change, an employer shall promptly inform his or her employees of the new location.

(d) The employer shall provide, upon request of his or her employee, employee representative, or employee's physician, access to any records or other documents required to be maintained pursuant to this chapter. Access shall be granted as soon as possible and not to exceed forty-eight hours from the date of the request.

INFORMATIONAL NOTE: Other requirements relating to hazard communication can be found in Sections 6602, 6618, 6619, 6724, 6726, 6738, 6744, 6764, 6766, 6770, and 6776.

NOTE: Authority cited: Section 12980, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agriclutural Code; and 29 Codes of Federal Regulations, Part 1910.1200.

6723.1. Application-Specific Information for Handlers.

(a) The operator of property used for the commercial or research production of an agricultural plant commodity shall display, at a central location, the following application-specific information while employees are employed to handle pesticides:

(1) Identification of the treated area;

(2) Time and date of the application;

(3) Restricted entry interval; and

(4) Product name, EPA registration number, and active ingredients.

(b) The information shall be displayed within 24 hours of the completion of an application and include all applications that have been made to any treated field on the agricultural establishment within 1/4 mile of where employees will be working. Once displayed, the information shall remain displayed until the area no longer meets the definition of a treated field or handler employees will no longer be on the establishment, whichever occurs earlier.

(c) The original or copies of documents otherwise required to be maintained by this chapter may be used to meet the requirements of this Section provided they contain the information required by this Section.

NOTE: Authority cited: Section 12981, Food and Agricultural Code.

Reference: Sections 11501, 12973, 12980, and 12981, Food and Agricultural Code.

6724. Handler Training.

The employer shall assure that employees who handle pesticides have been trained pursuant to the requirements of this Section and that all other provisions of this Section have been complied with for employees who handle pesticides.

(a) The employer shall have a written training program. The training program shall describe the materials (e.g., study guides, pamphlets, pesticide product labeling, Pesticide Safety Information Series leaflets, Material Safety Data Sheets, slides, video tapes) and information that will be provided and used to train his or her employees and identify the person or firm that will provide the training. The training program shall address each of the subjects specified in subsection (b) that is applicable to the specific pesticide handling situation. The employer shall maintain a copy of the training program while in use and for two years after use, at a central location at the workplace.

(b) The training shall cover, for each pesticide or chemically similar group of pesticides, to be used:

(1) Format and meaning of information, such as precautionary statements about human health hazards, contained in pesticide product labeling;

(2) Hazards of pesticides, including acute and chronic effects, delayed effects, and sensitization, as identified in pesticide product labeling, Material Safety Data Sheets, or Pesticide Safety Information Series leaflets;

(3) Routes by which pesticides can enter the body;

(4) Signs and symptoms of overexposure;

(5) Emergency first aid for pesticide overexposure;

(6) How to obtain emergency medical care;

(7) Routine and emergency decontamination procedures, including spill clean up and the need to thoroughly shower with soap and warm water after the exposure period;

(8) Need for, limitations, appropriate use, and sanitation, of, any required personal protective equipment;

(9) Prevention, recognition, and first aid for heat-related illness;

(10) Safety requirements and procedures, including engineering controls (such as closed systems and enclosed cabs) for handling, transporting, storing, and disposing of pesticides;

(11) Environmental concerns such as drift, runoff, and wildlife hazards;

(12) Warnings about taking pesticides or pesticide containers home;

(13) Requirements of this chapter and chapter 4 relating to pesticide safety, Material Safety Data Sheets, and Pesticide Safety Information Series leaflets;

(14) The purposes and requirements for medical supervision if organophosphate or carbamate pesticides with the signal word "DANGER" or "WARNING" on the labeling are mixed, loaded, or applied for the commercial or research production of an agricultural plant commodity;

(15) The location of the written Hazard Communication Information For Employees Handling Pesticides (Pesticide Safety Information Series leaflet A-8), other Pesticide Safety Information Series leaflets, and Material Safety Data Sheets;

(16) The employee's rights, including the right;

(A) To personally receive information about pesticides to which he or she may be exposed;

(B) For his or her physician or employee representative to receive information about pesticides to which he or she may be exposed; and

(C) To be protected against retaliatory action due to the exercise of any of his or her rights.

(c) The training shall be in a manner the employee can understand, be conducted pursuant to the written training program, and include response to questions.

(d) Training shall be completed before the employee is allowed to handle pesticides, continually updated to cover any new pesticides that will be handled, and repeated at least annually thereafter. Initial training may be waived if the employee submits a record showing that training meeting the requirements of this Section and covering the pesticides and use situations applicable to the new employment situation was received within the last year. A certified applicator is considered trained for the purposes of this Section.

(e) The date and extent of initial and annually required training given to the employee and the job to be assigned shall be recorded. This record shall be verified by the employee's signature and retained by the employer for two years at a central location at the workplace accessible to employees.

(f) The person conducting the training for employees who will be handling pesticides for the commercial or research production of an agricultural plant commodity shall be qualified as one of the following:

(1) A California certified commercial applicator;

(2) A California certified private applicator;

(3) A person holding a valid County Biologist License in Pesticide Regulation or Investigation and Environmental Monitoring issued by the Department of Food and Agriculture;

(4) A farm advisor employed by the University of California Extension Office;

(5) A person who has completed an "instructor trainer" program presented by one of the following:

(A) The University of California, Integrated Pest Management Program after January 1, 1993; or

(B) Other instructor training program approved by the Director;

(6) A California licensed Agricultural Pest Control Adviser;

(7) A California Registered Professional Forester; or

(8) Other trainer qualification approved by the Director.

NOTE: Authority cited: Section 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6726. Emergency Medical Care.

(a) Emergency medical care for employees handling pesticides shall be planned for in advance. The employer shall locate a facility where emergency medical care is available for employees who will be handling pesticides.

(b) Employees shall be informed of the name and location of a facility where emergency medical care is available. The employer shall post in a prominent place

at the work site, or work vehicle if there is no designated work site, the name, address and telephone number of a facility able to provide emergency medical care whenever employees will be handling pesticides and, if the identified facility is not reasonably accessible from that work location, procedures to be followed to obtain emergency medical care.

(c) When there is reasonable grounds to suspect that an employee has a pesticide illness, or when an exposure to a pesticide has occurred that might reasonably be expected to lead to an employee's illness, the employer shall ensure that the employee is taken to a physician immediately.

NOTE: Authority cited: Sections 11456 and 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6730. Working Alone.

(a) An employee mixing, loading, or applying a pesticide in toxicity category one for production of an agricultural commodity may not work alone during daylight hours unless personal, radio, or telephone contact is made to a responsible adult at intervals not exceeding two hours.

(b) An employee mixing, loading, or applying a pesticide in toxicity category one for production of an agricultural commodity may not work alone during nighttime hours unless personal, radio, or telephone contact is made to a responsible adult at intervals not exceeding one hour.

(c) A pilot, mixer-loader, and/or flagger team shall be considered as working together. In the case of two ground applicators working in the same field, no additional person is necessary if they can see each other or each other's application vehicles.

NOTE: Authority cited: Sections 11456 and 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6732. Change Area.

For any employee who regularly handles pesticides with the signal word "DANGER" or "WARNING", and for all employees who handle any pesticides for the commercial or research production of an agricultural plant commodity, the employer shall assure that there is, at the place where employees end their exposure period and remove their personal protective equipment, an area where employees may change clothes and wash themselves. Clean towels, soap, and sufficient water shall be available to allow for thorough washing. The employer shall provide a clean, pesticide-free place where employees may store any personal clothing not in use while at work handling pesticides.

NOTE: Authority cited: Section 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6734. Handler Decontamination Facilities.

(a) The employer shall assure that sufficient water, soap and single use towels for routine washing of hands and face and for emergency eye flushing and washing of the entire body are available for employees as specified in this Section.

(1) This water shall be of a quality and temperature that will not cause illness or injury when it contacts the skin or eyes or if it is swallowed, and shall be stored separate from that used for mixing with pesticides unless the tank holding water for mixing with pesticides is equipped with appropriate valves to prevent back flow of pesticides into the water.

(2) One clean change of coveralls shall be available at each decontamination site.

(b) The decontamination site for employees handling pesticides for the commercial or research production of an agricultural plant commodity shall be at the mixing/loading site and not more than 1/4 mile (or at the nearest point of vehicular access) from other handlers, except that the decontamination site for pilots may be at the loading site regardless of distance from where the pilot is working. The decontamination site shall not be in an area being treated or under a restricted entry interval unless:

(1) The handlers for whom the site is provided are working in that area being treated or under a restricted entry interval;

(2) The soap, towels, and extra change of coveralls are in an enclosed container; and

(3) The water is running tap water or enclosed in a container.

