WATER HYACINTH CONTROL PROGRAM
2013 ANNUAL REPORT

NPDES Permit No. CAG990005
NMFS Concurrence Letter No. 2013/9443
USFWS Biological Opinion No. 81410-2013-F-0005

Water Hyacinth Control Program
2013 Annual Report

Submitted Pursuant to:
Statewide General NPDES Permit (CAG990005)
USFWS Biological Opinion (81410-2013-F-0005)
NMFS Letter of Concurrence (2013/9443)

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 information submitted. Based on my inquiry of the persons who manage the program, Geoff Newman – *Acting Senior Environmental Scientist*, or those persons directly responsible for gathering the information, Angela Llaban – *Water Hyacinth Control Program Environmental Scientist*, 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.

Sylvia Ortega Hunter, Deputy Director

1/30/14
Date

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EXECUTIVE SUMMARY

Water hyacinth (*Eichhornia crassipes*) is a non-native, free-floating, invasive aquatic plant. It grows in wetlands, marshes, shallow water bodies, slow moving waterways, lakes, reservoirs, and rivers. Water hyacinth negatively influences biodiversity, recreation, and agriculture. It de-stabilizes dissolved oxygen cycles, crowds out native plants, shades out important shallow water fish habitat, obstructs waterways and navigational channels, and blocks agricultural and municipal water intakes.

In 1982, SB 1344, Chapter 2, Article 2, Section 64 amended the statutes of the California Harbors and Navigation Code to designate the California Department of Parks and Recreation, Division of Boating and Waterways (DBW) as the lead agency for controlling water hyacinth in the Sacramento-San Joaquin Delta (Delta), its tributaries, and the Suisun Marsh.

This program operates under the regulations imposed by the National Pollutant Discharge Elimination System (NPDES) Statewide General Permit (CAG990005) issued by the State Water Resources Control Board (SWRCB) and administered by the Central Valley Regional Water Quality Control Board (CVRWQCB), the U.S. Fish and Wildlife Service(USFWS) Biological Opinion (81410-2013-F-0005), and the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) Letter of Concurrence (2013/9443) pursuant to Section 7 of the Endangered Species Act (ESA). As part of the permits and biological opinions, a monitoring program was developed to evaluate effects of the Water Hyacinth Control Program (WHCP) on water quality and federally listed threatened and endangered species.

All WHCP water quality monitoring follows the WHCP NPDES Annual Monitoring Protocol as outlined in the WHCP Aquatic Pesticide Application Plan (APAP), which was approved in 2008 by the CVRWQCB. Monitoring activities include recording WHCP impacts on beneficial waters of the United States, observations of federally listed threatened or endangered species, and associated listed species habitats. DBW documented herbicide residues in receiving waters and monitored water quality parameters such as dissolved oxygen, temperature, conductivity, salinity, pH, and turbidity at representative locations. During 2013, there were several occurrences where dissolved oxygen levels, turbidity and pH exceeded basin limits. There were no herbicide or adjuvant (Agridex) residues detected at receiving water locations.

In 2013, the WHCP applied 1,889 gallons of glyphosate, and 777 gallons of Agridex. Herbicide treatments of the 2013 season began on March 18 and continued through November 27. The WHCP successfully treated 2,185 acres of water hyacinth in the Delta and its surrounding tributaries. In December 2013, DBW acquired contracted services to mechanically harvest water hyacinth from several Delta waterways. An estimated total of 124 acres were removed between December 4, 2013 and January 1, 2014.

1 INTRODUCTION

1.1 Extent of Infestation

The DBW is responsible for controlling water hyacinth (*Eichhornia crassipes*), an invasive, floating, aquatic weed that can potentially grow in approximately 67,779 water surface acres of the Sacramento-San Joaquin Delta and its tributaries. Determining the annual extent of infestation is difficult because both individual plants and large mats move with river currents, diurnal tidal movement and winds. Historically, pre- and post-season infestations have been assessed through visual estimates conducted by WHCP application crews.

Crews visually survey all the sites in their application region. Herbicide applications are then prioritized such that nursery areas with high amount of growth and areas that are critical to public, agricultural, municipal, industrial, recreational or navigational use are treated first. Logistics such as number of crews available, travel times to sites, herbicide label restrictions, fish passage protocols, and daily weather and tide conditions, are also factored into daily site selections for treatment.

1.2 Setting

The WHCP includes portions of eleven counties that encompass the Delta and its upland tributaries. The eleven counties include Alameda, Contra Costa, Fresno, Madera, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Tuolumne, and Yolo. 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
- East along the Merced River to Merced Falls, below Lake McClure

Within the 2013 WHCP project area, there were 418 possible treatment sites. These sites vary in size (between 5 and 1,700 acres) and may be between one and three miles in length. See Figure A-1 in Appendix A for a map of the WHCP project area and monitoring sites sampled in 2013.

2 SB 1344

2.1 Section 64 of the Harbors and Navigation Code

Section 64 of the Harbors and Navigation Code reads as follows:

"(a) The Legislature hereby finds and declares that the growth of water hyacinth and *Egeria densa* in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh has occurred at an unprecedented level and the resulting accumulations of water hyacinth and *Egeria densa* obstruct navigation, impair other recreational uses of waterways, have the potential for damaging manmade facilities, and may threaten the health and stability of fisheries and other ecosystems within the delta and marsh. Accordingly, 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."

"(b) The Division is designated as the lead agency of the state for the purpose of cooperating with agencies of the United States and other public agencies in controlling water hyacinth and *Egeria densa* in the delta, its tributaries, and the marsh."

3 COMPLIANCE

3.1 Summary of Regulatory Permits

The following constitutes a summary of the permits required to implement the WHCP. Each permit has regulations designed to ensure avoidance or minimization of significant impacts to beneficial uses of waters of the U.S. or federally threatened and endangered species protected by the Endangered Species Act (ESA). The DBW partners with the US Department of Agriculture (USDA) to obtain required approvals to operate the WHCP from two federal agencies: The U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS). DBW obtained five-year permits (2013-2017) from each agency to operate the WHCP pursuant to Section 7 of the Endangered Species Act (ESA).

- USFWS Biological Opinion (81410-2013-F-0005), effective March 13, 2013
- NMFS Letter of Concurrence (2013/9443), effective February 27, 2013

A third permit is required by the State Water Resources Control Board. Coverage under this permit was obtained in February 2013.

- Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States (Permit No.CAG990005, Water Quality Order 2004-2009-DWQ)

3.1.1 Reporting Requirements

The NPDES Statewide General Permit for Aquatic Pesticide Use requires DBW to submit an Annual Report March 1 following the WHCP application season. Reporting per NPDES guidelines must include the following: 1) an executive summary discussing permit compliance or violation of permit terms and conditions to beneficial waters of the U.S., 2) the effectiveness of the WHCP Aquatic Pesticide Application Plan (APAP), 3) the discharge of pollutants associated with aquatic pesticide applications, 4) a summary of monitoring data, including changes to water quality, and violations of compliance with water quality objectives as outlined in the Central Valley Basin Plan issued by the CVRWQCB, 5) identification of Best Management Practices (BMPs) and their effectiveness in meeting permit requirements, 6) a discussion of modifications or management corrections for any violations that occurred, 7) maps showing application area, acreage and sampling locations, types and amounts of aquatic pesticides used during each application event, information on surface area, volume and rate of application, and 8) sampling results for all required monitoring.

Both the USFWS Biological Opinion (BO) and the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) BO require Annual Reports to be submitted January 31, following the application season. These reports summarize compliance with the terms and conditions which include species and habitat protection, water quality monitoring, and any additional monitoring and studies that may have been conducted as part of regulatory requirements from other participating state or federal agencies. Additional reporting requirements are on a case-by-case basis in the event an incidental take should occur with any of the species discussed in these BOs. 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. Reporting of take begins with immediate notification to the USFWS or NMFS biologist (based on jurisdiction) in charge of administering the BOs and requires documentation of information, such as location of take, number of species, water quality conditions, chain of custody, and prescriptive action for preventing future occurrences.

3.1.2 Statewide General NPDES Permit

RECEIVING WATERS

There is a clear distinction in the NPDES Permit (No. CAG990005) regarding application area, treatment area, and receiving waters. In the NPDES Permit, an application area is defined as the area in which aquatic pesticides are directly applied. The treatment area is the area treated with an aquatic herbicide to control aquatic weeds. It is the responsibility of the Discharger to define the treatment area for each location that it discharges to. The WHCP sprays herbicide onto water hyacinth and does not inject herbicides into the water column to treat submerged plants. Therefore, the application and treatment areas are essentially the same geographic place. Receiving waters are defined in two manners: 1) waters directly down flow of the treatment area, and 2) waters within the treatment area after completion of the treatment event when herbicide residue levels fall below minimum effective concentrations. Herbicides applied to aquatic plants are not considered a pollutant until residues reach receiving waters. This is because an herbicide designed to treat aquatic plants and approved by the US EPA cannot also be a pollutant under the Clean Water Act when the herbicide is doing what it was designed and approved to do under federal pesticide use regulations.

NUMERIC LIMITS

Dissolved Oxygen

Dissolved oxygen (DO) limits are required under the NPDES permit. Figures A-2 and A-3 in Appendix A geographically show where these basin limits occur in the WHCP project area. Within the legal boundaries of the Delta, the DO concentration shall not be reduced below:

- 7.0 mg/l in the Sacramento River (below the I Street Bridge) and in all Delta waters west of the Antioch Bridge
- 6.0 mg/l in the San Joaquin River (between Turner Cut and Stockton, 1 September through 30 November)
- 5.0 mg/l in all other Delta waters

For surface water bodies outside the legal boundaries of the Delta, the monthly median of the mean daily DO concentration shall not fall below 85 percent of saturation in the main water mass, and the 95 percentile concentration shall not fall below 75 percent of saturation. To protect beneficial uses of water, the dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time:

- 5.0 mg/l for waters designated as warm freshwater habitat (WARM)
- 7.0 mg/l for waters designated as cold freshwater habitat (COLD)
- 7.0 mg/l for waters designated for spawning, reproduction, and development (SPWN)

In the locations listed in Table 1, dissolved oxygen concentrations shall not be reduced below the amount indicated during the stated time period.

Table 1. Specific Dissolved Oxygen Water Quality Objectives

Location	DO concentration	Time Period
Sacramento River from Keswick Dam to Hamilton City	9.0 mg/l*	1 June to 31 August
Feather River from Fish Barrier Dam at Oroville to Honcut Creek	8.0 mg/l	1 September to 31 May
Merced River from Cressy to New Exchequer Dam	8.0 mg/l	All year
Tuolumne River from Waterford to La Grange	8.0 mg/l	15 October to 15 June

* When natural conditions lower dissolved oxygen below this level, the concentration shall be maintained at or above 95 percent of saturation.

pH and Turbidity

In addition to DO limits, basin limits for pH and turbidity are also required under the NPDES permit. The discharge shall not cause the ambient pH to fall below 6.5 or exceed 8.5, and the 30-day average turbidity to increase as follows:

- More than 1 Nephelometric Turbidity Units (NTU) where natural turbidity is between 0 and 5 NTUs
- More than 20 percent where natural turbidity is between 5 and 50 NTUs
- More than 10 NTUs where natural turbidity is between 50 and 100 NTUs
- More than 10 percent where natural turbidity is over 100 NTUs

3.1.3 USFWS Biological Opinion for WHCP

The USFWS issued a biological opinion (BO) (Service file No. 81410-2013-F-0005) on the effects of DBW's WHCP on delta smelt (*Hypomesus transpacificus*) and its critical habitat, giant garter snake (*Thamnophis gigas*) and the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). The WHCP complies with the USFWS BO terms and conditions which include implementation of conservation measures identified in the WHCP project description. Below is a summary of the terms and conditions required under the biological opinion.

DELTA SMELT

The WHCP USFWS BO outlines specific mitigation measures to minimize impact to *H. transpacificus* (delta smelt) and associated habitats. Interagency Ecological Program (IEP) fish monitoring data is used to determine the presence or absence of delta smelt within or near herbicide application areas. Timing and location requirements specified in the USFWS BO aim to reduce the potential for negative impacts on delta smelt. The WHCP program area is divided into four USFWS Areas (Figures A-4 and A-5 in Appendix A): Area 1 (primary delta smelt habitat), Area 2 (secondary delta smelt habitat), Area 3 (tertiary delta smelt habitat) and Area 4 (non-delta smelt habitat). Herbicide applications in Areas 2, 3 and 4 may begin on March 1 and continue through November 30. Herbicide applications in Area 1 may begin June 1 and continue until November 30. For all treatments conducted between March 1 and June 30, the ability to treat water hyacinth depends on the presence of listed fish species, which is determined by a review of available fish monitoring data and by species surveys on the day of the planned treatment. Herbicide applications will be suspended in the immediate treatment area in the event that delta smelt are identified, harmed or killed in the action area.

In the 2001 WHCP USFWS BO, DBW was directed to determine the level of impact that WHCP herbicides might have on the Delta smelt. These impacts were to be determined for critical life stages only. Originally, the USFWS BO required egg and larvae 96-hr. definitive toxicity tests and "live-car" exposure studies. It was later determined by the USFWS that only 96-hr. definitive studies on larvae were necessary. It was also determined that 96-hr. acute toxicity tests using application-exposed field water from treatment sites was acceptable in lieu of live car studies. Both studies for delta smelt were completed and submitted to the USFWS in March 2004. After evaluation of these reports, in the spring of 2004, the USFWS determined that acute exposure from 2,4-D, glyphosate and Agridex® does not cause significant impacts and issued new terms and conditions for use of these herbicides and adjuvant.

The WHCP USFWS BO requires that personnel involved with the WHCP receive USFWS-approved worker environmental awareness training. Under this training program, personnel are informed about the presence of delta smelt and its associated habitat. Training includes 1) species identification, 2) the life history of delta smelt, 3) the importance of Delta migratory routes, and 4) all terms and conditions of the WHCP USFWS BO for protection, avoidance and minimization of impacts to protected species under ESA.

VALLEY ELDERBERRY LONGHORN BEETLE

The WHCP USFWS BO outlines specific mitigation measures to minimize impact to *Desmocerus californicus dimorphus,* the valley elderberry longhorn beetle (VELB), and associated elderberry shrub (*Sambucus* sp.) habitat. DBW was directed to avoid impact to VELB by surveying for *Sambucus* ssp. (elderberry shrub), and maintaining a 100 foot buffer between treatment sites and shoreline elderberry shrubs. In areas where treatment cannot occur away from VELB habitat, and where a 100 foot buffer would preclude DBW's ability to treat water hyacinth, DBW will use a 50 foot buffer when winds are less than 3 mph. In addition, wind speed and direction are also factors as to whether or not a treatment could occur in these areas. Herbicide applications occur away from and downwind of elderberry shrubs.

The USFWS BO requires that personnel involved with the WHCP receive worker environmental awareness training taught by a USFWS-approved biologist. Under this training program, personnel are informed about the presence of VELB and its habitat. Training includes 1) species identification, 2) the life history of VELB, 3) the importance of elderberry shrubs as habitat, and 4) all terms and conditions of the WHCP USFWS BO for protection, avoidance and minimization of impacts to protected species under ESA.

GIANT GARTER SNAKE

The WHCP USFWS BO outlines specific mitigation measures to minimize impact to *Thamnophis gigas* (giant garter snake, GGS). Restrictions regarding GGS in the USFWS BO apply to any land based operations, which occur on Delta banks other than existing roads or boat ramps, and to mechanical removal of water hyacinth in sensitive GGS habitat. Disturbance of upland GGS habitat will be conducted between May 1 and October 1 to lessen direct effects during the active season, because GGS are actively moving and avoiding danger.

Mechanical harvesters will maintain a speed of 2 to 2.5 knots in areas outside of sensitive GGS, or areas where GGS has been sighted in the past, making it likely for any present GGS to move out of the area. Additionally, the mechanical harvester will stop and/or reverse the harvester if a snake is seen within water hyacinth during removal.

Disposal of water hyacinth following handpicking or mechanical removal outside of the active season (May 1 – October 1) will be disposed of at an approved disposal facility with low to no value GGS habitat to ensure no hibernating GGS are buried under piles of collected water hyacinth. Mitigation measures beyond the requirements of the USFWS BO have been implemented to avoid impacts to GGS and their habitat.

The entire WHCP project area has been evaluated for GGS habitat. This evaluation has been incorporated into the GIS technology utilized by application crews. The application crews have also been provided with a set of maps of previously surveyed and sensitive areas for GGS to minimize impact where GGS are most likely to be found.

The 2001 WHCP USFWS BO required tests to evaluate acute toxicity of a representative species of garter snakes. DBW conducted oral and dermal exposure tests using the program herbicides and adjuvant on *Thamnophis elegans* (mountain garter snake) and *Thamnophis sirtalis* (common garter snake) in the spring of 2003. A final report of this study was submitted to the USFWS in the spring of 2004. The study found there were no observable effects to these two species when oral and dermal exposure was at maximum label concentrations.

The USFWS BO requires that personnel involved with the WHCP receive USFWS approved worker environmental awareness training. Under this training program, personnel are informed about the presence of GGS (*T. gigas*) and habitat associated with the species. Training includes: 1) species identification, 2) the life history of the GGS, 3) the importance of irrigation canals, marshes/wetlands, and seasonally flooded areas as habitat, and 4) all terms and conditions of the USFWS WHCP BO for protection, avoidance and minimization of impacts to protected species under ESA.

3.1.4 NMFS Letter of Concurrence for WHCP

In 2013, NMFS issued a Letter of Concurrence (2013/9443) in response to USDA and DBW's request for ESA Section 7 consultation. Based on the WHCP project description and supplemental material provided, and the best available scientific and commercial data, NMFS concurs with USDA and DBW's determination that the proposed use of herbicide products, adjuvants, or physical removal methods is not likely to adversely affect federally listed Sacramento River winter-run Chinook salmon (*Oncorhynchus tschawytscha*), Central Valley spring-run Chinook salmon (*O. tschawytscha*), Central Valley steelhead trout (*O. mykiss*), or the Southern distinct population segment (DPS) of North American green sturgeon (*Acipenser medirostris*) or any of their designated critical habitats.

The WHCP project description outlines specific mitigation measures and avoidance guidelines to minimize impact to Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead trout. Dependent upon type of water year and in-stream flows, juvenile Chinook salmon and steelhead may be present in the Delta through June. The DBW is authorized to begin herbicide applications as early as March 1 in sites where listed fish species are not likely to be present. The remainder of the action area may be treated provided that the available fish monitoring data indicates that salmonids are not likely present or that the pulse of Chinook salmon has migrated through the Delta. To minimize potential negative effects to steelhead, NMFS permitted 2,4-D applications from June 15 to September 15 within the legal Delta and from July 15 to August 15 in the San Joaquin River.

Specific guidelines ensure fish are not impacted by WHCP applications. The following practices are incorporated into the WHCP protocols to avoid oxygen depletion due to decaying vegetation and ensure fish passage: In slow-moving and back-end sloughs infested with water hyacinth, applicators may only treat up to 30% of the water hyacinth mat at one time. In Delta tidal waters, applicators may only treat up to 50% of the water hyacinth mat at one time. Mats will be treated up to 3-acre strips, leaving at least 100 foot buffer strips between treated areas. Applicators must maintain buffer zones, treat at specific dissolved oxygen levels, and never block escape routes. Each WHCP crew received a copy of the protocol and refresher training on Fish Passage Protocol prior to the 2013 treatment season.

DBW continues to require herbicide applicators to be informed about the presence of Chinook salmon, steelhead, and green sturgeon and their associated habitat. Training includes: 1) species identification, 2) salmonid and sturgeon life history, 3) importance of migratory routes and identification of associated habitat, 4) impact avoidance guidelines and 5) the terms and conditions of the NMFS concurrence letter.

4 PERSONNEL, MATERIALS AND METHODS

4.1 WHCP Personnel

4.1.1 Application Crews

During 2013, the DBW had six full-time crews, each consisting of a specialist and a technician, for herbicide application activities. Similarly, under contract with DBW, Merced County had one crew that conducted herbicide treatment activities in 2013. Fresno County had one crew that surveyed the San Joaquin River and Kings River for water hyacinth in 2013. Each crew contains a minimum of one member possessing a Qualified Applicators Certificate, category "F" (aquatics), administered by the California Department of Pesticide Regulation (CDPR).

APPLICATION PERSONNEL EDUCATION AND TRAINING

Qualified Applicator Certificate

Application crews receive continuing education credits in pesticide training to keep their licenses current. Continuing education covers pesticide laws and regulations which may include topics such as federal and state pesticide regulations, pesticide and worker safety, surface and ground water protection, pesticide labeling and label interpretation, and pesticide effects on the environment. Category F licenses are renewed every two years upon completion of the continued education credit requirements.

Environmental Awareness Training

Environmental awareness training was conducted in March 2013. This training included the following items:

- Species identification and impact avoidance guidelines on all threatened and endangered species associated with the WHCP
- Identification and protection of elderberry shrubs (*Sambucus* ssp.) and protocol for monitoring species fitness during an application season
- Identification and protection of the giant garter snake (*T. gigas*), including life history; importance of irrigation canals, marshes, wetlands, and seasonally flooded areas as habitat; and the terms and conditions of the biological opinion
- Identification and protection of Delta smelt (*H. transpacificus*), Chinook salmon (*O. tschawytscha*), steelhead (*O. mykiss*), green sturgeon (*A. medirostris*) and associated protected habitats, fishery closure dates, and other regulatory agency requirements
- Protocol for "take," including reviewing the "Incidental Take Statement," collection and handling of dead species, completion of chains of custody, and notification to either USFWS or NMFS

Equipment Training

Refresher training on the use and calibration of the dissolved oxygen meters and use of the Xplore tablet iX104C GPS system and ArcPad application took place in March 2013.

4.1.2 Monitoring Personnel

Monitoring activities are overseen by an environmental scientist and conducted by qualified personnel, which may include an environmental scientist and scientific aids. All water sampling events are carried out in accordance with the WHCP Quality Assurance Project Plan (QAPP) and the WHCP Environmental Monitoring Protocol as approved by the Central Valley Regional Water Quality Control Board, NMFS and USFWS.

Environmental scientists are responsible for understanding and adhering to the regulatory permits and biological opinion terms and conditions. They are also responsible for training other monitoring crew members on monitoring protocols, water sampling techniques, and the calibration and use of field equipment necessary to collect accurate data. Environmental scientists conducted monitoring training for all monitoring personnel during 2013 on environmental monitoring and field equipment protocols.

4.2 Materials and Methods

4.2.1 Herbicide Application

WHCP Operation Management Plan

The WHCP has an Operations Management Plan (WHCP OMP). This WHCP OMP details general requirements, an overview of program activities, a pre-application planning protocol, application/monitoring coordination protocol, herbicide application protocol, and Best Management Practices (BMP) for herbicide handling, spray equipment maintenance and calibration, spill avoidance and contingency plan, listed species avoidance and habitat evaluation, dissolved oxygen/temperature measurement, fish passage protocol, and agricultural and water intake coordination.

Herbicides and Adjuvant

Herbicides used in 2013 by the WHCP include the following:

Herbicides

- Glyphosate (Aquamaster®/Roundup Custom®), (N-(phosphonmethyl) glycine, in the form of isopropylamine salt), EPA Registration No. 524-343-ZF

Adjuvant

- Agridex® (active ingredients: paraffin base petroleum oil and polyoxyethylate polyol fatty acid esters), California State Registration 5905-50017-AA

In 2013 the WHCP did not utilize the herbicide 2,4-D (2,4-Dichlorophenoxyacetic acid, dimethylamine (DMA) salt) (Weedar64®). For the 2014 season, the WHCP will acquire restricted materials use permit with the County Agricultural Commissioners with the intent of utilizing 2,4-D within the authorized time frame. In 2013, the WHCP was also permitted to use two new herbicides, imazamox (Clearcast®) and penoxsulam (Galleon®) and one new adjuvant, Competitor®, in USFWS Areas 3 and 4 only. However, the WHCP did not utilize these two herbicides and adjuvant in 2013. The DBW plans to test these new chemicals in 2014 within selected sites (USFWS Areas 3 and 4 only).

Application Equipment

The application of herbicides in 2013 was conducted with hand held spray wands operated from 16 to 21-foot air or outboard aluminum boats. The boats are equipped for direct metering of herbicides, adjuvant and water into the pump system of the spraying unit.

Each application crew utilized a Hach® HQ-10 or HQ-30 Dissolved Oxygen Meter and an Xplore iX104C tablet GPS system to record pre-spray and post-spray temperature, dissolved oxygen, wind speed, beginning and ending UTM coordinates of spray area, amount of herbicide used, and the date and time of treatment.

EQUIPMENT MAINTENANCE

Spray equipment was calibrated on at least a weekly basis, after changing injection pumps and whenever problems with the equipment occur. Injection systems were cleaned daily and hoses were cleaned as needed. Pump oil was changed every 50 hours. Boat maintenance was also conducted on a regular basis.

SITE SELECTION

Prior to the start of the 2013 treatment season, application crews surveyed treatment sites and identified the amount of acres infested with water hyacinth. DBW prioritized treatment sites based on results of pre-season field surveys, combined with the aquatic pest control staff's experience and knowledge of water hyacinth growth patterns.

Following terms and conditions specified in the NPDES permit and biological opinions, a number of sites were available for treatment starting March 1, with the remainder of sites open for treatment after June 1. During the March to June time period when delta smelt, winter-run Chinook, spring-run Chinook, and/or steelhead juveniles are entering and/or present in the Delta, site selection depended on available Interagency Ecological Program (IEP) monitoring data showing the absence of special status fish species in treatment sites.

The first day of herbicide treatment in 2013 was March 18 in sites within USFWS Areas 2, 3 and 4, where protected fish species were not present. After June 1, sites in USFWS Area 1 became open for herbicide treatment. Throughout the season, fish monitoring data were continuously reviewed to avoid treating in sites where listed fish species were present. Sites selected for treatment were based on the level of impacts to navigation, threats to agricultural water pumping facilities, and high degrees of hyacinth infestation. During the 2013 WHCP site selection process criteria also considered information and concerns received from area residents and business owners.

4.2.2 Environmental Monitoring

WHCP NPDES ANNUAL MONITORING PROTOCOL

All WHCP water quality monitoring follows the WHCP NPDES Annual Monitoring Protocol as outlined in the WHCP Aquatic Pesticide Application Plan (APAP), which was approved in 2008 by the Central Valley Regional Water Quality Control Board. Quality control and quality analysis measures are outlined in the WHCP Quality Assurance Project Plan (QAPP). Monitoring activities include recording WHCP impacts on beneficial waters of the United States, federally listed threatened and endangered species, and associated threatened or endangered species habitats. DBW is required to document residues in receiving waters and monitor water quality parameters such as dissolved oxygen, temperature, conductivity, pH, and turbidity at representative locations.

MONITORING EQUIPMENT

A 19-21 foot aluminum air boat or a 22 foot fiberglass C-Dory outboard motorboat was used for monitoring activities. Boats used for sampling have never been used for herbicide applications. Water samples were collected using the MasterFlex® E/S® Portable Sampler fitted with 7-10 feet of tubing. Water samples were stored on ice in 1000 mL amber glass bottles.

Water quality parameters were measured with a Hydrolab® Model MS5 mini datasonde. Water quality parameters included water temperature, electrical conductivity, salinity, dissolved oxygen, pH and turbidity. Parameters measured by the Hydrolab® were geographically referenced with GPS coordinates with an Xplore iX104C PC tablet and ArcPad application. Data were captured electronically using Hydroplus® software specifically modified for the WHCP. In the event of datasonde malfunction, a Hach® HQ-30 Dissolved Oxygen Meter was used as a backup to measure temperature and dissolved oxygen within monitoring sites. In addition, all data was hand written on datasheets as a backup copy. These datasheets were subsequently used for data quality control purposes. A digital camera (Panasonic® DMC-TS3) was used to provide visual records of sampling locations and other notable factors that may affect water quality, species of concern, or the condition of the surrounding environment. Several monitoring sites were marked with flagging tape for quick identification for follow-up visits.

EQUIPMENT MAINTENANCE

To avoid water sample contamination, boats used for environmental monitoring are never used for herbicide applications. Monitoring boats were also periodically washed. To ensure that water quality data is reliable, Hydrolabs® and Hach® DO meters were calibrated on a regular basis based on the manufacturer's requirements.

SITE SELECTION

Environmental monitoring sites were selected based on requirements listed under the NPDES permit and biological opinions. The SWRCB Statewide General NPDES Permit requires that dischargers monitor a certain proportion of sites based on the total number of treated sites. Areas treated under the WHCP shall be classified by DBW as falling into one of two water body types: 1) Tidal and 2) Riverine. DBW monitors 10 percent of the sites it treats, for each aquatic pesticide used and per water body type. In 2013, a total of 15 sites within the Delta and along the San Joaquin River were designated as WHCP monitoring sites (Table 2). Locations of the sites monitored in 2013 are mapped in Appendix A, Figure A-1.

