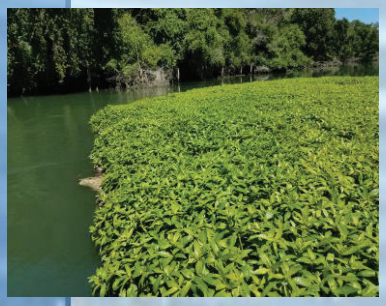
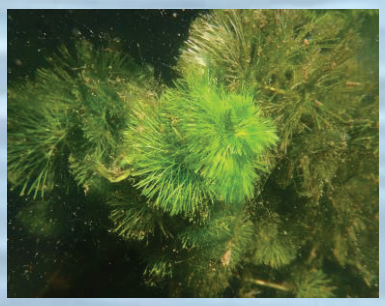
Aquatic Invasive Plant Control Program

2024 Annual Monitoring Report





California Department of Parks and Recreation
Division of Boating and Waterways
January 2025

Submitted Pursuant to:

- **State Water Resources Control Board (SWRCB)**
  - Statewide General National Pollutant Discharge Elimination System (NPDES) Permit (CAG990005)
- **United States Fish and Wildlife Service (USFWS) Biological Opinion**
  - Service File No. 08FBDT00-2018-F-0029, effective April 3, 2019
- **USFWS Reinitiation of Consultation**
  - Service File No. 08FBDT00-2018-F-0029-1, effective July 22, 2020
- **National Marine Fisheries Service (NMFS) Biological Opinion**
  - WCR-2017-8268, effective May 15, 2018

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, Edward Hard (Environmental Program Manager), Jeffrey Caudill (Senior Environmental Scientist, Supervisory), Patricia Gilbert (Senior Environmental Scientist, Specialist), Guphy Gustafson (Research Data Specialist) and the following AIPCP staff Lydia Kenison (Environmental Scientist), Ashley Fossett (Environmental Scientist), Kellie Wenstrom (Environmental Scientist), Aleksandra Ljubisavljevic (Environmental Scientist), and Abdul Ahmadzai (GIS Specialist), 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.

Signed by:
Ramona Fernandez
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8/26/2025

Ramona Fernandez, Deputy Director
California Department of Parks and Recreation
Division of Boating and Waterways

Date

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ACRONYMS AND ABBREVIATIONS

2,4-D	2,4-dichlorophenoxyacetic acid
AB	Assembly Bill
AIPCP	Aquatic Invasive Plant Control Program
AIS	Aquatic Invasive Species
APAP	Aquatic Pesticide Application Plan
BAMS	BioBase Aquatic Map System
BDCW	Python scripts titled Biovolume Data Correction Workflow
BMP	Best Management Practice
BiOp	Biological Opinion
CDFA	Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CDW	Change Detection Workflow
CEQA	California Environmental Quality Act
CNDDB	California Natural Diversity Database
CSV	Comma-separated Value
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
DBW	Division of Boating and Waterways
Delta	Sacramento-San Joaquin Delta, Suisun Marsh, and southern tributaries– the Tuolumne River and Merced River
DO	Dissolved Oxygen (measured in mg/l or ppm)
DPR	Department of Pesticide Regulation
DWR	Department of Water Resources
EAV	Emergent Aquatic Vegetation
EDCP	*Egeria densa* Control Program
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FAV	Floating Aquatic Vegetation
FRP	Fish Restoration Program
GGS	Giant Garter Snake
GIS	Geographic Information System
GPS	Global Positioning System
HPLC	High Performance Liquid Chromatography
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NTU	Nephelometric Turbidity Units
OMP	Operations Management Plan
PCR	Pest Control Recommendation
ppb	Parts per Billion (µg/l)
QAC	Qualified Applicator Certificate
QAPP	Quality Assurance Project Plan
RMA	Routine Maintenance Agreement
SAV	Submersed Aquatic Vegetation
SB	Senate Bill
SCP	Spongeplant Control Program
SWP	State Water Project
SWRCB	State Water Resources Control Board

UC	University of California
USDA-ARS	United States Department of Agriculture – Agricultural Research Service
USFWS	United States Fish and Wildlife Service
VELB	Valley Elderberry Longhorn Beetle
WHCP	Water Hyacinth Control Program

EXECUTIVE SUMMARY

Report Highlights: This annual report provides an overview of the activities conducted by the Aquatic Invasive Plant Control Program (AIPCP) under the Aquatic Invasive Species (AIS) Branch of the California Department of Parks and Recreation's Division of Boating and Waterways (DBW) during the 2024 calendar year in the Sacramento-San Joaquin Delta and southern tributaries– the San Joaquin River, Tuolumne River, and Merced River (hereinafter referred to as the "Delta").

Importance of Controlling Invasive Aquatic Plants: DBW is the authorized lead agency responsible for identifying, detecting, controlling and administering programs to manage aquatic invasive plants in the Delta. It is crucial to control invasive aquatic plants in the Delta for the economy, public health, and the environment. Aquatic invasive plants can rapidly displace native species, clog water conveyance systems, form dense mats that restrict water movement, trap sediment, provide habitat for mosquitos, and cause fluctuations in water quality. Additionally, dense growth may interfere with recreational uses of a waterbody and with navigation.

This program operates under the National Pollutant Discharge Elimination System (NPDES) Statewide General Permit (CAG990005), issued by the State Water Resources Control Board; the United States Fish and Wildlife Service (USFWS) Biological Opinion (08FBDT00-2018-F-0029-1); the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) Biological Opinion (WCR-2017-8268); and the California Department of Fish and Wildlife (CDFW) Lake and Streambed Alteration Agreement (LSA) (1600-2015-0132-R3). Federal consultations were conducted with the U.S. Department of Agriculture – Agricultural Research Service (USDA-ARS) as DBW's federal nexus. The program also complies with the California Environmental Quality Act (CEQA) Environmental Impact Report (DBW January 24, 2018, Addendum April 2, 2018) and Mitigation Monitoring and Reporting Program (MMRP).

Target Species: The AIPCP is currently authorized to treat the species listed in **Table ES-1**.

Table ES-1-: Target Species

Common Name	Scientific Name
Alligatorweed	*Alternanthera philoxeroides*
Brazilian waterweed	*Egeria densa*
Coontail	*Ceratophyllum demersum*
Curlyleaf pondweed	*Potamogeton crispus*
Eurasian watermilfoil	*Myriophyllum spicatum*
Fanwort	*Cabomba caroliniana*
Ribbon weed	*Valisneria australis*
South American spongeplant	*Limnobium laevigatum*
Uruguay water primrose	*Ludwigia hexapetala*
Water hyacinth	*Eichhornia crassipes*

Monitoring: All compliance parameters set forth in both the USFWS and NMFS biological opinions were met during the 2024 treatment season. All monitoring for herbicide residue concentrations at receiving water locations were either not detected or were below receiving water limits as specified in the NPDES Permit. Any occurrences where dissolved oxygen levels, turbidity and pH exceeded limits in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins, established by the Central Valley Regional Water Quality Control Board (CVRWQCB), were expected to be temporary given the tidal nature of the Delta, varying hydrodynamics, and periodic mixing of the water column. No incidental take of threatened or endangered species occurred during the 2024 season.

2024 season program treatment metrics:

- Official Treatment Season: March 1, 2024, to November 30, 2024.
  - 3,764 acres were treated of the 15,000 acres authorized per permits and Biological Opinions.
  - 2,649 acres were treated for Floating Aquatic Vegetation (FAV).
  - 1,115 acres were treated for Submerged Aquatic Vegetation (SAV).
  - 0 acres of FAV were mechanically harvested.
- Treatments occurred in 173 FAV sites and 56 SAV sites throughout the Delta.
- 137 water samples were collected for analysis to determine concentrations of herbicides in the water column.
- Conducted hydroacoustic mapping for all 56 SAV treatment sites.
- Conducted point sampling to identify the SAV species in all treatment sites.
- The following quantities of herbicide were applied:
  - 4,698.6 gallons of glyphosate
  - 2,286.2 gallons of imazamox
  - 4,999.1 gallons of diquat
  - 5,944.3 gallons of endothall

1 INTRODUCTION

The objective of the Aquatic Invasive Plant Control Program (AIPCP) is to control the growth and spread of aquatic invasive plants in the Sacramento-San Joaquin Delta, Suisun Marsh, and southern tributaries– the Tuolumne River and Merced River (hereinafter referred to as the "Delta") in support of the environment, economy, and public health. Due to the long-term presence and the persistence of aquatic invasive plants in the Delta, the AIPCP legislative mandates are for control, rather than eradication of aquatic invasive plants. The AIPCP is part of the California State Parks, Division of Boating and Waterways (DBW) Aquatic Invasive Species (AIS) Program. The mission of the AIS Program is to manage aquatic invasive plants and to help prevent the introduction and establishment of Dreissenid mussels (Quagga/zebra mussels) in unaffected lakes, rivers and/or reservoirs in the State of California in partnership with other state, local, and federal agencies. This document describes the program to control aquatic invasive plants in the Delta.

The AIPCP provides a comprehensive approach to aquatic invasive plant control in the Delta by incorporating all Delta plant control programs conducted by the Division of Boating and Waterways into a single Program. Previously, the control efforts were divided into the Water Hyacinth Control Program (WHCP), Spongeplant Control Program (SCP) and *Egeria densa* Control Program (EDCP). New aquatic invasive plants can be incorporated into the AIPCP through the process defined by Assembly Bill (AB) 763. The AIPCP is supported by the *Collaboration Guidelines for Delta Aquatic Invasive Plant Control* (Guidelines). These guidelines identify actions, goals, and metrics to support a comprehensive, adaptive, collaborative, flexible, practical, efficient, effective, and sustainable approach to managing AIS in the Delta. The AIPCP adheres to an adaptive management strategy with annual evaluation. This adaptive strategy allows the program to respond to changing conditions in the Delta and facilitates adaptability to changes in other elements, such as regulatory environment, public health, and the economy (Delta Stewardship Council, 2018).

The AIPCP's adaptive management approach to aquatic invasive plant control reflects the changing nature of the Delta ecosystem and the authorization granted by AB 763. It is based on the use of a comprehensive set of treatment tools and approaches to optimize efficacy and environmental protection and is defined by increased use of monitoring, performance metrics, and treatment triggers to guide program actions and reduce risks. The AIPCP uses a comprehensive, diverse, and integrated set of tools to effectively target treatments, with the aim of controlling infestations before they spread.

The AIPCP aims for efficacious management actions to control aquatic invasive plants while at the same time strives to minimize non-target species impacts and to prevent environmental degradation in the Delta.

DBW is the authorized lead agency for controlling nine aquatic invasive plant species. According to the California Department of Fish and Wildlife (CDFW), invasive species are organisms (plants, animals, or microbes) that are not native to an environment, and once introduced, they establish, quickly reproduce and spread, and cause harm to the environment, economy, or human health (California Department of Fish and Wildlife (CFDW), 2020). The federal definition of "invasive species" is an alien species (any species that is not native to that ecosystem) whose introduction does or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council, 1999). The nine invasive floating aquatic vegetation (FAV) and submersed aquatic vegetation (SAV) species listed in **Table 1-1** are targeted for control by DBW.

Table 1-1 – Targeted Invasive Plant Species

Common Name	Scientific Name	Floating or Submersed Aquatic Vegetation
Alligatorweed	*Alternanthera philoxeroides*	FAV
South American spongeplant	*Limnobium laevigatum*	FAV
Uruguay water primrose	*Ludwigia hexapetala*	FAV

Water hyacinth	*Eichhornia crassipes*	FAV
Brazilian waterweed/Egeria	*Egeria densa*	SAV
Coontail	*Ceratophyllum demersum*	SAV
Curlyleaf pondweed	*Potamogeton crispus*	SAV
Eurasian watermilfoil	*Myriophyllum spicatum*	SAV
Fanwort	*Cabomba caroliniana*	SAV
Ribbon weed	*Valisneria australis*	SAV

Plants that grow on top of the water surface (some with emergent characteristics) are known as FAV. They grow in wetlands, marshes, shallow water bodies, slow moving waterways, lakes, reservoirs, and rivers. FAV can be a problem for boating, agriculture, public safety, and can negatively impact the environment, industry, and local economies.