(c) One pint of water for emergency eye flushing shall be immediately available (carried by the handler or on the vehicle or aircraft the handler is using) to each employee handling pesticides for the commercial or research production of an agricultural plant commodity if the pesticide product labeling requires protective eyewear.

(d) The decontamination site for employees handling pesticides for uses other than the commercial or research production of an agricultural plant commodity shall be within 100 feet of the mixing/loading site when they are handling pesticides with the signal word "DANGER" or "WARNING" on the label.

NOTE: Authority cited: Section 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6736. Coveralls.

(a) The employer shall provide coveralls for each employee who handles any pesticide with the signal word "DANGER" or "WARNING" on the label except as provided in 6738(i).

(b) The employer shall assure that:

(1) Employees start each work day wearing coveralls whenever they handle pesticides with the signal word "DANGER" or "WARNING";

(2) Employees wear coveralls whenever they handle pesticides with the signal word "DANGER" or "WARNING" except as provided in 6738(i);

(3) Employees change out of their coveralls and wash at the end of the work day;

(4) Potentially contaminated coveralls removed at the worksite or headquarters are not taken home by employees; and

(5) Employees whose work day does not involve return to the employer's headquarters remove and store potentially contaminated coveralls in a sealable container outside of their own living quarters for later return to the employer.

(c) This Section does not apply to employees using fumigants unless the pesticide product labeling expressly requires the use of coveralls.

NOTE: Authority cited: Section 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6738. Personal Protective Equipment.

(a) The employer shall:

(1) Provide all required personal protective equipment, provide for its daily inspection and cleaning (according to pesticide labeling instructions or, absent any instructions, washed in detergent and hot water), and repair or replace any worn, damaged, or heavily contaminated personal protective equipment. Leather gloves previously used to apply only aluminum phosphide or magnesium phosphide pesticides and which have been aerated for 12 hours or more shall be considered cleaned;

(2) Assure that all clean personal protective equipment, when not in use, is kept separate from personal clothing and in a pesticide free, specifically designated place;

(3) assure that appropriate measures are taken to prevent heat related illness when necessary;

(4) Assure that personal protective equipment is used correctly for its intended purpose;

(5) Discard any absorbent materials that have been drenched or heavily contaminated with a pesticide with the signal word "DANGER" or "WARNING";

(6) Keep and wash potentially contaminated personal protective equipment separately from other clothing or laundry;

(7) Assure that all clean personal protective equipment is either dried thoroughly before being stored or is put in a well ventilated place to dry;

(8) Assure that personal protective equipment remains the property of the employer and that pesticide handlers are not allowed or directed to take potentially contaminated personal protective equipment into their homes;

(9) Assure that any person or firm assigned or hired to clean or repair potentially contaminated personal protective equipment is protected and informed in accordance with the requirements of Section 6744 (Equipment Maintenance).

(b) The employer shall assure that:
(1) Employees wear protective eyewear when required by pesticide product labeling (except as expressly provided in this section) or when employees are engaged in:
(A) Mixing or loading, except as provided in 6738(i);
(B) Adjusting, cleaning, or repairing mixing, loading, or application equipment that contains pesticide in hoppers, tanks, or lines;
(C) Application by hand or using hand held equipment, except when:
1. Applying vertebrate pest control baits that are placed without being propelled from application equipment;
2. Applying solid fumigants (including aluminum phosphide, magnesium phosphide, and smoke cartridges) to vertebrate burrows;
3. Baiting insect monitoring traps; or
4. Applying non-insecticidal lures.
(D) Ground application using vehicle mounted or towed equipment, except when:
1. Injecting or incorporating pesticides into soil;
2. Spray nozzles are located below the employee and the nozzles are directed downward; or
3. Working in an enclosed cab; or
(E) Flagging, except when the flagger is in an enclosed cab.

(2) Whenever protective eyewear is required, one of the following types of eyewear is worn:
(A) Safety glasses that provide front, and supplemental brow and temple protection (Common eyeglasses, including sunglasses, do not meet this requirement);
(B) Goggles;
(C) Face shield;
(D) Full face mask used in conjunction with respiratory protection; or
(E) Visor (for aircraft operation only).

(c) The employer shall assure that:
(1) Gloves are worn when required by the pesticide product labeling (except as expressly provided in this section) or (unless the pesticide product labeling specifies that gloves must not be worn), when employees are engaged in:
(A) Mixing or loading, except as provided in 6738(i);
(B) Adjusting, cleaning or repairing contaminated mixing, loading, or application equipment; and

(C) Application by hand or using hand-held equipment, except when applying vertebrate pest control baits using long handled implements that avoid actual hand contact with the bait or potentially contaminated areas of equipment.

(2) If a specific type of glove is not specified on product labeling for the pesticide being handled, gloves made of rubber, neoprene, or other chemical resistant material that provides equivalent or better protection are used. Gloves or glove linings of leather, cotton, or other absorbent materials shall not be worn unless expressly permitted by pesticide product labeling. If chemical resistant gloves with sufficient durability and suppleness are not available, leather gloves may be worn over chemical resistant glove liners. Once leather gloves have been used for this purpose, they shall not be worn in any other situation.

(d) The employer shall assure that:

(1) When chemical resistant footwear is specified by the pesticide product labeling, one of the following types of footwear is worn:

(A) Chemical resistant shoes;

(B) Chemical resistant boots; or,

(C) Chemical resistant coverings worn over boots or shoes.

(2) For aircraft operation, chemical resistant footwear need not be worn.

(e) The employer shall assure that when chemical resistant headgear is specified by the pesticide product labeling, either a chemical resistant hood or a chemical resistant hat with a wide brim is worn. For aircraft operation, a helmet may be substituted for chemical resistant headgear.

(f) The employer shall assure that when a chemical resistant apron is specified by the pesticide product labeling, a garment that covers the front of the body from mid-chest to the knees is worn.

(g) The employer shall assure that:

(1) When pesticide product labeling or regulations specify a chemical resistant suit, waterproof or impervious pants and coat or a rain suit, a chemical resistant suit that covers the torso, head, arms, and legs is worn.

(2) If the ambient temperature exceeds 80^{o}F during daylight hours or 85^{o}F during nighttime hours (sunset to sunrise) pesticides requiring a chemical resistant suit are not handled by employees unless they are handled pursuant to exceptions and substitutions permitted in (i) or employees use cooled chemical resistant suits or other control methods to maintain an effective working environment at or below 80^{o}F during daylight hours or 85^{o}F during nighttime hours (sunset to sunrise).

(h) The employer shall assure that:

(1) Employees use approved respiratory protective equipment when pesticide product labeling or regulations require respiratory protection or when

respiratory protection is needed to maintain employee exposure below an applicable exposure standard found in Title 8, California Code of Regulations, and Section 5155.

(2) Respiratory protection required by these regulations or labeling is currently approved by the National Institute for Occupational Safety and Health (NIOSH) and/or the Mine Safety and Health Administration (MSHA) for the specific chemical and exposure condition. Proper selection of respirators shall be made following pesticide product labeling, or absent specific instruction, according to the guidance of National Standard Practices for Respiratory Protection: Z88.2-1980, or the American National Standard Practices of Respiratory Protection During Fumigation: Z88.3-1983.

(3) Written operating procedures for selecting, fitting, cleaning and sanitizing, inspecting and maintaining respiratory protective equipment are adopted.

(4) Employees with facial hair that prevents an adequate seal are not assigned work requiring them to wear a respirator unless they are provided a respirator that does not rely on a face-to face piece seal for proper operation.

(5) Respirators maintained for stand-by or emergency use is inspected monthly or before use if occasions for possible use are more than one month apart. A record of the most recent inspection shall be maintained on the respirator or its storage container.

(6)(A) Employees are informed, prior to beginning work that certain medical conditions may interfere with wearing a respirator while engaged in potential pesticide exposure situations. A statement in substantially the following form shall be on file for each employee assigned to work that requires wearing a respirator.

> To the best of my knowledge, I have_____, have no_____ medical conditions which would interfere with wearing a respirator while engaged in potential pesticide exposure situations. I understand that heart disease, high blood pressure, lung disease or presence of a perforated ear drum are examples of conditions that require specific medical evaluation by a physician before safe use of a respirator can be determined.
>
> _____
> Name
>
> _____
> Date

(B) If an employee checks that he or she has such a condition, a physician's report of evaluation and approval for respirator use is on file before work

requiring respirator use is allowed. The following or substantially similar statement from a physician is acceptable.