Representative monitoring occurred in sites with varying degrees of habitat for the following species (Table 3): giant garter snake (*T. gigas*), Delta smelt (*H. transpacificus*), and valley elderberry longhorn beetle (VELB) (*D. californicus dimorphus*). Giant garter snake habitat has been rated as low, medium or high, while VELB and smelt habitat are classified as being absent or present based on the known distribution of smelt and the known locations of valley elderberry shrubs in the project area.

RESIDUE SAMPLING

All WHCP water quality monitoring followed the WHCP NDPES Annual Monitoring Protocol as outlined in the WHCP Aquatic Pesticide Application Plan, which was approved in 2008 by the Central Valley Regional Water Quality Control Board. Quality control and quality analysis measures are outlined in the WHCP Quality Assurance Project Plan (QAPP). Monitoring activities included recording WHCP impacts on beneficial waters of the United States, documenting observations of federally listed threatened or endangered species, and associated threatened or endangered species habitats. DBW is required to document herbicide and adjuvant residues in receiving waters and monitor water quality parameters such as dissolved oxygen, temperature, conductivity, pH and turbidity at representative monitoring locations.

Table 2. 2013 WHCP Monitoring Sites

Site #	Location	Water Body Type	Chemicals
10	Buckley Cove	Tidal	Glyphosate/Agridex
26	Fourteen Mile Slough	Tidal	Glyphosate/Agridex
37	White Slough	Tidal	Glyphosate/Agridex
39	White Slough	Tidal	Glyphosate/Agridex
44	Potato Slough	Tidal	Glyphosate/Agridex
59	Middle River	Tidal	Glyphosate/Agridex
60	Empire Cut	Tidal	Glyphosate/Agridex
65	Latham Slough	Tidal	Glyphosate/Agridex
66	Middle River	Tidal	Glyphosate/Agridex
68	Middle River	Tidal	Glyphosate/Agridex
100	Connection Slough	Tidal	Glyphosate/Agridex
300	San Joaquin River	Riverine	Glyphosate/Agridex
302	San Joaquin River	Riverine	Glyphosate/Agridex
319	San Joaquin River	Riverine	Glyphosate/Agridex
320	San Joaquin River	Riverine	Glyphosate/Agridex

Table 3. 2013 WHCP Monitoring Sites and Habitat Quality

Site #	Location	GGS Habitat Quality	Smelt Habitat	VELB Habitat
10	Buckley Cove	Low	Present	Present
26	Fourteen Mile Slough	Low	Present	Absent
37	White Slough	Low-Moderate	Present	Absent
39	White Slough	Moderate	Present	Absent
44	Potato Slough	Moderate	Present	Absent
59	Middle River	Low	Present	Absent
60	Empire Cut	Low	Present	Absent
65	Latham Slough	Low-Moderate	Present	Absent
66	Middle River	Moderate	Present	Absent
68	Middle River	Low	Present	Absent
100	Connection Slough	Moderate-High	Present	Absent
300	San Joaquin River	Low-Moderate	Absent	Absent
302	San Joaquin River	Low-Moderate	Absent	Present
319	San Joaquin River	Low-Moderate	Absent	Absent
320	San Joaquin River	Low-Moderate	Absent	Absent

Water sampling occurs on the same day of herbicide application, in addition to follow-up sampling at the same locations within a week after treatment. All sampling stations at representative locations are identified as “A”, “B”, and “C”. Sampling station “A” represents the treatment area where water hyacinth was treated. Sampling station “B” represents receiving water that is downstream from the treatment area. Sampling station “C” represents a control site

that is sampled before herbicide treatment, typically upstream of the treatment area. Sampling times are identified as “1”, “2”, and “3”. Sampling time “1” indicates pre-treatment. Sampling time “2” indicates immediately post-treatment. Sampling time “3” indicates within seven days after treatment. Thus, sample 1A is taken before a treatment, within the treatment area. Likewise, sample 3C is taken within one week after treatment, upstream of the treatment area (i.e. control site).

4.2.3 Contract Laboratory Standard Operating Procedures

The analytical methods used by contract laboratories are published in the U.S. EPA Test Methods for Evaluating Solid Waste Physical/Chemical SW 846 or U.S. EPA Method for Chemical Analysis of Water and Waste. Currently, analysis of water samples is conducted by the California Department of Food and Agriculture, Center for Analytical Chemistry. The method used for the WHCP to analyze 2,4-D in surface water is gas chromatography/mass spectrometry (GC/MS). Analysis of glyphosate in surface water is done by high performance liquid chromatography (HPLC).

For the 2,4-D GC/MS analysis, a linear calibration with options of using an average response factor or a linear regression is specified. An initial five-point calibration curve is completed, where the low-level standard concentration is less than or equal to the analyte quanitation limits. Glyphosate and Agridex undergo liquid chromatographic analysis with the same 5 point calibration curve. The 2,4-D results are also compared to percent recovery of the surrogate chemical 3,4-D to ensure accuracy of results. There are no comparable surrogates for glyphosate and Agridex at this time.

ANALYTICAL TESTING VALIDATION

DBW used several methods to validate results found by contracting laboratories. These methods include collecting split (duplicate) water samples, field spikes, field blanks and equipment blanks. An equipment blank sample (de-ionized water collected using the sampling device) was collected at every sampling event to detect potential contamination from sampling equipment.

5 MONITORING RESULTS AND DISCUSSION

5.1 Threatened and Endangered Species

The USFWS and NMFS have established incidental take limits for ESA listed species and outlined terms and conditions necessary to minimize the impact of incidental take on threatened and endangered species. No incidental take of threatened or endangered species occurred in the 2013 season.

5.2 Herbicide Application

Each crew completed a daily log to record herbicide treatment activities. The 2013 WHCP daily log information can be found in Appendix B, Tables B-1 to B-9. Herbicide applications were made only when dissolved oxygen (DO) levels were either above the Basin Plan limit adopted by the Central Valley Regional Water Quality Control Board or below 3.0 mg/L. No applications were made if DO concentrations were between 3.0 mg/L and the Basin Plan limits (5 mg/L to 8 mg/L, by location). DO limits for the entire WHCP project area are shown in Appendix A, Figures A-2 and A-3.

In 2013, the WHCP conducted a total of 510 herbicide applications within 130 sites of the project area (Appendix C, Figures A-6 and A-7). There were several locations in the Delta and tributaries that were identified to having high water hyacinth infestations and were considered high priority areas. Areas in the south Delta, which included Old River, Middle River, Salmon Slough and Sugar Slough had water hyacinth infestations that blocked entire sections of the waterways. The Stockton Marina and Waterfront, Port of Stockton, and Weatherbee Lake also experienced high infestations of water hyacinth. DBW worked with the Merced County crew and USFWS to control water hyacinth in the San Luis National Wildlife Refuge. Three application crews addressed sections of Salt Slough that were blocked with water hyacinth. The crews used airboats to break apart the water hyacinth mats, allowing for boat navigation and subsequently, treated the water hyacinth with herbicide.

In addition, DBW coordinated with the Contra Costa Water District (CCWD) to conduct herbicide treatments within Rock Slough. DBW has an MOU with the Contra Costa Water District that states that no applications shall occur within Rock Slough, or within one mile of the confluence of Rock Slough and Old River, or within one mile of CCWD's Old River or Mallard Slough intake pumps without consensual agreement between CCWD and DBW. In 2013, CCWD notified DBW that Rock Slough was infested with water hyacinth and requested chemical treatment. The DBW field crew coordinated with CCWD to schedule a time in which CCWD would shut down their intakes as DBW conducted herbicide applications in Rock Slough. Water intakes are typically shut down long enough to allow at least two complete tidal cycles between herbicide application and restart. This measure is primarily aimed at reducing the potential for drinking water contamination from the WHCP.

5.2.1 Summary of Herbicide Use

In 2013, a number of WHCP sites within USFWS Areas 2, 3 and 4 became available for herbicide application on March 18, 2013. To minimize potential negative effects to steelhead, NMFS permitted 2,4-D application from June 15 to September 15 within the Delta and from July 15 to August 15 in the San Joaquin River. However, in the WHCP did not utilize the herbicide 2,4-D in the 2013 season. Herbicide applications for the WHCP were conducted from March 18, 2013 to November 27, 2013. All herbicide applications utilized glyphosate with Agridex.

Glyphosate is a slow-acting herbicide, and time to symptom in treated water hyacinth plants ranged from 1 to 3 weeks. Visible effects were gradual wilting and yellowing of the plants which eventually advanced to complete browning. Observations of herbicide symptoms were observed from all treatments and although water hyacinth plants were effectively treated, plant matter continued to float and move with water flows of the Delta. Most decomposing plants eventually sank in to the water. However, there were some exceptions where large, dense mats of treated water hyacinth continued to float and block channel navigation. Water hyacinth infestations in Old River (sites 75-79) in the south Delta are an example of this.

In 2013, the WHCP used 1,889.25 gallons of glyphosate, and 777.25 gallons of Agridex to effectively treat a total of 2,184.99 acres of water hyacinth in the Delta and its tributaries (Table 4). The total acreage of water hyacinth each year between 1992 and 2013 varies (Figure 1) and ranged from 421 and 2791 acres. Water hyacinth was not treated in 2000 as the program was the subject of legal and regulatory changes, which prevented treatment during that year. The number of acres treated in a given year can reflect the magnitude of infestation; however other factors can also affect the amount of treatment that occurs (regulatory limits, local water conditions, weather, staff levels, etc.). These variables make it difficult to show efficacy throughout the years. Since the WHCP had an early start date in March to begin herbicide treatments, the program was successful in treating 2,185 acres of water hyacinth in the Delta and its surrounding tributaries, which is a significant increase from the 851 acres treated in 2012 where the WHCP did not begin herbicide treatment of water hyacinth until August.

Table 4. Summary of 2013 Herbicide Use and Acreage Treated by Month

Month	2,4-D		Glyphosate		Agridex
	Gallons	Acres	Gallons	Acres	Gallons
MARCH	0	0	100.50	134.00	32.88
APRIL	0	0	88.00	117.33	33.25
MAY	0	0	46.00	61.33	19.63
JUNE	0	0	115.00	153.33	47.00
JULY	0	0	145.00	188.49	53.50
AUGUST	0	0	259.50	300.63	118.25
SEPTEMBER	0	0	376.25	420.28	151.50
OCTOBER	0	0	601.00	641.06	257.50
NOVEMBER	0	0	158.00	168.53	63.75
Total	0	0	1889.25	2184.99	777.25

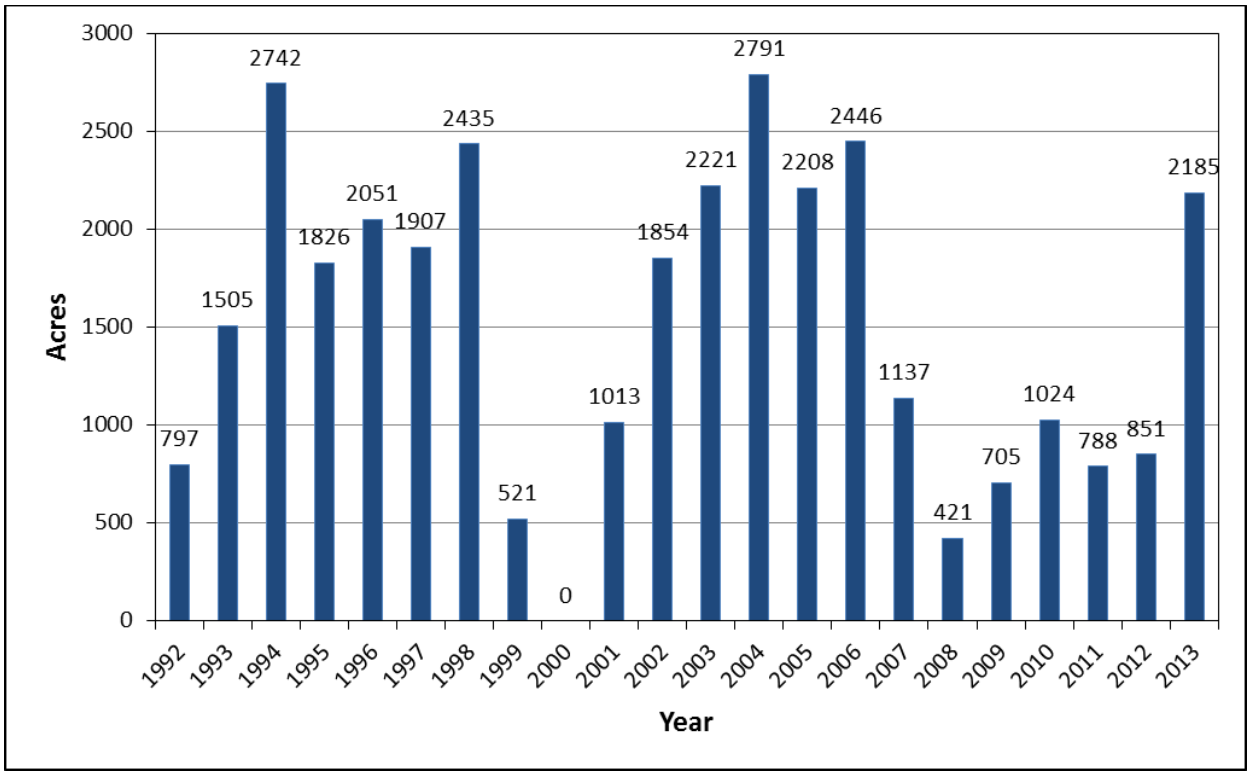


Figure 1. Total water hyacinth acres chemically treated by year, 1992-2013

5.3 Monitoring Data and Laboratory Results

The SWRCB Statewide General NPDES Permit requires dischargers monitor a certain proportion of sites based upon the total number of treated sites. Areas treated under the Water Hyacinth Control Program (WHCP) shall be classified by DBW as falling into one of two water body types: 1) Tidal and 2) Riverine. DBW monitors 10 percent of the sites it treats, for each aquatic pesticide used and per water body type. In 2013, DBW monitored 10% of tidal sites and 17% of riverine sites treated with glyphosate (Table 5). Since the WHCP did not utilize 2,4-D in 2013, there were no sites monitored for the herbicide residues. A total of 15 sites within the Delta and along the San Joaquin River were designated as WHCP monitoring sites (Table 2 and Figure A-1, Appendix A). Field monitoring data and lab results collected in compliance with the NPDES permit and BO's are summarized in Appendix D. Figures and tables found within Appendix D document the sample locations, chemical residues and water quality data for these 15 monitoring sites.

The new NPDES permit (General Permit No. CAG990005, Water Quality Order No. 2013-0002-DWQ), that became effective on December 1, 2013, contains sampling requirements that are materially less than what has been historically measured, in terms of frequency of measurement. To ensure that the WHCP maintains environmental quality measures, meets federal Endangered Species Act requirements, and that monitoring provides independent statistical validity, DBW seeks to maintain a more thorough monitoring plan as resources will allow.

Table 5. Number of treated and sampled sites per herbicide and water body type

Herbicide	Water Body Type	# Sites Treated	# Sites Sampled	% Sampled
Glyphosate	Tidal	107	11	10.3
	Riverine	23	4	17.4
2,4-D	Tidal	0	0	0
	Riverine	0	0	0

5.3.1 Dissolved Oxygen, Turbidity and pH

Basin Plan limits for receiving water DO levels are shown in Figures A-2 and A-3, Appendix A. One monitoring location within site 300 had a DO concentration within the treatment area below the basin plan limit of 5.0 mg/L. The measured DO exceeded the basin limit on October 15 and October 22. DO levels within this treatment area (locations 1A and 3A) on these dates were 2.45 mg/L and 3.64 mg/L, respectively. Site 300 covers a portion of the San Joaquin River in addition to a dead-end slough (Mexican Slough) where the DO was measured. This dead-end slough experiences low or stagnant water flow in addition to having an extremely high water hyacinth infestation. These have resulted in low DO levels within this site. Although the DO concentrations were below the basin plan limit on these dates, application crew DO measurements taken after these dates indicated that DO levels returned above basin limits. The reduced DO was shown to be temporary, all fish passage protocols were followed, and it is believed in this case that there were not any serious impacts to water quality or species of concern. All other DO levels in the 2013 treatment season were between 5.59 mg/L and 11.49 mg/L.

As per Basin Plan standards for turbidity, waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases in turbidity attributable to controllable water quality factors shall not exceed the following limits:

- Where natural turbidity is less than 1 Nephelometric Turbidity Units (NTU), controllable factors shall not cause downstream turbidity to exceed 2.
- Where natural turbidity is between 1 and 5 NTUs, increases shall not exceed 1 NTU.
- Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent.
- Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs.
- Where natural turbidity is between 100 NTUs, increases shall not exceed 10 percent

The average of the turbidity measurements taken at “A” and “C” locations on the sampling day in question will constitute an average natural turbidity against which the receiving water (“B” location) measurements will be compared. There were 8 occasions in 8 different sites, where turbidity levels exceeded Basin Plan limits. Six of these exceedances occurred on the day of herbicide application. However, in 5 of these cases, the turbidity levels measured on the follow up sampling day were again within the basin limits. Therefore, if the WHCP was responsible for the turbidity violations, the effects were only temporary and most likely did not have any significant adverse impacts on water quality, species of concern or beneficial uses. The other two turbidity exceedances occurred on the follow up sampling day, one in which was cause by the sampling boat entering the sample site where the water was shallow. For monitoring sites

within the Delta, turbidity readings were between 0 and 25.5 NTUs. Turbidity in monitoring sites on the upper San Joaquin River (Stanislaus County) ranged from 4.3 to 78.8 NTUs.

The Basin Plan Limit for pH is discharge shall not cause the ambient pH in the receiving water to fall below 6.5 or exceed 8.5. During the 2013 monitoring season, there were five treatment sites that had receiving water pH levels which exceeded the basin plan limit of 8.5. These included sites 60, 66, 68,100 and 300. The pH levels that measured greater than 8.5 ranged between 8.55 and 9.27. The pH levels described above that exceeded the basin plan limits were measured downstream of the treatment area, immediately post-treatment and 1 week post-treatment. However, in the five sites listed above, there were also pH levels greater than 8.5 measured in the control sampling stations and within the treatment areas (pre- and post-treatment). This suggests that higher pH levels were likely a result from other environmental factors and not necessarily a result of herbicide application activity. All other measured pH levels complied with basin plan limits and ranged between 7.11 and 8.50.

5.3.2 Herbicide Residue Concentrations

Maximum residue limits are based on Environmental Protection Agency (EPA) municipal drinking water standards. Herbicide residue shall not exceed the following concentrations in receiving waters (Table 6).

Table 6. Receiving water limits for WHCP herbicides

Herbicide Active Ingredient	Maximum Concentration
2,4-D	70 µg/L
Glyphosate	700 µg/L

During 2013, all herbicide (and Agridex) residue concentrations at receiving water locations were not detected or were below limits as specified in the WHCP NPDES permit (Appendix B). For all glyphosate water samples, herbicide residues were not detected.

5.4 Additional Information

5.4.1 Non-Chemical Control

Due to time restrictions and treatment limitations for the chemical application of water hyacinth, manual removal (handpicking) methods have been implemented as part of the WHCP's Integrated Pest Management Plan. Goals of manual removal are to control of water hyacinth by clearing areas that are 1) not accessible to chemical treatment, 2) subject to high infestation, 3) considered small and confined such as around docks or boat launching facilities, and 4) within emergent vegetation where reduction of chemical application impacts are needed. Specific protocols were established and implemented to protect water quality and endangered species. In 2013, no handpicking of water hyacinth occurred. Instead, DBW elected to conduct mechanical removal of water hyacinth.

In 2013, DBW acquired emergency contracts with three mechanical harvesting companies in order to remove water hyacinth from highly infested waterways. From surveying efforts, DBW found recreational and commercial navigation was blocked and required immediate action to prevent or mitigate the loss or impairment of life, health, property, or essential public services of navigational waterways for recreational and commercial purposes. Mechanical harvesting work began on December 4, 2013 and is planned to continue, on an as needed basis, to the start of

the 2014 treatment season in March. DBW partnered with land management and marina managers in removing and disposing water hyacinth in several locations. DBW directed contracted harvesting companies to remove water hyacinth in Old River (sites 75 -79), the Stockton Marina and Waterfront, Port of Stockton (Site 8), Whiskey Slough (Site 62), and Turner Cut (Site 12). DBW also partnered with the U.S. Bureau of Reclamation (USBR) in removing a buildup of water hyacinth at the Tracy Fish Facility fish screen. DBW crews herded large mats of water hyacinth to the mechanical arm and conveyor system operated by USBR where plant biomass was loaded into trucks and disposed of in the spoils areas adjacent to the Tracy Fish Facility. As of January 11, 2014, a total of approximately 124 acres of water hyacinth were mechanically removed from all harvesting efforts combined.

5.4.2 Dissolved Oxygen Monitoring Pilot Study

See Appendix E for the 2013 report: Long-Term Dissolved Oxygen Monitoring: A Pilot Study for the Water Hyacinth Control Program

5.4.3 Preliminary Spongeplant Control Efforts

DBW was permitted to chemically treat the South American weed, spongeplant (*Limnobium laevigatum*), during the 2013 WHCP treatment season. The USFWS determined that including the treatment of spongeplant (utilizing the same treatment methods, chemicals, monitoring procedures, and conservation measures) during 2013 within the approved 5,000 acres of water hyacinth treatment would not alter the effects determination made by the USFWS in the March 13, 2013 BO. Similarly, NMFS determined that the proposed treatment methodology for spongeplant is the same as that for the WHCP and therefor, their analyses and conclusions reached for the WHCP apply to spongeplant control efforts (i.e. not likely to adversely affect federally listed winter-run Chinook salmon, spring-run Chinook salmon, steelhead, or green sturgeon, or any of their respective designated critical habitats.

In 2013, DBW chemically treated spongeplant in 6 sites within the Delta. These 6 sites were Fern, Headreach & Tule Islands (Site 14), Three River Reach (Site 16), Middle River (Site 68), Discovery Bay (Site 93), Sportsman Yacht Club (120b), and Decker Island (Site 176). DBW estimates that less than 1 acres of spongeplant was treated, utilizing less than one gallon of herbicide. All herbicide treatments of spongeplant utilized glyphosate with Agridex. Spongeplant responded to glyphosate treatments, showing symptoms (yellowing or browning of leaves) in 1 ½ to 3 weeks. However, because the plants are often small and hidden under other vegetation, targeting spongeplant for herbicide treatments was challenging. In 2013, DBW also utilized nets to manually remove (handpick) spongeplant from areas in Discovery Bay. The total amount of spongeplant handpicked was enough to fill a 30 gallon barrel.

APPENDIX A

WHCP Maps

Figure A- 1. 2013 WHCP Project Area and Sampling Sites

2013 Water Hyacinth Sampling Sites

DBW Treatment Sites
Glyphosate Sampling Sites

California Department of Parks and Recreation
Division of Boating and Waterways

Insets: 0 1 2 Miles
0 5 10 Miles

January 10, 2014 - 2013Sampling

Figure A- 2. WHCP Dissolved Oxygen Limits: Northern Sites

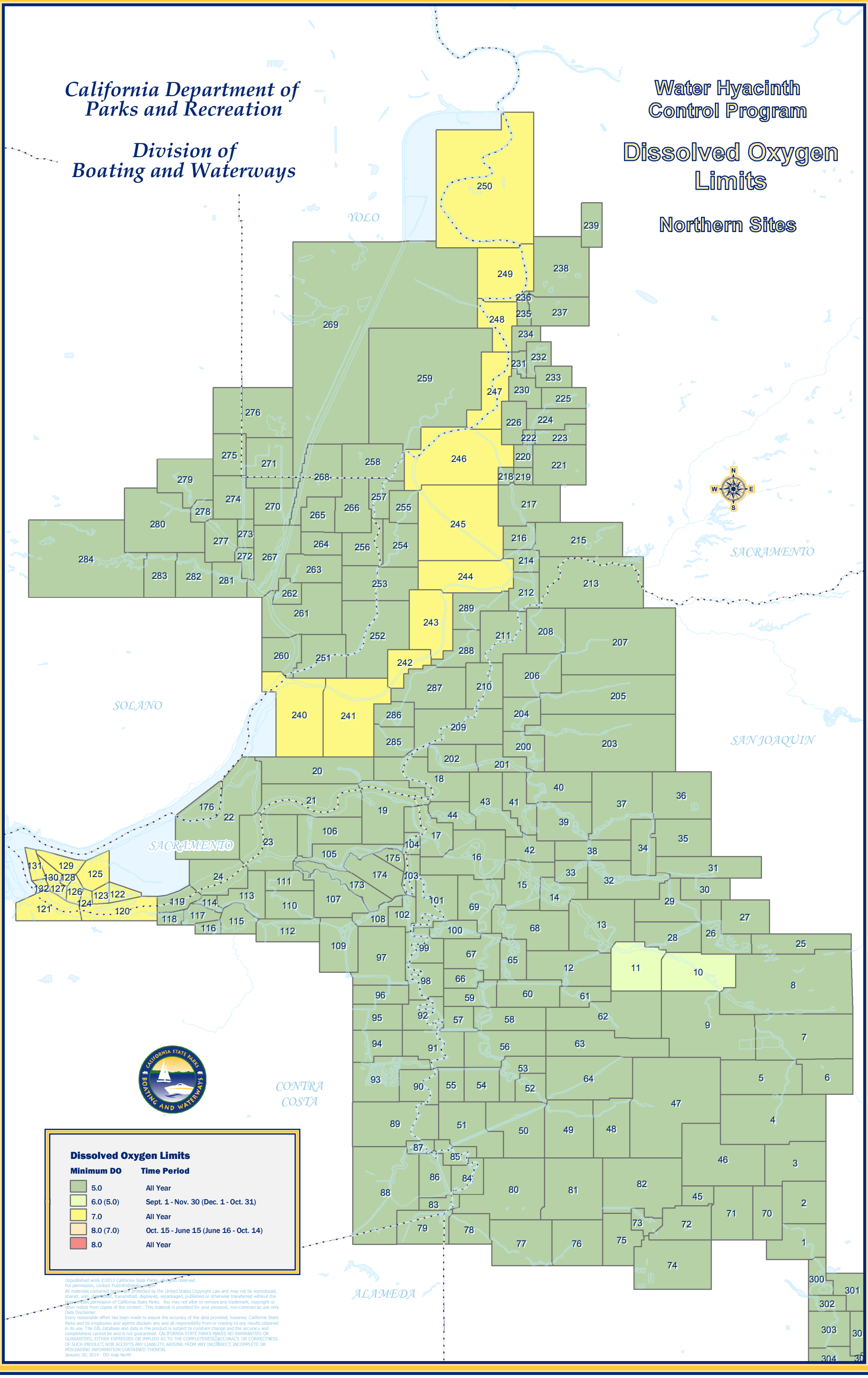
California Department of Parks and Recreation

Division of Boating and Waterways

Water Hyacinth Control Program

Dissolved Oxygen Limits

Northern Sites



Dissolved Oxygen Limits

Minimum DO	Time Period
5.0	All Year
6.0 (5.0)	Sept. 1 - Nov. 30 (Dec. 1 - Oct. 31)
7.0	All Year
8.0 (7.0)	Oct. 15 - June 15 (June 16 - Oct. 14)
8.0	All Year

Figure A- 3. WHCP Dissolved Oxygen Limits: Southern Sites

California Department of Parks and Recreation

Division of Boating and Waterways

Water Hyacinth Control Program

Dissolved Oxygen Limits

Southern Sites

STANISLAUS

MARIPOSA

MERCED

MADERA

FRESNO

Dissolved Oxygen Limits

Minimum DO	Time Period
5.0	All Year
6.0 (5.0)	Sept. 1 - Nov. 30 (Dec. 1 - Oct. 31)
7.0	All Year
8.0 (7.0)	Oct. 15 - June 15 (June 16 - Oct. 14)
8.0	All Year

January 30, 2014 - DO map South

Figure A- 4. WHCP Northern Sites with USFWS Areas

Water Hyacinth Control Program Project Area - Northern Sites

Water Hyacinth Control Program

- Area 1
- Area 2
- Area 3
- Area 4
- Legal Delta Boundary
- USGS Quadrangles
- Highways

Figure A- 5. WHCP Southern Sites with USFWS Areas

Water Hyacinth Control Program Project Area - Southern Sites

Water Hyacinth Control Program

- Area 1
- Area 2
- Area 3
- Area 4
- Legal Delta Boundary
- USGS Quadrangles
- Highways