Plants that grow under the water surface (some submersed plants may have floating leaves) are known as SAV. They grow in wetlands, marshes, shallow water bodies, slow moving waterways, lakes, reservoirs, and rivers. Some SAV are invasive, and if they are left unchecked, they can be a problem for boaters, agriculture, and public safety.

Extent of Infestation

The Delta (including Suisun Marsh and the southern tributaries) contains an estimated 101,000 water surface acres, all of which may provide habitat for FAV and SAV. Aquatic invasive plants are fast growing and have a significant impact on the shallow water habitat in the Delta ecosystem. Since these aquatic invasive plants were introduced to the region, many areas have become infested. Aquatic invasive species influence biological diversity, water conveyance, navigation, recreation, and agriculture of the Delta. Aquatic invasive plants can crowd out native vegetation, provide habitat for mosquitoes, reduce water flows, entrap sediments, de-stabilize dissolved oxygen cycles, obstruct waterways and navigational channels, impede anadromous fish migration, shade out crucial shallow-water fish habitat, and clog agricultural and municipal water intakes.

For example, water hyacinth coverage estimates in the Delta since 1981 have ranged from less than 1,000 acres up to approximately 4,500 acres (California Department of Parks and Recreation Division of Boating and Waterways (DBW), 2017). Shouldn't this be updated? It's almost 10 years old. This wide range of annual water hyacinth acreage in the Delta is dependent upon many factors including acreage treated, timing of treatments, seasonal air and water temperatures, water flows, water levels, and rainfall. During years with above average rainfall, high flows can flush water hyacinth out of the Delta into marine waters.

Determining the annual extent of infestation of invasive FAV and SAV in the Delta and its tributaries can be difficult because both individual plants and large mats can move with river currents, diurnal tidal movement, and winds. Historically, pre- and post-season infestations have been assessed through visual estimates conducted by DBW field staff. Additionally, hydroacoustic mapping, point-intercept survey, photo point monitoring, hyperspectral aerial photography, and multispectral satellite imagery analyses have assisted with tracking FAV and SAV distributions.

Setting

The AIPCP includes portions of 11 counties that encompass the Delta, including Alameda, Contra Costa, Fresno, Madera, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Tuolumne, and Yolo. General boundaries for the treatment area in the Delta are as follows:

- West up to and including Sherman Island, at the confluence of the Sacramento and San Joaquin Rivers
- West 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 from Clifton Court along Old River to Mossdale, and continuing along the San Joaquin River to Mendota, just east of Fresno
- East along the San Joaquin River to the city of Stockton, continuing east along the San Joaquin River to Friant Dam on Millerton Lake
- East along the Tuolumne River to La Grange Reservoir below Don Pedro Reservoir
- East along the Merced River to Merced Falls, below Lake McClure

Within the AIPCP's project area, there are 418 possible treatment sites. These sites vary in size between ten and 1,700 acres and may be between one and three miles in length. See **Figures A-1** through **A-3** in **Appendix A** and **Appendix B** for maps of the AIPCP's project area and monitoring sites sampled in 2024.

2 ENABLING LEGISLATION

Both the USDA-ARS and DBW will implement the AIPCP (See above.). The USDA-ARS is the federal nexus, providing research and scientific expertise for the AIPCP. Additionally, the USDA-ARS in conjunction with the AIPCP, manages, implements, and monitors the use of biological control methods. DBW is the lead agency for managing and implementing herbicide and physical control methods.

The AIPCP replaces the prior WHCP, SCP, and EDCP with one comprehensive aquatic invasive plant control program for the Delta. The Harbors and Navigation Code, Section 64, authorizes DBW AIS control programs. The legislature has provided authority through the following:

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

AB 763 requires DBW to consult regularly with the USDA-ARS, USFWS, NMFS, the University of California, members of the scientific and research communities, and other state agencies with authority over the control of invasive aquatic plants to determine which invasive plant species should be given the highest priority for management and to determine the best control, and, when feasible, eradication measures. To date, seven species have been added to the AIPCP through AB 763 risk assessments (*Ludwigia hexapetala*, *Potamogeton crispus*, *Myriophyllum spicatum*, *Cabomba caroliniana*, *Ceratophyllum demersum*, *Alternanthera philoxeroides,* and *Vallisneria australis*). AB 763 also requires DBW to notify CDFW of potential threats from aquatic plants that may be invasive and need to be controlled or eradicated. AB 763 requires CDFW, after receipt of that notice, in consultation with other appropriate local, state, and federal agencies, to conduct a risk assessment of that aquatic plant species to determine whether the plant presents a threat to the environment, economy, or human health, as determined after consideration of specified factors. AB 763 requires the risk assessment to specify whether the aquatic plant under consideration has been determined to be invasive. It requires CDFW, within

60 days after completing that assessment, to report its findings to DBW so that DBW may take any necessary action to control and, when feasible, eradicate the invasive aquatic plant. Rather than being guided by the historical species-by-species approach, the AIPCP is a single, comprehensive program that incorporates all current and potential future aquatic invasive plant control activities. This shifts the focus from separate treatment regimens for one target plant species to a holistic and integrated multispecies treatment approach by employing the most current, appropriate, and feasible available methods.

2.1 Section 64 of the Harbors and Navigation Code

Section 64 of the Harbors and Navigation Code is amended to read as follows:

“(a) The Legislature hereby finds and declares that the growth of water hyacinth (*Eichhornia crassipes*), Brazilian elodea (*Egeria densa*), and South American spongeplant (*Limnobium laevigatum*) in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh has occurred at an unprecedented level and that the resulting accumulations of water hyacinth, *Egeria densa*, and South American spongeplant 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, *Egeria densa*, and South American spongeplant 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, *Egeria densa*, and South American spongeplant in the Delta, its tributaries, and the marsh.”

SB 1344 (Garamendi and Nielsen, Ch. 263, Statutes of 1982) amended Section 64 of the Harbors and Navigation Code to read as follows:

“(a) The Legislature hereby finds and declares that the growth of water hyacinth (*Eichhornia crassipes*), Brazilian elodea (*Egeria densa*), and South American spongeplant (*Limnobium laevigatum*) in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh has occurred at an unprecedented level and that the resulting accumulations of water hyacinth, *Egeria densa*, and South American spongeplant 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, *Egeria densa*, and South American spongeplant 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, *Egeria densa*, and South American spongeplant in the delta, its tributaries, and the marsh.”

Egeria densa was first introduced in Assembly Bill 2193 (Rainey, Ch. 728, Statutes of 1996), then Assembly Bill 763 expanded jurisdiction to DBW in 2013.

“This bill would additionally designate the Division as the lead agency of the state for the purpose of cooperating with other state, local, and federal agencies in identifying, detecting, controlling, and administering programs to manage invasive aquatic plants, as defined, in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh.”

In 2012, Assembly Bill 1540 (Buchanan, Ch. 188, Statutes of 2012) was passed to add spongeplant control to DBW’s jurisdiction.

AB 763 (Buchanan, Ch. 330, Statutes of 2013) amended Section 64 of the Harbors and Navigation Code as follows:

“This bill would additionally designate the Division as the lead agency of the state for the purpose of cooperating with other state, local, and federal agencies in identifying, detecting, controlling, and administering programs to manage invasive aquatic plants, as defined, in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh.”

2.2 Section 64.5 of the Harbors and Navigation Code

Section 64.5 of the Harbors and Navigation Code is amended to read as follows:

“(a) The Division is designated as the lead agency of the state for the purpose of cooperating with other state, local, and federal agencies in identifying, detecting, controlling, and administering programs to manage invasive aquatic plants in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh. The Division, in consultation with appropriate state, local, and federal agencies, may take such action it determines is necessary, upon concurrence from the Department of Fish and Wildlife following the completion of the risk assessment described in subdivision (c), to implement control and, when feasible, eradication measures for invasive aquatic plants. Any actions taken to control invasive aquatic plants shall be in compliance with all applicable laws and regulations and conducted in an environmentally sound manner.”

“(b) The Division shall regularly consult with the United States Department of Agriculture, the United States Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the University of California, and other members of the scientific and research communities, as well as other state agencies with authority over the control of invasive aquatic plants to determine which species of those plants should be given the highest priority for management and determine the best control and, when feasible, eradication measures.”

“(c) (1) After consulting with the various entities as required in subdivision (b), if the Division identifies a species of aquatic plant that may be invasive and need to be controlled or eradicated, the division shall notify the Department of Fish and Wildlife of the potential threat from that aquatic plant species. After receipt of that notice, the Department of Fish and Wildlife, in consultation with other appropriate local, state, and federal agencies, including, but not limited to, the Department of Food and Agriculture, the Department of Water Resources, the State

Water Resources Control Board, the Department of Pesticide Regulation, and the Office of Environmental Health Hazard Assessment, shall conduct a risk assessment of the aquatic plant species identified by the Division to determine whether the plant species is invasive and presents a threat to the environment, economy, or human health. In making that determination, the Department of Fish and Wildlife shall take prompt action to minimize detrimental impacts and costs of management, and shall consider the following:

(A) Whether the aquatic plant species may obstruct navigation and recreational uses of waterways.

(B) Whether the aquatic plant species may cause environmental damage, including threats to the health and stability of fisheries, impairment to birds' access to waterways and nesting, roosting, and foraging areas, deterioration of water quality resulting from plant decay, and harm to native plants.

(C) Whether the aquatic plant species may cause harm to the state's economy, infrastructure, or manmade facilities such as state water storage facilities and pumping operations, by increasing flood risk, threatening water supplies by blocking pumps, canals, and dams necessitating early control efforts.

(2) Based on factors specified in subparagraphs (A), (B), and (C) of paragraph (1) and any other environmental, economic, or human health impacts, the risk assessment shall specify whether the plant species under consideration has been determined to be an invasive aquatic plant. Findings from the risk assessment shall be documented in a way that clearly describes the severity and types of impacts caused by a plant species determined to be an invasive aquatic plant.

(3) Within 60 days after completing the risk assessment required by paragraph (1), the Department of Fish and Wildlife shall report its findings to the division so that the division may take any necessary action to control and, when feasible, eradicate an invasive aquatic plant, as authorized under subdivision (a).

(d) For purposes of this section, "invasive aquatic plant" means an aquatic plant or algae species, including its seeds, fragments, and other biological materials capable of propagating that species, whose proliferation or dominant colonization of an area causes or is likely to cause economic or environmental harm or harm to human health.

(e) Aquatic plants shall be determined to be invasive through the risk assessment required to be completed by the Department of Fish and Wildlife in consultation with the division and other state, local, and federal agencies pursuant to subdivision (c)."

2.3 Risk Assessment Status

CDFW administers the risk assessment process to determine whether a species can be considered an invasive species in California. CDFW uses the U.S. Aquatic Weed Risk Assessment tool to evaluate aspects of a species' ecology, reproductive potential, dispersal mechanisms, competitive ability, actual and potential impacts (including impacts to navigation

and recreation, the environment, economy, and human health as specified in Harbors and Navigation Code 64.5), and resistance to management. Based on this evaluation, CDFW, in consultation with the California Department of Water Resources (DWR), State Water Resources Control Board (SWRCB), Department of Food and Agriculture (CDFA), Department of Pesticide Regulation (DPR), and Office of Environmental Health Hazard Assessment (OEHHA), and in concurrence with DWR will make a determination whether the species is an invasive aquatic plant that causes, or is likely to cause, economic or environmental harm, or harm to human health in California. The scoring system is broken into three categories, non-invaders score less than 31, scores between 31 and 39 require further evaluation, and any species with a score greater than 39 is considered a major invader. **Table 2-1** shows the risk assessment determination for each species.