On_____, I examined _____.
Date Patient's name

At this time there is no medical contraindication to the employee named above wearing a respirator to allow working in potential pesticide exposure environments. (Other comments)

_____
_____
_____
_____
_____
_____
_____
_____
_____
Physician

Date

(7) Compressed air used in Self Contained Breathing Apparatus (SCBA) or for air-line type respirators meets or exceeds the requirements for Grade D breathing air as described in the Compressed Gas Association Commodity Specification G-7.1 (ANSI Z86.1-1973).

(8) When air purifying-type respirators are required for protection against pesticides, the air purifying elements or entire respirator, if disposable, are replaced according to pesticide product labeling directions or respiratory equipment manufacturer recommendations, whichever provides for the most frequent replacement, or, absent any other instructions on service life, at the end of each day's work period. At the first indication of odor, taste, or irritation, the wearer leaves the area and checks the respirator for fit or function concerns or air purifying element replacement.

(i) The following exceptions and substitutions to personal protective equipment required by pesticide product labeling or regulations are permitted:

(1) Persons using a closed system to handle pesticide products with the signal word "DANGER" or "WARNING" may substitute coveralls, chemical resistant gloves, and a chemical resistant apron for personal protective equipment required by pesticide product labeling;

(2) Persons using a closed system to handle pesticide products with the signal word "CAUTION" may substitute work clothing for personal protective equipment required by pesticide product labeling;

(3) Persons using a closed system that operates under positive pressure shall wear protective eyewear in addition to the personal protective equipment listed in (1) or (2). Persons using any closed system shall have all personal

protective equipment required by pesticide product labeling immediately available for use in an emergency;

(4) Persons properly mixing pesticides packaged in water soluble packets are considered to be using a closed (mixing) system for the purposes of this subsection;

(5) Persons occupying an enclosed cab (including cockpit) may substitute work clothing for personal protective equipment required by pesticide product labeling. If respiratory protection is required it must be worn, except in an enclosed cockpit;

(6) Persons occupying an enclosed cab acceptable for respiratory protection may substitute work clothing for personal protective equipment required by pesticide product labeling;

(7) Persons working in an enclosed cab, as specified in (5) and (6), other than an aircraft, shall have all personal protective equipment required by pesticide product labeling immediately available and stored in a chemical resistant container, such as a plastic bag. Labeling-required personal protective equipment shall be worn if it is necessary to work outside the cab and contact pesticide treated surfaces in the treated area. Once personal protective equipment is worn in the treated area, it shall be removed and stored in a chemical resistant container, such as a plastic bag, before reentering the cab;

(8) A chemical resistant suit may be substituted for coveralls and/or a chemical resistant apron; and

(9) Pest control aircraft pilots are not required to wear gloves during operation but gloves shall be worn by any person entering or exiting an aircraft contaminated with pesticide residues. While in the cockpit, gloves shall be carried in a chemical resistant container, such as a plastic bag.

INFORMATIONAL NOTE FOR Section 6738(e): ANSI Z86.1 specifies in summary: Oxygen 19.5 to 23.5%, Hydrocarbons less than 5 mg/m^3 at normal temperature and pressure, Carbon Monoxide less than 20 ppm, no pronounced odor, Carbon Dioxide less than 1000 ppm.

NOTE: Authority cited: Sections 11456 and 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6740. Adequate Light.

Whenever natural light in a mixing/loading area is not adequate to allow an employee to read the label and work in a safe manner, artificial light shall be provided in such areas that are sufficient to perform these activities.

NOTE: Authority cited: Sections 11456 and 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6742. Safe Equipment.

(a) The employer shall assure that equipment used for mixing, loading, transferring, or applying pesticides is inspected before each day of use and equipment with any safety defect is repaired or altered to remove the hazard before further use.

(b)(1) All openings on tanks used for mixing or applying pesticides shall be equipped with covers that will prevent splashes and spills.

(2) Flexible hoses carrying liquid pesticides in toxicity categories one or two under pressure shall not pass unshielded through the cockpit of an airplane or helicopter.

(3) Shut-off devices shall be installed on the exit end of all hoses carrying liquid pesticides in toxicity categories one or two from mixing tanks that are adequate to prevent splashes onto the employee doing the loading when filling operations are stopped and the filler hose is removed from the inlet to the tank of the application vehicle. As an alternative, a reversing action pump, or similar system, may be used that will empty the hose and eliminate dripping of liquid from the end of the hose when the filling operation is stopped.

(4) Each tank, with a capacity of more than 49 gallons, that is used to mix or apply any liquid mixture derived from a pesticide in toxicity categories one or two, shall have either:

(A) A properly functioning means to indicate externally the internal liquid level in the tank such as a sight gauge; or

(B) The tank or the filler hose nozzle shall have a device that will automatically stop the filling operation before the pesticide liquid mixture spills over the top.

NOTE: Authority cited: Section 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6744. Equipment Maintenance.

Persons who own or operate pesticide mixing, loading, or application equipment shall inform each employee under their control who may be involved in the cleaning, servicing or repair of that equipment of the hazards of the pesticides that a person may encounter, and the methods of protecting against personal injury. If such cleaning, servicing or repairing is to be performed by persons not under the control of the owner or operator of the equipment, he/she shall so notify the person in charge of performing these services. Employees who clean, service, or repair mixing and application equipment shall be provided with any necessary protective equipment or clothing by their employer, and shall be instructed and supervised in the maintenance operation in a manner that will reduce work hazards.

NOTE: Authority cited: Sections 11456 and 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

6746. Closed Systems.

(a) Employers shall provide closed systems for employees who mix or load liquid pesticides in toxicity category one, or load diluted liquid mixes derived from dry pesticides in toxicity category one, for the production of an agricultural commodity. No employee shall be permitted to transfer, mix, or load these pesticides except through a closed system. The system's design and construction shall meet the director's closed-system criteria.

(b) The requirements of this Section do not apply to:

(1) Employees who handle a total of one gallon or less of pesticides in toxicity category one per day exclusively in original containers of one gallon or less; or

(2) Regulatory personnel collecting samples of pesticides according to official sampling procedures.

NOTE: Authority cited: Sections 11456 and 12981, Food and Agricultural Code.

Reference: Sections 12980 and 12981, Food and Agricultural Code.

APPENDIX J – Medical Emergency Contact Telephone Numbers

SACRAMENTO COUNTY Mercy General Hospital 4001 J Street, Sacramento (916) 453-4545	**NORTH DELTA** Lodi Memorial Hospital 975 S. Fairmont, Lodi (800) 323-3360
MIDDLE DELTA, San Joaquin C	
US Health Works 3663 E. Arch Road, Ste. 400, Stockton (209) 943-2202	Dameron Hospital 525 W. Acacia, Stockton (209) 944-5550
St. Joseph's Hospital 1800 North California Street, Stockton (209) 943-2000	San Joaquin General 500 West Hospital Road, French Camp (209) 468-6000
WEST DELTA, CONTRA COSTA COUNTY	
Sutter Delta Medical Center 3901 Lonetree Way, Antioch (925) 779-7200	Kaiser Foundation 3400 Delta Fair Boulevard, Antioch (925) 779-5000
SOUTH DELTA TRACY	
Sutter Tracy Community Hospital 1420 North Tracy Boulevard, Tracy (209) 835-1500	Doctor's Hospital 1205 East North, Manteca (209) 823-3111
MODESTO, CERES, AND SOUTH	
Memorial Hospital 1700 Coffee Road, Modesto (209) 526-4500	Doctor's Medical Center 1441 Florida Avenue, Modesto (209) 578-1211
Stanislaus Medical Center – Urgent Care 830 Scenic Drive, Modesto (209) 558-7212	Stanislaus Medical Center 1900 Memorial Drive, Ceres (209) 541-2929
MERCED COUNTY Merced Community Medical Center 301 E. 13th Street, Merced (209) 385-7000	**FRESNO COUNTY** St. Agnes Hospital 1303 E. Herndon Avenue, Fresno (559) 450-3000

APPENDIX J(1) – Medical Emergencies (American Red Cross)

APPENDIX J(2) – Spill Emergency Contact Telephone Numbers

State Agencies/Departments		
Contact Agency	Contact Name	Telephone Number
1. California Department of Fish and Game, Office of Spill Prevention and Response		(916) 445-9338 *24-Hour Response* (916) 445-0045
2. California Regional Water Quality Control Board (Central Valley)	Rudy Schnagl	(916) 255-3101
3. California Office of Emergency Services		(916) 464-3230