Figure A- 6. Treatment Count in 2013: Northern Sites

Water Hyacinth Control Program Treatment Areas

West Sacramento
Sacramento
Yolo
Davis
Solano
Sacramento
Isleton
Rio Vista
San Joaquin
Contra Costa
Alameda
Stanislaus
Pittsburg
Antioch
Clayton
Brentwood
Galt
Lodi
Stockton
Manteca
Ripon
Tracy
Dublin
Livermore
Pleasanton

N

Miles
0 2 4

Number of Water Hyacinth Treatments Per Site in 2013

0 1 2 3 4 5 6 7 8 9 10 11 13 14 15 19

Legal Delta Boundary
County Boundaries
Cities
Highways

California Department of Parks and Recreation
Division of Boating and Waterways

Figure A- 7. Treatment Count in 2013: Southern Sites

Water Hyacinth Control Program Treatment Areas

Number of Water Hyacinth Treatments Per Site in 2013

0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 13 | 14 | 15 | 19

Miles
0 2.5 5

Legal Delta Boundary
County Boundaries
Cities
Highways

California Department of Parks and Recreation
Division of Boating and Waterways

APPENDIX B

2013 WHCP Herbicide Application Daily Logs

Table B- 1. March 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
3/18/2013	3420	61	San Joaquin	18.20	18.70	1300	1600	6.40	6.90	0.50	0.13	96	0.67	4-6
3/18/2013	9339	300	San Joaquin	15.50	16.40	1300	1500	6.50	8.30	1.50	0.50	96	2.00	2-4
3/18/2013	9339	301	San Joaquin	15.20	15.50	1000	1200	6.40	6.50	1.00	0.25	96	1.33	0-2
3/18/2013	9607	75	San Joaquin	17.00	16.80	1400	1500	7.72	8.08	1.00	0.25	96	1.33	0-2
3/18/2013	9607	76	San Joaquin	16.30	16.50	1000	1400	8.24	6.85	5.00	1.50	96	6.67	0-2
3/19/2013	3420	12	San Joaquin	17.30	17.10	1300	1500	10.32	10.10	2.13	0.75	96	2.83	2-4
3/19/2013	3420	38	San Joaquin	15.70	17.00	900	1200	10.21	9.93	1.75	0.75	96	2.33	2-4
3/19/2013	8789	93	Contra Costa	15.90	15.30	900	1100	11.10	10.90	1.00	0.50	96	1.33	0-2
3/19/2013	8789	94	Contra Costa	15.70	15.60	1100	1200	11.00	11.20	0.50	0.25	96	0.67	2-4
3/19/2013	9339	48	San Joaquin	15.60	16.00	1200	1400	8.70	9.40	2.25	0.75	96	3.00	0-2
3/19/2013	9339	49	San Joaquin	15.10	15.30	900	1100	9.60	9.20	2.25	1.00	96	3.00	0-2
3/19/2013	9371	14	San Joaquin	17.10	17.00	1300	1600	10.70	12.30	2.00	0.50	96	2.67	0-2
3/19/2013	9371	28	San Joaquin	15.80	16.50	900	1300	10.50	11.40	2.50	0.50	96	3.33	0-2
3/19/2013	9607	75	San Joaquin	16.80	17.20	900	1400	9.30	7.60	6.00	2.00	96	8.00	0-2
3/21/2013	3548	47	San Joaquin	14.10	14.80	1200	1400	8.20	8.40	2.25	1.00	96	3.00	4-6
3/21/2013	3548	48	San Joaquin	13.70	14.10	1000	1200	7.80	8.20	2.25	1.00	96	3.00	4-6
3/21/2013	9122	74	San Joaquin	16.50	16.70	1000	1200	8.90	8.70	1.00	0.25	96	1.33	6-8
3/21/2013	9371	31	San Joaquin	15.20	16.10	900	1200	10.20	11.70	2.00	0.75	96	2.67	4-6
3/21/2013	9371	32	San Joaquin	16.80	16.80	1300	1500	10.80	11.50	1.50	0.50	96	2.00	4-6
3/25/2013	3420	80	San Joaquin	16.50	17.10	1000	1500	8.40	8.90	2.00	0.75	96	2.67	2-4
3/25/2013	3548	48	San Joaquin	15.40	15.60	1300	1500	9.30	9.50	2.25	1.25	96	3.00	2-4
3/25/2013	3548	49	San Joaquin	14.20	15.20	1000	1200	8.80	9.70	2.25	1.25	96	3.00	0-2
3/25/2013	9371	32	San Joaquin	15.00	15.70	1000	1400	10.40	10.50	2.50	0.75	96	3.33	4-6
3/25/2013	9371	33	San Joaquin	15.80	16.10	1400	1500	10.80	10.90	1.75	0.50	96	2.33	4-6
3/25/2013	9607	75	San Joaquin	15.90	16.30	1000	1500	9.30	8.10	6.00	2.00	96	8.00	0-2
3/26/2013	3420	76	San Joaquin	16.70	17.20	900	1500	9.10	8.40	2.00	0.75	96	2.67	2-4
3/26/2013	3548	46	San Joaquin	15.40	16.20	1000	1500	10.10	9.80	2.25	0.00	96	3.00	2-4
3/26/2013	8816	13	San Joaquin	16.30	17.60	1000	1500	10.74	10.27	3.00	1.00	96	4.00	0-2
3/26/2013	9371	26	San Joaquin	18.00	17.40	1100	1200	12.70	12.30	0.50	0.00	96	0.67	4-6
3/26/2013	9371	28	San Joaquin	18.80	18.80	1300	1500	11.30	10.50	1.50	0.00	96	2.00	4-6

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
3/26/2013	9371	37	San Joaquin	14.50	15.20	900	1000	10.80	11.00	0.75	0.00	96	1.00	4-6
3/26/2013	9607	76	San Joaquin	16.10	16.30	900	1000	9.50	7.80	1.50	0.50	96	2.00	2-4
3/26/2013	9607	77	San Joaquin	16.30	16.60	1000	1400	8.40	8.80	4.00	1.00	96	5.33	2-4
3/27/2013	3420	36	San Joaquin	17.30	17.50	1200	1500	8.50	8.20	2.00	0.75	96	2.67	4-6
3/27/2013	3420	38	San Joaquin	16.90	17.20	900	1200	8.70	8.50	2.00	0.75	96	2.67	4-6
3/27/2013	8816	59	San Joaquin	16.60	16.80	1000	1100	10.50	10.10	1.00	0.31	96	1.33	0-2
3/27/2013	8816	65	San Joaquin	16.90	18.20	1100	1300	11.00	9.89	1.13	0.31	96	1.50	0-2
3/27/2013	9371	32	San Joaquin	20.40	18.50	1200	1600	11.80	12.00	2.25	0.50	96	3.00	2-4
3/27/2013	9371	33	San Joaquin	15.20	15.90	800	1200	10.20	10.40	3.00	1.00	96	4.00	4-6
3/27/2013	9607	74	San Joaquin	15.40	16.50	1000	1200	9.30	8.10	1.50	0.50	96	2.00	2-4
3/27/2013	9607	291	San Joaquin	16.80	17.20	1200	1500	7.90	8.20	3.00	1.25	96	4.00	4-6
3/28/2013	3420	31	San Joaquin	16.50	16.70	900	1300	9.20	8.70	2.50	1.25	96	3.33	0-2
3/28/2013	8816	13	San Joaquin	16.20	17.30	900	1300	10.90	12.20	2.25	0.88	96	3.00	2-4
3/28/2013	8816	14	San Joaquin	17.30	17.70	1300	1500	12.20	11.60	0.75	0.25	96	1.00	2-4
3/28/2013	9371	34	San Joaquin	17.60	18.10	1100	1500	10.90	11.30	1.25	0.25	96	1.67	0-2
3/28/2013	9371	35	San Joaquin	16.00	17.40	800	1100	10.90	11.40	3.25	1.00	96	4.33	0-2
3/28/2013	9607	49	San Joaquin	15.80	16.30	900	1100	7.90	9.40	2.00	0.50	96	2.67	0-2
3/28/2013	9607	52	San Joaquin	16.10	17.40	1200	1500	8.40	10.40	2.00	0.50	96	2.67	0-2
									Total	**100.50**	**32.88**		**134.00**	

Table B- 2. April 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
4/2/2013	3548	79	Alameda	18.60	18.80	1200	1400	7.48	7.60	2.25	1.00	96	3.00	2-4
4/3/2013	3548	300	San Joaquin	18.10	18.60	1000	1300	7.20	7.50	2.25	1.25	96	3.00	0-2
4/3/2013	3548	301	San Joaquin	18.70	19.10	1300	1500	7.60	7.40	1.50	0.75	96	2.00	0-2
4/3/2013	8816	58	San Joaquin	18.00	19.60	1200	1500	9.13	9.32	1.50	0.50	96	2.00	0-2
4/3/2013	9012	93	Contra Costa	18.90	19.20	900	1500	11.50	11.30	1.00	0.50	96	1.33	0-2
4/3/2013	9122	53	San Joaquin	17.10	17.30	1200	1600	7.70	7.30	2.25	1.00	96	3.00	6-8
4/10/2013	3420	26	San Joaquin	16.30	16.50	900	1200	8.20	7.80	2.25	0.75	96	3.00	2-4
4/10/2013	3420	31	San Joaquin	16.70	16.90	1300	1600	7.90	8.10	2.25	0.75	96	3.00	2-4
4/10/2013	3548	46	San Joaquin	16.10	16.80	900	1200	7.80	7.40	2.25	1.00	96	3.00	2-4
4/10/2013	3548	47	San Joaquin	16.80	17.20	1200	1500	7.30	7.60	2.25	1.00	96	3.00	2-4
4/10/2013	8816	67	San Joaquin	16.90	18.40	1000	1500	8.54	8.91	3.00	1.00	96	4.00	4-6
4/10/2013	9012	93	Contra Costa	18.00	18.30	1000	1500	10.70	10.50	2.50	1.25	96	3.33	4-6
4/10/2013	9371	28	San Joaquin	15.50	18.90	900	1300	5.70	8.40	2.50	0.75	96	3.33	8-10
4/10/2013	9371	32	San Joaquin	18.00	22.20	1300	1600	5.30	9.00	2.75	0.50	96	3.67	8-10
4/10/2013	9607	75	San Joaquin	18.30	19.20	900	1500	9.60	8.50	5.00	1.50	96	6.67	2-4
4/11/2013	8816	10	San Joaquin	17.30	18.20	900	1100	11.42	10.49	0.75	0.25	96	1.00	6-8
4/11/2013	9371	30	San Joaquin	17.70	18.10	1000	1200	5.40	8.40	0.50	0.25	96	0.67	8-10
4/15/2013	3420	30	San Joaquin	17.20	17.30	900	1200	9.10	9.00	2.00	0.75	96	2.67	4-6
4/15/2013	9371	26	San Joaquin	17.70	18.50	1000	1300	7.50	7.90	1.25	0.50	96	1.67	8-10
4/18/2013	3420	37	San Joaquin	17.10	17.50	900	1500	9.00	9.40	4.00	1.50	96	5.33	4-6
4/18/2013	8816	56	San Joaquin	16.30	17.30	1000	1300	8.30	9.30	1.75	0.50	96	2.33	8-10
4/18/2013	9371	28	San Joaquin	15.40	17.10	800	1200	9.30	9.00	4.00	1.75	96	5.33	2-4
4/18/2013	9371	30	San Joaquin	17.70	17.90	1400	1500	9.50	9.50	0.25	0.00	96	0.33	2-4
4/18/2013	9371	31	San Joaquin	17.40	17.90	1300	1400	11.40	12.30	0.75	0.25	96	1.00	2-4
4/18/2013	964121	8	San Joaquin	18.50	19.50	1200	1400	7.60	8.70	1.00	0.25	96	1.33	2-4
4/18/2013	964121	26	San Joaquin	18.20	19.10	900	1100	9.30	8.10	1.50	0.50	96	2.00	0-2
4/24/2013	3420	33	San Joaquin	17.50	18.10	800	1200	9.50	9.30	2.50	1.00	96	3.33	2-4
4/24/2013	3420	38	San Joaquin	18.10	18.50	1300	1600	9.30	9.10	1.50	0.75	96	2.00	4-6
4/24/2013	3548	46	San Joaquin	18.80	18.70	900	1100	7.20	8.20	2.25	1.00	96	3.00	0-2
4/24/2013	3548	48	San Joaquin	19.10	19.60	1200	1400	8.10	8.30	2.25	1.00	96	3.00	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
4/24/2013	8816	60	San Joaquin	19.30	20.10	1100	1200	10.17	11.64	0.50	0.13	96	0.67	6-8
4/24/2013	8816	68	San Joaquin	17.00	18.20	900	1100	10.79	10.49	1.00	0.38	96	1.33	0-2
4/24/2013	9371	32	San Joaquin	17.30	20.20	800	1500	12.40	14.40	3.00	1.25	96	4.00	4-6
4/24/2013	9607	75	San Joaquin	19.20	18.10	1100	1400	10.50	9.60	3.00	1.00	96	4.00	2-4
4/24/2013	9607	76	San Joaquin	18.60	18.10	800	1100	9.70	8.10	2.00	0.50	96	2.67	2-4
4/29/2013	3420	8	San Joaquin	18.10	18.20	800	1100	8.60	8.90	1.00	0.25	96	1.33	2-4
4/29/2013	3420	10	San Joaquin	19.10	19.30	1100	1300	9.10	9.40	1.50	0.50	96	2.00	6-8
4/29/2013	3548	300	San Joaquin	18.70	19.20	900	1200	8.00	7.70	2.25	1.00	96	3.00	0-2
4/29/2013	3548	301	San Joaquin	21.20	22.70	1200	1500	7.40	7.50	2.25	1.00	96	3.00	4-6
4/29/2013	3738	76	San Joaquin	20.40	22.70	900	1400	7.20	7.30	3.50	1.00	96	4.67	2-4
4/29/2013	9012	94	Contra Costa	22.30	23.10	900	1200	11.10	10.60	1.00	0.50	96	1.33	6-8
4/30/2013	3420	79	San Joaquin	18.60	18.80	900	1200	8.50	9.20	1.50	0.50	96	2.00	4-6
4/30/2013	3548	49	San Joaquin	20.10	21.20	800	1000	7.10	7.30	2.00	0.75	96	2.67	6-8
4/30/2013	9122	77	San Joaquin	20.50	21.20	900	1100	8.70	7.20	1.75	0.75	96	2.33	4-6
									Total	**88.00**	**33.25**		**117.33**	

Table B- 3. May 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
5/6/2013	3420	74	San Joaquin	18.10	18.50	900	1500	8.40	7.80	2.50	1.00	96	3.33	2-4
5/6/2013	3548	49	San Joaquin	21.70	23.10	1100	1300	6.80	7.20	1.75	0.50	96	2.33	0-2
5/6/2013	9122	50	San Joaquin	20.30	21.50	1000	1200	10.70	9.50	2.00	0.50	96	2.67	2-4
5/6/2013	9122	53	San Joaquin	21.40	21.60	1200	1500	8.40	7.10	1.00	0.25	96	1.33	2-4
5/6/2013	9123	58	San Joaquin	20.40	20.10	1300	1400	8.50	8.80	1.50	0.63	96	2.00	4-6
5/6/2013	9123	62	San Joaquin	20.20	21.00	1000	1200	6.12	9.32	2.25	0.75	96	3.00	4-6
5/8/2013	9012	93	Contra Costa	20.60	20.90	900	1100	11.10	10.70	1.25	0.75	96	1.67	4-6
5/8/2013	9012	94	Contra Costa	20.90	20.90	1100	1300	10.70	10.70	1.25	0.50	96	1.67	4-6
5/13/2013	3420	31	San Joaquin	22.20	23.50	800	1200	9.50	9.30	2.50	1.00	96	3.33	4-6
5/13/2013	3420	36	San Joaquin	23.80	24.80	1200	1600	8.80	8.50	2.50	1.00	96	3.33	4-6
5/13/2013	8789	300	San Joaquin	17.70	18.10	900	1300	9.80	9.30	2.50	1.25	96	3.33	4-6
5/13/2013	8835	408	Merced	24.80	25.20	1100	1300	6.20	6.20	1.50	0.75	96	2.00	2-4
5/13/2013	9122	8	San Joaquin	20.40	21.90	800	1300	8.90	7.60	2.00	0.50	96	2.67	0-2
5/14/2013	8835	409	Merced	28.60	28.90	1000	1500	6.40	6.00	3.75	2.25	96	5.00	4-6
5/16/2013	3420	25	San Joaquin	22.50	22.90	800	1000	8.70	8.80	2.00	0.75	96	2.67	2-4
5/16/2013	3420	28	San Joaquin	23.40	24.10	1100	1400	8.60	8.30	2.50	1.00	96	3.33	4-6
5/20/2013	3548	709	Stanislaus	21.60	21.80	900	1100	9.30	9.40	1.25	0.50	96	1.67	0-2
5/20/2013	3548	710	Stanislaus	21.50	21.30	1100	1200	9.20	9.30	1.00	0.25	96	1.33	0-2
5/20/2013	3548	711	Stanislaus	21.20	21.40	1200	1300	8.90	8.60	0.75	0.25	96	1.00	0-2
5/20/2013	3548	712	Stanislaus	21.40	21.00	1300	1400	8.60	8.80	0.75	0.25	96	1.00	0-2
5/21/2013	3548	319	Stanislaus	23.40	23.30	1200	1400	9.00	8.70	1.00	0.50	96	1.33	6-8
5/21/2013	3548	320	Stanislaus	22.00	23.20	1000	1200	8.70	8.90	2.25	1.50	96	3.00	2-4
5/28/2013	3420	28	San Joaquin	19.60	20.10	900	1300	8.80	8.60	2.50	1.00	96	3.33	6-8
5/28/2013	3548	300	San Joaquin	20.20	19.80	1000	1300	14.10	14.60	2.25	1.50	96	3.00	4-6
5/29/2013	3420	31	San Joaquin	19.40	19.70	800	1000	9.00	8.90	1.50	0.50	96	2.00	4-6
									Total	**46.00**	**19.63**		**61.33**	

Table B- 4. June 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
6/6/2013	3420	215	Sacramento	21.20	21.80	900	1200	8.60	8.30	2.50	0.75	96	3.33	2-4
6/6/2013	3420	219	Sacramento	22.10	22.20	1300	1500	8.50	8.10	2.50	0.75	96	3.33	2-4
6/6/2013	8816	93	Contra Costa	24.10	24.80	900	1500	10.87	10.68	3.75	1.25	96	5.00	6-8
6/7/2013	8929	61	San Joaquin	22.10	23.00	1200	1500	8.60	8.00	2.00	1.00	96	2.67	0-2
6/7/2013	8929	92	Contra Costa	19.70	21.40	800	1200	10.20	8.40	5.00	1.50	96	6.67	0-2
6/11/2013	3420	214	Sacramento	23.40	23.50	1200	1300	7.50	7.80	2.25	0.75	96	3.00	2-4
6/11/2013	3420	219	Sacramento	23.10	23.30	800	1100	7.50	7.90	2.25	0.75	96	3.00	2-4
6/11/2013	9123	69	San Joaquin	21.60	8.10	1200	1400	8.30	22.30	2.75	1.25	96	3.67	0-2
6/12/2013	3420	40	San Joaquin	23.30	23.50	900	1100	8.20	8.60	2.50	1.00	96	3.33	4-6
6/12/2013	3420	200	San Joaquin	23.50	23.60	1200	1400	8.00	7.80	2.50	1.00	96	3.33	4-6
6/12/2013	8789	108	Contra Costa	22.10	22.40	1000	1500	7.00	7.30	2.50	1.25	96	3.33	4-6
6/12/2013	8816	14	San Joaquin	22.00	22.80	900	1200	7.58	7.87	2.25	1.25	96	3.00	4-6
6/12/2013	8816	37	San Joaquin	22.80	23.10	1400	1500	8.62	8.37	2.25	1.25	96	3.00	2-4
6/12/2013	8816	38	San Joaquin	22.70	22.80	1200	1400	8.48	8.53	2.25	1.25	96	3.00	2-4
6/12/2013	8929	93	Contra Costa	24.00	24.70	800	1100	9.64	9.82	2.50	1.00	96	3.33	2-4
6/13/2013	3420	215	Sacramento	23.10	23.40	900	1500	9.20	8.50	5.00	2.00	96	6.67	2-4
6/13/2013	9123	62	San Joaquin	23.90	23.60	1200	1400	10.69	9.70	2.00	0.75	96	2.67	6-8
6/13/2013	9371	37	San Joaquin	24.10	23.70	1300	1600	5.80	8.30	1.00	0.00	96	1.33	4-6
6/13/2013	9371	39	San Joaquin	21.50	22.30	900	1000	8.10	8.20	1.50	0.00	96	2.00	6-8
6/13/2013	9371	44	San Joaquin	21.70	21.80	1100	1200	8.80	10.10	1.00	0.00	96	1.33	6-8
6/19/2013	3420	40	San Joaquin	22.70	22.90	800	1300	7.60	7.70	2.50	1.00	96	3.33	2-4
6/19/2013	9607	84	San Joaquin	22.40	23.60	900	1200	8.50	7.30	2.50	1.00	96	3.33	4-6
6/19/2013	9607	84	Contra Costa	22.40	23.60	900	1200	8.50	7.30	2.50	1.00	96	3.33	4-6
6/19/2013	964121	40	San Joaquin	22.70	22.90	900	1300	7.60	7.70	4.00	2.00	96	5.33	2-4
6/21/2013	3548	84	San Joaquin	19.80	20.30	800	1000	9.38	9.24	5.00	2.00	96	6.67	4-6
6/21/2013	3548	84	Contra Costa	20.50	21.00	1000	1200	9.20	9.32	2.50	1.00	96	3.33	4-6
6/21/2013	8789	107	Contra Costa	20.70	20.90	1000	1500	8.20	8.30	2.50	1.25	96	3.33	4-6
6/21/2013	8789	108	Contra Costa	20.30	20.70	700	1000	8.10	8.00	2.50	1.25	96	3.33	4-6
6/26/2013	3548	300	San Joaquin	23.50	24.30	900	1500	7.10	7.40	6.75	3.75	96	9.00	0-2
6/26/2013	8816	58	San Joaquin	23.80	23.60	1000	1400	6.95	8.72	4.75	2.75	96	6.33	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
6/26/2013	8929	18	Sacramento	23.10	23.50	1200	1200	7.90	7.00	0.25	0.25	96	0.33	2-4
6/26/2013	8929	18	San Joaquin	23.30	24.30	1200	1400	6.80	8.50	3.00	1.75	96	4.00	2-4
6/26/2013	8929	19	Sacramento	22.20	24.70	900	1100	6.90	6.80	2.25	0.50	96	3.00	2-4
6/26/2013	9371	20	Sacramento	22.30	22.70	800	1500	8.50	8.20	6.75	3.00	96	9.00	0-2
6/27/2013	8929	40	San Joaquin	23.30	23.60	900	1500	9.30	8.80	5.00	2.00	96	6.67	0-2
6/27/2013	9371	28	San Joaquin	25.20	28.10	1300	1400	6.60	5.80	2.00	0.00	96	2.67	0-2
6/27/2013	9371	32	San Joaquin	26.90	26.60	1400	1600	8.30	8.60	1.50	0.00	96	2.00	0-2
6/27/2013	964121	40	San Joaquin	23.30	23.60	800	1200	9.30	8.80	2.50	1.25	96	3.33	0-2
6/27/2013	964121	58	San Joaquin	23.80	24.10	1200	1500	8.80	9.10	1.25	0.50	96	1.67	2-4
6/28/2013	3548	79	Alameda	23.90	23.40	800	1000	7.60	7.20	2.25	1.00	96	3.00	0-2
6/28/2013	3548	83	San Joaquin	24.90	24.60	1000	1200	7.00	7.30	2.50	1.00	96	3.33	4-6
									Total	**115.00**	**47.00**		**153.33**	

Table B- 5. July 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
7/2/2013	8929	40	San Joaquin	27.20	27.30	1300	1500	7.60	7.40	2.50	1.00	96	3.33	0-2
7/2/2013	8929	200	San Joaquin	26.80	27.10	900	1200	8.10	7.50	5.00	2.00	96	6.67	0-2
7/2/2013	9122	78	San Joaquin	22.80	24.20	900	1300	7.60	8.60	5.00	2.00	96	6.67	0-2
7/3/2013	8929	9	San Joaquin	28.40	28.80	900	1200	5.30	5.10	4.00	1.00	96	5.33	0-2
7/3/2013	9371	8	San Joaquin	27.00	27.30	900	1200	10.10	8.60	3.00	1.25	96	4.00	0-2
7/9/2013	3548	203	San Joaquin	24.50	24.80	900	1400	9.50	8.60	6.00	2.50	96	8.00	0-2
7/9/2013	9122	78	San Joaquin	23.50	24.30	1000	1500	10.70	8.90	5.00	2.00	96	6.67	0-2
7/10/2013	8816	78	San Joaquin	26.70	28.10	1100	1300	7.15	7.81	1.00	0.63	96	1.33	0-2
7/10/2013	8816	83	San Joaquin	26.70	28.10	1100	1300	7.15	7.81	1.00	0.63	96	1.33	0-2
7/10/2013	8929	204	San Joaquin	24.40	24.60	1000	1500	8.70	8.20	5.00	0.00	96	6.67	0-2
7/11/2013	8929	203	San Joaquin	24.70	24.70	1200	1500	8.80	8.40	2.50	1.00	96	3.33	2-4
7/11/2013	8929	205	San Joaquin	24.50	24.60	900	1200	9.30	9.10	5.00	2.00	96	6.67	2-4
7/11/2013	9122	84	Contra Costa	20.20	21.00	900	1400	8.10	6.60	5.00	1.50	96	6.67	6-8
7/12/2013	3548	76	San Joaquin	28.40	29.20	700	1300	7.20	6.80	8.00	2.50	96	10.67	0-2
7/12/2013	964121	58	San Joaquin	30.10	29.60	1300	1500	9.60	7.10	1.00	0.25	96	1.33	6-8
7/12/2013	964121	97	Contra Costa	27.40	28.10	800	1200	7.00	6.80	4.00	1.75	96	5.33	2-4
7/18/2013	8789	128	Sacramento	22.40	22.10	1100	1400	7.60	7.30	2.50	1.25	96	3.33	6-8
7/18/2013	8789	129	Sacramento	21.60	22.00	1000	1100	7.10	7.30	2.50	1.25	96	3.33	6-8
7/18/2013	8816	40	San Joaquin	25.20	25.30	900	1200	8.50	8.70	2.25	0.00	96	3.00	0-2
7/18/2013	8816	204	San Joaquin	25.60	25.70	1200	1500	8.80	9.10	2.50	0.00	96	3.33	0-2
7/18/2013	9371	39	San Joaquin	28.70	29.20	1300	1500	8.10	8.80	1.50	0.25	96	2.00	0-2
7/18/2013	9371	40	San Joaquin	22.90	28.70	1000	1200	8.50	7.80	2.50	1.00	96	3.33	0-2
7/19/2013	3548	300	San Joaquin	28.70	28.20	1000	1300	6.80	6.50	3.50	1.25	96	4.67	0-2
7/19/2013	3548	304	San Joaquin	29.10	29.50	700	1000	7.50	7.30	4.00	2.00	96	5.33	2-4
7/23/2013	8816	215	Sacramento	25.10	25.30	1200	1500	8.90	8.30	4.50	2.00	96	6.00	0-2
7/23/2013	8816	216	Sacramento	24.70	24.80	900	1100	9.20	9.30	2.00	0.75	96	2.67	0-2
7/24/2013	3738	26	San Joaquin	23.00	23.60	1200	1400	8.30	8.60	2.50	1.50	96	3.33	4-6
7/24/2013	3738	28	San Joaquin	22.90	23.80	1000	1200	6.10	6.80	2.00	1.00	96	2.67	2-4
7/24/2013	3738	29	San Joaquin	22.40	23.10	1400	1500	9.10	9.00	1.50	0.75	96	2.00	4-6
7/24/2013	8789	107	Contra Costa	21.90	22.10	900	1200	8.30	8.00	2.50	1.25	96	3.33	4-6

