San Francisco Estuary
Invasive *Spartina* Project
Water Quality Monitoring Report for 2023

Prepared by

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for the

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February 2024

Acknowledgements

The implementation of the Water Quality Monitoring Plan and the preparation of this annual report were funded by the San Francisco Bay Restoration Authority and State Coastal Conservancy.

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1. Executive Summary

The California State Coastal Conservancy's San Francisco Estuary Invasive *Spartina* Project (ISP) implemented their 2023 Water Quality Monitoring Plan in conjunction with the treatment of non-native *Spartina* (cordgrasses). Water samples and data on conventional water quality parameters were collected pre-treatment, immediately after the herbicide application, and one week after treatment, in compliance with the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications (Water Quality Order 2013-0002-DWQ). This report documents the water quality monitoring results from 2023 and compares them to the overall trends from ISP water quality monitoring since 2005.

Over the history of treatment implementation by the ISP Coalition partners, water sampling immediately after *Spartina* treatment has consistently found that any imazapyr concentrations detected in the receiving waters are two to four orders of magnitude below levels reported in the toxicology literature as a concern to humans or the animals that inhabit the associated tidal marsh system, including the benthic invertebrates so fundamental to the tidal marsh food web. Pursuant to the Monitoring and Reporting Program outlined in the General NPDES Permit, the ISP Coalition was required to monitor one application site in 2023, since the results from monitoring six sites at the inception of the new permit in 2014 did not exceed the Monitoring Trigger for imazapyr established by the State Water Board. The imazapyr Monitoring Trigger is 11.2 mg/L, which is equivalent to 11,200 ppb. The ISP's measured imazapyr concentration for the 2023 treatment event was 10 ppb, more than 11,000 ppb below this Monitoring Trigger.

The successful *Spartina* control achieved by the ISP Coalition partners since 2005 has reduced the Estuary-wide infestation by 97.2% from 805 net acres to 22.8 net acres. With 71% of historic sites either at Zero Detection or containing less than 10 m^2 net cover of invasive *Spartina* in 2023, most of the remaining infestations are so reduced that spot treatment by backpack or handheld sprayer is the only herbicide delivery system needed.-The ISP is also completing the eradication of all infestations of *S. densiflora* around the Estuary with purely manual removal after achieving successful reductions with imazapyr over the initial years of the project. In 2023, 55 ISP sites were at the zero-detection level, showing continued progress towards the long-term goal of functional eradication.

The 2023 one-week post-treatment sampling result of 0.31 ppb continues to demonstrate that imazapyr is short-lived in an estuarine environment, which is consistent with the published literature. This imazapyr concentration reflects a 96.9% reduction from the treatment sample one week earlier. This substantial reduction level has not been uncommon for this project, as demonstrated by the 95.8% mean reduction in imazapyr that the ISP reported over the four-year span from 2007-2010. With the rapid degradation of this herbicide in the tidal environment, as measured by the imazapyr concentration detected in the water at the site one week after treatment, it is anticipated that sites that still had measurable concentrations at that point would likely be below detectable levels within a short time after that third sample.

The monitoring of conventional water quality parameters (water temperature, dissolved oxygen, pH, conductivity, salinity and turbidity) continued to demonstrate that there is no indication that the herbicide applications to invasive *Spartina* have had any impact on Estuary surface water quality; this result was entirely anticipated because there is no relevant pathway for the imazapyr treatment of an emergent plant to significantly alter these parameters in this vast open aquatic system with twice-daily tidal exchange.

2. Introduction

2.1 Invasive Spartina *in the San Francisco Estuary*

The genus *Spartina* refers to cordgrasses, the majority of which are found in tidal salt marshes and sloughs, open mudflats, or brackish channels. Four species of non-native *Spartina* have been introduced to the San Francisco Estuary since the 1970s, and they spread aggressively (both vegetatively from underground rhizomes as well as by seed or vegetative propagules). *Spartina alterniflora* (smooth cordgrass) is native to the Atlantic and Gulf Coasts of the U.S. and was first introduced in 1976 by the U.S. Army Corps of Engineers as part of an experiment in tidal marsh restoration using dredge spoils at the Alameda Flood Control Channel. In the mid-1990s, researchers discovered that the introduced species had hybridized with our native Pacific cordgrass, *Spartina foliosa*, creating a fertile hybrid swarm with numerous morphologies and phenologies. These hybrids are the most problematic of the invaders, originally representing greater than 90% of the historical peak infestation of non-native *Spartina* that covered 805 net acres in 2005 but has been reduced by ISP partners to approximately 23.5 net acres. The second most prevalent invader is *Spartina densiflora* (Chilean cordgrass), which was mistakenly introduced to Creekside Park along Corte Madera Creek in Marin County as part of a wetland restoration in the 1970s. The species spread throughout the Corte Madera Creek watershed and other eastern Marin wetlands, but it has had a very limited distribution elsewhere around the Bay. The other two species of introduced cordgrass that are approaching eradication, *S. anglica* (English cordgrass) and *S. patens* (salt meadow cordgrass), are each centered at only one marsh site in the Estuary and have not spread from those locations.

There are many potential impacts from these aggressive non-native *Spartina* species. Over the past 160 years, the development of the marshes of the San Francisco Estuary for homes and commercial interests had reduced the remaining marsh acreage by over 90%. The resulting habitat loss has contributed to reductions in the populations of several endangered tidal marsh species including the California Ridgway's rail (*Rallus obsoletus obsoletus*) and salt marsh harvest mouse (*Reithrodontomys raviventris).* Invasive *Spartina* further degrades the remnants of habitat by colonizing tidal channels used for foraging by rail, competitively excluding native marsh vegetation such as *Sarcocornia pacifica* (perennial pickleweed) that is important salt marsh harvest mouse habitat, and rare plants such as *Chloropyron molle* ssp. *molle* (soft bird's beak, formerly *Cordylanthus mollis* ssp. *mollis*), and by transforming unvegetated mudflats into *Spartina* meadows and thereby eliminating foraging areas for millions of migratory and resident shorebirds. The infestations of non-native *Spartina* also present direct problems to the human population beyond the loss of biodiversity and habitat. Flood control channel capacity can be severely reduced by *Spartina* expansion, not allowing flood waters to be conveyed away from homes and businesses, and the resulting sediment accretion can significantly raise annual maintenance budgets for regular dredging. Dense stands of *Spartina* can also impound water and create ponded areas in the upper marsh that become excellent breeding areas for salt marsh mosquitoes.

2.2 Invasive Spartina *Project*

In response to the expanding infestation of non-native *Spartina*, the California State Coastal Conservancy and U.S. Fish & Wildlife Service formed the Invasive *Spartina* Project (ISP) in 2000 to coordinate a regional effort to arrest and reverse the spread of these aggressive invaders and eventually eradicate them from the Estuary. A major impetus for the effort was to protect the $100 million investment to acquire salt ponds from Cargill that will be converted to marsh and other related habitat as part of the South Bay Salt Ponds Restoration (SBSP), the largest such effort on the West Coast of the United States. Virtually every San Francisco Estuary tidal restoration project over the past 35 years has been colonized, and its marsh development trajectory potentially compromised, by hybrid *Spartina*. The ISP is working to remove this threat from the Estuary so that SBSP and other tidal restoration efforts can proceed successfully.

After several years of compiling environmental documentation and permits, completing initial surveys of the Estuary shoreline, and implementing several pilot projects on control methods, the ISP began control efforts in 2004 and baywide treatment in 2005. The Programmatic Environmental Impact Report (PEIR) for the ISP found that for most sites, the use of aquatic herbicide was the most effective method and caused the lowest environmental impacts, especially when confronted with the dense monocultures covering 50-100 contiguous acres of marshland and mudflat that existed at the peak of the infestation. The ISP developed individual Site-Specific Plans for each of their 220 sub-areas, incorporating Integrated Pest Management (IPM) strategies that evaluate the biology of the target invader and the suite of appropriate control methods to determine the most effective combination to utilize over time.

Treatment is conducted by a Coalition of ISP partners around the Estuary, with management and assistance from the ISP, and typically funded at least in part by grants from the California State Coastal Conservancy. In 2019, there was a transfer of responsibility for a portion of the ISP Coalition sites from California Wildlife Foundation to California Invasive Plant Council (Cal-IPC), with the necessary Notice of Termination and new Notice of Applicability issued by the State Water Board. Current ISP Coalition partners include the following:

1. California Department of Parks and Recreation (WDID#s 2 49AP00029)
2. California Invasive Plant Council (WDID# 2 01AP00040)
3. East Bay Regional Parks District (WDID# 2 01AP00022)
4. City of Alameda (WDID# 2 01AP00015)
5. City of Palo Alto (WDID# 2 43AP00011)
6. Friends of Corte Madera Creek Watershed (WDID# 2 21AP00010)
7. San Mateo County Mosquito & Vector Control District (WDID# 2 41AP00023)

The number of sites and total area addressed by each ISP partner varies. **Appendix V** lists the ISP partner associated with each treatment site, and **Appendix VII** provides maps showing the location of treatment sites for each partner.

Treatment is timed to achieve the longest possible tidal exposure of the *Spartina* to allow the herbicide to penetrate the leaf cuticle, so it is not washed off by the incoming tides (referred to as “dry time”). Therefore, ISP partners usually begin treatment on a low or receding tide just after sunrise during the active growing season of the cordgrass from June through October or November. Several other key aspects are factored into the timing equation. According to the California Department of Pesticide Regulation (CDPR) and the ISP Conservation Measures from our Programmatic Environmental Impact Report, herbicide applications should be conducted when sustained winds are less than 10 mph. Hence, ISP partners emphasize the need to begin treatment at dawn on appropriate days because the afternoon winds may halt control efforts prematurely. In addition, many of the marshes infested with non-native *Spartina* are home to the endangered California Ridgway’s rail, so work is scheduled around their breeding season into relatively tight windows of opportunity each year.

2.3 Herbicide Utilized for Spartina *Control*

ISP partners use the aquatic formulation of imazapyr (sold under the trade names Habitat® or Polaris™) for invasive *Spartina* treatment. These two formulations, approved for use in sensitive estuarine systems, are virtually identical and contain a solution of either 28.7% (Habitat®) or 27.7% (Polaris™) isopropylamine salt of imazapyr in water, with the remaining inert ingredients composed of a small amount of acidifier (probably acetic acid, but this proprietary trade secret is not disclosed on the label) as well as a blue dye.

Imazapyr is a non-selective herbicide that can effectively control monocots (e.g. grasses such as *Spartina*) as well as broadleaf plants (dicots). It is a systemic herbicide that normally enters through the foliage in tidal marsh applications, and is circulated (translocated) throughout the plant and down into the roots causing mortality of the entire plant or clone; this is in contrast to a “contact herbicide” that works only on the above-ground portion of the vegetation providing temporary, single season control of a perennial plant like *Spartina* but not translocating to the roots where it could produce full mortality of those structures as well. ISP partners do not use contact herbicide, only systemic formulations.

Imazapyr works by inhibiting the enzyme acetolactate synthase (ALS) required for the biosynthesis of the three branched-chain amino acids valine, leucine and isoleucine. The ALS pathway exists in plants, as well as microorganisms such as bacteria, fungi and algae. Animals do not produce these essential amino acids themselves, normally acquiring them by consuming plants, which is likely one reason for the low toxicity of imazapyr to animals. Although imazapyr does little to alter respiration, photosynthesis or lipid and protein synthesis in the target plant, it does inhibit the rate of DNA synthesis by 63% within 24 hours of treatment; this inhibition can be used as an indirect measure of cell division which relates directly to growth. To achieve the maximum herbicidal activity, imazapyr should be applied post-emergence when the target plants are growing vigorously and during weather conditions that allow for slow drying of the droplets. ISP partners have observed that treated *Spartina* plants remain green for a long period of time and can remain in an arrested state of development for weeks before finally showing signs of impending mortality. Fortunately, seed production is eliminated by the inhibition of DNA synthesis if the application occurs early enough in the phenology of the *Spartina*, even if clear evidence of full mortality is still weeks away.

Prior to the California registration of the aquatic formulation of imazapyr in August 2005, chemical control of non-native *Spartina* San Francisco Bay was attempted exclusively with glyphosate. However, this tool yielded consistently poor results and was falling far short of outpacing the spread of the invader. This failure is probably a result of glyphosate's affinity for adsorbing to sediment, causing it to bind to silt and salt that are deposited on the *Spartina* by the tides, thereby rendering the herbicide inactive. The glyphosate is not able to penetrate the leaf cuticle and enter the plant where it could be systemically circulated.

Within the first treatment season after imazapyr was approved by the State of California in August 2005, 96% of the applications by ISP partners had transitioned away from glyphosate to the new tool, and this rose to 100% utilizing imazapyr by 2006. In the recent past, glyphosate has only been used by ISP partners on a single site (Southampton Marsh) as part of the IPM strategy for eradication of *S. patens*, which is part of a multi-species noxious weed project focused mainly on *Lepidium latifolium* at this State Parks site. Glyphosate was added to the tank mix for the *S. densiflora* application at Creekside Park in 2011 in an effort to enhance the efficacy on the small remaining plants by inhibiting synthesis of an additional three amino acids (over the three aliphatic amino acids inhibited by imazapyr). There was no apparent enhancement achieved from the addition of a second herbicide to the mix, so glyphosate was not utilized in future treatments of this type.