Table 2-1 – Risk Assessment Scores

Common Name	Scientific Name	Score	Date of Determination
Brazilian waterweed	*Egeria densa*	*	Not Available
Water hyacinth	*Eichhornia crassipes*	*	Not Available
South American spongeplant	*Limnobium laevigatum*	*	Not Available
Curlyleaf pondweed	*Potamogeton crispus*	66	June 12, 2015
Eurasian watermilfoil	*Myriophyllum spicatum*	76	June 28, 2016
Uruguay water primrose	*Ludwigia hexapetala*	76	July 22, 2016
Coontail	*Ceratophyllum demersum*	58	October 14, 2016
Fanwort	*Cabomba caroliniana*	75	January 25, 2018
Alligatorweed	*Alternanthera philoxeroides*	74	March 1, 2018
Ribbon weed	*Vallisneria australis*	64	July 29, 2022

**Brazilian waterweed, water hyacinth, and South American spongeplant were determined to be invasive, prior to the use of this scoring tool.*

3 ENVIRONMENTAL COMPLIANCE

3.1 Summary of Regulatory Compliance Requirements

The following constitutes a summary of the environmental regulatory documents required to implement the AIPCP. These documents have requirements designed to ensure avoidance or minimization of significant impacts to beneficial uses of waters of the U.S., waters of the State, species protected by the federal Endangered Species Act (ESA) and to prevent the spread of invasive plants.

A National Pollutant Discharge Elimination System (NPDES) permit is required by SWRCB. Coverage under this permit was obtained in December 2013 and expired in 2018. The permit is referenced as the Statewide General NPDES Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States (Permit No. CAG990005, Water Quality Order 2013-0002-DWQ).

A 5-year Routine Maintenance Agreement (RMA; October 23, 2015-December 31, 2020) under the Lake or Streambed Alteration Agreement Program was entered into between DBW and CDFW for mechanical removal and harvesting efforts of FAV (Notification No. 1600-2015-0132-R3). A 5-year extension was granted on November 10, 2020.

DBW partners with the USDA-ARS for the AIPCP and the USDA-ARS acts as a federal nexus to obtain Biological Opinions (BiOp) from the USFWS and NMFS to operate the AIPCP. The following BiOps were obtained from the USFWS and NMFS to operate the AIPCP pursuant to Section 7 of the ESA:

- USFWS Biological Opinion (08FBDT00-2018-F-0029-1), effective July 22, 2020
- NMFS Biological Opinion (WCR-2017-8268), effective May 15, 2018

Two-year extensions of these Biological Opinions were submitted and approved by USFWS and NMFS, extending the BiOps until December 30, 2024.

3.2 Reporting Requirements

3.2.1 NPDES Statewide General Permit

The NPDES Statewide General Permit for Aquatic Pesticide Use requires DBW to submit an annual report on March 1, following the AIPCP application season. Reporting per NPDES guidelines must include the following:

> 1) An executive summary discussing compliance or violation of this General Permit and the effectiveness of the Aquatic Pesticide Application Plan (APAP) to reduce or prevent the discharge of pollutants associated with algaecide and aquatic herbicide applications.
>
> 2) A summary of monitoring data, including the identification of water quality improvements or degradation as a result of the aquatic pesticide application, if appropriate, and recommendations for improvements to the APAP [including proposed best management practices (BMPs)] and monitoring program based on the monitoring

results. All receiving water monitoring data shall be compared to receiving water limitations and receiving water monitoring triggers.

3) Identification of BMPs currently in use and a discussion of their effectiveness in meeting the requirements in this General Permit.

4) A discussion of BMP modifications addressing violations of this General permit.

5) A map showing the location of each treatment area (explanation of Treatment Site Selection and Prioritization on page 23).

6) Types and amounts of algaecides and aquatic herbicides used at each application event.

7) Information on surface area and/or volume of treatment areas and any other information used to calculate dosage, concentration, and quantity of each algaecide and aquatic herbicide used.

8) Sampling results shall indicate the name of the sampling agency or organization, detailed sampling location information (including latitude and longitude or township/range/section if available), detailed map or description of each sampling area (address, cross roads, etc.), collection date, name of constituent/parameter and its concentration detected, minimum levels, method detection limits for each constituent analysis, name or description of water body sampled, and a comparison with applicable water quality standards, description of analytical quality assurance/quality control plan. Sampling results shall be tabulated so that they are readily discernible.

9) Summary of algaecide and aquatic herbicide application log.

3.2.2 CDFW Lake and Streambed Alteration Agreement

The CDFW Lake and Streambed Alteration Agreement outlines all reporting requirements for DBW's mechanical harvesting efforts. DBW must routinely submit quarterly reports (i.e. February, May, August, and November); an annual report, due within 45 days of December 31; a 7-day pre-removal notification to CDFW, prior to scheduled mechanical harvesting at a given project site; documentation pursuant to CDFW approval of project-certified Designated Biologists; and Biological Pre-Construction Survey reports to CDFW within 5 business days of each survey and prior to the commencement of mechanical harvesting at a given project site.

Further reporting is necessary when a spill into the waters of the state occurs, or a special status species, chiefly giant garter snake, is observed in pre-construction surveys or project monitoring. In the event of a spill, DBW must immediately notify the California Emergency Management Agency and initiate cleanup activities. Observations of special status species must be submitted to the California Natural Diversity Database (CNDDB) within 15 working days of the sighting, and CDFW must be provided copies of the CNDDB forms and associated survey maps.

3.2.3 USFWS and NMFS Biological Opinions

The USFWS and NMFS BiOps require an Operations Management Plan to be submitted annually before the herbicide application season, an annual report to be submitted by January

31, following the application season and a Project Completion Report to be submitted within 45 days of project completion. This report fulfills the annual reporting requirements and summarizes compliance with the terms and conditions of the BiOps.

Additional reporting requirements are on a case-by-case basis in the event of incidental take of federally listed species. 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” (ESA; 16 U.S.C. 1532 et. Seq.). Reporting of take begins with immediate notification to the federal biologist (based on jurisdiction) in charge of administering the BiOp 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.

3.2.4 CDFA State Plant Pest Permits

The CDFA State Plant Pest Permits include specific conditions associated with the collection of approved plant pest species and work conducted under the permits, in general. These conditions include notifications to the CDFA Permits and Regulations Program regarding the following:

1) Arrival of each shipment of the regulated organism to the DBW office identified on the permits. Notification must be provided to the Sacramento County Agricultural Commissioner or the CDFA Permits and Regulations Program. If the county elects to waive the notification, DBW must notify the CDFA Permits Office.
2) Other plant pests found or identified that are not known to occur in California and/or are a quarantine plant pest, regardless of origin, not authorized under a valid permit.
3) The escape of a regulated organism not permitted for release.
4) Any violations and resolutions of permit conditions.

4 PERSONNEL, MATERIALS AND METHODS

4.1 AIPCP Personnel and Certifications

4.1.1 Application Crew

During 2024, DBW was able to field up to nine full-time crews, each crew consisting of an Aquatic Pest Control Specialist and an Aquatic Pest Control Technician. DBW also had an interagency contract with the California Conservation Corps for additional personnel to assist the application crews. Each crew contained a minimum of one member possessing a Category F (Aquatics) Qualified Applicators Certificate (QAC), administered by the California Department of Pesticide Regulation. In 2024, DBW also utilized a contractor for some treatments.

APPLICATION EQUIPMENT

Crews used a 19- or 21-foot aluminum boat powered by an outboard motor or an air drive. For pellet formulations, each crew uses either an Earthway Commercial spreader (30-foot spread), Hopper (50-foot to 60-foot spread), or Vortex (15-foot spread) unit with handheld blower tube to

disperse herbicide to the target site. For liquid injection applications, each crew uses a spray rig connected to tubing with installed orifice plates to control herbicide flow. The spray units are equipped for direct metering of herbicide, adjuvant, and water into the pump system of each unit. At the start of each treatment, the application crew takes dissolved oxygen and temperature measurements using a HACH® HQ-30 Dissolved Oxygen Meter within the treatment site. These readings must be within the parameters outlined in the NPDES Permit and the USFWS BiOp before an application can be made. The crews use electronic tablets equipped with a Global Positioning System (GPS) unit to record the beginning and ending spray lines, coordinates of the spray area, time of treatment, treatment data and environmental data.

Spray equipment was calibrated routinely, after changing injection pumps, or whenever problems with the equipment occurred. 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 schedule.

All boats are washed regularly to remove herbicide residues, and all application pumps, hoses, and nozzles are inspected and, if found defective, are replaced on an as-needed basis.

APPLICATION PERSONNEL EDUCATION AND TRAINING

Qualified Applicator Certificate

All Aquatic Pest control specialists are required to have a Qualified Applicator Certificate (QAC).

Application crews receive continuing education credits in pesticide training to keep their QACs 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 QACs are renewed every two years upon completion of the continued education credit requirements.

Environmental Awareness Training

Environmental awareness training was conducted in-person in February 2024 and as-needed via video recorded sessions for new employees hired after February. This training included the following items:

- Identification of commonly observed invasive aquatic plants in the Delta.
- Species identification and impact avoidance guidelines on all threatened and endangered species associated with the AIPCP.
- Identification and protection of elderberry shrubs and protocol for monitoring species during an application season.
- Identification and protection of the giant garter snake including life history, importance of irrigation canals, marshes, wetlands, and seasonally flooded areas as habitat.
- Identification and protection of Delta smelt, longfin smelt, Chinook salmon, steelhead, green sturgeon, and associated protected habitats, fishery closure dates, and other regulatory agency requirements.

- Terms and conditions of the USFWS and NMFS BiOps for the AIPCP for protection, avoidance and minimization of adverse effects to protected species under the ESA.
- Avoidance and minimization measures for species of concern that are outlined in the Routine Maintenance Agreement for mechanical removal/harvesting of FAV.
- Protocol for "take," including reviewing the "Incidental Take Statement," collection and handling of dead species, completion of chains of custody, and notification to USFWS.

Equipment Training

Refresher trainings on the use and calibration of the dissolved oxygen meters and use of Tablets, Survey 123, and Field Map applications take place routinely.

4.1.2 Monitoring Personnel

Environmental monitoring activities are overseen by a Senior Environmental Scientist and conducted by qualified personnel, which may include a Senior Environmental Scientist, Environmental Scientist, and/or Environmental Services Interns. All water sampling events are carried out in accordance with the Quality Assurance Project Plan QAPP) and the FAV Environmental Monitoring Protocol as approved by the SWRCB, NMFS, and USFWS.

Environmental Scientists are responsible for understanding and adhering to the regulatory permits and BiOps 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 training for all monitoring personnel on environmental monitoring and field equipment protocols.

Scientists schedule and plan all field sampling events. Pictures are used to document any unusual conditions of the sampling locations, vegetation, or surrounding areas. Additional responsibilities include quality control field monitoring, laboratory analysis and reporting of findings in this annual report.

MONITORING EQUIPMENT

A 21-foot outboard motorboat was used for monitoring activities. Water samples for FAV water quality testing were collected using the MasterFlex® E/S® Portable Sampler fitted with 7 to 10 feet of tubing. Water samples for SAV water quality testing were collected using a sampling pole. Water quality parameters were measured with a YSI ProDSS Multiparameter Water Quality Meter with a 4-port cable assembly. Water quality parameters included water temperature, dissolved oxygen, electrical conductivity, salinity, pH, and turbidity. Parameters measured by the YSI ProDSS were geographically referenced with GPS coordinates using ArcGIS Survey123 on a smart phone/tablet. In the event of equipment malfunction, a Hach® HQ-30 Dissolved Oxygen Meter was used as a backup to measure temperature and dissolved oxygen within monitoring sites. Photographs were taken 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.