Local Government Agencies/Departments				
County	Agricultural Commissioners Office	Sheriff's Office	California Highway Patrol	Health Services Department
Contra Costa	(925) 646-5250	(925) 335-1500	(925) 646-4980	(925) 646-2286
Fresno	(559) 456-7510	(559) 488-3121	(559) 441-5441	(559) 445-3357
Kings	(559) 582-3211 X 2831	(559) 582-3211 X 2790	(559) 582-0231	(559) 584-1411
Sacramento	(916) 875-6603	(916) 874-5115	(916) 338-6710	(916) 875-8484
San Joaquin	(209) 468-3300	(209) 468-4570	(209) 943-8666	(209) 468-3420
Solano	(707) 421-7465	(707) 421-6330	(707) 428-2100	(707) 784-8600
Stanislaus	(209) 525-4730	(209) 525-7216	(209) 545-7440	(209) 558-7000
Yolo	(530) 666-8140	(530) 666-6612	(530) 622-4685	(530) 666-8646

Department of Boating and Waterways			
Name	Title	Telephone	Cellular Telephone
Field			
Paul Ryan	Field Supervisor	(916) 263-8143	(916) 416-6981
Terri Ely	Office Supervisor (Designee)	(916) 263-8138	(916) 416- 9284
Office			
Marcia Carlock	Aquatic Weed Unit Manager	(916) 263-8142	(916) 417-0075
Geoff Newman	Environmental Scientist	(916) 274-6126	(916) 240-8723
Carrie Holler	Daily Logs/Daily Recording/ NOIs	(916) 263-6676	(916) 240-8724
Terri Ely	Staff Environmental Scientist	(916) 416-9284	(916) 263-8138
Paul Ryan	Environmental Scientist	(916) 263-8143	(916) 416-6981
Doreene Smith	Electronic Data Problems, Mapping	(916) 263-6703	
Cate Schmeidt	NOI/Office Asst.	(916) 263-8135	

APPENDIX K – Notice of Intent to Operate (NOI)

This appendix includes a copy of a Notice of Intent to Operate (NOI) Summary for the week of October 15th, 2007. The NOI summary specifies the following information for the week:

NOI date and time
County (Contra Costa, Solano, Sacramento, San Joaquin, Stanislaus)
Intended sites to treat
Dates planned to treat
Applicator name and telephone number.

APPENDIX L – Environmental Checklists

This appendix includes a copy of a completed Environmental Observations Checklist. Staff should make sure to check boxes related to Fish Take (yes/no), **Giant Garter snake observed (yes/no)**, and number of Elderberry bushes observed (0, or a number). These boxes should be checked and a form completed even if none of these species are observed.

APPENDIX M – MOU with Water Agencies

This appendix includes a copy of the Memoranda of Understanding (MOU) that the DBW has with the following water agency:

- Contra Costa Water Department

The MOU identifies that applications within one mile of these water agency's water intakes cannot occur without concurrence from a district representative (noted in the MOU).

APPENDIX N – Ounce to Gallon Conversion Table

Ounce	Gallon	Ounce	Gallon	Ounce	Gallon	Ounce	Gallon
1	0.01	40	0.31	79	0.62	118	0.92
2	0.02	41	0.32	80	0.63	119	0.93
3	0.02	42	0.33	81	0.63	120	0.94
4	0.03	43	0.34	82	0.64	121	0.95
5	0.04	44	0.34	83	0.65	122	0.95
6	0.05	45	0.35	84	0.66	123	0.96
7	0.05	46	0.36	85	0.66	124	0.97
8	0.06	47	0.37	86	0.67	125	0.98
9	0.07	48	0.38	87	0.68	126	0.98
10	0.08	49	0.38	88	0.69	127	0.99
11	0.09	50	0.39	89	0.70	128	1.00
12	0.09	51	0.40	90	0.70		
13	0.10	52	0.41	91	0.71		
14	0.11	53	0.41	92	0.72		
15	0.12	54	0.42	93	0.73		
16	0.13	55	0.43	94	0.73		
17	0.13	56	0.44	95	0.74		
18	0.14	57	0.45	96	0.75		
19	0.15	58	0.45	97	0.76		
20	0.16	59	0.46	98	0.77		
21	0.16	60	0.47	99	0.77		
22	0.17	61	0.48	100	0.78		
23	0.18	62	0.48	101	0.79		
24	0.19	63	0.49	102	0.80		
25	0.20	64	0.50	103	0.80		
26	0.20	65	0.51	104	0.81		
27	0.21	66	0.52	105	0.82		
28	0.22	67	0.52	106	0.83		
29	0.23	68	0.53	107	0.84		
30	0.23	69	0.54	108	0.84		
31	0.24	70	0.55	109	0.85		
32	0.25	71	0.55	110	0.86		
33	0.26	72	0.56	111	0.87		
34	0.27	73	0.57	112	0.88		
35	0.27	74	0.58	113	0.88		
36	0.28	75	0.59	114	0.89		
37	0.29	76	0.59	115	0.90		
38	0.30	77	0.60	116	0.91		
39	0.30	78	0.61	117	0.91		

Other conversion factors:
# of Acres x 0.405 = # of Hectares
# of Hectares / 0.405 = # of Acres

APPENDIX O – Daily Log

This appendix includes a copy of a blank and completed daily log for the WHCP.

APPENDIX P – Pesticide Use Report

This appendix includes a copy of a Monthly Pesticide Use Report completed in October, 2008. The Pesticide Use Report includes:

The manufacturer and name of product
EPA/California registration number (from label)
Total product used
Number of applications
Code (chose code 100, see form for description)
Site treated
Acres treated.

Pesticide Use Reports currently are prepared at Headquarters Offices based on data accumulated by DBW administrative staff.

APPENDIX Q – Drinking Water Intake Locations

APPENDIX R – ENDANGERED SPECIES & OTHER SPECIES OF CONCERN

APPENDIX S – NEW INVASIVE SPECIES

Appendix D
WHCP Fish Passage Protocol

Water Hyacinth Control Program
Fish Passage Protocol

Background

Water hyacinth (Eichhornia crassipes) is a non-native, free-floating aquatic macrophyte. Water hyacinth was first reported in California in 1904, and by the early 1980s, had become a significant problem for agriculture, boating and recreation, and wildlife in the Sacramento San Joaquin Delta and its tributaries. Water hyacinth is characterized by showy lavender flowers and thick, highly glossy leaves up to ten inches across. The plant grows from 1 ½ to 4 feet in height, and the floating portion of the plant can grow to more than four feet in diameter. In the Delta, the plant is found in sloughs, connecting waterways, and tributary rivers. The growing season for water hyacinth in the Delta is typically from March to early December. Water hyacinth spreads and grows rapidly under favorable temperature and nutrient conditions such as those found in the Delta in the summer months, and mats may double in surface area in six to fifteen days.

In 1982, SB 1344 amended the California Harbors and Navigation Code to designate the California Department of Boating and Waterways (DBW) as the lead agency for controlling water hyacinth in the Delta, its tributaries, and the Suisun Marsh. The DBW developed an interagency task force to coordinate the control activities of federal, state, and local interests and to resolve problems and concerns associated with public health and safety, and environmental impacts. The Task Force's primary role has been to review results of the previous year's treatment program and to develop and approve the water hyacinth treatment protocol each year. The DBW initiated the water hyacinth control program (WHCP) in 1983. The primary treatment method has been chemical. Almost 97 percent of the treatment uses 2,4-Dichlorophenoxyacetic acid, dimethlyamine salt (2,4-D), with limited amounts of diquat and glyphosate used in special circumstances. Treatment is typically conducted with hand-held sprayers from 19 to 21 foot aluminum air or outboard motor boats. The boats are equipped for direct metering of herbicides, adjuvants, and water into pump systems. Trained field crews spray the chemical mixture directly onto the plants. For the seventeen years between 1983 and 1999, the DBW treated between 160 and 2,700 acres of water hyacinth a year with no known measurable water quality or environmental degradation, including impacts on fish.