The aquatic herbicide formulation of imazapyr does not contain a surfactant; consequently, this is added to the tank mix from a short list of products that are approved for use in aquatic systems. Since the leaves of the target *Spartina* plants in turbid San Francisco Bay can be covered with depositional material, uptake of the herbicide by the plant is difficult to achieve and the use of a surfactant plays a vital role in the application process. Surfactants improve uptake and enhance efficacy by lowering the surface tension of liquids, thereby improving the spread of the liquid herbicide mixture over the leaf surface, increasing adherence of the formulation to the leaf (wetting) while reducing runoff, and enhancing the penetration of the leaf cuticle.

ISP partners have primarily used Liberate® (Loveland Industries) during recent treatment seasons, with a handful of applications employing Competitor® (Wilbur-Ellis). Liberate® is a natural lecithin-based (soybean) product and consequently is presumed to have rapid biodegradation; this product also acts as a drift retardant which aids in ISP aerial or high-pressure hose applications, has a relatively low toxicity to aquatic life, and has been highly effective on hybrid *Spartina*. Competitor® is a methylated seed oil (MSO) recommended for use with imazapyr by the original manufacturer (BASF); this product strikes a good balance by combining one of the lowest relative toxicities to aquatic life of the available surfactants while consistently yielding high efficacy results. A non-toxic blue marker dye (e.g. Turf Trax or similar) is also included in the tank mix for ground-based treatment to help the applicator get full coverage without re-treating, which helps reduce the amount of chemical entering the marsh environment.

Recent studies have raised concern over a group of surfactants containing nonylphenol ethoxylate due to their moderate toxicity and suspected endocrine disruption in fish and aquatic organisms. Consequently, the ISP partners <u>do not</u> use these nonylphenol products (such as R-11®, ProSpreader®) for invasive *Spartina* control, although they are commonly used by other vegetation managers and are known to perform well at improving herbicide efficacy.

2.4 NPDES Compliance

Application of herbicides to waters of the United States requires coverage under a National Pollutant Discharge Elimination System (NPDES) permit pursuant to Section 402 of the Clean Water Act (CWA). The State Water Resources Control Board adopted the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, Water Quality Order 2013-0002-DWQ, for the reissuance of General NPDES Permit CAG990005 in June 2013. Order 2013-0002-DWQ became effective on December 1, 2013. The new permit replaces the interim Statewide General NPDES permit (Water Quality Order No. 2001-12-DWQ) that was adopted in 2001.

The General Permit allows for the use of a small list of U.S. EPA-approved aquatic herbicides, including the aquatic formulations of imazapyr (e.g. Habitat®, Polaris®) and glyphosate (e.g. Roundup Custom®, Aquamaster®, Rodeo®). For constituents that do not have Ambient Water Quality Criteria, the Instantaneous Maximum Receiving Water Monitoring Trigger is based on one tenth of the lowest 50 Percent Lethal Concentration (LC_{50}) from U.S. EPA's *Ecotoxicity Database*. Currently, there is no State or U.S. EPA-based numeric objective or criteria for imazapyr, but the new General Permit establishes an imazapyr Monitoring Trigger of 11.2 mg/L. Interestingly, this concentration is an order of magnitude beyond the highest water sample analyzed for ISP over the history of the project. Since ISP partners do not use surfactants containing nonylphenol ethoxylate (e.g. R-11®, ProSpreader®) the ISP did not perform any chemical concentration analyses for these compounds.

Each ISP Coalition partner conducting treatment with herbicide has prepared and submitted a Notice of Intent (NOI) to comply with the terms of the General Permit and paid the appropriate invoiced state fees. The partners were listed in Section 2.2 of this report. **Appendix V** shows the sites associated with each ISP partner, and **Appendix VII** provides maps of the location of treatment sites for each partner.

The ISP prepared an Aquatic Pesticide Application Plan (APAP) on behalf of the Coalition partners, which includes the annual Water Quality Monitoring Plan (WQMP). ISP also collects water quality samples, sends them to Pacific Agricultural Laboratory for herbicide concentration analysis, collects standard water quality parameter data at each of those events, and prepares and submits annual reports to the RWQCB for compliance with the General Permit.

3. Water Quality Monitoring Plan

3.1 Aquatic Pesticide Application Plan

The Statewide General Permit requires the discharger to develop and implement an Aquatic Pesticide Application Plan (APAP). ISP revised its extensive programmatic APAP in 2014 to comply with the requirements of the new General Permit (pages 9-11); the APAP was submitted to the State Water Board on behalf of the Coalition and was posted for the 30-day comment period (no comments were received). Each ISP partner reviews and adopts the Coalition APAP, submits a completed Notice of Intent to Comply with the Terms of this General Permit (Notice of Intent, NOI) along with the invoiced annual fee to the Regional Water Board. ISP's Coalition APAP provides an in-depth description of the water body where treatment will occur (the San Francisco Estuary), including background on the ecology, natural processes affecting water quality, and a survey of the general sediment and water quality characteristics currently documented for the system. The four species of non-native cordgrass (*Spartina*) are described as well as the motivation for the control work and the project's control tolerances. The pros and cons of various treatment methods are evaluated (including the reasoning behind the need for herbicide use), and the types of aquatic herbicide and expected application rates are provided. Finally, all ISP sites are described including their location and the status of the *Spartina* infestation, and a map of treatment areas is provided for each partner.

The APAP includes a Water Quality Monitoring Plan (WQMP) that the ISP implements in the field during the *Spartina* treatment season. ISP contracted with San Francisco Estuary Institute (SFEI) to implement the WQMP at the start of the project but took over the responsibility in 2006. In accordance with the new General Permit requirements, six sites were monitored in the first year (2014). Since none of those sites had returned an imazapyr concentration above the Monitoring Trigger of 11.2 mg/L (equivalent to 11,200 ppb), moving forward the ISP Coalition was only required to monitor a single site in future years under the current General Permit.

3.2 Treatment Monitoring Site Selection

The ISP had historically selected the treatment sites to be sampled for NPDES at locations that are representative of the overall, baywide *Spartina* control effort and used the following four treatment site types as a guide:

I. Tidal Marsh, Microtidal Marsh, Former Diked Bayland, Backbarrier Marsh
II. Fringing Tidal Marsh, Mudflats, and Estuarine Beaches
III. Major Tidal Slough, Creek or Flood Control Channel
IV. Urbanized Rock, Rip-Rap, Docks, Ramps, etc.

Each year, the ISP tried to select a relatively even distribution of these marsh site types to be sampled for water quality, as well as sampling the range of herbicide delivery systems and marsh dynamics present in the work program. However, now only a single site is monitored each year pursuant to the requirements of the General Permit. Type IV infestation sites are usually very small, sparse, and adjacent to large bodies of water with constant flushing that will serve to quickly dilute any herbicide incidentally entering the water column, so this site type is not considered as high a priority for sampling as they were the least likely of the sites to retain detectable levels of herbicide related to the application. In addition, effective treatment by ISP partners has greatly reduced the number of Type II sites with any significant amount of non-native *Spartina* remaining; these fringe marshes had often been accreted by hybrid *Spartina* on previously-unvegetated mudflat and responded particularly well to treatment, returning these areas back to their natural condition preferred by shorebirds for foraging. Site Type I has been considered the most likely to retain detectible levels of herbicide in the water column, so the sampling program was normally weighted slightly in this direction. All recent WQMPs have been implemented on Type I sites.

3.3 Sampling Design, Procedures & Analysis

Sampling Design

The sampling events were intended to characterize the potential impacts involved with imazapyr applications relative to adjacent surface waters. Consistent with permit requirements, the monitoring program included background or pre-treatment sampling within the 24-hour period prior to herbicide application, treatment event sampling immediately following herbicide application, and post-treatment sampling one week after herbicide application. During background sample collection, the location was recorded using GPS to aid ISP staff in relocating the point for subsequent sampling events. The treatment event sample was collected immediately adjacent to the treatment area after sufficient time had elapsed such that treated water would have entered the adjacent area on the incoming tide. Since the standard protocol is for the ISP partners to treat *Spartina* on a low or receding tide (with little to no water present) when possible, application event samples are often taken 1-4 hours post-treatment when the tide had again flooded the site, but samples could sometimes be collected within a short period after the treatment crew had left the area if sufficient water was already present (e.g. in the bottom of an adjacent channel). Finally, the one-week post-treatment monitoring was conducted when sufficient water was present at the site on the seventh day after the application. It is standard for the lab to include blanks as part of their quality control, but the ISP also submits trip blanks to enhance quality assurance, one over the course of the abridged monitoring season now that only one site is monitored.

Field Sampling Procedures

The ISP has conducted its own water quality monitoring program since 2006, modeled after sampling procedures developed for the State Water Resources Control Board (SWRCB) APMP and outlined in the 2004 APMP Quality Assurance Program Plan (QAPP). Water samples were collected using a sampling rod and pre-cleaned amber glass 250 milliliter bottles. To collect the sample, the bottle was attached to the sampling rod with a clamp, extended out over the water at the application site, and lowered to approximately 50% of the water depth. When the bottle was filled it was pulled back out of the water and the cap was affixed to the mouth of the bottle. The sample was labeled in permanent ink with the sample ID number, date, time, and initials of the sampler.

The sample ID number was assigned by using the following protocol: a four-letter code unique to the site, followed by the site visit number (e.g., “01” for pre-treatment, “02” for treatment, or “03” for one-week post-treatment), followed by the time since the application (e.g., “pre” for the baseline sample, the number of hours since the application for the treatment sample, or “1w” for the one-week post-treatment event).

Equipment Calibration

Temperature, electrical conductivity, salinity, and dissolved oxygen were measured in the field with a newly purchased (2022) portable YSI Xylem ProSolo (Yellow Springs Instruments Inc., Ohio, USA), pH was measured with a newly purchased (2023) HM digital waterproof pH meter (Hanna Instruments), and turbidity was measured with an Oakton T-100. To assure accurate and reliable measurements, all three instruments were calibrated, operated, and maintained in accordance with their manuals.

Field Data Sheets

At each sampling location, the sample ID number, the time of the sampling, the sample depth, and the water temperature, pH, dissolved oxygen, conductivity, and salinity measurements were entered on a Field Data Collection Form (FDCF, **Appendix II**). Also recorded on the FDCF was site information including the site ID number, the station location (application point, upstream, downstream), station type (reference, treated), wind conditions, tidal cycle, water color, and the type of herbicide and surfactant utilized. Any other unusual conditions or concerns were noted, and any fish, birds, or other wildlife present at the point were recorded. The FDCFs were dated and numbered consecutively for each site on that date. Upon return to the office, the data were entered into an electronic spreadsheet for processing, and the FDCFs were compiled into a data log and kept permanently in the office.

Sample Shipment

Following collection, water samples were stored on ice packs and shipped for priority overnight delivery to the laboratory. ISP continued to utilize the Pacific Agricultural Laboratory in Sherwood, Oregon due to their consistent fulfillment of their contract requirements since 2010. In addition, pursuant to the requirements of the new General Permit from 2013, PAL underwent an audit and subsequent certification as an environmental testing laboratory by the California Department of Public Health.

If samples were not shipped until the following day, they were stored in a refrigerator and subsequently transferred back into a cooler with ice packs for shipping. Samples were not shipped on Fridays because they would not be received by the lab until the following Monday and the appropriate temperature could not be maintained.

Sample Analysis

The samples were analyzed within the appropriate holding times for imazapyr (extracted within seven days, analyzed within 21 days of extraction). Results are reported as parts per billion (ppb), equivalent to μg/L (micrograms per liter). The analytical method used for imazapyr is EPA 8321B in which the extracts are analyzed using liquid chromatography with mass spectroscopy (LC/MS/MS) detection, with a Limit of Quantitation (LOQ) of 0.02 ppb (the minimum detectable level of the instrument) and Reporting Limit (RL) of 0.05 ppb. The lab ran one blank each time it conducted an analysis (minimum of one sample tested per batch, maximum of three). Results are submitted to the San Francisco Bay State and Regional Water Quality Control Boards in this annual report and placed on the ISP’s website for public viewing.

Lab QC & Data Quality Indicators

The contracted analytical laboratory ("lab") is required to provide a Quality Assurance Plan ("QAP") that meets U.S. EPA standards prior to initiating analysis (Pacific Agricultural Laboratory QA documents are attached as **Appendix VI)**. The lab plan specifies the method of analysis to be used and describes any variations from standard protocol. The WQMM and ISP Director both reviewed the lab QAPs and determined that they were adequate. The data quality indicators (DQIs) established for the lab are listed in **Table 1**.

Table 1. Minimum Data Quality Indicators (DQIs) for an ISP-contracted Laboratory

Criteria	*Method*	*Indicator Goal*
Accuracy of measurement	Analyze matrix spikes and spike duplicates	1 matrix spike per 10 samples (10%) > 65% @ 2.0 µg/L
Agreement between measurements	Analyze lab duplicates and/ or matrix spike duplicates	Relative percent difference < 25%
Completeness	Percent of usable data (completed/submitted)	95% return
Comparability of results	Standard reporting units	All data reported in micrograms per liter (µg/L)/parts per billion (ppb)
	Use of standardized analysis methods	Standard method used if possible, any modifications identified, described, and supported.
Detection Limits (imazapyr, EPA 8321B)	Method detection limit Lab reporting limit	MDL </= 0.02 ppb LRL </= 0.05 ppb

4. 2023 *Spartina* Treatment and Water Quality Monitoring

4.1 Summary of 2023 Herbicide Applications

ISP partners utilized herbicide at 160 sites during the 2023 Treatment Season, with one site monitored for imazapyr in the adjacent receiving water pursuant to the most recent General NPDES Permit requirements. **Table 2** provides the site monitored, treatment date, and application method for 2023, while **Appendix V** provides the full list of treatment sites around the Estuary, the coordinates of site centroids, and the amount of herbicide applied. **Appendix VII** provides maps showing the location of treatment sites for each ISP Coalition partner ("discharger").

