California Department of Water Resources
Aquatic Pesticides Application Plan
Water Quality Order No. 2013-0002-DWQ
Statewide General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
%R	percent recovery
APAP	Aquatic Pesticide Application Plan
Banks Pumping Plant	Harvey O. Banks Pumping Plant
BG	background
BMP	best management practice
Cal/OSHA	California Occupational Safety and Health Administration
CDFW	California Department of Fish and Wildlife
COC	chain-of-custody
Delta	Sacramento–San Joaquin River Delta
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
EPA	U.S. Environmental Protection Agency
FB	field blank
FD	field duplicate
HDPE	high-density polyethylene
IPM	Integrated Pest Management
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
MB	method blank
MIB	2-methylisoborneol
MP	Mile Post
MS	matrix spike
MSD	matrix spike duplicate
ND	non-detect
NMFS	National Marine Fisheries Service
PCA	Pest Control Adviser
Permit	Statewide General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications
QA/QC	quality assurance and quality control
QAC	Qualified Applicator Certificate
QAL	Qualified Applicator License
RPD	relative percent difference
RWQCB	Regional Water Quality Control Board
Skinner Fish Facility	Skinner Delta Fish Protective Facility
SWP	California State Water Project
SWRCB	State Water Resources Control Board
USFWS	U.S. Fish and Wildlife Service

1 Introduction

The Statewide General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, herein referred to as the "Permit," was adopted on March 5, 2013, and became active on December 1, 2013. The California Department of Water Resources (DWR) prepared and submitted a Notice of Intent and Aquatic Pesticide Application Plan (APAP), and received coverage under the Permit to conduct algaecide and/or aquatic herbicide applications, when necessary, to California State Water Project (SWP) aqueducts, forebays, and reservoirs, as listed in Table 1. Figures 1 through 24 show the locations of SWP facilities that may require use of algaecides and/or aquatic herbicides.

A Mitigated Negative Declaration was prepared by DWR to comply with the California Environmental Quality Act associated with regulatory requirements established by the State Water Resources Control Board (SWRCB). DWR, a public entity, was granted a State Implementation Policy Section 5.3 Exception by SWRCB for the use of copper at the following six water bodies (Water Quality Order 2004-0009-DWQ):

- Clifton Court Forebay
- Castaic Lake
- Lake Perris
- South Bay Aqueduct
- Coastal Branch Aqueduct
- East Branch Aqueduct

In 2014, DWR prepared another Mitigated Negative Declaration and applied for a State Implementation Policy Section 5.3 Exception for the use of copper at the following four additional water bodies:

- O'Neill Forebay
- Pyramid Lake
- Silverwood Lake
- Quail Lake

DWR has previously received approval to apply the following algaecides and aquatic herbicides:

- Copper
- Diquat
- Endothall
- Fluridone
- Glyphosate
- Imazamox
- Sodium carbonate peroxyhydrate
- Triclopyr

The above-listed active ingredients may be applied on an as-needed basis to control aquatic weeds and algal blooms. Aquatic weed control is needed to properly store and convey water, and algal bloom control is needed to address impacts to drinking water quality due to objectionable tastes and odors, production of algal toxins, clogging of filters, and reduction in water flows. DWR is adding the following algaecides and aquatic herbicides to the list of active ingredients that may be used for treatment of SWP facilities:

- Flumioxazin
- Hydrogen peroxide
- Imazapyr
- Penoxsulam
- Peroxyacetic acid

When treating SWP water bodies listed herein, DWR may use adjuvants labeled for aquatic use to increase the effectiveness of algaecides and/or aquatic herbicides.

This APAP provides for the continued application of algaecides and/or aquatic herbicides to control aquatic weeds and algal blooms at SWP reservoirs and aqueducts operated by DWR, as listed in Table 1. Figure 1, Project Locations, provides an overview map of SWP facilities covered under the Permit. Figures 2 through 24 provide area maps for each of the reservoirs, aqueducts, and drainage ditches covered under the Permit. The facilities are within the boundaries of five Regional Water Quality Control Boards (RWQCBs). In the case of algaecide and/or aquatic herbicide application in the Lahontan Region, DWR must obtain a site-specific prohibition exemption from the Lahontan RWQCB prior to making an application to comply with the Lahontan RWQCB's discharge requirements.

Table 1. Aquatic Weed and Algal Bloom Control Programs in the California State Water Project

Site	Region (RWQCB)[1]	County	Typical Problem Biota	Associated Problems
Reservoirs and Forebays				
Thermalito Diversion Pool	5	Butte	Algae, aquatic weeds, and cyanobacteria	Reduced water flow and toxins
Thermalito Forebay	5	Butte	Algae, aquatic weeds, and cyanobacteria	Navigation, recreation safety, reduced water flow, toxins
Thermalito Afterbay	5	Butte	Algae, aquatic weeds, and cyanobacteria	Navigation, recreation safety, reduced water flow, toxins
Clifton Court Forebay	5	Contra Costa	Algae, aquatic weeds, and cyanobacteria	Taste and odor, toxins, trash rack and/or filter clogging
Bethany Reservoir	5	Alameda	Algae, aquatic weeds, and cyanobacteria	Filter clogging, reduced water flows, taste and odor, toxins
Dyer Reservoir	2	Alameda	Algae, aquatic weeds, and cyanobacteria	Filter clogging, reduced water flows, taste and odor, toxins
Patterson Reservoir	2	Alameda	Algae, aquatic weeds, and cyanobacteria	Filter clogging, reduced water flows, taste and odor, toxins
Lake Del Valle	2	Alameda	Algae, aquatic weeds, and cyanobacteria	Filter clogging, reduced water flows, taste and odor, toxins
O'Neill Forebay	5	Merced	Algae, aquatic weeds, and cyanobacteria	Navigation, taste and odor, toxins, trash rack and/or filter clogging, unsafe recreation
San Luis Reservoir	5	Merced	Cyanobacteria	Taste and odor, toxins
Los Banos Creek Detention Dam and Reservoir	5	Merced	Aquatic weeds	Impaired dam toe drain function, reduced water flows
Quail Lake	6	Los Angeles	Algae, aquatic weeds, and cyanobacteria	Reduced water flow, toxins

Table 1. Aquatic Weed and Algal Bloom Control Programs in the California State Water Project

Site	Region (RWQCB)[1]	County	Typical Problem Biota	Associated Problems
Pyramid Lake	4	Los Angeles	Algae, aquatic weeds, and cyanobacteria	Taste and odor, toxins, navigation, recreation safety
Castaic Lake	4	Los Angeles	Algae, aquatic weeds, and cyanobacteria	Filter clogging, taste and odor, toxins, recreation safety
Silverwood Lake	6	San Bernardino	Algae, aquatic weeds, and cyanobacteria	Taste and odor, toxins, recreation safety
Lake Perris	8	Riverside	Algae, aquatic weeds, and cyanobacteria	Filter clogging, taste and odor, toxins, navigation, recreation safety
Aqueducts, Canals, and Rivers				
Thermalito Power Canal	5	Butte	Aquatic weeds	Reduced water flows, trash rack and/or filter clogging
Lower Feather River (river mile 64 to river mile 54)	5	Butte	Aquatic weeds and non-native invasive weeds	Reduced water flow, recreation safety, fish passage, non-native weed management
California Aqueduct (MPs 0.0–0.93, intake channel at MP 0.93 to Harvey O. Banks Pumping Plant, MPs 249.65–250.99, MPs 277.31–278.13, MPs 279.05–280.45, and MPs 285.69–292.16)	4, 5, 8	Contra Costa, Kern, Alameda, San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Los Angeles, San Bernardino, and Riverside	Algae, aquatic weeds, and cyanobacteria	Aquatic weeds, reduced water flows, taste and odor, trash rack and/or filter clogging
South Bay Aqueduct	2, 5	Alameda	Algae, cyanobacteria, and diatoms	Taste and odor, toxins, trash rack and/or filter clogging
Coastal Branch Aqueduct	5	Kings and Kern	Algae, aquatic weeds, and cyanobacteria	Filter clogging, taste and odor
East Branch Aqueduct	6	Kern, Los Angeles, and San Bernardino,	Algae, aquatic weeds, and cyanobacteria	Aquatic weeds, taste and odor, toxins, trash rack and/or filter clogging

RWQCB = Regional Water Quality Control Board; MP = Mile Post.

1 RWQCB regions are as follows: Region 2 – San Francisco Bay; Region 4 – Los Angeles; Region 5 – Central Valley; Region 6 – Lahontan; Region 8 – Santa Ana.

2 Project Background

DWR operates and manages the SWP, the largest state-built, multipurpose water project in the United States. The SWP depends on a complex system of dams, reservoirs, power plants, pumping plants, and aqueducts to deliver water. The SWP provides drinking water to 27 million Californians, and SWP water is used to irrigate approximately 750,000 acres of farmland, mainly in the south San Joaquin Valley. Also, the SWP was designed and built to control floods, generate power, provide recreational facilities, and enhance habitats for fish and wildlife.

The mission of DWR is to manage the water resources of California in cooperation with other agencies; to benefit Californians; and to protect, restore, and enhance the natural and human environments. To carry out this mission, DWR routinely monitors and tests water samples from its reservoirs, aqueducts, and other water supply facilities to monitor compliance with state and federal requirements for safe drinking water quality.

Water quality monitoring provides detailed information on concentrations and distribution of chemical, physical, and biological properties at more than 40 stations throughout the SWP. Objectives of this monitoring are as follows:

- Assess the influence of hydrological conditions and DWR operations on water quality
- Document long-term changes in SWP water quality
- Provide water quality data to assess water treatment plant operational needs
- Identify, monitor, and respond to water quality emergencies and determine impacts to the SWP
- Provide data needed to determine if State Water Contracts Article 19 and SWRCB Drinking Water Standards are being met
- Assess issues of concern through special studies

DWR applies algaecides and aquatic herbicides for two main purposes: to control cyanobacteria, also known as planktonic or blue-green algae, which can produce objectionable taste and odor and toxic compounds, and to control aquatic weeds and algae that can negatively impact water storage and conveyance for municipal, irrigation, and industrial purposes.

3 Description of Water Systems

This chapter provides a description of the DWR water systems covered under the Permit.

3.1 Thermalito Diversion Pool

The 298-acre Thermalito Diversion Pool is a reservoir on the Feather River, approximately 4.5 miles downstream of Oroville Dam (Figure 2, Thermalito Diversion Pool). The site is within the jurisdiction of the Central Valley RWQCB, Region 5. Water from the diversion pool is diverted to the Thermalito Power Canal and Forebay by the Thermalito Diversion Dam, which has a maximum operating storage of 13,350 acre-feet. The Thermalito Diversion Pool also creates a tailwater pool for the Edward Hyatt Powerplant and acts as a forebay when the Hyatt Powerplant is pumping water back into Lake Oroville.

3.2 Thermalito Power Canal

The Thermalito Power Canal is a 10,000-foot-long concrete-lined canal that extends from the Thermalito Diversion Pool to Thermalito Forebay; it is within the borders of the Central Valley RWQCB, Region 5 (Figure 3, Thermalito Power Canal). The site includes perennial drainage ditches that flow into the Thermalito Power Canal or run along access roads.

3.3 Thermalito Forebay

The Thermalito Forebay is an off-stream reservoir downstream of Lake Oroville and approximately 4 miles west of the City of Oroville; it is within the borders of the Central Valley RWQCB, Region 5 (Figure 4, Thermalito Forebay). The forebay has a storage capacity of 11,768 acre-feet, a surface area of 630 acres, 10 miles of shoreline, and a water surface elevation of 225 feet. The site also includes three perennial drainage ditches. Water enters the forebay from the Thermalito Power Canal and exits at the Thermalito Pumping/Generating Plant, which leads to the Thermalito Afterbay.

3.4 Thermalito Afterbay

The Thermalito Afterbay is an off-stream reservoir approximately 6 miles southwest of the City of Oroville and 2 miles southwest of the Thermalito Forebay (Figure 5, Thermalito Afterbay). It is under the jurisdiction of the Central Valley RWQCB, Region 5. It has a maximum operating storage of 57,040 acre-feet, a surface area of 4,300 acres, and 17 miles of shoreline. Water stored in the afterbay may be pumped back into Lake Oroville or used to produce controlled flow in the Lower Feather River. It also serves as a warming basin for agricultural water delivered to the numerous rice and grain fields west of the Thermalito Afterbay.

3.5 Lower Feather River

The Lower Feather River conveys water releases from Lake Oroville and the Thermalito Complex to the Sacramento River (Figure 6, Lower Feather River), which subsequently flows to the Sacramento–San Joaquin River Delta (Delta). The Lower Feather River falls under the jurisdiction of the Central Valley RWQCB, Region 5.

Daily flows in the river are typically held at 300 cubic feet per second, although periodic high-flow releases from Lake Oroville may exceed 50,000 cubic feet per second. The segment of the Lower Feather River that may be treated with algaecides and/or aquatic herbicides stretches from River Mile 68 (Thermalito Fish Barrier Dam) to River Mile 54 (FERC Project Area South Boundary).

3.6 Clifton Court Forebay

Clifton Court Forebay is in the southeast corner of Contra Costa County, approximately 10 miles northwest of the City of Tracy and within the borders of the Central Valley RWQCB, Region 5 (Figure 7, Clifton Court Forebay). The forebay is a shallow, 31,258-acre-foot reservoir covering 2,180 acres at the head of the California Aqueduct. Water enters the forebay via a gated structure connected at the West Canal, a channel of the Old River that allows Delta water to enter the forebay.

The forebay provides storage for off-peak pumping, and permits regulation of flows into the Harvey O. Banks Pumping Plant (Banks Pumping Plant). Inflows to the forebay are generally made during high tides. Construction of the forebay was completed in December 1969. Clifton Court Forebay has been treated with aquatic herbicides to reduce aquatic weeds that clog and obstruct the primary and secondary trash racks at the Skinner Delta Fish Protective Facility (Skinner Fish Facility) and the Banks Pumping Plant. In addition, taste- and odor-causing and toxin-producing cyanobacteria have been controlled with copper sulfate.

3.7 California Aqueduct

The California Aqueduct conveys SWP water from the Delta to agricultural lands in the San Joaquin Valley and to residential, municipal, and industrial users in the East Bay region, Central Coast Region, and Southern California.

The California Aqueduct begins on the western edge of the Clifton Court Forebay and terminates at Lake Perris at Mile Post (MP) 440.97. It conveys water through the Skinner Fish Facility at MP 0.89 to the Banks Pumping Plant at MP 3.04. After the Banks Pumping Plant, the California Aqueduct travels a short distance to the Bethany Reservoir (MP 4.49), where water can be diverted to the South Bay Aqueduct. After the Bethany Reservoir, the California Aqueduct continues 60 miles to O'Neill Forebay. At O'Neill Forebay, water can be pumping into San Luis Reservoir. Downstream of O'Neill Forebay, the California Aqueduct continues through open canals (except for several small siphons) past the diversion to the Coastal Branch Aqueduct at MP 184.63 to the Edmonston Pumping Plant at MP 293.45. From the beginning of the California Aqueduct to the Edmonston Pumping Plant, the California Aqueduct is fully within the borders of the Central Valley RWQCB, Region 5. The Edmonston Pumping Plant lifts the water 1,926 feet into a series of pipelines through the Tehachapi Range where it is ultimately released into the Tehachapi Afterbay, 0.5 miles upstream of the bifurcation and the start of the East and West Branch Aqueducts. This final 0.5 miles of the California Aqueduct is within the boundaries of the Lahontan RWQCB, Region 6.

Portions of the California Aqueduct that may be treated with algaecides and/or aquatic herbicides under the Permit are as follows:

- MPs 0.0–0.93; Clifton Court Forebay to fish screens (Figure 8A, California Aqueduct from Mile Marker 0.0 to 0.93)

- Intake channel at MP 0.93; Skinner Fish Facility to Banks Pumping Plant (Figure 8B, California Aqueduct from Mile Marker 0.93 to BAPP)
- MPs 249.65–250.99; spillway to Buena Vista Pumping Plant (Figure 8C, California Aqueduct from Mile 246.65 to 250.99)
- MPs 277.31–278.13; Arvin-Edison turnout to Teerink Pumping Plant (Figure 8D, California Aqueduct from Mile 277.31 to 278.13)
- MPs 279.05–280.45; Chrisman Headworks Road to Chrisman Pumping Plant (Figure 8E, California Aqueduct from Mile 279.05 to 280.45)
- MPs 285.69–292.16; Interstate 5 to Pastoria Creek Siphon (Figure 8F, California Aqueduct from Mile 285.69 to 292.16)

3.8 Bethany Reservoir

Bethany Reservoir is an enlarged section of the California Aqueduct approximately 1 mile downstream from the Banks Pumping Plant near the town of Byron (Figure 9, Bethany Reservoir). Located within the borders of the Central Valley RWQCB, Region 5, the reservoir has a capacity of 5,070 acre-feet. Water from Bethany Reservoir exits via the South Bay Aqueduct and supplies water to downstream water retailers.

3.9 Dyer Reservoir

Dyer Reservoir is a small storage facility within the boundaries of the San Francisco Bay RWQCB, Region 2 (Figure 10, Dyer Reservoir). The reservoir was completed by DWR in 2011 as part the enlargement of the South Bay Aqueduct Branch of the SWP. Dyer Reservoir serves the primary purposes of increasing water reliability by providing water to treatment plants during power interruptions, lowering power costs, and improving quality of delivered water. The reservoir has a maximum storage capacity of 515 acre-feet, a surface area of 24 acres, and a depth of approximately 25 feet. Water is pumped into the Dyer Reservoir from the Bethany Reservoir and discharged into the Dyer Canal, the first aqueduct reach of the South Bay Aqueduct.

3.10 South Bay Aqueduct

The South Bay Aqueduct originates at Bethany Reservoir, crossing from the Central Valley RWQCB, Region 5, to the San Francisco Bay RWQCB, Region 2. Completed in 1966, the 42-mile-long system supplies water to three water retailers (Zone 7 Water Agency, Alameda County Water District, and Santa Clara Valley Water Agency) in Alameda and Santa Clara Counties in the San Francisco Bay area, serving approximately 2 million residents. It currently supplies approximately 170,000 acre-feet of water annually for groundwater replenishment and for six municipal water treatment plants (Figure 11, South Bay Aqueduct); 11 miles of the system is open aqueduct, with the remainder consisting of pipelines and tunnels.

The open aqueduct section begins at the Backsurge Pool (MP 3.25) to Dyer Altamont Check (MP 5.15), and then continues as a pipeline for approximately 2.5 miles. The open aqueduct section continues from MP 7.48 to Del Valle Check 7 (MP 16.32), at which point the South Bay Aqueduct becomes a pipeline again to the terminus at the Santa Clara terminal tank (MP 42.18). During this last pipeline stretch, the Del Valle Pipeline can divert water to and from Del Valle Reservoir for storage. Due to the shallow water (approximately 5 feet deep), filter-clogging diatoms and taste- and odor-causing cyanobacteria create water quality and delivery problems from approximately March through October each year.

3.11 Patterson Reservoir

Patterson Reservoir, an expansion of the South Bay Aqueduct, is a small storage facility within the boundaries of the San Francisco Bay RWQCB, Region 2 (Figure 12, Patterson Reservoir). The primary purpose of the reservoir is to increase water reliability by providing water to the Zone 7 Water Agency Patterson Pass Water Treatment Plant during power interruptions, lowering power costs and improving the quality of delivered water. Patterson Reservoir has a surface area of 4.2 acres, a storage capacity of 90 acre-feet, and 0.3 miles of shoreline.

Water enters the reservoir from the South Bay Aqueduct through a weir at MP 9.36. Water exits the reservoir through the intake for Zone 7 Water Agency's Patterson Pass Water Treatment Plant. At high water elevations, water within Patterson Reservoir can mix with incoming water from the South Bay Aqueduct and return over the weir back into the South Bay Aqueduct. When the water level is lowered below the height of the weir, the reservoir and aqueduct are hydrologically separated.

3.12 Lake Del Valle

Lake Del Valle is a storage reservoir 10 miles south of the City of Livermore, within the boundaries of the San Francisco Bay RWQCB, Region 2 (Figure 13, Lake Del Valle). The lake has a capacity of 40,000 acre-feet, spans 5 miles, and has 16 miles of shoreline. Water from Lake Del Valle enters and exits via the South Bay Aqueduct. Natural flows enter the reservoir from Arroyo Valle, and water is released back into Arroyo Valle below the dam.

3.13 O'Neill Forebay

O'Neill Forebay is approximately 10 miles west of Los Banos in Merced County and is within the borders of the Central Valley RWQCB, Region 5 (Figure 14, O'Neill Forebay). The forebay has a capacity of 56,433 acre-feet, a surface area of 2,700 acres, 12 miles of shoreline, and a maximum depth of approximately 40 feet.

O'Neill Forebay receives Delta water via the California Aqueduct (SWP facility) and the Delta–Mendota Canal (federal Central Valley Project facility). The Gianelli Pumping-Generating Plant, operated by DWR, pumps water from O'Neill Forebay into San Luis Reservoir for storage beginning in fall or for temporary storage to generate electricity when water is released from the reservoir back into O'Neill Forebay. During irrigation months, water is released into O'Neill Forebay and into the Delta–Mendota Canal or the San Luis Canal (California Aqueduct between MPs 70.85 and 172.44) and flows by gravity to Dos Amigos Pumping Plant where it is lifted more than 100 feet to allow gravity flow for 165 miles to the Buena Vista Pumping Plant. Water is lifted at several pumping plants and continues down the California Aqueduct to water contractors serving customers in Southern California.

3.14 San Luis Reservoir

The San Luis Reservoir lies at the base of the foothills on the west side of the San Joaquin Valley in Merced County, approximately 2 miles west of O'Neill Forebay (Figure 15, San Luis Reservoir). Impounded by Sisk Dam, the reservoir falls within the boundaries of the Central Valley RWQCB, Region 5, and provides off-stream storage for excess winter and spring flows diverted from the Delta. The San Luis Reservoir has a capacity of more than 2 million acre-feet and is a shared SWP and Central Valley Project facility.