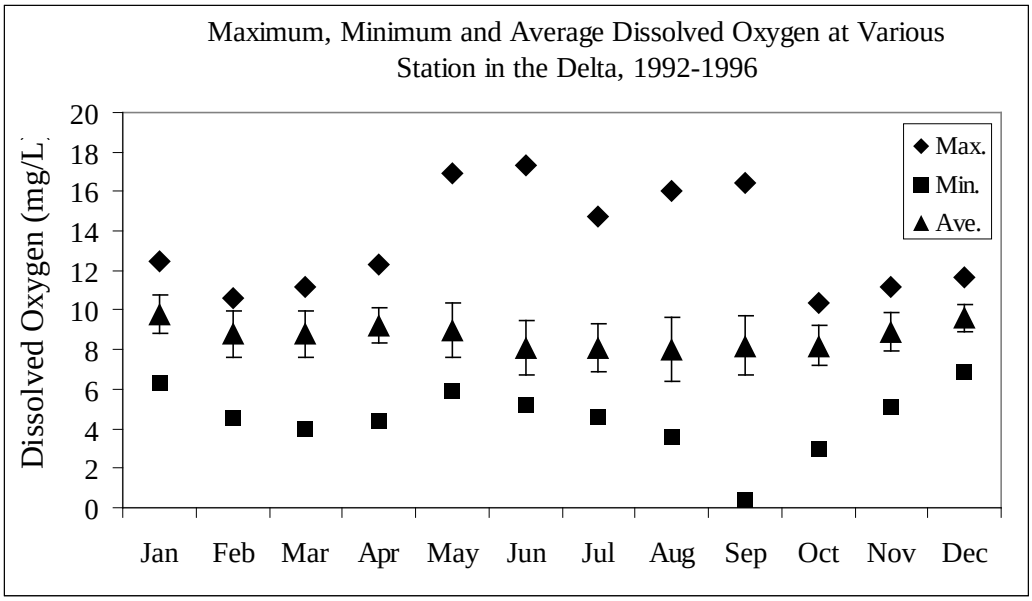
The DBW and cooperating counties halted the WHCP in 2000 after a legal action from the Delta Keepers claimed that the DBW must obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Central Valley Regional Water Quality Control Board (CVRWQCB). The DBW applied for the NPDES permit in January 2000, and the CVRWQCB developed permit conditions in October 2000, but did not issue a permit. In March 2001, the State Water Board issued the DBW a NPDES permit for the WHCP, incorporating most of the conditions developed by the CVRWQCB. One of the conditions requires the DBW to develop a protocol to be followed to ensure that the WHCP operations provide a zone of passage to fish at all times. This letter describes the fish passage protocol. The DBW also prepared a biological assessment for the WHCP in February 2001, and in June 2001 received a biological opinions and Section 7 permits for

the program. Conditions in the permits by the U.S. Fish and Wildlife Service and the National Marina Fisheries Service also promote fish passage in the Delta waters.

Dissolved Oxygen and Water Hyacinth

Dissolved oxygen (DO) 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/liter. DO levels drop in warmer temperatures, and increase with precipitation, wind, and water flow. Running water, such as the 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. As illustrated in **Exhibit 1**, DO levels measured at various locations in the Delta averaged between 8 and 9.8 mg/l.

Exhibit 1.



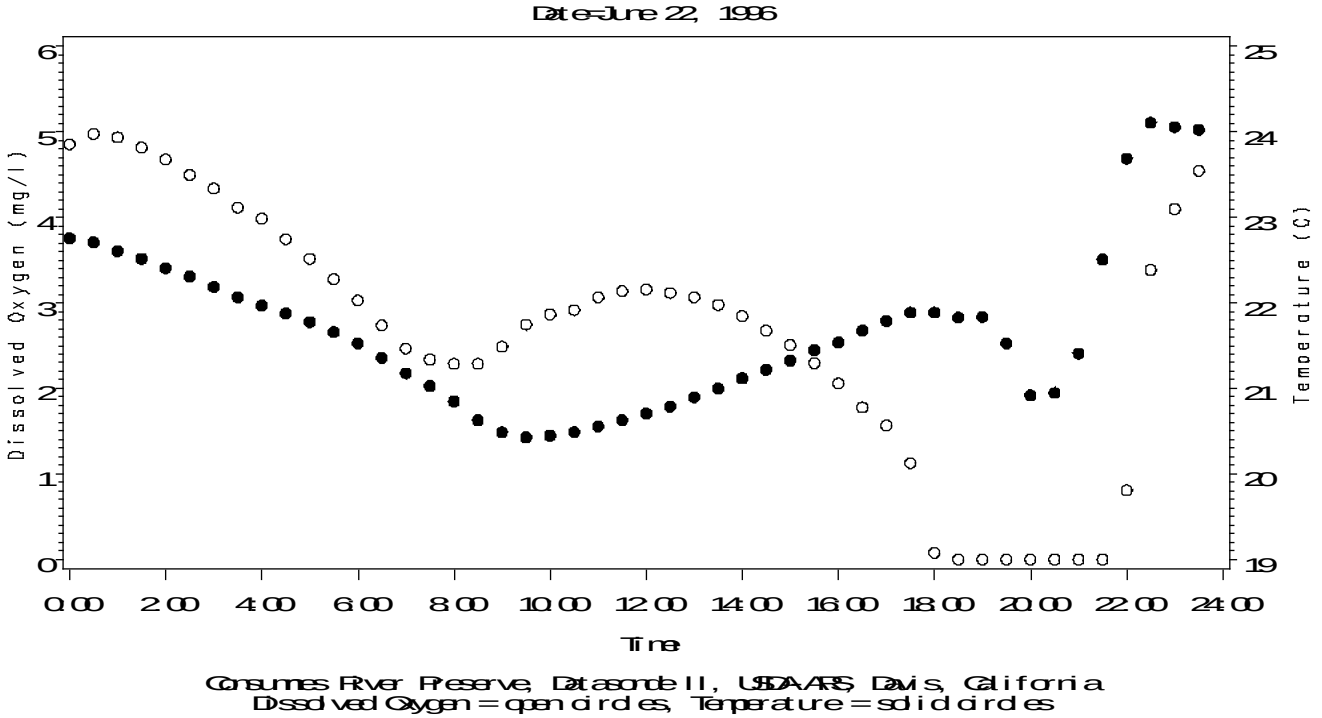
Concern exists that, following herbicide treatment, the biomass of decaying plant material will create a large biological oxygen demand, resulting in decreases in dissolved oxygen. The DBW recognizes that decaying water hyacinth has the potential to reduce DO levels. The label for Weedar 64 (2,4-D) notes that decaying weeds use up oxygen, and recommend treating only one half of a lake or pond to avoid fish kill. In larger areas of coverage in lakes and ponds, the label recommends leaving 100-foot strips. The label also recommends repeating treatment as necessary to kill regrowth and water hyacinth plants missed in the previous operation. For Rodeo (glyphosate), the label recommends treating the area in strips when there is full coverage of the weed in impounded areas to

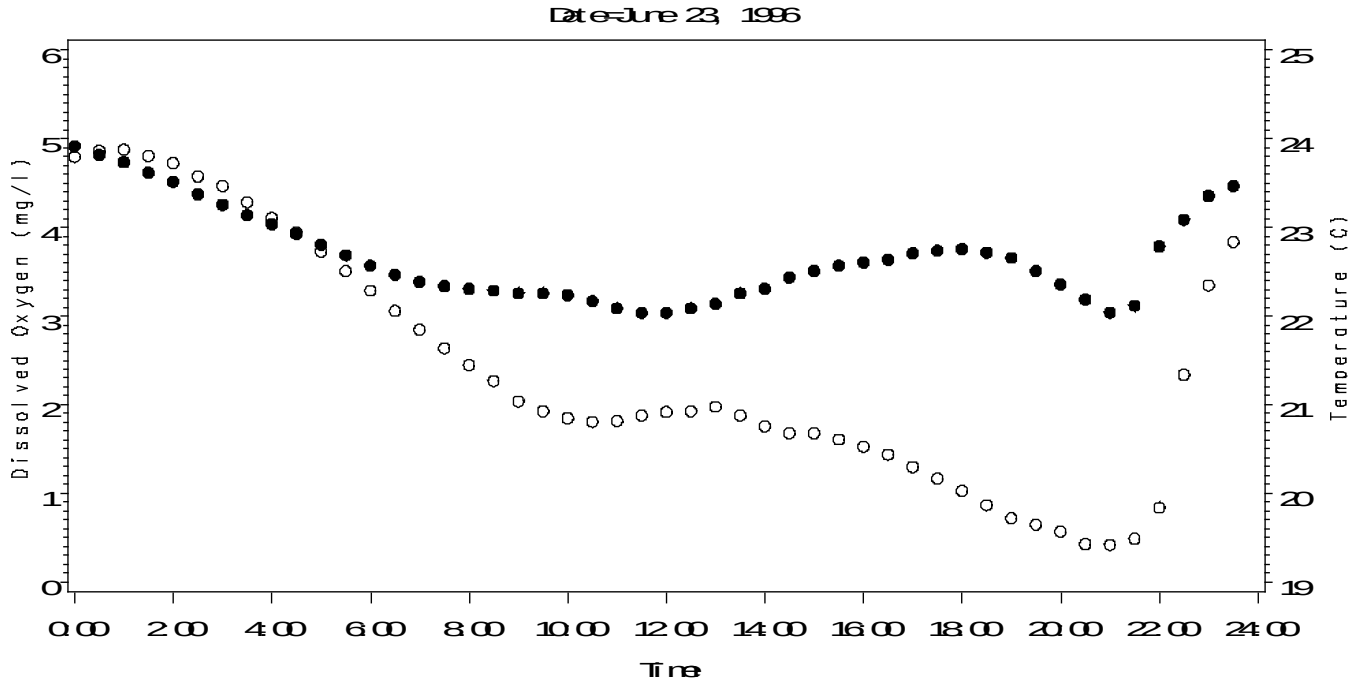
prevent oxygen depletion. Similarly, the Reward (diquat) label recommends treating only one half to one third of a water body at a time to avoid fish suffocation.