Table 2. Water Quality Monitoring Site for the 2023 Treatment Season

Site	*Site Number*	*Marsh Type*	*Treatment Date*	*Application*
Pinole Creek Marsh	22f	I (tidal marsh)	9/19/2023	Imazapyr – Backpack

Low-pressure backpack sprayer application was the herbicide delivery system across Pinole Creek Marsh in 2023, including some larger patches that had colonized out on the soft mudflats. The reliance on spot treatment methods reflects the significant progress ISP Coalition partners have made in reducing the non-native *Spartina* infestation around the Estuary.

4.2 Herbicide Levels in the Water at Sampled Treatment Site

ISP contracted with Pacific Agricultural Laboratories (PAL) again in 2023. No water samples were broken in shipment to PAL in 2023 and none were misplaced by FedEx.

Table 3. Herbicide Concentrations in Adjacent Surface Water for 2023 *Spartina* Treatment (ND = not detected at 0.02 ppb LOQ)

Site	*Herbicide Concentration (ppb = µg/L)*			*Application*
	Pre-Treatment	*Treatment*	*One-Week Post*	
Pinole Creek Marsh	0.13	10	0.31	Imazapyr – Backpack

Table 3 shows the imazapyr levels at the one site monitored for this herbicide in 2023, Pinole Creek Marsh. The lab reported an imazapyr concentration of 0.13 ppb was detected in the pre-treatment sample (ND). In the experience of the ISP, it is not uncommon for a very low level of imazapyr to be detected prior to *Spartina* treatment because this herbicide is widely used for ground clearing in residential and commercial landscaping higher in the watersheds, providing a non-point source around the Estuary. Pinole Creek Marsh is located downstream of several communities with tens of thousands of residents and numerous commercial enterprises.

Treatment event monitoring reported an imazapyr concentration of 10 ppb as the tide waters returned to the site. The one-week post-treatment sample from Pinole Creek Marsh reported an imazapyr concentration of 0.31 ppb in the Estuary water. The analytical reports from the lab are provided in **Appendix IV**.

Figure 1. Shoreline infestation of hybrid *Spartina alterniflora* amongst the native cordgrass fringe at the Pinole Creek Marsh water quality sampling location after imazapyr treatment on September 19, 2023.

4.3 Conventional Water Quality Parameters at Treatment Site

Table 4 lists the data on the conventional parameters (water temperature, dissolved oxygen, pH, conductivity, salinity, and turbidity) collected at Pinole Creek Marsh in 2023.

Table 4. Conventional Water Quality Parameters Measured at 2023 Events

Site	Water Temp (C)			DO (mg/L)			pH			Conductivity (mS)			Salinity (ppt)			Turbidity (NTU)		
	Pre	Treat	Post	Pre	Treat	Post	Pre	Treat	Post	Pre	Treat	Post	Pre	Treat	Post	Pre	Treat	Post
Pinole Creek Marsh	21.6	21.8	21.1	8.5	8.6	8.4	7.9	8.0	8.2	35.6	34.0	31.1	24.2	23.4	21.1	36.3	24.8	25.9

The mean water temperature over all three sampling events was 21.5°C. Dissolved oxygen (DO) averaged 8.5 mg/L but varied little across all sampling events. The pH of the Estuary water averaged 8.0 and did not vary greatly over the three samples. Conductivity averaged 33.6 mS/cm over the three sampling events, ranging from a minimum of 31.1 mS/cm to a maximum of 35.6 mS/cm. Salinity averaged 22.9 ppt, ranging from 21.1 ppt to 24.2 ppt. Finally, turbidity averaged 29.0 NTU over the three sampling events, ranging from a minimum of 24.8 NTU to a maximum of 36.3 NTU on the incoming tide).

5. Toxicology

Although there are currently no State or U.S. EPA-based numeric objectives or criteria for imazapyr, one can compare the post-treatment levels to the LC_{50} (defined as the lowest tested concentration of a chemical that was lethal to 50% of test organisms in a laboratory experiment) for various species of wildlife to determine whether the sample concentration should be a cause of concern for a given species or the trophic interactions of the estuarine ecosystem. At this point in the eradication, ISP Coalition partners normally apply imazapyr by spot treatment at the FIFRA label rate of 96 oz/A, equivalent to 680 grams 'acid equivalent' per acre (e.g., a tank mix of 3 g/L for 60 gal/A). A sample was submitted to Pacific Agricultural Laboratory by the ISP in 2010 straight from a hand-mixed tank that was to be applied at 25 gal/A and the lab reported it contained an appropriate concentration of 3.6 g/L.

The ISP imazapyr sample from the receiving waters from the 2023 treatment event was 10 ppb collected shortly after treatment, equivalent to 0.01 mg/L. Grue (cited in Entrix 2003) reported a 96-hr LC_{50} for juvenile rainbow trout of 23,336 mg/L and King *et al*. (2004) affirmed that level with their results of 22,305 mg/L. These lethal levels are orders of magnitude greater than the ISP's treatment sample from the 2023 treatment season, far below any level of concern. These LC_{50} values in the literature for fish are obviously far higher concentrations than even the actual tank mix being applied to the target *Spartina*, not to mention the ecologically relevant residual concentration that may be found in adjacent surface water after a *Spartina* treatment event.

A survey of the available literature on imazapyr by Leson & Associates (2005) includes studies with various fish species [bluegill sunfish (*Lepomis macrochirus*), rainbow trout (*Oncorhynchus mykiss*), channel catfish (*Ictaluras punctatis*), fathead minnow (*Pimephales promelas*), Atlantic silverside (*Menidia menidia*), Nile tilapia (*Tilapia nilotica*), and silver barb (*Barbus genionotus*)] exposed to both the technical grade imazapyr as well as tank mixes with surfactants (Hasten® and Agri-Dex®). Hasten® is the pre-cursor to the Competitor® product that the ISP partners occasionally still use and therefore can serve well for comparison. As expected, the 96-hour LC_{50} was lower when surfactants are included, and some fish species are more sensitive than the previously reported rainbow trout that are the standard for EPA fish toxicology evaluation. However, the lowest lethal concentrations were in the range of 100 mg/L, as compared with the ISP's 2022 measured treatment concentration of 0.01 mg/L, representing four orders of magnitude difference. In addition, with this relatively low observed environmental concentration, salt marsh birds and mammals are at very low risk from the herbicide treatment because even the lowest no-observable-effect-level (NOEL) reported from an 18-week dietary study on mallards was ≈ 200 mg/kg of body weight (b.w.); levels for rats were in the 2,000-10,000 mg/kg b.w. range. Either of these representative wildlife species would have to ingest many liters of treated water to reach the reported NOEL, and many more liters beyond that to reach the lethal level. This is obviously a very unlikely scenario, especially with the documented rapid excretion of imazapyr compensating for any incidental ingestion.

These imazapyr levels may also be compared to published toxicity data for aquatic invertebrates; these organisms can be more sensitive in general than the fish species reported above. Mangels & Ritter (2000) reported the no-observable-effect concentration (NOEC) for imazapyr for the Eastern oyster (*Crassostrea virginica*) was >132 mg/L (the highest dose tested). Manning (1989) found the 21-day NOEC for the freshwater flea (*Daphnia magna*) was 97.1 mg/L. Again, comparing these values to the ISP's 2021 measured post-treatment concentration of 0.01 mg/L shows approximately four orders of magnitude difference, well below any level of concern.

In addition, imazapyr is reported to have a low potential for bioaccumulation and is therefore not expected to adversely impact predators that feed on exposed aquatic invertebrates.

Finally, the applications to invasive *Spartina* occur just once annually, with minor exceptions when late-season surveys find individual plants that were missed during the initial application which could then receive a follow-up treatment before senescence stops the potential for translocation. With the herbicide applications occurring just once each year, any inhabitants of the tidal marsh ecosystem are only subjected to a single acute exposure and are not receiving chronic, prolonged exposure; this enhances the already-substantial buffer of safety described above in this survey of the toxicology literature.

6. Conclusion

The State Coastal Conservancy's Invasive *Spartina* Project successfully implemented their Water Quality Monitoring Plan at the required representative sample of their aquatic herbicide application sites around the San Francisco Estuary during the 2023 *Spartina* treatment season, in compliance with the Statewide General Permit and National Pollutant Discharge Elimination System (NPDES). The successful *Spartina* control achieved since 2005 has reduced the estuary-wide infestation by 97.1% from 805 net acres to 23.5 net acres by 2023. Much less herbicide is now necessary to complete the annual treatment than in the initial years of the project, and this success has also enabled ISP partners to shift away from broadcast applications over the historic *Spartina* monocultures down to spot applications from airboat and backpack. By 2023, the majority of ISP sites are treated simply by backpack or handheld sprayer as the only herbicide delivery system needed, and the ISP is completing the eradication of all infestations of *S. densiflora* around the Estuary with only manual removal after successful reductions with imazapyr in the initial years. Fifty-five ISP sites were at the zero-detection level in 2023, showing continued progress towards the goal of eradication.

The imazapyr sampling conducted immediately after *Spartina* treatment has consistently found that any concentrations detected in the receiving waters are two to four orders of magnitude below those reported in the toxicology literature as a concern to humans or the animals that inhabit the associated tidal marsh system, including the benthic invertebrates so fundamental to the tidal marsh food web. The most recent General Permit established an imazapyr Monitoring Trigger of 11.2 mg/L; this is equivalent to 11,200 ppb. ISP's maximum measured imazapyr concentration in 2022 was 10 ppb from the treatment event, more than 11,000 ppb below the Monitoring Trigger.

The one-week post-treatment sampling results are also consistent with the published literature that have found imazapyr is short-lived in an estuarine environment. In 2023, the imazapyr concentration measured one week after treatment was .31 ppb, representing a reduction of 96.9%, compared to the four-year mean reduction from 2007-2010 at all monitored ISP sites of 95.8%. With the rapid degradation of this herbicide in the tidal environment, as measured by the imazapyr concentration in the water at the site one week after treatment, it is anticipated that sites that still had measurable concentrations at that point would likely be below detectable levels within a short time after that third sample.

7. References

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Appendix I

ISP Coalition Certifications for
2023 Water Quality Monitoring Report

Invasive *Spartina* Project
2023 Water Quality Monitoring Report

DocuSign Envelope ID: 0CC10F07-8F71-401C-B012-B89194E1D4B0

CERTIFICATION
for 2023 ISP Water Quality Monitoring Report
City of Alameda

In accordance with Attachment B, Section V.B.l. Standard Provisions - Reporting, Signatory and Certification Requirements, 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, General Permit No. CAG 990005:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." 40 C.F.R. § 122.22(d)

Signed and Agreed:

DocuSigned by:

Erin Smith

Erin Smith
Public Works Director
City of Alameda

Drew Kerr

Drew Kerr
Treatment Program Manager
State Coastal Conservancy's Invasive *Spartina* Project

Peggy Olofson

Peggy Olofson
Director
State Coastal Conservancy's Invasive *Spartina* Project

CERTIFICATION
for 2023 ISP Water Quality Monitoring Report
California Invasive Plant Council

In accordance with Attachment B, Section V.B.1. Standard Provisions - Reporting, Signatory and Certification Requirements, 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, General Permit No. CAG 990005:

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Signed and Agreed:

Doug Johnson

Doug Johnson
Executive Director
California Invasive Plant Council

Drew Kerr

Drew Kerr
Treatment Program Manager
State Coastal Conservancy's Invasive *Spartina* Project

Peggy Olofson

Peggy Olofson
Director
State Coastal Conservancy's Invasive *Spartina* Project

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CERTIFICATION
for 2023 ISP Water Quality Monitoring Report
California Department of Parks and Recreation

In accordance with Attachment B, Section V.B.l. Standard Provisions - Reporting, Signatory and Certification Requirements, 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, General Permit No. CAG 990005:

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Signed and Agreed:

DocuSigned by:
Gina Benigno
D7D779665EBF4C2...

Gina Benigno
Natural Resource Manager (acting)
Diablo Range District – Northern Region
California Department of Parks and Recreation

Drew Kerr

Drew Kerr
Treatment Program Manager
State Coastal Conservancy's Invasive *Spartina* Project

Peggy Olofson

Peggy Olofson
Director
State Coastal Conservancy's Invasive *Spartina* Project

CERTIFICATION
for 2023 ISP Water Quality Monitoring Report
East Bay Regional Parks District

In accordance with Attachment B, Section V.B.l. Standard Provisions - Reporting, Signatory and Certification Requirements, 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, General Permit No. CAG 990005:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." 40 C.F.R. § 122.22(d)

Signed and Agreed:

Matthew Graul

Matt Graul
Chief of Stewardship
East Bay Regional Parks District

Drew Kerr

Drew Kerr
Treatment Program Manager
State Coastal Conservancy's Invasive *Spartina* Project

Peggy Olofson

Peggy Olofson
Director
State Coastal Conservancy's Invasive *Spartina* Project

CERTIFICATION
for 2023 ISP Water Quality Monitoring Report
Friends of Corte Madera Creek Watershed

In accordance with Attachment B, Section V.B.l. Standard Provisions - Reporting, Signatory and Certification Requirements, 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, General Permit No. CAG 990005:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." 40 C.F.R. § 122.22(d)

Signed and Agreed:

Sandra Guldman

Sandra Guldman
President
Friends of Corte Madera Creek Watershed

Drew Kerr

Drew Kerr
Treatment Program Manager
State Coastal Conservancy's Invasive *Spartina* Project

Peggy Olofson

Peggy Olofson
Director
State Coastal Conservancy's Invasive *Spartina* Project

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CERTIFICATION
for 2023 ISP Water Quality Monitoring Report
City of Palo Alto

In accordance with Attachment B, Section V.B.1. Standard Provisions - Reporting, Signatory and Certification Requirements, 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, General Permit No. CAG 990005:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." 40 C.F.R. § 122.22(d)

Signed and Agreed:

DocuSigned by:
Lisa Myers
CBAB6B34A38C4D0...