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
7/24/2013	8789	108	Contra Costa	22.40	22.70	1200	1500	7.80	8.30	2.50	1.25	96	3.33	4-6
7/24/2013	8816	203	San Joaquin	25.10	25.50	900	1500	9.10	8.30	5.25	2.25	96	7.00	2-4
7/25/2013	8789	109	Contra Costa	22.00	22.10	1100	1500	7.70	7.90	2.50	1.25	96	3.33	4-6
7/25/2013	8789	173	Contra Costa	21.70	21.90	800	1100	8.00	8.30	2.50	1.25	96	3.33	4-6
7/25/2013	8816	203	San Joaquin	25.20	25.40	900	1500	9.00	8.60	5.00	2.00	96	6.67	0-2
7/30/2013	3420	214	Sacramento	24.50	24.70	1200	1500	7.60	7.90	3.50	0.00	128	3.50	0-2
7/30/2013	3420	216	Sacramento	24.10	24.40	900	1200	7.40	7.60	3.50	0.00	128	3.50	0-2
7/30/2013	8816	99	San Joaquin	22.10	22.90	1100	1400	8.49	8.48	5.00	2.50	128	5.00	4-6
7/30/2013	9122	83	San Joaquin	24.70	23.70	1000	1400	8.40	10.90	6.00	2.00	96	8.00	0-2
7/31/2013	3420	204	Sacramento	24.50	24.60	1200	1500	8.10	8.50	3.75	1.75	96	5.00	2-4
7/31/2013	3420	206	Sacramento	24.20	24.50	900	1200	7.70	7.90	3.75	1.75	96	5.00	2-4
7/31/2013	8789	110	Contra Costa	21.30	21.70	1200	1500	8.30	8.00	2.50	1.25	128	2.50	4-6
									Total	**145.00**	**53.50**		**188.50**	

Table B- 6. August 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
8/6/2013	3420	40	San Joaquin	24.40	24.30	900	1100	8.80	8.50	1.50	0.50	128	1.50	2-4
8/6/2013	3420	200	San Joaquin	24.60	24.80	1300	1500	8.00	7.70	2.25	1.00	128	2.25	4-6
8/6/2013	3420	204	San Joaquin	24.40	24.60	1200	1300	8.20	8.10	2.25	1.00	128	2.25	2-4
8/7/2013	3420	202	San Joaquin	24.20	24.40	900	1200	8.90	8.50	2.50	1.25	128	2.50	4-6
8/9/2013	3548	302	San Joaquin	19.80	20.40	900	1400	7.28	7.56	3.00	0.00	128	3.00	4-6
8/9/2013	8789	300	San Joaquin	20.50	20.70	800	1400	12.10	11.90	3.00	1.50	128	3.00	4-6
8/13/2013	9122	93	Contra Costa	25.30	24.80	1000	1400	10.80	10.30	3.00	1.00	96	4.00	0-2
8/14/2013	8789	112	Contra Costa	23.00	22.90	800	1400	7.60	7.80	10.00	4.00	128	10.00	4-6
8/14/2013	3548	49	San Joaquin	24.20	24.50	900	1500	6.20	7.00	5.00	2.00	128	5.00	0-2
8/14/2013	8834	49	San Joaquin	24.50	24.40	1200	1500	7.60	7.20	0.50	1.00	128	0.50	2-4
8/14/2013	8835	48	San Joaquin	23.60	24.60	1000	1500	5.80	6.10	7.00	3.25	96	9.33	0-2
8/14/2013	9122	74	San Joaquin	23.70	24.60	800	1400	7.40	9.20	6.50	2.50	96	8.67	2-4
8/14/2013	9607	45	San Joaquin	24.50	26.20	1300	1500	6.20	7.80	2.50	1.25	96	3.33	2-4
8/14/2013	9607	46	San Joaquin	23.40	24.50	900	1200	2.60	6.20	5.00	2.50	96	6.67	0-2
8/15/2013	8789	116	Contra Costa	23.70	23.70	1100	1500	7.90	8.30	9.00	3.75	128	9.00	2-4
8/15/2013	8789	117	Contra Costa	23.20	23.60	800	1100	7.90	8.10	3.00	1.25	128	3.00	4-6
8/15/2013	3548	49	San Joaquin	24.40	24.70	900	1500	6.40	7.30	5.00	2.00	128	5.00	0-2
8/15/2013	8835	47	San Joaquin	23.60	24.80	1100	1600	5.90	6.10	8.75	5.00	120	9.33	0-2
8/15/2013	9122	76	San Joaquin	24.50	25.30	800	1500	7.10	7.90	5.50	2.00	96	7.33	0-2
8/15/2013	9339	49	San Joaquin	22.90	22.70	1000	1200	0.13	3.10	2.00	1.25	128	2.00	0-2
8/15/2013	9607	46	San Joaquin	23.60	23.90	900	1100	2.40	6.10	2.25	1.25	96	3.00	0-2
8/15/2013	9607	300	San Joaquin	24.40	25.30	1100	1300	10.70	10.50	4.50	1.75	96	6.00	0-2
8/15/2013	9607	304	San Joaquin	26.20	26.40	1400	1500	6.30	11.80	1.75	0.75	96	2.33	0-2
8/16/2013	3548	49	San Joaquin	23.70	23.90	900	1500	8.00	7.80	3.00	1.50	96	4.00	0-2
8/16/2013	9339	49	San Joaquin	22.40	22.30	900	1300	7.14	7.00	2.00	1.50	128	2.00	0-2
8/17/2013	3548	49	San Joaquin	23.70	23.90	900	1400	6.20	6.80	5.00	3.00	96	6.67	0-2
8/17/2013	8816	78	San Joaquin	23.70	23.40	800	1400	7.73	7.41	5.00	2.00	128	5.00	2-4
8/19/2013	8835	32	San Joaquin	23.60	26.40	900	1600	8.30	7.60	6.50	3.00	96	8.67	0-2
8/20/2013	3420	7	San Joaquin	25.40	25.50	1300	1500	8.10	7.80	2.75	1.25	96	3.67	0-2
8/20/2013	3420	8	San Joaquin	26.10	25.20	900	1200	7.20	8.00	2.75	1.25	96	3.67	0-2

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
8/21/2013	3420	40	San Joaquin	25.10	25.40	900	1200	8.50	7.90	2.50	1.00	120	2.67	2-4
8/21/2013	9607	77	San Joaquin	25.40	25.90	1200	1500	8.30	7.30	5.00	1.50	96	6.67	2-4
8/21/2013	9607	78	San Joaquin	25.50	24.70	800	1100	9.40	10.50	4.00	1.50	96	5.33	2-4
8/21/2013	3548	708	Stanislaus	26.10	26.70	1000	1400	8.60	8.30	2.25	1.00	96	3.00	0-2
8/21/2013	3548	709	Stanislaus	27.30	27.40	1400	1500	8.70	8.40	1.50	0.75	96	2.00	0-2
8/21/2013	3548	710	Stanislaus	27.40	27.30	1500	1600	8.40	8.20	1.25	0.75	96	1.67	0-2
8/22/2013	3420	215	Sacramento	25.10	25.40	1200	1500	8.60	8.10	2.75	0.00	120	2.93	2-4
8/22/2013	3420	214	San Joaquin	24.80	25.10	900	1200	9.10	8.70	2.75	0.00	120	2.93	2-4
8/22/2013	3548	300	San Joaquin	24.50	24.60	900	1200	11.80	10.50	3.75	1.50	128	3.75	2-4
8/22/2013	3548	301	San Joaquin	25.20	25.80	1200	1400	10.70	10.40	2.25	1.00	128	2.25	4-6
8/22/2013	9371	37	San Joaquin	23.90	24.20	900	1100	8.20	10.10	1.50	1.25	120	1.60	0-2
8/22/2013	964121	74	San Joaquin	24.90	25.50	1200	1500	7.90	9.30	2.50	0.75	96	3.33	2-4
8/22/2013	964121	76	San Joaquin	23.90	24.30	900	1100	7.30	8.20	2.00	0.75	96	2.67	2-4
8/24/2013	3548	48	San Joaquin	26.70	26.90	900	1400	7.90	8.20	3.00	1.50	120	3.20	0-2
8/24/2013	964121	46	San Joaquin	24.20	24.40	800	1200	7.20	7.20	6.00	2.50	120	6.40	4-6
8/24/2013	964121	47	San Joaquin	25.40	25.40	1200	1400	7.00	6.90	2.00	1.50	120	2.13	2-4
8/26/2013	9012	110	Contra Costa	23.00	22.90	1000	1500	7.90	8.30	4.50	2.25	128	4.50	4-6
8/26/2013	9012	112	Contra Costa	22.90	22.70	800	1000	7.70	7.80	3.00	1.50	128	3.00	4-6
8/26/2013	3420	214	Sacramento	22.90	23.10	1200	1500	8.50	8.10	2.75	1.25	120	2.93	0-2
8/26/2013	3420	216	Sacramento	22.60	22.80	900	1200	8.90	8.60	2.75	1.25	120	2.93	2-4
8/26/2013	9122	77	San Joaquin	24.90	25.30	1100	1500	8.60	9.70	5.50	1.50	96	7.33	2-4
8/26/2013	9122	78	San Joaquin	24.10	24.70	800	1100	7.80	8.40	5.00	2.00	96	6.67	2-4
8/26/2013	3548	707	Stanislaus	24.90	26.80	900	1300	8.60	7.70	4.25	1.75	96	5.67	0-2
8/26/2013	3548	708	Stanislaus	26.80	27.10	1300	1500	8.10	7.90	3.25	1.25	96	4.33	2-4
8/27/2013	8835	37	San Joaquin	23.80	26.80	900	1600	8.50	7.30	7.25	5.00	96	9.67	0-2
8/27/2013	9123	12	San Joaquin	23.70	27.80	900	1400	10.90	9.79	6.00	2.50	120	6.40	2-4
8/27/2013	3619	706	Stanislaus	25.60	27.00	1100	1500	7.80	8.50	5.00	2.50	96	6.67	0-2
8/28/2013	3420	212	Sacramento	23.10	23.50	900	1500	7.90	8.80	4.50	1.75	120	4.80	0-2
8/28/2013	8789	126	Sacramento	22.00	22.50	900	1200	8.30	8.00	4.00	2.00	120	4.27	6-8
8/28/2013	8789	128	Sacramento	22.30	22.70	1200	1500	7.90	8.10	3.00	1.50	120	3.20	6-8
8/28/2013	3548	8	San Joaquin	23.40	24.00	1000	1400	8.90	7.90	3.00	1.50	120	3.20	0-2

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
8/28/2013	9123	58	San Joaquin	24.30	24.20	1200	1500	10.50	9.87	4.00	3.00	120	4.27	4-6
8/28/2013	9123	66	San Joaquin	24.10	24.50	1100	1200	9.09	10.10	2.50	1.50	120	2.67	0-2
8/28/2013	9123	100	San Joaquin	22.50	24.90	800	1000	9.37	6.50	2.50	2.00	120	2.67	0-2
8/30/2013	3548	47	San Joaquin	25.40	25.10	1200	1500	8.50	7.90	3.00	1.50	120	3.20	0-2
8/30/2013	3548	48	San Joaquin	24.20	25.10	900	1100	7.60	8.20	3.00	1.50	120	3.20	0-2
8/30/2013	9123	13	San Joaquin	23.90	25.30	1000	1400	10.10	10.34	4.75	2.00	120	5.07	2-4
8/31/2013	3548	48	San Joaquin	24.20	24.50	1200	1500	7.70	8.00	3.00	1.50	120	3.20	0-2
8/31/2013	3548	49	San Joaquin	23.60	23.90	900	1200	8.10	7.90	3.00	1.50	120	3.20	0-2
8/31/2013	964121	47	San Joaquin	24.60	25.40	700	1200	7.60	7.00	2.25	1.75	120	2.40	0-2
									Total	**259.50**	**118.25**		**300.63**	

Table B- 7. September 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
9/3/2013	3713	8	San Joaquin	23.10	23.30	900	1200	8.60	8.40	3.00	0.00	120	3.20	2-4
9/3/2013	3713	10	San Joaquin	23.50	23.60	1200	1500	8.10	8.30	3.00	0.00	120	3.20	2-4
9/3/2013	8835	28	San Joaquin	23.00	24.10	1300	1500	7.00	7.80	1.75	0.50	96	2.33	6-8
9/3/2013	8835	31	San Joaquin	24.50	23.90	900	1100	7.60	7.50	3.00	2.50	96	4.00	6-8
9/3/2013	9122	81	San Joaquin	23.50	24.10	800	1200	9.60	8.20	6.00	2.50	120	6.40	2-4
9/3/2013	9123	58	San Joaquin	24.40	24.80	1100	1400	8.61	8.82	2.50	0.50	120	2.67	6-8
9/3/2013	3548	707	Stanislaus	25.50	26.60	1100	1400	7.10	7.10	4.50	1.75	128	4.50	2-4
9/3/2013	3548	708	Stanislaus	26.60	26.80	1400	1500	7.10	7.20	2.25	1.25	128	2.25	4-6
9/4/2013	9012	110	Contra Costa	22.60	22.80	800	1200	7.20	7.60	3.00	1.50	120	3.20	6-8
9/4/2013	9012	112	Contra Costa	22.90	23.10	1200	1500	8.00	7.90	3.00	1.50	120	3.20	6-8
9/4/2013	8835	29	San Joaquin	24.00	24.00	1000	1400	7.20	7.30	6.00	3.00	96	8.00	0-2
9/4/2013	8835	32	San Joaquin	25.20	25.60	1400	1500	10.50	8.90	2.50	0.50	96	3.33	4-6
9/4/2013	9122	81	San Joaquin	23.70	25.10	800	1500	8.50	10.50	9.00	2.50	120	9.60	2-4
9/4/2013	9123	13	San Joaquin	23.30	25.60	1000	1500	8.34	10.01	4.25	2.25	120	4.53	4-6
9/4/2013	3548	714	Stanislaus	21.30	21.40	1300	1500	8.00	8.30	1.75	0.75	128	1.75	4-6
9/4/2013	3548	715	Stanislaus	21.10	21.00	1000	1300	8.10	7.70	2.25	1.25	128	2.25	2-4
9/5/2013	9122	74	San Joaquin	23.50	23.90	800	1300	7.40	9.50	9.00	1.75	96	12.00	2-4
9/5/2013	9122	76	San Joaquin	25.20	24.60	1300	1500	7.30	7.10	3.00	0.75	96	4.00	2-4
9/9/2013	9012	107	Contra Costa	22.50	22.80	800	1200	8.70	8.30	3.00	1.50	120	3.20	4-6
9/9/2013	9012	108	Contra Costa	23.10	23.30	1200	1500	8.80	8.60	3.00	1.00	120	3.20	0-2
9/9/2013	9122	84	Contra Costa	23.70	24.70	1300	1600	7.90	11.80	2.00	0.25	96	2.67	0-2
9/9/2013	3548	34	San Joaquin	23.40	23.60	900	1100	7.70	7.90	3.00	1.50	120	3.20	2-4
9/9/2013	3548	37	San Joaquin	23.80	24.10	1200	1400	8.10	7.20	3.00	1.50	120	3.20	2-4
9/9/2013	8835	100	San Joaquin	24.10	24.50	900	1200	7.91	7.80	6.00	0.00	120	6.40	2-4
9/9/2013	9122	50	San Joaquin	24.20	24.50	1100	1300	7.60	8.10	3.00	0.75	96	4.00	0-2
9/9/2013	9122	52	San Joaquin	23.80	24.20	800	1100	9.30	8.30	5.00	1.25	96	6.67	0-2
9/9/2013	9122	84	San Joaquin	23.70	24.70	1300	1600	7.90	11.80	2.00	0.25	96	2.67	0-2
9/10/2013	3420	40	San Joaquin	21.00	21.20	900	1200	7.70	8.30	3.50	1.50	96	4.67	4-6
9/10/2013	9122	76	San Joaquin	23.90	24.30	800	1100	7.30	7.90	4.00	1.00	96	5.33	2-4
9/10/2013	9122	78	San Joaquin	24.60	24.90	1100	1500	9.50	8.30	8.00	3.00	96	10.67	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
9/10/2013	9371	40	San Joaquin	24.20	24.50	900	1400	8.30	8.10	6.00	2.50	120	6.40	2-6
9/11/2013	3420	28	San Joaquin	24.20	24.60	1000	1400	9.10	8.80	3.00	1.25	120	3.20	2-4
9/12/2013	3420	37	San Joaquin	24.10	24.50	1000	1400	8.60	8.20	3.00	0.00	120	3.20	2-4
9/13/2013	8789	48	San Joaquin	23.70	23.90	1200	1500	7.80	8.20	3.00	1.50	120	3.20	0-2
9/13/2013	8789	49	San Joaquin	23.20	23.60	900	1200	7.90	8.10	3.00	1.50	120	3.20	0-2
9/13/2013	9123	12	San Joaquin	24.10	24.80	1300	1500	9.17	8.76	3.00	1.50	120	3.20	4-6
9/13/2013	9123	62	San Joaquin	23.70	24.50	900	1300	7.79	7.89	7.50	3.75	120	8.00	2-4
9/13/2013	964121	47	San Joaquin	25.60	25.90	900	1500	7.80	7.10	4.00	2.00	120	4.27	0-2
9/14/2013	9012	108	Contra Costa	22.70	22.90	900	1200	7.90	8.00	3.00	1.50	120	3.20	0-2
9/14/2013	9012	109	Contra Costa	23.20	23.40	1200	1500	8.30	8.00	3.00	1.50	120	3.20	2-4
9/14/2013	964121	97	Contra Costa	24.50	25.70	700	1100	8.20	7.90	3.00	2.00	120	3.20	0-2
9/16/2013	8789	122	Sacramento	21.60	21.90	800	1200	8.30	8.00	3.00	1.50	120	3.20	4-6
9/16/2013	8789	128	Sacramento	22.20	22.70	1200	1500	8.40	8.10	3.00	1.50	120	3.20	4-6
9/16/2013	3548	1	San Joaquin	24.50	24.60	1200	1400	7.70	7.40	4.50	2.00	120	4.80	0-2
9/16/2013	3548	300	San Joaquin	24.50	24.50	900	1200	8.10	7.80	4.50	2.00	120	4.80	0-2
9/16/2013	8835	308	San Joaquin	22.40	22.70	1200	1400	7.70	7.50	2.50	1.25	120	2.67	4-6
9/16/2013	8835	309	San Joaquin	22.20	22.40	1000	1200	8.00	7.70	2.25	1.00	120	2.40	2-4
9/16/2013	9122	73	San Joaquin	24.30	24.70	1400	1600	7.80	9.50	3.00	1.00	96	4.00	2-4
9/16/2013	9122	81	San Joaquin	23.30	23.80	800	1200	9.20	8.30	6.00	2.00	96	8.00	0-2
9/16/2013	9122	82	San Joaquin	23.80	24.20	1200	1400	8.90	7.50	3.00	1.00	96	4.00	2-4
9/16/2013	9123	92	San Joaquin	23.50	23.80	1100	1500	8.86	8.12	5.00	4.00	120	5.33	2-4
9/17/2013	9122	93	Contra Costa	23.10	23.50	800	1100	10.80	9.40	6.00	2.00	96	8.00	2-4
9/17/2013	8789	123	Sacramento	21.90	21.70	900	1200	8.30	7.90	3.00	1.50	120	3.20	8-10
9/17/2013	8789	124	Sacramento	22.00	22.10	1300	1500	8.20	8.50	3.00	1.50	120	3.20	8-10
9/17/2013	3548	301	San Joaquin	22.80	22.90	1200	1400	7.30	7.20	3.00	1.25	120	3.20	4-6
9/17/2013	3548	303	San Joaquin	22.50	22.60	900	1100	7.30	7.50	3.00	1.25	120	3.20	4-6
9/17/2013	8835	300	San Joaquin	22.70	22.90	1200	1400	8.10	8.20	3.00	1.25	120	3.20	4-6
9/17/2013	8835	302	San Joaquin	22.40	22.70	900	1100	7.20	8.10	3.00	1.25	120	3.20	2-4
9/17/2013	9122	74	San Joaquin	23.90	24.30	1200	1500	7.40	7.20	3.00	1.00	96	4.00	4-6
9/17/2013	9123	59	San Joaquin	22.20	23.60	1000	1400	6.87	9.93	10.00	4.50	120	10.67	6-8
9/18/2013	9122	79	Alameda	22.80	23.40	800	1000	9.30	8.90	3.00	1.00	120	3.20	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
9/18/2013	8789	129	Sacramento	21.00	21.50	800	1200	8.60	8.30	3.00	1.50	120	3.20	4-6
9/18/2013	8789	130	Sacramento	21.70	22.00	1200	1500	7.90	8.50	3.00	1.50	120	3.20	4-6
9/18/2013	3713	8	San Joaquin	22.60	22.80	900	1100	7.20	6.90	2.00	0.75	120	2.13	2-4
9/18/2013	8835	13	San Joaquin	25.00	26.10	1000	1300	13.10	10.10	2.50	1.75	120	2.67	0-2
9/18/2013	9122	78	San Joaquin	23.50	23.40	1000	1300	7.40	8.90	6.00	2.00	120	6.40	2-4
9/19/2013	3548	308	San Joaquin	23.10	23.30	900	1200	7.20	7.10	4.00	2.00	120	4.27	0-2
9/19/2013	3548	309	San Joaquin	23.30	23.40	1300	1400	7.30	7.50	4.00	2.00	120	4.27	0-2
9/19/2013	8789	303	San Joaquin	22.50	23.10	900	1500	8.00	8.30	7.00	3.50	120	7.47	2-4
9/19/2013	9122	76	San Joaquin	23.90	24.10	800	1200	8.10	7.30	6.00	2.00	120	6.40	2-4
9/19/2013	9371	32	San Joaquin	23.70	23.60	1400	1600	7.30	8.60	1.50	0.50	120	1.60	0-2
9/19/2013	9371	38	San Joaquin	21.90	23.00	1000	1300	8.50	7.90	5.75	2.00	120	6.13	0-2
9/19/2013	8834	715	Stanislaus	19.30	19.80	1000	1400	8.30	8.60	3.00	1.50	120	3.20	0-2
9/20/2013	8789	112	Contra Costa	21.10	21.70	800	1200	8.40	8.10	3.00	1.50	120	3.20	4-6
9/20/2013	8789	113	Contra Costa	22.00	22.30	1200	1300	7.90	8.30	4.00	2.00	120	4.27	4-6
9/20/2013	9371	53	San Joaquin	20.90	22.00	800	1100	9.20	7.40	5.00	2.50	120	5.33	0-2
9/20/2013	964121	301	San Joaquin	22.70	23.60	900	1400	7.80	6.80	6.00	2.50	120	6.40	2-4
9/21/2013	3548	303	San Joaquin	22.40	22.80	900	1200	7.80	7.40	3.00	1.25	120	3.20	2-4
9/21/2013	3548	304	San Joaquin	22.60	23.10	1200	1400	7.10	6.80	3.00	1.25	120	3.20	4-6
9/23/2013	3548	306	San Joaquin	22.60	22.70	900	1200	7.90	8.10	3.00	1.50	120	3.20	0-2
9/23/2013	3548	307	San Joaquin	22.60	22.80	1200	1400	7.50	7.30	3.00	1.50	120	3.20	0-2
9/23/2013	9122	76	San Joaquin	22.90	23.30	800	1100	7.10	7.80	4.50	1.50	120	4.80	0-2
9/23/2013	9122	78	San Joaquin	23.20	24.10	1200	1500	9.30	7.90	4.50	1.50	120	4.80	2-4
9/23/2013	9123	37	San Joaquin	19.80	21.60	900	1400	8.18	8.43	9.00	5.00	120	9.60	2-4
9/23/2013	9371	32	San Joaquin	19.50	20.90	800	1300	7.00	8.40	3.50	1.75	120	3.73	0-2
9/23/2013	9371	42	San Joaquin	23.30	23.70	1400	1500	9.70	8.50	3.00	1.75	120	3.20	4-6
9/23/2013	8835	708	Stanislaus	21.30	22.90	900	1400	9.80	9.20	7.00	3.75	120	7.47	0-2
9/24/2013	3420	37	San Joaquin	20.00	21.10	900	1100	8.60	8.90	2.50	1.25	120	2.67	2-4
9/24/2013	8929	309	San Joaquin	20.30	21.00	1000	1400	8.00	7.70	6.00	2.50	120	6.40	2-4
9/24/2013	9122	81	San Joaquin	22.80	23.50	800	1000	7.30	8.20	4.00	1.00	120	4.27	2-4
9/24/2013	9122	82	San Joaquin	23.60	23.20	1000	1500	7.60	9.30	8.00	1.50	120	8.53	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
9/25/2013	9122	74	San Joaquin	23.10	23.60	800	1400	7.10	7.60	7.00	2.00	120	7.47	0-2
9/30/2013	9122	79	Alameda	22.80	23.30	1200	1300	7.30	8.60	2.00	0.75	120	2.13	2-4
9/30/2013	9122	78	San Joaquin	22.90	23.40	1300	1500	8.10	9.30	4.00	1.25	120	4.27	2-4
									Total	**376.25**	**151.50**		**420.28**	