The DBW also contends that existing DO levels in large mats are already low, and that with adequate avoidance measures, further decreases in dissolved oxygen that would impede fish passage can be avoided and/or minimized. Large patches of water hyacinth can cause low dissolved oxygen levels (Toft 2000). Data summarized below indicate that DO levels under water hyacinth mats are lower than DO levels elsewhere in the Delta. In a study of DO in aquatic weeds in Texas, water hyacinth was found to have the lowest DO levels as compared to milfoil, hydrilla, pondweed, and a mix of native species, and was the only plant to have DO levels below 5 mg/l (Madsen 1997 in Toft). Toft found average spot DO measurements below 5 mg/l for water hyacinth and above 5 mg/l for pennywort (Toft 2000).

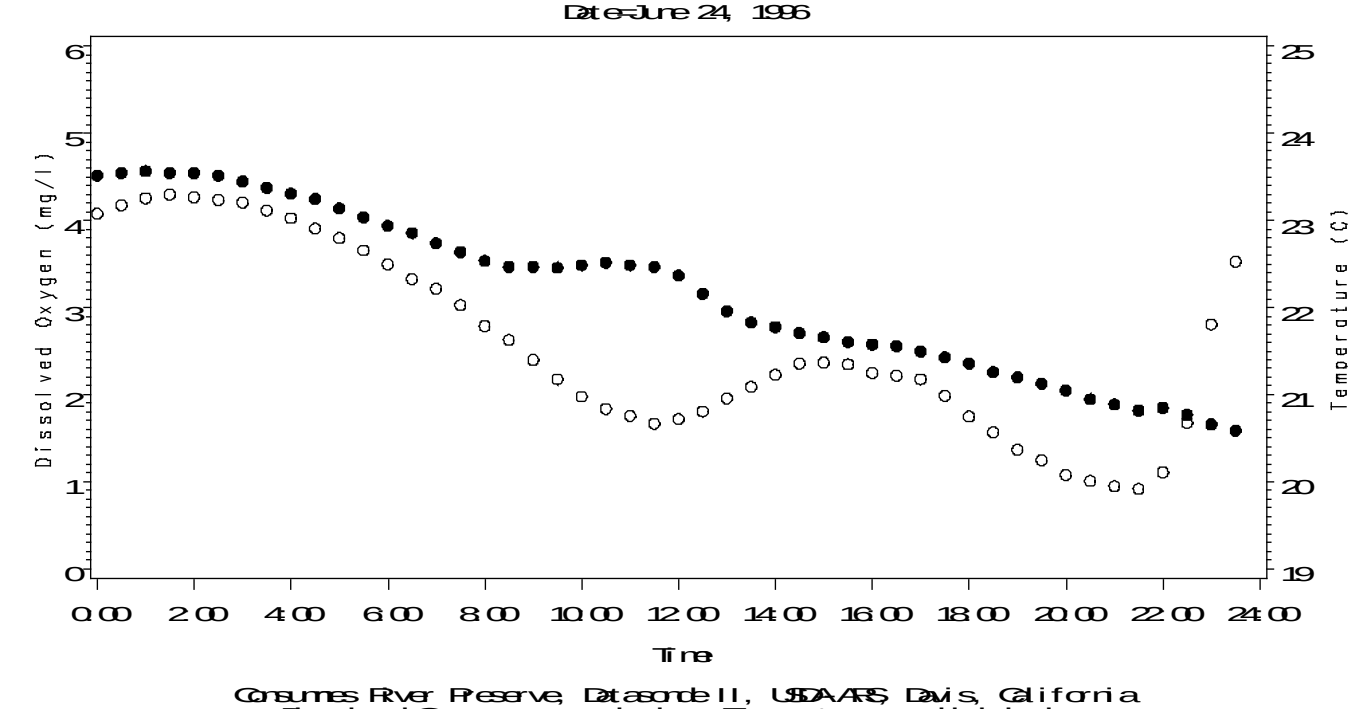
Research in the Delta conducted by the United States Department of Agriculture, Agricultural Research Service measured DO levels every half-hour under a large mat of water hyacinth that completely covered a 15-meter wide slough on the Consumnes River Nature Preserve. The slough was subject to tidal flows. Over a four-day period in June 1996 DO levels each day ranged from 0mg/l to just over 5mg/l. Only about 5 of 200 data points measured under the mat were above 5mg/l, and the vast majority of the data points were between 2 mg/l to 4mg/l (Spencer 2001). The results of the DO testing are shown in **Exhibit 2**. This data indicates that large infestations of water hyacinth across waterways, such as those that have occurred on the Merced and San Joaquin Rivers prior to treatment are likely to impede the passage of fish.

Exhibit 2. Four graphs depicting datasonde results under a dense mat of water hyacinth plants in a slough on the Consumnes River Nature Preserve.

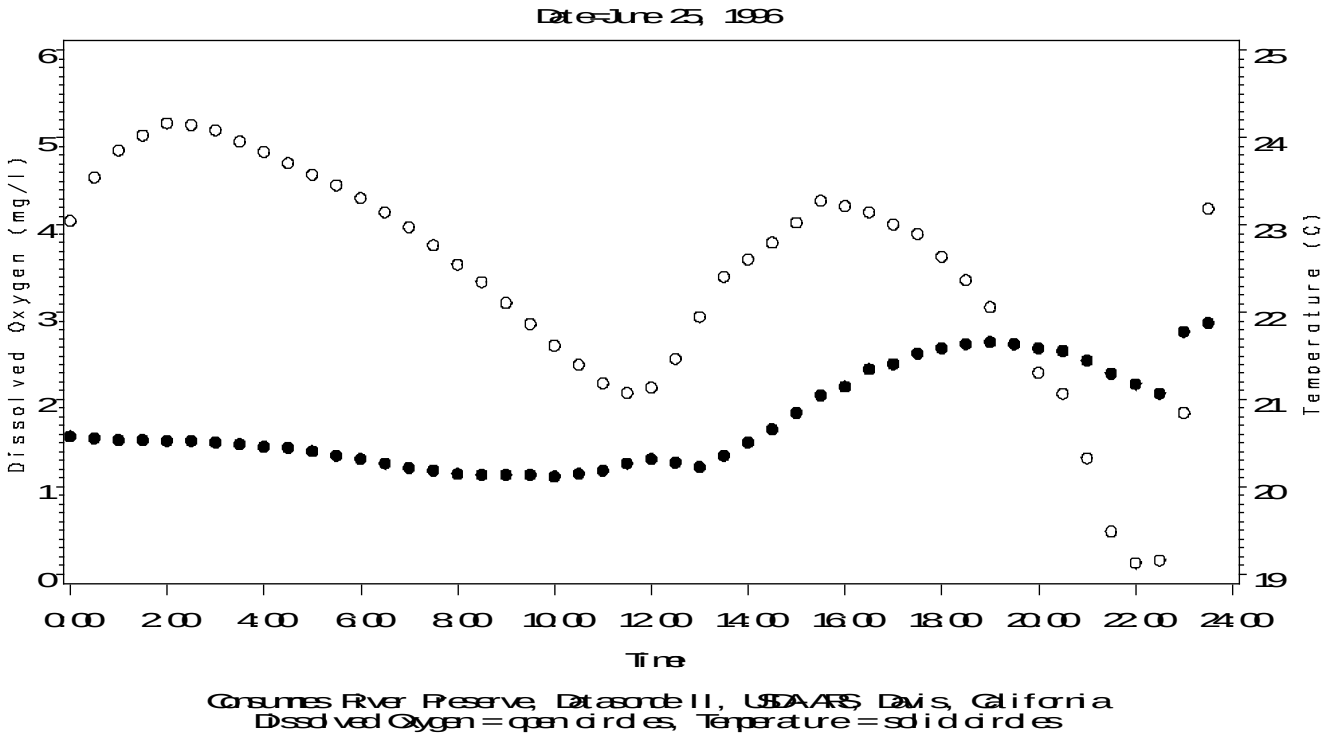




Consumnes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles



Consumnes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles



Consumnes River Preserve, Datasonde II, USDA-ARS, Davis, California
Dissolved Oxygen = open circles, Temperature = solid circles

Decreases in DO resulting from treatment of water hyacinth are likely to be short-term since the Delta is a flowing rather than a standing water system. One of the long-term benefits of treating with herbicides is a reduction in the volume of water hyacinth in the Delta. Removing large patches of water hyacinth will allow DO levels to increase, thus enhancing the ability of fish to move unimpeded in Delta waters. It can be argued that such a benefit outweighs the impact of short-term localized decreases in dissolved oxygen.

