Chapter 2

# Program Description and Program Alternatives

# 2. Program Description and Program Alternatives

This chapter of the Final PEIR describes WHCP objectives, program alternatives, and the selected control alternative. This chapter is organized as follows:

*A. Program Overview and Objectives*
*B. Program Area*
*C. Program Alternatives*
*D. Selected Program Approach.*

## A. Program Overview and Objectives

The goal of the WHCP is to keep waterways safe and navigable by controlling the growth and spread of water hyacinth in the Delta and its surrounding tributaries. Because of the persistence of water hyacinth in the Delta, the WHCP legislative mandate is for control, rather than eradication of water hyacinth. The primary purpose of the WHCP is to control the growth and spread of water hyacinth in order to minimize negative impacts of the plant on navigation, recreation, and agricultural activities in Delta waterways. The DBW seeks to manage water hyacinth growth while (1) minimizing non-target plant and species impacts and (2) preventing environmental degradation in Delta waterways and tributaries.

Through the WHCP, the DBW clears water hyacinth and maintains adequate navigation channels for Delta users; and clear water hyacinth areas surrounding marinas, launch ramps, pumping facilities, and intake pipes. Another important WHCP objective is to improve habitat for native species by reducing the negative impacts of water hyacinth on surrounding ecosystems. This objective links directly to the CALFED Ecosystem Restoration Program (CALFED 2000).[1] By clearing Delta water hyacinth, DBW contributes to the creation of shallow-water habitat suitable for native species.

The DBW utilizes treatment protocols that balance the need to control water hyacinth with the need to minimize resulting environmental impacts to Delta waterways. **Table 2-1,** on the next page, identifies a total of ten specific objectives for the WHCP. Table 2-1 also identifies performance measures (i.e. expected outcomes) that the DBW uses to evaluate success of the WHCP in meeting these project objectives.

The WHCP currently operates under the following three permits:

- NPDES Statewide General Permit (CAG990005)

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[1] The CALFED Ecosystem Restoration Program Plan Objective 5 states: "Prevent the establishment of additional non-native invasive species and reduce the negative ecological and economic impacts of established non-native species in the Bay-Delta estuary and its watershed."

**Table 2-1**
**WHCP Objectives and Performance Measures**

| Objectives | Performance Measures |
|---|---|
| 1. Limit future growth and spread of water hyacinth in the Delta<br>2. Improve boat and vessel navigation in the Delta<br>3. Utilize the most efficacious treatment methods available with the least environmental impacts<br>4. Prioritize sites so that WHCP activities are focused on sites with a high degree of infestation, as well as navigational, agricultural, or recreational significance<br>5. Employ a combination of control methods to allow maximum program flexibility<br>6. Improve the WHCP as more information is available on appropriate control methods for the Delta<br>7. Monitor results of the WHCP to fully understand impacts of the WHCP on the environment<br>8. Improve shallow-water habitat for native species by controlling water hyacinth<br>9. Decrease WHCP control efforts, if sufficient efficacy of water hyacinth treatment is realized<br>10. Minimize use of control methods that could cause adverse environmental impacts. | ■ Reduce total acres infested with water hyacinth<br>■ Reduce water hyacinth biomass at high priority navigation sites currently infested with water hyacinth<br>■ Reduce water hyacinth biomass at nursery sites<br>■ Prevent water hyacinth infestation of new sites<br>■ Produce fewer incidents of boat navigation, agricultural, and recreation problems related to water hyacinth<br>■ Prepare reports for regulatory agencies and the public summarizing WHCP monitoring results<br>■ Minimize WHCP environmental impacts, as measured by compliance with program permits<br>■ Increase efficacy of the WHCP, and of each control method over time<br>■ Increase the number of shallow-water sites suitable for native species<br>■ Limit the number of, and significance of, environmental impacts resulting from the WHCP<br>■ Limit the number of WHCP acres treated with methods that have the potential for adverse environmental impacts<br>■ Reduce the quantity of herbicides and adjuvants applied to the Delta over time. |

- USFWS Biological Opinion (1-1-04-F-0149)
- National Oceanic and Atmospheric Administration-Fisheries (NOAA-Fisheries) Biological Opinion (151422SWR2005SA00681:JSS).

These permits substantially guide current program operations, and are described in Subsection D.

## B. Program Area

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

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

Within the WHCP project area, there are approximately 368 possible treatment sites that average between one and two miles in length. **Exhibit 2-1,** on the following pages, provides a map of the WHCP project area.