3.15 Los Banos Creek Detention Dam and Reservoir

Los Banos Creek Detention Dam and Reservoir are approximately 7 miles southwest of Los Banos in Merced County and within the boundaries of the Central RWQCB, Region 5 (Figure 16, Los Banos Creek Detention Dam and Reservoir). Los Banos Creek Reservoir drains approximately 160 square miles in the Diablo Mountain Range. The reservoir has a maximum operating storage of 34,562 acre-feet. At maximum operating storage, the reservoir has a water surface elevation of 353.5 feet, a water surface area of 620 acres, and 12 miles of shoreline. Los Banos Creek Detention Dam is a joint-use facility owned by the Bureau of Reclamation and operated and maintained by DWR. The site also includes a box culvert canal drain east of the California Aqueduct at MP 79.02 where released water flows to Los Banos Creek (Figure 17, Box Culvert Drain to Los Banos Creek).

From September through March, 14,000 acre-feet is maintained by controlled releases through the outlet works to provide flood protection for the San Luis Canal, Delta–Mendota Canal, City of Los Banos, and other downstream developments. The dam has two discharge lines and a spillway that releases water to a basin at the toe of the dam. The toe drain collects seepage water from the dam.

3.16 Coastal Branch Aqueduct

The Coastal Branch Aqueduct originates at MP 184.63 of the California Aqueduct, near Kettleman City, and extends 115 miles to near Vandenberg Air Force Base in San Luis Obispo County (Figure 18, Coastal Branch Aqueduct). Most of the aqueduct system consists of enclosed pipelines and tunnels. Algae and aquatic weed problems are restricted to the first 14.8-mile open section of the aqueduct, beginning at the junction of the California Aqueduct to Devil's Den Pumping Plant and the forebays of Bluestone and Polonio Pass Pumping Plants. The treated section is within the boundaries of the Central Valley RWQCB, Region 5.

3.17 Quail Lake

Quail Lake is a reservoir on the West Branch of the California Aqueduct in the Tejon Ranch area of western Antelope Valley in Los Angeles County and within the boundaries of the Lahontan RWQCB, Region 6 (Figure 19, Quail Lake). Quail Lake provides fish and wildlife habitat, recreation, and regulatory water storage for generating electricity at DWR's William E. Warne Powerplant during peak demand periods. Quail Lake has a maximum volume of 7,580 acre-feet and a surface area of 290 acres. SWP water enters Quail Lake from the West Branch Aqueduct and exits via the Lower Quail Canal into the Peace Valley Pipeline.

3.18 Pyramid Lake

Pyramid Lake is a reservoir on the West Branch of the California Aqueduct at MP 14.10 and is within the boundaries of the Los Angeles RWQCB, Region 4 (Figure 20, Pyramid Lake). It has a surface area of 1,300 acres, a storage capacity of 171,200 acre-feet, a length of 25,300 feet, and 21 miles of shoreline. SWP water enters Pyramid Lake from the Peace Valley Pipeline via the William E. Warne Power Plant and exits the lake through the Angeles Tunnel, which feeds into Elderberry Forebay and Castaic Lake. Natural inflows enter Pyramid Lake from Piru Creek, Los Alamos Creek, and Gorman Creek. Flows are released from Pyramid Dam to Piru Creek.

As an SWP reservoir, Pyramid Lake stores water that is delivered to the City of Los Angeles and other cities of Southern California. It also provides cooling water for the William E. Warne Power Plant; regulated storage for the Castaic Pumping-Generating Powerplant; flood protection along Piru Creek; emergency storage for water deliveries from the West Branch; fish and wildlife enhancement; and various recreational uses, including fishing, swimming, and boating.

3.19 Castaic Lake

Castaic Lake is the terminal reservoir on the West Branch of the California Aqueduct, 45 miles northwest of Los Angeles and within the boundaries of the Los Angeles RWQCB, Region 4 (Figure 21, Castaic Lake). The lake, completed in 1974, has four main purposes: providing emergency storage in the event of shutdown of the California Aqueduct to the north, acting as a regulatory storage facility for deliveries during normal operation, providing recreation, and providing fish and wildlife enhancement.

Castaic Lake has a maximum operating storage of 323,700 acre-feet and a surface area of 2,240 acres. SWP water enters the lake from Elderberry Forebay and exits at the outlet tower, which feeds several local districts' supply pipelines. Natural inflows enter Castaic Lake from Castaic Creek and Fish Creek via Elderberry Forebay and Elizabeth Canyon Creek. Castaic Lake supplies water to Castaic Lagoon through the Castaic Creek discharge channel.

3.20 East Branch Aqueduct

The California Aqueduct divides into two branches at the bifurcation in Tehachapi Afterbay at MP 303.92. The West Branch extends for 32 miles, passing through Pyramid Lake to the terminus at Castaic Lake. The East Branch continues approximately 140 miles from the bifurcation with the West Branch to its terminus at Lake Perris at MP 443. From the bifurcation, the East Branch flows through the Tehachapi East Afterbay, an enlarged section of the California Aqueduct, then proceeds in an open canal until it reaches the Mojave Siphon at MP 403.41. This section is fully within the boundaries of the Lahontan RWQCB, Region 6 (Figure 22, East Branch Aqueduct). From the Mojave Siphon, SWP water goes through Silverwood Lake to the Devil Canyon Power Plant and into the Santa Ana Pipeline to its terminus at Lake Perris. Silverwood Lake and Lake Perris are discussed in more detail below.

3.21 Silverwood Lake

Silverwood Lake is an SWP reservoir on the East Branch of the California Aqueduct at MP 405.70 and is within the boundaries of the Lahontan RWQCB, Region 6 (Figure 23, Silverwood Lake). Silverwood Lake is the highest reservoir in the SWP system, with an elevation of 3,350 feet. It has a surface area of 995 acres, a storage capacity of 74,970 acre-feet, a length of 25,300 feet, and 13 miles of shoreline.

As an SWP reservoir, Silverwood Lake stores water that is delivered to Lake Perris and to water contractors in Southern California. It also provides various recreational uses, including swimming, boating, water skiing, and fishing. SWP water enters the lake from the Mojave Siphon and exits via the San Bernardino Tunnel to Devil Canyon Power Plant and associated afterbays. Natural flows from West Fork Mojave River and the East Fork of the West Fork Mojave River enter Silverwood Lake. Water is released through Cedar Spring Dam to the West Fork Mojave River.

3.22 Lake Perris

Lake Perris is the terminal storage facility of the East Branch of the California Aqueduct, located in northwestern Riverside County approximately 13 miles southeast of the City of Riverside and within the boundaries of the Santa Ana RWQCB, Region 8 (Figure 24, Lake Perris). Completed in 1975, Lake Perris has a storage capacity of 131,450 acre-feet and a surface area of 2,320 acres. This shallow, off-stream reservoir has a mean depth of approximately 50 feet and is a multipurpose facility that provides water supply, recreation, and fish and wildlife enhancement. SWP water enters Lake Perris from the Santa Ana Pipeline and exits via the outlet tower to a Metropolitan Water District of Southern California's water supply pipeline.

4 Description of the Application and Treatment Areas

DWR may apply algaecides and/or aquatic herbicides to any of the sites described in this APAP and Notice of Intent if aquatic weed or algae treatment thresholds are met.

The application area is defined as the area to which algaecides and/or aquatic herbicides are directly applied. The treatment area is defined as the area being targeted to receive an appropriate rate of application. The specific application and treatment areas are variable and dependent on the location of aquatic weeds and/or algae targeted for control.

The Permit covers the point-source discharge of residual pesticides to receiving waters resulting from pesticide applications for aquatic weed control. Receiving waters are defined as waters of the United States anywhere outside of the treatment area at any time, and anywhere inside the treatment area after completion of the treatment event. According to the U.S. Environmental Protection Agency (EPA), waters of the United States generally include the following (40 CFR Part 120.2):

- Territorial seas
- All interstate waters and wetlands currently, formerly, or potentially used in interstate commerce, including all waters subject to the ebb and flow of the tide
- Tributaries
- Lakes and ponds, and impoundments of jurisdictional waters
- Adjacent wetlands

5 Description of Aquatic Weeds and Algae

Nuisance biota found throughout the SWP system include emergent, floating, and submersed aquatic vegetation, and diatoms and algae that create operational challenges or adversely affect the quality of SWP water delivered to end users. Examples of emergent, floating, and submersed aquatic vegetation include pondweed species (*Potamogeton* spp.), such as American and sago pondweed; Brazilian waterweed (*Egeria densa*); coontail (*Ceratophyllum demersum*); watermilfoil (*Myriophyllum* spp.); common elodea (*Elodea canadensis*); and cattails. Examples of the group generally described as algae include diatoms, cyanobacteria, and green algae. Cyanobacteria encountered in DWR facilities include *Dolichospermum* spp., *Aphanizomenon* spp., *Microcystis* spp., *Oscillatoria* spp., and *Woronichinia* spp. Green algae encountered in DWR facilities include filamentous algae, such as the benthic species *Cladophora* and the floating species *Spirogyra.*

Efficient water conveyance and maintenance of water quality are critical to the functions of the SWP. The presence of algae and aquatic vegetation in SWP water systems can adversely impact water capacity and reduce the flow of water used for municipal, irrigation, and industrial purposes; clog filters at water treatment plants; and cause taste, odor, and toxicity concerns.

6 Algaecides and Aquatic Herbicides Available for Use

Table 2 provides a summary of the algaecides and aquatic herbicides that may be used by DWR to manage algae and aquatic weeds in SWP facilities, including those listed herein.

Table 2. Algaecides and Aquatic Herbicides that May Be Used in State Water Project Facilities

Herbicide	Application Methods	Adjuvant	Degradation Byproducts
Copper (chelated)	Submersed boom or injection, handgun sprayer	Not applicable	None, persists as various speciations of copper[1]
Copper sulfate	Slug application, spreader, submersed burlap sack, helicopter/aerial	Not applicable	None, persists as various speciations of copper[1]
Diquat dibromide	Submersed boom, handgun, boom sprayer	Various "aquatic" labeled adjuvants	No major degradates[2]
Endothall	Submersed boom/injection, handgun, boom sprayer or spreader (granules)	Not applicable	Endothall acid, potassium ions, coco-alkylamine[3]
Flumioxazin	Submersed boom/injection, handgun or boom sprayer or spreader (granules)	Various "aquatic" labeled adjuvants	TPHA, A-TPA, 482-HA, 482-PHO, PHO-HA, APF, and SAT-482-HA-2[4]
Fluridone	Backpack sprayer, handgun, submersed boom spreader, boom sprayer	Not applicable	N-methyl formamide (NMF)[5]
Glyphosate	Backpack sprayer, handgun, boom sprayer	Various "aquatic" labeled adjuvants	Aminomethyl phosphonic acid (AMPA), carbon dioxide[6]
Hydrogen peroxide[7]	Handgun, boom sprayer, injection	Various "aquatic" labeled adjuvants	Water and oxygen
Imazamox	Backpack sprayer, handgun, boom sprayer	Various "aquatic" labeled adjuvants	Nicotinic acid and imazamox parent chemicals[8]
Imazapyr	Backpack sprayer, handgun, boom sprayer	Various "aquatic" labeled adjuvants	Pyridine hydroxy-dicarboxylic acid, pyridine dicarboxylic acid, and nicotinic acid[9]
Penoxsulam	Backpack sprayer, handgun, boom sprayer	Not applicable	11 major and 2 minor degradants[10]
Peroxyacetic acid	Handgun, boom sprayer, injection	Various "aquatic" labeled adjuvants	Oxygen, carbon dioxide, water, and acetic acid[11]
Sodium carbonate peroxyhydrate	Handgun, boom sprayer (liquid) or spreader (granules)	Not applicable	Sodium carbonate, water, and oxygen[12]
Triclopyr	Backpack sprayer, handgun, or boom sprayer	Various "aquatic" labeled adjuvants	3,5,6-trichloro-2-pyridinol (TCP)[13]

1 Source: EPA 2009.
2 Source: EPA 1995.
3 Endothall-containing herbicides are formulated as either endothall dipotassium salt or N,N-dimethylalkylamine salt. Both formulations produce endothall acid as a degradation byproduct, along with corresponding cation components (potassium ions and coco-alkylamine for the dipotassium salt and N,N-dimethylalkylamine formulations, respectively) (EPA 2005).
4 Major flumioxazin degradants include 3,4,5,6-tetrahydrophthalic acid (THPA); 3,4,5,6-Tetrahydrophthalic acid anhydride (A-TPA); 7-Fluoro-6[(2-carboxy-cyclohexenoyl)amino]-4-(2-propynyl)-1,4-benzoxazin-3(2H)-one (482-HA); N-(2-propynyl)-4-[4-carboxy-3-fluoro-2-

(3,4,5,6-tetrahydrophthalimido)-2-butenylidene]azetidine-2-one (482-PHO); N-(2-propynyl)-4-[4-carboxy-3-fluoro-2-(2-carboxy-1-cyclohexencarbonylamino)-2-butenylidene]azetidine-2-one (PHO-HA); 6-Amino-7-fluoro-4-(2-propynyl)-1,4,-benzoxazin-3(2H)-one (APF); and (1S,2S)-2-{[7-fluoro-3-oxo-4-(prop-2-yn-1-yl)-3,4-dihydro-2H-1,4-benzoxazin-6-yl]carbamoyl} cyclohexanecarboxylic acid (SAT-482-HA-2) (EFSA et al. 2020).

5 NMF was identified as the major degradant of fluridone when applied to water bodies (EPA 2004). Minor degradants may include 1-methyl-3-(4-hydroxyphenol)-5-[3-trifluoromethyl)phenyl]- 4[1H]-pyridone and 1,4-dihydro-1-methyl-4-oxo-5-[3-(trifluoromethyl)phenyl]-3-pyridine (West et al. 1983, as cited in McLaren/Hart 1995), and benzaldehyde, 3-(trifluoromethyl)-benzaldehyde, benzoic acid, and 3-(trifluoromethyl)-benzoic acid (Saunders and Mosier 1983, as cited in McLaren/Hart 1995).

6 Source: EPA 1993a.

7 Hydrogen dioxide is a synonym for hydrogen peroxide and shares the same CAS number (CAS No. 772-84-1).

8 The major imazamox degradant in the environment is CL 354,825 (Nicotinic acid, 5-hydrody-6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl). Other metabolites include AC 312,622 (demethylated parent with intact ring structures and two carboxylic acid groups) and AC 354,825 (demethylated, decarboxylated parent with intact rings and one carboxylic acid group) (EPA 2008).

9 Source: EPA 2006.

10 Major penoxsulam degradants include BSA, 2-amino-TP, TPSA, BSTCA, BSTCA methyl, 2-amino-TCA, 5-OH-penoxsulam, SFA, sulfonamide, 5,8-di-OH and 5-OH 2 amino TP. Minor degradants include di-FESA and BST (EPA 2007).

11 Source: EPA 1993b.

12 Source: EPA 2002.

13 Source: EPA 1998.

Algaecide and aquatic herbicide applications are made in accordance with the product label and for the appropriate pest based on a written recommendation prepared by a California Department of Pesticide Regulation (DPR)-licensed Pest Control Adviser (PCA). For example, liquid formulations of endothall will be applied with weighted injection nozzles calibrated to deliver the correct amount of material per acre-foot treated in a static water body, such as O'Neill Forebay, to achieve the desired target concentration.

When applicable, aquatic-labeled adjuvants may be used to enhance the efficacy of an algaecide and/or aquatic herbicide.

Table 3 summarizes examples of aquatic vegetation controlled by various algaecides and aquatic herbicides.

Table 3. Examples of Biota Controlled by Various Algaecides and Aquatic Herbicides

	Algae and Algae-Like		Aquatic Vegetation		
Control Tool	*Filamentous*	*Cyanobacteria and Diatoms*	*Submersed*	*Floating*	*Emergent*
Copper	X[1]	X	X	X	0[1]
Diquat	X	X	X	X	X
Endothall, dipotassium salt	0	0	X	X	0
Endothall, mono (N,N-dimethylalkylamine) salt	X	X	X	X	0
Flumioxazin	X (floating)	0	X	X	X
Fluridone	0	0	X	X	X
Glyphosate	0	0	0	X	X
Hydrogen peroxide[2]	X	X	0	0	0
Imazamox	0	0	X	X	X
Imazapyr	0	0	0	X	X
Penoxsulam	0	0	X	X	X
Peroxyacetic acid	X	X	0	0	0

Table 3. Examples of Biota Controlled by Various Algaecides and Aquatic Herbicides

Control Tool	Algae and Algae-Like		Aquatic Vegetation		
	Filamentous	*Cyanobacteria and Diatoms*	*Submersed*	*Floating*	*Emergent*
Sodium carbonate peroxyhydrate	X	X	0	0	0
Triclopyr	0	0	X (dicots)	X (dicots)	X (dicots)

1 "X" indicates the tool may provide control of the associated biota. "0" indicates the tool is ineffective and/or not currently labeled for use for control of the associated biota. Target biota and efficacy may vary between products. Always read and follow the product label.

2 Hydrogen dioxide is a synonym for hydrogen peroxide and shares the same CAS number (CAS No. 772-84-1).

7 Gates and Control Structures

DWR operates and maintains numerous water control structures throughout the SWP system. As applicable or necessary, DWR staff close gates, valves, and other structures during algaecide and aquatic herbicide application to control the extent, if any, that receiving waters are affected by residual algaecides or aquatic herbicides.

To evaluate the presence of leaks, control structures within the treatment area are inspected prior to and during applications. The Aquatic Herbicide Application Log, or equivalent, is the form used to document this inspection (Appendix A). If leaks develop on closed valves or gates, they are stopped as soon as practicable.

Site-specific information regarding gates and control structures is provided below.

Thermalito Forebay

Water operations through Thermalito Forebay are altered during algaecide and/or aquatic herbicide applications if necessary to enhance efficacy or reduce movement of treated water out of the treatment area.

Clifton Court Forebay

Prior to treatment, the radial gates at the Clifton Court Forebay inlet structure are closed to allow fish to move out of the proposed treatment area(s) and toward the salvage facility. The radial gates remain closed during and after algaecide and/or aquatic herbicide application to maintain contact time with target biota in the forebay. Pumping from Clifton Court Forebay to Bethany Reservoir is halted during the application and contact time to reduce movement of treated water out of the treatment area. Additional protective measures for listed fish species may be implement during treatments, as per the current biological opinions and incidental take permits issued for operation of the SWP.

Dyer Reservoir

The Dyer Reservoir outlet valves are closed prior to applying algaecides and/or aquatic herbicides, and remain closed for a minimum of 6 hours. If a copper-containing product is applied, outlet valves generally remain closed for approximately 24 hours.

South Bay Aqueduct

SWP contractors close their turnouts for a minimum of 2 hours prior to the start of treatment, and they remain closed for a minimum of 2 hours after treated water has passed their locations. The following three turnouts are operated by DWR and release to waters of the United States:

- Arroyo Mocho Check – At MP 14.6 on the South Bay Aqueduct
- Arroyo Valle 1 – At MP 0.9DV on the Del Valle Branch Pipeline
- Arroyo Valle 2 – At MP 1.53DV on the Del Valle Branch Pipeline

Arroyo Valle 1 and Arroyo Valle 2 are operated manually, and the Arroyo Mocho gate is controlled remotely at the Delta Field Division in Byron. The gates at Arroyo Valle 1 and Arroyo Valle 2 are inspected during operation to confirm that the gates are closed and no treated water is discharged into Arroyo Valle Creek. The Arroyo

Mocho Check gate is equipped with a flow meter that is monitored in the DWR control room to verify proper operation of the gate and to confirm that no treated water is discharged into Arroyo Macho Creek.

O’Neill Forebay

Pumping from O’Neill Forebay to the San Luis Reservoir is curtailed during algaecide and/or aquatic herbicide application, as feasible. Releases from the San Luis Reservoir to O’Neill Forebay and from O’Neill Forebay to the Delta Mendota Canal are also curtailed, as feasible. Additionally, pumping at Dos Amigos Pumping Plant to the San Luis Canal is curtailed, as feasible.

Pyramid Lake, Castaic Lake, Silverwood Lake, and Lake Perris

Surface water releases from the reservoirs/lakes are restricted or reduced, as feasible and appropriate, prior to application of algaecides and/or aquatic herbicides. Depending on the drinking water use restrictions associated with the applied herbicide, SWP contractors close their turnouts, and any water treatment plants that draw directly off of a reservoir/lake are taken offline.

8 Factors Influencing Herbicide Use

Treatment of aquatic vegetation and algae by DWR is determined through an Integrated Pest Management (IPM) program. One of the primary operational goals of the IPM program is to establish a general and reasonable set of control measures that not only aid in managing algae and aquatic vegetation, but also address public health and safety, and economic, legal, and operational requirements. A control threshold is the point at which monitoring indicates that control of aquatic weeds and algae should be implemented to prevent unacceptable impacts to water quality or SWP operations.

For example, DWR routinely monitors objectionable taste and odor compounds produced by algae. Chemical substances in water that often are associated with earthy, musty smelling or tasting water include geosmin and 2-methylisoborneol (MIB), which are natural by-products of algal and cyanobacteria chlorophyll production. When microscopic evaluation and chemical analysis of water samples indicate that concentrations of geosmin or MIB in reservoir waters are approaching control thresholds, DWR water quality staff respond by searching for the source of these substances and developing an application plan to control the algae species that are associated with the elevated geosmin and/or MIB concentrations.