Table B- 8. October 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
10/1/2013	8929	8	San Joaquin	22.30	22.50	900	1500	8.40	7.80	6.00	3.00	120	6.40	2-4
10/1/2013	9122	81	San Joaquin	22.90	22.70	800	1500	7.50	9.10	9.00	3.00	120	9.60	2-4
10/1/2013	9123	8	San Joaquin	22.10	23.40	1100	1500	7.10	7.90	5.75	2.50	120	6.13	2-4
10/1/2013	9123	8	San Joaquin	22.10	23.40	1100	1500	7.10	7.90	5.75	2.50	120	6.13	2-4
10/1/2013	9123	38	San Joaquin	20.00	21.40	1100	1400	10.54	11.40	6.00	3.50	120	6.40	2-4
10/1/2013	9123	38	San Joaquin	20.00	21.40	1100	1400	10.54	11.40	6.00	3.50	120	6.40	2-4
10/2/2013	8789	112	Contra Costa	19.00	19.50	800	1200	8.60	8.60	6.00	3.00	120	6.40	2-4
10/2/2013	8789	113	Contra Costa	19.70	20.00	1300	1500	8.10	8.40	2.00	1.00	120	2.13	4-6
10/2/2013	3713	31	San Joaquin	20.10	23.40	1200	1500	9.70	10.90	5.50	1.50	120	5.87	4-6
10/2/2013	3713	32	San Joaquin	19.10	22.70	900	1200	8.60	8.40	5.00	2.75	120	5.33	0-2
10/2/2013	9122	73	San Joaquin	23.20	22.90	900	1200	8.60	7.30	6.00	1.50	120	6.40	0-2
10/2/2013	9122	75	San Joaquin	22.90	23.20	1200	1500	7.30	9.10	6.00	1.50	120	6.40	2-4
10/2/2013	9123	7	San Joaquin	20.10	21.50	1000	1500	9.32	7.56	9.00	4.25	120	9.60	4-6
10/2/2013	3548	709	Stanislaus	20.10	21.70	1000	1400	10.20	11.10	5.00	2.50	120	5.33	2-4
10/4/2013	8789	113	Contra Costa	19.90	20.10	800	1500	8.10	7.90	4.00	2.00	120	4.27	6-8
10/4/2013	9123	300	San Joaquin	16.40	16.50	1000	1200	10.53	6.81	3.00	1.50	120	3.20	2-4
10/4/2013	9123	301	San Joaquin	16.90	17.10	1200	1300	7.65	7.74	2.00	0.75	120	2.13	4-6
10/4/2013	964121	34	San Joaquin	20.00	20.00	1500	1600	8.00	7.70	2.00	1.00	120	2.13	0-2
10/5/2013	8789	123	Sacramento	17.90	18.30	800	1000	8.20	7.90	3.00	1.50	120	3.20	4-6
10/5/2013	8789	126	Sacramento	19.40	19.70	1100	1500	8.10	8.30	3.00	1.50	120	3.20	4-6
10/7/2013	8789	113	Contra Costa	17.40	17.90	800	1300	9.40	9.10	4.00	2.00	120	4.27	4-6
10/7/2013	8789	114	Contra Costa	18.30	18.60	1300	1500	8.90	9.00	2.00	1.00	120	2.13	4-6
10/7/2013	8929	8	San Joaquin	19.70	20.20	900	1500	7.20	8.30	9.00	3.50	120	9.60	4-6
10/7/2013	9122	78	San Joaquin	21.80	22.30	800	1400	9.60	7.30	12.00	4.00	120	12.80	0-2
10/7/2013	964121	36	San Joaquin	24.90	25.10	1500	1700	7.90	7.80	3.00	1.50	120	3.20	0-2
10/8/2013	8789	113	Contra Costa	17.10	17.40	800	1200	9.10	8.70	4.00	2.00	120	4.27	4-6
10/8/2013	8789	114	Contra Costa	17.80	18.10	1300	1500	9.00	8.90	2.00	1.00	120	2.13	4-6
10/8/2013	3713	8	San Joaquin	20.10	20.80	900	1400	7.50	8.10	9.00	4.50	120	9.60	2-4
10/8/2013	9122	73	San Joaquin	21.50	21.70	800	1100	7.80	7.80	6.00	2.00	120	6.40	0-2
10/8/2013	9122	75	San Joaquin	21.90	22.40	1100	1500	8.60	7.30	6.00	1.50	120	6.40	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
10/8/2013	9123	30	San Joaquin	18.80	19.10	1100	1300	8.10	7.90	3.75	2.75	120	4.00	6-8
10/8/2013	964121	32	San Joaquin	21.00	21.00	1000	1200	8.10	10.30	1.50	0.75	120	1.60	4-6
10/8/2013	964121	34	San Joaquin	22.10	23.10	800	1000	8.90	9.60	1.50	0.75	120	1.60	0-2
10/9/2013	8789	115	Contra Costa	17.30	17.70	800	1200	9.00	8.80	3.00	1.50	120	3.20	4-6
10/9/2013	8789	116	Contra Costa	18.20	18.50	1200	1500	9.30	9.10	3.00	1.50	120	3.20	4-6
10/9/2013	9122	93	Contra Costa	21.20	22.40	800	1500	11.60	8.20	6.00	2.00	120	6.40	0-2
10/9/2013	8929	8	San Joaquin	18.70	19.00	1000	1400	7.80	8.10	5.00	2.75	120	5.33	2-4
10/10/2013	3713	19	Sacramento	20.30	20.60	900	1300	8.70	9.00	3.00	1.50	120	3.20	0-2
10/10/2013	3713	20	Sacramento	20.60	20.50	1300	1600	9.10	8.80	3.00	1.50	120	3.20	0-2
10/10/2013	8789	127	Sacramento	17.20	17.50	800	1200	8.90	9.20	3.00	1.50	120	3.20	4-6
10/10/2013	8789	130	Sacramento	17.90	18.00	1200	1500	9.30	9.30	3.00	1.50	120	3.20	4-6
10/10/2013	9122	74	San Joaquin	21.30	22.30	800	1400	7.50	9.50	12.00	3.00	120	12.80	0-2
10/10/2013	9123	12	San Joaquin	17.40	20.40	1200	1600	8.30	7.50	5.00	1.50	120	5.33	2-4
10/10/2013	9123	62	San Joaquin	16.60	17.20	800	1200	8.80	7.90	6.00	2.50	120	6.40	2-4
10/10/2013	964121	36	San Joaquin	25.60	26.50	900	1100	8.50	9.80	2.00	1.50	120	2.13	4-6
10/10/2013	964121	40	San Joaquin	25.00	26.10	1200	1400	7.90	8.10	2.00	1.50	120	2.13	0-2
10/11/2013	8789	120	Contra Costa	17.10	17.30	800	1200	8.90	9.10	3.00	1.50	120	3.20	6-8
10/11/2013	8789	129	Sacramento	17.70	17.50	1200	1500	9.00	9.10	3.00	1.50	120	3.20	6-8
10/14/2013	8789	122	Sacramento	17.50	17.70	900	1200	9.40	9.20	3.00	1.50	120	3.20	4-6
10/14/2013	8789	126	Sacramento	17.90	18.10	1300	1500	9.00	9.30	2.00	1.00	120	2.13	4-6
10/14/2013	3713	26	San Joaquin	20.50	20.60	1300	1500	8.80	8.50	3.50	1.75	120	3.73	0-2
10/14/2013	3713	40	San Joaquin	20.10	20.30	900	1200	9.30	9.30	3.50	1.75	120	3.73	0-2
10/14/2013	9122	81	San Joaquin	21.20	20.20	800	1200	7.90	8.30	7.00	2.00	120	7.47	0-2
10/14/2013	9123	12	San Joaquin	17.70	20.30	1000	1500	8.60	9.40	9.00	3.00	120	9.60	4-6
10/14/2013	9371	32	San Joaquin	22.60	22.90	1300	1500	7.90	7.80	2.00	0.75	120	2.13	2-4
10/14/2013	8835	319	Stanislaus	17.40	18.60	1000	1400	8.60	8.20	6.00	2.50	120	6.40	2-4
10/15/2013	3713	8	San Joaquin	19.50	20.20	900	1400	7.60	8.30	8.00	4.00	120	8.53	0-2
10/15/2013	8835	300	San Joaquin	17.50	16.90	1100	1200	8.80	7.80	1.75	0.75	120	1.87	2-4
10/15/2013	8835	302	San Joaquin	15.90	16.60	1000	1100	8.90	9.40	1.25	0.50	120	1.33	2-4
10/15/2013	9122	83	San Joaquin	18.60	19.30	1100	1500	8.50	9.30	6.00	2.00	120	6.40	2-4
10/15/2013	9122	84	San Joaquin	19.60	19.80	800	1100	8.70	7.50	5.00	1.00	120	5.33	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
10/15/2013	9123	39	San Joaquin	20.50	22.00	900	1500	10.80	9.60	6.00	3.00	120	6.40	4-6
10/15/2013	964121	46	San Joaquin	18.10	18.60	1200	1400	7.01	7.80	2.00	2.00	120	2.13	0-2
10/15/2013	964121	47	San Joaquin	17.80	18.40	900	1200	7.43	7.02	1.00	0.50	120	1.07	0-2
10/16/2013	9122	79	Alameda	18.40	19.30	800	1000	7.50	10.40	3.00	1.00	120	3.20	0-2
10/16/2013	8789	115	Contra Costa	17.30	17.50	800	1300	9.00	9.30	4.00	2.00	120	4.27	4-6
10/16/2013	3713	200	San Joaquin	19.50	19.70	900	1500	7.80	8.20	8.00	4.00	120	8.53	0-2
10/16/2013	8835	304	San Joaquin	16.70	18.40	1000	1500	9.30	9.40	9.00	3.25	120	9.60	0-2
10/16/2013	9122	78	San Joaquin	18.10	18.50	1000	1300	8.60	9.30	5.00	2.00	120	5.33	0-2
10/16/2013	9122	80	San Joaquin	20.20	20.40	1300	1500	9.40	8.70	4.00	1.00	120	4.27	0-2
10/16/2013	9123	13	San Joaquin	18.00	19.40	1100	1500	7.52	8.72	6.00	2.75	120	6.40	2-4
10/16/2013	9371	39	San Joaquin	21.60	22.80	1000	1500	7.90	8.30	5.75	1.75	120	6.13	0-2
10/16/2013	964121	34	San Joaquin	18.10	19.20	1000	1600	7.80	7.80	4.50	2.75	120	4.80	0-2
10/17/2013	3713	8	San Joaquin	19.30	19.90	900	1500	7.50	7.90	7.00	3.50	120	7.47	0-2
10/17/2013	9122	56	San Joaquin	17.90	19.60	1000	1300	8.10	8.80	4.50	2.00	120	4.80	0-2
10/17/2013	9122	58	San Joaquin	18.80	19.90	1300	1500	7.90	6.20	4.25	1.75	120	4.53	2-4
10/17/2013	9123	8	San Joaquin	18.00	19.50	900	1500	7.73	7.71	8.50	4.25	120	9.07	2-4
10/17/2013	9371	12	San Joaquin	22.60	22.60	1000	1500	6.80	6.80	5.25	1.00	120	5.60	0-2
10/18/2013	9123	13	San Joaquin	17.50	19.50	1000	1500	8.50	9.50	10.50	4.50	120	11.20	2-4
10/21/2013	3713	215	San Joaquin	19.30	19.80	900	1500	9.40	8.70	8.00	4.00	120	8.53	0-2
10/21/2013	9122	73	San Joaquin	18.10	18.50	1100	1500	11.30	7.90	6.00	2.00	120	6.40	0-2
10/21/2013	9122	82	San Joaquin	17.20	17.80	800	1100	9.80	8.60	6.00	2.00	120	6.40	0-2
10/21/2013	9123	14	San Joaquin	17.90	19.60	1100	1600	7.56	8.40	7.50	3.00	120	8.00	2-4
10/21/2013	9371	16	San Joaquin	22.60	23.30	1200	1600	7.30	8.10	7.00	1.50	120	7.47	0-2
10/21/2013	8835	319	Stanislaus	17.30	19.60	1000	1400	7.90	7.50	6.00	2.50	120	6.40	2-4
10/22/2013	3420	29	San Joaquin	21.20	21.00	1400	1600	9.50	11.80	3.00	2.00	120	3.20	0-2
10/22/2013	3420	31	San Joaquin	20.10	20.00	1200	1300	9.90	8.30	2.00	1.50	120	2.13	0-2
10/22/2013	3420	32	San Joaquin	19.00	19.50	1000	1200	9.40	9.50	2.00	1.00	120	2.13	0-2
10/22/2013	3713	215	San Joaquin	19.60	19.90	1200	1400	8.90	8.20	6.00	3.00	120	6.40	0-2
10/22/2013	3713	219	San Joaquin	19.30	19.60	900	1200	9.10	9.30	3.00	1.50	120	3.20	0-2
10/22/2013	9607	76	San Joaquin	17.50	17.90	800	1400	8.10	7.40	11.50	3.50	120	12.27	0-2
10/22/2013	8835	320	Stanislaus	18.10	18.60	1000	1300	7.50	7.80	9.00	3.25	120	9.60	2-4

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
10/22/2013	8835	321	Stanislaus	18.60	19.10	1300	1400	7.80	8.10	3.00	1.25	120	3.20	2-4
10/23/2013	9122	91	Contra Costa	18.70	18.60	900	1300	8.80	9.10	7.25	2.50	120	7.73	4-6
10/23/2013	9123	11	San Joaquin	18.50	18.80	1100	1500	7.91	6.80	6.75	2.25	120	7.20	2-4
10/23/2013	9607	74	San Joaquin	17.80	17.50	900	1200	8.70	7.10	6.00	1.75	120	6.40	0-2
10/23/2013	9607	75	San Joaquin	17.90	18.20	1200	1500	8.30	9.40	6.00	1.75	120	6.40	0-2
10/24/2013	3713	40	San Joaquin	18.90	19.20	900	1200	8.60	9.00	4.00	2.00	120	4.27	4-6
10/24/2013	3713	200	San Joaquin	19.20	19.40	1300	1500	9.10	8.90	4.00	2.00	120	4.27	0-2
10/25/2013	9123	15	San Joaquin	17.20	18.60	1000	1400	10.54	8.99	8.00	5.00	120	8.53	2-4
10/28/2013	3713	219	Sacramento	19.30	19.80	900	1400	10.20	9.70	6.00	3.00	120	6.40	2-4
10/28/2013	964121	34	San Joaquin	17.30	18.40	1000	1300	10.90	8.90	2.00	1.00	120	2.13	0-2
10/29/2013	3713	217	Sacramento	19.10	19.60	900	1400	8.90	8.40	3.00	1.50	120	3.20	2-4
10/29/2013	3420	31	San Joaquin	16.70	16.40	900	1400	7.70	11.20	9.00	3.00	120	9.60	0-2
10/29/2013	8835	301	San Joaquin	14.60	16.90	1000	1500	7.80	8.00	9.00	3.75	120	9.60	0-2
10/29/2013	9123	12	San Joaquin	17.50	18.30	1000	1500	7.56	6.34	8.50	5.25	120	9.07	2-4
10/29/2013	9607	75	San Joaquin	16.60	0.00	1100	1500	8.20	0.00	6.00	2.50	120	6.40	2-4
10/29/2013	9607	76	San Joaquin	17.10	0.00	800	1100	9.30	0.00	6.00	2.50	120	6.40	0-2
10/30/2013	8929	28	San Joaquin	15.70	16.40	1300	1600	8.30	8.10	4.00	1.75	120	4.27	2-4
10/30/2013	9123	8	San Joaquin	17.40	18.70	1300	1600	7.64	4.24	4.00	1.25	120	4.27	2-4
10/31/2013	3420	13	San Joaquin	15.90	16.00	1400	1600	12.20	10.80	3.00	1.50	120	3.20	0-2
10/31/2013	3420	26	San Joaquin	16.70	16.90	1000	1100	7.20	10.10	2.89	1.02	120	3.08	0-2
10/31/2013	3420	28	San Joaquin	16.70	16.90	1100	1400	7.20	10.10	5.61	1.98	120	5.98	0-2
10/31/2013	3713	10	San Joaquin	18.90	19.20	1200	1400	7.70	7.30	3.00	1.50	120	3.20	0-2
10/31/2013	3713	28	San Joaquin	18.20	18.60	900	1200	7.00	7.50	6.00	3.00	120	6.40	0-2
10/31/2013	8929	58	San Joaquin	15.90	16.40	1200	1400	8.40	9.20	5.00	2.00	120	5.33	0-2
10/31/2013	8929	92	San Joaquin	14.90	15.70	900	1200	8.70	9.10	5.75	1.75	120	6.13	0-2
10/31/2013	9123	15	San Joaquin	16.10	17.50	1000	1600	8.87	6.30	8.25	6.25	120	8.80	0-2
									Total	**601.00**	**257.50**		**641.07**	

Table B- 9. November 2013, Glyphosate/Agridex Use

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
11/4/2013	3420	34	San Joaquin	15.10	15.20	1200	1400	9.90	8.70	3.00	1.50	120	3.20	6-8
11/4/2013	3420	37	San Joaquin	15.10	15.10	900	1200	9.80	11.30	6.00	2.50	120	6.40	6-8
11/4/2013	9607	74	San Joaquin	17.20	17.40	800	1100	8.90	9.10	6.00	2.50	120	6.40	2-4
11/4/2013	9607	75	San Joaquin	17.30	17.60	1100	1500	7.40	8.20	6.00	2.50	120	6.40	2-4
11/5/2013	9122	73	San Joaquin	16.90	17.80	1000	1500	8.10	9.30	4.05	1.08	120	4.32	2-4
11/5/2013	9122	81	San Joaquin	17.50	17.60	800	1000	10.50	7.80	4.00	1.50	120	4.27	0-2
11/5/2013	9122	82	San Joaquin	16.90	17.80	1000	1500	8.10	9.30	3.45	0.92	120	3.68	2-4
11/6/2013	8929	56	San Joaquin	15.90	16.60	1300	1500	9.30	9.20	4.25	1.25	120	4.53	0-2
11/6/2013	8929	58	San Joaquin	15.60	15.80	1000	1300	9.00	9.10	4.75	1.25	120	5.07	2-4
11/6/2013	9012	120	Contra Costa	16.20	16.60	1200	1500	9.10	9.30	3.00	1.50	120	3.20	4-6
11/6/2013	9012	120	Contra Costa	16.40	16.70	900	1200	8.60	8.90	3.00	1.50	120	3.20	4-6
11/6/2013	9122	80	San Joaquin	16.90	16.10	900	1500	8.50	9.10	0.00	0.00	120	0.00	0-2
11/6/2013	9122	81	San Joaquin	16.90	16.10	900	1500	8.50	9.10	0.00	0.00	120	0.00	0-2
11/6/2013	9123	8	San Joaquin	15.90	16.90	1100	1500	2.36	8.03	7.25	5.50	120	7.73	2-4
11/7/2013	3713	32	San Joaquin	13.60	16.90	900	1400	9.80	9.70	9.00	3.75	120	9.60	0-2
11/7/2013	9122	80	San Joaquin	15.90	15.30	1100	1500	8.70	10.30	6.00	2.50	120	6.40	2-4
11/7/2013	9122	81	San Joaquin	14.70	15.50	800	1100	9.30	7.80	6.00	2.50	120	6.40	0-2
11/12/2013	8929	2	San Joaquin	15.10	16.90	900	1500	7.80	8.20	3.00	1.25	120	3.20	2-4
11/13/2013	3713	200	San Joaquin	16.50	16.70	900	1100	8.20	8.40	4.50	2.00	120	4.80	0-2
11/13/2013	3713	204	San Joaquin	16.70	16.90	1100	1400	8.60	9.10	4.50	2.00	120	4.80	0-2
11/13/2013	8929	56	San Joaquin	15.80	17.30	1000	1400	9.00	9.20	4.75	1.75	120	5.07	2-4
11/13/2013	9123	8	San Joaquin	15.60	16.20	1100	1400	8.49	7.77	5.50	3.75	120	5.87	2-4
11/13/2013	9607	76	San Joaquin	14.30	15.40	800	1500	7.80	8.20	9.00	3.00	120	9.60	0-2
11/14/2013	8929	92	San Joaquin	15.30	16.40	900	1100	9.50	9.20	3.00	1.25	120	3.20	0-2
11/14/2013	9122	84	Contra Costa	15.50	14.90	800	1500	9.30	7.60	12.00	5.00	120	12.80	0-2
11/18/2013	3713	200	San Joaquin	12.80	12.90	900	1300	8.50	8.90	4.50	2.00	120	4.80	0-2

Date	Vessel ID	Site ID	County	Before Temp (°C)	After Temp (°C)	Time Arrived	Time Departed	DO Before (mg/L)	DO After (mg/L)	Glyphosate (gal)	Agridex (gal)	Chem Rate	Glyphosate Acres	Wind Speed
11/18/2013	3713	204	San Joaquin	13.20	13.50	1300	1600	8.60	8.10	4.50	2.00	120	4.80	2-4
11/18/2013	8835	300	San Joaquin	14.00	14.60	1200	1500	9.30	13.80	6.00	2.50	120	6.40	2-4
11/18/2013	8835	301	San Joaquin	14.10	13.80	900	1200	11.30	10.20	6.00	2.50	120	6.40	0-2
11/18/2013	9122	87	San Joaquin	15.30	15.50	800	1500	7.10	8.30	9.00	0.00	120	9.60	0-2
11/25/2013	8835	48	San Joaquin	12.80	13.60	900	1500	9.00	9.20	6.00	2.50	120	6.40	0-2
									Total	**158.00**	**63.75**		**168.53**	

APPENDIX C

2013 Treatment Count Per Site

2013 Hyacinth Treatment Count (Glyphosate)

11/27/2013

Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓
1	1	34	7	73	5	101A	0	134	0	222	0	255	0	290B	0	411	0	521	0	902	0
2	1	35	1	74	11	101B	0	135	0	223	0	256A	0	291	1	412	0	522	0	903	0
3	0	36	4	75	10	102	0	136	0	224	0	256B	0	300	15	413	0	523	0	904	0
4	0	37	11	76	15	103A	0	137	0	225	0	257A	0	301	9	414	0	524	0	905	0
5	0	38	6	77	4	103B	0	138	0	226	0	257B	0	302	3	414A	0	525	0	906	0
6	0	39	4	78	11	104A	0	139	0	230	0	258A	0	303	3	415	0	526	0	907	0
7	2	40	15	79	6	104B	0	140	0	231	0	258B	0	304	4	416	0	527	0	908	0
8	19	41	0	80	4	105	0	141	0	232	0	259	0	305	0	417	0	528	0	909	0
9	1	42	1	81	9	106	0	173	1	233	0	260	0	306	1	418	0	529	0	910A	0
10	4	43	0	82	4	107	3	174	0	234	0	261	0	307	1	419	0	530	0	910B	0
11	1	44	1	83A	0	108	5	175	0	235	0	262	0	308	2	420	0	531	0	911	0
12	7	45	1	83B	3	109	2	176	0	236	0	263	0	309	3	421	0	532	0	912	0
13	8	46	7	84A	5	110	3	200	7	237	0	264	0	310	0	422	0	533	0	913	0
14	4	47	8	84B	5	111	0	201	0	238	0	265	0	311	0	423	0	534	0	914	0
15	2	48	10	85A	0	112	5	202	1	239	0	266	0	312	0	424	0	535	0	915	0
16	1	49	14	85B	0	113	5	203	4	240A	0	267	0	313	0	425	0	536	0	916	0
17A	0	50	2	86A	0	114	2	204	6	240B	0	268	0	314	0	426	0	537	0	917	0
17B	0	51	0	86B	0	115	2	205	1	241	0	269	0	315	0	427	0	600	0	918	0
18A	1	52	2	87A	0	116	2	206	1	242	0	270	0	316	0	500	0	700	0	919	0
18B	1	53	3	87B	1	117	1	207	0	243	0	271	0	317	0	501	0	701	0	920	0
19A	2	54	0	88	0	118	0	208	0	244	0	272	0	318	0	502	0	702	0	921	0
19B	0	55	0	89A	0	119A	0	209A	0	245	0	273	0	319	3	503	0	703	0	922	0
20	2	56	4	89B	0	119B	0	209B	0	246A	0	274	0	320	2	504	0	704	0	923	0
21A	0	57	0	90A	0	120A	1	210A	0	246B	0	275	0	321	1	505	0	705	0	924	0
21B	0	58	10	90B	0	120B	2	210B	0	247A	0	276	0	322	0	506	0	706	1	925	0
22	0	59	2	91A	2	121A	0	211A	0	247B	0	277	0	323	0	507	0	707	2	926	0
23A	0	60	1	91B	0	121B	0	211B	0	248A	0	278	0	324	0	508	0	708	4	927	0
23B	0	61	2	92A	0	122	2	212A	1	248B	0	279	0	325	0	509	0	709	3	928	0
24A	0	62	4	92B	3	123	2	212B	0	249A	0	280	0	400	0	510	0	710	2	929	0
24B	0	63	0	93	9	124	1	213A	0	249B	0	281	0	401	0	511	0	711	1	**Sites Treated**	
25	1	64	0	94	3	125	0	213B	0	250A	0	282	0	402	0	512	0	712	1		
26	7	65	1	95	0	126	3	214	4	250B	0	283	0	403	0	513	0	713	0	130	
27	0	66	1	96	0	127	1	215	6	251A	0	284	0	404	0	514	0	714	1	**Treatment Count**	
28	13	67	1	97	2	128	3	216	3	251B	0	285	0	405	0	515	0	715	2		
29	3	68	1	98A	0	129	3	217	1	252A	0	286	0	406	0	516	0	716	0	510	
30	4	69	1	98B	0	130	2	218	0	252B	0	287	0	407	0	517	0	717	0	**Tidal**	
31	10	70	0	99A	0	131	0	219	4	253A	0	288	0	408	1	518	0	718	0	107	444
32	15	71	0	99B	1	132	0	220	0	253B	0	289	0	409	1	519	0	900	0	**Riverine**	
33	3	72	0	100	2	133	0	221	0	254	0	290A	0	410	0	520	0	901	0	23	66

Less Treatments →→→ →→→ →→→ More Treatments

APPENDIX D

Site Maps and Monitoring and Laboratory Data

Monitoring Results – Site 10, Buckley Cove

Glyphosate Residue

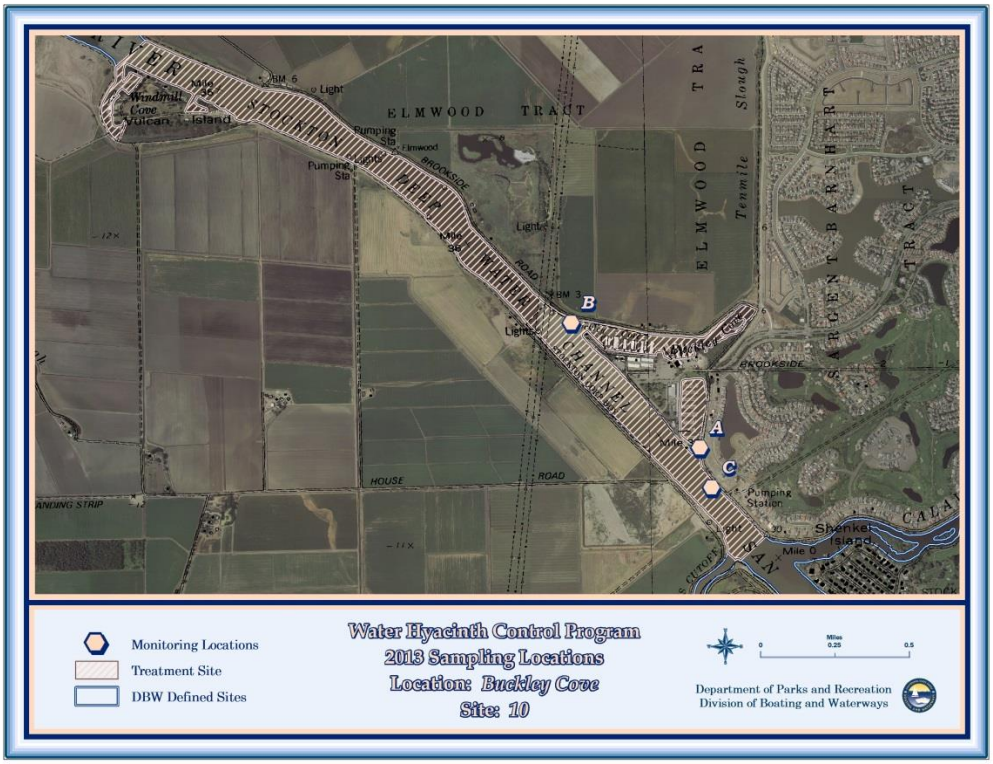
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3339	H010-041113-3	4/11/2013	4/11/2013	4/15/2013	4/16/2013	ND
1C	2012-3338	H010-041113-2	4/11/2013	4/11/2013	4/15/2013	4/16/2013	ND
2B	2012-3341	H010-041113-5	4/11/2013	4/11/2013	4/15/2013	4/16/2013	ND
3A	2012-3414	H010-041813-3	4/18/2013	4/18/2013	4/30/2013	4/30/2013	ND
3B	2012-3416	H010-041813-5	4/18/2013	4/18/2013	4/30/2013	4/30/2013	ND
3C	2012-3413	H010-041813-2	4/18/2013	4/18/2013	4/30/2013	4/30/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3339	H010-041113-3	4/11/2013	4/11/2013	4/19/2013	4/23/2013	ND
1C	2012-3338	H010-041113-2	4/11/2013	4/11/2013	4/19/2013	4/23/2013	ND
2B	2012-3341	H010-041113-5	4/11/2013	4/11/2013	4/19/2013	4/23/2013	ND
3A	2012-3414	H010-041813-3	4/18/2013	4/18/2013	4/19/2013	4/23/2013	ND
3B	2012-3416	H010-041813-5	4/18/2013	4/18/2013	4/19/2013	4/23/2013	ND
3C	2012-3413	H010-041813-2	4/18/2013	4/18/2013	4/19/2013	4/23/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H010-041113-3	04/11/2013	642900	4203957	09:14:00	18.03	0.806	0.42	8.14	7.48	3.9	ebb
1C	H010-041113-2	04/11/2013	642963	4203742	09:10:00	17.85	0.801	0.42	7.70	7.54	4.3	ebb
2B	H010-041113-5	04/11/2013	642202	4204632	10:35:00	17.82	0.798	0.41	8.54	8.50	6.1	ebb
3A	H010-041813-3	04/18/2013	642889	4203951	09:09:00	17.37	0.834	0.43	8.20	8.25	5.2	flood
3B	H010-041813-5	04/18/2013	642178	4204618	09:30:00	17.30	0.834	0.43	8.33	8.31	6.3	flood
3C	H010-041813-2	04/18/2013	642958	4203736	09:00:00	17.40	0.835	0.43	8.14	8.10	3.4	flood