**Exhibit 2-1a**

**WHCP Project Area Map – Northern Sites**

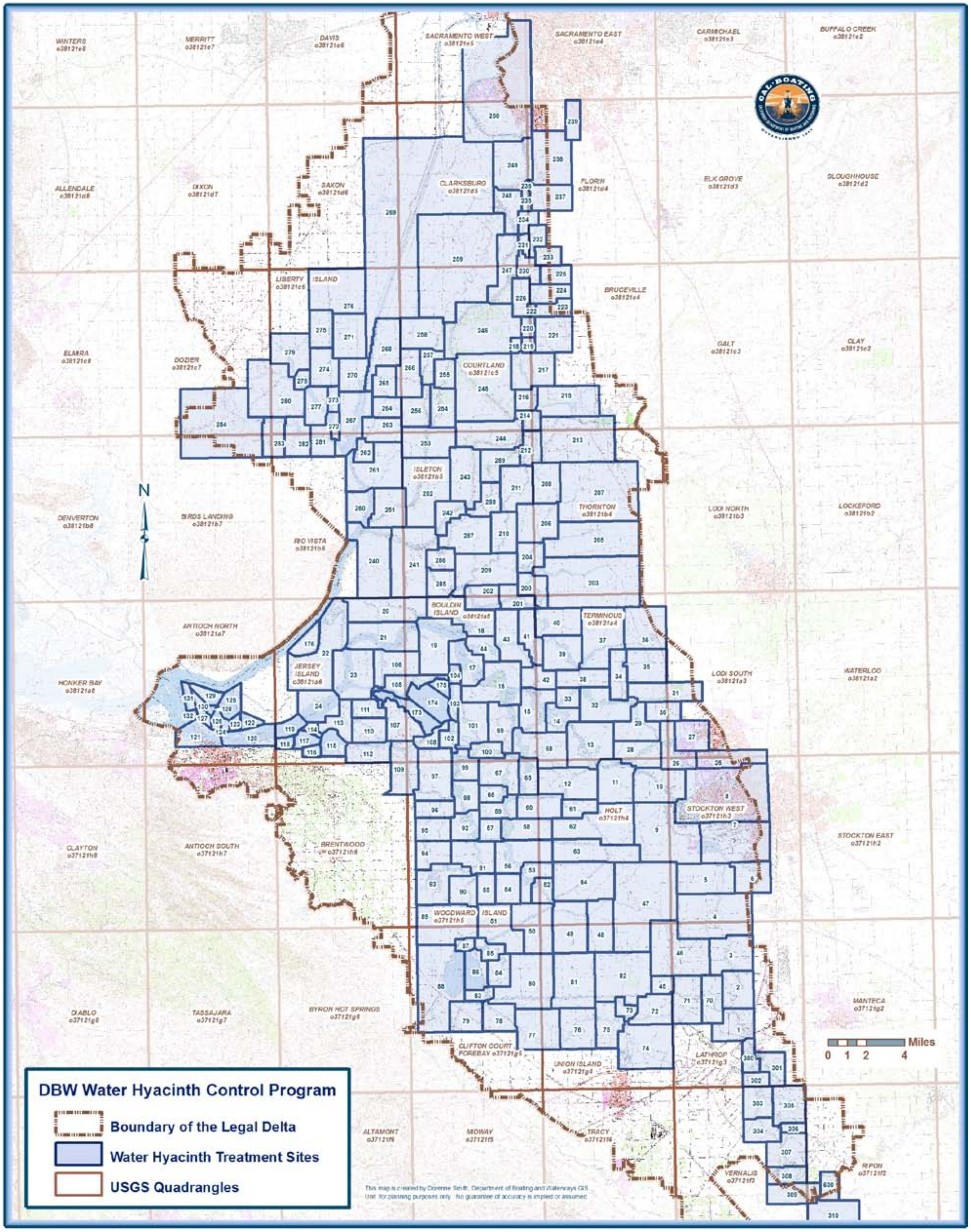

**Exhibit 2-1b**

WHCP Project Area Map – Southern Sites

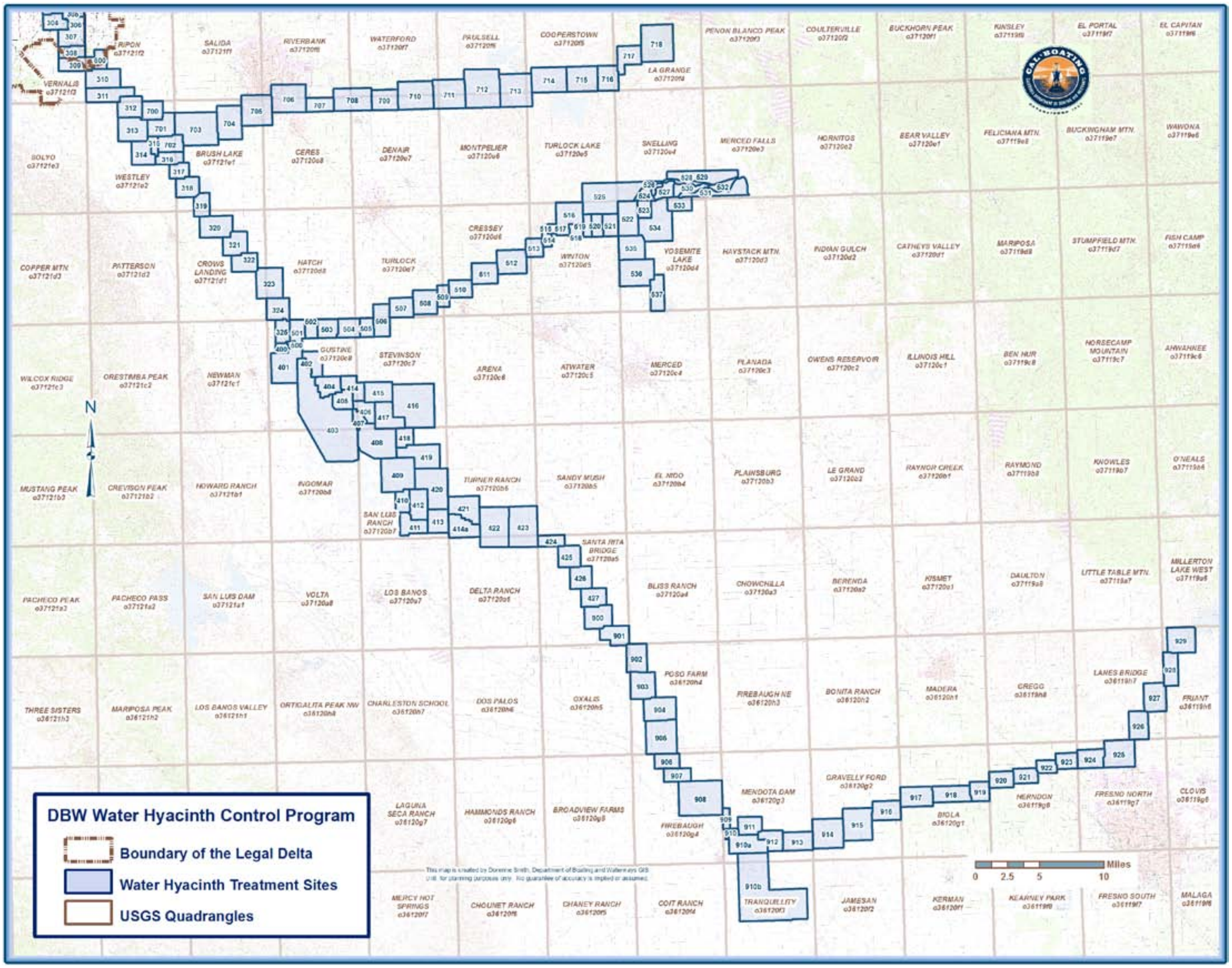

**Table 2-2**, starting on the next page, provides a listing of the approximately 369 WHCP treatment sites.

## C. Program Alternatives

CEQA requires that an EIR discuss a reasonable range of alternatives that could avoid, or substantially lessen, the significant environmental impacts of the proposed program, even if the alternative might impede to some degree attainment of program objectives, or the alternative would be more costly. The discussion of each program alternative should provide sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed program. An EIR must also evaluate the impacts of the "No Program Alternative" to allow decision makers to compare the impacts of approving the proposed program with the impacts of not approving the proposed program.

This subsection identifies, discusses, and compares program alternatives for controlling water hyacinth in the Delta and surrounding tributaries, including the selected alternative and a No Program Alternative. This subsection also briefly discusses alternatives that the DBW considered, but rejected as infeasible. **Table 2-3,** on page 2-11, provides a summary of the expected impacts of program alternatives 2 through 6 on the five resource areas for which the WHCP has potentially significant impacts.

In over twenty-five years of operating the WHCP, the DBW has examined and tested a broad range of potential control methods. Reflecting an adaptive management approach, the WHCP has evolved during this time to incorporate new information and experience. The selected WHCP alternative reflects this experience, and provides flexibility to continue to adapt the program over time.

### Program Alternative 1 (Selected Alternative) – Integrated Management

The selected program alternative consists of an integrated management approach, emphasizing chemical treatment, with limited handpicking and herding, and continued assessment of biological controls. Selected herbicides are 2,4-D and glyphosate, with 2,4-D to be used for the majority of treatments. Both herbicides are applied with an adjuvant, Agridex®. The DBW will continue to research and evaluate other less toxic herbicides and adjuvants, including the vegetable oil based adjuvant, Competitor®.

The DBW will conduct handpicking as required, particularly when chemical treatments are not allowed. The DBW is currently completing a three-year cost-benefit analysis of the handpicking program. The results of this study will be incorporated into the hand-picking program.

The DBW will conduct limited herding, typically during the winter, when chemical treatments are not allowed. Herding will generally be limited to locations in the west Delta, near Antioch, and only when weather and water conditions are appropriate.

The DBW is also working with the United States Department of Agriculture – Agricultural Research Service (USDA-ARS) and the California Department of Food and Agriculture (CDFA) to establish viable biological control methods for water hyacinth. These research efforts currently focus on identifying water hyacinth pathogens (e.g. fungi).

For each particular season and treatment site, DBW will evaluate characteristics of the site, and select the most appropriate treatment option(s).

The selected program alternative is guided by the general NDPES permit and USFWS and NOAA-Fisheries biological opinions issued for the program. Subsection D of this chapter describes the approach, permits, operations, and environmental monitoring for program alternative 1 in more detail.

**Table 2-2**
**WHCP Treatment Sites**



| Site Number(s) | County | Location | Water-Type(s) |
|---|---|---|---|
| 1, 2, 3, 4, 5 | San Joaquin | San Joaquin River | Tidal |
| 6 | San Joaquin | French Camp Slough<br>Walker Slough | Tidal<br>Tidal |
| 7 | San Joaquin | San Joaquin River | Tidal |
| 8 | San Joaquin | Mormon Slough<br>San Joaquin River- Stockton Deep Water Channel | Tidal<br>Tidal |
| 9 | San Joaquin | Burns Cutoff | Tidal |
| 10 | San Joaquin | Buckley Cove<br>San Joaquin River- Stockton Deep Water Channel | Tidal<br>Tidal |
| 11 | San Joaquin | Black Slough<br>Black Slough Landing<br>Fourteen Mile Slough<br>San Joaquin River | Tidal<br>Tidal<br>Tidal<br>Tidal |
| 12 | San Joaquin | Turner Cut | Tidal |
| 13 | San Joaquin | Heypress Reach<br>Hog Island Cut<br>San Joaquin River- Stockton Deep Water Channel<br>Twentyone Mile Cut | Tidal<br>Tidal<br>Tidal |
| 14 | San Joaquin | San Joaquin River | Tidal |
| 15 | San Joaquin | Empire Tract Slough | Tidal |
| 16 | San Joaquin | Mandeville Cut<br>Mandeville Reach<br>San Joaquin River- Stockton Deep Water Channel<br>Three River Reach<br>Venice Cut<br>Venice Reach | Tidal<br>Tidal<br>Tidal<br>Tidal<br>Tidal<br>Tidal |
| 17 | San Joaquin | Potato Slough | Tidal |
| 18 | San Joaquin | Mokelumne River | Tidal |
| 19 | Contra Costa | San Joaquin River | Tidal |
| 20 | Sacramento | San Joaquin River<br>Seven Mile Cut | Tidal<br>Tidal |
| 21 | Contra Costa<br>Sacramento | San Joaquin River | Tidal |
| 22 | Sacramento | Sacramento River<br>Three Mile Slough | Tidal<br>Tidal |
| – | Sacramento | Lake Natoma | Slow-moving |