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

4.2 Materials and Methods

4.2.1 Herbicide Application

AIPCP Operations Management Plan

The AIPCP Operations Management Plan (OMP) details general requirements, the scope of program activities, a pre-application planning protocol, application/monitoring coordination protocol, herbicide application protocol, 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

The herbicide products used for AIPCP treatment include the following:

- Glyphosate (Round-up Custom™), EPA Reg. No. 524-343-ZG
- Imazamox (Clearcast herbicide), EPA Reg. No. 241-437-67690
- 2,4-D (Nufarm Weedar® 64), EPA Reg. No. 71368-1-ZB
- Diquat (Reward Landscape and Aquatic Herbicide), EPA Reg. No. 100-1091
- Diquat (Tribune Herbicide), EPA Reg. No. 100-1390
- Fluridone (Sonar Q®) - EPA Reg. No. 67690-3 (Pellets)
- Fluridone (Sonar One®) - EPA Reg. No. 67690-45 (Pellets)
- Fluridone (Sonar PR®) - EPA Reg. No. 67690-12 (Pellets)
- Fluridone (Sonar H4C ®) - EPA Reg. No. 67690-61 (Pellets)
- Endothall (Aquathol K) - EPA Reg. No. 70506-176

Sites to be treated with Sonar AIPCP will conduct regular water sampling per the fluridone annual monitoring protocol. This protocol will provide a baseline treatment plan that will be adjusted on a weekly basis, if necessary, based on results from water samples taken at treatment sites throughout the treatment season.

Best Management Practices

The DBW developed a series of BMP's that outline methods or techniques that have been found to be the most effective and practical means of achieving a particular objective and/or to comply with AIPCP requirements.

- Herbicide Handling Requirements – All personnel will be trained in herbicide handling in accordance with Food and Agriculture Code and Title 3 of California Code of Regulations pertaining to Pesticides and Pest Control Operations.

- Spray Equipment Calibration – Herbicide application equipment used for the AIPCP is to be calibrated on at least a monthly basis during the treatment season.
- Spill Avoidance and Contingency Plan – All herbicide spills are treated as emergencies and need to be remediated immediately. DBW applies preventative measures to reduce the potential for a serious spill.
- Annual Environmental Awareness Training – All program personnel involved in herbicidal treatments receive required Annual Environmental Awareness training.
- Endangered Species Avoidance Measures – Implement avoidance measures to reduce or eliminate potential impacts of the programs on endangered species.
- Agricultural and Water Intake Coordination – Specific measures are implemented to ensure herbicide treatments do not negatively impact water intakes. All herbicide label requirements are followed as they related to use of treated water for irrigation or drinking purposes. DBW also coordinates with county, water districts, State Water Project (SWP) or Central Valley Project (CVP) regarding water quality impacts.

TREATMENT SITE SELECTION AND PRIORITIZATION

Prior to the start of the treatment season, field crews visually surveyed all sites in their application region and estimated the acres infested with invasive aquatic plants. Site prioritization was determined to be the same as 2023, therefore, the same prioritization evaluation was used for 2024.

Herbicide applications were prioritized such that nursery areas with a high amount of growth and areas that are critical to public, agricultural, municipal, industrial, recreational, or navigational use were treated first. DBW prioritized treatment sites based on results of these pre-season field surveys, combined with the staff experience and knowledge of AIS growth patterns and distribution. Each site was ranked on several factors including: 1) whether the site was a nursery area, 2) current infestation levels, 3) potential for infestation, and 4) whether the site is important for navigation, public safety, recreation, and/or commercial use, and Fish Restoration Program (FRP) sites. A score was given to each of the previous factors from 0 to 4: 0 having no weed infestation, 1 having a low infestation, 2 having a medium infestation, 3 having a high infestation, and 4 having a very high infestation. The environmental scientists collected their scores and entered them into a spreadsheet. The FAV prioritization spreadsheet relies not only on the scores/input provided by the field crews, but also on a historical score given by the database. This historical score gathers a decade of data collected and the level of frequency a site is being treated. The sites with the highest historical score have a high chance of being a nursery site or a site with a high level of infestation. The site selection process also considered information and concerns received from the public.

Initial plans indicated the general priority for site treatment, and treatment plans were modified during the season due to weather conditions, growth and movement of floating aquatic vegetation, and environmental considerations.

There are other logistical factors involved in daily site selections for treatment, including the number of application crews available, travel-time to sites, herbicide label restrictions, environmental mitigations measures, and daily tidal conditions.

For SAV treatments, Post Treatment Surveys conducted the previous fall which includes hydroacoustic sonar data and rake pull data is used to determine which sites have the greatest SAV on site and are therefore prioritized. Treatments for SAV in general prioritizes marinas, residential communities, and recreational areas.

The herbicide application season began on March 1, 2024, throughout the Delta where protected fish species were not likely to be present, and in spawning and rearing habitat sites for Delta smelt. The USDA-ARS and partner agency DBW sent a letter on April 8, 2020, requesting reinitiation of the April 3, 2019 section 7 consultation on the 2018-2022 AIPCP (Service file number (08FBDT00-2018-F-0029). DBW requested an amendment to the April 3, 2019, biological opinion to include (1) selected north and west Delta treatments when Delta smelt may be spawning or rearing and (2) selected additional use of diquat dibromide treatment locations. The USFWS issued a new biological opinion on July 22, 2020, that supersedes the 2019 biological opinion and revised the *Description of the Proposed Action* and subsequent sections to reflect change in timing of herbicide application within the Delta and the increased use of diquat. As a result, treatments take place in areas where treatment was not previously allowed and increased the use of diquat.

DBW reviewed fish survey data through the entire treatment season and avoided specific areas where special status fish species were present.

4.2.2 Environmental Monitoring

The AIPCP is responsible for collecting water quality monitoring data for the NPDES permit, as well as collecting water samples for herbicide residue testing.

AIPCP NPDES Annual Monitoring Protocol

All water quality monitoring follows the NPDES Annual Monitoring Protocol as outlined in the AIPCP APAP, which was approved in January 2014 by the SWRCB. Quality control and quality analysis measures are outlined in the Quality Assurance Project Plan. Monitoring activities include recording FAV and SAV 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 herbicide residues in receiving waters and monitor water quality parameters such as water temperature, electrical conductivity, salinity, dissolved oxygen, pH, and turbidity. DBW also conducts physical inspections of the treated and surrounding areas to identify odor or color changes of water, along with changes in vegetative health of the species within and around the treatment area.

NPDES Monitoring Site Selection

Environmental monitoring sites were selected based on requirements listed under the NPDES permit and BiOps. The SWRCB Statewide General NPDES Permit requires that dischargers monitor a certain proportion of sites based on the total number of treated sites. Since DBW does not conduct herbicide applications in non-flowing water, and tidal and riverine water body types are considered flowing water, all monitoring took place only in the “flowing water” environmental setting category. Laboratory results data can be found in **Appendix C.**

In 2024, Hass Slough was designated as an NPDES monitoring site for endothall treatments, and Duraflame was chosen for diquat treatments for the SAV program.
(Table 4-1)

Table 4-1. 2024 SAV NPDES Monitoring Sites

Site Number	Site Name	Water Body Type	Herbicide
277.H	Hass Slough	Flow Through-Tidal	Endothall
8.D	Duraflame	Dead End Inlet-Tidal	Diquat

In 2024, French Camp Slough was designated as monitoring site for the FAV program (**Table 4-2,** and **Appendix A, Figure A-1**). Monitoring for the FAV Program occurred in sites with varying degrees of habitat for the following species: giant garter snake, Delta smelt, and Valley elderberry longhorn beetle (VELB). Giant garter snake habitat has been rated as No Habitat, Low, Low-Moderate, Moderate, Moderate-High, and High, while VELB and Delta smelt habitat are classified as being absent or present based on the known distribution of Delta smelt and the known locations of elderberry shrubs in the project area (**Table 4-3**).

Table 4-2. 2024 FAV NPDES Monitoring Sites

Site Number	Site Name	Water Body Type	Herbicide
6	French Camp Slough	Flow Through-Tidal	Glyphosate
6	French Camp Slough	Flow Through-Tidal	Imazamox

Table 4-3. 2024 FAV Monitoring Sites and Habitat Quality

Site Number	Site Name	GGS Habitat Quality	Delta Smelt Habitat	VELB Habitat
6	French Camp Slough	Moderate to High	Absent	Present

NPDES Residue Sampling

For liquid herbicides used for FAV, water sampling occurs on the same day immediately prior to the respective 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 the respective FAV or SAV species were 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).

For Sonar pellet applications the NPDES sampling protocol differs. For each application event, DBW takes a pre-sample and as many weekly post samples as necessary until a non-detection of fluridone is obtained. These samples are identified as A, B, and C. Sample location A is inside of the application area, approximately 1/4 to 1/3 the distance from the downstream edge of the application polygon. Sample location B is located on the downstream edge of the application polygon, and sample site C is in an adjacent non-impacted area with similar hydrological conditions as the application or receiving waters. For fluridone, A, B, and C are taken prior to treatment. After the last fluridone application is made in that site, A, B, and C samples are taken weekly until fluridone concentration is below the detection limit.

Diquat treatment sites followed a protocol with sample A being taken immediately before treatment, sample B taken within 24 hours after treatment, and sample C taken one week after treatment.

All water quality monitoring followed the NDPES Annual Monitoring Protocol as outlined in the APAPs.

Fluridone Annual Monitoring Protocol

DBW will also take water samples at approximately three feet depth and submit these samples to Dr. Pramod K. Pandey's Laboratory at the Department of Population and Health, School of Veterinary Medicine, UC Davis. The lab will determine herbicide concentrations by High Performance Liquid Chromatography (HPLC). This regular herbicide monitoring will allow AIPCP staff to ensure that herbicide concentrations are maintained at efficacious levels, and that water quality standards are not exceeded, particularly for irrigation. Depending on the

results, the treatment protocol may be adjusted to achieve an appropriate herbicide concentration.

FLURIDONE MONITORING SITE SELECTION

Each treatment polygon has at least one water sample site selected that best represents the treatment site. These sample points are generally selected at the middle and end points for sloughs and equally spaced around larger polygon areas such as Franks Tract. Each site is sampled weekly. Most of the sites are established at the beginning of the treatment season and remain throughout.

DIQUAT MONITORING SITE SELECTION

Diquat quickly binds to sediment and suspended solids in the water column causing it to become chemically inactive in a short amount of time. Therefore, weekly residue sampling of diquat treatments sites is unnecessary, as it does not provide information that will affect the rate of the next treatment.

FLURIDONE RESIDUE SAMPLING

The results of the water samples were used to monitor and adjust the herbicide rate of application to ensure that the residues in the water column are conducive to attain the maximum aquatic invasive plant treatment efficacy, preferably 1.5 to 3.5 ppb. DBW did not use fluridone during the 2024 season and did not collect any samples.

CONTRACT LABORATORY STANDARD OPERATING PROCEDURES

The analytical methods used by contract laboratories are published in the EPA Test Methods for Evaluating Solid Waste Physical/Chemical SW 846 or EPA Method for Chemical Analysis of Water and Waste. Analysis of water samples was conducted by Dr. Pramod K. Pandey's Laboratory at the Department of Population and Health, School of Veterinary Medicine, UC Davis. The method used to analyze fluridone and diquat in surface water is HPLC (High Performance Liquid Chromatography). The method used to analyze glyphosate in surface water is HPLC with a post column reactor. The method used to analyze imazamox in surface waters is LC-MSMS (Liquid Chromatograph Triple Quadrupole Mass Spectrometer). The method used to analyze 2,4-D in surface waters is HPLC-SPE-UV (High Performance Liquid Chromatography-Solid Phase Extraction-Ultraviolet).