Specific control thresholds are values that exceed the following:

- **Taste and Odor.** MIB less than 5 nanograms per liter and geosmin less than 10 nanograms per liter are not detected in drinking water by most customers. Taste and odor production is regularly monitored using solid phase microextraction followed by gas chromatography/mass spectrometry. The taste- and odor-causing substances, MIB and geosmin, are reported in parts per trillion (nanograms per liter) concentrations.
- **Cyanotoxins.** Control thresholds are site-specific and vary based on the type of water use (recreation vs. drinking water). Generally, once cyanotoxin concentrations have reached the California recreational health advisory threshold of warning or danger, algaecide treatments may be applied.
- **Algal Fluorescence.** Algal fluorescence less than 200 units does not cause operational problems to water conveyance or reduction in filter run times at water treatment plants. Algal fluorescence is measured continuously with a Turner 10AU fluorometer in some SWP water bodies. The data are posted daily to the DWR Water Quality website (https://cdec.water.ca.gov/).
- **Algal Biomass.** Algal biomass less than 5,000 milligrams per cubic meter does not cause operational problems to water conveyance or reduction in filter run times at water treatment plants. Algal biomass and species composition are analyzed directly using the Utermohl technique (inverted microscope method). Samples are analyzed and data is provided as needed.
- **Pumping Capacity.** Accumulation of aquatic vegetation and algae on trash racks at pumping plants, turnouts, and siphons may result in flow restrictions, complete plant shutdown, or reduced pumping capacity. Algaecides or aquatic herbicides may be applied as needed to address these problems. This is a qualitative and/or site-specific threshold.
- **Aqueduct Flow.** Accumulation of aquatic vegetation and algae on the sides and/or bottom of an aqueduct and associated features may cause reduced capacity in the aqueduct and a decrease in water velocity. Algaecides or aquatic herbicides may be applied as needed to address these problems. This is a qualitative and/or site-specific threshold.
- **Impact to Intended Use.** This is a qualitative and/or site-specific threshold.

Factors that influence when a treatment threshold is met for cyanobacteria typically include taste and odor, cyanotoxins, algal fluorescence, and/or algal biomass. When sampling results indicate that a control tolerance has been exceeded, DWR water quality staff respond by searching for the source of the problem. To do this, water quality samples are collected and analyzed, and field staff attempt to determine possible algae sources. Control tolerances for filamentous algae may include algal fluorescence, algal biomass, pumping capacity, aqueduct flow, and/or impact to intended use. For aquatic vegetation, relevant control tolerances include pumping capacity, aqueduct flow, and/or impact to intended use. In some locations, aquatic vegetation may provide harborage for taste- and odor-producing cyanobacteria or nuisance filamentous algae, and a control action may be implemented to mitigate the indirect effect of aquatic vegetation presence.

Algaecide and/or aquatic herbicide applications may also be made prior to threshold exceedance. Based on predicted growth rate and density, historical algae and aquatic vegetation trends, weather, water flow, herbicide properties, and site-specific experience, aquatic weeds or algae may reasonably be predicted to cause future problems. Accordingly, they may be treated soon after emergence or when appropriate based on the algaecide and/or aquatic herbicide to be used. For example, chelated copper herbicides are most effective when applied when growth first begins to appear. Chelated copper works by binding to proteins along the surface of plants or algae and inhibiting their ability to photosynthesize, resulting in plant injury and death. Because chelated copper is most effective on small, sensitive plants and control is reduced when target weeds have produced thick stands of vegetation, it is necessary to treat early in the growth cycle to effectively control aquatic weeds. Therefore, chelated copper herbicides may be applied at SWP facilities when submersed aquatic vegetation begins active growth, as opposed to when pumping capacity or impact to intended use control tolerances are exceeded.

Even though algae and/or nuisance vegetation may not be an immediate problem at this growth stage, treating them before they mature, reproduce, and spread reduces the total amount of aquatic herbicide needed because the younger aquatic weeds are more susceptible and there is less plant biomass to target. Furthermore, treating aquatic vegetation or algae within the ideal timeframe of its growth cycle enhances the likelihood that the selected control measures will be most effective. Managing aquatic plant populations before they produce seeds, tubers, or other reproductive organs is an important step in DWR's comprehensive aquatic vegetation management program. Generally, treating algae and aquatic weeds earlier in their growth cycle results in fewer controls needed and less total algaecide and/or aquatic herbicide used.

Selection of appropriate algaecide and/or aquatic herbicide(s) and rate of application are determined based on the identification of the algae and aquatic weed, its growth stage, and the appearance of that algae or aquatic weed or a related species on the product label. The selection of and decision to use an algaecide or aquatic herbicide is based on the recommendation of a DPR-licensed PCA. The PCA considers a variety of control options, which may include mechanical and/or cultural techniques that alone or in combination with algaecide or aquatic herbicide use are the most efficacious and protective of the environment.

Evaluating alternative control techniques is part of DWR's IPM approach; therefore, an alternative treatment may be selected as part of a test program. Non-chemical alternative control techniques can generally be described as physical/mechanical controls, cultural controls, or biological controls. Additional information on specific alternative control techniques is presented in Section 13.1, Evaluation of Other Management Options.

In general, testing and evaluation of non-chemical alternative control techniques have indicated that they are often more expensive and labor intensive, and not as effective as chemical treatment; may cause temporary water quality degradation; and/or may further spread algae or aquatic vegetation. In addition, the equipment and labor required to perform these techniques is not always readily available. This may cause delays in implementation of alternative control methods, leading to increased plant material to remove and increased cost.

9 State Implementation Policy Section 5.3 Exception

In 2004, DWR was granted a State Implementation Policy Section 5.3 Exception to treat the following SWP water bodies with copper-based herbicides:

- South Bay Aqueduct, including Patterson Reservoir and Dyer Reservoir
- Clifton Court Forebay
- Coastal Branch Aqueduct
- East Brach Aqueduct
- Tehachapi Afterbays
- Castaic Lake
- Lake Perris

With the exception of Clifton Court Forebay, application of copper may be carried out as needed during the year when control thresholds have been exceeded. For Clifton Court Forebay, applications of algaecides and aquatic herbicides containing copper may only be made during the permitted work window or as authorized by the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), or California Department of Fish and Wildlife (CDFW).

In 2014, DWR applied for and was granted an additional State Implementation Policy Section 5.3 Exception to treat the following four additional water bodies with copper-based herbicides:

- O'Neill Forebay
- Quail Lake
- Pyramid Lake
- Silverwood Lake

Application of copper may be carried out as needed during the year when control thresholds have been exceeded.

10 Description of Monitoring Program

Attachment C of the Permit presents the Monitoring and Reporting Program, which addresses the following two key questions:

- **Question 1:** Does the residual algaecides and aquatic herbicides discharge cause an exceedance of the receiving water limitations?
- **Question 2:** Does the discharge of residual algaecides and aquatic herbicides, including active ingredients, inert ingredients, and degradation byproducts, in any combination cause or contribute to an exceedance of the "no toxics in toxic amount" narrative toxicity objective?

Attachment C of the Permit provides Monitoring and Reporting Program guidelines that DWR uses to address the aforementioned questions.

10.1 Data Collection

Visual monitoring is performed for all algaecide and/or aquatic herbicide applications at all sites and recorded by qualified personnel.

The Aquatic Herbicide Application Log (Appendix A) and Aquatic Herbicide Field Monitoring and Sampling Forms (Appendix B), or their equivalents, are used to document application and monitoring activities for Permit compliance.

10.2 Monitoring Locations and Frequency

Water quality sampling for glyphosate is conducted for one application event from each environmental setting (flowing and non-flowing water) per year. For application of all other algaecides and aquatic herbicides listed on the Permit, DWR collects samples from a minimum of six application events for each active ingredient in each environmental setting per year. If there are fewer than six application events in a year for an active ingredient, DWR collects samples for each application event in each environmental setting.

Water quality sampling is required for applications of products that contain sodium carbonate peroxyhydrate, peroxyacetic acid, and/or hydrogen peroxide; however, no chemical analysis for these active ingredients is needed. If applications of sodium carbonate peroxyhydrate, peroxyacetic acid, and/or hydrogen peroxide are made, DWR will collect samples consistent with permit requirements and analyze them for the field parameters of pH, dissolved oxygen, temperature, turbidity, and electrical conductivity.

If the results from six consecutive sampling events show concentrations that are less than the applicable receiving water limitation/trigger in an environmental setting (flowing or non-flowing water), DWR reduces the sampling frequency for that active ingredient to one per year in that environmental setting. If the annual sampling shows exceedances of the applicable receiving water limitation/trigger, DWR is required to return to sampling six applications the next year.

Sites are chosen to represent the variations in treatment that occur, including algaecide and/or aquatic herbicide use, hydrology and environmental setting (e.g., flowing or non-flowing water), conveyance or impoundment type, and seasonal and regional variations. The exact location(s) of sample site(s) are determined after site scouting, and treatment area definition and the decision to make an algaecide and/or aquatic herbicide application are made per DWR's IPM approach.

10.2.1 Sample Locations

Sampling includes background (BG), event, and post-event monitoring, as described below:

Background Monitoring: In flowing water, the BG sample is collected upstream of the treatment area at the time of the application event, or in the treatment area within 24 hours prior to the start of the application.

The BG sample for non-flowing (static) water is collected in the treatment area within 24 hours prior to the start of the application.

Event Monitoring: The event sample for flowing water is collected immediately downstream of the treatment area immediately after the application event, but after sufficient time has elapsed such that the treated water has exited the treatment area.

The event sample for non-flowing (static) water is collected immediately outside of the treatment area immediately after the application event, but after sufficient time has elapsed such that treated water has exited the treatment area.

The location and timing for the collection of the event sample may be based on a number of factors, including algae and aquatic weed density and type, flow rates, size of the treatment area, and duration of treatment. If event monitoring indicates that treated water is entirely contained within the treatment area, sample collection is not required.

Post-Event Monitoring: The post-event sample is collected within the treatment area within 1 week after the application, or when treatment is deemed complete.

One full set of three samples (i.e., BG, event, and post-event) is collected during each treatment from the representative site(s) according to the monitoring frequency and locations described earlier.

Additionally, one field duplicate (FD) and one field blank (FB) are collected and submitted for analysis for each analyte, once per year. The FD and FB samples are typically collected during event monitoring and are helpful in assessing quality assurance and quality control (QA/QC) (refer to Section 10.10, Quality Assurance and Quality Control).

See Appendix B for examples of the field sampling forms.

10.3 Sample Collection

If the water depth is 6 feet or greater, the sample is collected at a depth of 3 feet. If the water depth is less than 6 feet, the sample is collected at the approximate mid-depth. As necessary, an intermediary sampling device (e.g., Van-Dorn style sampler, Kemmerer sampler, or long-handled sampling pole) is used for locations that are difficult to access. Long-handled sampling poles with attached sampling container are inverted before being lowered into the water to the desired sample depth, where it is turned upright to collect the sample. Appropriate sample equipment cleaning techniques are discussed in Section 10.8.4, Sampling Equipment Cleaning.

10.4 Field Measurements

In conjunction with sample collection, temperature and dissolved oxygen are measured in the field. Turbidity, electrical conductivity, and pH may be measured in the field using field meters as available, or analyzed in the laboratory. Conductivity, turbidity, pH, and dissolved oxygen meters are calibrated according to manufacturer's specifications at the recommended frequency. The calibration for these meters and for temperature are checked throughout the year according to manufacturer specifications against standards to evaluate instrument performance. If the calibration is outside the manufacturer's specifications, the probe is recalibrated. Calibration logs are maintained for all instruments to document calibration and equipment performance.

10.5 Sample Preservation and Transportation

Samples are collected directly into preserved containers or collected in unpreserved containers and preserved at the laboratory upon receipt if the analytical method requires preservation. If monitoring for dissolved copper and hardness, the sample is field filtered at the time of collection or as soon as practically possible; samples are preserved to a pH of less than 2 within 24 hours, as required by EPA Method 200.7 and EPA Method 200.8. Once a sample is collected and labeled, it is immediately placed in a dark, cold (approximately 39.2°F [4°C]) environment, typically a cooler/ice chest with ice. Delivery to the laboratory occurs as soon as practicable after sample collection.

10.6 Sample Analysis

Table 4 provides a list of the constituents that are analyzed in each sample.

Table 4. Required Sample Analysis

Constituent	Analytical Method[1]	Typical Reporting Limit	Hold Time (Days)	Container	Chemical Preservative
Temperature[2]	SM 2550B, 4500-OG	N/A	Immediately	N/A	None
Dissolved Oxygen[2]	SM 4500-OG	0.0 mg/L	Immediately	N/A	None
Turbidity[3]	EPA 180.1, SM 2130B	0.00 NTU	Immediately	N/A	None
Electrical Conductivity[3]	EPA 120.1	0.0 µS/cm	1 if unpreserved; 28 if preserved	250 mL glass or HDPE	None[6]
	SM 2510B	0.0 µS/cm	28	500 mL glass or HDPE	None
pH[3]	EPA 150.2	1-14	Immediately	100 mL glass or HDPE	None
	SM 4500H+B	1-14	0.08 (2 hours)	100 mL glass or HDPE	None
Nonylphenol[4]	EPA 550.1m, GC/MS	0.5 µg/L	7	2 x 40 mL VOA	None
Hardness[5] (dissolved[6])	SM 2340B	0.332 mg/L	1 if unpreserved; 180 if preserved	250 mL HDPE	HNO_3
	SM 2340C	0.332 mg/L	1 if unpreserved; 180 if preserved	250 mL HDPE	HNO_3 or H_2SO_4

Table 4. Required Sample Analysis

Constituent	Analytical Method[1]	Typical Reporting Limit	Hold Time (Days)	Container	Chemical Preservative
*Copper (dissolved[6])	EPA 200.8	0.5 to 2.0 µg/L	1 if unpreserved; 180 if filtered and preserved	250 mL HDPE	HNO_3
*Diquat	EPA 549.2	4.0 µg/L	7	500 mL amber HDPE	H_2SO_4
*Endothall	EPA 548, 548.1	20 µg/L	7	500 mL or 125 mL amber glass	None or HCl
*Flumioxazin	HPLC	10 µg/L	14	500 mL amber glass	None
*Fluridone	SePro FasTest, HPLC	1.0 to 5.0 µg/L	28	30 mL amber HDPE or 2 x 40 mL VOA	None
*Glyphosate	EPA 547	5.0 µg/L	14	2 x 40 mL VOA	None
*Imazamox	HPLC	1.0 µg/L	14	2 x 40 mL VOA	None
*Imazapyr	EPA 532m	100 µg/L	7	1 L amber glass	None
*Penoxsulam	EPA 532m	20 µg/L	7	1 L amber glass	None
*Triclopyr	EPA 8151, 8150A, 615	0.5 µg/L	7	2 x 40 mL VOA	None

N/A = not applicable; mg/L = milligrams per liter; EPA = U.S. Environmental Protection Agency; NTU = nephelometric turbidity unit; µS/cm = microsiemens per centimeter; mL = milliliter; HDPE = high-density polyethylene; GC/MS = gas chromatography-mass spectrometry; µg/L = micrograms per liter; VOA = volatile organic analysis; HNO_3 = nitric acid; HCl = hydrochloric acid; HPLC = high performance liquid chromatography; m = modified extraction or analysis technique; H_2SO_4 = sulfuric acid; L = liter.

* Signifies algaecide or aquatic herbicide active ingredient. Chemical analysis is only required for the active ingredient(s) used in treatment. Active ingredient analysis not required for algaecides and aquatic herbicides containing sodium carbonate peroxyhydrate, peroxyacetic acid, and/or hydrogen peroxide; however, field parameters must still be measured and reported.

1 Examples of methods commonly used for sample analysis. Method details obtained from NEMI (2021). Analytes may be analyzed using analytical methods described in the Code of Federal Regulations (CFR) (40 CFR Part 136) or equivalent methods that are commercially and reasonably available and that provide quantification of sampling parameters and constituents sufficient to evaluate compliance with applicable effluent limits and to perform reasonable potential analysis. Equivalent methods must be more sensitive than those specified in 40 CFR Part 136 if the method is available in 40 CFR Part 136, and must be approved for use by the Regional Water Quality Control Board Executive Officer. Methods not specified in 40 CFR Part 136 may include modifications to methods specified in 40 CFR Part 136 or other methods as deemed appropriate by the analytical laboratory.

2 Field measured.

3 May be field or laboratory measured.

4 Required only when adjuvant ingredients are represented by the surrogate nonylphenol.

5 Required for copper applications only.

6 Preservation via filtration through a 0.45 micron filter and storage at 39.2°F (4°C).

10.7 Reporting Procedures

10.7.1 Annual Report

An annual report for each reporting period (i.e., January 1 through December 31) is prepared by March 1 of the following year and submitted to the appropriate RWQCB(s). In years when no algaecides or aquatic herbicides are used, a letter stating that no applications occurred is sent to the appropriate RWQCB(s) in lieu of an annual report.

The annual report contains the following information, as described in Attachment C of the Permit:

- An executive summary discussing compliance or violation of the Permit and the effectiveness of the APAP.
- A summary of monitoring data, including the identification of water quality improvements or degradation as a result of algaecide or aquatic herbicide application.

DWR or its contractors collect and retain applicable information on the previous reporting year. When requested by the Deputy Director or Executive Officer of the applicable RWQCB, DWR submits the annual information collected, including the following:

- An executive summary discussing compliance or violation of the Permit and the effectiveness of the APAP to reduce or prevent the discharge of pollutants associated with herbicide applications.
- A summary of monitoring data, including the identification of water quality improvements or degradation as a result of algaecide or aquatic herbicide application, if appropriate, and recommendations for improvement to the APAP (including proposed best management practices [BMPs]) and monitoring program based on the monitoring results. All receiving water monitoring data is compared to applicable beneficial use–based receiving water limitations and receiving water monitoring triggers as defined in the Permit.
- Identification of BMPs and a discussion of their effectiveness in meeting the Permit requirements.
- A discussion of BMP modifications addressing violations of the Permit.
- A map showing the locations of each treatment area.
- Types and amounts of aquatic herbicides used at each application event during each application.
- Information on surface area and/or volume of treatment areas and any other information used to calculate dosage, concentration, and quantity of each aquatic herbicide used.
- Sampling results that indicate the name of the sampling agency or organization, detailed sampling location information (including latitude and longitude or township/range/section, if available), a detailed map or description of each sampling area (e.g., address, cross-roads), collection date, the name of constituent/ parameter and its concentration detected, minimum levels, method detection limits for each constituent analysis, the name or description of water body sampled, a comparison with applicable water quality standards, and a description of the analytical QA/QC plan. Sampling results are tabulated so that they are readily discernible.
- A summary of Aquatic Herbicide Application Logs (see Appendix A).

10.7.2 Noncompliance Reporting

DWR will report to the SWRCB and appropriate RWQCB(s) noncompliance, including any unexpected or unintended effect of an algaecide or aquatic herbicide that may endanger public health and/or the environment. Compliance with receiving water limitations and monitoring triggers is determined through event and post-event monitoring results.

An Immediate Notification is given by DWR if it becomes aware of an adverse incident to a federally listed threatened or endangered species or its federally designated critical habitat that may have resulted from an algaecide and/or aquatic herbicide application. This notification is provided to NMFS in the case of an anadromous or marine species incident, or USFWS in the case of a terrestrial or freshwater species incident.

A Twenty-Four Hour Report is provided by DWR orally, by way of a phone call, to the SWRCB and appropriate RWQCB(s) within 24 hours from the time DWR becomes aware of any noncompliance. The Twenty-Four Hour Report includes the following information:

- The caller's name and telephone number
- Applicator name and mailing address
- Waste Discharge Identification number
- How and when the discharger became aware of the noncompliance
- Description of the location of the noncompliance
- Description of the noncompliance identified and the EPA pesticide registration number for each product the discharger applied in the area of the noncompliance
- Description of the steps that the discharger has taken or will take to correct, repair, remedy, cleanup, or otherwise address any adverse effects

If DWR is unable to notify the SWRCB and appropriate RWQCB(s) within 24 hours, DWR will do so as soon as possible and provide a rationale for why DWR was unable to provide notification of noncompliance within 24 hours.

In addition to the Twenty-Four Hour Report, DWR is responsible for providing a written submission within 5 days of the time DWR becomes aware of the noncompliance. The Five-Day Written Report contains the following information:

- Date and time DWR contacted the SWRCB and the appropriate RWQCB(s) notifying of the noncompliance and any instructions received from the SWRCB and/or RWQCB(s); information required to be provided in Section D.1 (Twenty-Four Hour Report) of the Permit
- A description of the noncompliance and its cause, including exact date and time and species affected, estimated number of individuals and approximate size of dead or distressed organisms (other than the pests to be eliminated)
- Location of incident, including the names of any waters affected and appearance of those waters (e.g., sheen, color, clarity)
- Magnitude and scope of the affected area (e.g., aquatic square area or total stream distance affected)
- Algaecide and aquatic herbicide application rate, intended use site (e.g., banks, above, or direct to water), method of application, name of algaecide and herbicide product, description of algaecide and herbicide ingredients, and EPA registration number
- Description of the habitat and the circumstances under which the noncompliance activity occurred (including any available ambient water data for aquatic algaecides and aquatic herbicides applied)
- Laboratory tests performed, if any, and timing of tests; DWR will provide a summary of the test results within 5 days after they become available
- If applicable, explanation why the discharger believes the noncompliance could not have been caused by exposure to the algaecides or aquatic herbicides from DWR's application
- Actions to be taken to prevent recurrence of adverse incidents

The Five-Day Written Report is submitted within 5 days of the time DWR becomes aware of the noncompliance unless SWRCB staff or RWQCB staff waive the above-described report if an oral report has been received within 24 hours.

10.8 Sampling Methods and Guidance

The purpose of this section is to present methods and guidelines for the collection and analysis of samples necessary to meet the APAP objective of assessing adverse impacts, if any, to beneficial uses of water bodies treated with algaecides and/or aquatic herbicides.

This section includes a description of the techniques, equipment, analytical methods, and QA/QC procedures for sample collection and analysis. Guidance for the preparation of this section included the National Pollutant Discharge Elimination System Storm Water Sampling Guidance Document (EPA 1992), Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA 1980), and U.S. Geological Survey National Field Manual for the Collection of Water Quality Data (USGS 1995).