**Table 2-2**
**WHCP Treatment Sites** *(continued)*



| Site Number(s) | County | Location | Water-Type(s) |
|---|---|---|---|
| 23 | Contra Costa<br>Sacramento | ■ False River<br>■ San Joaquin River | ■ Tidal<br>■ Tidal |
| 24 | Contra Costa<br>Sacramento | ■ San Joaquin River | ■ Tidal |
| 25 | San Joaquin | ■ Fourteen Mile Slough | ■ Tidal |
| 26, 28, 29 | San Joaquin | ■ Fourteen Mile Slough | ■ Tidal |
| 27 | San Joaquin | ■ Five Mile Slough | ■ Tidal |
| 30 | San Joaquin | ■ Mosher Slough | ■ Tidal |
| 31 | San Joaquin | ■ Bear Creek<br>■ Disappointment Slough<br>■ Pixley Slough | ■ Tidal<br>■ Tidal<br>■ Tidal |
| 32, 33 | San Joaquin | ■ Disappointment Slough | ■ Tidal |
| 34 | San Joaquin | ■ Bishop Cut | ■ Tidal |
| 35 | San Joaquin | ■ Telephone Cut | ■ Tidal |
| 36, 37, 39 | San Joaquin | ■ White Slough | ■ Tidal<br>■ Tidal |
| 38 | San Joaquin | ■ Bishop Cut | ■ Tidal |
| 40, 41 | San Joaquin | ■ Little Potato Slough | ■ Tidal |
| 42 | San Joaquin | ■ Little Connection Slough | ■ Tidal |
| 43, 44 | San Joaquin | ■ Potato Slough | ■ Tidal |
| 45, 46, 47, 48, 49, 52, 53, 56, 58, 59, 66, 67, 68 | San Joaquin | ■ Middle River | ■ Tidal |
| 50, 51 | San Joaquin | ■ North Canal<br>■ Victoria Canal | ■ Tidal |
| 54, 55 | San Joaquin | ■ North Victoria Canal<br>■ Woodard Canal | ■ Tidal<br>■ Tidal |
| 57 | San Joaquin | ■ Railroad Cut | ■ Tidal |
| 60 | San Joaquin | ■ Empire Cut | ■ Tidal |
| 61, 62, 63 | San Joaquin | ■ Whiskey Slough | ■ Tidal |
| 64 | San Joaquin | ■ Trapper Slough | ■ Tidal |
| 65 | San Joaquin | ■ Latham Slough | ■ Tidal |
| 69 | San Joaquin | ■ Connection Slough<br>■ Middle River | ■ Tidal |
| 70, 71 | San Joaquin | ■ Old River | ■ Tidal |
| 72 | San Joaquin | ■ Old River<br>■ Paradise Cut | ■ Tidal |

**Table 2-2**
**WHCP Treatment Sites** *(continued)*

*Page 3 of 5*

| Site Number(s) | County | Location | Water-Type(s) |
|---|---|---|---|
| 73 | San Joaquin | ■ Old River<br>■ Paradise Cut<br>■ Salmon Slough | ■ Tidal<br>■ Tidal<br>■ Tidal |
| 74 | San Joaquin | ■ Sugar Cut<br>■ Tom Paine Slough | ■ Tidal<br>■ Tidal |
| 75, 76, 77, 78, 79, 83, 84, 85, 87, 89, 90, 91, 92, 98, 99 | San Joaquin | ■ Old River | ■ Tidal |
| 80, 81, 82 | San Joaquin | ■ Fabian & Bell Canal<br>■ Grant Line Canal | ■ Tidal |
| 86 | Contra Costa | ■ Old River<br>■ West Canal | ■ Tidal<br>■ Tidal |
| 88 | Contra Costa | ■ Italian Slough | ■ Tidal |
| 93 | Contra Costa | ■ Indian Slough | ■ Tidal |
| 94, 95, 96 | Contra Costa | ■ Warner Dredger Cut | ■ Tidal |
| 97 | Contra Costa | ■ Rock Slough | ■ Tidal |
| 100 | San Joaquin | ■ Connection Slough<br>■ Old River | ■ Tidal |
| 101 | San Joaquin | ■ Old River | ■ Tidal |
| 102 | Contra Costa | ■ Sheep Slough | ■ Tidal |
| 103, 104 | Contra Costa<br>San Joaquin | ■ Old River | ■ Tidal |
| 105 | Contra Costa | ■ False River | ■ Tidal |
| 106 | Contra Costa | ■ Fishermen's Cut | ■ Tidal |
| 107 | Contra Costa | ■ Piper Slough | ■ Tidal |
| 108 | Contra Costa | ■ Roosevelt Cut<br>■ Sand Mound Slough | ■ Tidal |
| 109 | Contra Costa | ■ Sand Mound Slough | ■ Tidal |
| 110, 111 | Contra Costa | ■ Taylor Slough | ■ Tidal |
| 112 | Contra Costa | ■ Dutch Slough<br>■ Emerson Slough | ■ Tidal<br>■ Tidal |
| 113, 114 | Contra Costa | ■ Dutch Slough | ■ Tidal |
| 115, 116, 117, 118 | Contra Costa | ■ Big Break | ■ Tidal |
| 119, 120, 121 | Contra Costa<br>Sacramento | ■ San Joaquin River | ■ Tidal |
| 122, 123, 124, 125, 126, 127, 128, 129, 130, 131 | Sacramento | ■ Sherman Lake | ■ Tidal |
| 176 | Solano | ■ Sacramento River-Decker Island | ■ Tidal |
| 200, 201, 202, 204, 206, 208 | San Joaquin | ■ South Mokelumne River | ■ Tidal |

**Table 2-2**
**WHCP Treatment Sites** *(continued)*



| Site Number(s) | County | Location | Water-Type(s) |
|---|---|---|---|
| 203 | San Joaquin | ■ Sycamore Slough | ■ Tidal |
| 205 | San Joaquin | ■ Hog Slough | ■ Tidal |
| 207 | San Joaquin | ■ Beaver Slough | ■ Tidal |
| 209, 210, 211, 213 | Sacramento<br>San Joaquin | ■ North Mokelumne River | ■ Tidal |
| 214, 215, 216, 217, 218, 219 | Sacramento | ■ Snodgrass Slough | ■ Tidal |
| 220, 221, 222, 223, 224, 225, 226, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239 | Sacramento | ■ Stone Lakes | ■ Tidal |
| 300, 302, 303, 304, 305, 306, 307, 308, 309 | San Joaquin | ■ San Joaquin River | ■ Fast or slow-moving |
| 301 | San Joaquin | ■ Welthall Slough | ■ Fast or slow-moving |
| 310, 313, 314, 316, 318, 319, 320, 321, 322, 323 | Stanislaus | ■ San Joaquin River | ■ Fast or slow-moving |
| 316 | Stanislaus | ■ Brush Lake | ■ Fast or slow-moving |
| 311, 312 | Stanislaus | ■ Finnegan Cut<br>■ San Joaquin River | ■ Fast or slow-moving |
| 315 | Stanislaus | ■ Laird Slough | ■ Fast or slow-moving |
| 317 | Stanislaus | ■ Del Puerto Creek<br>■ San Joaquin River | ■ Fast or slow-moving |
| 320 | Stanislaus | ■ Lake Ramona | ■ Fast or slow-moving |
| 324, 325 | Merced<br>Stanislaus | ■ San Joaquin River | ■ Fast or slow-moving |
| 401, 403, 414, 415, 417, 418, 419, 421, 422, 423, 424, 425, 426, 427 | Merced | ■ San Joaquin River | ■ Fast or slow-moving |
| 402 | Merced | ■ Snag Slough<br>■ San Joaquin River | ■ Fast or slow-moving |
| 404 | Merced | ■ San Joaquin River | ■ Fast or slow-moving |
| 405, 406, 407, 408, 409, 410, 412, 413 | Merced | ■ Salt Slough | ■ Fast or slow-moving |
| 414 | Merced | ■ Poso Slough<br>■ Salt Slough | ■ Fast or slow-moving |
| 411 | Merced | ■ Mud Slough | ■ Fast or slow-moving |
| 416 | Merced | ■ Bear Creek<br>■ Bravel Slough | ■ Fast or slow-moving |
| 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 | Merced | ■ Merced River | ■ Fast or slow-moving |
| 516 | Merced | ■ Ingalsbe Slough<br>■ Hope Town Slough | ■ Fast or slow-moving |
| 525 | Merced | ■ Ingalsbe Slough | ■ Fast or slow-moving |