ANALYTICAL TESTING VALIDATION

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

4.2.3 Hydroacoustic Monitoring

Measuring efficacy is an important part of any treatment program. Monitoring methods need to be non-intrusive, repeatable, and show consistent and reliable results over time.

Hydroacoustic monitoring has been employed in a robust and systematic fashion. These surveys provided detailed, quantitative metrics of the change in bio-volume and percent cover in treated sites.

HYDROACOUSTICS AND BIOBASE

The sonar system used by DBW is a combination of Lowrance™ High Definition System (HDS®) consumer echosounders and a cloud-based algorithm called BioBase. BioBase is a geo-spatial web platform designed to process Lowrance sonar logs for mapping SAV. The software is retailed by Navico on an annual subscription basis. BioBase generates data on water depth, SAV presence/absence, SAV height, bottom hardness (composition), and biovolume. The Lowrance / BioBase combination has a distinct advantage over other sonar systems for mapping aquatic vegetation by having lower hardware and analysis costs as well as faster processing times (Radomski, 2015). In addition, BioBase outputs are automatically adjusted to Mean Lower Low Tide for consistency across all measurements; an important feature when mapping tidal-influenced systems such as the Delta. The service provided by BioBase offers vegetation point data, interpolated vegetation grids, default maps and tabular data that can be viewed online or downloaded to the subscription holder (BioBase, 2013).

Acoustic and global positioning system (GPS) data are obtained using echosounders connected to 200-Khz 20 degree, single-beam transducers mounted on the research vessels' sterns. When conducting hydroacoustic surveys, the transducer transmits sound pulses through the water column, termed pings, and the return acoustic signals are recorded by the unit. Settings for the echosounders follow those recommended by BioBase. The units are set to collect fifteen acoustic pings per second and GPS coordinates every one millisecond. The internal GPS units are differentially corrected using a Wide-area Augmented System (WAAS). The acoustic and GPS signals are logged to secure digital cards in sl2 format.

Upon completion of a survey, the sonar data is uploaded to BioBase. The algorithm evaluates each ping to determine SAV presence/absence and calculates water depth and a plant height for valid features. These values are concatenated into biovolume, the proportion of plant height occupying the water column. The vegetation data points from the survey are interpolated into a raster grid format and map products are produced from this data. The original vegetation point data and the raster grids are available for download as text files in Comma Separated Values (csv) format.

PYTHON CODES, TOOLS, AND MAP PRODUCTS

Data Processing

Hydroacoustic data collected by DBW staff uses the BioBase Aquatic Map System (BAMS) to analyze data which is then converted into aquatic maps using a series of Python script titled Biovolume Data Correction Workflow (BDCW). The first step of the process is shown in **Figure 1**.

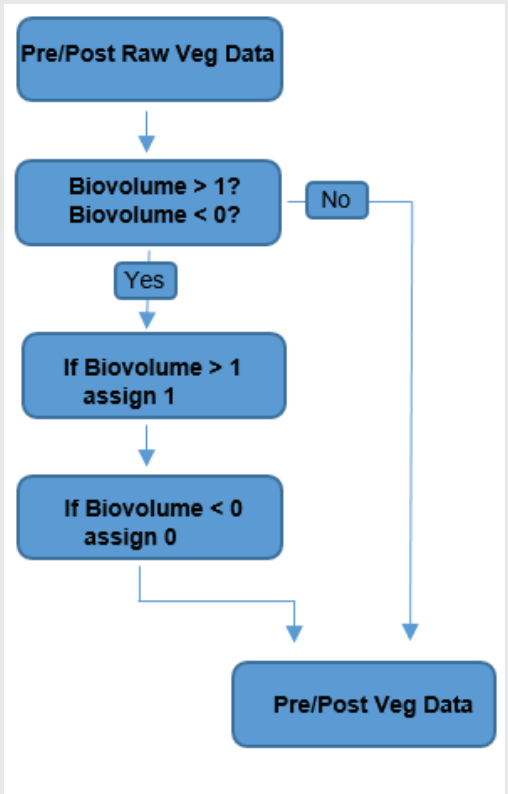

Figure 1. Biovolume Data Correction Workflow

Pre and post grid data are analyzed through a series of steps that are designed to remove negative numbers and values greater than one that do not satisfy the criteria for the aquatic vegetation analysis.

The next step of the process involves the Change Detection Workflow (CDW) which uses a set of geoprocessing operations, including Spline Interpolation, to generate raster surfaces and vegetation percent coverages that are then used to obtain aquatic vegetation change detection and percent cover maps respectively. The logical process is shown in **Figure 2**.

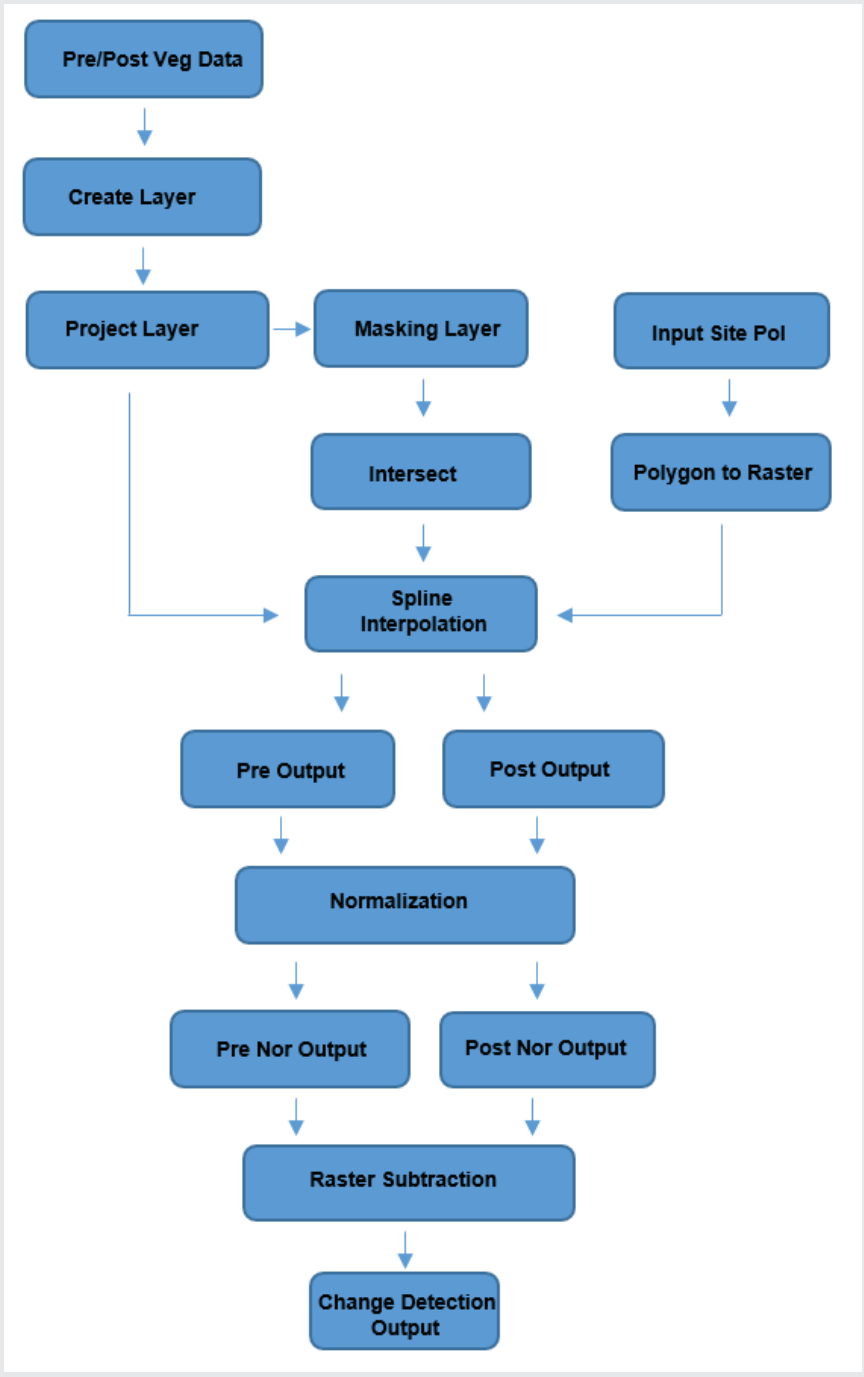

Figure 2. Change Detection Workflow

Biovolume value is the relation between the actual height of the aquatic plant divided by the height of the water column and is ranged from zero to one. Vegetation cover is any sort of aquatic plants present in a water body which has a biovolume greater than 0.05 percent. The percent cover of this vegetation is calculated as vegetation cover divided by the total area surveyed. This parameter is used to compare both the pre- and post- treatment vegetation presence.

MAP PRODUCT

The final biovolume maps show SAV with color gradients: blue indicates areas with no aquatic plants, to red where aquatic plants fill the entire water column, with intermediate gradients of green to yellow to orange. A histogram accompanies each map to show the frequency of biovolume data. A list of biovolume maps for each Diquat treatment site can be found in **Appendix D**.

The two values used are Biovolume data and vegetation cover. Biovolume value is the relation between aquatic plant height divided by the height of the water column, ranging from zero to one.

Vegetation cover is any sort of aquatic plants present in a water body which has a biovolume value greater than 0.05.

A Percent Cover of this vegetation is calculated as vegetation cover divided by the total area surveyed. This parameter is used to compare both the pre and post treatment. A list of Percent Cover maps for each Diquat treatment site can be found in **Appendix E** for Diquat treatments.

In addition to biovolume data, point sample data is overlaid on top to illustrate a sample of the biomass volume and understand which submersed aquatic plants species are found in the area. A list of point sample maps for each treatment site with pre- and post-treatment point sample data can be found in **Appendix F** for Diquat treatments.

SURVEY METHODS

Hydroacoustic surveys were conducted in the treated SAV sites within our program area. Fifty-six sites totaling 1,115 surface acres were selected for treatment and mapped based on confirmation of visual and hydroacoustic surveys for high densities of Brazilian waterweed and other invasive SAV. Pre- and post-treatment hydroacoustic surveys were instituted to accomplish two efficacy-orientated goals. First, the pre- treatment surveys establish a measure of SAV abundance/density at these sites and the level of treatment needed. Second, the post-treatment surveys provide a current assessment of treatment efficacy and will be used to assess the program's overall efficacy on an annual basis. Surveys were completed by various DBW staff using unit research vessels. Since the Delta is comprised of sloughs, riverine areas, and large shallow waterbodies, mapping was divided into two strategic methods. In sloughs and marina areas, transects followed the contours of the shoreline and internal structure (e.g., boat docks, tule islands) and ranged between 5 and 20 meters in width. Transects were performed in water depths ranging from 1 to 15 feet as SAV are shallow-water plants not typically found deeper than 12 feet.

SAV POINT SAMPLE MONITORING

Hydroacoustic mapping is a tool used to measure the abundance of submersed aquatic vegetation in an area but does not identify the plants scanned. Therefore, a new metric was added in the 2017 treatment season – point sampling. Point sample data is gathered by using double-sided rakes that are tossed from the boat and dragged along the bottom substrate bringing the submersed aquatic plants back to the boat. Density and health data of submersed aquatic vegetation were evaluated and rated onto Survey 123.

Rating	Description
1	Stem, leaves, and/or roots are necrotic, mushy, and have little structural integrity.
2	Stem defoliated and partially necrotic (i.e. discolored).
3	Some leaves gone, partially defoliated along stems (i.e. defoliated).
4	Leaves chlorotic or abnormal (i.e. darkened, senescent).
5	Completely healthy, green tissues.

The above health scale was developed for *Egeria densa* and is slightly modified for other submersed aquatic plants evaluated, such as curly leaf pondweed and fanwort.