Lisa Myers
Supervising Ranger

Drew Kerr

Drew Kerr
Treatment Program Manager
State Coastal Conservancy's Invasive *Spartina* Project

Peggy Olofson

Peggy Olofson
Director
State Coastal Conservancy's Invasive *Spartina* Project

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CERTIFICATION
for 2023 ISP Water Quality Monitoring Report
San Mateo County Mosquito & Vector Control District

In accordance with Attachment B, Section V.B.1. Standard Provisions - Reporting, Signatory and Certification Requirements, 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, General Permit No. CAG 990005:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." 40 C.F.R. § 122.22(d)

Signed and Agreed:

DocuSigned by:
Brian Weber
646572F497EE46B...

Brian Weber
District Manager
San Mateo County Mosquito & Vector Control District

Drew Kerr

Drew Kerr
Treatment Program Manager
State Coastal Conservancy's Invasive *Spartina* Project

Peggy Olofson

Peggy Olofson
Director
State Coastal Conservancy's Invasive *Spartina* Project

Appendix II

2023 ISP Field Data Collection Form

Invasive *Spartina* Project
2023 Water Quality Monitoring Report

Page ___ of ___ on this date

NPDES Field Data Collection Form

San Francisco Estuary Invasive *Spartina* Project, Aquatic Pesticide Application Plan, 1001 42nd Street, Suite 230, Oakland, CA 94608

Site ID (XXXX) (e.g. DEAD): ____________________ Date: ___________________ Collected By: __________________________

Monitoring Area Description: ____

Water Color (circle): green green-brown brown blue (dye) Other waterway observations: ____

Station Location (circle): at application point upstream downstream Station Type (circle): Reference Treated

Wind (circle): low high Weather (circle): fog rain Tidal Cycle (circle): high low slack

Herbicide: imazapyr glyphosate Surfactant (circle): Liberate Competitor

Field Measurements

Water Depth	**pH**	**Dissolved Oxygen**	**Water Temp**	**Conductivity**	**Salinity**	**Turbidity**
Meters	Number	mg/L	^{O} C	mS	ppt	NTU

Samples Collected

Sample ID (XXXX-YY-Ab)*	**Time**	**Sample Depth (m)**	**Notes**

*** XXXX-YY-Ab** (e.g. DEAD-01-pre, ZIPY-02-0.5h) = **XXXX:** Site, **YY:** site visit number (01-1st, 02-2nd, 03-3rd, etc.), **A:** time to application (either pre, increments thereafter in half hours – 0.5), **b:** time increment (h=hour, w=week (for 1 week post-treatment))

Additional Notes or Comments: ____

Wildlife Presence: ____

Appendix III

2023 Aquatic Herbicide Application Log

Invasive *Spartina* Project
2023 Water Quality Monitoring Report

SAN FRANCISCO ESTUARY INVASIVE SPARTINA PROJECT
1830 Embarcadero Cove ● Suite 100 ● Oakland ● California 94606 ● (510) 536-4782
Preserving native wetlands

Aquatic Herbicide Application Log

for NPDES Compliance

I. GENERAL

Date: ___________ ISP Onsite Lead: _____________ Start time: _____________Stop time: _____________

Coalition Partner(s): ____

Applicator (lead agency /contractor): ____

II. HERBICIDE INFORMATION

Herbicide (circle): **Imazapyr** **Glyphosate** Concentration: ______% Application rate (est.): ______ gpa

Site #1: ISP Site ____ Ounces of concentrate applied: _________

Site #2: ISP Site ____ Ounces of concentrate applied: _________

Site #3: ISP Site ____ Ounces of concentrate applied: _________

TOTAL ounces of concentrate applied on this date: _________

III. VISUAL MONITORING OF TREATMENT AREA

Treatment area description (circle all): Tidal marsh Mudflat Channel Riprap Other __________

Water appearance (circle all): Absent Clear Turbid Films/Sheens/Coatings

Color: Green Brown Blue (dye) Other _____________________

Other observations relevant to water quality: ____

____

IV. CERTIFICATION

I certify that the aquatic herbicide application to non-native Spartina documented on this log sheet followed the ISP's Aquatic Pesticide Application Plan (APAP) that was reviewed and approved by the State Water Resources Control Board.

(Sign here) X____
Signature of Lead Applicator (on behalf of Coalition Partner)

Copy distribution: White-ISP Yellow-applicator Pink-partner

Appendix IV

Pacific Agricultural Laboratory
2023 Analytical Reports

Invasive *Spartina* Project
2023 Water Quality Monitoring Report

PACAGLAB.COM
503.626.7943
21830 S.W. Alexander Ln
Sherwood, OR 97140

SFEI Spartina Project
1001 42nd Street, Suite 230
Oakland, CA 94608

Report Number: P232261
Report Date: October 18, 2023
Client Project ID: [none]

Analytical Report

Client Sample ID: PICR-01-pre
Matrix: water

PAL Sample ID: P232261-01RE1
Sample Date: 9/18/23
Received Date: 9/20/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8321B (LC-MS/MS)					
10/17/23	10/18/23	Imazapyr	0.13 ug/L	0.020 ug/L	

Surrogate Recovery: 95 %
Surrogate Recovery Range: 60-140
(Imazamethabenz-methyl used as Surrogate)

Client Sample ID: PINO-01-pre
Matrix: water

PAL Sample ID: P232261-02RE1
Sample Date: 9/18/23
Received Date: 9/20/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8321B (LC-MS/MS)					
10/17/23	10/18/23	Imazapyr	ND	0.020 ug/L	

Surrogate Recovery: 95 %
Surrogate Recovery Range: 60-140
(Imazamethabenz-methyl used as Surrogate)

Client Sample ID: PICR-02-5h
Matrix: water

PAL Sample ID: P232261-03RE1
Sample Date: 9/19/23
Received Date: 9/20/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8321B (LC-MS/MS)					
10/17/23	10/18/23	Imazapyr	10 ug/L	0.20 ug/L	

Surrogate Recovery: 96 %
Surrogate Recovery Range: 60-140
(Imazamethabenz-methyl used as Surrogate)

Rick Jordan, Laboratory Director

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

PACAGLAB.COM
503.626.7943
21830 S.W. Alexander Ln
Sherwood, OR 97140

SFEI Spartina Project
1001 42nd Street, Suite 230
Oakland, CA 94608

Report Number: P232261
Report Date: October 18, 2023
Client Project ID: [none]

Quality Assurance

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
10/17/23	10/18/23	23J1706-BLK1	Imazapyr	Not Detected	< 0.020 ug/L	

Blank Spike Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
10/17/23	10/18/23	23J1706-BS1	Imazapyr	118	60-140	
10/17/23	10/18/23	23J1706-BSD1	Imazapyr	100	60-140	

Rick Jordan, Laboratory Director

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Matrix SCIENCES | PAL PACIFIC AGRICULTURAL LABORATORY

PACAGLAB.COM
503.626.7943
21830 S.W. Alexander Ln
Sherwood, OR 97140

SFEI Spartina Project
1001 42nd Street, Suite 230
Oakland, CA 94608

Report Number: P232358
Report Date: October 16, 2023
Client Project ID: [none]

Analytical Report

Client Sample ID: PICR-03-1w
Matrix: water

PAL Sample ID: P232358-01
Sample Date: 9/26/23
Received Date: 9/28/23

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8321B (LC-MS/MS)					H3
10/09/23	10/9/23	Imazapyr	0.31 ug/L	0.020 ug/L	

Surrogate Recovery: 116 %
Surrogate Recovery Range: 60-140
(Imazamethabenz-methyl used as Surrogate)

Rick Jordan, Laboratory Director

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

PACAGLAB.COM
503.626.7943
21830 S.W. Alexander Ln
Sherwood, OR 97140

SFEI Spartina Project
1001 42nd Street, Suite 230
Oakland, CA 94608

Report Number: P232358
Report Date: October 16, 2023
Client Project ID: [none]

Quality Assurance

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
10/9/23	10/9/23	23J0907-BLK1	Imazapyr	Not Detected	< 0.020 ug/L	

Blank Spike Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
10/9/23	10/9/23	23J0907-BS1	Imazapyr	117	60-140	
10/9/23	10/9/23	23J0907-BSD1	Imazapyr	123	60-140	

Project Notes

Notes	Definition
H3	The sample was analyzed outside of recommended hold time.

Rick Jordan, Laboratory Director

This analytical report complies with the ISO/IEC 17025:2017 Quality Standard.

Appendix V

2023 NPDES Discharger's Table

Invasive *Spartina* Project
2023 Water Quality Monitoring Report

NPDES Discharger's Table for *Spartina* Treatment Sub-Areas

ISP Sub-Area Number	ISP Sub-Area Name	Estimated Treatment Area (m^2)	WDID#	Place ID#	NOI entity*	Adjacent or Nearby Waterways	Sub-area centroid X (UTM)	Sub-area centroid Y (UTM)	Herbicide Applied	Truck	Back-pack	Amphib-ious vehicle	Airboat	Aerial: Broad cast	Digging	Volume Imazapyr Applied (Ounces)
01a	Channel Mouth	62.2	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Flood Control Channel	576807.5381	4157810.0568	X		X					14
01b	Lower Channel (not including mouth)	12.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Flood Control Channel	578360.9955	4158281.016	X		X					2
01c	Upper Channel	5.3	n/a	n/a	n/a	San Francisco Bay	580899.5769	4157737.918	X		X					1
01d	Upper Channel - Union City Blvd - I-880	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Alameda Flood Control Channel	582900.3291	4158662.8535		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
01e	Strip Marsh No. of Channel Mouth	No Invasive Spartina	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Flood Control Channel	576189.9361	4158613.5408		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
01f	Pond 3-AFCC	0.1	n/a	n/a	n/a	San Francisco Bay, Alameda Flood Control Channel	577535.9107	4158581.2734	X		X					1
02a.1a	Belmont Slough Mouth	552.2	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough, Bay Slough	566362.0750	4156428.1213	X	X	X		X			136
02a.1b	Belmont Slough Mouth South	563.4	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough	566065.8772	4155491.5067	X	X	X		X			162
02a.2	Upper Belmont Slough and Redwood Shores	4427.4	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough, Bay Slough, Redwood Shores Lagoons, Steinberger Slough	566082.5157	4154633.3787	X		X		X			684
02a.3	Bird Island	183.0	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough, Bay Slough	567418.8179	4156363.7723	X		X		X			36
02a.4	Redwood Shores Mitigation Bank	107.8	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	Belmont Slough, Bay Slough, Redwood Shores Lagoons	566472.3438	4155766.6832	X		X					16
02b.1	Corkscrew Slough	1371.8	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Redwood Creek, Steinberger Slough, Deepwater Slough	568493.0329	4153078.2898	X		X		X			417
02b.2	Steinberger Slough South, Redwood Creek Northwest	3189.0	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Steinberger Slough, Smith Slough	568355.2157	4153771.8800	X		X		X			268
02c.1a	B2 North Quadrant West	Not treated in 2023	n/a	n/a	n/a	San Francisco Bay, Steinberger Slough	568874.5824	4155083.5605		NOT TREATED IN 2023						X
02c.1b	B2 North Quadrant East	87111.7	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Steinberger Slough	569319.4725	4154586.8620	X		X		X			9168
02c.2	B2 North Quadrant South	35772.7	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Deepwater Slough, Redwood Creek	568753.8607	4153996.8675	X		X		X			5817
02d.1a	B2 South Quadrant West	190.4	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek	569924.5881	4154840.4242	X		X		X			30

NPDES Discharger's Table for *Spartina* Treatment Sub-Areas

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02d.1b	B2 South Quadrant East	1.7	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay	570171.0739	4154599.6276	X		X					1
02d.2	B2 South Quadrant (2)	195.8	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough	569759.2321	4154331.9176	X		X					30
02d.3	B2 South Quadrant (3)	174.8	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Corkscrew Slough	570294.9192	4154262.0363	X		X					25
02e	Westpoint Slough NW	43.1	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Westpoint Slough, First Slough	571040.8501	4152180.4614	X		X		X			12
02f	Greco Island North	2423.9	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Westpoint Slough, First Slough	571707.7828	4152201.4530	X		X		X			188
02g	Westpoint Slough SW and East	348.5	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Westpoint Slough, First Slough	571895.9674	4150389.3685	X		X					30
02h	Greco Island South	1328.4	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Westpoint Slough, First Slough, Ravenswood Slough	573401.4651	4150787.4274	X		X		X			210
02i	Ravenswood Slough & Mouth	1147.9	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Ravenswood Slough	575260.0121	4150291.9616	X		X					114
02j.1	Ravenswood Open Space Preserve (N of Hwy 84)	741.6	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay	576795.9752	4150761.5653	X		X					78
02j.2	Ravenswood Open Space Preserve (S of Hwy 84)	456.9	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay	577181.0843	4150018.6035	X		X					40
02k	Redwood Creek and Deepwater Slough	2736.0	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	Redwood Creek, Deepwater Slough	569362.5429	4151619.3444	X		X		X			216
02l	Inner Bair Island Restoration	415.6	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	Smith Slough, Steinberger Slough	567544.0765	4150917.8264	X		X					46
02m	Pond B3 - Middle Bair Island Restoration	10667.4	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Steinberger Slough	567798.6934	4153491.6125	X				X			3206
02n	SF2	Not treated in 2023	n/a	n/a	n/a	San Francisco Bay	576559.3772	4149561.8265		NOT TREATED IN 2023						X
02o	Central Bair	16810.9	2 01AP00040 2 41AP00023	859302 714649	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Smith Slough	576559.3772	4149561.8265	X				X			1728
03a	Blackie's Creek (above bridge)	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Blackie's Creek	544943.3291	4194484.1644		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
03b	Blackie's Creek Mouth	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Blackie's Creek	545776.0946	4193474.5260		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X