Fish Passage Protocol

The DBW will take the following steps to ensure that the WHCP operations provide a zone of passage for fish:

1. For each site, the DBW staff shall treat no more than three (3) contiguous acres. After treating three maximum acres, staff must then skip at least one adjacent site before treating another site. DBW staff may not treat skipped sites until two tidal changes have occurred or, in non-tidal areas, until the next day.

2. DO levels will be measured and the DBW will treat according to permit conditions.

3. For completely infested dead-end sloughs greater than one acre, DBW staff shall treat no more than half the area at one time to allow for fish passage. The DBW will return to treat the remaining half according to the label instructions and permit conditions.

4. For completely infested moving waterways, such as across the entire width of a river, the DBW shall treat no more than half the area at one time, to allow for fish passage. The DBW will not treat the remaining area until the water hyacinth is decomposed or until a passage has opened up in the waterway.

5. If the DO levels in an area to be treated are at a level considered to be detrimental to fish species prior to treatment, the DBW may treat the entire area, therefore allowing the DO levels to increase once the water hyacinth is controlled.

References

DBW. 2001. *Egeria densa* Control Program Volume III: Response to Comments. Sacramento: California Department of Boating and Waterways. 90pp.

DBW. 2001. Water Hyacinth Control Program Biological Assessment. Sacramento: California Department of Boating and Waterways. 125pp.

Spencer, David. 2001 Personal communication and unpublished data. United States Department of Agriculture, Agricultural Research Service. Davis, California.

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.

United States Environmental Protection Agency. Dissolved oxygen and biochemical oxygen demand, in Monitoring Water Quality. Washington D.C.: EPA Office of Water. http://www.epa.gov/owowwtr1/monitoring/volunteer/stream/vms52.html. 11pp.

Appendix E
WHCP Environmental Checklist

Appendix E
WHCP Environmental Checklist

This appendix provides a summary checklist of WHCP activities to be conducted by the DBW in order to maintain compliance with the PEIR mitigation measures; WHCP Operations Management Plan (OMP); and USFWS, NOAA-Fisheries, and NPDES permits. There are two separate checklists, one for supervisors/environmental scientists (**Exhibit E-1**), and one for the field crew (**Exhibit E-2**). We include activities to be conducted by the Field Supervisor in the first checklist. Each checklist is divided chronologically into (1) Planning/Pre-Season; (2) In-Season; and (3) Post-Season. Following each activity, we identify the activity source – either a PEIR mitigation measure number, the WHCP Operations Management Plan (OMP), or both. Federal permit requirements are incorporated into the mitigation measures and OMP.

Table E-1, on the next page, provides a listing of the 22 mitigation measures following the same responsible party/chronology classification. Some mitigation measures appear in both the Supervisor/Environmental Scientist column, and the Field Crew column. One mitigation measure, #7 (Implement an adaptive management approach to minimize the use of herbicides) appears in all time periods for the Supervisor/Environmental Scientist, because it is a foundation of all WHCP activities.

Table E-1
WHCP Mitigation Measures by Responsible Party and Time Period

		Supervisor/Environmental Scientist Activities		Field Crew Activities
Planning/ Pre-Season	7.	Implement an adaptive management approach to minimize the use of herbicides	18.	Require treatment crews to participate in training on herbicide and heat hazards
	8.	Provide treatment crews with electronic mapping that identifies previously surveyed areas for giant garter snake habitat		
	18.	Require treatment crews to participate in training on herbicide and heat hazards		
In-Season	5.	Implement temporal and spatial limitations and restrictions on herbicide treatments to minimize treatments during times, and at locations, where larval and/or migratory fish are likely to be present	1.	Avoid herbicide application near special status species, and sensitive riparian and wetland habitat; and other biologically important resources
	6.	Monitor herbicide and adjuvant levels to ensure that the WHCP does not result in potentially toxic concentrations of chemicals in Delta waters	2.	Provide a 250 foot buffer between treatment sites and shoreline elderberry shrubs (*Sambucus* ssp.), host plant for the valley elderberry longhorn beetle *(Desmocerus californicus dimorphus)*
	7.	Implement an adaptive management approach to minimize the use of herbicides	3.	Conduct herbicide treatments in order to minimize potential for drift
	14.	Conduct handpicking and herding only during winter	4.	Operate program vessels in a manner that causes the least amount of disturbance to the habitat
	20.	Implement safety precautions on hot days to prevent heat illness	9.	Monitor dissolved oxygen levels pre- and post-treatment for all WHCP treatments
	21.	Follow the Memorandum of Understanding (MOU) protocol for herbicide applications within one (1) mile of Contra Costa Water District (CCWD) drinking water intake facilities	10.	Treat no more than three contiguous acres at any treatment site
	22.	Notify County Agricultural Commissioners about WHCP activities	11.	Treat no more than one-half of the area of completely infested dead-end sloughs to allow for fish passage
			12.	Treat no more than one-half of completely infested moving waterways at one time to allow for fish passage
			13.	Use dip nets during and immediately following treatment to collect plant fragments
			15.	Identify and utilize disposal areas that have no and/or low habitat value for the federal and State listed giant garter snake *(Thamnophis gigas)*
			16.	Identify and utilize disposal areas that are at least 100 feet away from elderberry shrubs (*Sambucus* ssp.)
			17.	Minimize public exposure to herbicide treated water
			19.	Follow best management practices to minimize the risk of spill and to minimize the impact of a spill, should one occur
			20.	Implement safety precautions on hot days to prevent heat illness
Post-Season	7.	Implement an adaptive management approach to minimize the use of herbicides		

Checklist #1 – Supervisor/Environmental Scientist Activities

Planning/Pre-Season

- ☐ 1. Obtain and update records for crew Qualified Applicator Certificates (QAC) and continuing education. (OMP)
- ☐ 2. Ensure that the WCHP is utilizing the most recent herbicide labels and MSDS, and provide training to crews on reading, understanding, and following herbicide label requirements. (OMP)
- ☐ 3. Prepare and conduct environmental awareness training for treatment crews. (OMP)
- ☐ 4. Prepare and conduct training on use of field equipment for treatment crews. (OMP)
- ☐ 5. Conduct herbicide handling training for the field staff, in accordance with Title 3, Food and Agriculture, Division 6 of the California Code of Regulations, "Pesticides and Pest Control Operations." (OMP)
- ☐ 6. Require treatment crews to participate in training on herbicide and heat hazards (Mitigation #18)
- ☐ 7. Provide treatment crews with electronic mapping that identifies previously surveyed areas for giant garter snake habitat. (Mitigation #8 and OMP)
- ☐ 8. Provide treatment crews with a Delta map that specifies the date when treatment can begin at specific sites throughout the Delta. (OMP)
- ☐ 9. Prepare Pesticide Use Recommendations (PUR) for all application areas. The PUR must be prepared by a licensed Pest Control Advisor (PCA), and submitted to the County Agricultural Commissioner (CAC) offices. (OMP)
- ☐ 10. Obtain a Restricted Use Permit (RUP) from CAC offices, if necessary. Communicate RUP provisions to application crews. (OMP)
- ☐ 11. Prepare a prioritized list of treatment sites based on current field observations, prior infestation history, and staff knowledge. (OMP)
- ☐ 12. Develop a plan and tentative schedule for water sampling required to fulfill USFWS, NOAA-Fisheries, and NPDES permit requirements. (OMP)
- ☐ 13. Implement an adaptive management approach to minimize the use of herbicides. (Mitigation #7)