Monitoring Results – Site 26, Fourteen Mile Slough

Glyphosate Residue

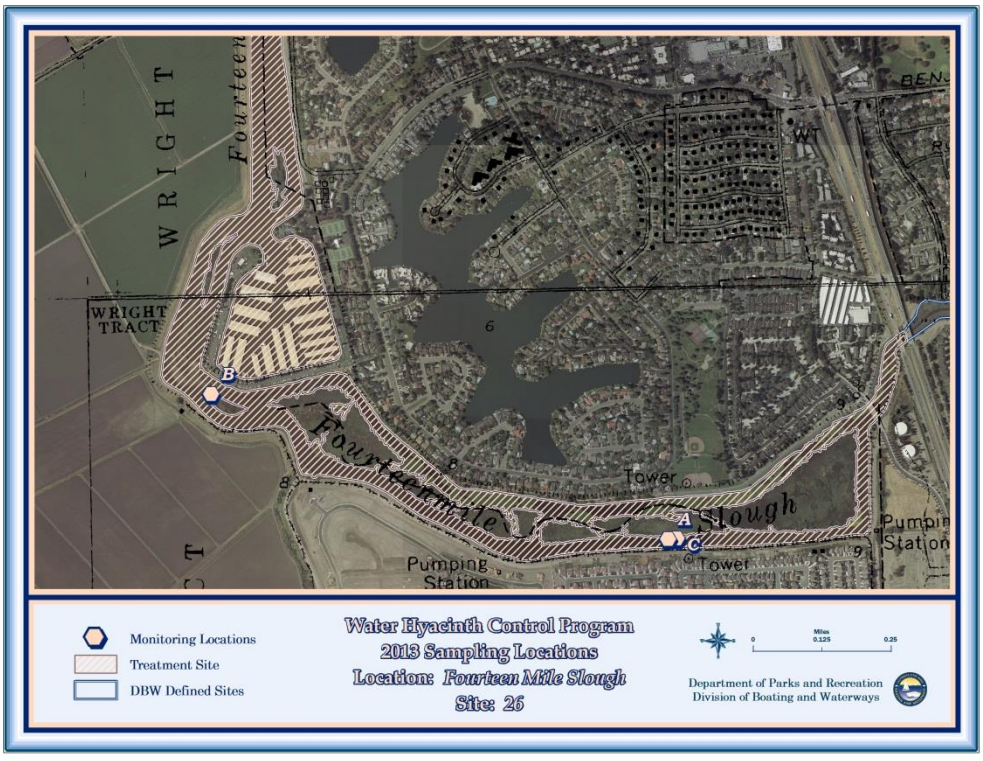
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3161	H026-032613-3	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
1C	2012-3160	H026-032613-2	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
2B	2012-3163	H026-032613-5	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
3A	2012-3240	H026-040313-3	4/3/2013	4/3/2013	4/5/2013	4/5/2013	ND
3B	2012-3242	H026-040313-5	4/3/2013	4/3/2013	4/5/2013	4/5/2013	ND
3C	2012-3239	H026-040313-2	4/3/2013	4/3/2013	4/5/2013	4/5/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3161	H026-032613-3	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
1C	2012-3160	H026-032613-2	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
2B	2012-3163	H026-032613-5	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
3A	2012-3240	H026-040313-3	4/3/2013	4/3/2013	4/5/2013	4/9/2013	ND
3B	2012-3242	H026-040313-5	4/3/2013	4/3/2013	4/5/2013	4/9/2013	ND
3C	2012-3239	H026-040313-2	4/3/2013	4/3/2013	4/5/2013	4/9/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H026-032613-3	03/26/2013	644275	4206351	09:49:00	16.33	0.699	0.36	10.18	8.08	18.0	ebb
1C	H026-032613-2	03/26/2013	644297	4206352	09:46:00	16.29	0.702	0.36	10.17	8.01	10.2	ebb
2B	H026-032613-5	03/26/2013	642938	4206773	12:05:00	16.80	0.674	0.35	10.77	8.12	7.7	ebb
3A	H026-040313-3	04/03/2013	644255	4206349	08:59:00	18.71	0.636	0.33	6.03	7.59	9.2	flood
3B	H026-040313-5	04/03/2013	642940	4206773	09:35:00	18.58	0.639	0.33	7.22	7.11	1.4	flood
3C	H026-040313-2	04/03/2013	644303	4206357	08:55:00	18.55	0.626	0.32	5.59	7.46	13.0	flood



Monitoring Results – Site 37, White Slough

Glyphosate Residue

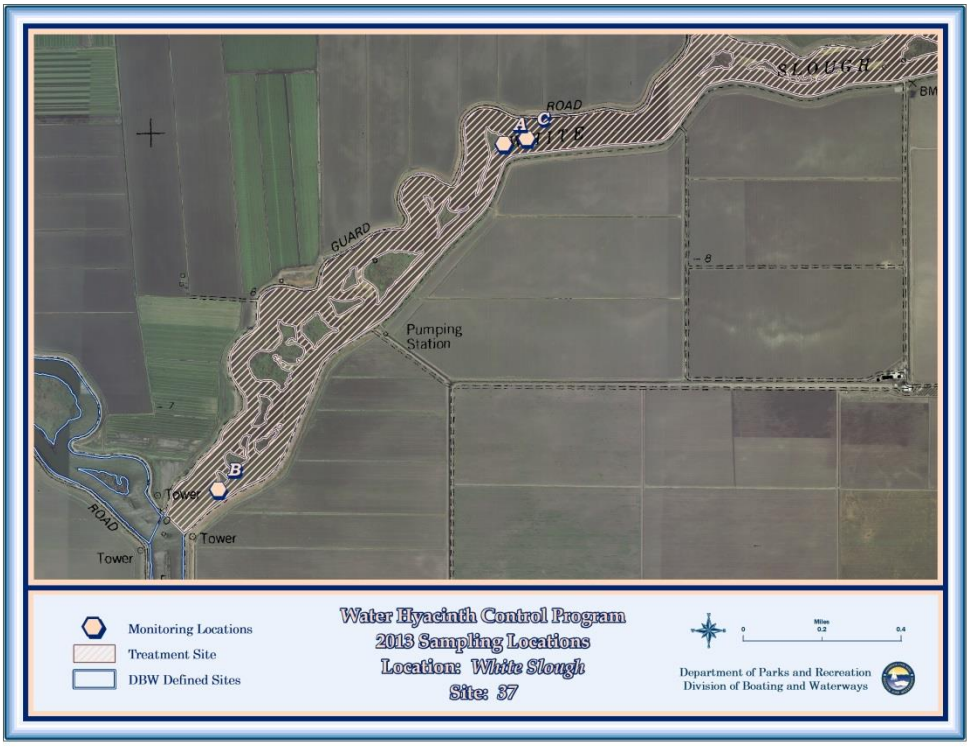
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3167	H037-032613-3	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
1C	2012-3166	H037-032613-2	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
2B	2012-3169	H037-032613-5	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
3A	2012-3245	H037-040313-3	4/3/2013	4/3/2013	4/5/2013	4/5/2013	ND
3B	2012-3247	H037-040313-5	4/3/2013	4/3/2013	4/5/2013	4/5/2013	ND
3C	2012-3244	H037-040313-2	4/3/2013	4/3/2013	4/5/2013	4/5/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3167	H037-032613-3	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
1C	2012-3166	H037-032613-2	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
2B	2012-3169	H037-032613-5	3/26/2013	3/26/2013	4/2/2013	4/2/2013	ND
3A	2012-3245	H037-040313-3	4/3/2013	4/3/2013	4/5/2013	4/9/2013	ND
3B	2012-3247	H037-040313-5	4/3/2013	4/3/2013	4/5/2013	4/9/2013	ND
3C	2012-3244	H037-040313-2	4/3/2013	4/3/2013	4/5/2013	4/9/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H037-032613-3	03/26/2013	636546	4216127	08:50:00	15.66	0.208	0.10	10.75	8.50	6.8	ebb
1C	H037-032613-2	03/26/2013	636639	4216148	08:43:00	15.13	0.212	0.10	10.78	8.38	4.9	ebb
2B	H037-032613-5	03/26/2013	635380	4214715	11:01:00	15.20	0.200	0.09	10.71	8.16	4.6	ebb
3A	H037-040313-3	04/03/2013	636546	4216127	11:47:00	18.05	0.208	0.10	10.10	8.16	2.7	flood
3B	H037-040313-5	04/03/2013	635374	4214700	12:02:00	18.07	0.208	0.10	9.92	7.94	0.0	flood
3C	H037-040313-2	04/03/2013	636635	4216152	11:42:00	17.82	0.204	0.09	10.03	7.83	4.1	flood



Monitoring Results – Site 39, White Slough

Glyphosate Residue

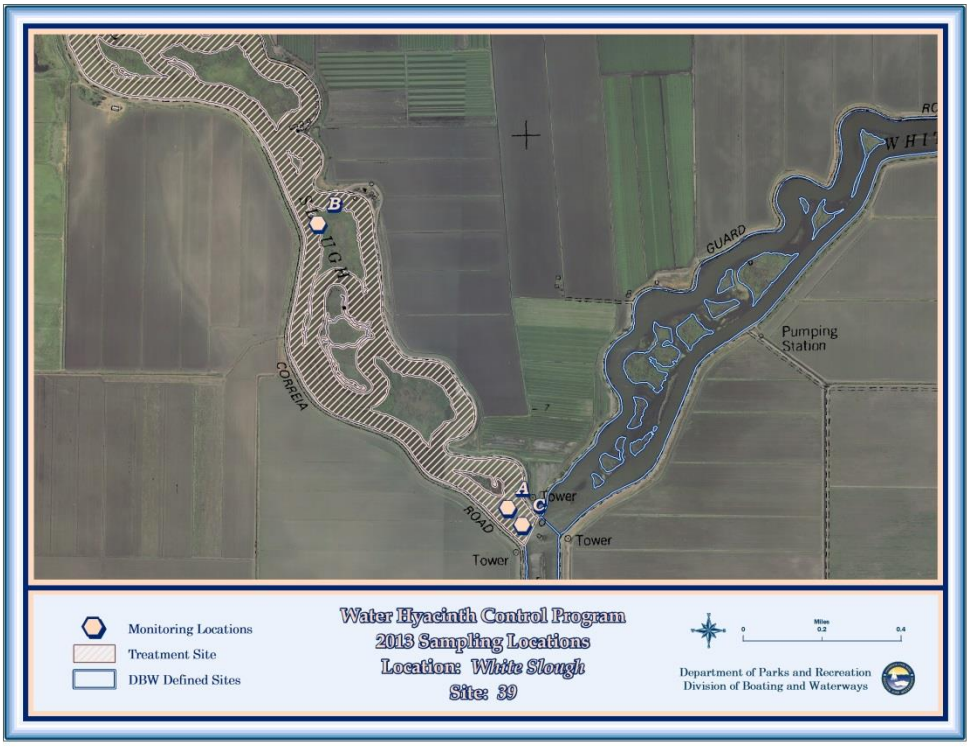
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-4080	H039-061313-3	6/13/2013	6/13/2013	6/26/2013	6/27/2013	ND
1C	2012-4079	H039-061313-2	6/13/2013	6/13/2013	6/26/2013	6/27/2013	ND
2B	2012-4082	H039-061313-5	6/13/2013	6/13/2013	6/26/2013	6/27/2013	ND
3A	2012-4100	H039-061913-3	6/19/2013	6/19/2013	7/10/2013	7/11/2013	ND
3B	2012-4102	H039-061913-5	6/19/2013	6/19/2013	7/10/2013	7/11/2013	ND
3C	2012-4099	H039-061913-2	6/19/2013	6/19/2013	7/10/2013	7/11/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-4080	H039-061313-3	6/13/2013	6/13/2013	6/17/2013	6/17/2013	ND
1C	2012-4079	H039-061313-2	6/13/2013	6/13/2013	6/17/2013	6/17/2013	ND
2B	2012-4082	H039-061313-5	6/13/2013	6/13/2013	6/17/2013	6/17/2013	ND
3A	2012-4100	H039-061913-3	6/19/2013	6/19/2013	6/26/2013	6/26/2013	ND
3B	2012-4102	H039-061913-5	6/19/2013	6/19/2013	6/26/2013	6/26/2013	ND
3C	2012-4099	H039-061913-2	6/19/2013	6/19/2013	6/26/2013	6/26/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H039-061313-3	06/13/2013	635029	4214648	08:35:00	21.71	0.198	0.09	8.39	7.93	9.7	ebb
1C	H039-061313-2	06/13/2013	635087	4214579	08:27:00	21.81	0.195	0.09	8.24	7.74	9.1	ebb
2B	H039-061313-5	06/13/2013	634252	4215810	10:50:00	21.65	0.192	0.09	8.36	7.86	25.5	ebb
3A	H039-061913-3	06/19/2013	635025	4214652	08:17:00	20.83	0.184	0.08	7.85	7.90	3.6	ebb
3B	H039-061913-5	06/19/2013	634247	4215758	08:25:00	20.98	0.187	0.09	8.34	7.77	1.9	ebb
3C	H039-061913-2	06/19/2013	635085	4214582	08:12:00	21.11	0.185	0.08	7.68	7.87	3.2	ebb



Monitoring Results – Site 44, Potato Slough

Glyphosate Residue

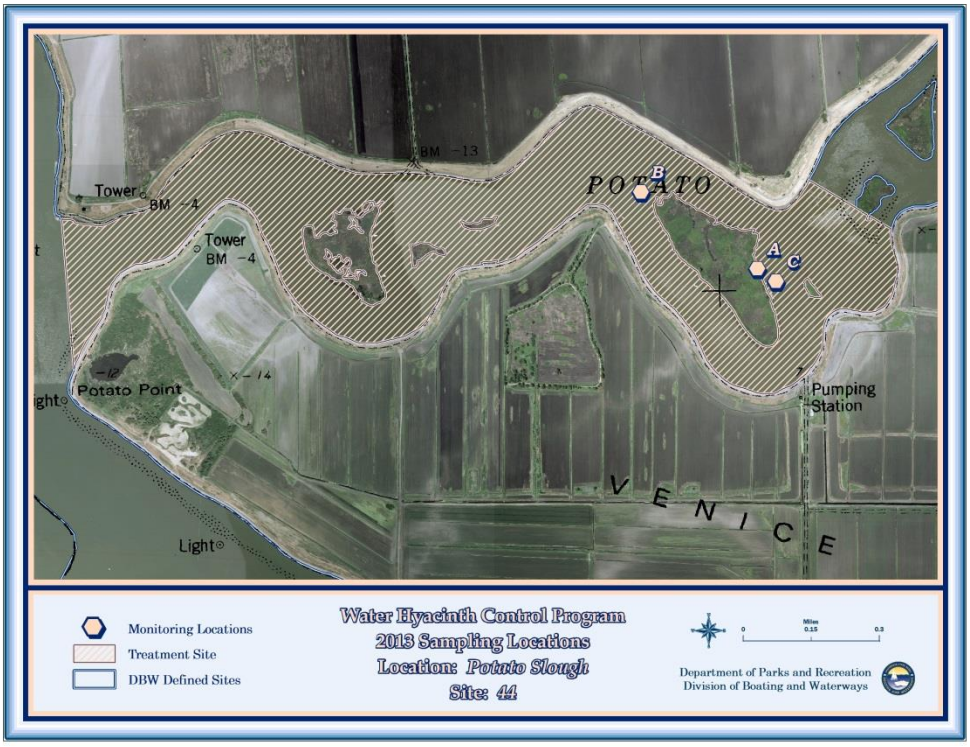
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-4086	H044-061313-3	6/13/2013	6/13/2013	6/26/2013	6/27/2013	ND
1C	2012-4085	H044-061313-2	6/13/2013	6/13/2013	6/26/2013	6/27/2013	ND
2B	2012-4088	H044-061313-5	6/13/2013	6/13/2013	6/26/2013	6/27/2013	ND
3A	2012-4106	H044-061913-3	6/19/2013	6/19/2013	7/10/2013	7/11/2013	ND
3B	2012-4108	H044-061913-5	6/19/2013	6/19/2013	7/10/2013	7/11/2013	ND
3C	2012-4105	H044-061913-2	6/19/2013	6/19/2013	7/10/2013	7/11/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-4086	H044-061313-3	6/13/2013	6/13/2013	6/17/2013	6/17/2013	ND
1C	2012-4085	H044-061313-2	6/13/2013	6/13/2013	6/17/2013	6/17/2013	ND
2B	2012-4088	H044-061313-5	6/13/2013	6/13/2013	6/17/2013	6/17/2013	ND
3A	2012-4106	H044-061913-3	6/19/2013	6/19/2013	6/26/2013	6/26/2013	ND
3B	2012-4108	H044-061913-5	6/19/2013	6/19/2013	6/26/2013	6/26/2013	ND
3C	2012-4105	H044-061913-2	6/19/2013	6/19/2013	6/26/2013	6/26/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H044-061313-3	06/13/2013	627929	4216131	10:22:00	21.51	0.199	0.09	9.31	8.08	12.4	ebb
1C	H044-061313-2	06/13/2013	627996	4216086	10:20:00	21.48	0.199	0.09	8.78	8.17	15.7	ebb
2B	H044-061313-5	06/13/2013	627516	4216402	12:20:00	21.73	0.200	0.09	8.77	7.89	15.2	ebb
3A	H044-061913-3	06/19/2013	627933	4216192	09:16:00	21.06	0.180	0.08	8.32	7.94	11.9	ebb
3B	H044-061913-5	06/19/2013	627508	4216434	09:22:00	21.02	0.185	0.08	8.46	7.94	13.6	ebb
3C	H044-061913-2	06/19/2013	628061	4216014	09:12:00	21.01	0.182	0.08	8.41	7.97	12.0	ebb



Monitoring Results – Site 59, Empire Cut/ Middle River

Glyphosate Residue

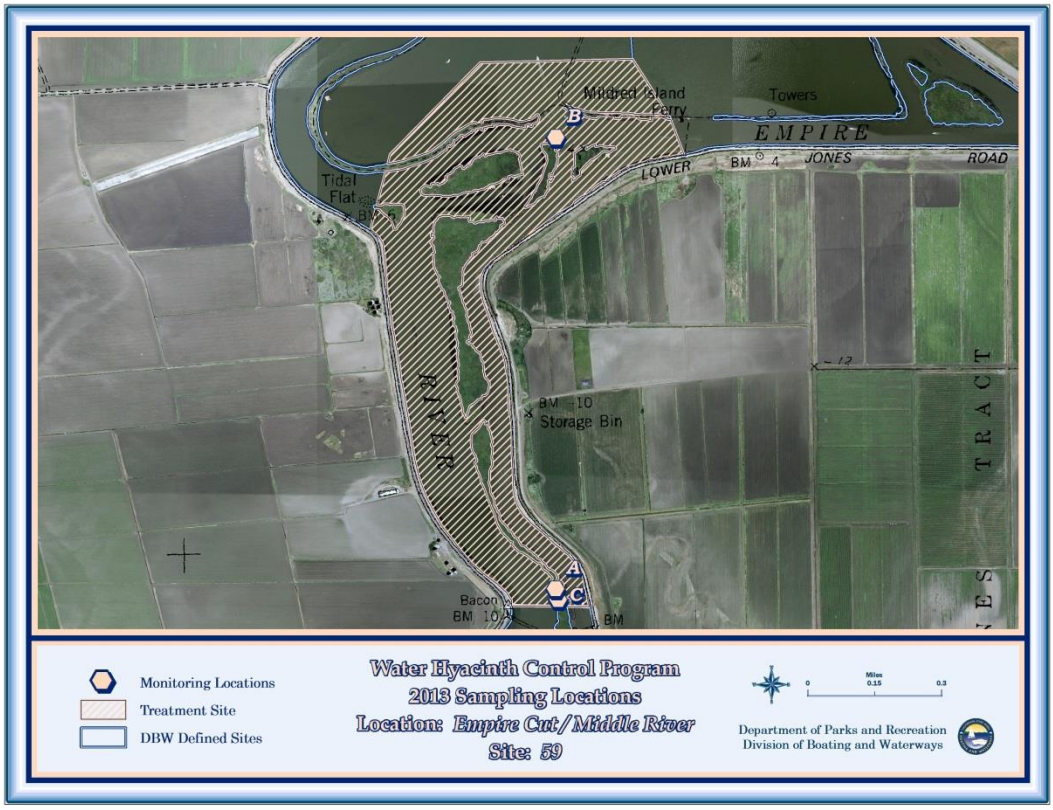
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3177	H059-032713-3	3/27/2013	3/27/2013	4/4/2013	4/4/2013	ND
1C	2012-3176	H059-032713-2	3/27/2013	3/27/2013	4/4/2013	4/4/2013	ND
2B	2012-3179	H059-032713-5	3/27/2013	3/27/2013	4/4/2013	4/4/2013	ND
3A	2012-3251	H059-040313-3	4/3/2013	4/3/2013	4/8/2013	4/8/2013	ND
3B	2012-3253	H059-040313-5	4/3/2013	4/3/2013	4/8/2013	4/8/2013	ND
3C	2012-3250	H059-040313-2	4/3/2013	4/3/2013	4/8/2013	4/8/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3177	H059-032713-3	3/27/2013	3/27/2013	3/29/2013	4/4/2013	ND
1C	2012-3176	H059-032713-2	3/27/2013	3/27/2013	3/29/2013	4/4/2013	ND
2B	2012-3179	H059-032713-5	3/27/2013	3/27/2013	3/29/2013	4/4/2013	ND
3A	2012-3251	H059-040313-3	4/3/2013	4/3/2013	4/4/2013	4/8/2013	ND
3B	2012-3253	H059-040313-5	4/3/2013	4/3/2013	4/4/2013	4/8/2013	ND
3C	2012-3250	H059-040313-2	4/3/2013	4/3/2013	4/4/2013	4/8/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H059-032713-3	03/27/2013	629357	4202060	09:04:00	15.69	0.306	0.15	9.52	7.87	2.7	ebb
1C	H059-032713-2	03/27/2013	629366	4202021	08:58:00	15.64	0.289	0.14	9.47	7.73	2.9	ebb
2B	H059-032713-5	03/27/2013	629358	4203690	10:50:00	16.09	0.353	0.17	9.77	7.87	11.7	ebb
3A	H059-040313-3	04/03/2013	629356	4202057	10:28:00	17.31	0.292	0.14	9.04	7.75	0	flood
3B	H059-040313-5	04/03/2013	629310	4203667	10:42:00	17.37	0.305	0.15	9.50	7.80	0	flood
3C	H059-040313-2	04/03/2013	629366	4202018	10:24:00	17.30	0.292	0.14	9.04	7.64	0	flood



Monitoring Results – Site 60, Empire Cut/ Mildred Island

Glyphosate Residue

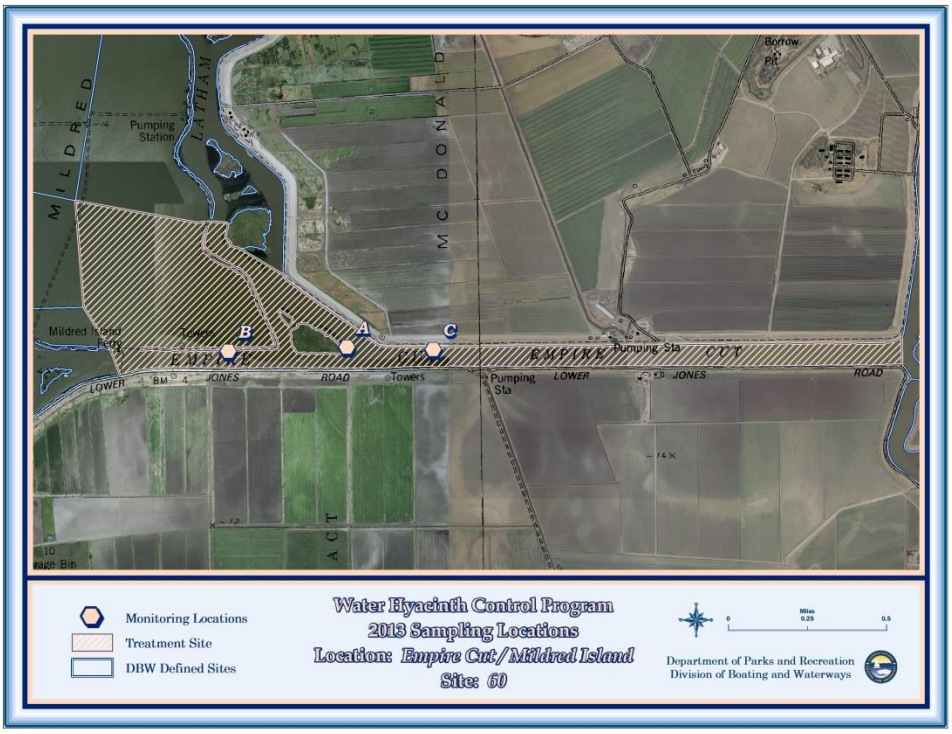
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3473	H060-042413-3	4/24/2013	4/24/2013	4/24/2013	4/25/2013	ND
1C	2012-3472	H060-042413-2	4/24/2013	4/24/2013	4/24/2013	4/25/2013	ND
2B	2012-3475	H060-042413-5	4/24/2013	4/24/2013	4/24/2013	4/25/2013	ND
3A	2012-3562	H060-050113-3	5/1/2013	5/1/2013	5/1/2013	5/7/2013	ND
3B	2012-3564	H060-050113-5	5/1/2013	5/1/2013	5/1/2013	5/7/2013	ND
3C	2012-3561	H060-050113-2	5/1/2013	5/1/2013	5/1/2013	5/7/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3473	H060-042413-3	4/24/2013	4/24/2013	5/2/2013	5/2/2013	ND
1C	2012-3472	H060-042413-2	4/24/2013	4/24/2013	5/2/2013	5/2/2013	ND
2B	2012-3475	H060-042413-5	4/24/2013	4/24/2013	5/2/2013	5/2/2013	ND
3A	2012-3562	H060-050113-3	5/1/2013	5/1/2013	5/2/2013	5/6/2012	ND
3B	2012-3564	H060-050113-5	5/1/2013	5/1/2013	5/2/2013	5/6/2012	ND
3C	2012-3561	H060-050113-2	5/1/2013	5/1/2013	5/2/2013	5/6/2012	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H060-042413-3	04/24/2013	630974	4203769	10:02:00	18.30	0.492	0.25	9.15	8.10	16.6	ebb
1C	H060-042413-2	04/24/2013	631413	4203757	09:53:00	18.26	0.487	0.25	9.35	7.99	4.3	ebb
2B	H060-042413-5	04/24/2013	630371	4203749	12:17:00	18.83	0.323	0.16	10.98	8.47	10.8	ebb
3A	H060-050113-3	05/01/2013	630970	4203756	09:09:00	18.74	0.378	0.19	10.22	8.83	19.0	flood
3B	H060-050113-5	05/01/2013	630414	4203751	09:20:00	18.94	0.355	0.17	10.54	9.03	15.4	flood
3C	H060-050113-2	05/01/2013	631370	4203768	09:02:00	18.96	0.375	0.19	10.37	8.75	15.9	flood



Monitoring Results – Site 65, Latham Slough/ Mildred Island

Glyphosate Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3183	H065-032713-3	3/27/2013	3/27/2013	4/4/2013	4/4/2013	ND
1C	2012-3182	H065-032713-2	3/27/2013	3/27/2013	4/4/2013	4/4/2013	ND
2B	2012-3185	H065-032713-5	3/27/2013	3/27/2013	4/4/2013	4/4/2013	ND
3A	2012-3256	H065-040313-3	4/3/2013	4/3/2013	4/8/2013	4/8/2013	ND
3B	2012-3258	H065-040313-5	4/3/2013	4/3/2013	4/8/2013	4/8/2013	ND
3C	2012-3255	H065-040313-2	4/3/2013	4/3/2013	4/8/2013	4/8/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3183	H065-032713-3	3/27/2013	3/27/2013	3/29/2013	4/4/2013	ND
1C	2012-3182	H065-032713-2	3/27/2013	3/27/2013	3/29/2013	4/4/2013	ND
2B	2012-3185	H065-032713-5	3/27/2013	3/27/2013	3/29/2013	4/4/2013	ND
3A	2012-3256	H065-040313-3	4/3/2013	4/3/2013	4/4/2013	4/8/2013	ND
3B	2012-3258	H065-040313-5	4/3/2013	4/3/2013	4/4/2013	4/8/2013	ND
3C	2012-3255	H065-040313-2	4/3/2013	4/3/2013	4/4/2013	4/8/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H065-032713-3	03/27/2013	630500	4204265	10:10:00	16.02	0.420	0.21	9.53	7.78	3.8	ebb
1C	H065-032713-2	03/27/2013	630526	4204223	10:00:00	16.07	0.438	0.22	9.87	7.79	7.0	ebb
2B	H065-032713-5	03/27/2013	630440	4205405	12:39:00	15.96	0.280	0.13	9.98	7.94	3.1	ebb
3A	H065-040313-3	04/03/2013	630500	4204265	10:56:00	17.45	0.284	0.14	9.39	7.84	2.4	flood
3B	H065-040313-5	04/03/2013	360440	4205405	11:08:00	17.27	0.254	0.12	9.46	8.02	0	flood
3C	H065-040313-2	04/03/2013	630526	4204223	10:50:00	17.49	0.312	0.15	8.72	7.80	3.2	flood