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ISP Sub-Area Number	ISP Sub-Area Name	Estimated Treatment Area (m^2)	WDID#	Place ID#	NOI entity*	Adjacent or Nearby Waterways	Sub-area centroid X (UTM)	Sub-area centroid Y (UTM)	Herbicide Applied	Truck	Back-pack	Amphib-ious vehicle	Airboat	Aerial: Broad cast	Digging	Volume Imazapyr Applied (Ounces)
04a	Corte Madera Ecological Reserve (CMER)	42.6	2 21AP00010	654135	FCMCW	San Francisco Bay, Corte Madera Creek	543242.2392	4199188.5874	X		X				X	7
04b	College of Marin Ecology Study Area	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	540025.7477	4200463.1205		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
04c	Piper Park East	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	541445.9928	4199241.0019		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
04d	Piper Park West	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	541273.7174	4199466.3364		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
04e	Larkspur Ferry Landing Area	No Invasive Spartina	2 21AP00010	654135	FCMCW	San Francisco Bay, Corte Madera Creek	543623.8572	4199608.8718		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
04f	Riviera Circle	0.6	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	541849.0263	4199323.0762							X	X
04g	Creekside Park	3.9	2 21AP00010	654135	FCMCW	San Francisco Bay, Corte Madera Creek	540464.4410	4200237.4338	X		X				X	1
04h	Upper Corte Madera Creek (Above Bon Air)	17.1	2 21AP00010	654135	FCMCW	San Francisco Bay, Corte Madera Creek	540079.0231	4200187.2701	X		X				X	3
04i	Lower Corte Madera Creek (between Bon Air Rd & HWY 101)	43.2	2 21AP00010	654135	FCMCW	San Francisco Bay, Corte Madera Creek	541630.9851	4199280.0106	X		X				X	7
04j.1	Corte Madera Creek Mouth - North Bank	126.4	2 21AP00010	654135	FCMCW	San Francisco Bay, Corte Madera Creek	543020.8672	4199668.7449	X		X				X	11
04j.2	Corte Madera Creek Mouth - South Bank	27.6	2 21AP00010	654135	FCMCW	San Francisco Bay, Corte Madera Creek	542870.8257	4199569.0736	X		X				X	4
04k	Boardwalk No. 1 (Arkites)	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	541153.7225	4199466.8852		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
04l	Murphy Creek	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek, Murphy Creek	539240.0199	4200747.8377		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
05a.1	Mowry Marsh & Slough	1931.2	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Mowry Slough	584085.4488	4149879.9347	X		X		X			332
05a.2	Calaveras Marsh	1354.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Coyote Creek, Alviso Slough	585433.8865	4147064.2403	X		X		X			402
05b	Dumbarton/Audubon	1537.6	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Newark Slough, Plummer Creek	580752.5334	4151756.3530	X		X		X			196
05c.1	Newark Slough West	283.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Newark Slough	581007.8869	4153897.0920	X		X					21

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05c.2	Newark Slough East	0.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Newark Slough	582519.4127	4153792.0368	X		X					1
05d	LaRiviere Marsh	55.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Newark Slough	582271.4863	4154643.9756	X		X					5
05e	Mayhew's Landing	2.3	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Newark Slough	583256.3695	4154148.8125	X		X					2
05f	Coyote Creek- Alameda County	273.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Mud Slough, Coyote Creek	591599.2199	4147451.6133	X		X					38
05g	Cargill Pond (W Hotel)	224.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Newark Slough	582751.3564	4154755.5841	X		X					25
05h	Plummer Creek Mitigation	27.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Plummer Creek	584095.9610	4152505.6441	X		X					8
05i	Island Ponds	285.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Coyote Creek, Mud Slough, Guadalupe River	591432.5212	4147089.4857	X				X			48
06a	Emeryville Crescent East	27.2	2 49AP00029	275293	State Parks	San Francisco Bay	561699.8488	4187349.9580	X		X					4
06b	Emeryville Crescent West	205.4	2 01AP00022	714642	EBRPD	San Francisco Bay	560382.4104	4186763.9652	X		X					24
07a	Oro Loma Marsh-East	1010.5	2 01AP00022	714642	EBRPD	San Francisco Bay	575270.4502	4168555.9513	X		X					89
07b	Oro Loma Marsh-West	727.2	2 01AP00022	714642	EBRPD	San Francisco Bay	574537.3296	4168456.4328	X		X					144
8	Palo Alto Baylands	1709.0	2 43AP00011	712643	City of Palo Alto	San Francisco Bay	579177.0832	4146088.4657	X		X					310
9	Pickleweed Park / Tiscornia Marsh	43.6	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Rafael Bay, San Rafael Creek	544516.6791	4202044.3461	X		X					8
10a	Whittel Marsh	1.4	2 01AP00022	714642	EBRPD	San Francisco Bay	557120.0455	4206623.3549	X		X					1
10b	Southern Marsh	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	555675.2928	4206327.0165		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
10c	Giant Marsh	4.4	2 01AP00022	714642	EBRPD	San Francisco Bay	556182.6896	4205001.3122	X		X					2
10d	Breuner Marsh Restoration	No Invasive Spartina	2 01AP00022	714642	EBRPD	San Francisco Bay	555762.8235	4204091.8802		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
11	Southampton Marsh	62.3	2 49AP00029	275293	State Parks	San Francisco Bay	571048.6663	4213968.1874	X		X					9

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12a	Pier 94	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Islais Creek Channel	554299.4193	4177929.9424		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12b	Pier 98/Heron's Head	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Lash Lighter Basin	555264.9581	4176959.9151		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12c	India Basin	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, India Basin	555242.7180	4176479.3978		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12d	Hunters Point Naval Reserve	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, South Basin, Yosemite Slough	555137.8265	4174899.3500		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12e	Yosemite Channel	No Invasive Spartina	2 49AP00029	275293	State Parks	San Francisco Bay, South Basin, Yosemite Slough	554648.8915	4174786.1888		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12f	Candlestick Cove	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Brisbane Lagoon, South Basin, Yosemite Channel	554210.3646	4173693.4206		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12g	Crissy Field	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Crissy Field Marsh	547860.4257	4184289.8432		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12h	Yerba Buena Island	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Clipper Cove, Bar Channel, Oakland Outer Harbor	552797.8047	4188324.8471		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
12i	Mission Creek	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Mission Bay, China Basin Water Channel	553339.9421	4180850.3878		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
13a	Old Alameda Creek North Bank	3.5	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Creek, North Creek	578285.9047	4161172.7648	X		X					1
13b	Old Alameda Creek Island	12.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Creek, North Creek	578056.2824	4161048.7760	X		X					8
13c	Old Alameda Creek South Bank	84.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Creek, North Creek	577676.9180	4160934.9285	X		X					12
13d	Whale's Tail North Fluke	32.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Creek, Mt. Eden Creek	575382.9293	4162274.4760	X		X					3
13e	Whale's Tail South Fluke	21.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Creek	575549.1260	4160382.9676	X		X					4
13f	Cargill Mitigation Marsh	9.7	n/a	n/a	n/a	San Francisco Bay, Alameda Creek	576027.8116	4160537.6794	X		X					2
13g	Upstream of 20 Tide Gates	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Alameda Creek, Ward Creek	580712.6186	4162631.4590		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
13h	Eden Landing-North Creek	26.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, North Creek	577712.8065	4161727.4755	X		X					8
13i	Eden Landing-Pond 10	10.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Mt. Eden Creek	575558.9621	4163349.4809	X		X					2
13j	Eden Landing-Mt Eden Creek	116.5	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Mt. Eden Creek	576555.7056	4163552.6524	X		X					25

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13k	Eden Landing Reserve-North Creek Marsh	8281.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Mt. Eden Creek, North Creek	578457.9175	4162866.8947	X		X		X			1018
13l	Eden Landing Reserve-Mt Eden Creek Marsh	3640.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Mt. Eden Creek	578609.9049	4163467.7623	X		X					732
13m	Eden Landing Pond E8A, E9, E8X	2172.3	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alameda Creek, North Creek	576950.3669	4161521.3412	X		X		X			351
15a.1	Charleston Slough to Mountainview Slough	131.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay	581163.2100	4144605.2611	X		X					16
15a.2	Stevens Ck to Guadalupe Sl	16.2	2 01AP00040	859302	Cal-IPC	San Francisco Bay	583330.7181	4144746.8321	X		X					7
15a.3	Guadalupe Slough	413.5	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Guadalupe Slough, Moffett Channel	587005.3597	4143439.3709	X		X					144
15a.4	Alviso Slough	16656.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Alviso Slough, Coyote Creek, Guadalupe River	587728.9332	4145171.7403	X	X	X		X			2294
15a.5	Coyote Creek to Artesian Slough	1543.5	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Coyote Creek, Mud Slough, Guadalupe River	591300.7634	4145809.2865	X		X		X			154
15a.6	Knapp Tract	184.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Guadalupe Slough, Moffett Channel, Alviso Slough, Coyote Creek	586042.9779	4145699.8644	X		X		X			20
15b	Faber/Laumeister Marsh	636.3	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Francisquito Creek	577599.4651	4147190.7879	X		X					84
15c	Shoreline Regional Park	82.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Charleston Slough, Stevens Creek	580629.1350	4144020.5634	X		X					17
16.1	Cooley Landing Central	4493.6	2 01AP00040	859302	Cal-IPC	San Francisco Bay	577025.0576	4148338.0763	X	X	X		X			715
16.2	Cooley Landing East	8305.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay	577161.5535	4148618.6894	X	X	X		X			1076
17a	Alameda Island South (Elsie Roemer Bird Sanctuary, Crab Cove)	175.6	2 01AP00013	806207	Alameda	San Francisco Bay, Tidal Channel, Airport Channel, San Leandro Bay, East Creek	564576.4152	4179452.7150	X		X					13
17b	Bay Farm Island	77.3	2 01AP00013	806207	Alameda	San Francisco Bay, San Leandro Bay	566538.2648	4177776.0313	X		X					24
17c.1	Arrowhead Marsh West	10676.8	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek	569196.9046	4177663.1478	X		X		X			1480

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17c.2	Arrowhead Marsh East	Not treated in 2023	n/a	n/a	n/a	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek	569343.0266	4177725.6164		NOT TREATED IN 2023						X
17d.1	MLK Regional Shoreline - Fan Marsh Shoreline	306.7	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	568699.4696	4177934.7370	X		X		X			40
17d.2	Airport Channel - MLK Shoreline	345.6	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569175.3023	4177345.1389	X		X					35
17d.3	East Creek -MLK Shoreline	132.1	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Tidal Canal, Colisuem Channels, Damon Slough	568767.9456	4179382.0109	X		X					15
17d.4	MLK Regional Shoreline-Damon Marsh	584.0	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569374.5323	4178733.3863	X	X	X					184
17d.5	Damon Sl/Elmhurst Cr - MLK Shoreline	146.5	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569699.5033	4178168.7218	X		X					17
17e.1	San Leandro Creek North	10.7	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Damon Slough	569907.7297	4177360.2491	X		X					2
17e.2	San Leandro Creek South	85.2	2 01AP00040	859302	Cal-IPC	San Francisco Bay	570581.9076	4176544.5715	X		X					6
17f	Oakland Inner Harbor	97.6	2 01AP00040	859302	Cal-IPC	Oakland Inner Harbor, Oakland Middle Harbor, Lake Merritt Channel, Brooklyn Basin	563483.6971	4182956.2947	X		X					24
17g	Coast Guard Island	2.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Oakland Inner Harbor, Brooklyn Basin, Fortmann Basin	566098.0075	4181978.0308	X		X					1
17h	MLK New Marsh	Not treated in 2023	n/a	n/a	n/a	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Damon Slough	569805.8839	4177186.5004		NOT TREATED IN 2023						X
17i	Coliseum Channels	360.9	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Coliseum Channels, East Creek Slough, Damon Slough	570171.9029	4178869.4467	X		X					76