In-Season

- ☐ 1. Prepare and submit Notices of Intent (NOI) for each week, and submit to the appropriate County Agricultural Commissioner (CAC) and field offices (to be completed by the Aquatic Pest Control Field Supervisor); notify County Agricultural Commissioners about WHCP activities. (Mitigation #22, OMP)
- ☐ 2. Update the prioritized list of treatment sites based on new information, as appropriate.
- ☐ 3. Implement temporal and spatial limitations and restrictions on herbicide treatments to minimize treatments during times, and at locations, where larval and/or migratory fish are likely to be present. (Mitigation #5)
- ☐ 4. 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 #21)
- ☐ 5. Monitor herbicide and adjuvant levels to ensure that the WHCP does not result in potentially toxic concentrations of chemicals in Delta waters. (Mitigation #6)

CHECKLIST #1 – SUPERVISOR/ENVIRONMENTAL SCIENTIST ACTIVITIES

Exhibit E-1
Checklist #1 – Supervisor/Environmental Scientist Activities *(continued)*

In-Season (continued)
☐ 6. Coordinate with treatment crews and conduct water sampling, as required, throughout the season. (OMP)
☐ 7. Notify application crews one week in advance of a planned treatment when conducting water sampling at that planned treatment. (OMP)
☐ 8. Conduct a survey of elderberry shrubs at the beginning and end of the treatment season to compare the health of elderberry shrubs at control and treatment sites. (OMP)
☐ 9. Cancel applications when wind and/or weather could be a factor in worker safety, and/or compromise the effectiveness of an application. (OMP)
☐ 10. Consult with field crews regarding presence of an Endangered Species in planned treatment areas. (OMP)
☐ 11. Enter and review Daily Log information from the field crews on at least a weekly basis. (OMP)
☐ 12. Prepare a Pesticide Use Report for the appropriate CACs each month. (OMP)
☐ 13. Conduct handpicking and herding only during winter (Mitigation #14)
☐ 14. Implement safety precautions on hot days to prevent heat illness. (Mitigation #20)
☐ 15. Implement an adaptive management approach to minimize the use of herbicides. (Mitigation #7)

Post-Season
☐ 1. Prepare Water Hyacinth Control Program Annual Report, including information required for USFWS, NOAA-Fisheries, and NPDES permits. (OMP)
☐ 2. Update WHCP Operations Management Plan. (OMP)
☐ 3. Implement an adaptive management approach to minimize the use of herbicides. (Mitigation #7)

CHECKLIST #1 – SUPERVISOR/ENVIRONMENTAL SCIENTIST ACTIVITIES

Checklist #2 – Field Crew Activities

Planning/Pre-Season

- ☐ 1. At least one member of all two-person crews (the Aquatic Pest Control specialist) must obtain a Qualified Applicators Certificate (QAC) from the California Department of Pesticide Regulation (DPR). Aquatic Pest Control technicians are encouraged to work toward obtaining a QAC. (OMP)
- ☐ 2. Read, understand, and be able to follow herbicide label requirements. (OMP)
- ☐ 3. Participate in environmental awareness training, and in particular become familiar with avoidance measures for delta smelt, Chinook salmon, giant garter snake, and valley elderberry. (OMP)
- ☐ 4. Participate in herbicide handling training. (OMP)
- ☐ 5. Participate in field equipment training. (OMP)
- ☐ 6. Participate in training on herbicides and heat hazards. (Mitigation #18)
- ☐ 7. Conduct field surveys to provide information on current field conditions (i.e. level and location of water hyacinth infestations). (OMP)

In-Season

General Activities

- ☐ 1. Make all herbicide applications according to herbicide label specifications and California Code of Regulation requirements. (OMP)
- ☐ 2. Follow environmental protocols required by the USFWS Biological Opinion, NOAA-Fisheries Biological Opinion, and CVRWQCB NPDES General Permit. (OMP)
- ☐ 3. Follow all requirements for herbicide storage, transport, mixing, loading applications, and container disposal, as specified in Best Management Practice (BMP) #WH 1, Herbicide Handling Requirements. (OMP)
- ☐ 4. Conduct spray equipment maintenance and calibration on at least a weekly basis, as specified in BMP #WH2, Spray Equipment Maintenance and Calibration. (OMP)
- ☐ 5. Follow BMP WH#3, Spill Contingency Plan, in the event of an aquatic or terrestrial spill; follow best management practices to minimize the risk of spill and to minimize the impact of a spill, should one occur. (Mitigation #19, OMP)
- ☐ 6. Conduct field surveys to provide information on current field conditions (i.e. level and location of water hyacinth infestations and locations of drinking water intakes). (OMP)
- ☐ 7. Consult with the Environmental Scientist about upcoming applications to determine whether presence of an Endangered Species in a planned treatment area will prevent a scheduled application. (OMP)
- ☐ 8. Provide a 250 foot buffer between a treatment site and shoreline elderberry bushes. (Mitigation #2, OMP)
- ☐ 9. Utilize the Giant Garter Snake Habitat Evaluation Maps and visually check for giant garter snakes when launching a boat from an unimproved location on a levy. (OMP)
- ☐ 10. Minimize public exposure to herbicide treated water. (Mitigation #17)
- ☐ 11. Implement safety precautions on hot days to prevent heat illness. (Mitigation #20)

Exhibit E-2
Checklist #2 – Field Crew Activities *(continued)*

In-Season (continued)

TREATMENT DAY ACTIVITIES

- ☐ 12. Understand and follow the PUR and label requirements before making any herbicide applications. (OMP)
- ☐ 13. Check that all required equipment is in the boat prior to leaving the dock or storage bay. (OMP)
- ☐ 14. Record the appropriate pre-treatment information on the Daily Log, after boating to the treatment site. (OMP)
- ☐ 15. Perform a visual survey for species of concern and complete the Environmental Observations Checklist. If any sensitive species are present at the site, the application crew should not perform the treatment. (OMP)
- ☐ 16. Avoid herbicide application near special status species, and sensitive riparian and wetland habitat; and other biologically important resources. (Mitigation #1)
- ☐ 17. Utilize the dissolved oxygen monitor/meter, wind meter, and GPS to take the appropriate measures (water temperature, DO level, time, location, equipment calibration date, wind speed) and record in the Daily Log. (OMP)
- ☐ 18. If the wind speed is greater than 10mph, or 7mph in Contra Costa County, do not perform the treatment at that particular site. (OMP)
- ☐ 19. Complete electronic data collection in the handheld computer and determine whether the application meets the applicable NPDES permit conditions for treatment. (OMP)
- ☐ 20. Monitor dissolved oxygen levels pre- and post-treatment for all WHCP treatments. (Mitigation #9)
- ☐ 21. Do not conduct the treatment if the dissolved oxygen level is between 3.0 mg/l and the basin plan limit for that location, based on the dissolved oxygen maps. (OMP)
- ☐ 22. Do not treat more than 2.75 acres[1] of a given site in one day. If 3 acres of a site are treated, skip treatment on adjacent sites, leaving an adequate portion of waterway open (i.e. without treatment) to allow for fish to pass the site. (Mitigation #10, OMP)
- ☐ 23. Treat no more than one-half of the area of completely infested dead-end sloughs to allow for fish passage. (Mitigation #11)
- ☐ 24. Treat no more than one-half of completely infested moving waterways at one time to allow for fish passage. (Mitigation #12)
- ☐ 25. Conduct herbicide treatments in order to minimize potential for drift. (Mitigation #3)
- ☐ 26. Operate program vessels in a manner that causes the least amount of disturbance to the habitat. (Mitigation #4)
- ☐ 27. Use dip nets during and immediately following treatment to collect plant fragments. (Mitigation #13)
- ☐ 28. Identify and utilize disposal areas [for handpicking] that have no and/or low habitat value for the federal and State listed giant garter snake *(Thamnophis gigas).* (Mitigation #15)
- ☐ 29. Identify and utilize disposal areas [for handpicking] that are at least 100 feet away from elderberry shrubs (*Sambucus* ssp.) (Mitigation #16)
- ☐ 30. Record the appropriate post-treatment information in the Daily Log, and submit to DBW Headquarters staff. (OMP)

Post-Season

- ☐ 1. Conduct field surveys to provide information on current field conditions (i.e. level and location of water hyacinth infestations and locations of drinking water intakes). (OMP)

[1] The requirement is no more than 3 acres, the OMP specifies 2.75 acres in order to be conservative in meeting the 3 acre requirement.

CHECKLIST #2 – FIELD CREW ACTIVITIES

CAL BOATING
CALIFORNIA DEPARTMENT OF BOATING AND WATERWAYS
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Water Hyacinth Control Program