Monitoring Results – Site 66, Middle River/Mildred Island

Glyphosate Residue

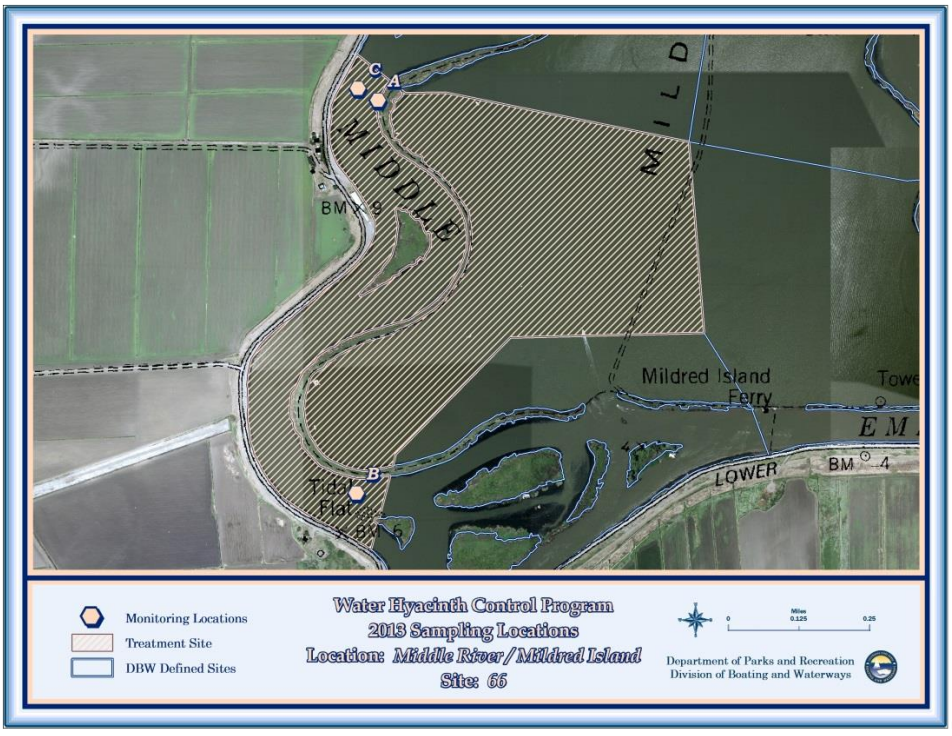
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2013-0614	H066-082813-3	8/28/2013	8/28/2013	8/28/2013	9/12/2013	ND
1C	2013-0613	H066-082813-2	8/28/2013	8/28/2013	8/28/2013	9/12/2013	ND
2B	2013-0616	H066-082813-5	8/28/2013	8/28/2013	8/28/2013	9/12/2013	ND
3A	2013-0687	H066-090313-3	9/3/2013	9/3/2013	10/2/2013	10/3/2013	ND
3B	2013-0689	H066-090313-5	9/3/2013	9/3/2013	10/2/2013	10/3/2013	ND
3C	2013-0686	H066-090313-2	9/3/2013	9/3/2013	10/2/2013	10/3/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2013-0614	H066-082813-3	8/28/2013	8/28/2013	9/3/2013	9/4/2013	ND
1C	2013-0613	H066-082813-2	8/28/2013	8/28/2013	9/3/2013	9/4/2013	ND
2B	2013-0616	H066-082813-5	8/28/2013	8/28/2013	9/3/2013	9/4/2013	ND
3A	2013-0687	H066-090313-3	9/3/2013	9/3/2013	9/5/2013	9/5/2013	ND
3B	2013-0689	H066-090313-5	9/3/2013	9/3/2013	9/5/2013	9/5/2013	ND
3C	2013-0686	H066-090313-2	9/3/2013	9/3/2013	9/5/2013	9/5/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H066-082813-3	08/28/2013	628710	4204633	09:23:00	23.01	0.362	0.18	10.32	9.02	18.2	flood
1C	H066-082813-2	08/28/2013	628653	4204666	09:20:00	22.95	0.371	0.18	10.36	8.97	9.9	flood
2B	H066-082813-5	08/28/2013	628649	4203517	11:38:00	23.31	0.365	0.18	10.50	8.77	12.3	flood
3A	H066-090313-3	09/03/2013	628720	4204647	10:07:00	22.92	0.385	0.19	8.81	8.77	13.4	ebb
3B	H066-090313-5	09/03/2013	628632	4203510	10:17:00	23.10	0.380	0.19	8.42	8.55	10.3	ebb
3C	H066-090313-2	09/03/2013	628651	4204694	10:04:00	23.02	0.379	0.19	8.65	8.67	9.9	ebb



Monitoring Results – Site 68, Middle River

Glyphosate Residue

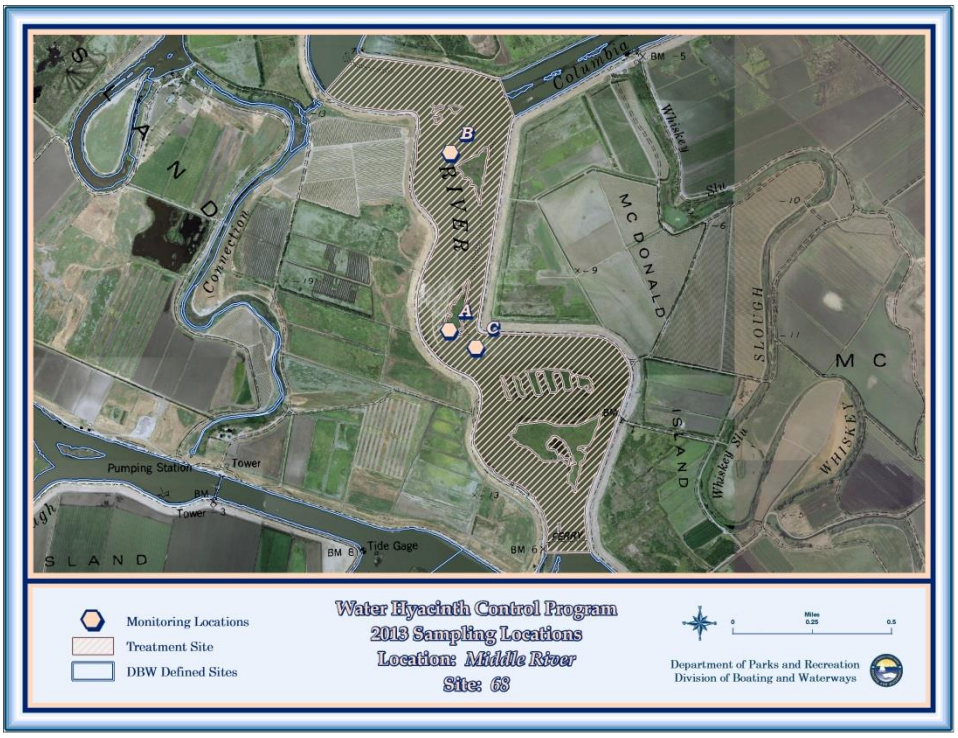
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3479	H068-042413-3	4/24/2013	4/24/2013	4/24/2013	4/25/2013	ND
1C	2012-3478	H068-042413-2	4/24/2013	4/24/2013	4/24/2013	4/25/2013	ND
2B	2012-3480	H068-042413-5	4/24/2013	4/24/2013	4/24/2013	4/25/2013	ND
3A	2012-3567	H068-050113-3	5/1/2013	5/1/2013	5/1/2013	5/7/2013	ND
3B	2012-3569	H068-050113-5	5/1/2013	5/1/2013	5/1/2013	5/7/2013	ND
3C	2012-3566	H068-050113-2	5/1/2013	5/1/2013	5/1/2013	5/7/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3479	H068-042413-3	4/24/2013	4/24/2013	5/2/2013	5/2/2013	ND
1C	2012-3478	H068-042413-2	4/24/2013	4/24/2013	5/2/2013	5/2/2013	ND
2B	2012-3480	H068-042413-5	4/24/2013	4/24/2013	5/2/2013	5/2/2013	ND
3A	2012-3567	H068-050113-3	5/1/2013	5/1/2013	5/2/2013	5/6/2012	ND
3B	2012-3569	H068-050113-5	5/1/2013	5/1/2013	5/2/2013	5/6/2012	ND
3C	2012-3566	H068-050113-2	5/1/2013	5/1/2013	5/2/2013	5/6/2012	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H068-042413-3	04/24/2013	630048	4208159	08:35:00	17.60	0.277	0.13	10.51	8.50	9.2	ebb
1C	H068-042413-2	04/24/2013	630185	4208070	08:28:00	17.64	0.277	0.13	10.70	8.37	6.6	ebb
2B	H068-042413-5	04/24/2013	630055	4209057	10:41:00	17.77	0.284	0.14	10.43	8.44	17.4	ebb
3A	H068-050113-3	05/01/2013	630054	4208155	09:43:00	18.78	0.310	0.15	10.79	9.01	10.8	flood
3B	H068-050113-5	05/01/2013	630136	4209005	09:53:00	18.69	0.309	0.15	10.65	9.27	23.0	flood
3C	H068-050113-2	05/01/2013	630241	4208132	09:36:00	18.89	0.313	0.15	11..08	9.09	17.0	flood



Monitoring Results – Site 100, Connection Slough

Glyphosate Residue

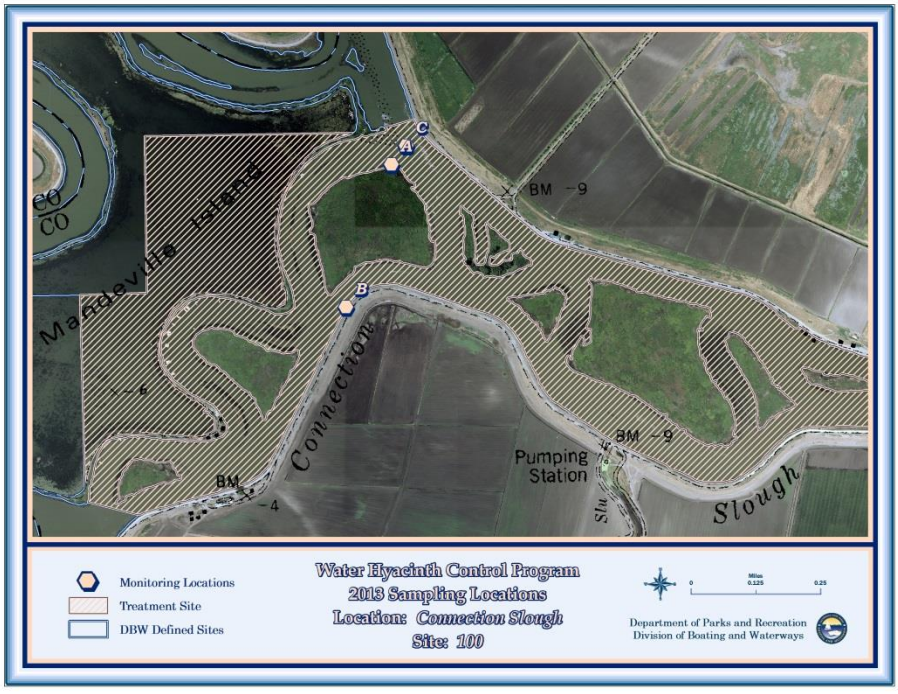
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2013-0620	H100-082813-3	8/28/2013	8/28/2013	8/28/2013	9/12/2013	ND
1C	2013-0619	H100-082813-2	8/28/2013	8/28/2013	8/28/2013	9/12/2013	ND
2B	2013-0643	H100-082813-5	8/28/2013	8/28/2013	8/28/2013	9/12/2013	ND
3A	2013-0692	H100-090313-3	9/3/2013	9/3/2013	10/2/2013	10/3/2013	ND
3B	2013-0694	H100-090313-5	9/3/2013	9/3/2013	10/2/2013	10/3/2013	ND
3C	2013-0691	H100-090313-2	9/3/2013	9/3/2013	10/2/2013	10/3/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2013-0620	H100-082813-3	8/28/2013	8/28/2013	9/3/2013	9/4/2013	ND
1C	2013-0619	H100-082813-2	8/28/2013	8/28/2013	9/3/2013	9/4/2013	ND
2B	2013-0643	H100-082813-5	8/28/2013	8/28/2013	9/3/2013	9/4/2013	ND
3A	2013-0692	H100-090313-3	9/3/2013	9/3/2013	9/5/2013	9/5/2013	ND
3B	2013-0694	H100-090313-5	9/3/2013	9/3/2013	9/5/2013	9/5/2013	ND
3C	2013-0691	H100-090313-2	9/3/2013	9/3/2013	9/5/2013	9/5/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H100-082813-3	08/28/2013	626791	4208214	08:56:00	22.48	0.533	0.27	9.77	8.82	8.3	flood
1C	H100-082813-2	08/28/2013	626837	4208272	08:49:00	22.52	0.505	0.25	9.95	8.57	7.5	flood
2B	H100-082813-5	08/28/2013	626650	4207771	10:27:00	22.68	0.656	0.34	7.29	8.27	10.4	flood
3A	H100-090313-3	09/03/2013	626789	4208211	09:30:27	22.15	0.747	0.39	8.27	8.54	8.8	ebb
3B	H100-090313-5	09/03/2013	626689	4207826	09:42:00	22.39	0.737	0.36	8.35	8.72	10.2	ebb
3C	H100-090313-2	09/03/2013	626827	4208337	09:27:00	22.64	0.463	0.24	8.72	8.54	12.4	ebb



Monitoring Results – Site 300, San Joaquin River

Glyphosate Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2013-1199	H300-101513-3	10/15/2013	10/15/2013	10/16/2013	10/17/2013	ND
1C	2013-1198	H300-101513-2	10/15/2013	10/15/2013	10/16/2013	10/17/2013	ND
2B	2013-1201	H300-101513-5	10/15/2013	10/15/2013	10/16/2013	10/17/2013	ND
3A	2013-1281	H300-102213-3	10/22/2013	10/22/2013	10/23/2013	11/21/2013	ND
3B	2013-1283	H300-102213-5	10/22/2013	10/22/2013	10/23/2013	11/21/2013	ND
3C	2013-1280	H300-102213-2	10/22/2013	10/22/2013	10/23/2013	11/21/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2013-1199	H300-101513-3	10/15/2013	10/15/2013	10/21/2013	10/24/2013	ND
1C	2013-1198	H300-101513-2	10/15/2013	10/15/2013	10/21/2013	10/24/2013	ND
2B	2013-1201	H300-101513-5	10/15/2013	10/15/2013	10/21/2013	10/24/2013	ND
3A	2013-1281	H300-102213-3	10/22/2013	10/22/2013	10/24/2013	10/24/2013	ND
3B	2013-1283	H300-102213-5	10/22/2013	10/22/2013	10/24/2013	10/24/2013	ND
3C	2013-1280	H300-102213-2	10/22/2013	10/22/2013	10/24/2013	10/24/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H300-101513-3	10/15/2013	650259	4181064	10:42:00	16.05	0.869	0.45	2.45	7.37	53.6	none
1C	H300-101513-2	10/15/2013	649438	4181493	10:59:00	17.24	0.746	0.39	10.19	8.41	16.5	none
2B	H300-101513-5	10/15/2013	649560	4181498	12:15:00	18.71	0.699	0.36	11.21	8.95	35.4	none
3A	H300-102213-3	10/22/2013	650231	4181088	11:06:00	17.17	0.831	0.43	3.64	7.61	43.0	none
3B	H300-102213-5	10/22/2013	649558	4181490	11:27:00	17.68	0.629	0.32	9.14	8.15	19.3	none
3C	H300-102213-2	10/22/2013	649512	4181495	10:53:00	17.39	0.667	0.34	11.49	8.90	36.5	none

Monitoring Results – Site 302, San Joaquin River

Glyphosate Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2013-1205	H302-101513-3	10/15/2013	10/15/2013	10/16/2013	10/17/2013	ND
1C	2013-1204	H302-101513-2	10/15/2013	10/15/2013	10/16/2013	10/17/2013	ND
2B	2013-1207	H302-101513-5	10/15/2013	10/15/2013	10/16/2013	10/17/2013	ND
3A	2013-1287	H302-102213-3	10/22/2013	10/22/2013	10/23/2013	11/21/2013	ND
3B	2013-1289	H302-102213-5	10/22/2013	10/22/2013	10/23/2013	11/21/2013	ND
3C	2013-1286	H302-102213-2	10/22/2013	10/22/2013	10/23/2013	11/21/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2013-1205	H302-101513-3	10/15/2013	10/15/2013	10/21/2013	10/24/2013	ND
1C	2013-1204	H302-101513-2	10/15/2013	10/15/2013	10/21/2013	10/24/2013	ND
2B	2013-1207	H302-101513-5	10/15/2013	10/15/2013	10/21/2013	10/24/2013	ND
3A	2013-1287	H302-102213-3	10/22/2013	10/22/2013	10/24/2013	10/24/2013	ND
3B	2013-1289	H302-102213-5	10/22/2013	10/22/2013	10/24/2013	10/24/2013	ND
3C	2013-1286	H302-102213-2	10/22/2013	10/22/2013	10/24/2013	10/24/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H302-101513-3	10/15/2013	650331	4179620	09:55:00	15.95	0.821	0.43	8.48	7.80	25.3	none
1C	H302-101513-2	10/15/2013	650347	4179578	09:47:00	15.82	0.814	0.42	8.98	8.13	78.8	none
2B	H302-101513-5	10/15/2013	649039	4180569	11:19:00	16.70	0.780	0.40	9.63	8.26	31.8	none
3A	H302-102213-3	10/22/2013	650325	4179621	10:15:00	16.10	0.643	0.33	8.91	7.99	26.2	none
3B	H302-102213-5	10/22/2013	649040	4180569	10:35:00	16.48	0.627	0.33	9.1	8.22	12.4	none
3C	H302-102213-2	10/22/2013	650332	4179592	10:06:00	16.47	0.662	0.34	9.39	7.94	4.3	none

Monitoring Results – Site 319, San Joaquin River

Glyphosate Residue

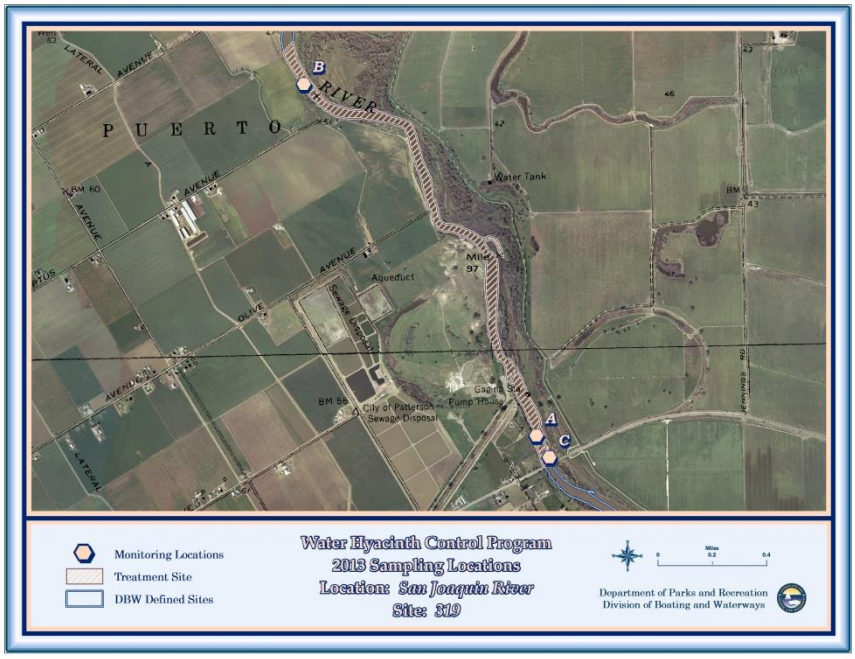
Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3777	H319-052113-3	5/21/2013	5/21/2013	5/21/2013	6/19/2013	ND
1C	2012-3776	H319-052113-2	5/21/2013	5/21/2013	5/21/2013	6/19/2013	ND
2B	2012-3779	H319-052113-5	5/21/2013	5/21/2013	5/21/2013	6/19/2013	ND
3A	2012-3855	H319-052813-3	5/28/2013	5/28/2013	6/24/2013	6/25/2013	ND
3B	2012-3857	H319-052813-5	5/28/2013	5/28/2013	6/24/2013	6/25/2013	ND
3C	2012-3854	H319-052813-2	5/28/2013	5/28/2013	6/24/2013	6/25/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3777	H319-052113-3	5/21/2013	5/21/2013	5/22/2013	5/23/2013	ND
1C	2012-3776	H319-052113-2	5/21/2013	5/21/2013	5/22/2013	5/23/2013	ND
2B	2012-3779	H319-052113-5	5/21/2013	5/21/2013	5/22/2013	5/23/2013	ND
3A	2012-3855	H319-052813-3	5/28/2013	5/28/2013	5/29/2013	5/30/2013	ND
3B	2012-3857	H319-052813-5	5/28/2013	5/28/2013	5/29/2013	5/30/2013	ND
3C	2012-3854	H319-052813-2	5/28/2013	5/28/2013	5/29/2013	5/30/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H319-052113-3	05/21/2013	669590	4181556	10:39:00	22.31	1.221	0.64	8.36	7.94	36.3	none
1C	H319-052113-2	05/21/2013	669667	4151428	10:30:00	22.22	1.226	0.65	8.53	7.88	28.1	none
2B	H319-052113-5	05/21/2013	668128	4153635	10:48:00	22.30	1.297	0.68	8.16	8.15	30.6	none
3A	H319-052813-3	05/28/2013	669593	4151545	11:08:00	21.35	1.230	0.65	9.62	8.05	34.7	none
3B	H319-052813-5	05/28/2013	668246	4153664	11:32:00	21.82	1.272	0.67	11.29	8.22	50.8	none
3C	H319-052813-2	05/28/2013	669671	4151429	10:57:00	21.35	1.239	0.65	7.97	7.97	37.0	none



Monitoring Results – Site 320, San Joaquin River

Glyphosate Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Glyphosate (ppb)
1A	2012-3783	H320-052113-3	5/21/2013	5/21/2013	5/21/2013	6/19/2013	ND
1C	2012-3782	H320-052113-2	5/21/2013	5/21/2013	5/21/2013	6/19/2013	ND
2B	2012-3785	H320-052113-5	5/21/2013	5/21/2013	5/21/2013	6/19/2013	ND
3A	2012-3860	H320-052813-3	5/28/2013	5/28/2013	6/24/2013	6/25/2013	ND
3B	2012-3862	H320-052813-5	5/28/2013	5/28/2013	6/24/2013	6/25/2013	ND
3C	2012-3859	H320-052813-2	5/28/2013	5/28/2013	6/24/2013	6/25/2013	ND

Agridex Residue

Sample Location	Lab Sample ID	DBW ID	Date Sample Taken	Date Sample Received	Date Sample Extracted	Date Sample Analyzed	Agridex (ppb)
1A	2012-3783	H320-052113-3	5/21/2013	5/21/2013	5/22/2013	5/23/2013	ND
1C	2012-3782	H320-052113-2	5/21/2013	5/21/2013	5/22/2013	5/23/2013	ND
2B	2012-3785	H320-052113-5	5/21/2013	5/21/2013	5/22/2013	5/23/2013	ND
3A	2012-3860	H320-052813-3	5/28/2013	5/28/2013	5/29/2013	5/30/2013	ND
3B	2012-3862	H320-052813-5	5/28/2013	5/28/2013	5/29/2013	5/30/2013	ND
3C	2012-3859	H320-052813-2	5/28/2013	5/28/2013	5/29/2013	5/30/2013	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1A	H320-052113-3	05/21/2013	672434.00	4149531.00	10:06:00	21.74	1.129	0.59	7.94	7.84	41.4	none
1C	H320-052113-2	05/21/2013	672494.00	4149445.00	09:59:00	21.65	1.124	0.59	7.84	7.73	40.4	none
2B	H320-052113-5	05/21/2013	669907.00	4141158.00	11:45:00	22.73	1.202	0.63	9.21	8.02	59.9	none
3A	H320-052813-3	05/28/2013	672445.00	4149517.00	10:19:00	20.71	1.153	0.61	8.92	7.92	41.3	none
3B	H320-052813-5	05/28/2013	669910.00	4151157.00	10:45:00	21.06	1.230	0.65	9.76	8.04	36.7	none
3C	H320-052813-2	05/28/2013	672525.00	4149438.00	10:15:00	20.60	1.141	0.60	8.75	7.78	38.5	none

APPENDIX E

2013 Dissolved Oxygen Monitoring Pilot Study

Dissolved Oxygen Monitoring:
A Pilot Study for the Water Hyacinth Control Program

Introduction

Water hyacinth (*Eichhornia crassipes*) is a non-native, invasive, free-floating aquatic macrophyte. Water hyacinth was first reported in California in 1904 in a Yolo County slough. There were increased reports of water hyacinth in the Delta region during the 1970s, and by the 1980s, this invasive weed had become a significant problem for agriculture. Water hyacinth is characterized by showy lavender flowers and thick, highly glossy leaves up to ten inches across. The plant grows from 1.5 to 4 feet in height, and the floating portion of a single plant can grow to more than four feet in diameter. In the Delta, water hyacinth is found in sloughs, connecting waterways, and tributary rivers. The growing season for water hyacinth in the Delta is typically from March to October. Plants reduce growth and frost can kill foliage during the cold winter months. However, the majority of plants do not die; stem bases often survive and begin to develop new foliage in spring as the weather warms. Water hyacinth spreads and grows rapidly in the summer months, and mats may double in surface area in six to fifteen days.

In 1982, in response to concerns about water hyacinth in the Delta, the California Legislature passed Senate Bill 1344 (Garamendi, Chapter 263, Statutes of 1982), designating the California Department of Parks and Recreation, Division of Boating and Waterways (DBW) as the lead agency for controlling water hyacinth in the Delta, its tributaries, and Suisun Marsh. DBW subsequently initiated the Water Hyacinth Control Program (WHCP) in 1983. The WHCP's primary treatment method has been chemical, supported by hand-picking, herding, and biological controls.

Treatment of aquatic weeds with certain herbicides can result in a faster than natural decaying of plant biomass that may create a large biological oxygen demand, resulting in decreases in dissolved oxygen. DBW recognizes that decaying water hyacinth has the potential to temporarily reduce dissolved oxygen (DO) levels. The low DO following herbicide treatment may be amplified by the fact that large patches of water hyacinth can cause low DO levels (Toft 2000), particularly in slower-moving waters and dead-end sloughs. Toft found average spot DO measurements below 5mg/l for water hyacinth and above 5 mg/l for pennywort (Toft 2000). In a similar 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). For every herbicide application conducted under DBW's WHCP, DBW crews measure DO concentrations immediately prior to treating, and approximately one hour post-treatment to evaluate impacts. DBW has several years of pre- and post-treatment DO data for the WHCP; however there is limited availability of data sets with continuous DO measurements in water hyacinth impacted waterways.

A dissolved oxygen (DO) monitoring study was proposed by the US Department of Agriculture, Agricultural Research Service (USDA-ARS) and DBW as a response to comments raised in January 2013 by the US Fish and Wildlife Service (USFWS) regarding the WHCP Biological Assessment (October 25, 2012). Subsequently, the DO study was included as a Conservation Measure in the 2013-2017 WHCP Biological Opinion (81410-2013-F-0005) issued by the USFWS. The Biological Opinion states:

“USDA-ARS and CDBW will conduct a DO monitoring study to evaluate the ongoing impacts of water hyacinth and water hyacinth treatment on DO. During the 2013 treatment season, USDA-ARS and CDBW will place stationary logging DO meters at up to three pair locations (under a water hyacinth mat and at an adjacent open water site). Meters will be left in place for several weeks, including at least one week prior to treatment, and three weeks post-treatment. The DO meters will log DO and temperature every one-half hour during the entire period. Data will be summarized graphically and in a written report. The study will include, at a minimum, two sites with different characteristics, for example, one site in a dead-end slough, and one site with stronger tidal influence.”

Materials and Methods

In 2013, DBW planned to conduct a complete study during the summer season that met the biological opinion requirements. However, DBW experienced delays in acquiring the necessary equipment to conduct a DO study and ultimately decided to conduct a one month pilot study that began in September 2013, with the intentions of conducting a comprehensive study in 2014.

MiniDOT loggers from Precision Measurement Engineering, Inc. (PME) were used to collect temperature and dissolved oxygen measurements (Figure 1). The data loggers were fitted with two AA Lithium batteries and set to measure and record dissolved oxygen in milligrams per liter, dissolved oxygen saturation (%), temperature in Celsius, date, and time data at 20 minutes intervals. Data were automatically stored on an internal SD card.