NPDES Discharger's Table for *Spartina* Treatment Sub-Areas

ISP Sub-Area Number	ISP Sub-Area Name	Estimated Treatment Area (m^2)	WDID#	Place ID#	NOI entity*	Adjacent or Nearby Waterways	Sub-area centroid X (UTM)	Sub-area centroid Y (UTM)	Herbicide Applied	Truck	Back-pack	Amphib-ious vehicle	Airboat	Aerial: Broad cast	Digging	Volume Imazapyr Applied (Ounces)
17j.1	Fan Marsh Wings	80.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Leandro Bay, Airport Channel, Tidal Canal, San Leandro Creek, Elmhurst Creek	568622.8884	4177686.1551	X	X	X					8
17j.2	Fan Marsh Main	33166.3	n/a	n/a	n/a	San Francisco Bay, San Leandro Bay, Airport Channel, Tidal Canal, San Leandro Creek, Elmhurst Creek	568622.8884	4177686.1551	X	X	X					3513
17k	Airport Channel	19.6	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569575.6733	4176600.2674	X		X		X			3
17l	Doolittle Pond	19.6	2 01AP00022	714642	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel	568262.7345	4178012.4256	X		X					4
17m	Alameda Island (East: Aeolian Yacht Club & Eastern Shoreline)	114.8	2 01AP00013	806207	Alameda	San Francisco Bay, San Leandro Bay	567981.4525	4178863.3414	X		X		X			20
18a	Colma Creek	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough	552893.2013	4166658.8629		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
18b	Navigable Slough	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough	552516.1349	4166294.7372		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
18c	Old Shipyard	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	553312.8267	4166086.5650		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
18d	Inner Harbor	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, San Bruno Creek, Inner Harbor	553504.2489	4166073.3490		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
18e	Sam Trans Peninsula	1.1	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek	553855.0371	4166240.1813	X		X					2
18f	Confluence Marsh	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek	553484.8149	4166398.6648		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
18g	San Bruno Marsh	1.7	n/a	n/a	n/a	San Francisco Bay, Colma Creek, San Bruno Creek	554005.7446	4166785.6127	X		X					1

NPDES Discharger's Table for *Spartina* Treatment Sub-Areas

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18h	San Bruno Creek	No Invasive Spartina	2 41AP00023	714649	SMCMVCD	San Francisco Bay, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	552715.1192	4165551.0968		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19a	Brisbane Lagoon	3.2	2 41AP00023	714649	SMCMVCD	San Francisco Bay, Brisbane Lagoon, Oyster Cove	553456.5474	4171432.4131	X		X					2
19b	Sierra Point	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Oyster Cove, Brisbane Lagoon	554374.8916	4169974.0510		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19c	Oyster Cove	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Oyster Cove, Brisbane Lagoon	553830.1190	4169119.5867		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19d	Oyster Point Marina	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Oyster Cove	554681.7949	4168800.7361		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19e	Oyster Point Park	2.4	2 41AP00023	714649	SMCMVCD	San Francisco Bay, Oyster Cove	554776.6012	4168331.5764	X		X					4
19f	Point San Bruno	No Invasive Spartina	n/a	n/a	n/a	Colma Creek, Navigable Slough, San Bruno Creek	554826.2418	4167481.7146		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19g	Seaplane Harbor	0.8	2 41AP00023	714649	SMCMVCD	Colma Creek, Seaplane Harbor	554416.5399	4165260.2112	X		X					1
19h	SFO	247.5	2 41AP00023	714649	SMCMVCD	San Francisco Bay, Seaplane Harbor, Mills Creek	555678.9186	4162816.6627	X		X					20
19i	Mills Creek Mouth	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Mills Creek	554736.1754	4161836.3844		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19j	Easton Creek Mouth	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Easton Creek	556395.5787	4160789.7311		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19k	Sanchez Marsh	2189.0	2 41AP00023	714649	SMCMVCD	San Francisco Bay, Sanchez Marsh, Burlingame Lagoon	556935.1249	4160354.8299	X		X				X	376
19l	Burlingame Lagoon	260.9	2 41AP00023	714649	SMCMVCD	San Francisco Bay, Sanchez Marsh, Burlingame Lagoon	557909.1080	4160341.2512	X		X				X	36
19m	Fisherman's Park	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Coyote Point Marina/Marsh	559023.7151	4160477.7444		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19n	Coyote Point Marina / Marsh	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Coyote Point Marina/Marsh, San Mateo Creek	560371.4138	4160420.9899		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19o	San Mateo Creek / Ryder Park	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Mateo Creek, Seal Slough	560913.9538	4159238.4069		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19p.1	Seal Slough Mouth - Central Marsh	2.6	2 41AP00023	714649	SMCMVCD	San Francisco Bay, San Mateo Creek, Seal Slough	562572.4336	4158728.9495	X		X					2
19p.2	Seal Slough Mouth - Peripheral Marshes	2.3	2 41AP00023	714649	SMCMVCD	San Francisco Bay, San Mateo Creek, Seal Slough	563160.4826	4158642.0730	X		X					2
19q	Foster City	1.6	2 41AP00023	714649	SMCMVCD	San Francisco Bay, Foster City Lagoon, Belmont Slough	566144.9786	4157898.9211	X		X					1

NPDES Discharger's Table for *Spartina* Treatment Sub-Areas

ISP Sub-Area Number	ISP Sub-Area Name	Estimated Treatment Area (m^2)	WDID#	Place ID#	NOI entity*	Adjacent or Nearby Waterways	Sub-area centroid X (UTM)	Sub-area centroid Y (UTM)	Herbicide Applied	Truck	Back-pack	Amphib-ious vehicle	Airboat	Aerial: Broad cast	Digging	Volume Imazapyr Applied (Ounces)
19r	Anza Lagoon	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Bay Front Channel	557936.6006	4160676.5827		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
19s	Maple Street Channel	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Maple St. Channel	568945.5661	4149933.6355		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
20a	Oyster Bay Regional Shoreline	219.8	2 01AP00022	714642	EBRPD	San Francisco Bay, Oyster Bay, Golf Links Channel, San Leandro Small Boat Lagoon, Estudillo Creek Channel	570801.9998	4173701.8444	X		X		X			30
20b	Oakland Metropolitan Golf Links	27.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay	570754.9450	4175284.9633	X		X		X			4
20c	Dog Bone Marsh	181.3	2 01AP00040	859302	Cal-IPC	San Francisco Bay	572540.0802	4171007.8804	X		X					32
20d.1	Citation Marsh South	1413.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573748.5251	4170761.4745	X	X	X					776
20d.2a	Citation Marsh Upper	6960.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573448.9646	4171236.3464	X	X	X					2312
20d.2b	Citation Marsh Central	108957.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573448.9646	4171236.3464	X	X	X					10093
20e	East Marsh	170.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573894.9872	4170003.6933	X		X					144
20f	North Marsh	Not treated in 2023	n/a	n/a	n/a	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573124.0431	4171013.8826		NOT TREATED IN 2023						X
20g	Bunker Marsh	656.5	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573617.2539	4170076.4293	X	X	X					384
20h.1	San Lorenzo Creek & Mouth North	2.9	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573829.9856	4169716.9799	X		X					1
20h.2	San Lorenzo Creek & Mouth South	511.6	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Lorenzo Creek, Bockman Channel	573575.6909	4169277.7370	X		X					96
20i	Bockmann Channel	241.7	2 01AP00022	714642	EBRPD	San Francisco Bay, Bockman Channel	574439.3640	4169066.3661	X		X					41

NPDES Discharger's Table for *Spartina* Treatment Sub-Areas

APPENDIX V

ISP Sub-Area Number	ISP Sub-Area Name	Estimated Treatment Area (m^2)	WDID#	Place ID#	NOI entity*	Adjacent or Nearby Waterways	Sub-area centroid X (UTM)	Sub-area centroid Y (UTM)	Herbicide Applied	Truck	Back-pack	Amphib-ious vehicle	Airboat	Aerial: Broad cast	Digging	Volume Imazapyr Applied (Ounces)
20j	Sulphur Creek	25.4	2 01AP00022	714642	EBRPD	San Francisco Bay	575682.9812	4168238.4657	X		X					2
20k	Hayward Landing	1.3	2 01AP00022	714642	EBRPD	San Francisco Bay	574480.4286	4166871.6234	X		X					2
20l	Johnson's Landing	8.2	2 01AP00022	714642	EBRPD	San Francisco Bay	575114.0955	4164936.1630	X		X					2
20m	Cogswell Marsh, Quadrant A	123.1	2 01AP00022	714642	EBRPD	San Francisco Bay	574931.9598	4166149.9615	X		X					16
20n.1	Cogswell Marsh, Quadrant B Bayfront	1532.2	2 01AP00022	714642	EBRPD	San Francisco Bay	575335.3739	4165643.2601	X	X	X					168
20n.2	Cogswell Marsh, Quadrant B South	462.3	2 01AP00022	714642	EBRPD	San Francisco Bay	575335.3739	4165643.2601	X		X					30
20n.3	Cogswell Marsh, Quadrant B Main	39127.9	2 01AP00022	714642	EBRPD	San Francisco Bay	575335.3739	4165643.2601	X	X	X					6444
20o	Cogswell Marsh, Quadrant C	728.3	2 01AP00022	714642	EBRPD	San Francisco Bay	574956.5922	4165441.6011	X		X					90
20p	Hayward Shoreline Outliers	4.8	2 01AP00022	714642	EBRPD	San Francisco Bay, Estudillo Creek Channel	574600.2360	4165756.5503	X		X					1
20q	San Leandro Shoreline Outliers	34.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Leandro Flood Control Channel	572880.2444	4170476.5038	X		X					15
20r	Oakland Airport Shoreline and Channels	39.2	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Oyster Bay	568108.0862	4174678.0156	X		X					8
20s	H.A.R.D. Marsh	95.5	2 01AP00022	714642	EBRPD	San Francisco Bay	576039.4964	4164671.5808	X		X					13
20t	San Leandro Marina	45.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Estudillo Creek Channel	571443.2484	4172293.1436	X		X					8
20u	Estudillo Creek Channel	2505.9	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Estudillo Creek Channel	572896.1587	4171843.5860	X	X	X					638

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20v	Hayward Landing Canal	24.9	2 01AP00040	859302	Cal-IPC	San Francisco Bay	575733.4612	4166692.8267	X		X					2
20w	Triangle Marsh	82.2	2 01AP00022	714642	EBRPD	San Francisco Bay	574798.9094	4166726.9403	X		X					6
21a	Ideal Marsh North	7.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay	577168.1437	4156871.9542	X		X					1
21b	Ideal Marsh South	132.61	2 01AP00040	859302	Cal-IPC	San Francisco Bay	578260.5253	4154929.5490	X		X					12
22a	Wildcat Marsh	2493.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Pablo Strait, San Pablo Bay, Wildcat Creek	553471.9133	4201446.4859	X		X		X			329
22b.1	San Pablo Marsh East	178.5	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Pablo Bay	555164.7368	4203396.3757	X		X		X			115
22b.2	San Pablo Marsh West	182.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Pablo Bay, San Pablo Creek	554356.0947	4203049.4775	X		X		X			48
22c	Rheem Creek	389.6	2 01AP00022	714642	EBRPD	San Francisco Bay	555762.8235	4204091.8802	X		X					60
22d	Stege Marsh	No Invasive Spartina	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Richmond Inner Harbor	558645.9564	4196085.9714		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
22e	Hoffman Marsh	No Invasive Spartina	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Richmond Inner Harbor	559733.3437	4195529.7690		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
22f	Richmond/ Albany /Pinole Shoreline	311.1	2 01AP00040 2 49AP00029	859302 275293	Cal-IPC State Parks	San Francisco Bay, San Pablo Strait, San Pablo Bay	558964.2231	4198575.6514	X		X					30
23a	Brickyard Cove	No Invasive Spartina	2 01AP00040	859302	Cal-IPC	San Francisco Bay	546741.3839	4204071.1520		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
23b	Beach Drive	116.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Pablo Bay	545845.7691	4203107.4268	X		X					8
23c	Loch Lomond Marina	10.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Pablo Bay	545550.5115	4202862.4070	X		X					2
23d.1	San Rafael Canal Mouth East	168.4	2 01AP00040	859302	Cal-IPC	San Francisco Bay	544208.8498	4202838.9725	X		X				X	24
23d.2	San Rafael Canal Mouth West	15.9	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Rafael Creek	544384.0636	4202417.5570	X		X					3
23e	Muzzi & Marta's Marsh	162.9	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Clemente Creek, Corte Madera Ecological Reserve Pond	543400.9387	4198048.4476	X		X				X	19
23f	Paradise Cay	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	546065.6059	4196097.5885		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X