To measure density, a rake pull is measured from 10% to 100% of a "full rake pull", in 10% increments. An example of a 100% full rake pull would be submersed aquatic plants covering the rake, and the rake is not visible or recognizable. Alternatively, if there is only a fragment of a species found on a rake, less than "10%", it is recorded as a trace amount of the species found.

The amount of rake pulls at each site is dependent on the size of the site. Sites with 1 to 9 acres had 5 rake pulls; 10 to 100 acres had 10 rake pulls; and sites over 100 acres had 15 rake pulls.

4.2.4 FAV Elderberry Surveys

The FAV program conducts treatments in up to 418 defined sites throughout the Delta and its tributaries. Many of these sites are surrounded by riparian habitat containing *Sambucus ssp.* (elderberry shrub) the host plant for VELB, a species listed as threatened (Federal Register 45: 52803-52807), under the Endangered Species Act of 1973 and completely dependent on the elderberry shrub for its reproductive life cycle. AIPCP scientists conducted surveys beginning on May 9 and ending on July 31, 2024. Surveys for shrubs were completed by boat using binoculars.

- On April 3, 2019, DBW was issued a BiOp from the USFWS. In accordance with this BiOp the DBW-AIPCP follows specific guidelines to minimize potential impacts to the VELB resulting from treatment activities. The BiOp states that DBW will conduct a survey of treatment sites to prepare a map that identifies locations of *Sambucus ssp.* and provide this map to field crews.
- In most locations, AIPCP crews will maintain a 100-foot buffer zone for herbicide treatments when elderberry shrubs are present and conduct treatments downwind of elderberry shrubs.
- For selected treatment sites where Priority 1 and Priority 2 treatment occurs adjacent to elderberry shrubs, DBW crews will utilize backpack style spray wands to target herbicide directly onto FAV species.
- Service-approved AIPCP environmental scientists will compare the health of elderberry shrubs at control sites (i.e., not adjacent to treatments) with elderberry shrubs located adjacent to treated sites. If elderberry shrubs located near treatment sites show signs of

adverse effects from treatment AIPCP will develop additional conservation measures to protect elderberry shrubs.

5 MONITORING RESULTS AND DISCUSSION

5.1 Threatened and Endangered Species

The USFWS established incidental take for federally listed species and outlined terms and conditions necessary to minimize the impact of incidental take on listed species. No incidental take of federally listed species occurred in the 2024 season. Since NMFS concurs with USDA and DBW's determination that the proposed AIPCP is not likely to adversely affect federally listed salmonids or green sturgeon, or their habitat, there is no incidental take provided by NMFS in implementing the AIPCP.

5.2 Infestation and Herbicide Application

In 2024, the DBW treated a total of 1,115 acres at 56 sites of the project area for SAV, and 2,649 acres at 173 sites of the project area for FAV. The treated sites encompassed most of the Delta and can be found in **Appendix A,** Figures **A-4** and **A-5, Appendix B,** and Figures **5** through **8** below.

5.2.1 Summary of Herbicide Use

Each crew completed a daily treatment log to record herbicide treatment activities. The 2024 daily treatment log information can be found in **Appendices G-1 and G-2.** Number of crews available, travel time to sites, herbicide label restrictions, and environmental mitigation measures were important factors used when scheduling which sites to treat each day. No applications were made if DO concentrations were between 3.0 mg/L and the California Regional Water Quality Control Board Water Quality Control Plan (Basin Plan) limits (5 mg/L to 7 mg/L, by location) as adopted by the CVRWQCB (California Regional Water Quality Control Board, 1998).

For FAV treated with glyphosate and imazamox, the time to symptom development 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 such as wilting, yellowing, and browning were observed from all treatments. However, as temperatures decreased in October and November, herbicide symptoms were slower to appear due to decreased plant growth rates, which caused a decrease in herbicide uptake and translocation rates. In some cases, treated plants remained floating for a significant amount of time, but most decomposing plants eventually sank into the water column.

In 2024, DBW applied 4,698.6 gallons of glyphosate, 2,286.2 gallons of imazamox, and 0 gallons of 2,4-D for FAV control. DBW treated approximately 2,649 acres of water hyacinth, spongeplant, water primrose, and/or alligatorweed in the Delta and its tributaries. Total herbicide and adjuvant usage for the FAV Program varies from year to year (**Figures 3** and **4**) due to differing infestation levels, treatment start dates, regulatory restrictions, local water conditions, weather conditions, resources, and other factors **(Appendix A)**.

In 2024, the AIPCP SAV program used no fluridone, 4,999.1 gallons of diquat, and 5.944.3 gallons of endothall to effectively treat a total of 1,115 acres of SAV in the Delta. Totals of herbicide usage by product for the SAV program since 2019 are found in **Figure 5**. A breakdown of the SAV acreage treated since 2019 is found in **Figure 6**.

Observations of herbicide symptoms such as bleaching, defoliation and biomass reduction were observed as a result from all treatments. Visible effects of diquat treatment were dark, necrotic plant tissue, defoliation, and biomass reduction within one week post treatment.

The BiOp for the AIPCP states, “The proposed limit of the AIPCP is 15,000 acres per year for all SAV, EAV (emergent aquatic vegetation), and FAV during a 5-year (2018-2022) implementation period.” DBW prioritizes areas that need the most treatment, and the areas treated last year totaled approximately 3,764 acres and fell below the 15,000 acres threshold.

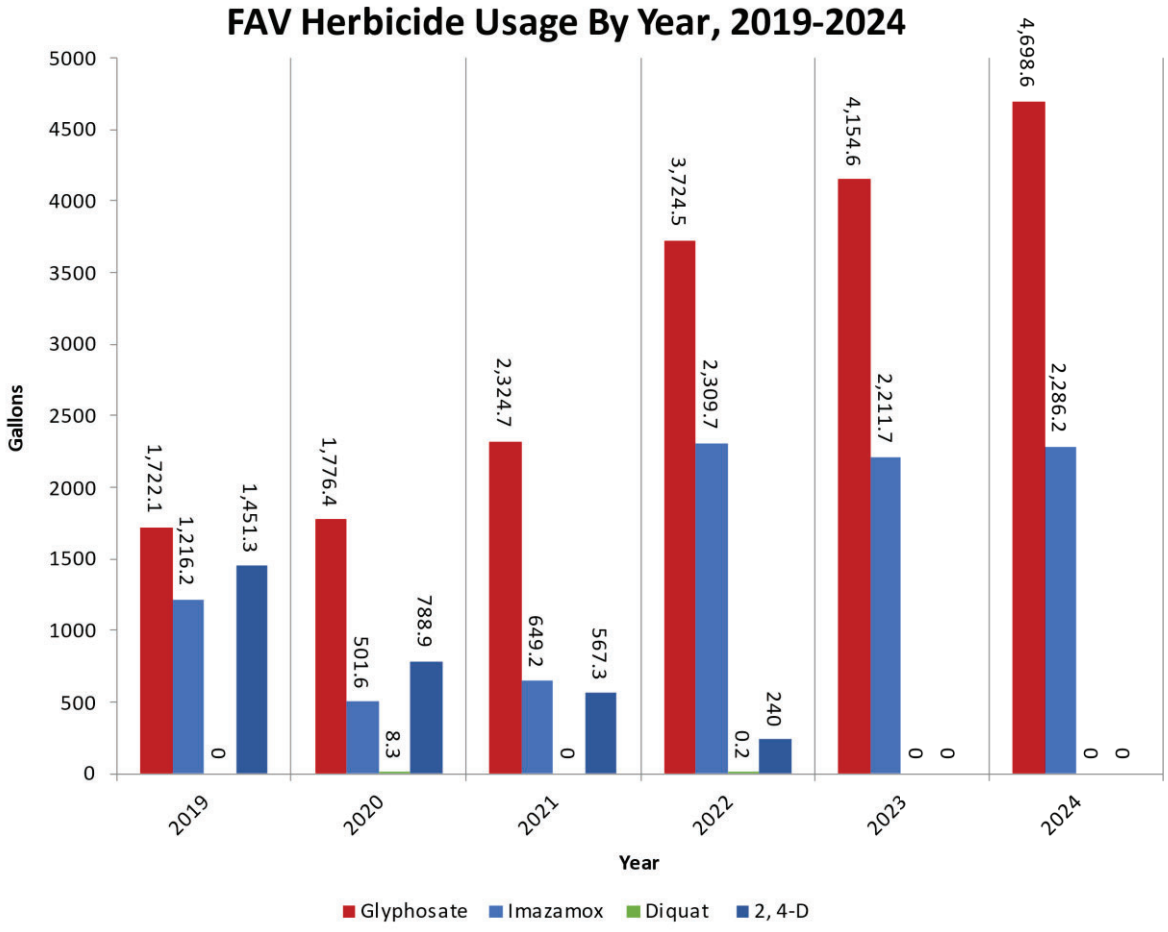

Figure 3. 2,4-D, glyphosate, diquat, and imazamox usage by year from 2019 to 2024