**Table 2-2**
**WHCP Treatment Sites** *(continued)*

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| Site Number(s) | County | Location | Water-Type(s) |
|---|---|---|---|
| 528, 529 | Merced | ■ Merced River<br>■ North Canal | ■ Fast or slow-moving |
| 531, 533, 537 | Merced | ■ Main Canal | ■ Fast or slow-moving |
| 534, 535 | Merced | ■ Main Canal<br>■ Canal Creek | ■ Fast or slow-moving |
| 536 | Merced | ■ Main Canal<br>■ Parkinson Creek | ■ Fast or slow-moving |
| 600 | Stanislaus | ■ Stanislaus | ■ Fast or slow-moving |
| 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718 | Stanislaus | ■ Tuolumne River | ■ Fast or slow-moving |
| 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 | Fresno | ■ San Joaquin River | ■ Fast or slow-moving |
| 910 | Fresno | ■ San Joaquin River<br>■ Mendota Pool | ■ Fast or slow-moving |
| 910A, 910B | Fresno | ■ Fresno Slough<br>■ Kings River | ■ Fast or slow-moving |

## Program Alternative 2 – Chemical Control Only

The chemical control only alternative would include only the chemical control aspects of the selected program alternative. The DBW would utilize 2,4-D and glyphosate to treat water hyacinth, following existing program operational requirements. This alternative would not include handpicking or the ongoing evaluation or use of biological control agents.

The chemical control only alternative would result in all of the alternative 1 potential impacts related to use of herbicides, without the additional flexibility that an integrated management approach would provide. This chemical only approach would not allow for adaptive adjustment of treatment methods to site-specific and season-specific needs and requirements. In addition, the chemical only approach would not provide any treatment alternatives during the majority of the year, when chemical treatments are limited or prohibited.

## Program Alternative 3 – Handpicking Only

The handpicking only alternative would include expanded, year-round, handpicking of water hyacinth. The current handpicking program is generally conducted only from November through February. Two-person field crews utilize boats, 30-gallon barrels, and lawn-grooming rakes for handpicking. Each crew consists of one person driving the boat and one person handpicking water hyacinth. The crew member would use the lawn-groom rake to collect water hyacinth and place it in 30-gallon barrels.

Once the 30-gallon barrels are filled, field crews would locate a dispersal area. Dispersal areas are defined as levees or other previously surveyed areas with no- and low-habitat values to the federal and state listed threatened giant garter snake (*Thamnophis gigas*). Dispersal would also be located at least 100 feet away from elderberry

**Table 2-3**
**Comparison of WHCP Alternatives**



| Resource | Program Alternative 2 – Chemical Control Only | Program Alternative 3 – Handpicking Only | Program Alternative 4 – Biological Control Only | Program Alternative 5 – Mechanical Harvesting Only | Program Alternative 6 – No Program Alternative |
|---|---|---|---|---|---|
| 1. Biological Resources | Under alternative 2, there would be the same potential impacts to biological resources due to herbicide use as discussed in Chapter 3, for the selected program alternative. | Under alternative 3 there would be no biological impacts due to herbicide use. Handpicking would not result in impacts to biological resources, however the increased growth in water hyacinth due to the inability of handpicking to effectively control the plant could result in direct and indirect negative impacts to biological resources. | Under alternative 4 there would be no biological impacts due to herbicide use. Biological control would not result in impacts to biological resources, however the increased growth in water hyacinth due to the inability of biological control to effectively manage the plant could result in direct and indirect negative impacts to biological resources. | Under alternative 5 there would be no biological impacts due to herbicide use, however there is the potential for harvesting to kill, injure, or disturb mammals, birds, reptiles, amphibians, fish, and insects, and to damage or kill plants. This would result in potentially significant impacts to biological resources. | Under the no program alternative, uncontrolled growth of water hyacinth would result in direct and indirect negative impacts to Delta ecosystems, fish habitat, and special status fish and plant species. To the extent that local landowners would conduct ad hoc chemical treatments, there would be additional potentially significant impacts to biological resources. |
| 2. Hazards and Hazardous Materials | Under alternative 2, there would be the same potential impacts related to hazards and hazardous materials due to herbicide use as discussed in Chapter 4, for the selected program alternative. | Alternative 3 would result in no impacts related to hazards and hazardous materials. | Alternative 4 would result in no impacts related to hazards and hazardous materials. | Alternative 5 would result in no impacts related to hazards and hazardous materials. | Under the no program alternative, there would be no impacts related to hazards and hazardous materials. |
| 3. Hydrology and Water Quality | Under alternative 2, there would be the same potential impacts to hydrology and water quality due to herbicide use as discussed in Chapter 5, for the selected program alternative. | Alternative 3 would result in no impacts to hydrology and water quality. | Alternative 4 would result in no impacts to hydrology and water quality. | Alternative 5 would not have a significant impact on Delta water quality or nutrient loading. There would be temporary impacts on turbidity, and potential localized temporary reductions in DO levels as cut plants decomposed. | Under the no program alternative, uncontrolled growth of water hyacinth could result in reduced DO levels under water hyacinth mats, however there would be no impacts to water quality due to herbicide treatments. |

**Table 2-3**
**Comparison of WHCP Alternatives** *(continued)*

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| Resource | Program Alternative 2 – Chemical Control Only | Program Alternative 3 – Handpicking Only | Program Alternative 4 – Biological Control Only | Program Alternative 5 – Mechanical Harvesting Only | Program Alternative 6 – No Program Alternative |
|---|---|---|---|---|---|
| 4. Utilities and Service Systems | Under alternative 2, there would be the same potential impacts to utilities and service systems due to herbicide use as discussed in Chapter 6, for the selected program alternative. | Under alternative 3, there would be less control of water hyacinth than under the selected program alternative. This would potentially result in significant impacts to utility pump systems due to clogging by water hyacinth plants. | Under alternative 4, there would be less control of water hyacinth than under the selected program alternative. This would potentially result in significant impacts to utility pump systems due to clogging by water hyacinth plants. | Alternative 5 would potentially negatively affect utility pump systems, due to increased concentrations of plant fragments following harvesting. If harvested water hyacinth was removed from the water, this alternative would increase solid waste generation, with potentially significant impacts. | Under the no program alternative, uncontrolled growth of water hyacinth would result in potentially significant impacts to utility pump systems due to clogging by water hyacinth plants. |
| 5. Agricultural Resources | Under alternative 2, there would be the same potential impacts to agricultural resources due to herbicide use as discussed in Chapter 6 for the selected program alternative. | Under alternative 3, there would be less control of water hyacinth than under the selected program alternative. This would potentially result in significant impacts to agricultural irrigation systems due to clogging by water hyacinth plants. There would be no potential for negative impacts to crops due to herbicide treatments. | Under alternative 4, there would be less control of water hyacinth than under the selected program alternative. This would potentially result in significant impacts to agricultural irrigation systems due to clogging by water hyacinth plants. There would be no potential for negative impacts to crops due to herbicide treatments. | Alternative 5 would potentially negatively affect agricultural irrigation systems, due to increased concentrations of plant fragments following harvesting. There would be no potential for negative impacts to crops due to herbicide treatments. | Under the no program alternative, uncontrolled growth of water hyacinth would result in potentially significant impacts to agricultural irrigation systems due to clogging by water hyacinth plants. There would be no potential for negative impacts to crops due to herbicide treatments. |

shrubs (*Sambucus* ssp.) that are potential habitat for the federally threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*).

The DBW would leave water hyacinth in these dispersal areas to desiccate naturally, and DBW would periodically monitor the dispersal areas to observe and record the fate of the water hyacinth and any effects of dispersal activities.

Handpicking avoids all impacts resulting from application of herbicides. Handpicking is likely to result in impacts to utilities and agricultural irrigation due to the release of small plants that are not captured by raking.

While handpicking only volumes would be relatively low, a handpicking only alternative would potentially result in solid waste impacts, as more water hyacinth would be deposited on shorelines.

Handpicking only would result in fewer recreational and ecosystem benefits, as compared to the selected program alternative, because significantly less water hyacinth would be controlled in any given year.

While handpicking provides a viable option to control water hyacinth during the winter months, and in areas when chemicals cannot be used, handpicking alone is not a feasible program alternative. Problems with this alternative include: high cost and labor requirements, potential solid waste impacts, and relatively low acres managed.