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23g	Greenwood Cove	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	543968.0294	4194454.3149		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
23h	Strawberry Point	38.3	2 01AP00040	859302	Cal-IPC	San Francisco Bay	543809.6824	4193371.4703	X		X				X	5
23i	Strawberry Cove	22.8	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Richardson Bay, Strawberry Cove	542806.8182	4193556.0582	X		X					4
23j	Bothin Marsh	9.4	2 01AP00040	859302	Cal-IPC	SF Bay, Richardson Bay,Tennessee Creek	541869.3253	4193729.5841	X		X					1
23k	Sausalito	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Richardson Bay	544463.7580	4191267.2214		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
23l	Starkweather Park	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	544991.3212	4200379.3919		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
23m	Novato	No Invasive Spartina	n/a	n/a	n/a	SF Bay, San Pablo Bay, Novato Creek, Gallinas Creek	542946.0401	4210189.9809		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
23n	Triangle Marsh & shoreline	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	544517.7632	4197330.3743		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
23o	China Camp	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	545298.7767	4207049.8282		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
24a	Upper Petaluma River-Upstream of Grey's Field	105.1	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Pablo Bay, Petaluma River, Lynch Creek	533514.3403	4231615.3849	X		X		X			11
24b	Grey's Field	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Pablo Bay, Petaluma River	533514.3403	4231615.3849		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
24c	Petaluma Marsh	0.1	2 01AP00040	859302	Cal-IPC	SF Bay, Petaluma River, Tule Slough, Schulz Slough, Mira Slough, Mud Hen Slough, Donahue Slough, San Antonio Creek	538235.2999	4226806.4746	X		X		X			1
25a	Tom's Point, Tomales	No Invasive Spartina	n/a	n/a	n/a	Tomales Bay, Lagunitas Creek, Cataract Creek, Keys Creek	510090.2733	4222167.8403		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
25b	Limantour Estero	No Invasive Spartina	n/a	n/a	n/a	Limantour Estero, Drakes Estero	508123.6920	4209794.3048		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
25c	Drakes Estero	No Invasive Spartina	n/a	n/a	n/a	Drakes Estero, Limantour Estero, Home Bay	505420.4630	4213621.8460		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
25d	Bolinas Lagoon, North	No Invasive Spartina	n/a	n/a	n/a	Bolinas Lagoon, Pine Gulch Creek	527828.4138	4196780.6086		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
25e	Bolinas Lagoon, South	No Invasive Spartina	n/a	n/a	n/a	Bolinas Lagoon, Pine Gulch Creek	530524.8145	4195323.9548		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
26a	White Slough / Napa River	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	560519.6727	4224322.3600		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X

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26b	San Pablo Bay NWR & Mare Island	9.7	2 01AP00040	859302	Cal-IPC	San Pablo Bay, Sonoma Creek, Mare Island Strait	559560.2447	4218371.6666	X		X					6
26c	Sonoma Creek	6.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, San Pablo Bay, Sonoma Creek	551632.5000	4224116.4390	X		X					2
26d	Sonoma Baylands	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Pablo Bay	547593.7330	4220328.0882		ZERO NON-NATIVE SPARTINA FOUND IN 2023						X
27a	Point Buckler	7.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Suisun Bay	586305.8450	4216946.9250	X		X					1
27b	MOTCO Islands	29.3	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Suisun Bay	587588.0000	4214989.0000	X		X					8
27c	Honker Bay	73.7	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Suisun Bay	593472.0000	4214251.0000	X		X					9
27d	MOTCO Mainland	9.0	2 01AP00040	859302	Cal-IPC	San Francisco Bay, Suisun Bay	593472.0000	4214251.0000	X		X					2

Estuary Total (m^2) **445723**

Total Oz. **59042**

* Alameda = City of Alameda
City of Palo Alto = City of Palo Alto
Cal-IPC= California Invasive Plant Council
EBRPD = East Bay Regional Park District
FOCMCW = Friends of Corte Madera Creek Watersed
SMCMVCD = San Mateo County Mosquito and Vector Control District
State Parks = California Department of Parks and Recreation

Appendix VI

Quality Assurance Plan for
Pacific Agricultural Laboratory

Invasive *Spartina* Project
2023 Water Quality Monitoring Report

Extraction of Imidazolinone Herbicides in Water

1.0 Scope and Application

1.1 This procedure describes the extraction of imidazolinone herbicides from aqueous samples. This method is applicable to all types of water including, but not limited to, drinking water, storm water, surface water, and groundwater.

2.0 Summary of Method

2.1 A 500mL aliquot of sample is acidified to pH 2 and 12.5g sodium chloride is added. Sample is shaken in a separatory funnel with three 50mL portions of dichloromethane. Organic layers are drained **[through acidified sodium sulfate]** into a round bottom flask, and concentrated by rotary evaporation (SOP-AM-027).

3.0 Interferences

3.1 Potential interferences may include contamination from glassware and solvents, and co-extracted materials from the sample matrix. Care must be taken to avoid and/or minimize these potential interferences.

4.0 Sample Handling and Preservation

4.1 Samples should be taken in 1-L amber glass bottles with a PTFE lined cap.

4.2 Samples are taken at neutral pH, and stored at 4°C prior to extraction.

4.3 All water samples shall be extracted within seven (7) days of sampling.

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5.0 Apparatus and Instrumentation

5.1 1000 mL glass separatory funnel

5.2 500 mL graduated cylinder

5.3 600 mL beaker

5.4 250 mL round bottom flask

5.5 Large glass funnel

5.6 pH meter

5.7 Top-loading balance, accurate to ±0.01g

5.8 Magnetic stir bar

5.9 Magnetic stir plate

5.10 Rotary evaporator, Rotavap; Yamato RE50

6.0 Reagents and Supplies

6.1 Organic-free water, DI H_2O

6.2 Methanol (MeOH) w/0.5% Formic Acid

6.3 Pesticide-grade Dichloromethane, DCM

6.4 6 N Hydrochloric Acid, HCl

6.5 Sodium chloride, ACS grade

6.6 Glass beads

6.7 **[Glass wool]**

6.8 **[Acidified sodium sulfate, Na_2SO_4]**

7.0 Procedure

7.1 For each sample, the necessary glassware items (separatory funnel, 600 mL beaker, and flat-bottom flask) are obtained, rinsed with Dichloromethane if necessary, and labeled with sample number. Beakers contain a magnetic stir bar, and two glass beads are added to each flat-bottom flask. Using a graduated cylinder, measure 500 mL of organic-

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free water for QC and transfer to a beaker with a stir bar. Likewise, measure and transfer 500 mL of sample into a beaker with a stir bar.

7.2 **[Sodium sulfate funnels are prepared by placing a small plug of glass wool into a glass powder funnel, to which ~25g *acidified* Sodium Sulfate is added. Funnels are rinsed with ~10mL DCM, and solvent is drained into waste. A funnel is placed on each labeled collection flask.]**

7.3 Using a 500 mL graduated cylinder, a 500 mL aliquot of sample is measured and transferred to the labeled 600 mL beaker.

7.4 Method Blank (BLK) consists of 500 mL deionized water in a 600mL beaker. This sample will be the negative control (QC) for the analysis.

7.5 Lab Control Sample/Lab Control Sample Duplicate (LCS/LCSD) each consist of 500 mL DI water in a 600mL beaker. Project specific spike compounds are added to each, and the standard log number and spike volume are recorded on extraction bench sheet. These samples will be the positive control (QC) for the analysis.

7.6 The pH of each sample and QC is adjusted to 2.0 by dropwise addition of 6N hydrochloric acid.

7.7 12.5 g of sodium chloride is added to each beaker, stirring until salt is completely dissolved.

7.8 The contents of each beaker are transferred into the appropriately labeled separatory funnel. Samples and QC are extracted by shaking three times with 50mL DCM. The lower (DCM) layers are drained **[through the acidified sodium sulfate funnel]** into the corresponding flat-bottom round flask.

7.9 **[After all solvent is collected, Na_2SO_4 funnels are rinsed with ~20mL Dichloromethane, to optimize recovery of analytes.]**

7.10 Extracts are concentrated to ~0.5 mL using rotary evaporation (SOP-AM-027), and remaining solvent is evaporated to dryness under a steady stream of nitrogen gas.

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7.11 Extract is transferred to labeled culture tubes as per SOP-AM-XXX (Rotavap) using MeOH w/0.5% Formic acid as final solvent. Final volume is 2mL for most Imidazolinone extractions.

7.12 Extracts should be stored in refrigerator until analysis.

8.0 Calculations

8.1 N/A

9.0 Quality Control

9.1 At a minimum, batch QC will include a method blank (MB), and a Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD). Additional QC will be performed if there are project and/or method specific requirements. An extraction batch consists of a batch of 20 consecutive samples extracted within 7 days.

9.2 Spike recoveries are calculated after analysis to evaluate extraction efficiency.

10.0 Reporting

10.1 N/A

11.0 References

11.1 American Cyanamid Method 2261

11.2 American Cyanamid Method M1900

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Imidazolinone Herbicides in Water by EPA 8321B

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1.0 Scope and Application

1.1 This procedure is used to determine the concentrations of Imidazolinone herbicides in liquid matrices.

2.0 Summary of Method

2.1 A measured volume of sample is extracted using AM-033, Extraction of Imidazolinone Herbicides in Water.

2.2 Extracts are analyzed using liquid chromatography with mass spectroscopy (LC/MS) detection.

3.0 Interferences

3.1 Potential interferences may include contaminated solvents and extraction glassware, dirty chromatographic equipment, and co-extracted materials from the sample matrix. Care must be taken to avoid and/or minimize these interferences.

4.0 Sample Handling and Preservation

4.1 Store samples at $4^{o}C$ out of direct sunlight. Water samples should be extracted within 7 days of sampling and analyzed within 40 days of extraction

4.2 Personal protection measures should be taken while handling solvents and samples.

5.0 Apparatus and Instrumentation

5.1 Analytical balance, Sartorius model CP124S, accurate to 0.0001g. Calibration of balance shall be checked daily (SOP EQ-001).

5.2 N-EVAP evaporation manifold with heated water bath

5.3 HPLC System

5.3.1 Agilent 1100 HPLC system equipped with binary pump, autosampler, solvent degasser, and single quadrapole mass spectrometer.

5.3.2 Agilent Chemstation software

5.3.3 Analytical Column – C18 reverse phase column, 100mm x 3.0mm ID, 2.5 µm particle size, Agilent Zorbax SB-C18 or equivalent.

6.0 Reagents and Supplies

6.1 Organic-free reagent water

6.2 Methanol, Chemsolve, HPLC Grade

6.3 Acetonitrile (ACN), Chemsolve, HPLC Grade

6.4 Formic Acid, EMD, ACS Grade

6.5 Luer lock tipped syringe

6.6 Screw capped tubes with Teflon lined lids

6.7 13mm 45 µm nylon syringe filters

6.8 Auto sampler vials with PTFE lined caps

6.9 Volumetric flasks, class A

6.10 Gas tight syringes with PTFE tipped plungers

6.11 HPLC/MS Tuning Standard – Aglient ES Tuning Mix G2421A

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7.0 Procedures

7.1 Sample Extraction:

7.1.1 Extract waters via the procedure outlined in Pacific Agricultural Laboratory SOP AM-033 “Extraction of Imidazolinone Herbicides in Water”.

7.1.2 Store extracts in refrigerator until analysis.

7.2 Solvent exchange of water extracts:

7.2.1 Transfer a 1 ml aliquot of the sample extract to a culture tube. Mark the meniscus of the liquid in the tube.

7.2.2 Evaporate the solvent under a steady stream of nitrogen using the N-Evap evaporation manifold.

7.2.3 Reconstitute the extract as follows: add 500 uL methanol, then 500 uL Mobile Phase A (95% organic free water, 5% ACN, 0.05% formic acid). .

7.2.4 Filter the sample extract into an autosampler vial through a 45 µm 13 mm syringe filter using a luer tipped syringe.

7.2.5 Cap the vial and label with appropriate moniker.

7.3 Preparation of HPLC mobile phase:

7.3.1 The mobile phase is contained in two reservoirs, one containing the aqueous portion (Mobile Phase A) and one containing the organic(Mobile Phase B) portion.

7.3.2 Prepare Mobile Phase A by combining 950 mL of organic free water, 50 mL ACN, and 0.5 mL formic acid.

7.3.3 Prepare Mobile Phase B by combining 950 mL of ACN, 50 mL organic free water, and 0.5 mL formic acid.

7.4 Chromatographic conditions:

7.4.1 Flow rate: 0.40 mL/minute

7.4.2 Injection volume: 10 ul

7.4.3 Column Temperature: 45 ^{o}C

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7.4.4 Solvent Gradient:

Time	%A	%B
0.0	80	20
1.5	80	20
8.0	30	70
10	30	70

7.4.5 Re-equilibration time: 3 minutes, 80% A/20% B

7.5 Mass Spectrometer Conditions:

7.5.1 Ionization Mode: API-Electrospray

7.5.2 Drying Gas: N_2, 11.0 L/min, 250 ^oC

7.5.3 Nebulizer Pressure: 30 psig

7.5.4 Capillary Voltage: 1500 V

7.6 Mass Spectrometer Detector settings:

7.6.1 Settings for use in MS data acquisition (SIM ions and fragmentor voltages) vary by analyte and are displayed in Table 2 of the Appendix (12.2).

7.7 If the peak areas of the sample signals exceed the calibration range of the system, dilute the extract as necessary and reanalyze the diluted extract.

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7.8 Calibration:

7.8.1 Electrospray MS System: The MS system is calibrated for accurate mass assignment, sensitivity, and resolution using the Agilent ES Tuning Mix G2421A. The following masses are calibrated in positive and negative ionization modes:

MASS	POSITIVE	NEGATIVE
1	118.09	112.99
2	322.05	431.98
3	622.03	601.98
4	922.01	1033.99
5	1521.97	1633.95

Tune parameters are adjusted to ensure ions are present at each of the masses with counts >50000 and peak widths within the range of 0.60 – 0.70 amu.

7.8.2 Stock Standards: Individual analyte stock standards are made at concentrations between 500-1000 μg/ml by transferring 25-50 mg neat standard to a 50 mL class A volumetric flask, dissolving the neat standard in acetonitrile or methanol, and diluting to the mark with acetonitrile or methanol. Stock standards prepared from neat standards may be used for a maximum of two years. Alternatively, a solution containing 1000 μg/ml of analyte may be obtained from ChemService or other reputable manufacturer and used as a stock standard. In this case, the stock standard may be used until the expiration date provided by the manufacturer.