10.8.1 Surface Water Sampling Techniques

As discussed in Section 10.3, Sample Collection, if the water depth is 6 feet or greater, the sample is collected at a depth of 3 feet. If the water depth is less than 6 feet, the sample is collected at the approximate mid-depth. As necessary, an intermediary sampling device (e.g., Van-Dorn style sampler, Kemmerer sampler, or long-handled sampling pole) may be used for locations that are difficult to access. Long-handled sampling poles with attached sampling container are inverted before being lowered into the water to the desired sample depth, where they are turned upright to collect the sample. Appropriate cleaning technique is discussed in Section 10.8.4 of this document.

Samples are collected in a manner that minimizes the amount of suspended sediment and debris in the sample. Surface water grab samples are collected directly using the sample container or using an intermediary container in the event that the sample container cannot be adequately or safely used. Intermediary samplers may be constructed of high-density polyethylene (HDPE) plastic, stainless steel, glass, or other suitable material. Any container that will be reused between sites are washed thoroughly and triple rinsed before collection of the next sample (see Section 10.8.4). Alternatively, disposable HDPE or glass intermediary sample containers may be used.

10.8.2 Sample Containers

Clean, empty sample containers with caps are supplied in protective cardboard cartons or ice chests by the primary laboratory. The containers are certified clean by either the laboratory or the container supplier. To support data quality control, the sampler uses the appropriate sample container as specified by the laboratory for each sample type. Typical sample container type, holding time, and appropriate preservatives are listed in Table 4, Required Sample Analysis. Each container is affixed with a label indicating a discrete sample number for each sample location. The label also indicates the date and time of sampling.

10.8.3 Sample Preservation and Filtering

Samples may either be collected with bottles containing the correct preservative(s) or collected in unpreserved bottles and preserved upon receipt at the analytical lab. If monitoring for dissolved copper or hardness, the sample is field filtered at the time of collection or as soon as practically possible; samples are preserved to a pH of less than 2 within 24 hours, as required by EPA Method 200.7 or EPA Method 200.8. After collection, samples are refrigerated at approximately 39.2°F (4°C), stored in a dark place, and transported to the analytical laboratory. Refer to Table 4.

10.8.4 Sampling Equipment Cleaning

In the event that sampling equipment will be used in more than one sample location, the equipment is thoroughly cleaned with a non-phosphate cleaner, triple-rinsed with distilled water, and then rinsed once with the water being sampled prior to its first use at a new sample collection location.

10.9 Field Sampling Operations

10.9.1 Field Logbook

A three-ring binder, bound logbook, or other suitable recording media is maintained by members of the sampling team to provide a record of sample location, significant events, observations, and measurements taken during sampling (field logbook). Sample records are intended to provide sufficient data and observations to enable team members to reconstruct events that occurred during the sampling, and must be legible, factual, detailed, and objective. As appropriate and at the discretion of DWR field staff or contractors, observations and measurements may be supplemented with pictures of site conditions at the time of sampling.

When recording observations in the field logbook, the sampling team notes the presence or absence of the following:

- Floating or suspended matter
- Discoloration
- Bottom deposits
- Aquatic life
- Visible films, sheens, or coatings
- Fungi, slimes, or objectionable growths
- Potential nuisance conditions

See Appendix B for examples of the forms to be used to record relevant field data when sampling.

10.9.2 Alteration of Sampling Techniques

It is possible that field conditions may require modifications to the procedures outlined herein. Specifically, water levels, weather, and other environmental parameters and hazards, including water flow, rainfall, pump operation, and water use, may pose access and/or sampling challenges. In such instances, variations from standard procedures and planned sampling locations and frequencies are documented in the field logbook.

10.9.3 Flow Estimation

Flow estimation measurements must be made for all flowing water sampling locations. If feasible, a flow meter calibrated according to the manufacturer's directions may be placed as close to the center of the stream, creek, or canal as possible and a reading taken in feet per second. Flows can also be estimated by DWR operations personnel based on pumping rates and modeled flow. Alternatively, a common floating object (e.g., ball, branch, leaf) may be placed as close to the center of the conveyance as possible, and the time it travels a known distance is estimated and represented in feet per second. A minimum travel distance of approximately 25 feet is used.

10.9.4 Chain-of-Custody

The chain-of-custody (COC) record is employed as physical evidence of sample custody. The sampler completes a COC record to accompany each sample shipment from the field to the laboratory. The COC record specifies the following information:

- Time, date, and location of sample collection
- Unique sample name or identifier
- Requested analysis
- Sampler name
- Whether the sample has been filtered and/or preserved
- Preservative used, if any
- Required turn-around time for analysis
- Time and date of sample transaction between field and laboratory staff
- Name of receiving party at the laboratory

Corrections to the COC record are made by drawing a line through, initialing, and dating the error, and entering the correct information. Erasures are not permitted.

Upon receipt of the samples, laboratory personnel check to confirm that the samples and requested analyses are accurately described by the COC record. Upon verification of the number and type of samples and the requested analysis, a laboratory representative signs the COC record, indicating receipt of the samples, and returns a copy of the COC to DWR.

10.9.5 Sample Label

The sample label contains information on the specific activity (e.g., herbicide treatment), the unique sample ID (e.g., Silverwood Lake – Endothall BG), and the date and time the sample was collected.

10.10 Quality Assurance and Quality Control

The purpose of QA/QC is to ensure and control the quality of data generated during sample collection and analysis, as described earlier in this document. QA/QC is measured in a variety of ways, as described in the following subsections.

10.10.1 Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. It is a quantitative measure of the variability of a group of measurements compared to the average value of the group, and is expressed as the relative percent difference (RPD). Sources of error in precision (imprecision) can be related to field and laboratory techniques. Specifically, lack of precision is caused by inconsistencies in instrument settings, measurement and sampling techniques, and record keeping.

Field precision is estimated by collecting FDs in the field and calculating RPD. In general, field RPD values of less than 35% are considered acceptable. Refer to the discussion of FDs in Section 10.10.5, Field Duplicate.

Laboratory precision is estimated by generating analytical laboratory matrix spike (MS) and matrix spike duplicate (MSD) sample results and calculating RPD. Alternatively, laboratory control spike (LCS) and laboratory control spike duplicate (LCSD) may be used to calculate RPD. Laboratory RPD values vary by analysis method, but, generally, an RPD of less than 25% is considered acceptable. Precision can also be determined at the laboratory by running duplicate analysis on the same sample.

10.10.2 Accuracy

Accuracy is a measure of how close data are to their true values and is expressed as percent recovery (%R), which is the difference between the mean and the true value expressed as a percentage of the true value. Sources of error (inaccuracy) are the sampling process, field contamination, preservation, handling, sample matrix effects, sample preparation, analytical techniques, and instrument error.

Laboratory accuracy is estimated using reference standards, and MS/MSD and/or LCS/LCSD samples. Acceptable accuracy is generally between 75% and 125%.

Refer to Section 10.10.5 for additional discussion of MS/MSD and LCS/LCSD.

10.10.3 Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. The completeness objective is that sufficiently valid data are generated to allow for submittal to the SWRCB and RWQCB(s). Completeness is assessed by comparing the number of valid sample results to the number of samples collected. The objective for completeness is greater than or equal to 80%.

10.10.4 Representativeness

Representativeness refers to a sample or group of samples that reflects the predominant characteristics of the media at the sampling point. The objective in addressing representativeness is to assess whether the information obtained during the sampling and analysis represents actual site conditions.

10.10.5 Field Duplicate

The purpose of the FD is to quantify the precision, or reproducibility, of the field sampling technique. It involves the duplication of the technique used for a particular field sample collection method and the subsequent comparison of the original and duplicate values. This comparison is measured as RPD. RPD is calculated as follows:

$$RPD = [(Sample1 - Sample2) / (Average\ of\ Samples\ 1\ and\ 2)] \times 100$$

An acceptable field RPD value is less than or equal to 35%. The FD is collected at the same time as the actual field sample, and one FD per year per active ingredient applied is collected.

10.10.6 Field Blank

The purpose of the FB is to ensure that the field sampling technique, equipment, and equipment cleaning techniques and materials do not impart a false positive or false negative result during the collection of samples. The FB is prepared with distilled water and allowed to come into contact with the sampling device in a manner identical to the actual sample. Analyte concentrations in an acceptable FB should be non-detect (ND) above the method reporting limit.

The FB is collected at the same time as the actual field sample, and one FB per year per active ingredient applied is collected.

10.10.7 Laboratory Quality Assurance and Quality Control

Laboratory precision and accuracy are monitored by a series of laboratory-generated QC samples. As long as sufficient sample volume is collected and submitted to the laboratory, no additional effort is required by field activities to generate laboratory QC samples. For most analytical methods, field samples have an associated set of laboratory QC samples.

10.10.7.1 Method Blank

The purpose of the method blank (MB) is to ensure that the analytical technique does not impart a false positive result during preparation or analysis of the sample. An MB is prepared by the laboratory from high-purity distilled or deionized water. Analyte concentrations in an acceptable MB should be ND above the method reporting limit.

10.10.7.2 Matrix Spike or Laboratory Control Spike

The purpose of an MS is to quantify accuracy and to ensure that the analytical technique does not impart a false negative or false positive result during preparation or analysis of the sample. The MS involves the introduction of the analyte (or an analyte surrogate) into the actual sample matrix and then quantitating it.

In addition to or in lieu of the MS, an LCS may be prepared to quantify accuracy and to provide assurance of the laboratory's capability to report unbiased measurements. The LCS involves introduction of the analyte (or an analyte surrogate) into a purified sample material, such as deionized water, and then quantitating it.

The amount detected divided by the amount added to the matrix is expressed as %R. Depending on the analysis, acceptable values of %R generally range from 75% to 125%. %R is calculated as follows:

$$\%R = [(\text{Spike Amount Detected} - \text{Sample Value}) / \text{Amount Spiked}] \times 100$$

10.10.7.3 Matrix Spike Duplicate or Laboratory Control Spike Duplicate

The purpose of an MSD and/or LCSD is to quantify laboratory precision. An acceptable RPD is generally less than or equal to 25%. The spike duplicate involves replication of the MS or LCS resulting in two data points from which RPD is calculated, as follows:

$$RPD = [(\text{Spike} - \text{Spike Duplicate}) / (\text{Average of Spike and Spike Duplicate})] \times 100$$

Where:
Spike = Analyte concentration measured in the MS or LCS
Spike Duplicate = Analyte concentration measured in the MSD or LCSD

10.10.8 Data Validation

Data validation uses data generated from the analytical laboratory and the field. References that can be used to assist in data validation include EPA's Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 1994) and EPA's Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA 1999).

The purpose of data validation is to verify that data collected are of sufficient quality for inclusion in reports to RWQCB(s). The following information must be available to evaluate data validity:

- **Date of Sample Collection.** This is required to uniquely identify a sample and holding time.
- **Location of Samples.** This is required to identify a sample.
- **Laboratory QA/QC Procedures.** These are required to assess analytical accuracy, precision, and sample integrity. A laboratory QA/QC sample set typically consists of an MS, an MSD, and an MB. A laboratory QA/QC sample set is analyzed by the laboratory for each field sample batch. Sufficient sample volume and number are supplied to the laboratory to prepare and evaluate the laboratory QA/QC sample set.
- **Analytical Methods.** These are required to assess appropriateness and acceptability of analytical method used.
- **Detection Limits.** These are required to assess a lower limit of parameter identification.
- **Holding Times, Preservation, and Dates of Extraction and Analysis.** These are required to assess if a sample was extracted and analyzed within the specified time limit, and if a sample was stored at the appropriate temperature.
- **Field QA/QC Procedures.** These are required to assess field precision and sample integrity. A field QA/QC sample set consists of FB and FD samples. A field QA/QC sample set is analyzed by the laboratory for one sampling event per active ingredient applied per year. Sufficient sample volume and number are collected in the field and supplied to each laboratory in order to prepare and evaluate the field QA/QC sample set.

10.10.9 Data Qualification

Data collected for compliance with the Permit is qualified through the analytical lab validation process described in Section 10.10.8, Data Validation. This process is used to document that all data has been thoroughly reviewed and qualified as valid. During the data validation process, data qualifiers are used to classify sample data. The following qualifiers are used:

- **Acceptable (A).** The data have satisfied each of the requirements and are quantitatively acceptable (i.e., valid). Valid data is presented in reports.
- **Reject (R).** Data not valid. This qualifier is used for samples that cannot be uniquely identified by date of collection or sample location, or that fail holding time or detection limit requirements. Invalid data is not presented in reports submitted to the RWQCB.

10.10.10 Quality Assurance and Quality Control Corrective Action

If previously described criteria for valid data are not met, then corrective action is taken, as follows:

1. The laboratory is asked to check its QA/QC data and calculations associated with the sample in question. If the error is not found and resolved, then the following occurs:
   a. The extracts or the actual samples, which are saved until the data are validated, are reanalyzed by the laboratory if they are within holding time limitations. These new results are compared with the previous results. If the error is not found and resolved, then the following occurs:
   b. If field analytical equipment is used, calibration records are reviewed. If the error is not found, then:
   c. The sampling procedure and sample preparation is rechecked and verified. If the procedures appear to be in order and the error is not resolved, then:
   d. The data is deemed invalid and not used.
2. Upon discovery of the source of an error, every attempt is made to address the cause of the error and remedy the problem.

10.10.11 Data Reporting

The results of sampling and analysis are summarized in an annual report. The data are tabulated so that they are readily discernible.

11 Procedures to Prevent Sample Contamination

Water quality sampling is conducted by trained DWR staff or designees following established procedures designed to prevent contamination of samples.

The following procedures help to prevent sample contamination:

- Samplers use clean, laboratory-provided sample bottles that are non-reactive. Glass and polyethylene bottles are generally used for SWP water samples.
- Samplers wear gloves that are nitrile or powder-free vinyl to avoid potential contamination associated with latex gloves. New gloves are donned immediately prior to sample collection.
- Samples are placed in resealable bags and then into an ice chest away from contaminants immediately following collection.
- Sample collection is conducted outside of the influence of application equipment, and in a manner that prevents contact with algaecide and/or aquatic herbicide application equipment, containers, and used personal protective equipment.
- Samplers minimize contact with treated vegetation.
- Sampling equipment, such as intermediary sampling containers, is thoroughly cleaned between sites if that equipment is used at more than one location.

For additional information, refer to Section 10.8, Sampling Methods and Guidance.

12 Best Management Practices Implemented

DWR employs the following BMPs to support the safe, efficient, and efficacious use of algaecides and/or aquatic herbicides.

12.1 Measures to Prevent Spills and Spill Containment in the Event of a Spill

DWR personnel or contract applicators apply algaecides and aquatic herbicides according to label instructions to prevent spills. In the event of a spill, staff follow DWR's established emergency response procedures and refer to the applicable safety data sheet for instructions on containing and cleaning up the spill. Emergency response and safety data sheet procedures are reviewed regularly. A copy of the emergency response procedures and safety data sheets are available during each treatment.

Cleanup equipment is kept in good working order and is readily available at each application site. DWR or its contract applicator staff are trained to contain any spilled material and are familiar with the use of absorbent materials (e.g., cat litter, "pigs," and "pillows"). Spills are cleaned up according to label instructions, and equipment used to remove spills is properly contained and disposed of or decontaminated, as appropriate.

Where feasible, mixing and loading occurs in closed systems, or at a location where spilled material would not enter the water.

As necessary, and taking into consideration the quantity, type, and location of an accidental spill or release, DWR will notify appropriate regulatory agencies. For example, in the event of an accidental spill at Clifton Court Forebay, CDFW, NMFS, and USFWS will be notified.

12.2 Measures to Ensure Appropriate Use Rate

The following BMPs are used to select an appropriate algaecide and/or aquatic herbicide application rate.

12.2.1 Target Biota Identification and Monitoring

Prior to treatment, target algae and/or aquatic vegetation are identified and populations are monitored to evaluate the extent to which acceptable algae or aquatic vegetation thresholds have been exceeded. Thresholds are described in Chapter 8, Factors Influencing Herbicide Use, and are generally based on water quality, pumping or conveyance capacity, impacts to intended use, and ability to deliver water to end users.

If a location is deemed to have exceeded a threshold, or the given algae and/or aquatic vegetation population is anticipated to exceed a threshold based on site and weather conditions, historic aquatic weed growth, or other information, an algaecide and/or aquatic herbicide application is considered. If the application can be made without negatively impacting water quality, then an application may be made.

12.2.2 Written Recommendations Prepared by a Pest Control Adviser

Following a positive identification of pest(s) present, an in-house or contracted PCA checks applicable product label(s) for control efficacy, and in collaboration with DWR staff, the PCA prepares a written recommendation, including rates of application, and any warnings or conditions that limit the application so that non-target flora and fauna are not adversely impacted. Licensed PCAs must complete 40 hours of continuing education every 2 years to stay licensed, and therefore are up to date on the latest techniques for pest control.

12.2.3 Applications Made by Qualified Personnel

Algaecides and/or aquatic herbicides are applied by or under the direct supervision of a certified herbicide applicator or by a qualified contractor. DWR retains licensed PCAs under contract and has in-house staff holding Qualified Applicator Certificates (QACs). These individuals, and individuals holding Qualified Applicator Licenses (QALs), are trained to confirm that aquatic herbicides are applied at rates consistent with label requirements, in a manner that avoids potential adverse effects (including, but not limited to, fish kills), and following proper application, storage, and disposal practices. Staff holding QACs and QALs must complete 20 hours of continuing education every 2 years to maintain certification, and therefore are up to date on the latest techniques for pest control.

12.2.4 Applications Made According to Label

All algaecide and aquatic herbicide applications are made according to the product label and in accordance with the regulations of the EPA, California EPA, DPR, California Occupational Safety and Health Administration (Cal/OSHA), and local Agricultural Commissioner. DWR's in-house staff holding QACs and contracted individuals holding QALs regularly monitor updates and amendments to product labels so that applications are in accordance with label directions.

For aqueducts, a spreadsheet program (FlowTimes) developed by DWR may also be used to calculate the amount of copper to apply based on aqueduct flow and the target dose. The model calculates the amount (in pounds) of copper sulfate required at specified application points, and the start and end times of the copper sulfate application required to meet the target concentration in the treatment area.

12.3 Educating Staff and Herbicide Applicators on Avoiding Any Potential Adverse Effects From Herbicide Applications

As noted in Section 12.2.3, Applications Made by Qualified Personnel, those holding QACs and QALs must complete 20 hours of continuing education every 2 years to maintain certification, and therefore are up to date on the latest techniques for pest control. PCAs are also subject to DPR licensing and continuing education requirements. In addition, DWR has a Job Hazard Analysis for each treatment that includes personal protective equipment requirements and/or recommendations for the pesticides being applied.

12.4 Application Coordination to Minimize Impact of Application on Water Users

12.4.1 Notification to Public Agencies, Downstream Users, and Contractors

Notification of intended algaecide and/or aquatic herbicide applications is provided to appropriate parties by email at least 48 hours prior to a treatment. The notification includes information such as the type of algaecide and/or aquatic herbicide to be applied, surface area, and treatment date and time, as appropriate. As discussed in Chapter 7, Gates and Control Structures, gates, weirs, and other structures are closed, as necessary, to prevent discharge of residual algaecide and aquatic herbicides.

Table 5 provides a list of the entities notified for each SWP facility.

Table 5. Entities Notified Prior to Applications

State Water Project Facility	Notified Entities
Thermalito Diversion Pool	Downstream users
Thermalito Power Canal	Downstream users
Thermalito Forebay	Downstream users and recreation facility managers
Thermalito Afterbay	Downstream users
Lower Feather River	Downstream users
Clifton Court Forebay	Byron-Bethany Irrigation District and South Bay Aqueduct water contractors
California Aqueduct	Downstream users (may include Byron Bethany Irrigation District, South Bay Aqueduct water users, MWD, Central Coast Water Agency, and Kern County Water Agency)
Bethany Reservoir	Downstream users (may include South Bay Aqueduct water users, Oak Flat Water District, or USBR) and recreation facility managers (State Parks)
Dyer Reservoir	South Bay water contractors (Alameda County Flood Control and Water Management District, Zone 7 Water Agency; Alameda County Water District; and Santa Clara Valley Water District)
South Bay Aqueduct	South Bay water contractors (Alameda County Flood Control and Water Management District, Zone 7 Water Agency; Alameda County Water District; and Santa Clara Valley Water District)
Patterson Reservoir	Zone 7 Water Agency
Lake Del Valle	South Bay water contractors (Alameda County Flood Control and Water Management District, Zone 7 Water Agency; Alameda County Water District; and Santa Clara Valley Water District), East Bay Regional Parks District
O'Neill Forebay	State water contractors, USBR, recreation facility managers (State Parks), CDFW, non-SWP water users
San Luis Reservoir	State water contractors, recreation facility managers (State Parks), CDFW, USBR, non-SWP water users
Los Banos Creek Detention Dam and Reservoir	California Department of Parks and Recreation, Central California Irrigation District, and USBR
Coastal Branch Aqueduct	Downstream users (Berrenda Mesa Water District and Central Coast Water Authority)

Table 5. Entities Notified Prior to Applications

State Water Project Facility	Notified Entities
Quail Lake	State water contractors, CDFW
Pyramid Lake	State water contractors, recreation facility managers (DWR concessionaire), USFS, CDFW, Los Angeles Department of Water and Power
Castaic Lake	CDFW, recreation facility managers (Los Angeles County Parks and Recreation), state water contractors
East Branch Aqueduct	State water contractors and downstream users
Silverwood Lake	State water contractors, recreation facility managers (State Parks), CDFW
Lake Perris	State water contractors, CDFW, and recreation facility managers (State Parks)

SWP = California State Water Project; MWD = Metropolitan Water District of Southern California; CDFW = California Department of Fish and Wildlife; DWR = California Department of Water Resources; USBR = U.S. Bureau of Reclamation; USFS = U.S. Forest Service.