## Program Alternative 4 – Biological Control Only

Biological control is the use of biological agents, typically insects or pathogens, to control undesirable plants. The biological control only alternative would consist of expanded introduction of the water hyacinth weevil, *Neochetina bruchi*, as well as other biological control agents (the moth, *Sameodes albiguttailis*, and/or new agents as they are developed and approved) into the Delta. As the history of biological control agents in the Delta illustrates, this alternative is not likely to result in substantial control of water hyacinth.

In 1982, the USDA-ARS first released the water hyacinth-eating weevil, *Neochetina bruchi*, in the Delta. Following the initial releases of *Neochetina bruchi*, USDA-ARS released other host-specific species (*Neochetina eichhorniae* and *Sameodes albiguttailis*).

Recent surveys have shown that *Neochetina bruchi* is the only species to have survived and spread throughout the Delta. However, the small size of *Neochetina bruchi* populations have failed to effectively control water hyacinth. Between 2003 and 2006, the DBW contracted with the California Department of Food and Agriculture to examine populations of *Neochetina bruchi* in an effort to understand the impacts and dynamics of *Neochetina bruchi* populations in the Delta.

A California Department of Food and Agriculture study demonstrated the challenge of biological control in the Delta (Akers and Pitcairn 2006). The study found that there is essentially a mismatch between the life cycle of the weevil, and the climate and growing cycle of water hyacinth in the Delta. Weevils have limited survival during the winter, because the 7ºC average temperature in the Delta (Akers and Pitcairn 2006) is well below *Neochetina bruchi* optimum feeding and oviposition temperatures, at 30ºC (Julien 2001).

In the spring, when water hyacinth starts to grow rapidly, weevil populations are too low to effectively damage the plant. In October, when the weevil population has increased to a level where it might provide some control, the plant is starting to decline. In addition, perhaps because of low humidity in the Delta, plant weevil populations that provide effective control in other regions (at least 5 weevils per plant), do not provide control in the Delta. Akers and Pitcairn summarize, "the weevils do not exert a level of damage consistent enough to bring the weed under control" (Akers and Pitcairn 2006).

These findings are consistent with evaluations of success and failure factors related to biological control of water hyacinth. Factors that may reduce the effectiveness of biological controls include: temperate climates, high nutrient status of the water, periodic flooding or drought conditions, and uptake of heavy metals by water hyacinth (Julien 2001). All of these factors are present in the Delta.

Implementation of the biological control only alternative would require a significant increase in deployment of biological controls in the Delta. The biological control only alternative would also require extensive monitoring to determine the impacts of this deployment.

When it is effective, biological control of water hyacinth is attractive because of low potential environmental impacts, long-term sustainability, and low cost. In the Delta, this alternative has been shown to have severely limited effectiveness.

In addition, researchers and waterway managers generally recommend that biological control alone is not a solution, and it should be part of an integrated management approach (Labrada 1995, Julien 2001, Center et al 1999). The DBW will continue to evaluate and incorporate biological control as part of the WHCP, but will not solely rely on biological agents to control water hyacinth in the Delta.

The biological control only alternative would result in fewer recreational and ecosystem benefits, as compared to the selected program alternative, because significantly less water hyacinth would be controlled in any given year.

### Program Alternative 5 – Mechanical Harvesting Only

Mechanical harvesters utilize equipment which cuts (and in some cases collects) aquatic plants. There are several types of mechanical harvesters, ranging from simple hydraulic cutters attached to pontoon boats or airboats, to 10,000 pound capacity harvesters with conveyors to remove the cut plant material to the shore (Mossler and Langeland 2006). Mechanical harvesters have been used to control water hyacinth in Florida and other Southeastern states.

Because mechanical harvesting can be costly, it is often used only when immediate removal of weeds is required. In addition to the high cost, concerns with mechanical harvesting include disposal costs and permitting, rapid regrowth of plants following harvesting, nutrient loading due to cut plants in the water, potential release of mercury, and the impact of harvesting on non-target aquatic species.

During 2003 and 2004, the San Francisco Estuary Institute (SFEI) conducted a study of mechanical harvesting of water hyacinth in the Delta (Greenfield et al 2005). The study examined costs and permitting issues, regrowth potential, and impacts on nutrient loading in Delta waters. This study was part of a settlement between the State Water Board and Waterkeepers Northern California. The State Water Board funded the Aquatic Pesticide Monitoring Program (APMP) to assess pesticide alternatives, contracting with SFEI to conduct the research. SFEI tested three different mechanical harvesters in two different Delta locations, in both the spring and fall (Greenfield, Blankenship and McNabb 2006). The cut pieces of water hyacinth from all three harvesters remained in Delta waters.

Plant pieces were tested for regrowth in both laboratory and field conditions. Cut plants, including those that were cut twice, had very high survival rates (from 50 percent to 100 percent). Plants that had been cut once produced new leaves at a greater rate than uncut plants (Spencer et al 2006). Plants that had been cut produced new leaves within one week of cutting, and floating water hyacinth fragments remained in the cut areas six months after treatment.

The study concluded that, at least for the three mechanical harvesters tested, cutting water hyacinth in the Delta has limited effectiveness (Spencer et al 2005). Greenfield and McNabb identified the primary concern with mechanical harvesting: the shredding operation could actually worsen the infestation by increasing the spread and recruitment of plants (Greenfield and McNabb 2005).

Because of these issues, the DBW has determined not to further pursue mechanical harvesting as a program alternative, even within their integrated management approach. Mechanical harvesting would not achieve the goals of the WHCP, and would likely increase the amounts of water hyacinth in the Delta.

Mechanical control would result in fewer recreational and ecosystem benefits, as compared to the selected program alternative, because significantly less water hyacinth would be controlled in any given year.

**Table 2-4**
**Potential WHCP Methods Rejected as Infeasible**

| Control Method | Description | Reason Rejected |
|---|---|---|
| 1. Triploid Grass Carp | Sterilized, herbivorous fish that provide control by consuming aquatic weeds and other plants in waterways. | Water hyacinth is not a preferred food for triploid grass carp. In addition, the California Department of Fish and Game prohibits the use of triploid grass carp in non-enclosed water bodies. |
| 2. Physical Barriers | Physical barriers (such as booms) to limit the ability of water hyacinth to spread. | Barriers are not effective in the winter high-flow period. Barriers require extensive maintenance, and are not effective in controlling water hyacinth. |
| 3. Shade Barriers | Use of shade fabrics placed over aquatic weeds to limit the amount of photosynthetically available light. | Utilizing shade fabrics in the Delta would be technically challenging, difficult to maintain, and expensive. |
| 4. Water Level Manipulation | Pumping or releasing water via a dam or weir to dewater an area. | Delta channels do not have structures available to control water levels. In addition, water hyacinth seeds can germinate after years of exposure to air. |
| 5. Flow Rate Manipulation | Increasing or decreasing water flow through a channel for weed control | Flow rates in the Delta could not be artificially increased to create enough force to flush water hyacinth fully out of the Delta. |

### Program Alternative 6 – No Program Alternative

The No Program Alternative would be in conflict with existing state law. In 1982, Senate Bill 1344 amended the California Harbors and Navigation Code to designate the California Department of Boating and Waterways as the lead agency for controlling water hyacinth in the Delta. The Harbors and Navigation Code, Section 64, specifies that it is “necessary that the state, in cooperation with agencies of the United States, undertake an aggressive program for the effective control of water hyacinth and *Egeria densa* in the Delta, its tributaries, and the marsh [Suisun Marsh].” Thus, the DBW is mandated to conduct water hyacinth control efforts.

In addition, the uncontrolled growth of water hyacinth which would result from the No Program Alternative would lead to negative impacts to navigation, recreation, agriculture, and Delta ecosystems. While it would avoid potential impacts due to herbicides, the No Program Alternative would not achieve any goals of the WHCP.

### Alternatives Rejected as Infeasible

In addition to the six program alternatives described in this chapter, the DBW considered a number of other alternatives for controlling water hyacinth in the Delta. The DBW determined that these alternatives were legally, technically, or operationally infeasible; would fail to meet most of the basic project objectives; or would result in significant environmental impacts. **Table 2-4,** above, briefly summarizes five alternatives that were not considered for further analysis.

## D. Selected Program Alternative

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

IPM denotes the coordinated use of available control methods for a particular pest. MCP refers to practices that minimize plant biomass through regular, low-level, control treatments applied at times during a plant's life cycle when treatments are most effective. Ideally, under a maintenance control program, the acres of water hyacinth required to be treated are reduced each year until they reach a minimal level.