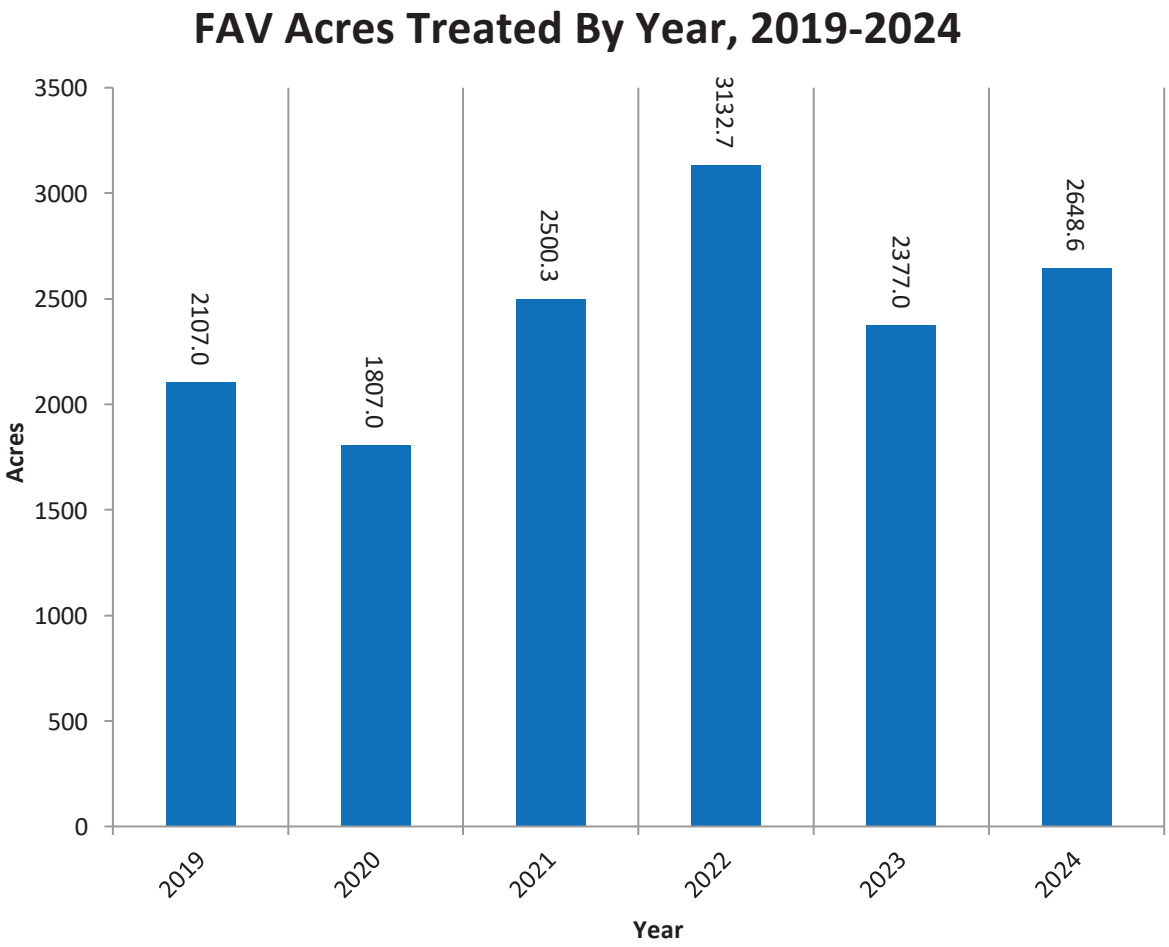

Figure 4. Total FAV Acres Treated by Year, 2019-2024

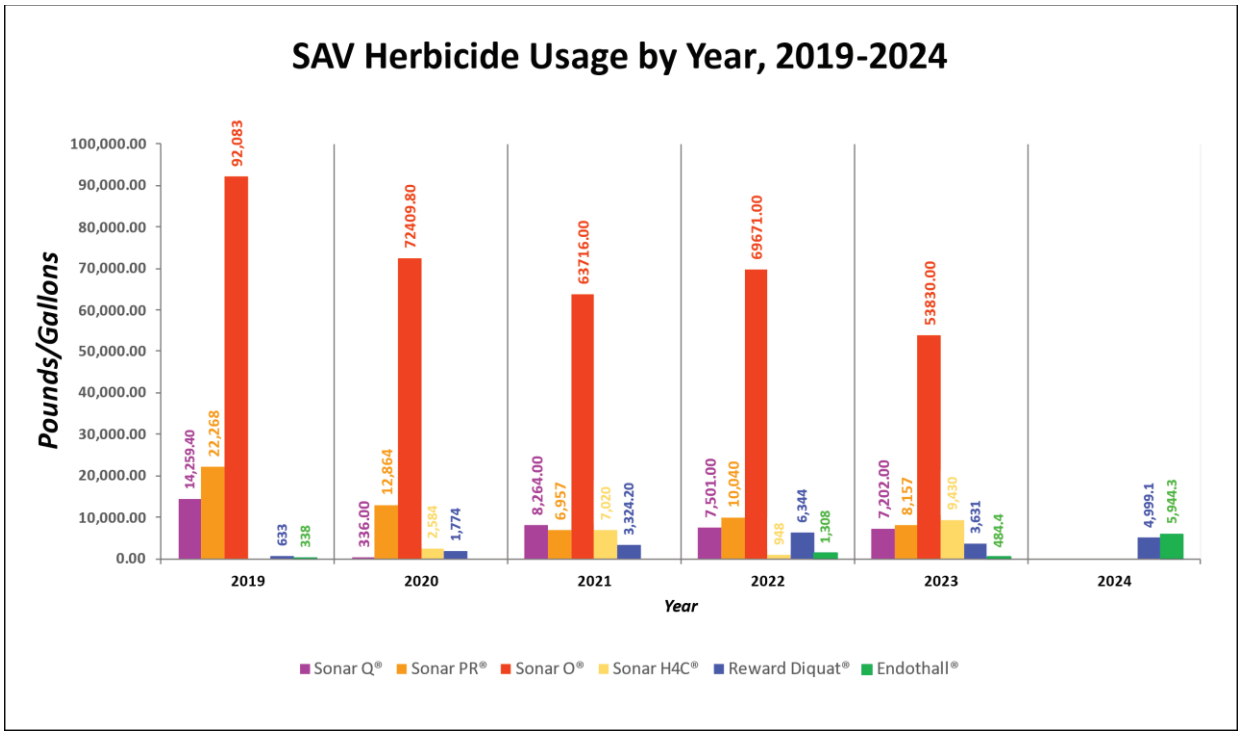

Figure 5. SAV Herbicide usage by year for 2019 to 2024

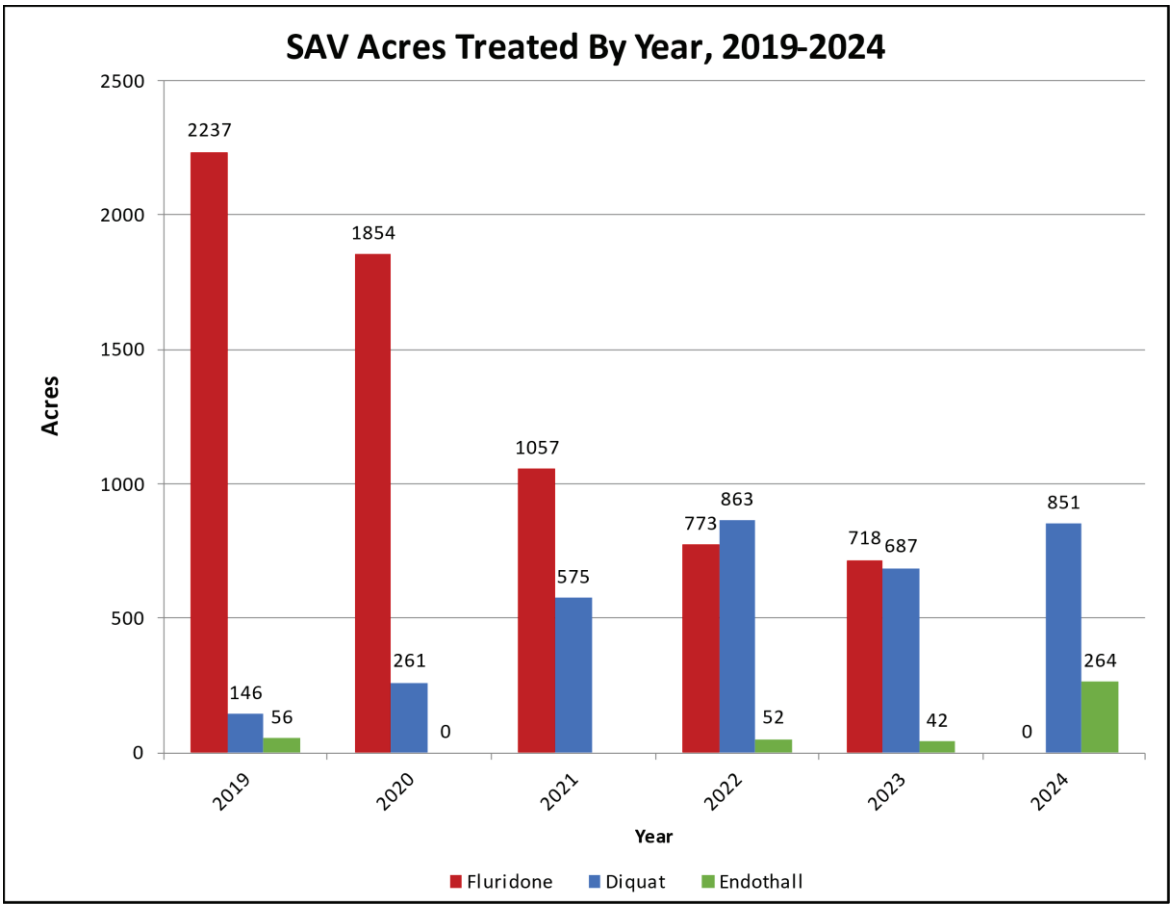

Figure 6. Number of acres of SAV treated from 2019 to 2024

5.3 Monitoring Data and Laboratory Results

5.3.1 NPDES Results

In 2024, a total of 3 sites within the legal Delta were selected as monitoring sites for the SAV and FAV Programs. Field monitoring data and lab results collected, in compliance with the NPDES permit and BiOps, are summarized in **Appendix C.** The 2024 NPDES sites can be found in **Tables 4-1** (SAV) and **4-2** (FAV). The NPDES permit (General Permit No. CAG990005, Water Quality Order No. 2013-0002-DWQ), 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 AIPCP maintains environmental quality measures and meets federal ESA requirements, and that monitoring provides independent statistical validity, DBW aims to maintain a more thorough monitoring plan as resources will allow.

A total of 13 samples were collected during the 2024 treatment season for FAV NPDES monitoring. A total of 6 samples were collected for SAV NPDES monitoring.

DISSOLVED OXYGEN, TURBIDITY AND PH

The average of the measurements taken at "A" (treatment area) and "C" (control site) locations on the sampling day in question will constitute an average natural against which the receiving water "B" (downstream location) measurements will be compared (refer to maps in **Appendix C).**

Dissolved Oxygen

There were no occurrences where DO concentrations were between 3.00 mg/L and the Basin Plan limit (5.00 to 8.00 mg/L, depending on location) during FAV NPDES monitoring. All DO levels measured during FAV NPDES monitoring and sampling efforts for glyphosate and imazamox in 2024 were between 7.38 mg/L and 8.13 mg/L.

There were no occurrences where DO concentrations were between 3.00 mg/L and the Basin Plan limit (5.00 to 8.00 mg/L, depending on location) during SAV NPDES monitoring. All DO levels measured during SAV NPDES monitoring and sampling efforts for diquat and endothall were between 7.89 mg/L and 9.04 mg/L.

There were no observations of injured or impacted wildlife during follow-up visits.

Turbidity

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 limits.

During FAV NPDES monitoring for glyphosate and imazamox, turbidity measurements ranged from 1.4 NTUs to 3.03 NTUs.

During SAV NPDES monitoring for endothall and diquat, turbidity measurements ranged from 0.17 NTUs to 2.05 NTUs.

During the 2024 season, the AIPCP program experienced calibration challenges with a multiparameter digital water quality meter. This resulted in an inaccurate reading of turbidity. However, no significant visual changes to turbidity were observed following treatments. All other water quality parameters for NPDES monitoring functioned properly.

Turbidity ranges fluctuate significantly due to activities that take place in the water such as swimming, boating, skiing, and anything that may disturb sediment in the waterbody. Treatment sites consist of very shallow waterbodies where boat propellers often stir up sediment just by navigating to the site. Sites also include ski runs and high traffic areas that are often used for recreation. Changes to turbidity in post treatment data may have been caused by natural waterway characteristics or propeller wash from the sampling boat. For future data collection, the sampling boat will be shut off so that sediment from propeller wash or boat movement will have time to settle. If the program was responsible for the turbidity violations, the effects were expected to be temporary due to the tidal nature of the Delta, varying hydrodynamics and periodic mixing of the water column. There were no injured or impacted species of concern observed during post-treatment follow-up monitoring.

pH

The Basin Plan Limit for pH shall not cause the ambient pH in the receiving water to fall below 6.50 or exceed 8.50.

There were no occurrences where pH fell below 6.50 or above 8.50 during FAV or SAV NPDES monitoring.

5.3.2 Herbicide Residue Concentrations

Maximum residue limits are based on EPA municipal drinking water standards. Herbicide residue shall not exceed the following concentrations in receiving waters or Municipal and Domestic Supply (MUN) waters. See **Table 5-1** for the maximum receiving water limits for each herbicide used by AIPCP.

Table 5-1. Receiving water limits for herbicides

Herbicide Active Ingredient	Maximum Concentration (MUN)*
2,4-D	70 ppb
Diquat	20 ppb
Endothall	100 ppb
Fluridone	560 ppb
Glyphosate	700 ppb
Imazamox	No receiving water limit

** Municipal and Domestic Supply = MUN*

All herbicide residue concentrations at receiving water locations were either non-detect or as specified in the NPDES permit.

FLURIDONE WATER SAMPLING RESULTS

No fluridone was used during the 2024 season and no water samples were collected because?.

5.3.3 SAV Hydroacoustic Mapping

RESULTS AND CONCLUSION

Below are the results of the hydroacoustic mapping for SAV sites conducted pre- and post-treatment (**Figures 7** and **8**). When comparing changes in SAV before and after diquat treatments, changes in both plant biovolume and percent cover are assessed. Changes in biovolume indicate the amount of plant biomass vertically in the water column. Any changes in percent cover indicate that the lateral distribution of plants has changed. The post-treatment mapping results indicate 54.4% of diquat treatment sites decreased in biovolume and 48.5% of diquat treatment sites decreased in percent cover.