Additionally, DWR staff or its PCA submit a written recommendation for use of the algaecide and/or aquatic herbicide to the County Agricultural Commissioner, if required.

12.4.2 Restrictions on Public Access During Applications

The following SWP facilities that are typically open for recreational use are closed to the public during algaecide and/or aquatic herbicide applications:

- Thermalito Forebay
- California Aqueduct
- Lake Del Valle
- O'Neill Forebay
- San Luis Reservoir
- Los Banos Creek Reservoir
- Quail Lake
- Pyramid Lake
- East Branch Aqueduct
- Silverwood Lake
- Lake Perris

Notices are posted to inform the public of lake closures at Thermalito Forebay, Lake Del Valle, O'Neill Forebay, San Luis Reservoir, Quail Lake, Pyramid Lake, Castaic Lake, Silverwood Lake, and Lake Perris.

As appropriate, facilities are posted with precautionary signage to advise water users about site-specific hazards, such as potential presence of algal toxins.

There are limited recreational activities along the California Aqueduct, and no recreational activities along the South Bay Aqueduct and Coastal Branch Aqueduct. Most sections are inaccessible to the public with locked gates and fences.

No recreational boats are permitted on Clifton Court Forebay except during a limited period during duck hunting season. In addition, Patterson Reservoir and Thermalito Power Canal have locked gates that allow access to authorized personnel only. Public access is not permitted at these facilities.

12.5 Measures to Prevent Fish Kills

The use of aquatic herbicides and/or algaecides, even when used according to label instructions, may result in unavoidable fish kills. DWR takes measures to reduce the likelihood of fish kills, as described in the following subsections. Generally speaking, the concentration of residual aquatic herbicides and/or algaecides (i.e., the concentration of the aquatic herbicide or algaecide present after the treatment is complete) is not sufficiently high to result in a fish kill. Most commonly, it is the aerobic decomposition of dead vegetative matter that consumes oxygen that then depletes dissolved oxygen that can result in fish kills.

12.5.1 Applications Made According to Label

All algaecide and aquatic herbicide applications are made according to the product label in accordance with the regulations of the EPA, California EPA, DPR, Cal/OSHA, and local Agricultural Commissioner. Precautions on the product label to prevent fish kills are followed. For example, limitations on the total water volume treated within a water body are followed to prevent dead algae or aquatic weeds from accumulating and then decaying and subsequently depressing the dissolved oxygen level. Depressed dissolved oxygen may adversely impact fish populations.

12.5.2 Written Recommendations Prepared by the Pest Control Adviser

Prior to application, a PCA licensed by DPR and/or qualified DWR staff scouts the area to be treated; makes a positive identification of pest(s) present; checks applicable product label(s) for control efficacy; and, in collaboration with DWR staff, prepares a written recommendation, including rates of application and any warnings or conditions that limit the application, so that fish are not adversely impacted.

12.5.3 Applications Made by Qualified Personnel

Consistent with applicable regulations, DWR uses staff and contractors holding QACs or QALs, or uses DWR staff under the direct supervision of staff holding QALs or QACs, to make or supervise applications recommended by the PCA. These applicators have knowledge of proper equipment loading, calibration, and operation so that spills are minimized, precise application rates are made according to the label, and only target algae and vegetation are treated. Equipment calibration is an important factor in applying the correct quantity and rate of material to meet the target concentration in the water or on target vegetation.

12.6 Measures to Protect Endangered Fish in Clifton Court Forebay

12.6.1 Preliminary Site Evaluation

Clifton Court Forebay is surveyed by boat and from the shore to determine when and if a chemical treatment is necessary to control aquatic vegetation. Based on the species to be controlled, DWR may apply copper- or endothall-containing products. Clifton Court Forebay is also monitored for algal blooms producing taste and odor compounds and/or cyanotoxins on a weekly to monthly basis. Algaecide treatments may be warranted when compounds reach nuisance levels in the South Bay Aqueduct and affect the water quality supplied to downstream water treatment plants. DWR may apply copper- or peroxide-containing algaecides.

Secondary site evaluations and pre-treatment monitoring are routinely performed. The location of treatment sites in Clifton Court Forebay are based on results of surveys conducted from a boat or from satellite imagery. The size and location of the treatment sites and application rates are determined by location, density, and species of aquatic vegetation or algae present. The intended treatment area, timing, and target biota are conveyed to the applicator so a treatment plan may be prepared.

12.6.2 Treatment

Prior to treatment, the radial gates that allow water to enter Clifton Court Forebay from the Old River are closed. The forebay elevation is also lowered to reduce water volume in the forebay and thus decrease the total amount of algaecide and/or aquatic herbicide needed to achieve the target concentration. Clifton Court Forebay is isolated from the Delta during treatment. The radial gates are re-opened after the algaecide and/or herbicide application is completed. For peroxide-based algaecides, the radial gates can reopen immediately after application. Additional fish protection measures are outlined in the Coordinated Long-Term Operation of the CVP and SWP Biological Assessment (Reclamation 2019), the Biological Opinion on Long-Term Operation of the CVP and SWP (NMFS 2019), the Environmental Impact Report for Long-Term Operation of the California State Water Project (DWR 2020), and the 2020 Incidental Take Permit for Long-Term Operation of the State Water Project in the Sacramento–San Joaquin Delta (2081-2019-066-00).

12.6.3 Fish Monitoring

The geographic distribution of listed fish in the Delta and the salvage of listed fish at the Skinner Fish Facility are monitored prior to the application in Clifton Court Forebay. As appropriate, DWR consults with CDFW, NMFS, and USFWS before application if listed fish species are observed prior to treatment.

12.7 Additional Measures to Protect Water Quality

12.7.1 Ongoing Water Quality Monitoring

Water quality, including active ingredient analyses, is monitored before, during, and after treatments as required by the Permit and described in Chapter 10, Description of Monitoring Program.

Early detection of target biota allows for implementation of control activities before algae and aquatic vegetation reach significant biomass, and before plants produce viable reproductive structures. The result is that lower quantities and/or fewer applications of algaecide or aquatic herbicide are necessary to achieve control and reduce or prevent treatment threshold exceedances.

Examples of site-specific water quality monitoring measures are discussed below.

Clifton Court Forebay and Banks Pumping Plant Intake Channel Section of California Aqueduct

Clifton Court Forebay water quality is monitored on a real-time basis with automated equipment. The station at Clifton Court Forebay is equipped with sensors to measure water temperature, turbidity, pH, specific conductance, and algal biomass (flow-through fluorometry). Additional data are obtained near the Banks Pumping Plant. The Banks Pumping Plant water quality station measures the same water quality parameters as at Clifton Court Forebay. Real-time total and dissolved organic carbon, bromide, chloride, sulfate, nitrate, dissolved oxygen, phycocyanin, and chlorophyll are also measured at the Banks Pumping Plant. Additional data are obtained from monthly grab samples collected at these stations. The analytical results of these grab samples are available online through DWR's Water Data Library (http://www.water.ca.gov/waterdatalibrary/). Data from algal taste and odor and cyanotoxin monitoring are not available on the Water Data Library.

South Bay Aqueduct

Select water quality parameters in the South Bay Aqueduct are monitored continuously by automated instrumentation. The station at Del Valle Check 7 (MP 16.38) is equipped with sensors to measure water temperature, turbidity, pH, specific conductance, and algal biomass (flow-through fluorometry). Additional data are obtained from monthly grab samples collected at this station. The analytical results of these grab samples are available online through DWR's Water Data Library (http://www.water.ca.gov/waterdatalibrary/). Additional real-time data are obtained at the Vallecitos Check (MP 22.4) water quality station, which is equipped with water quality instruments that measure water temperature, turbidity, pH, and specific conductance. Data from algal taste and odor and cyanotoxin monitoring are not available on the Water Data Library.

O'Neill Forebay

O'Neill Forebay water quality is monitored continuously by automated instrumentation. The automated station at California Aqueduct Check 13 (MP 70.89) is equipped with sensors to measure water temperature, turbidity, pH, and specific conductance. Additional data are obtained from monthly grab samples collected at this station. The analytical results of these grab samples are available online through DWR's Water Data Library (http://www.water.ca.gov/waterdatalibrary/). Data from algal taste and odor and cyanotoxin monitoring are not available on the Water Data Library.

State Water Project Reservoirs

Water quality is monitored at Pyramid Lake, Castaic Lake, Silverwood Lake, Lake Perris, and other SWP reservoirs at least once a month. Analytical results are available online through DWR's Water Data Library (http://www.water.ca.gov/waterdatalibrary/). Data from algal taste and odor and cyanotoxin monitoring are not available on the Water Data Library.

12.7.2 Post-Treatment Surveys

Treatment efficacy is evaluated at approximately 1 week after application of algaecides and/or aquatic herbicides, or when treatment is deemed complete. As appropriate, algae areas are surveyed to determine the effectiveness of the treatment at reducing algal biomass and/or the effectiveness of the treatment at reducing cyanobacteria populations. Toxins and taste and odor compounds produced by cyanobacteria are monitored on a routine basis. Aquatic vegetation populations are surveyed by boat and from the shore to determine the effectiveness of the treatment.

12.7.3 Minimize Treatment Area

The area to which algaecides and/or aquatic herbicides are applied is limited where possible to minimize cost, amount of material applied, and secondary impacts. For example, only those specific sections or aqueduct “pools” where attached filamentous algae grow are selected for treatment in the East Branch Aqueduct, and the smallest practicable area is treated in Castaic Lake. In Clifton Court Forebay, the smallest area that provides the required aquatic vegetation control to SWP pumping operations is treated.

13 Examination of Possible Alternatives

This chapter provides a discussion of possible alternatives for aquatic weed control at DWR facilities covered under the Permit.

13.1 Evaluation of Other Management Options

Treatment of algae and/or aquatic weeds is determined by the application of IPM. For example, if a population of aquatic weeds equals or exceeds a threshold, a control measure, such as application of an algaecide and/or aquatic herbicide, is implemented. Thresholds are met when aquatic weeds or algae cause problems, typically associated with pumping or conveyance capacity, taste and odor, flow impediment, or impacts to intended uses.

Algaecide and/or aquatic herbicide applications may also be made prior to threshold exceedance. For example, based on predicted growth rate and density, weather, water availability, and historical records and experience, aquatic weeds may reasonably be predicted to cause future problems. Accordingly, they may be treated soon after emergence. Even though aquatic weeds may not be an immediate problem at this phase, treating them before they mature reduces the amount of algaecide and aquatic herbicide needed because the younger aquatic plants are more susceptible to treatment and there is less plant biomass to target. Selection of appropriate algaecides and/or aquatic herbicides, rate and method of application, and treatment timing are based on the identification of the algae or aquatic weed and the appearance of that algae or aquatic weed on the product label.

DWR applies a decision matrix concept to determine suitable management options at each SWP site. A general template of this decision matrix is shown as Table 6.

Table 6. Decision Matrix Template

Decision-Making Criteria	No Action	Prevention	Mechanical or Physical	Cultural Methods	Biological Agents	Algaecides and Aquatic Herbicides
Is the impact to the environment low or easily mitigated?						
Is the cost of this option reasonable?						
Has (have) the method(s) been effectively implemented at this site?						
Option(s) selected for the site						

Table 7 summarizes physical/mechanical, cultural, and biological control tools that are considered by DWR for the management of algae and/or aquatic weeds occurring in SWP facilities. A brief description of each tool is provided in the subsections following Table 7. Refer to Table 3, Examples of Biota Controlled by Various Algaecides and Aquatic Herbicides, for a summary of the algaecides and aquatic herbicides currently considered for use.

Table 7. Non-Chemical Control Tools Considered for Algae or Aquatic Vegetation Management

Control Tool	Algae and Algae-Like		Aquatic Vegetation		
	Filamentous	*Cyanobacteria and Diatoms*	*Submersed*	*Floating*	*Emergent*
Physical/Mechanical Controls					
Aquatic weed excavation	0[1]	0	X[1]	X	X
Benthic barriers	0	0	X	0	0
Chain dragging	0	0	X	0	X
Floating boom deflector	0	0	X	X	X
Hand removal	X	0	X	0	X
Mechanical harvesting	X	0	X	X	X
Raking/netting	X	0	0	X	0
Travelling screens	X	0	X	X	0
Wall brushing	X	X	X	X	X
Cultural Controls					
Aeration	0	X	0	0	0
Nutrient management	X	X	X	X	X
Reduction of light	X	X	X	X	0
Revegetation with native species	0	0	0	0	X
Sediment dredging	X	X	X	0	X
Strategic treatment timing	X	X	X	X	X
Water drawdown	X	X	X	X	X
Biological Controls					
Herbivorous fish	X	0	X	X	0
Grazing	0	0	0	0	X

[1] "X" indicates the tool may provide control of the associated biota. "0" indicates the tool is ineffective or unlikely to provide control of the associated biota. Efficacy of implementation is variable based on target species.

13.1.1 No Action

No action involves intentionally implementing no control measures. As feasible, this technique is used. For example, consistent with the IPM program used by DWR, a threshold is typically reached prior to treatment. In such instances, prior to reaching a threshold, no control is considered.

13.1.2 Physical/Mechanical Controls

Physical/mechanical controls are practices that kill, damage, or remove aquatic vegetation or algae directly; physically block or prevent entry of aquatic vegetation or filamentous algae into managed areas; or make the environment unsuitable to support their growth. Physical/mechanical control tools used or considered for use by DWR are described below.

13.1.2.1 Aquatic Weed Excavation

Aquatic vegetation, such as pondweeds, water hyacinth, or cattails, may be removed using an excavator. Excavation can be an effective component of an IPM approach to managing aquatic vegetation; however, this method is labor intensive, and the total area or linear distance of aqueduct cleared daily is minor compared to the total impacted area. Therefore, excavation may be used effectively in combination with other control tools, such as algaecides and/or aquatic herbicides.

13.1.2.2 Benthic Barriers

Benthic barriers are materials that come in sheets and are negatively buoyant. They can be rolled over the top of existing aquatic plant beds and then weighted or pinned to the lake bottom. These systems provide immediate and long-term control of all aquatic vegetation where they are placed, and have been considered for use in small areas, such as swim beaches and launch ramps, in Pyramid and Silverwood Lakes. One significant drawback is the generally high cost of materials. Benthic barriers cost from $0.75 to $1.50 per square foot installed. The barriers may need to be removed at the end of each growing season and reinstalled in the spring. Benthic barriers may not be practical to use in reservoirs where the water level fluctuates or drops over the season because they may need to be moved to cover target plants. In addition, benthic barriers can trap gases between the lake sediment and the barrier, causing them to lift into boat propellers or create areas that might be a threat to swimmers diving under the water line. Regular maintenance and inspections are required.

13.1.2.3 Chain Dragging

DWR manages aquatic vegetation and filamentous algae in the Coastal Branch Aqueduct by dragging a large chain along the aqueduct lining. The method can remove filamentous algae mats and aquatic weeds, but is time-consuming, requires a large expenditure of labor, and often damages the canal lining. The procedure provides a short-term solution and must be repeated frequently to reduce the impact of aquatic vegetation on water conveyance. Chain dragging is not suitable for use in all sites. For example, chain dragging has been considered for use in the East Branch segment of the California Aqueduct, but the growth of the aquatic weeds on primarily the upper liner renders the application of this method infeasible. Previous implementation attempts in the South Bay Aqueduct resulted in damage to the concrete aqueduct lining and mass loading of debris. In addition, the chain could not be used upstream of any water turnouts due to the potential risk of breaking off large amounts of attached algae and aquatic weeds that could clog the water intakes.

13.1.2.4 Floating Boom Deflector

DWR staff installed a weed-deflecting boom system in the California Aqueduct to prevent floating aquatic weeds from entering the Coastal Branch Aqueduct intake channel and other turn-outs. The main contribution of nuisance vegetation is from plants growing upstream in the 100-mile aqueduct section below the Dos Amigos Pumping Plant. These weeds regularly break off and may enter the Coastal Branch Aqueduct. The floating boom is installed at an angle to deflect floating weeds but not impede flow in the main aqueduct.

13.1.2.5 Hand Removal

Removal of weeds by hand using dive teams can be an effective method of controlling watermilfoil and other aquatic plants under certain conditions. Pioneering infestations of watermilfoil may be targeted using this control method before substantial rhizomes develop. Divers swim through the littoral area of the lake and hand remove and bag the plant material and roots. The method provides rapid removal and clears the plants from the water column. It has been considered for sites such as Pyramid and Quail Lakes. One of the drawbacks of this method is the expense of deploying divers. Additionally, species like watermilfoil spread through stem fragments; parts of the plant not removed by divers or inadvertently broken off can drift within the water body and develop into new plants.

13.1.2.6 Mechanical Harvesting

In sites such as Clifton Court Forebay and O'Neill Forebay, aquatic weeds may be harvested with an aquatic weed harvester that can remove aquatic vegetation from the water column by cutting and pulling it out of the water with a conveyer belt and then offloading it onto a barge or the shore. Harvesting may occur after aquatic vegetation has grown to a nuisance level during the summer and fall months. A mechanical harvester may be used for regular removal of floating or submersed aquatic vegetation near the outlet from Clifton Court Forebay to help maintain flows to the Skinner Fish Facility and Banks Pumping Plant. In some circumstances, floating filamentous algae mats can be removed by mechanical harvesters. Harvesting is labor intensive, and the area cleared of aquatic weeds daily is minor compared to the total area of the forebay impacted by weeds. As discussed in Section 13.1.2.5, Hand Removal, fragmentation of stems can result in further spreading of the targeted plants.

13.1.2.7 Raking/Netting

Filamentous algae and other floating aquatic vegetation can sometimes be controlled via physical or automated removal with a rake or net. Automated weed rakes are installed on trash racks in front of many of DWR's pumping plants and are continuously operated during heavy weed load periods. Due to the rapid rate of growth of the algae and aquatic vegetation during the growing season, this method requires ongoing efforts and a significant amount of staff resources.

13.1.2.8 Travelling Screens

Continuously operating or self-cleaning travelling screens are used as appropriate to remove aquatic vegetation and filamentous algae from sites such as the South Bay and Coastal Branch Aqueducts. Travelling screens are not suitable for removal of small, filter-clogging diatoms or cyanobacteria. The travelling screen is effective in the Coastal Branch Aqueduct when aquatic weed biomass is low; however, when weeds are abundant, removal of the weeds from the screen must be assisted with one to two DWR staff working nearly continuously during the peak weed season.

13.1.2.9 Wall Brushing

Wall brushing may be considered to control taste- and odor-causing periphytic cyanobacteria on lined aqueduct walls. In a non-SWP assessment of wall brushing in the Arizona Canal using a tractor-mounted custom-designed rotating metal brush, this tool was effective in reducing periphytic biomass for up to 2 weeks. Like chain dragging, wall brushing provides a short-term solution and must be repeated frequently to reduce the impact of cyanobacteria on water quality. Wall brushing may not be appropriate upstream of water turnouts when there is potential risk of breaking off large amounts of attached algae that could clog the water intakes.

13.1.3 Cultural Controls

Cultural controls can generally be described as preventive measures that discourage weed and algae populations from developing by reducing the plant or algae's ability to establish, reproduce, disperse, and survive. Cultural control tools used or considered for use by DWR are described below.

13.1.3.1 Aeration

Mechanical aerators oxygenate the water column and upper portions of lake sediment. One effect of this oxygenation is to prevent the release of reduced forms of phosphorus from bottom sediments back into the water. Reduction in phosphorus and other changes in water quality parameters may decrease algal blooms. When used in combination with other control methods, aeration can be a useful tool in algae management. However, aeration can be costly and may not be feasible in large water bodies such as Silverwood Lake and Castaic Lake due to staff needed to maintain a large aeration system and infrastructure challenges such as availability of power to run aeration compressors.

13.1.3.2 Nutrient Management

Nutrient management involves limiting the introduction of, or reducing existing levels of, nutrients in water that support aquatic vegetation and algae growth. Although it is potentially feasible for some sites, the vast size of the SWP system and numerous inflows to various SWP facilities present challenges in successful implementation of nutrient management. Additionally, permitting challenges may make some methods of nutrient management (e.g., application of lanthanum-modified clay or alum as a phosphorus mitigation material) infeasible.

13.1.3.3 Reduction of Light

Shading or reduction of light can be an effective mechanism of discouraging cyanobacteria, filamentous algae, and aquatic vegetation growth by reducing the amount of light available for photosynthesis. A variety of light-reduction strategies have been considered, such as enclosing 11 open miles of the South Bay Aqueduct, adding floating shade balls to small forebays, dredging to deepen Clifton Court Forebay, and installing solar panels to shade the aqueduct. The primary challenge associated with enclosing or shading the aqueduct or deepening forebays is the high cost. The use of dyes would not be a feasible alternative in a flowing aqueduct because dye would have to be continually added to be effective and may impact treatment plant operations.

Dredging involves excavation of soil and weeds from an area of water. DWR evaluated the use of dredging in Clifton Court Forebay to deepen areas impacted by aquatic plant growth and reduce the amount of suitable habitat where light can penetrate. The evaluation determined the dredging activities to be cost prohibitive.

13.1.3.4 Revegetation with Native Species

Removal of emergent non-native vegetation and re-establishment of native species is a potential option for sites where emergent vegetation is problematic. No appropriate submersed aquatic native plants have been found that could establish within lakes, canals, or other DWR facilities to outcompete aquatic weed species and not create similar or other operational challenges. Limitations to this option include the availability of native species; availability of labor to remove the non-native species, plant native species, and maintain the revegetated areas once established; and safe access to the site for workers. Due to these limitations, this option is not feasible for the SWP.