The WHCP has historically been following IPM and MCP, and will continue to do so. The DBW balances IPM and MCP in order to simultaneously reduce impacts and increase effectiveness. For example, in order to avoid impacts to migrating special status fish, treatments occur as early in the growing season as possible, but later in a plant's lifecycle than would be ideal.

To minimize potential environmental impacts, DBW selects the most appropriate control methods for a given site in the Delta based on the season and that site's conditions. The DBW conducts limited handpicking to supplement chemical treatment, when appropriate. The DBW also monitors results of the WHCP, and bases future control methods on these results. This selected alternative is chosen to provide the greatest reduction in water hyacinth biomass while avoiding or minimizing environmental impacts.

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

- Evaluates the need for control measures on a site-by-site basis
- Follows NPDES general permit pre- and post-treatment monitoring protocols and evaluates data to determine environmental impacts
- Supports ongoing research to explore the impacts of the WHCP and alternative control methodologies, including biological controls and herbicides and adjuvants with reduced environmental impacts
- Reports findings from monitoring evaluations and research to regulatory agencies and stakeholders
- Adjusts program actions, as necessary, in response to recommendations and evaluations by regulatory agencies and stakeholders.

## 1. WHCP Permits and Reporting

Since the WHCP was reinitiated in 2001, the NPDES permits and biological opinions have guided much of the program's operations and environmental monitoring. This subsection provides an overview of these permit requirements.

### NPDES General Permit

The DBW obtained an individual National Pollutant Discharge Elimination System (NPDES) permit in 2001 (CA0084654) from the Central Valley Regional Water Quality Control Board (CVRWQCB). The individual NPDES permit expired in March 2006. In April 2006, the CVRWQCB replaced the individual NPDES permit with a general NPDES permit (CAG990005). The general NPDES permit has fewer monitoring requirements than the individual NPDES permit.

The NPDES permit includes specific receiving water limits for herbicide concentrations, dissolved oxygen (DO), pH, and turbidity. Key NPDES requirements for the WHCP are as follows:

- **Dissolved oxygen** – specific DO limits depend on the location and season, but range from 5.0 mg/l (ppm) to 9.0 mg/l (ppm). DO levels are not to drop below these levels as a result of WHCP treatments

- **Turbidity** – specific turbidity standards are not to increase above a specified number or percent of Nephelometric Turbidity Units (NTUs), depending on the initial level of natural turbidity. Generally, the WHCP shall not increase turbidity more than 10 to 20 percent
- **pH** – WHCP discharges shall not cause pH to fall below 6.5, or exceed 8.5, or change by more than 0.5 units
- **2,4-D residues** – maximum 2,4-D levels are based on EPA municipal drinking water standards, and shall not exceed 70 µg/l, or 70 ppb
- **Glyphosate residues** – maximum glyphosate levels are based on EPA municipal drinking water standards, and shall not exceed 700 µg/l, or 700 ppb
- **Adjuvant residues** – there are no specified limits for adjuvants; however, the DBW is required to monitor adjuvant levels
- **Monitoring** – requires a monitoring protocol. Monitoring is required at 10 percent of sites treated, for each chemical and waterbody type. Sampling stations are identified as : "A" (where treatment occurred), "B" (downstream of the treatment area), and "C" (control, typically upstream). Sampling times are identified as: "1" (pre-treatment), "2" (immediately post-treatment), and "3" (within seven days after treatment). Thus, sample 2B is taken immediately post-treatment, downstream of the treatment location
- **Reporting** – The DBW is required to submit an annual report by March 1st of each year
- **Initial individual NPDES requirements** – as part of the initial individual NPDES permit, The DBW was required to conduct toxicity studies on algae, water fleas, and minnows, develop a Quality Assurance Project Plan (QAPP),prepare a biological assessment, report on herbicide residues in sediment, and develop a fish passage protocol.

## USFWS Biological Opinion

The United States Fish and Wildlife Service (USFWS) issued a biological opinion for the WHCP on June 1, 2001. This biological opinion was subsequently amended three times, and then reissued on May 21, 2004. The WHCP is currently operating under the May 21, 2004 USFWS biological opinion, 1-1-04-F-0149. This biological opinion includes an incidental take statement and reasonable and prudent measures to minimize impacts on delta smelt and its critical habitat, the valley elderberry longhorn beetle, and the giant garter snake.

Updates to the biological opinion reflect improved understanding of the impact of the WHCP on special status species. The original USFWS permit required toxicity testing on delta smelt, Sacramento splittail (since delisted), and garter snakes. USFWS removed the toxicity testing requirements after results showed no significant impacts.

Key requirements of the USFWS biological opinion are as follows:

- **Avoidance** – there are no longer avoidance measures in place for delta smelt. To avoid impacts to the valley elderberry longhorn beetle, the DBW is required to survey for *Sambucus ssp.* (elderberry shrub), and treat at low tide if any elderberry shrubs are within 100 feet of the water's edge. The DBW must also consider wind speed and direction, and if treatment cannot occur away from habitat, treat a maximum of one-half of the area. Avoidance measures for giant garter snake apply only to land based operations away from launch ramps and roads. There are currently no such operations, however the DBW implements additional avoidance measures for giant garter snakes. These measures include mapping of giant garter snake habitat, and training crews to minimize impacts when treatment occurs in potential giant garter snake habitat

- **Environmental training** – personnel involved with the WHCP are required to receive USFWS approved environmental awareness training related to valley elderberry longhorn beetles, and giant garter snakes. The DBW also provides training related to delta smelt
- **Monitoring** – requires that the NPDES permit monitoring sites include sites with valley elderberry longhorn beetle, giant garter snake, and delta smelt habitats
- **Reporting** – requires the DBW to report results and impacts (including take) by January 31st of each year
- **Requirements of earlier USFWS biological opinions** – the DBW was required to conduct laboratory research trials on the impacts of WHCP herbicides and adjuvants on smelt and splittail eggs and larvae, and on a representative species of the giant garter snake. Early BOs also required avoidance measures and environmental training for delta smelt.

## NOAA-Fisheries Biological Opinion

National Oceanic and Atmospheric Administration-Fisheries (NOAA-Fisheries) issued a biological opinion for the WHCP on June 8, 2001, with subsequent biological opinions issued on June 11, 2002, and August 11, 2003. The WHCP is currently operating under the April 4, 2006 biological opinion, 151422SWR2005SA00681:JSS.

The NOAA-Fisheries biological opinion includes an incidental take statement and reasonable and prudent measures to minimize impacts on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and critical habitats for each of these species. The April 4, 2006 biological opinion also includes an incidental take statement and measures to minimize impacts on the southern district population segment of North American green sturgeon, which was designated as threatened by NOAA-Fisheries, effective June 6, 2006. Key metrics for the most recent NOAA-Fisheries biological opinion are as follows:

- **Avoidance** – measures restrict treatments in order to avoid periods when juvenile steelhead and salmon may be present. Treatments are unrestricted between July 1st, and October 15th. Treatments in sites that are not considered salmon habitat are allowed starting April 1st, or April 15th. If Interagency Ecology Program (IEP) monitoring shows that the salmon pulse has migrated through the system by June 1st, and DBW receives written verification, treatments in the remainder of the Delta may start on June 1st
- **Environmental training** – there are no longer any formal training requirements; however, the DBW provides training on the life history, importance of migratory routes, and terms and conditions of the biological opinion for Chinook salmon, steelhead, and green sturgeon
- **Dissolved oxygen** – DO levels of above 5.0 ppm and below 3.0 ppm are required for treatment (in addition to the NPDES DO requirements). The DBW may treat if DO is below 3.0 ppm
- **Monitoring** – there are no specific monitoring requirements
- **Fish passage** – requires the DBW to follow a fish passage protocol to ensure fish are not impacted by WHCP operations
- **Reporting** – requires the DBW to report results and impacts (including take) by January 31st of each year.

Each year, the DBW prepares a WHCP Annual Report that fulfills reporting requirements of the NPDES, USFWS, and NOAA-Fisheries permits. The annual report describes the treatment program, herbicide use, permit requirements, monitoring protocols, monitoring results, and compliance with permit requirements. WHCP Annual Reports are available at the DBW offices.