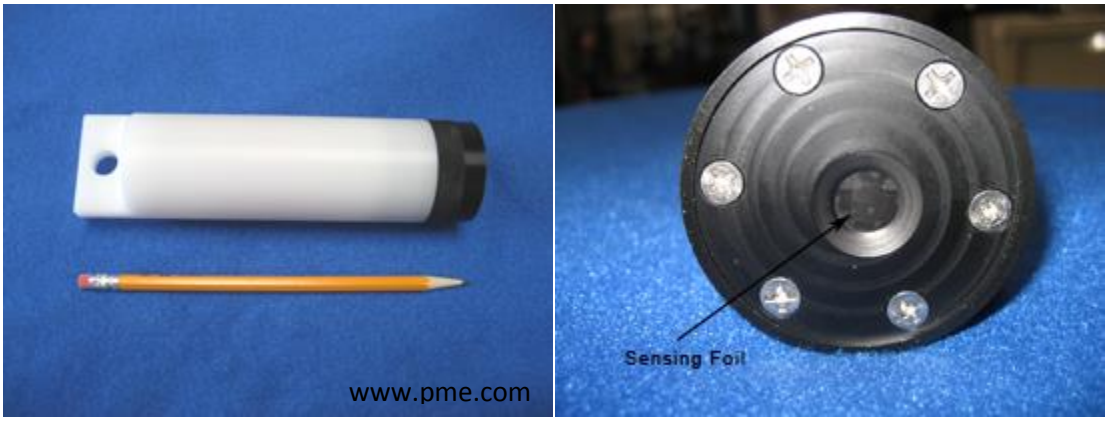


Figure 1. miniDOT oxygen logger with dissolved oxygen sensor

Three miniDOT dissolved oxygen and temperature loggers were deployed at Union Point on Middle River in San Joaquin County (WHCP Site 52) on September 3, 2013. Data loggers were hung from the docks at Union Point Marina using nylon rope and were positioned about 2 feet below the water surface. One data logger was placed in open water, with no water hyacinth present (Figures 2). The remaining two data loggers were placed underneath a large water hyacinth mat that surrounded the far end of the dock. One logger was located on the inner side of the dock (herein referred to as WH1) and the other was placed on the outer edge of the dock (WH2). GPS coordinates (in UTM) of the data logger locations were recorded using a PC tablet with ArcPad. The study site and data logger locations were photographed on a weekly basis during the study.

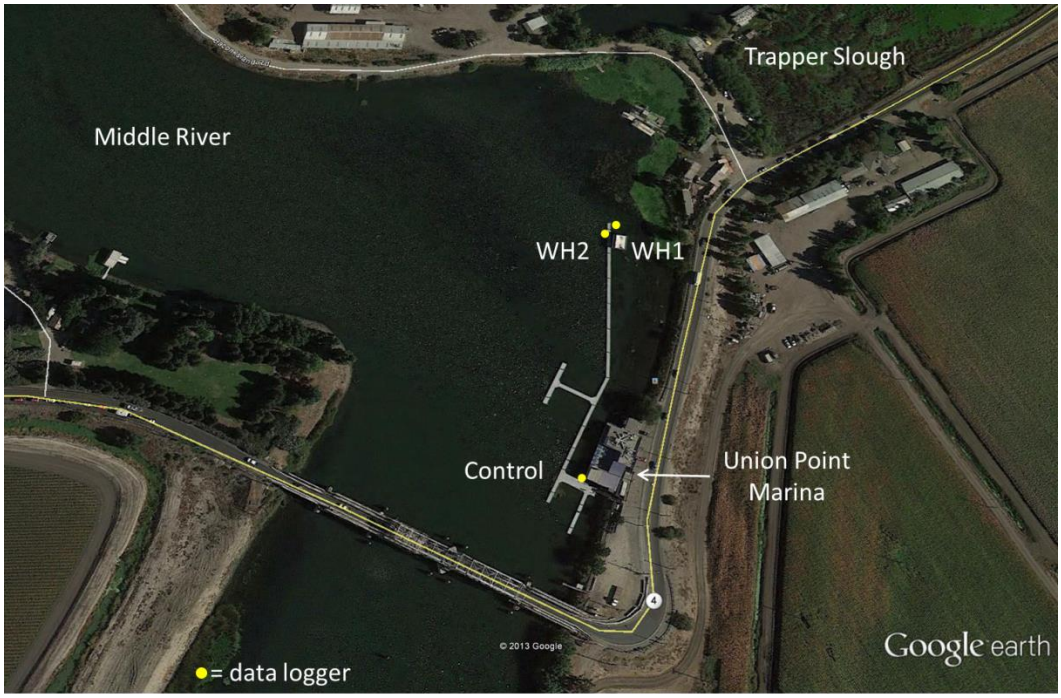


Figure 2. Study location at Union Point

The data loggers were deployed one week prior to the application of herbicide (glyphosate) onto the water hyacinth. On September 9, 2013, glyphosate with the adjuvant Agridex was applied onto the water hyacinth at the study site. The data loggers were left in place for approximately 4 weeks after the herbicide treatment and were deployed at Union Point for a total of 36 days. The data loggers were removed from the study site on October 8, 2013.

The study location was visited once a week during the study period to download data, check the loggers for fouling, conduct equipment maintenance as necessary, observe site and environmental conditions (i.e. ensure loggers remain under water hyacinth), and monitor herbicide impacts on water hyacinth. Weekly maintenance included removing debris, cleaning biofoul and checking equipment security. In order to download data, the miniDOT loggers were turned off for a brief period of time in order to change the SD cards. After a new SD card was installed, the data loggers were turned on for further data collection.

Data were downloaded to a PC computer via a USB card reader and were viewed using the miniDOTPlot software provided by PME. Since the miniDOT Logger is set to record time in Coordinated Universal Time (UTC), the time zone was offset by -7 hours. The miniDOTPlot software calculated oxygen saturation and was set to adjust the data based on air pressure of 1013.9 mbar and a salinity of 0.19 ppt. The mean, standard deviation and range was calculated for water temperature, dissolved oxygen and percent saturation for each location.

Results

The time-series data (September 3, 2013 to October 8, 2013) for DO and water temperature are depicted in Figures 3, 4 and 5. Diel changes in DO were observed, with lower DO levels mostly occurring at night or early morning and the highest concentrations occurring in the afternoon. DO fluctuations were greater within the water hyacinth mats compared to open water. On average, there was no significant difference in mean DO between the water hyacinth locations

and the control location in open water. Mean dissolved oxygen was 7.56 ± 1.27 mg/L (mean ± standard deviation; n=2,522) at WH1, 7.52 ± 1.35 mg/L (n=2,522) at WH2, and 7.94 ± 0.81 mg/L (n=2,521) in open water (Figure 6). There was however, a noticeable difference in the range of DO between the water hyacinth locations and open water. DO concentrations ranged from 1.43 mg/L to 11.20 mg/L at WH1, and from 2.16 mg/L to 11.76 mg/L at WH2. In open water, DO concentrations ranged from 6.12 mg/L to 9.79 mg/L. At WH1, there were 11 records (out of 2,522) of DO levels ≤ 3 mg/L and 54 records with DO levels < 5 mg/L. At WH 2, there were 9 records (out of 2,521) of DO levels ≤ 3 mg/L and 97 records of DO levels < 5mg/L.

Similar trends were observed with DO percent saturation between water hyacinth locations and open water (Figure 7). A greater range of DO saturation was observed in the water hyacinth mats, however on average, there was no significant difference in saturation between open water and water underneath the hyacinth mats. The mean DO saturation was 86.20 ± 13.99% at WH1, 85.70 ± 14.87% at WH2, and 90.26 ± 7.95% in open water. Percent saturation ranged from 15.68% to 128.49% at WH1, 24.88% to 133.90% in WH2, and 72.58% to 110.13% in open water. Diel changes in water temperature were observed (Figure 3, 4 and 5). There was also a decrease in water temperature of about 5°C, where the decline began in mid-September into October. The water temperature was similar across all three locations (Figure 8). Water temperature was 21.93 ± 1.97°C at WH1, 21.90 ± 2.02°C at WH2 and 21.79 ± 1.94°C in open water.

Herbicide symptoms were observed in the water hyacinth plants during a follow up visit, 8 days after the initial treatment. These symptoms included wilted leaves and chlorosis, where some plants had turned yellow to light brown. Treated water hyacinth plants were completely brown 16 days after treatment, but continued to remain afloat with other healthy water hyacinth mats that floated into the Union Point area.

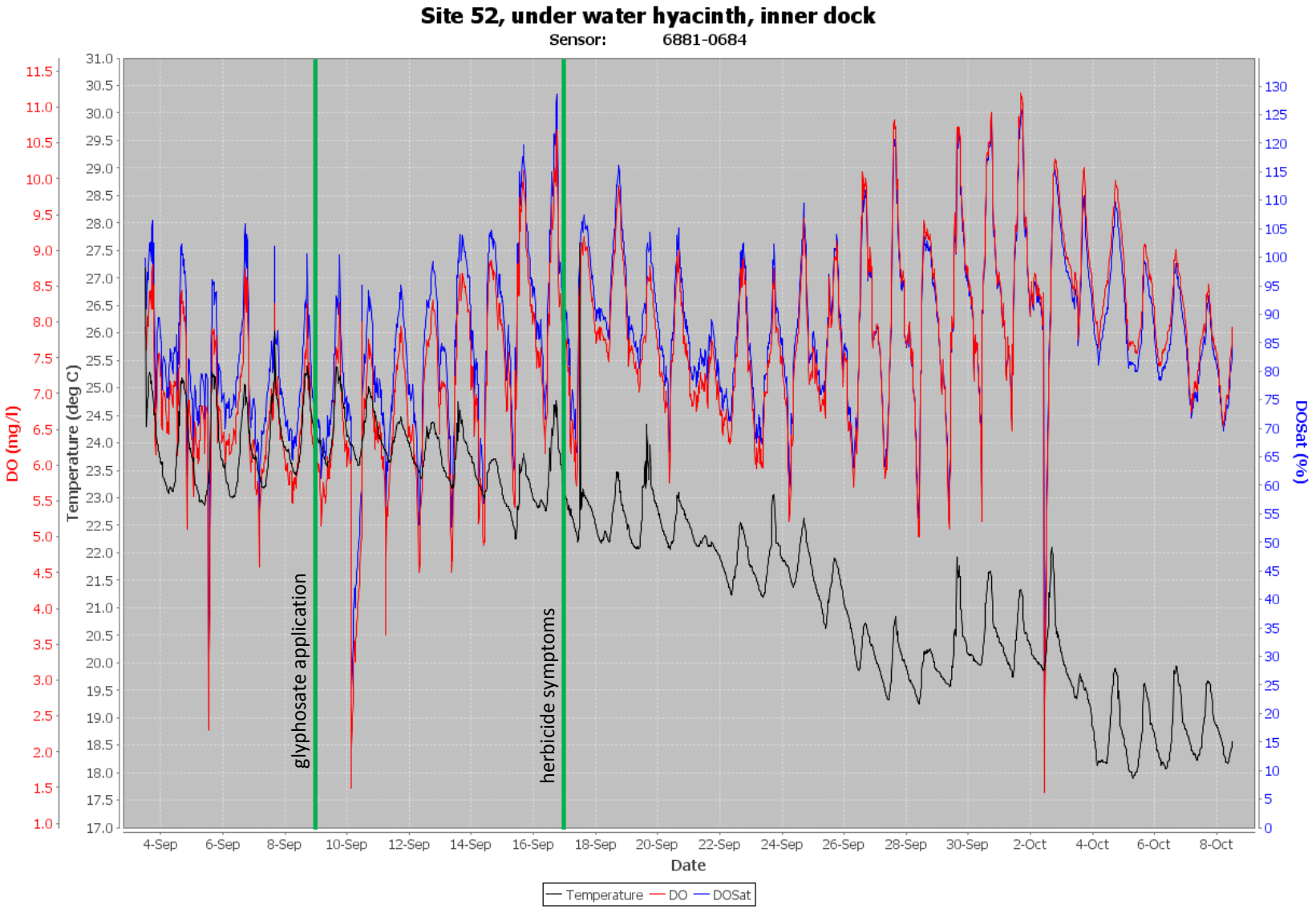


Figure 3. Dissolved Oxygen and Water Temperature at WH1

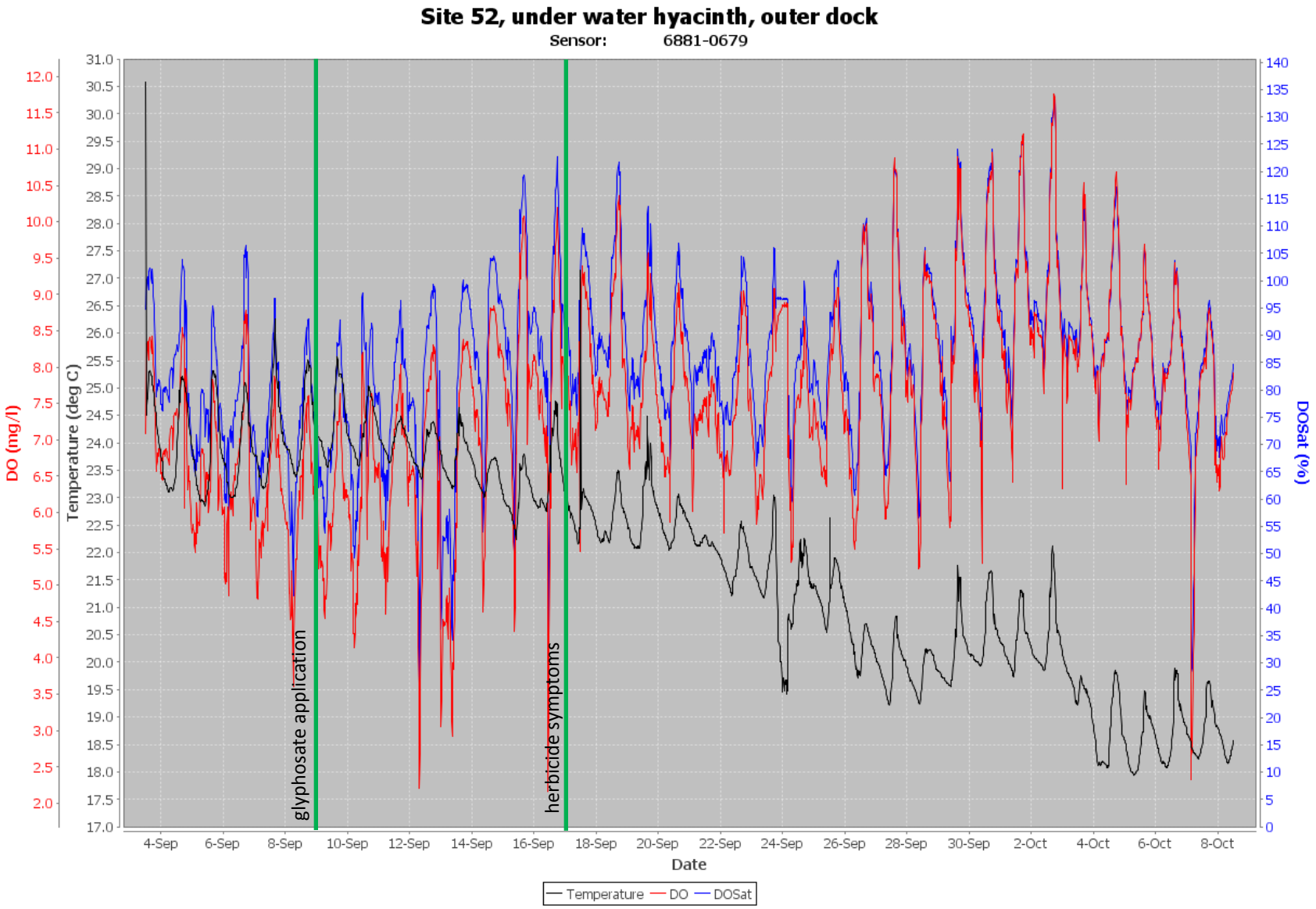


Figure 4. Dissolved Oxygen and Water Temperature at WH2

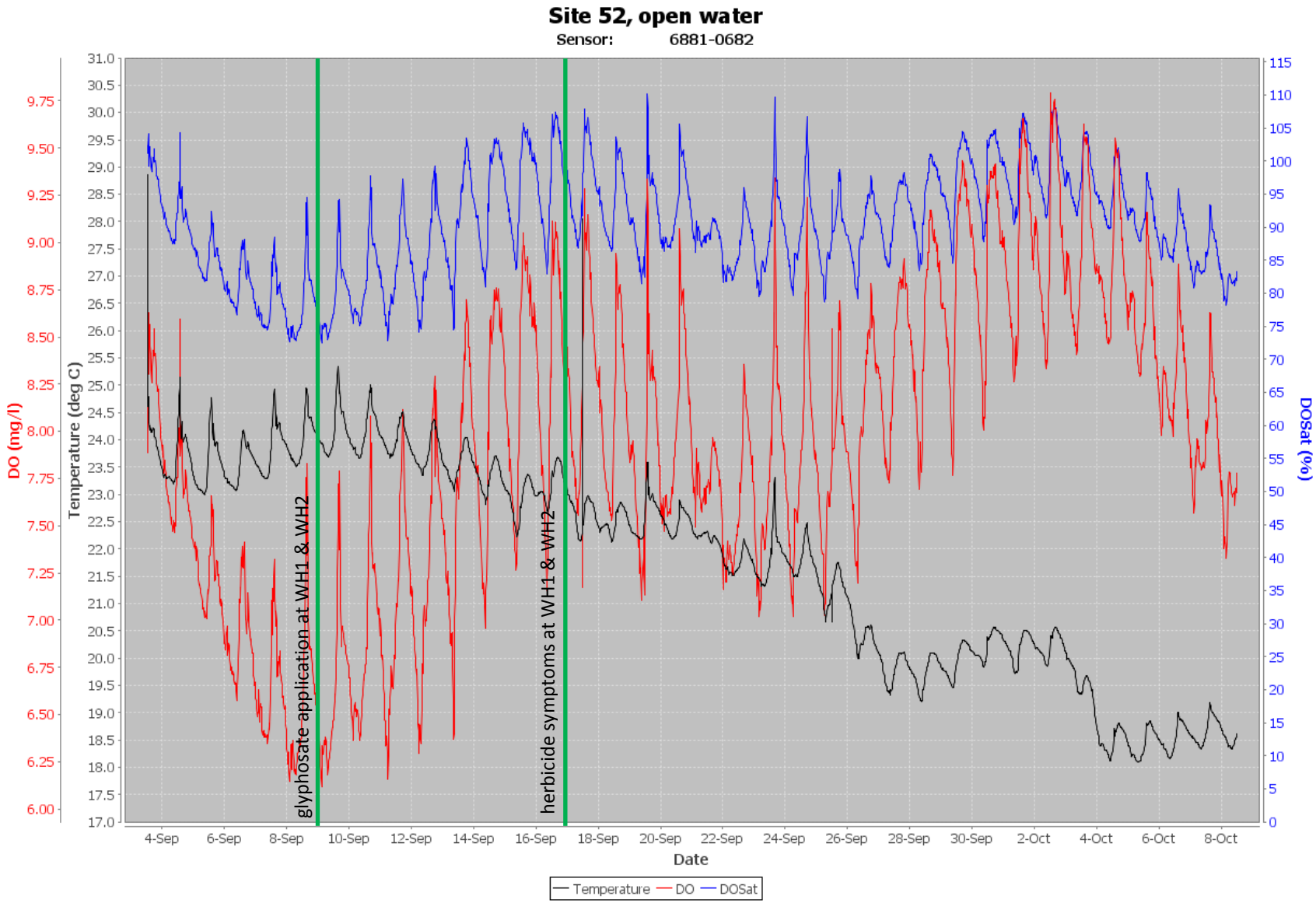


Figure 5. Dissolved Oxygen and Water Temperature in Open Water Location

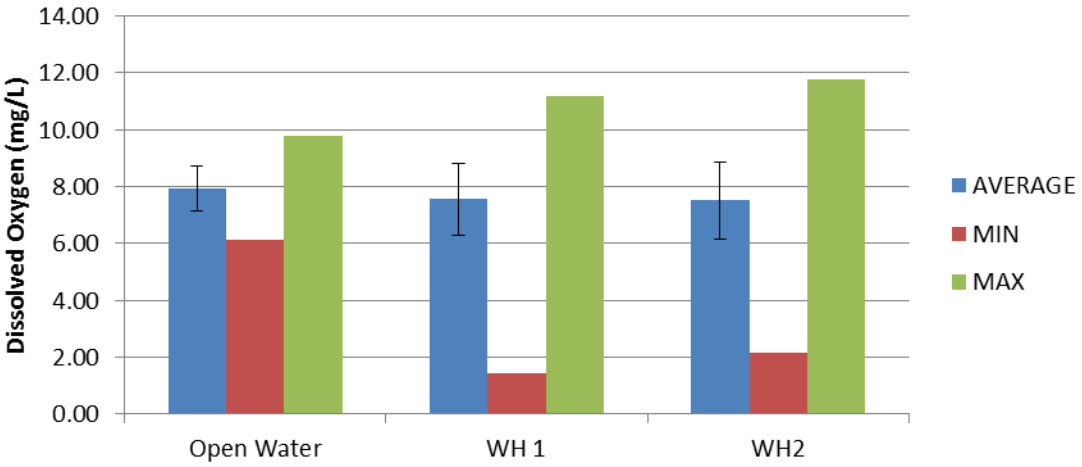


Figure 6. Dissolved oxygen, mean (± SD) and range

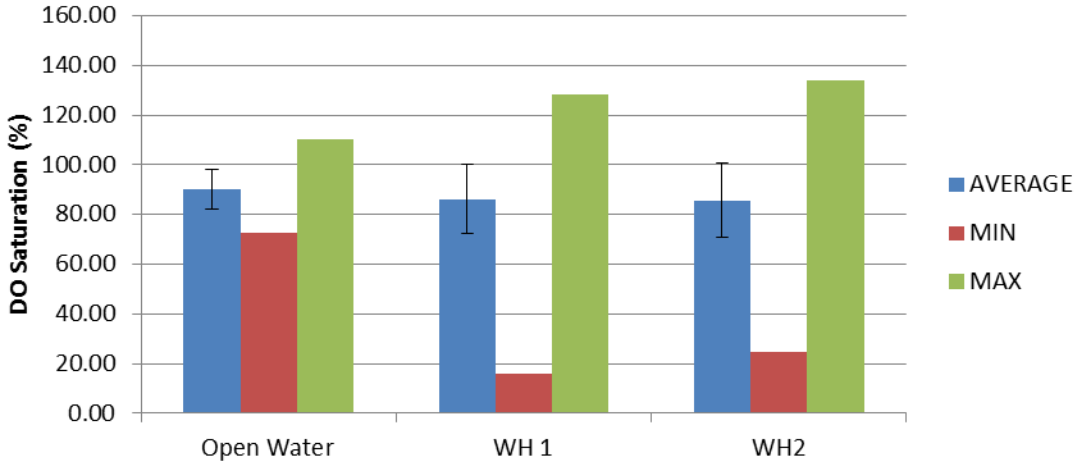


Figure 7. Dissolved oxygen saturation, mean (± SD) and range

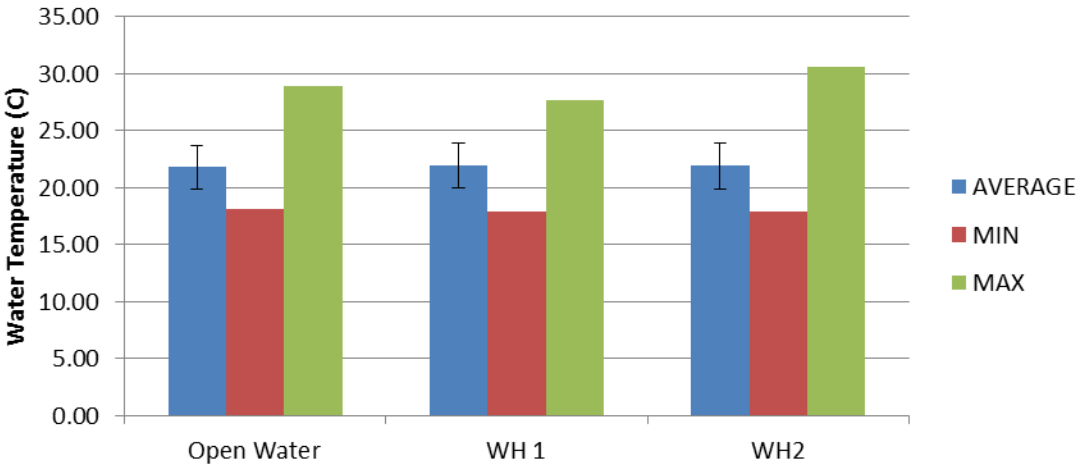


Figure 8. Water temperature, mean (±SD) and range

Discussion

Greater fluctuations of DO observed within the water hyacinth mat compared to open water were an expected result. In the water hyacinth mats (WH1 and WH2), higher DO levels were measured during the day and lowest DO levels occurred at night. Algae and aquatic plants can increase DO through photosynthesis, but decrease DO through respiration at night. DO levels fluctuate throughout the day, and are typically lowest in the morning and peak in the afternoon. The basin plan limits established by the Central Valley Regional Water Quality Control Board has water quality standards for DO in order to protect beneficial uses of water. The basin plan limits for DO depend on location and time of year, and range from 5 mg/L to 8 mg/L. There were several instances where DO concentrations were below 5 mg/L. There were also a number of occurrences where DO concentrations were below 3 mg/L, which is the level below which DO is considered to be detrimental to fish species. However, these events of low DO concentrations were temporary, followed by an increase in DO levels.

Since decomposition decreases DO, there is potential for the herbicide treatment to lower DO due to decaying water hyacinth. However, there was no noticeable decrease in DO after the herbicide treatment and time when herbicide symptoms were visible. Water temperature changes in September overwhelmed any possible DO changes due to herbicide treatments or water hyacinth growth, since DO levels naturally increase with colder water temperatures. Lack of DO impacts from the herbicide treatment could also be due to the influence of wind and water flow. The study location along Middle River at Union Point experiences relatively high water movement resulting from diurnal tidal movement and water export pumping in the south Delta. Mean daily flow at Middle River (CDEC, 2014) between September 3, 2013 to October 8, 2013 ranged from -5,603 to -1,640 cfs (negative cfs indicates net reverse flows). Flowing water, such as the tidal water in the Delta, dissolves more oxygen than still water. Diurnal tidal movement also mixes lower DO water that might be present under a growing or decaying water hyacinth mat with incoming, higher DO water. Occurrences of decreased DO due to treated and decaying water hyacinth are more likely to be observed in a slow-moving, dead end slough.

The WHCP implements mitigation measures to minimize impacts to DO. Application crews monitor dissolved oxygen levels pre- and post-treatments for all WHCP treatments, and at selected locations in the Delta over time. Data from the Water Hyacinth Control Program (WHCP) daily treatment logs indicate that there is no significant impact on DO immediately post-treatment (DBW 2012). Of 719 treatments occurring between 2007 and 2011, there were 13 cases with no change in DO, 404 cases with an increase in DO (average increase of 0.8 mg/L), and 302 cases with an average decrease in DO (average decrease of 0.6 mg/L). The average pre-treatment DO was 7.9 mg/L, and the average post-treatment DO was 8.1 mg/L. The minimum allowable DO in most of the WHCP program area is 5.0 mg/L. Both pre- and post-treatment levels are well above the 5.0 mg/L considered safe for fish. Application crews also follow a fish passage protocol to reduce the potential for low dissolved oxygen levels from decaying water hyacinth to negatively impact fish species. WHCP crews follow current herbicide label requirements regarding dissolved oxygen impacts for each herbicide in order to avoid adverse impacts. Depending on the herbicide, these requirements include treating in strips, and specific wait times between treatments.

Data collected from this pilot study support the findings of Toft and others that DO levels underneath water hyacinth mat are lower. Average DO measurements were below 5 mg/L in water hyacinth and above 5 mg/L in pennywort (*Hydrocotyle ranunculoides*). A University of California Davis study found dissolved oxygen levels as low as 0 mg/L below a solid water hyacinth mat (Toft 2000). Additionally, DO levels under the roots of water hyacinth mats in the

Parana River floodplain in Argentina were a maximum 2.3 mg/L within the first meter, and typically only 1 mg/L, with even lower DO levels deeper in the river (Petr 2000). DO measured in the Sudd River in Sudan were 1.8 mg/L at 30 cm below the water hyacinth mat (Petr 2000).

DBW plans to conduct a comprehensive DO monitoring study in 2014. There are a couple of challenges with conducting a DO monitoring study with water hyacinth that DBW hopes to address in the 2014 study design. One challenge is the dynamic nature of water hyacinth. An ideal study would have the initial hyacinth mat(s) (treated vs. untreated) remain in the same orientation to the data loggers and study location in order to capture accurate influences of plant growth decomposition on DO. However most often, this is not the case with water hyacinth, as flows and winds constantly influence the orientation of the plants, resulting in a mixture of healthy and herbicide treated plants in the study site. Another challenge is locating study sites that have good security for equipment with stable and secure structures to anchor the data loggers.

The 2014 study will include two locations in the Sacramento-San Joaquin Delta that are infested with water hyacinth with different characteristics: one in a dead-end slough with slow moving water and one with stronger tidal influence. Both of these locations will receive herbicide treatments during the study to evaluate impacts of the treatment on DO levels. A third location with water hyacinth infestation will be selected as a control site. This site will not be treated with herbicide to evaluate impacts of water hyacinth itself on DO. The study will be conducted during the summer when water and air temperatures remain relatively stable, in order to eliminate any seasonal temperature effects on DO. This future study will likely reveal more information about impacts of water hyacinth and herbicide treatment on DO.

References

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