13.1.3.5 Sediment Dredging

DWR may consider habitat-modifying techniques, such as sediment dredging appropriate for the individual target area. In areas where sedimentation has significantly impacted the capacity of the water body, dredging can increase the water volume and remove nutrient-containing sediment. Additionally, dredging sites like drainage ditches reduces habitat available to emergent vegetation, such as cattails. DWR dredges sediment in the Coastal Branch Aqueduct and forebays, Dyer Reservoir, and Patterson Reservoir, and has observed reductions in algal blooms and weed growth.

13.1.3.6 Strategic Treatment Timing

Cultural methods to reduce the amount of aquatic herbicides used include modifying the timing of algaecide and/or aquatic herbicide, and non-herbicide controls such as cutting and harvesting to prevent plants from reaching reproductive growth stages. Strategic treatment timing also includes making applications before the density of algae or aquatic vegetation is high enough to require higher algaecide or aquatic herbicide application rates or additional applications to maintain algae or aquatic weed populations below threshold levels.

13.1.3.7 Water Drawdown

Lowering the water level with drawdown is a potential method to control some species of algae and aquatic weeds by desiccation. The South Bay Aqueduct, for example, has been drained approximately every 8 years since 1970. Although the main purpose of draining the aqueduct is to remove accumulated silt that is deposited in the aqueduct invert, dewatering can help provide temporary relief from algae and aquatic vegetation pressure. The major drawback is that a long outage period of several weeks would be necessary, limiting the number of sites where this control can effectively be implemented. For example, a drawdown of that length of time would be difficult due to demands on many sites for water supply, conveyance, pumping, and other uses. In addition, some genera of cyanobacteria are tolerant of desiccation and may not be sufficiently controlled in sites actively managing cyanobacteria.

Drawdown or flow reduction may also be used to reduce the water volume within a treatment area so a lower amount of algaecide or aquatic herbicide is necessary to achieve a target concentration. This can enhance the efficacy of a treatment while reducing overall impacts to the environment.

13.1.4 Biological Controls

Biological control is the use of natural enemies or other species to manage pests, typically in an effort to restore, enhance, or mimic naturally occurring conditions. Biological control tools used or considered for use by DWR are described below.

13.1.4.1 Herbivorous Fish

Triploid grass carp (*Ctenopharyngodon idella* Val.) has been approved for stocking by CDFW under controlled conditions where the water body is a closed system, like for the Imperial Irrigation District. These fish can be effective in controlling submersed aquatic vegetation; however, as sources of preferred plants become scarce, feeding will continue on other plants, which can result in reduction of native vegetation needed for fish habitat. As a result, stocking of fish has been considered but not implemented at sites such as the Coastal Branch Aqueduct, Silverwood Lake, Lake Perris, and Los Banos Creek Detention Dam and Reservoir. CDFW is not issuing permits for stocking triploid carp in new areas outside of Coachella and Imperial Valleys.

13.1.4.2 Grazing

Introduction of grazing sheep and goats is sometimes used to control terrestrial and some types of emergent aquatic vegetation, but is not suitable for submerged aquatic weeds and algae. Impacts to water quality from animal feces; increases in turbidity, nutrients, and bank erosion; and impacts to desirable species make this option unfeasible in SWP facilities. The cost of hiring grazing animals is also generally more costly than algaecide and aquatic herbicide control alternatives.

13.1.5 Algaecides and Aquatic Herbicides

The selection of and decision to use an algaecide and/or aquatic herbicide is based on the recommendation of a PCA in collaboration with DWR staff or its qualified contractor. The PCA may consider a variety of control options that may include mechanical and cultural techniques that alone, or in combination with chemical controls, are the most efficacious and protective of the environment.

Evaluating alternative control techniques is part of DWR's IPM approach; therefore, an alternative treatment may be selected as part of its program. Alternative control techniques are described in Section 13.1, Evaluation of Other Management Options. Where feasible, alternative measures have been implemented in SWP facilities (trash racks, travelling screens, deflector booms). In general, alternative control techniques are expensive, labor intensive, less effective, and may cause temporary water quality degradation. In addition, the equipment and labor required to perform alternative control techniques is not always readily available. This may cause delays in management actions, leading to increased quantities of biomass material to control or remove, and subsequently higher removal cost.

The quantity or rate of algaecide and/or aquatic herbicide required for an application is determined by a PCA who is following the label directions. The rate at which an algaecide and/or aquatic herbicide is used is highly variable and depends on the target biota, time of year, setting, density, historical growth patterns, water presence, and goal of the treatment. All these factors are considered by the PCA prior to making a recommendation for an application.

13.2 Using the Least Intrusive Method of Aquatic Herbicide Application

DWR uses a variety of application methods, such as hand application, specialized mechanized vehicles (e.g., trucks, all-terrain vehicles, trailers), boats with submersed injection nozzles or granular spreaders, and helicopters, to conduct algaecide and/or aquatic herbicide treatments, depending on the site. Combined with the need to hold, safely transport, and properly apply algaecides and aquatic herbicides, DWR's techniques are as unintrusive as feasibly possible.

Please refer to Table 2, Algaecides and Aquatic Herbicides that May Be Used, for potential application methods.

13.3 Applying a Decision Matrix Concept to the Choice of the Most Appropriate Formulation

As previously stated, a PCA and/or qualified DWR staff scouts the area to be treated, makes a positive identification of pest(s) present, checks appropriate algaecide and/or aquatic herbicide product label(s) for control efficacy, considers the intended use of the water, and prepares a written recommendation. The written recommendation includes rates of application and any warnings, use restrictions, or conditions that may limit the application.

The PCA may also recommend that an adjuvant be used to enhance the efficacy of the algaecide or aquatic herbicide, as needed.

14 References and Preparers

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15 Limitations

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SOURCE: DWR

DUDEK

0 50 100 Miles

FIGURE 1

Project Locations

California Department of Water Resources Aquatic Pesticide Application Plan

SOURCE: ESRI World Imagery; DWR 2020

DUDEK

FIGURE 2

Thermalito Diversion Pool

California Department of Water Resources Aquatic Pesticide Application Plan

SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 1,000 2,000 Feet

FIGURE 3

Thermalito Power Canal

California Department of Water Resources Aquatic Pesticide Application Plan

SOURCE: ESRI World Imagery; DWR 2020

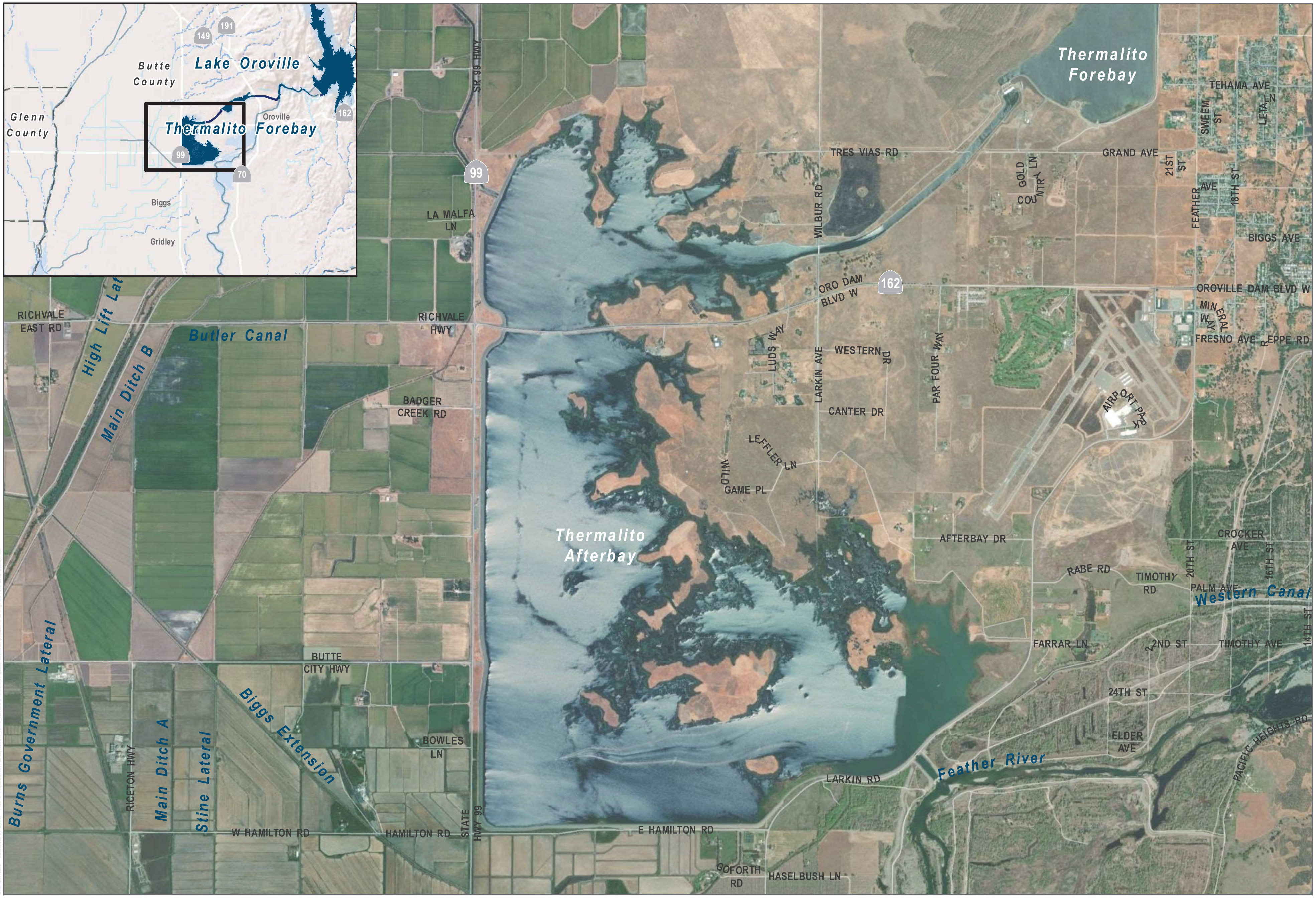
DUDEK

0 1,000 2,000 Feet

FIGURE 4

Thermalito Forebay

California Department of Water Resources Aquatic Pesticide Application Plan



SOURCE: ESRI World Imagery; DWR 2020

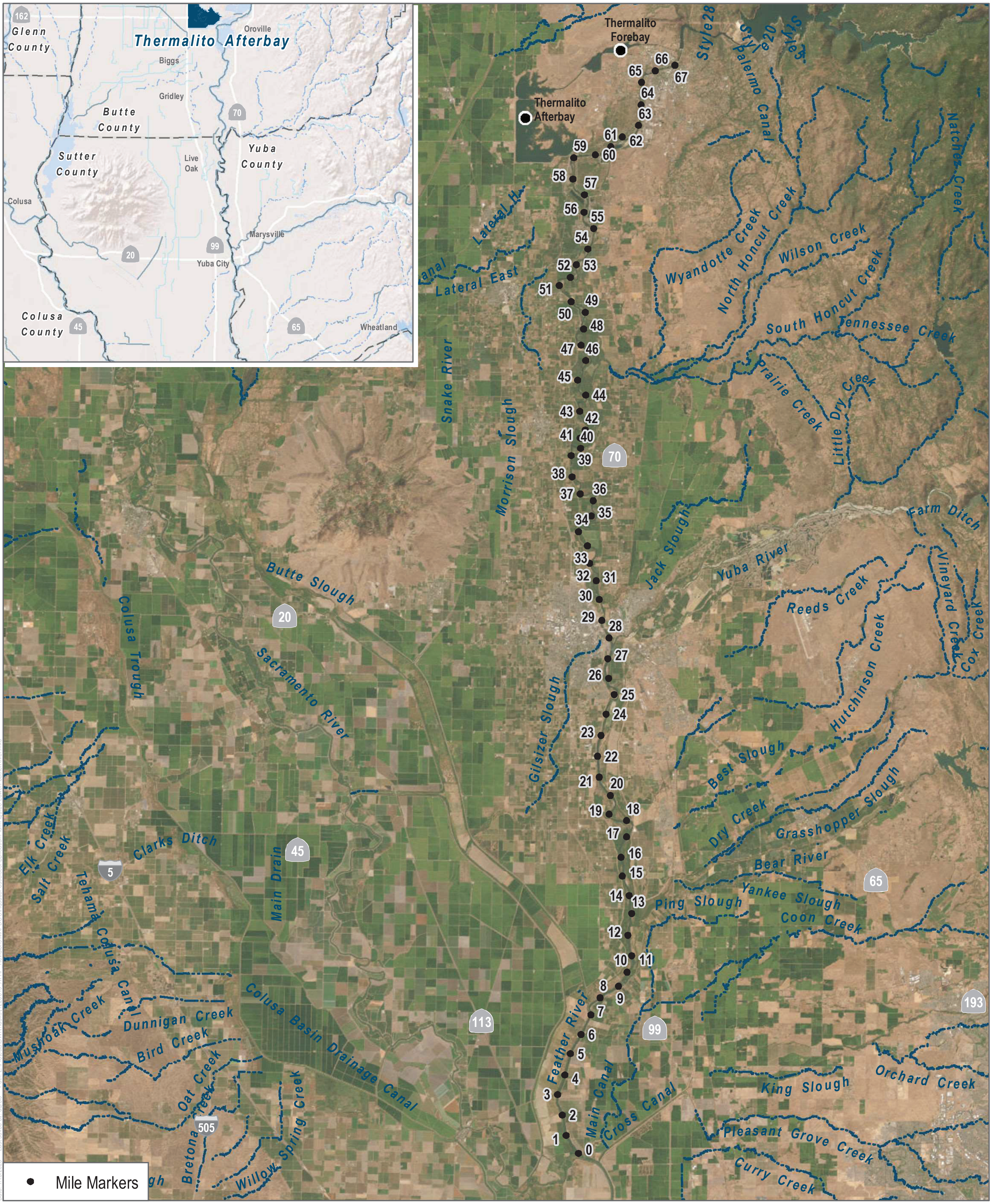
DUDEK

0 1,500 3,000 Feet

FIGURE 5

Thermalito Afterbay

California Department of Water Resources Aquatic Pesticide Application Plan



BASEMAP SOURCE: ESRI World Imagery; DWR 2020

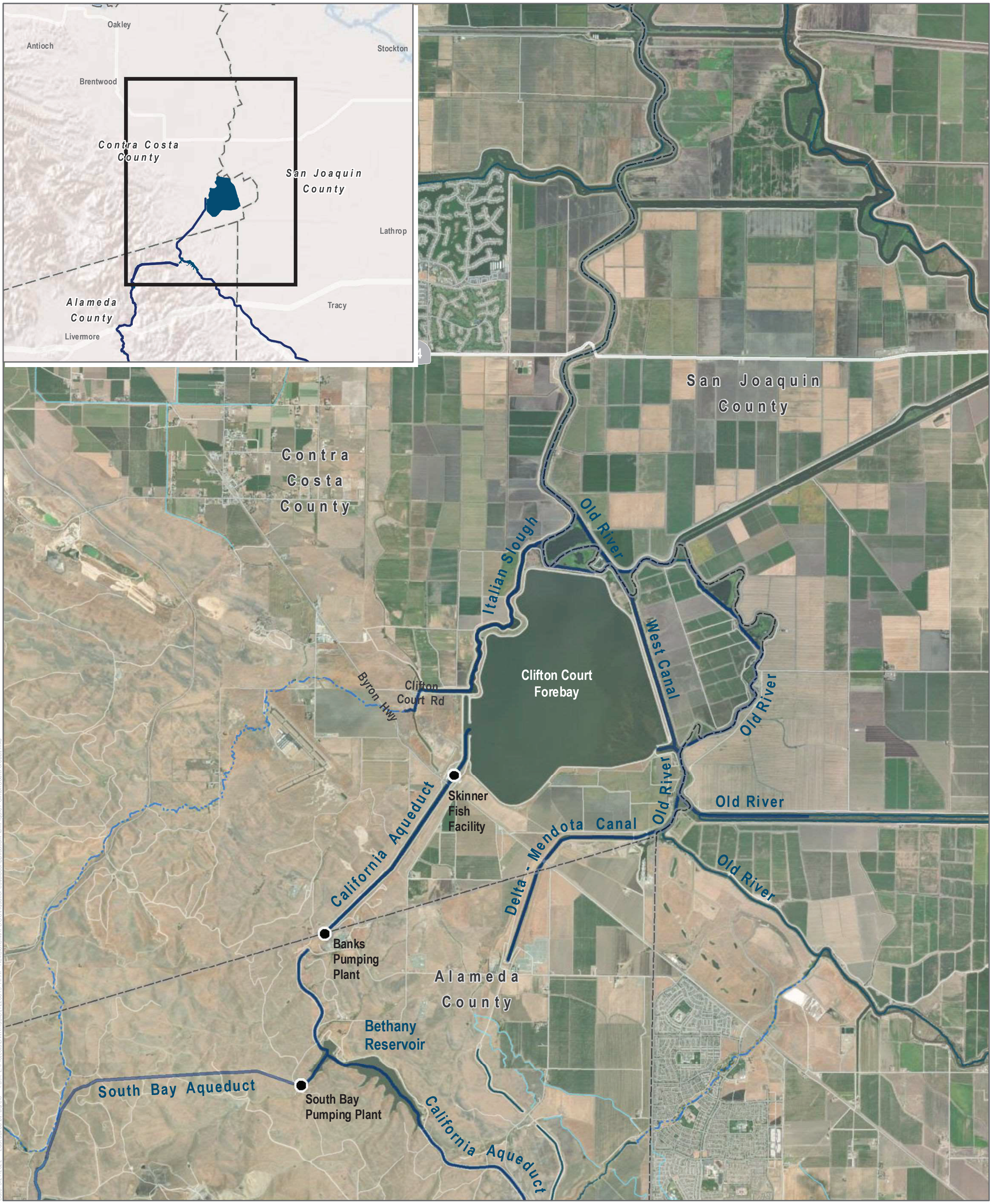
FIGURE 6

Lower Feather River

California Department of Water Resources Aquatic Pesticide Application Plan

DUDEK

0 2 4 Miles



BASEMAP SOURCE: DWR 2020; USGS 2020; ESRI World Imagery

DUDEK

0 1 2 Miles

FIGURE 7

Clifton Court Forebay

California Department of Water Resources Aquatic Pesticide Application Plan

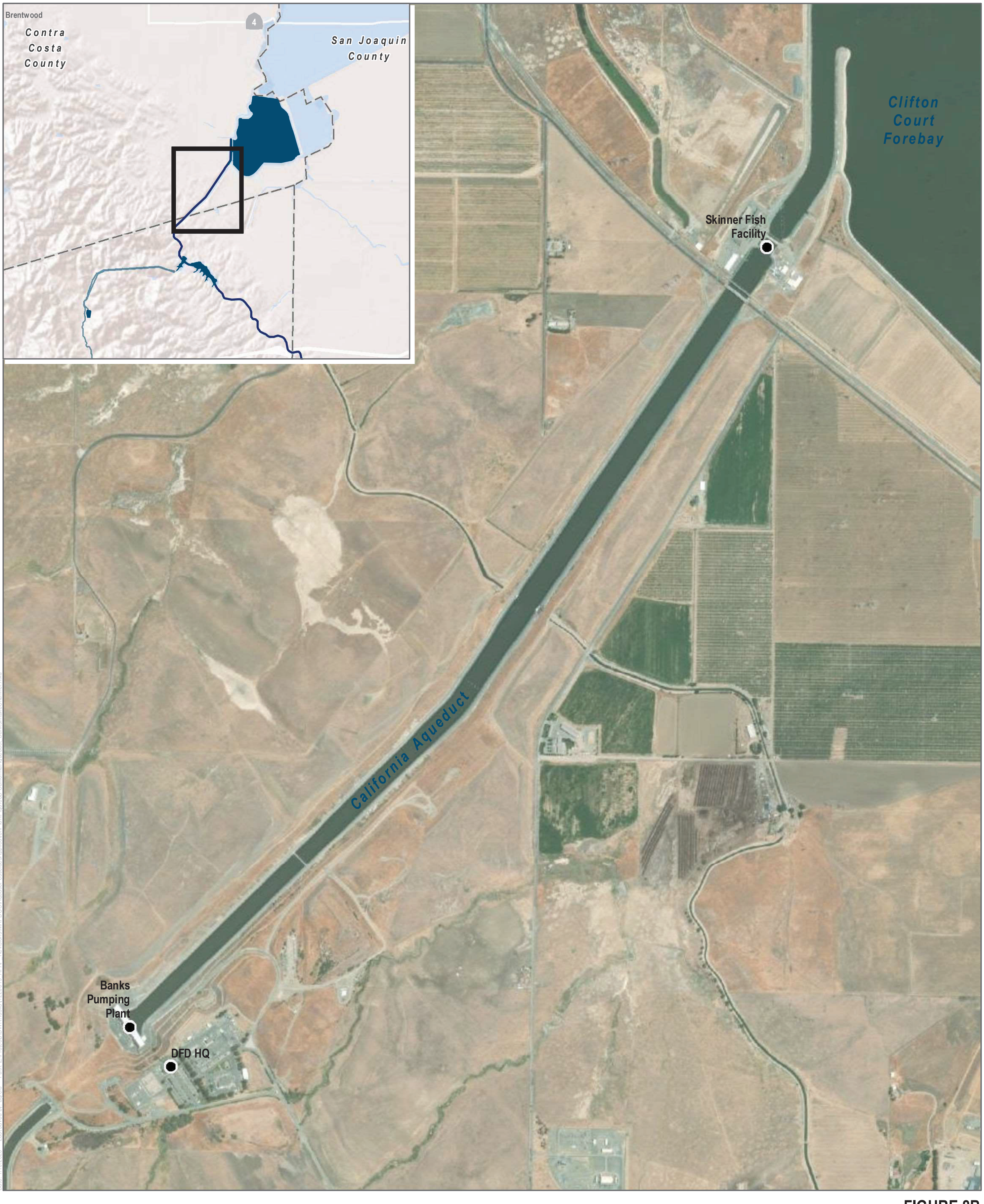
BASEMAP SOURCE: ESRI World Imagery; DWR 2020