*Photo: Water hyacinth spraying*

Since 2001, the DBW has commissioned or conducted a number of special studies to better understand the impacts and efficacy of the WHCP. These studies include the following:

- *Acute Oral and Dermal Toxicity of Aquatic Herbicides and a Surfactant to Garter Snakes*, Robert C. Hosea, California Department of Fish and Game (2004)
- *Chronic Toxicities of Herbicides Used to Control Water Hyacinth and Brazilian Elodea on Neonate Cladoceran and Larval Fathead Minnow,* Frank Riley and Sandra Finlayson, California Department of Fish and Game (2004)
- *Acute Toxicities of Herbicides Used to Control Water Hyacinth and Brazilian Elodea on Larval Delta Smelt and Sacramento Splittail*, Frank Riley and Sandra Finlayson, California Department of Fish and Game (2004)
- *Ceriodaphnia dubia (water flea) Static Definitive Chronic Toxicity Test Data (7-day) for Exposure to Various Aquatic Herbicides*, California Department of Fish and Game, Aquatic Toxicology Laboratory (2003)
- *Pogonichthys macrolepitdotus (Sacramento Splittail) Static Definitive Acute Toxicity Test Data (96-hour) for Exposure to Various Aquatic Herbicides*, California Department of Fish and Game, Aquatic Toxicology Laboratory (2003)
- *Biological Control of Water Hyacinth in the Sacramento-San Joaquin Delta,* Lars W.J. Anderson, Ph.D, and Jason Brennan, USDA-ARS Exotic and Invasive Weed Research (2003)
- *Biological Control of Water Hyacinth: Second Year Progress Report,* Lars W.J. Anderson and Jason Brennan, USDA-ARS Exotic and Invasive Weed Research (2005)
- *Biological Control of Water Hyacinth in the Sacramento-San Joaquin Delta: Year 3 – Final Report*, R. Patrick Akers and Michael J. Pitcairn, California Department of Food and Agriculture (2006)
- *Mapping Invasive Plant Species in the Sacramento-San Joaquin Delta Region Using Hyperspectral Imagery,* Susan L. Ustin, Ph.D., et al, Center for Spatial Technologies and Remote Sensing (CSTARS), California Space Institute Center of Excellence (CalSpace), UC Davis (2004)
- *Monitoring Valley Longhorn Elderberry Beetle Elderberry Shrub Habitat,* Paul Ryan, et al., California Department of Boating and Waterways (multiple years).

## 2. WHCP Methods

### Environmental Training

Prior to the start of each treatment season, the DBW conducts environmental awareness training for all field crew members. The training includes: species identification and impact avoidance guidelines; protocol for identification and protection of elderberry shrubs; protocol for identification and protection of delta smelt, Chinook salmon, steelhead, green sturgeon, and associated protected habitats; and protocol for take of protected species. In addition, field crew members also are trained on use and calibration of equipment and the WHCP Operations Management Plan.

## Chemical Control

Since 2001, the DBW has had between three and six full-time treatment crews of two persons each conducting treatments during the WHCP season. Most of this time, at least one crewmember has possessed a Qualified Applicators Certificate, category "F" (aquatics), from the California Department of Pesticide Regulation (DPR). The DBW assigns each crew to one of four large regions: west, north, central, or south.

Treatment crews visually survey all sites in their applicable regions prior to starting treatment. In developing each season's treatment plan, the DBW prioritizes herbicide applications. Nursery areas and areas that are critical to public, agricultural, and industrial uses are treated first.

Factors that DBW considers in selecting sites include impacts to navigation, threats to agricultural pumping facilities, and high levels of infestation. The DBW considers logistical factors, such as tides and travel times, and factors daily weather conditions such as wind speed into daily site selection. The DBW may update, revise, or reprioritize the treatment site list over the course of the treatment year based upon new information about the treatment sites.

Each week, the DBW submits Notices of Intent (NOIs) to the appropriate County Agricultural Commissioner. NOIs detail the sites, dates, and herbicides and adjuvants to be used for the following week. This list typically includes back-up sites, in case wind and weather conditions preclude spraying in designated areas.

The DBW may begin chemical treatments as early as April 1st in sites that are not considered salmon habitat, including some sites on the San Joaquin River and eastern Delta. The DBW may begin treatments in the remainder of the Delta after June 1st, as long as (1) Interagency Ecology Program (IEP) Real-Time Monitoring shows the salmon pulse has migrated through the system, (2) water temperatures have increased, and (3) NOAA- Fisheries issues written verification. There are no restrictions on treatment locations within the WHCP project area between July 1st and October 15th.

Crews typically conduct treatment with hand-held sprayers applied from 19 to 21 foot aluminum airboats or outboard motor boats. The boats are equipped with direct metering of herbicides, adjuvants, and water pump systems. The crews spray the chemical mixture directly onto the plants. Treatment crews follow specific requirements to account for wind, dissolved oxygen, drinking water intakes, agricultural intakes, and total acres treated. Treatment crews also implement a fish passage protocol to ensure that migratory fish are not impacted by the WHCP.

### *Aquatic Herbicide Use*

The amount of herbicide used and number of acres treated in a given year can reflect the magnitude of infestation. However, there are several other factors that affect the amount of treatment that DBW conducts (regulatory limits, local water conditions, weather, staff levels, etc.). For example, in winter 2006/2007, there was an early freeze in the Delta, which likely contributed to the significant decline in acres requiring water hyacinth treatment between 2006 and 2007. In 2008, water hyacinth levels were low, perhaps due to weather and water conditions, and/or the cumulative effects of annual treatments.

**Table 2-5,** on the next page, provides the acres treated, and gallons of herbicides and adjuvant used by the WHCP from 2001 to 2008. The two herbicides are 2,4-D (Weedar® 64) and glyphosate (AquaMaster™). The WHCP also utilizes Agridex®, an adjuvant. The DBW is also considering another adjuvant, Competitor®. Labels and Material Safety Data Sheets (MSDSs) for all four chemicals are provided in Appendix B.

**Table 2-5**
**WHCP Herbicide and Adjuvant Use and Acres Treated (2001 to 2008)**

| Year | Gallons 2,4-D | Gallons Glyphosate | Total Gallons Herbicide | Gallons Adjuvant* | Total Acres Treated |
|---|---|---|---|---|---|
| 2001 | 948 | 16 | 964 | 82 | 1,013 |
| 2002 | 1,762 | 67 | 1,829 | 540 | 1,854 |
| 2003 | 1,719 | 367 | 2,086 | 519 | 2,222 |
| 2004 | 2,062 | 517 | 2,579 | 751 | 2,770 |
| 2005 | 1,903 | 219 | 2,122 | 736 | 2,208 |
| 2006 | 2,176 | 208 | 2,384 | 918 | 2,446 |
| 2007 | 938 | 149 | 1,087 | 441 | 1,137 |
| 2008 | 336 | 64 | 400 | 163 | 420 |

* In 2001, the DBW utilized the adjuvant Placement, in 2002 and 2003, the DBW utilized the adjuvant R-11. Both of these adjuvants were found to be potentially more toxic than the adjuvant Agridex, which the DBW began using in 2005.

Herbicide use in future years will be heavily dependent on weather conditions. One possible reason for the low acreage of water hyacinth in the Delta in 2008 was the extremely low rainfall during winter 2007/2008. Another low rainfall season in 2008/2009 would likely result in even lower quantities of water hyacinth in the 2009 season.

A high rainfall winter could potentially result in significant increases in water hyacinth in the following season. This is because riverbeds and shorelines exposed by drought conditions act as nursery areas. When nursery areas become inundated again after heavy rains, water hyacinth seeds germinate, and the new plants move downriver into the Delta.

## Handpicking

Primarily during the period from October 15th to April 1st, when chemical treatment is restricted, treatment crews survey for water hyacinth, and conduct handpicking in selected areas. The goals of the handpicking program are to aid in the control of water hyacinth and reduce impacts of chemical application by clearing areas that are not accessible to chemical treatment, subject to high infestation, and within emergent vegetation.

Crews follow specific handpicking protocols to ensure the protection of water quality and special status species. The DBW is currently conducting a three-year cost benefit analysis of the handpicking program. During the 2007/2008 off-season (October 15 to April 1), treatment crews collected over 4,000 30-gallon barrels of water hyacinth. Once collected, water hyacinth is left on the levee banks, at selected dispersal sites, to decompose.

## Herding

Herding is conducted by field crews using spray boats fitted with a rebar and wire U-shaped “cage” mounted to the front of the boat. The boats approach water hyacinth and push the mat or section of mat toward a main channel. Once in a main channel, the water hyacinth flows out of the Delta, into saline waters and dies. Water hyacinth cannot survive in waters of greater than 2ppt saline water (brackish water).