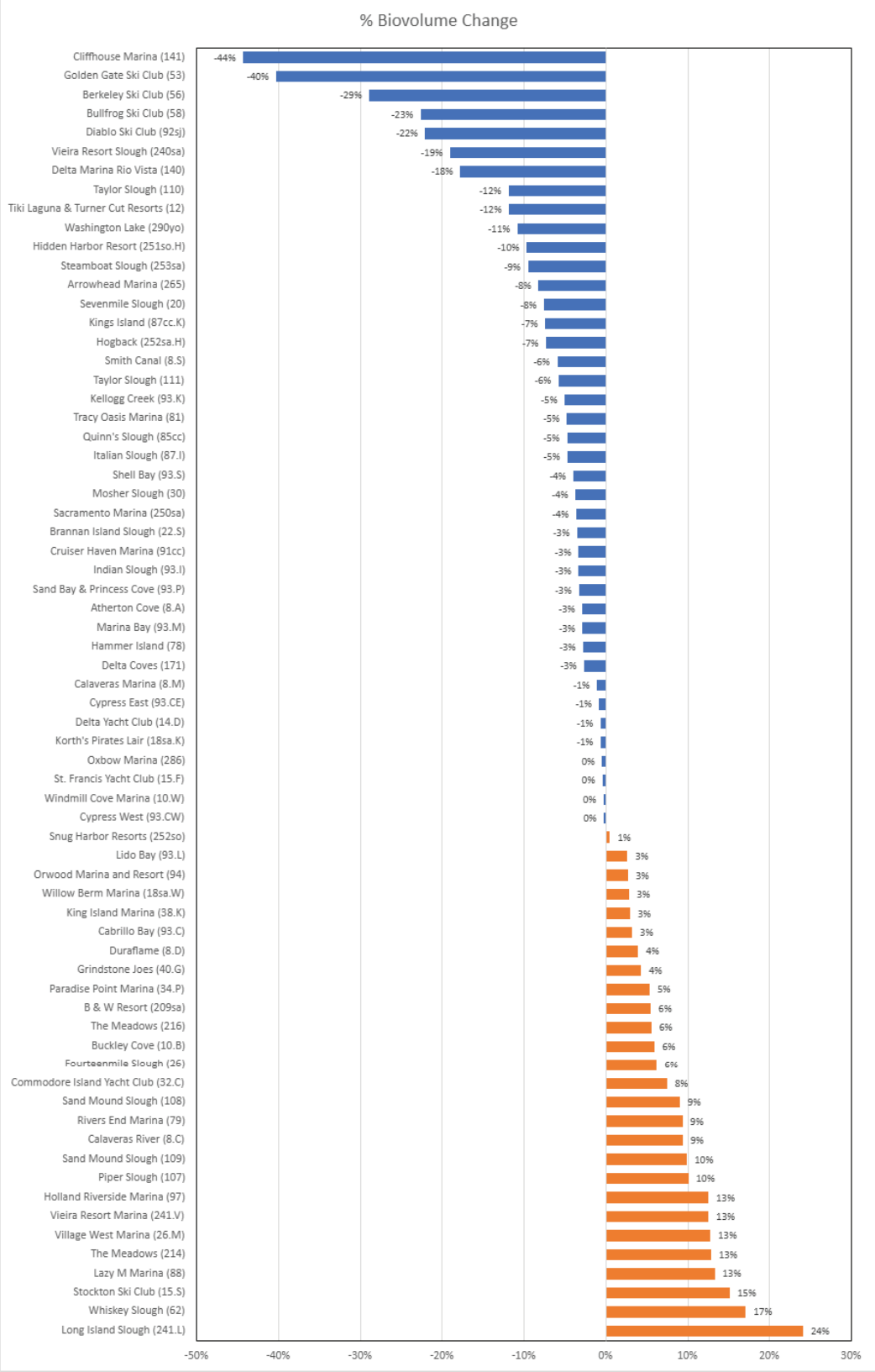

Figure 7. Graph depicting the Mean Percent Change in Biovolume in Diquat Sites between Pre- and Post-Treatment.

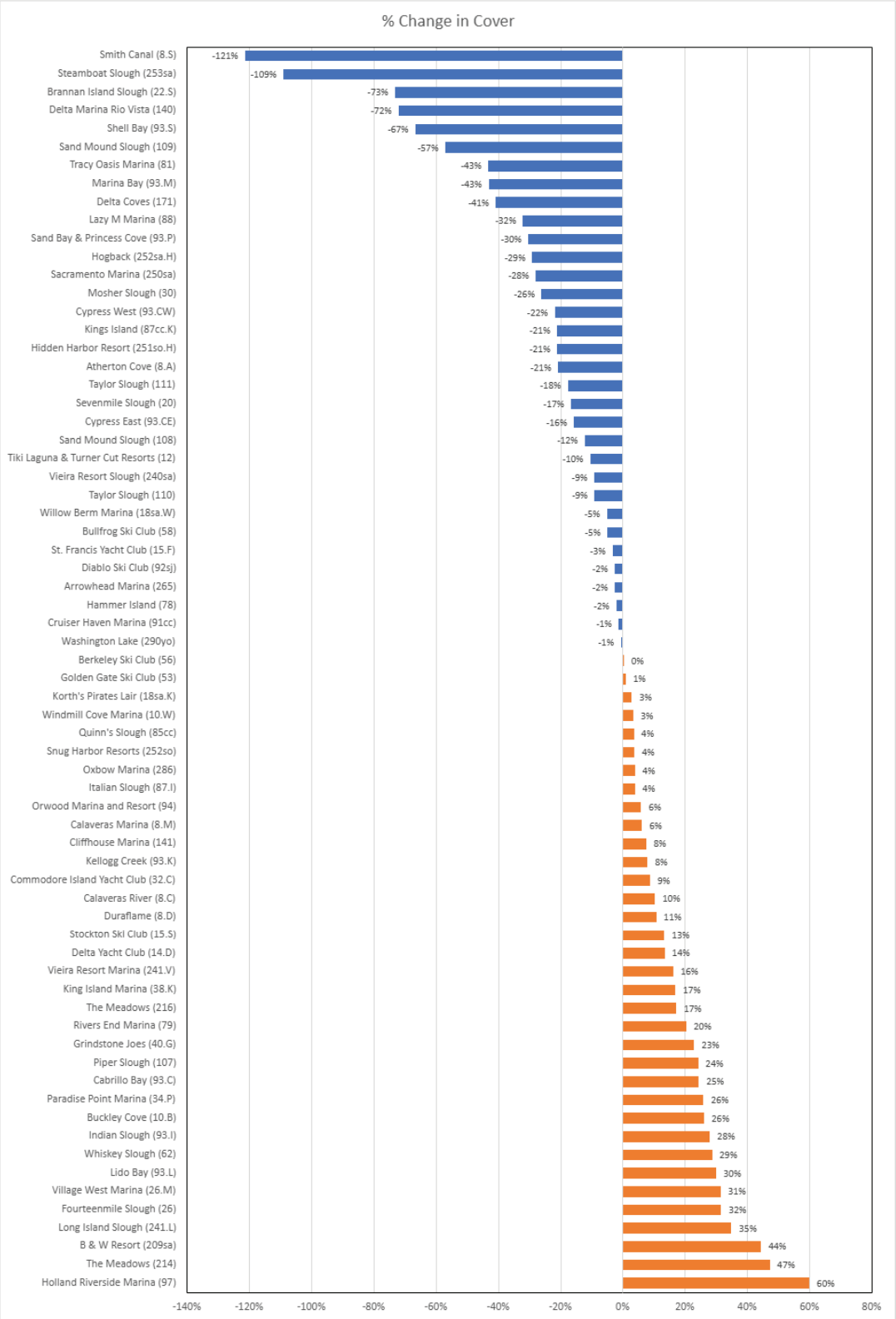

Figure 8. Graph depicting the Mean Percent Change in SAV Cover in Diquat Sites between Pre- and Post-Treatment

5.3.4 SAV Point Sample Monitoring

RESULTS AND CONCLUSION

Analysis was performed for the overall percentages of each of the species collected while rake pulling. Below are the results between the rake pulls conducted pre- and post-treatment (**Table 5-2**). In these results, the "% Change" amounts for each AIPCP controlled plant is based on the change in recorded plant observations from the post rake pull surveys in relation to the pre rake pull surveys. The term "full rake pull" is equivalent to one (1) rake pull filled to 100% or 1.00 rake pull. Thus, the "Difference in Full Rake Pulls" numbers are the physical amounts of observed plant differences between post and pre rake pull surveys.

Table 5-2. Rake Pull Results Summary for Rake Coverage in Diquat Sites

	How Much Total?	Coontail	Curlyleaf Pondweed	Egeria	Eurasian watermilfoil	Fanwort
2024 Pre Diquat	108.2	21.6	0.66	63.3	2.5	16.1
2024 Post Diquat	117.8	29.7	4.07	47.3	10.6	20.8
% Change	8.8%	37.6%	516.7%	-25.4%	328.7%	29.1%
Difference in Full Rake Pulls	9.6	8.1	3.41	-16.1	8.1	4.7

Diquat treatment sites saw slight increases across AIPCP controlled plants, with an overall increase of 8.8% (9.6 full rake pulls). Curlyleaf pondweed increased by 516.7% (3.4 full rake pulls), Eurasian watermilfoil by 328.7% (8.1 full rake pulls) Coontail by 37.6% (8.1 full rake pulls) and Fanwort increased by 29.1% (4.7 full rake pulls). Egeria had a decrease of -25.4% or -16 full rake pulls between pre and post recorded amounts. Although the individual percentage changes for Curlyleaf pondweed and Eurasian watermilfoil are in excess of 100%, the actual difference between pre and post amounts were an increase of 3.41 and 8.1 full rake pulls respectively.

5.3.5 Special Project Report for Aquathol K

In May of 2023 DBW sent a special request to USFWS and asked for approval to use Endothall (Aquathol K) in four sites in the north delta. The request was granted. The report complete with results can be found in Appendix H.

5.3.6 Aquatic Pesticide Application Plan Effectiveness

The APAP describes aquatic pesticides and application methods used for the AIPCP. Herbicide application methods and BMPs were effective in maintaining herbicide residues in receiving water below the maximum concentration limits. In addition, all reporting requirements described in the APAP such as providing a Pest Control Recommendation (PCR), Notice of Intent (NOI) and public notification, were met. NOI were provided to County Agricultural Commissioners at least 24 hours before herbicide applications were made with 2,4-D. The NOI included descriptions, treatment locations, and application rates for restricted use materials in addition to all other herbicides used by the AIPCP. To improve public notifications outreach, DBW used

weekly email notifications through a marketing platform called Constant Contact, available to anyone who subscribes to the distribution list.

6 ACKNOWLEDGEMENTS

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California Department of Fish and Wildlife
California Department of Food and Agriculture
California Department of Water Resources
City of Stockton
Contra Costa Water District
County Agricultural Commissioners
County Sheriffs
County Vector Control Districts
Delta Conservancy
Delta Coves
Delta Protection Commission
Delta Stewardship Council
Lauritzen Yacht Harbor
National Aeronautics and Space Administration
National Oceanic and Atmospheric Administration – National Marine Fisheries Service
Reclamation District 800
Reclamation District 1601
Regents of the University of California, Davis
State Water Resources Control Board
Stockton Sailing Club
Turlock Irrigation District
United States Bureau of Reclamation
United States Department of Agriculture – Agricultural Research Service

United States Fish and Wildlife Service

A special thanks to:

Various Chambers of Commerce
Stakeholders and Members of the Public
Numerous Legislative Offices

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