FIGURE 8A

California Aqueduct from Mile Marker 0.0 to 09.3 (CCF to Fish Screens)

California Department of Water Resources Aquatic Pesticide Application Plan

DUDEK

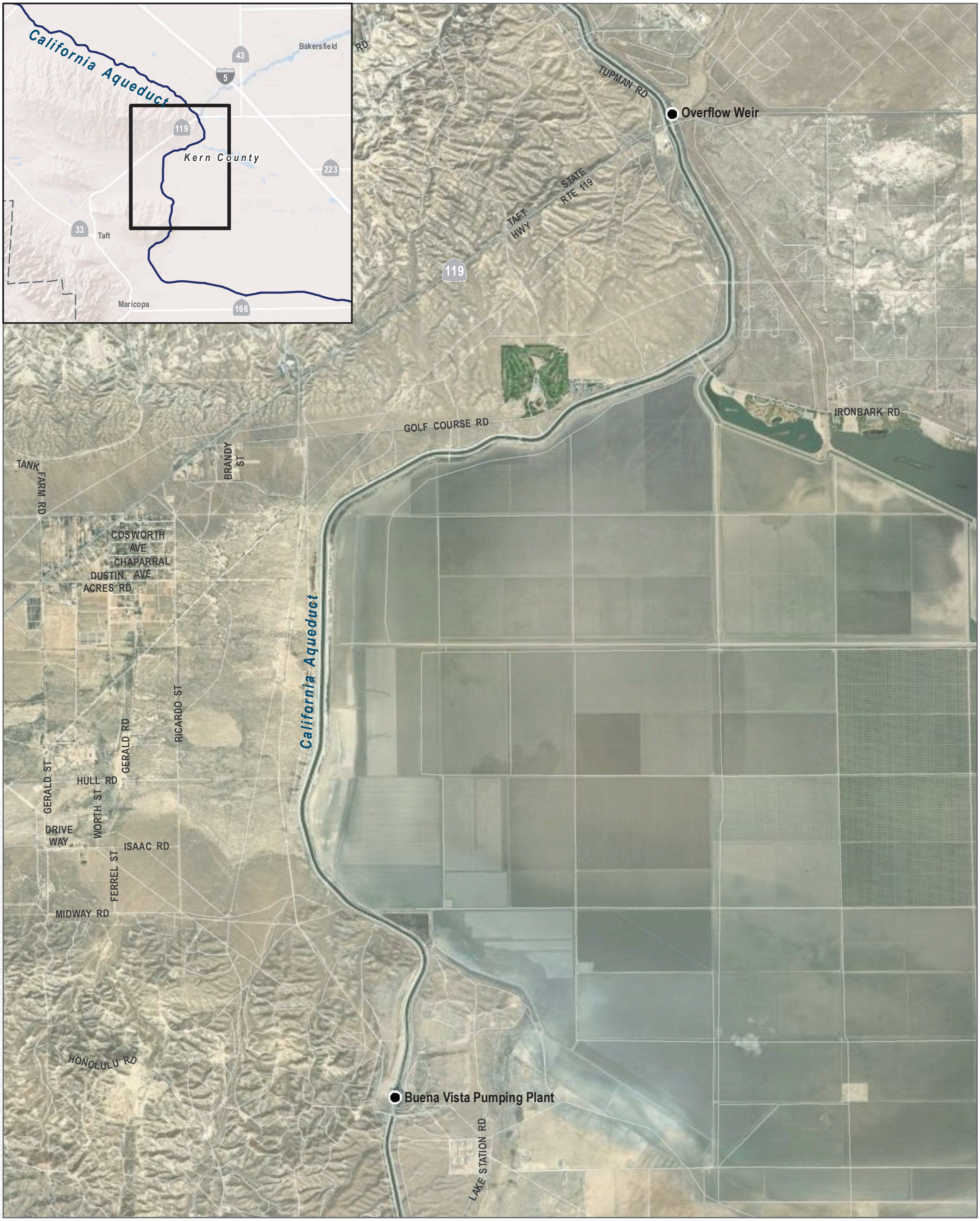


BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

FIGURE 8B

California Aqueduct from Mile Marker 09.3 to BAPP (Banks Intake Pumping Plant)



SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 0.5 1 Miles

FIGURE 8C

California Aqueduct from Mile Marker 246.65 to 250.99
(Spillway to Buena Vista Pumping Plant)

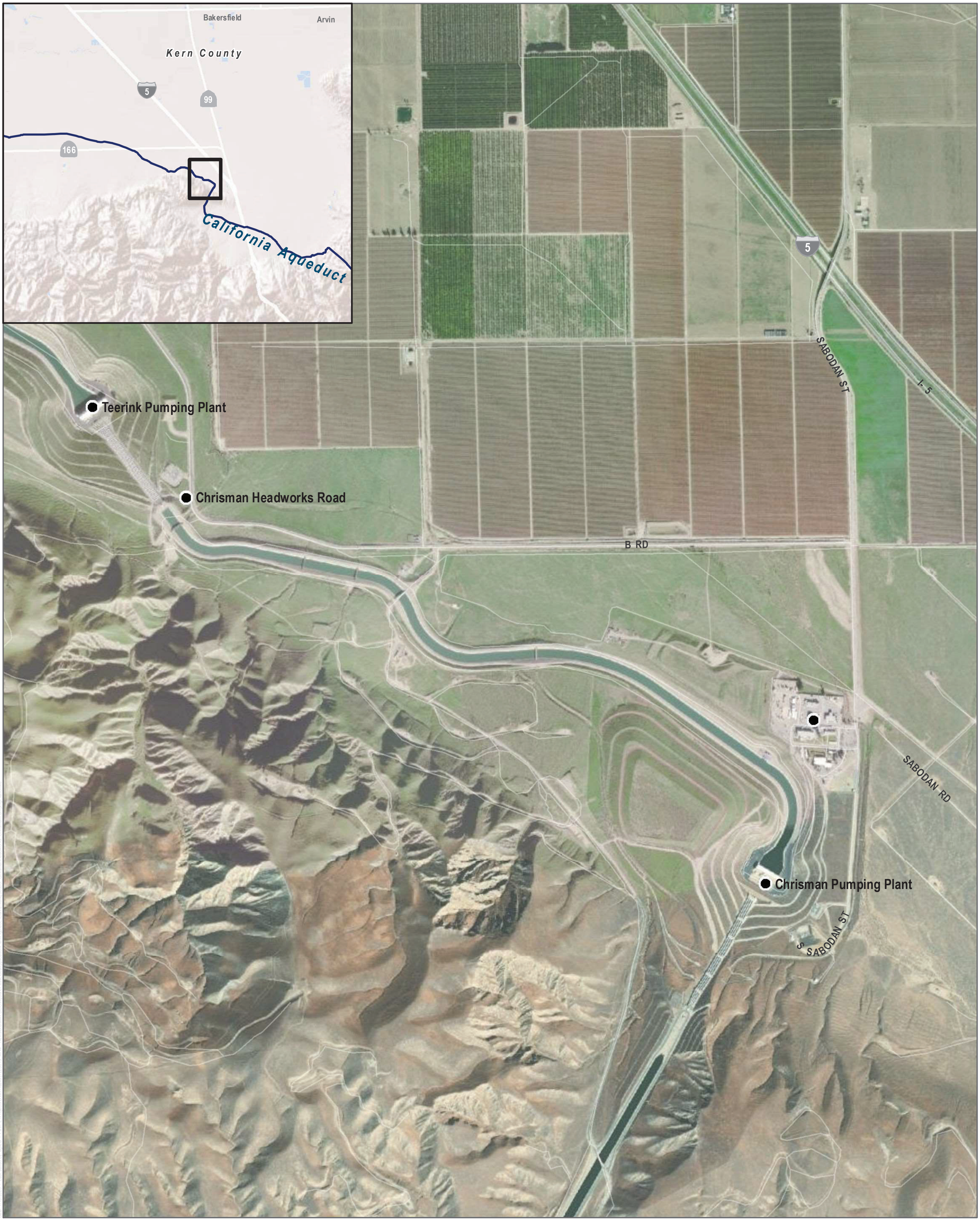
SOURCE: ESRI World Imagery; DWR 2020

FIGURE 8D

California Aqueduct from Mile Marker 277.31 to 278.13
(Arvin-Edison to Teerink Pumping Plant)

DUDEK

0 1,000 2,000 Feet



SOURCE: ESRI World Imagery; DWR 2020

FIGURE 8E

California Aqueduct from Mile Marker 279.05 to 280.45

(Chrisman Headworks to Chrisman Pumping Plant)

DUDEK

0 1,000 2,000 Feet

SOURCE: ESRI World Imagery; DWR 2020

DUDEK

FIGURE 8F

California Aqueduct from Mile Marker 285.69 to 292.16 (I-5 to Pastoria Creek Siphon)