Herding is generally limited to selected periods during November to February. Field supervisors take into account tides, storm events, and dam releases to select appropriate days and times for herding to take place. Herding typically occurs in the western portion of the Delta, near Antioch, to ensure that water hyacinth mats will be pushed out of the Delta. Crews do not herd in areas where physical damage to emergent, native vegetation is likely to occur such as among stands of cattails (*Typha* spp.), *Phragmites* spp., bulrushes (*Scirpus* spp.), or native cordgrass (*Spartina foliosa*). In addition, the total amount of water hyacinth herded in one area is limited to avoid impeding navigation. Due to timing and logistical limitations of herding activities, this method is not used as frequently as handpicking.

### Biological Control

While successful implementation of biological control for water hyacinth is challenging in the Delta, DBW and their partners continue to evaluate and consider new alternatives. The DBW is currently funding research at UC Davis to identify plant pathogens in the Delta with potential for controlling water hyacinth. Plant pathogens, in combination with other mechanisms, may be a promising future alternative for water hyacinth control (Charudattan 2001). Because the biological control component of the WHCP consists of research only, we do not analyze biological control methods further within this PEIR.

## 3. WHCP Environmental Monitoring

The DBW conducts extensive monitoring for the WHCP. The DBW is responsible for collecting water quality monitoring data, as well as collecting water samples for chemical residue testing.

Based on NPDES permit requirements, DBW follows a monitoring protocol. This protocol fulfills requirements of the Regional Water Quality Control Board, NOAA Fisheries, and USFWS. **Exhibit 2-2,** on the next page, illustrates the field and laboratory components of WHCP monitoring. At each monitoring site, DBW's environmental scientists take samples immediately pre-application (adjacent to the water hyacinth mat), and post-application (upstream, adjacent to, and downstream of the treatment area). WHCP environmental scientists also take a sample one week following treatment.

The DBW selects monitoring sites that reflect a mix of water types (tidal, riverine, tidal dead-end), both herbicides, sites with the greatest amount of herbicide use, and different habitat types. The DBW typically conducts monitoring at approximately 20 sites during a treatment season. Each treatment season, DBW is required to conduct monitoring at 10 percent of the sites it treats and 10 percent of each type of waterway.

At each monitoring site, environmental scientists monitor dissolved oxygen, turbidity, pH, and several other water quality measures. The DBW environmental scientists collect water samples in amber bottles, packed in ice, and submit them to a Certified Analytical Laboratory to measure chemical residue levels. Between 2001 and 2005, the DBW also submitted water samples to the California Department of Fish and Game (CDFG) Toxicology Laboratory to conduct a series of toxicity tests. The DBW has not been required to conduct toxicity tests since 2005.

Treatment crews conduct daily monitoring, in addition to the extensive monitoring conducted by DBW environmental scientists. Treatment crews monitor and report pre- and post-treatment dissolved oxygen and turbidity, wind speed, temperature, acres treated, quantity of herbicide and adjuvant, presence of elderberry shrubs or other species of concern, and coordinates of treatment location. **Table 2-6,** on the next page, lists monitoring requirements for WHCP environmental scientists and WHCP treatment crews.

We discuss results of WHCP monitoring in detail in Chapters 3 and 4. In summary, over eight years of monitoring results (2001 to 2008) have indicated no degradation of Delta water quality following water hyacinth treatments. Concentrations of chemicals following treatments were minimal, with most non-detectable, or far below labeled rates, application concentrations, and guiding standards.

**Exhibit 2-2**
**WHCP Water Quality Data and Water Sample Collection**

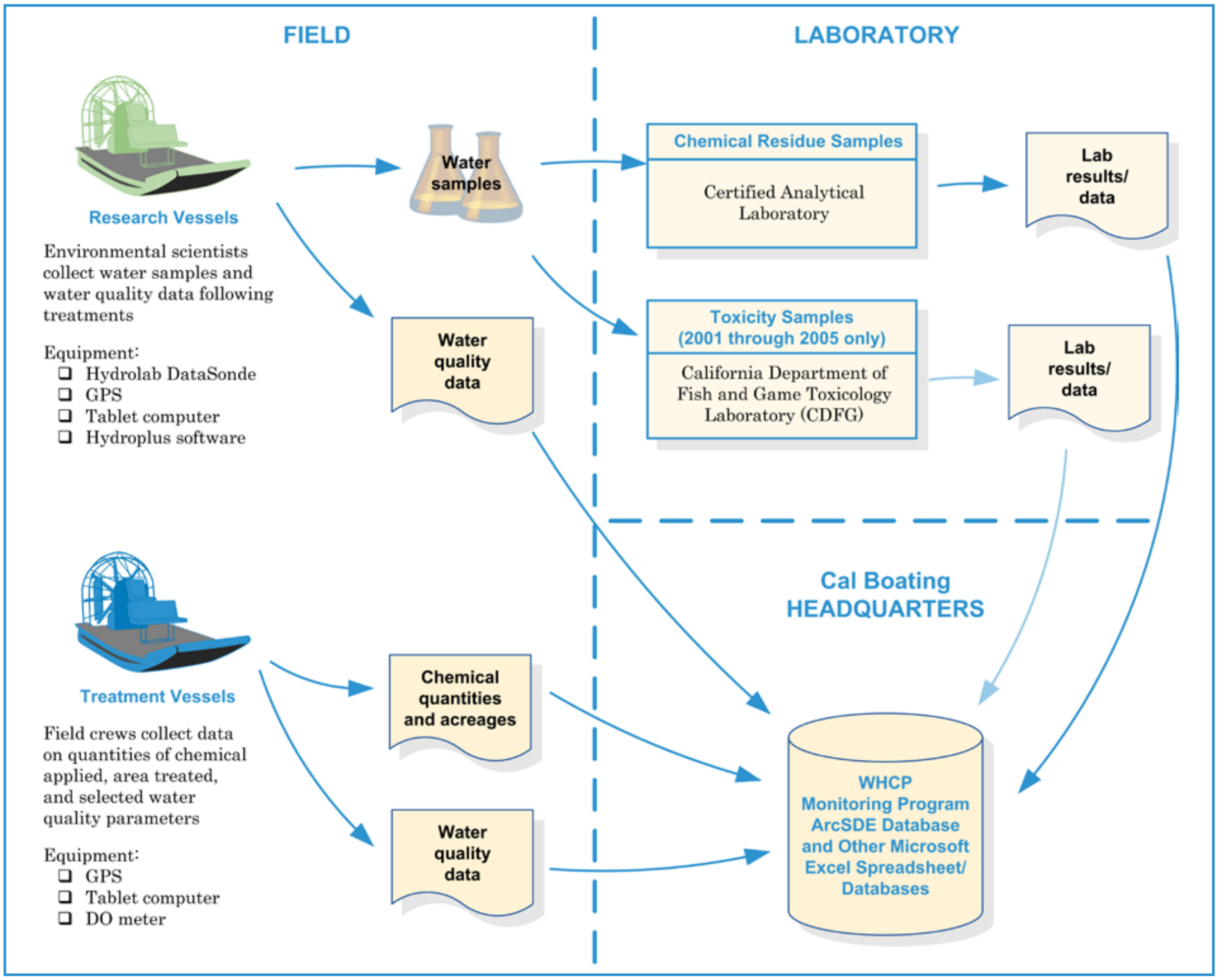


**Table 2-6**
**WHCP Environmental Monitoring Requirements**

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

In 2007 and 2008, the highest level of 2,4-D, at 27 ppb, was found immediately post-treatment. All other post-treatment 2,4-D levels were either non-detectable, or below 9.5 ppb. The maximum allowable residue level of 2,4-D is 70 ppb. All except one WHCP post-treatment glyphosate residue samples in 2007 and 2008 were at non-detectable levels.

The toxicology testing conducted by CDFG Toxicology Laboratory between 2001 and 2005 found less than significant toxicity impacts due to WHCP herbicides. The DBW eliminated the use of the herbicide diquat, and the adjuvants Placement® and R-11®, when toxicity tests showed potentially negative impacts. Diquat was used for only a small portion of WHCP treatments, and was replaced with 2,4-D and glyphosate. The DBW replaced Placement® and R-11® with a less toxic alternative, Agridex®.

In the field, the DBW has not identified any WHCP impacts on special status species' habitat resulting from the WHCP. In addition, the DBW has found no known "take" of threatened or endangered species as a result of the WHCP.