California Department of Water Resources Aquatic Pesticide Application Plan

BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 500 1,000 Feet

FIGURE 9

Bethany Reservoir

California Department of Water Resources Aquatic Pesticide Application Plan

SOURCE: DWR 12/28/2020; ESRI World Imagery

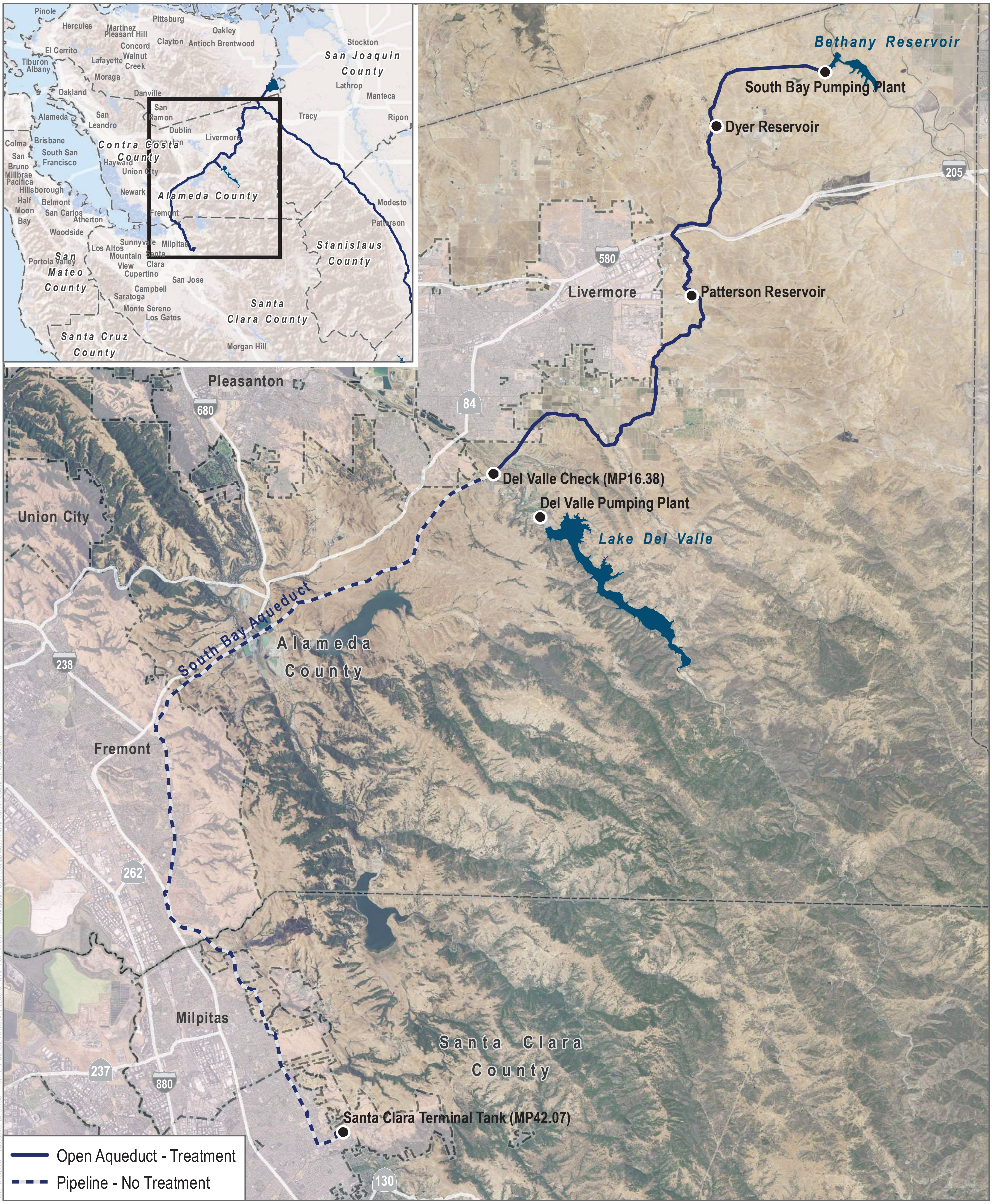
DUDEK

0 200 400 Feet

FIGURE 10

Dyer Reservoir

California Department of Water Resources Aquatic Pesticide Application Plan



BASEMAP SOURCE: DWR 2020; USGS 2020; ESRI World Imagery

FIGURE 11

South Bay Aqueduct

California Department of Water Resources Aquatic Pesticide Application Plan

DUDEK

0 2 4 Miles

SOURCE: DWR 12/11/2020; ESRI World Imagery

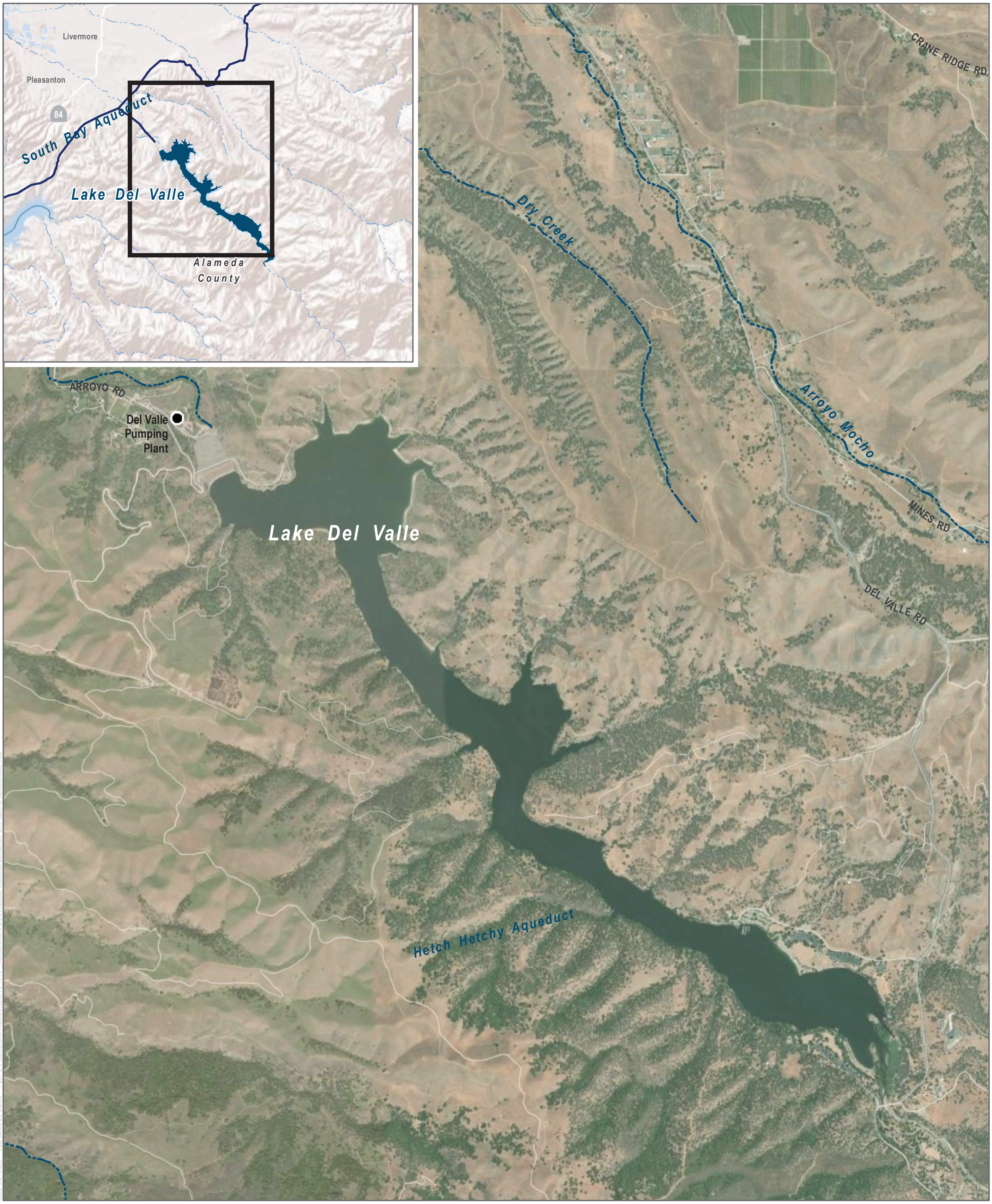
DUDEK

0 200 400 Feet

FIGURE 12

Patterson Reservoir

California Department of Water Resources Aquatic Pesticide Application Plan



BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 1,500 3,000 Feet

FIGURE 13

Lake Del Valle

BASEMAP SOURCE: ESRI World Imagery; DWR 2020

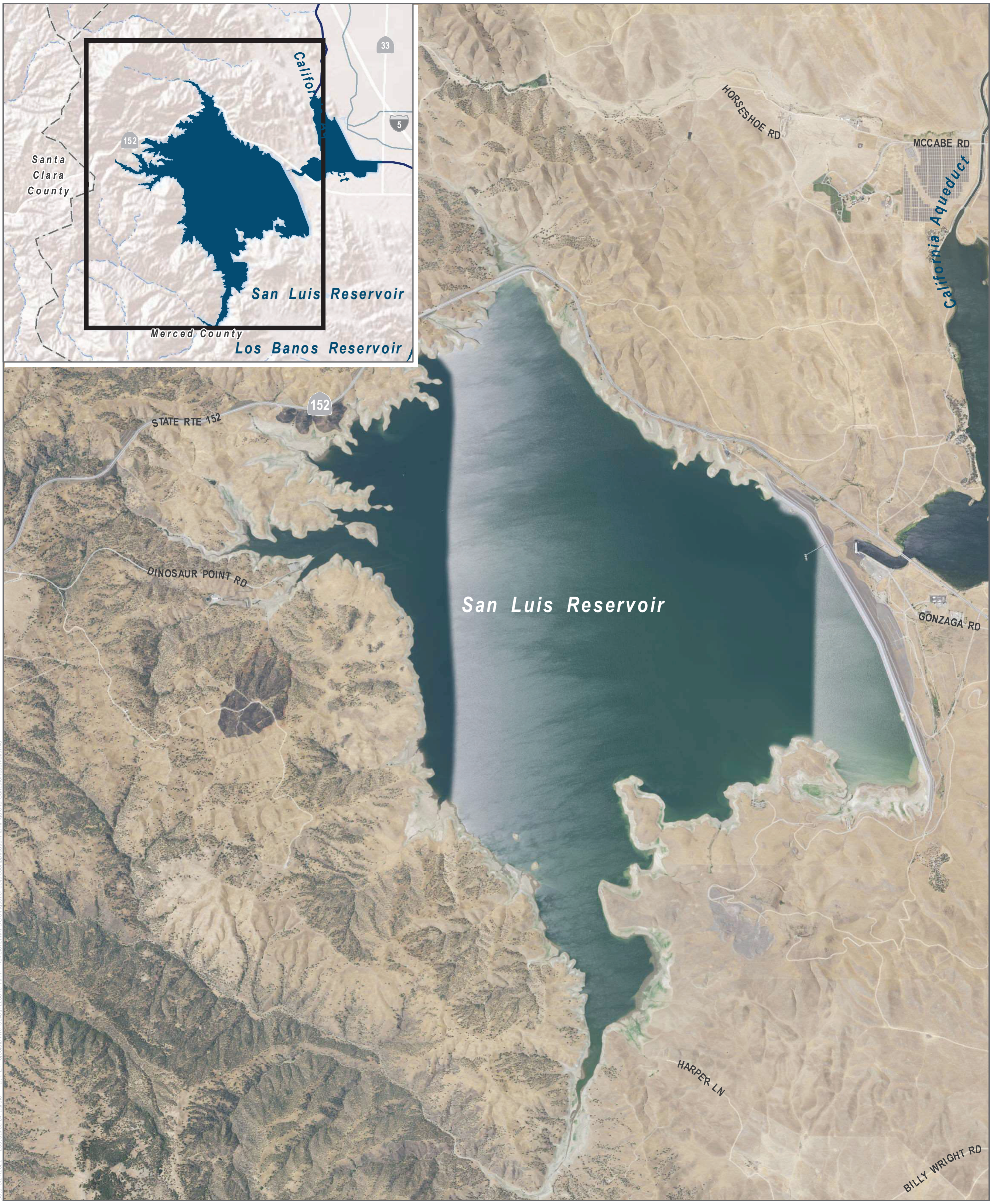
DUDEK

0 1,500 3,000 Feet

FIGURE 14

O'Neill Forebay

California Department of Water Resources Aquatic Pesticide Application Plan



BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 0.5 1 Miles

FIGURE 15

San Luis Reservoir

California Department of Water Resources Aquatic Pesticide Application Plan

BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 1,500 3,000 Feet

FIGURE 16

Los Banos Creek Detention Dam and Reservoir

California Department of Water Resources Aquatic Pesticide Application Plan

BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 150 300 Feet

FIGURE 17

Box Culvert Drain to Los Banos Creek

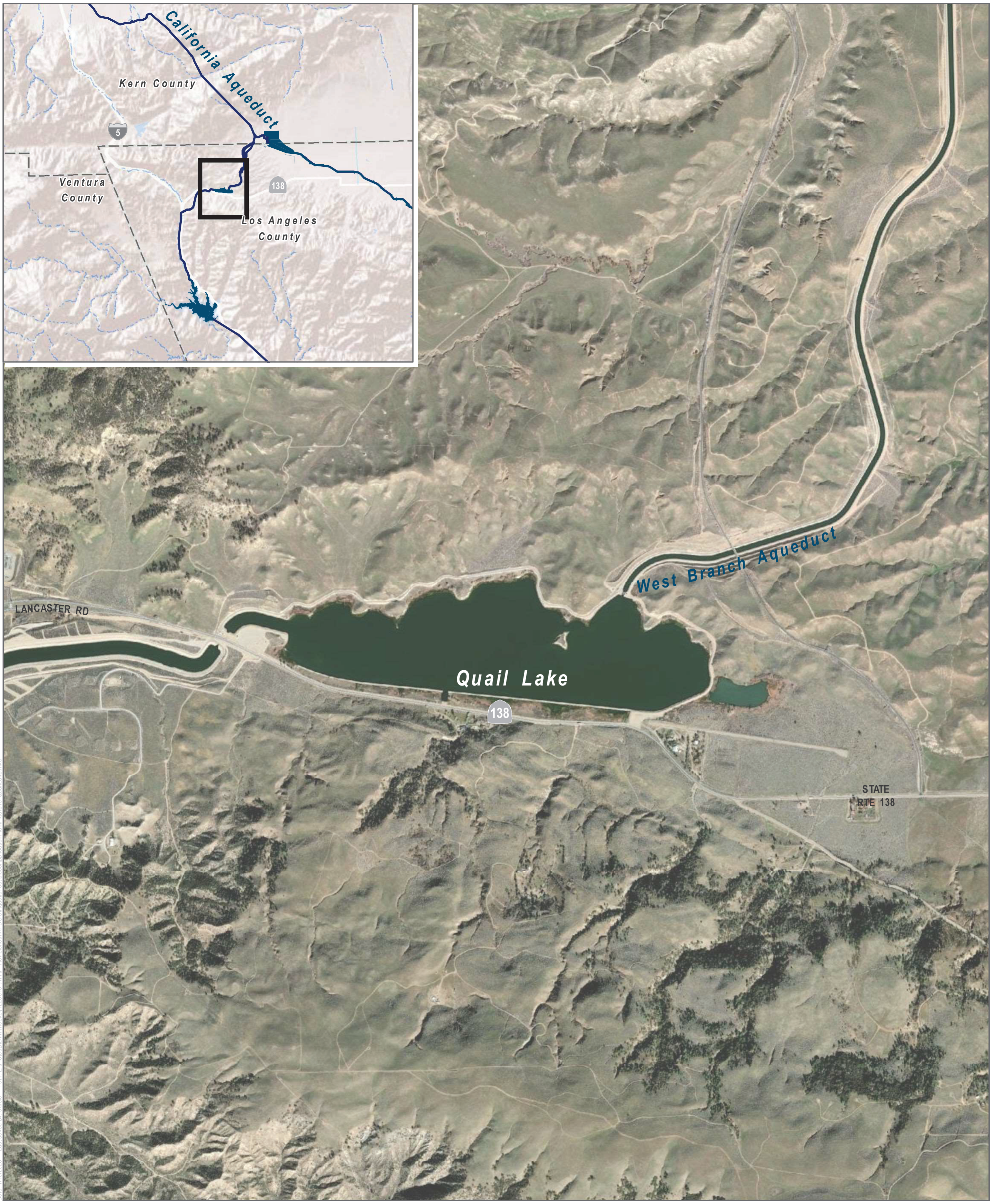
California Department of Water Resources Aquatic Pesticide Application Plan

BASEMAP SOURCE: DWR 2020; USGS 2020; ESRI World Imagery

FIGURE 18

Coastal Branch Aqueduct

California Department of Water Resources Aquatic Pesticide Application Plan



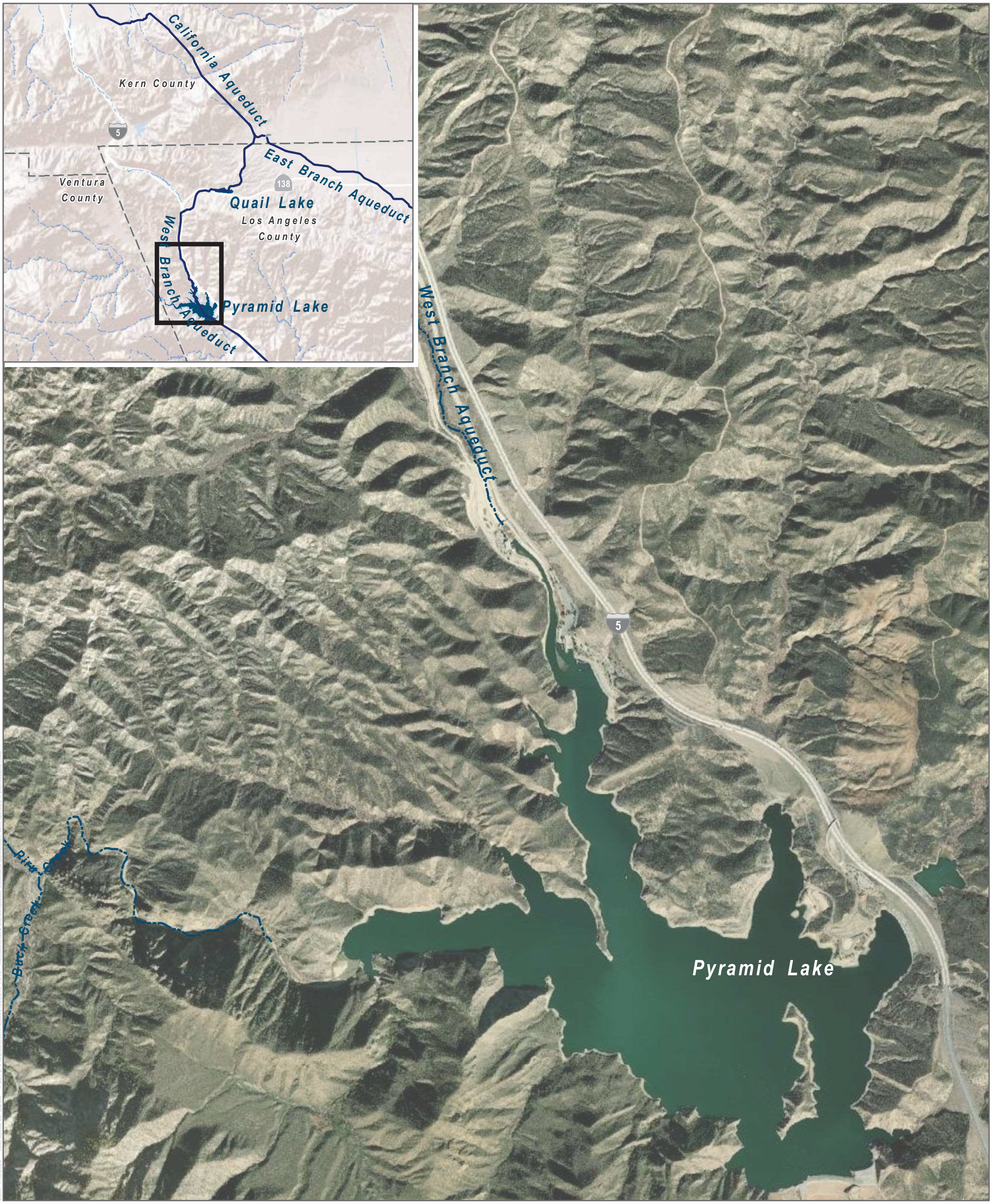
BASEMAP SOURCE: ESRI World Imagery; DWR 2020

FIGURE 19

Quail Lake

DUDEK

0 1,000 2,000 Feet

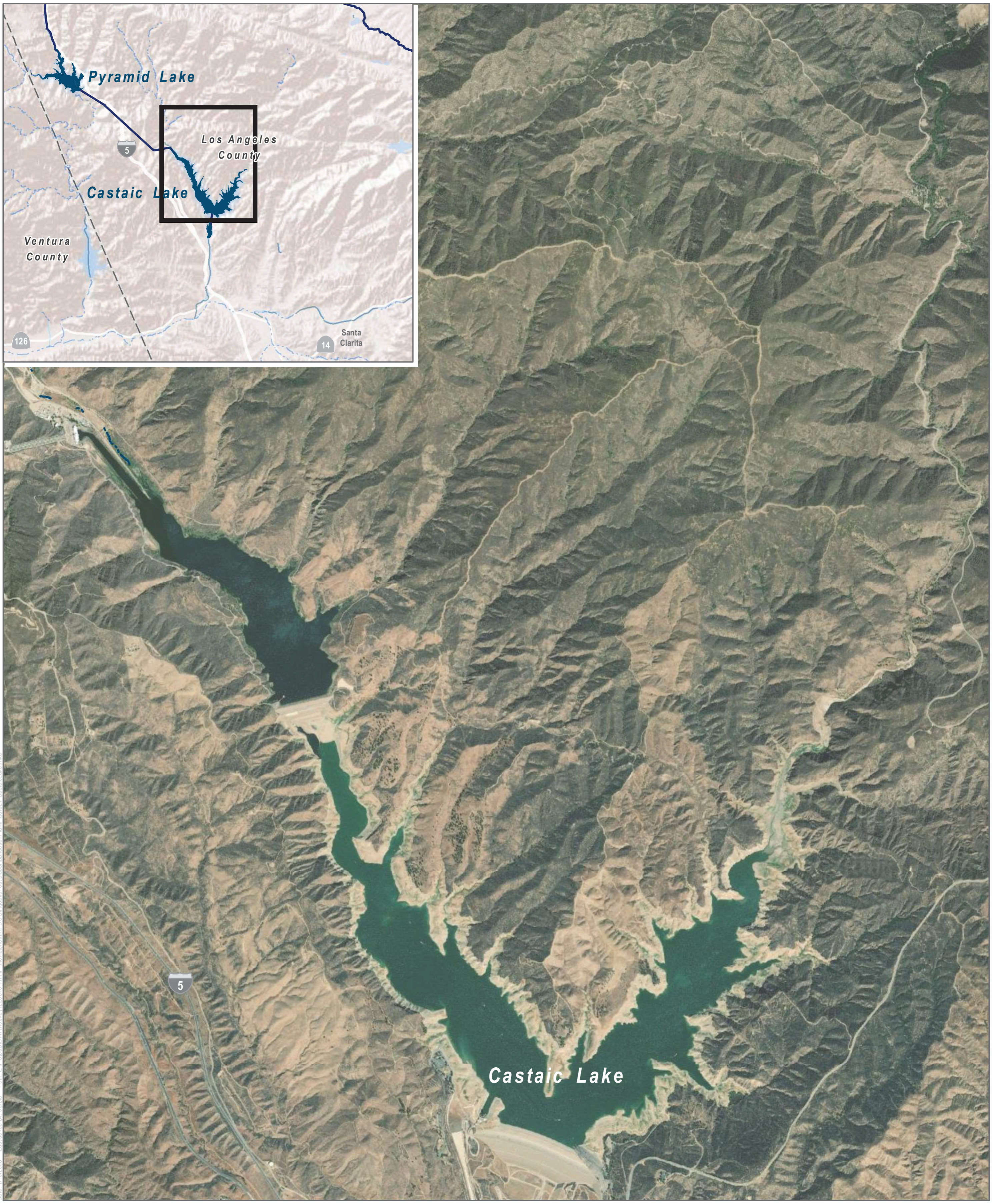


BASEMAP SOURCE: ESRI World Imagery; DWR 2020

0 1,500 3,000 Feet

FIGURE 20

Pyramid Lake



BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 0.5 1 Miles

FIGURE 21

Castaic Lake

California Department of Water Resources Aquatic Pesticide Application Plan

BASEMAP SOURCE: DWR 2020; USGS 2020; ESRI World Imagery

DUDEK

0 5 10 Miles

FIGURE 22

East Branch Aqueduct

California Department of Water Resources Aquatic Pesticide Application Plan

BASEMAP SOURCE: ESRI World Imagery; DWR 2020

DUDEK

0 1,000 2,000 Feet

FIGURE 23

Silverwood Lake

California Department of Water Resources Aquatic Pesticide Application Plan

BASEMAP SOURCE: ESRI World Imagery; DWR 2020

FIGURE 24

Lake Perris

DUDEK

0 1,500 3,000 Feet

Appendix A

Aquatic Herbicide Application Log

Aquatic Herbicide Application Log rev 3.4.15

For Client Use Only

****IMPORTANT** To Be Completed EVERY TIME an Aquatic Herbicide Application is Made**

App. Start: Time ________________ Date ________________

App. End: Time ________________ Date ________________

Application Location ____

Agency ______________________________ Personnel ______________________________

Air Temperature (F°) _______ Wind Speed (mph) _________ Target Weeds ______________________

____

____

Treatment Area Size (choose one):

Acres ____________ Linear Feet ____________

Herbicide #1 Used ______________ Rate/Target Conc. ________ Units ______ Total Amt. Applied ________ Units ______

Herbicide #2 Used ______________ Rate/Target Conc. ________ Units ______ Total Amt. Applied ________ Units ______

Adjuvant #1 Used ______________ Rate/Target Conc. ________ Units ______ Total Amt. Applied ________ Units ______

Adjuvant #2 Used ______________ Rate/Target Conc. ________ Units ______ Total Amt. Applied ________ Units ______

Method of Application ____________________ Application Made (Circle One) **With** water flow / **Against** water flow / **Not Applicable**

Waterbody Type (Circle One) lined canal / unlined canal / creek / drain / ditch / basin / reservoir / lake / pond or list Other: ______________

Water Flow (ft/sec, cfs) __________ Water Depth (ft) ____________ Water Temperature (F°) ____________

Percent Weed Cover __________ Water Sheen (Circle One) yes / no

Water Color (Circle One) none / blue / green / brown Water Clarity (Circle One) poor / fair / good

Please enter any other information regarding the application in the space provided below:

I (sign name) ____ certify that the APAP has been followed.

Appendix B

Aquatic Herbicide Field Monitoring and Sampling Forms

Aquatic Herbicide Field Monitoring & Sampling Form

****IMPORTANT** Attach Relevant Aquatic Herbicide Application Log (AHAL) Form**

SAMPLE #1: Background Monitoring (Background)

Collect upstream of or just outside of treatment area at time of treatment, or within in treatment area within 24 hours of the treatment starting.

Section 1: Herbicide Application Information

Agency: ____________________

System Treated: ____________________

Application Start Date: ____________________

Herbicides Applied: ____________________

Surfactants Used: ____________________

Target Vegetation: ____________________

Environmental Setting (circle one): Flowing | Static

Section 2: Monitoring Information

Monitoring Date: __________ Time: __________

Sampler Name: ____________________

Monitoring Location: ____________________

GPS Coordinates: ____________________

Sketch monitoring location or describe location with identifiable points of reference (required if GPS coordinates not provided).

Section 3: Water Quality Characteristics

DO (mg/L): __________ EC (µS/cm): __________ pH: __________

Temperature (°C): __________ Turbidity (NTU): __________ Water speed (ft/sec)*: __________

** Water speed only required for flowing water*

Section 4: Site Observations *(Refer to Definitions Sheet and mark a response for each field)*

Do you notice	N/A	No	Unknown	Yes, the beneficial use is adversely affected. Describe.
Adverse Incident				
Floating Material				
Settleable Substances				
Suspended Material				
Bottom Deposits				
Tastes and Odors				
Water Coloration				
Visible Films, Sheens, or Coatings				
Fungi, Slimes, or Objectionable Growths				
Aquatic Community Degradation				

Aquatic Herbicide Field Monitoring & Sampling Form

SAMPLE #2: Event Monitoring (Event)

Collect just outside of the treatment area immediately after the application of herbicide(s), but after sufficient time has elapsed such that treated water would have exited the treatment area. The timing for the collection of this sample will be a site-specific estimation.

Is water leaving the treatment area? ☐ **Yes** ☐ **No**

If no water is leaving the treatment area, complete sections 1, 2, and 4, skip section 3, and do not collect a sample.

Section 1: Herbicide Application Information

Agency: ______________________

System Treated: ______________________

Application Start Date: ______________________

Herbicides Applied: ______________________

Surfactants Used: ______________________

Target Vegetation: ______________________

Environmental Setting (circle one): Flowing | Static

Section 2: Monitoring Information

Monitoring Date: ____________ Time: ____________

Sampler Name: ______________________

Monitoring Location: ______________________

GPS Coordinates: ______________________

Sketch monitoring location or describe location with identifiable points of reference (required if GPS coordinates not provided).

Section 3: Water Quality Characteristics

DO (mg/L): ____________ EC (µS/cm): ____________ pH: ____________

Temperature (°C): ____________ Turbidity (NTU): ____________ Water speed (ft/sec)*: ____________

** Water speed only required for flowing water*

Section 4: Site Observations (*Refer to Definitions Sheet and mark a response for each field)*

Do you notice	N/A	No	Unknown	Yes, the beneficial use is adversely affected. Describe.
Adverse Incident				
Floating Material				
Settleable Substances				
Suspended Material				
Bottom Deposits				
Tastes and Odors				
Water Coloration				
Visible Films, Sheens, or Coatings				
Fungi, Slimes, or Objectionable Growths				
Aquatic Community Degradation				

Aquatic Herbicide Field Monitoring & Sampling Form

For Client Use Only

****For each active ingredient, one Field Duplicate and one Field Blank must be collected per environmental setting (moving water vs static water) per year****

SAMPLE #3: Post-Event Monitoring (Post)

Collect from inside treatment area within 7 days of application, or when treatment is deemed complete.

Section 1: Herbicide Application Information

Agency: ______________________________

System Treated: ______________________________

Application Start Date: ______________________________

Herbicides Applied: ______________________________

Surfactants Used: ______________________________

Target Vegetation: ______________________________

Environmental Setting (circle one): Flowing | Static

Section 2: Monitoring Information

Monitoring Date: ______________ Time: ______________

Sampler Name: ______________________________

Monitoring Location: ______________________________

GPS Coordinates: ______________________________

Sketch monitoring location or describe location with identifiable points of reference (required if GPS coordinates not provided).

Section 3: Water Quality Characteristics

DO (mg/L): ______________ EC (µS/cm): ______________ pH: ______________

Temperature (°C): ______________ Turbidity (NTU): ______________ Water speed (ft/sec)*: ______________

** Water speed only required for flowing water*

Section 4: Site Observations *(Refer to Definitions Sheet and mark a response for each field)*

Do you notice	N/A	No	Unknown	Yes, the beneficial use is adversely affected. Describe.
Adverse Incident				
Floating Material				
Settleable Substances				
Suspended Material				
Bottom Deposits				
Tastes and Odors				
Water Coloration				
Visible Films, Sheens, or Coatings				
Fungi, Slimes, or Objectionable Growths				
Aquatic Community Degradation				

Aquatic Herbicide Field Monitoring & Sampling Form

**** For each active ingredient, one Field Duplicate (FD) and one Field Blank (FB) must be collected per environmental setting (moving water vs static water) per year****

Field Duplicate (FD) Sample:

Collect at same location and time as the monitoring sample (if possible collect with event or post-event sample) and using the same sampling technique.

Section 1: Herbicide Application Information

Agency: ______________________________________

System Treated: ________________________________

Application Start Date: ___________________________

Herbicides Applied: ______________________________

Surfactants Used: ________________________________

Target Vegetation: _______________________________

Section 2: Monitoring Information

Monitoring Date: _______________ Time: _______________

Sampler Name: _________________________________

Monitoring Location: _*See (circle one): BG / Event / Post__

GPS Coordinates: __*See (circle one): BG / Event / Post___

Sketch monitoring location or describe location with identifiable points of reference (required if GPS coordinates not provided).

Section 3: Water Quality Measurements

DO (mg/L): ______________________ EC (µS/cm): ____________________ pH: _________________________

Temperature (°C): _________________ Turbidity (NTU): ________________ Water speed (ft/sec)*: ___________

** Water speed only required for flowing water*

Section 4: Site Observations

See (circle one): BG / Event / Post

DO YOU NOTICE	N/A	NO	UNKNOWN	YES, THE BENEFICIAL USE IS ADVERSELY AFFECTED. DESCRIBE.
Adverse Incident				
Floating Material				
Settleable Substances				
Suspended Material				
Bottom Deposits				
Tastes and Odors				
Water Coloration				
Visible Films, Sheens, or Coatings				
Fungi, Slimes, or Objectionable Growths				
Aquatic Community Degradation				

Aquatic Herbicide Field Monitoring & Sampling Form

**** For each active ingredient, one Field Duplicate (FD) and one Field Blank (FB) must be collected per environmental setting (moving water vs static water) per year****

Field Blank (FB) Sample:

Prepare using distilled water at the monitoring site immediately prior to or immediately after the collection of the monitoring sample.

Section 1: Herbicide Application Information

Agency: ______________________________

System Treated: ______________________________

Application Start Date: ______________________________

Herbicides Applied: ______________________________

Surfactants Used: ______________________________

Target Vegetation: ______________________________

Section 2: Monitoring Information

Monitoring Date: ______________ Time: ______________

Sampler Name: ______________________________

Section 3: Water Quality Measurements

DO (mg/L): ______________ EC (µS/cm): ______________ pH: ______________

Temperature (°C): ______________ Turbidity (NTU): ______________ Water speed (ft/sec): ____N/A____

Section 4: Site Observations *(Refer to Definitions Sheet and mark a response for each field)*

DO YOU NOTICE	N/A	NO	UNKNOWN	YES, THE BENEFICIAL USE IS ADVERSELY AFFECTED. DESCRIBE.
Adverse Incident	X			
Floating Material	X			
Settleable Substances	X			
Suspended Material	X			
Bottom Deposits	X			
Tastes and Odors	X			
Water Coloration	X			
Visible Films, Sheens, or Coatings	X			
Fungi, Slimes, or Objectionable Growths	X			
Aquatic Community Degradation	X			