7.9.3 Working Standards: A 10 μg/ml working standard is made by transferring appropriate amounts, depending on initial concentrations, of stock standards to a 10 mL class A volumetric flask and diluting to the mark with methanol or acetonitrile. The

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amount of stock standard to transfer will range between 100-200 μL and is calculated using the formula:

$$\text{Amt. Stock Std.}(\mu L) = \frac{[\text{Final Conc. } (10\mu g/ml)] \times [\text{Final Vol. } (10ml)}{\text{Initial Stock Conc. } (\mu g/\mu L)}$$

The working standard solution is transferred to an appropriately labeled screw cap tube and may be used for a maximum of one year.

7.9.4 Preparation of external standard calibration curve: an appropriate aliquot of the working standards are added to an autosampler vial and diluted to 1 ml with Mobile Phase A. A minimum of 5 standards are prepared at the following suggested levels: 0.005 ug/ml, 0.010 ug/ml, 0.020 ug/ml, 0.05 ug/ml, and 0.10 ug/ml. The calibration range can be adjusted to meet expected levels in the samples. The calibration standards are prepared as follows:

Calibration level	Aliquot volume	Concentration of aliquot(s)	Volume of buffer	Final volume
100 ng/ml	100 μl	1000 ng/ml	900 μl	1.0 ml
50 ng/ml	50 μl	1000 ng/ml	950 μl	1.0 ml
20 ng/ml	200 μl	100 ng/ml	800 μl	1.0 ml
10 ng/ml	100 μl	100 ng/ml	900 μl	1.0 ml
5 ng/ml	50 μl	100 ng/ml	950 μl	1.0 ml

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7.9.5 The system is calibrated prior to the injection of a set of sample extracts. After injecting a set of standards, a linear calibration curve is prepared. Exclude the origin as a point. The R value of the generated curve should be 0.99 of better. If the calibration fails to meet these criteria, the cause of the deviation should be rectified and the system recalibrated.

7.9.6 The calibration is verified by injecting a CCV at the mid point concentration of the calibration curve after no more than twenty samples. If the response deviates by more than +/- 15% from the initial calibration, the system should be recalibrated and the samples bracketed by the either the initial calibration or the prior passing CCV and the failing CCV should be reanalyzed. If the CCV is >15% of initial calibration, the samples bracketed by the either the initial calibration or the prior passing CCV and the failing CCV can be used if the sample contains no detectable residues.

8.0 Calculations

8.1 Water Samples:

$$\frac{\text{amount f/curve (ng/ml)} \times \text{final volume (ml)} \times \text{dilution factor}}{\text{sample volume (ml)}} = \text{result (ug/liter, ppb)}$$

9.0 Quality Control

9.1 Initial Demonstration of Proficiency – the laboratory shall demonstrate initial proficiency with each sample preparation technique, by generating data of acceptable accuracy and precision for target analytes in a clean matrix. The laboratory must also repeat the demonstration whenever new staff is trained or significant changes in instrumentation are made.

9.1.1 Calculate the average recovery and the standard deviation of the recoveries of the four QC reference samples. Refer to Section 8.0 of EPA Method 8000 for procedures in evaluating method performance.

9.2 Method Reporting Limits (MDLs)

9.2.1 The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.

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9.2.2 The extraction and analysis of seven replicates of a spiked sample determine the MDL.

9.2.3 Multiply the standard deviation of the seven replicate results by the one sided 99%t-statistic (3.14) to obtain the MDL for each analyte.

9.2.4 These results are kept on file and should be re-evaluated annually, when significant changes in instrumentation are made, or when new staff are added.

9.3 Sample Quality Control for Preparation and Analysis

9.3.1 The laboratory will have procedures for documenting the effect of matrix on method performance.

9.3.2 Water matrix – minimum QC samples shall include a method blank (MB), Laboratory Control Sample (LCS), and a Laboratory Control Sample Duplicate (LCSD). A matrix spike may be prepared and analyzed provided there is adequate sample.

9.4 QC Frequency – an analytical batch is defined as a set of no more than 20 samples extracted within 14 days. The QC frequency for each analytical batch is as follows:

Method blank – 5%

Matrix Spike/Matrix Spike Duplicate – 5%

Laboratory Control Sample/Laboratory Control Sample Duplicate – 5%

9.4.1 In house method performance criteria for spike and surrogate compounds should be developed using guidance found in Section 8.0 of EPA Method 8000.

9.4.2 If the recovery data is outside acceptance limits, the samples should be re-extracted and/or the data flagged as necessary.

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10.0 Reporting

10.1 If all QC criteria have been met, the data is then compiled and a report is generated, including sample raw analytical results and QC data, and submitted to the client.

11.0 References

11.1 EPA Method 8321B, SW-846 Revision 2, December 2007.

11.2 Pacific Agricultural Laboratory Quality System Manual.

11.3 EPA Method 8000B, SW-846 Revision 2, December 1996.

11.4 SW-846, Chapter One, Revision 1, 1992.

12 Figures and Appendices

12.1 Table 1 - Analyte list and reporting limits

12.2 Table 2 – Mass Spectrometer Data Acquisition Settings

Approved: ________________________________

Date: ________________________________

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TABLE 1	
ANALYTE LIST AND LIMIT OF QUANTITATION (LOQ)	
Analyte	**LOQ, ug/L**
Imazamox	0.02
Imazapic	0.02
Imazapyr	0.02
Imazethapyr	0.02

TABLE 2 – MASS SPECTROMETER DATA ACQUISITION SETTINGS

Time	SIM Ions	Fragmentor Voltage	Capillary Voltage
0.00	220,222,234, 248,262,277, 278,290,293, 306,307	200	2000 V

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TABLE 3 – SIM IONS FOR IDENTIFICATION/QUANTIFICATION

Analyte	Quantification Ion	Qualifier Ions	Ionization Mode	Fragmentor Voltage
Imazamox	306	307,278	positive	200
Imazapic	293	277,220	positive	200
Imazapyr	262	234,222	positive	200
Imazethapyr	290	262,248	positive	200

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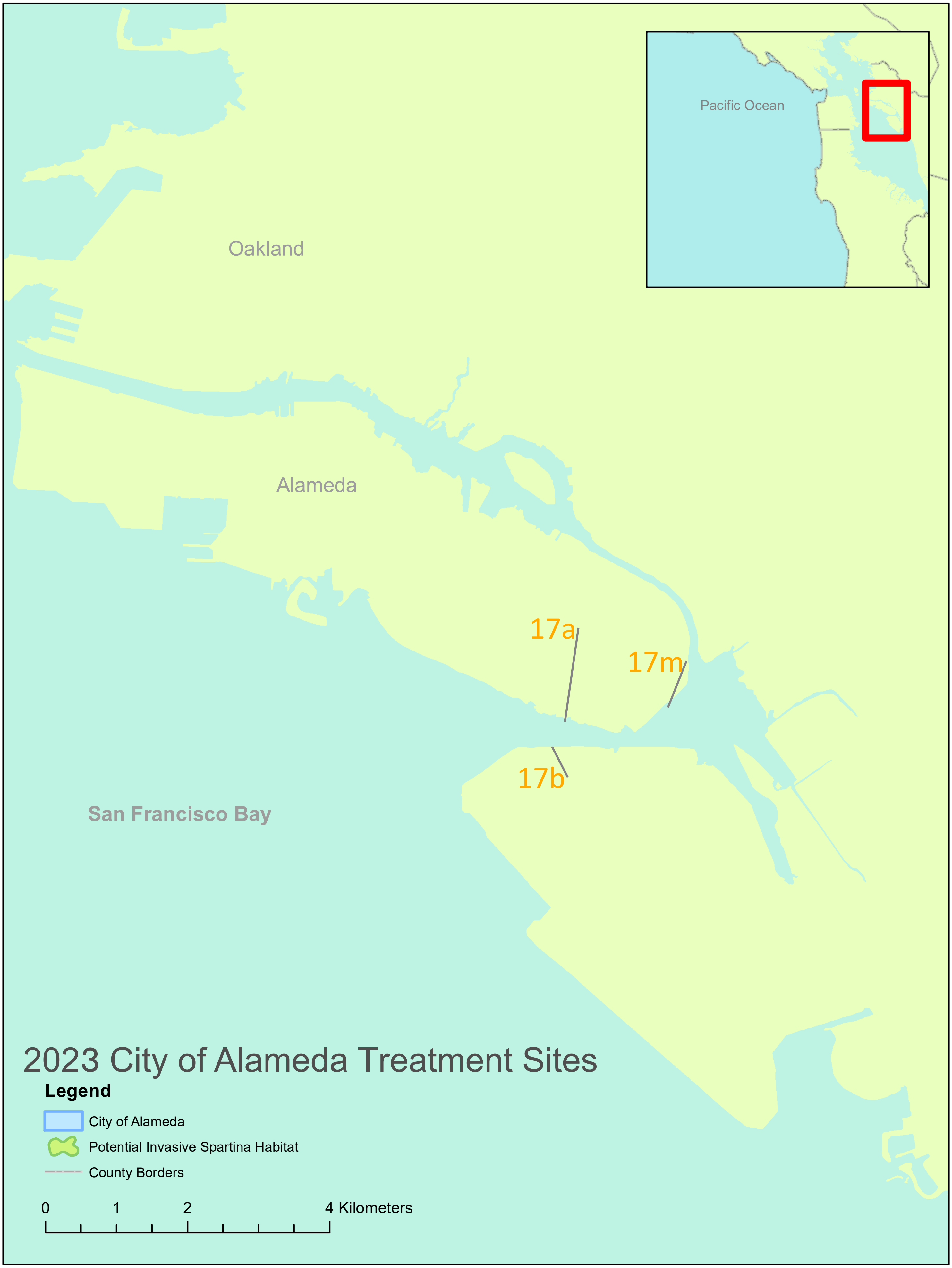
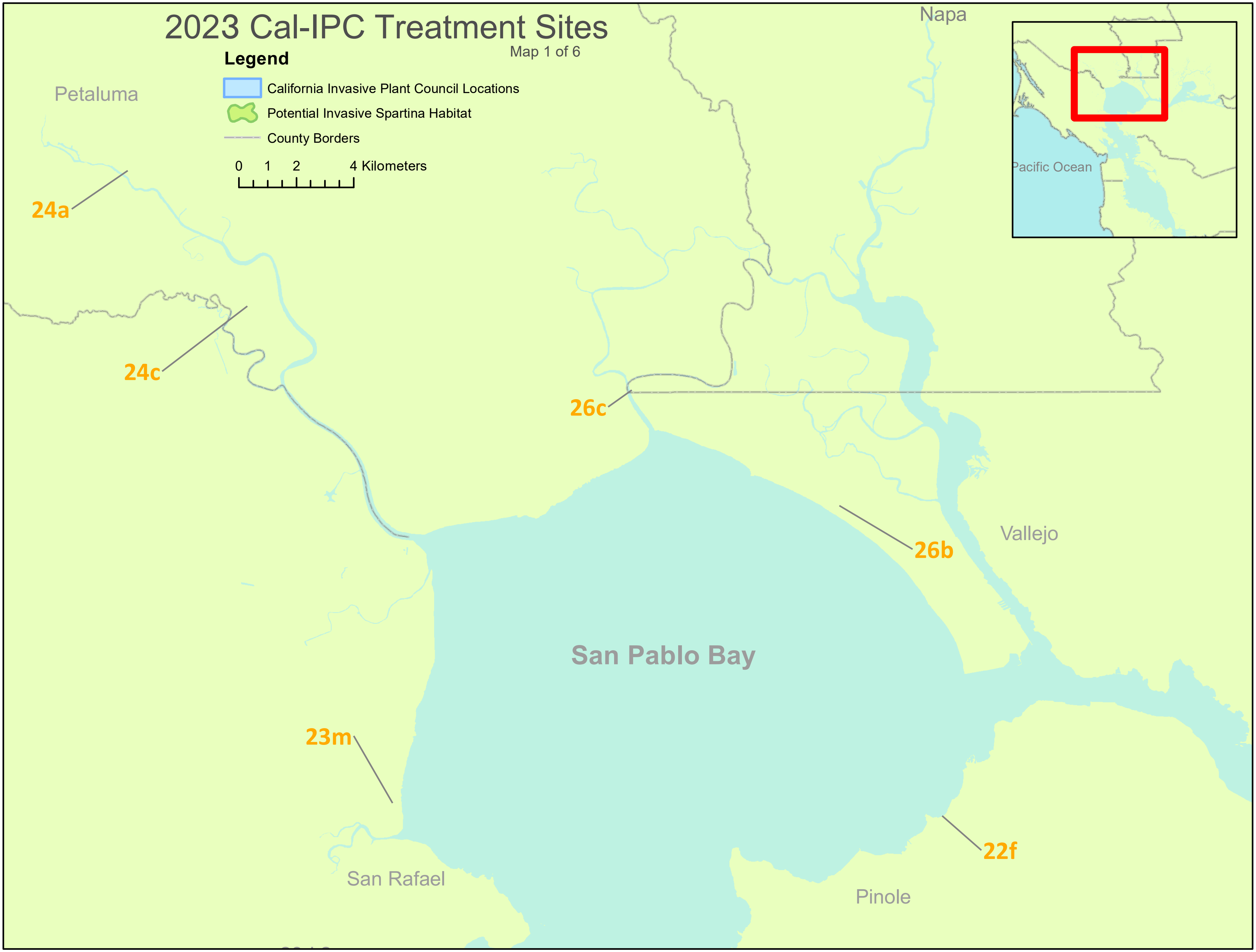
Appendix VII

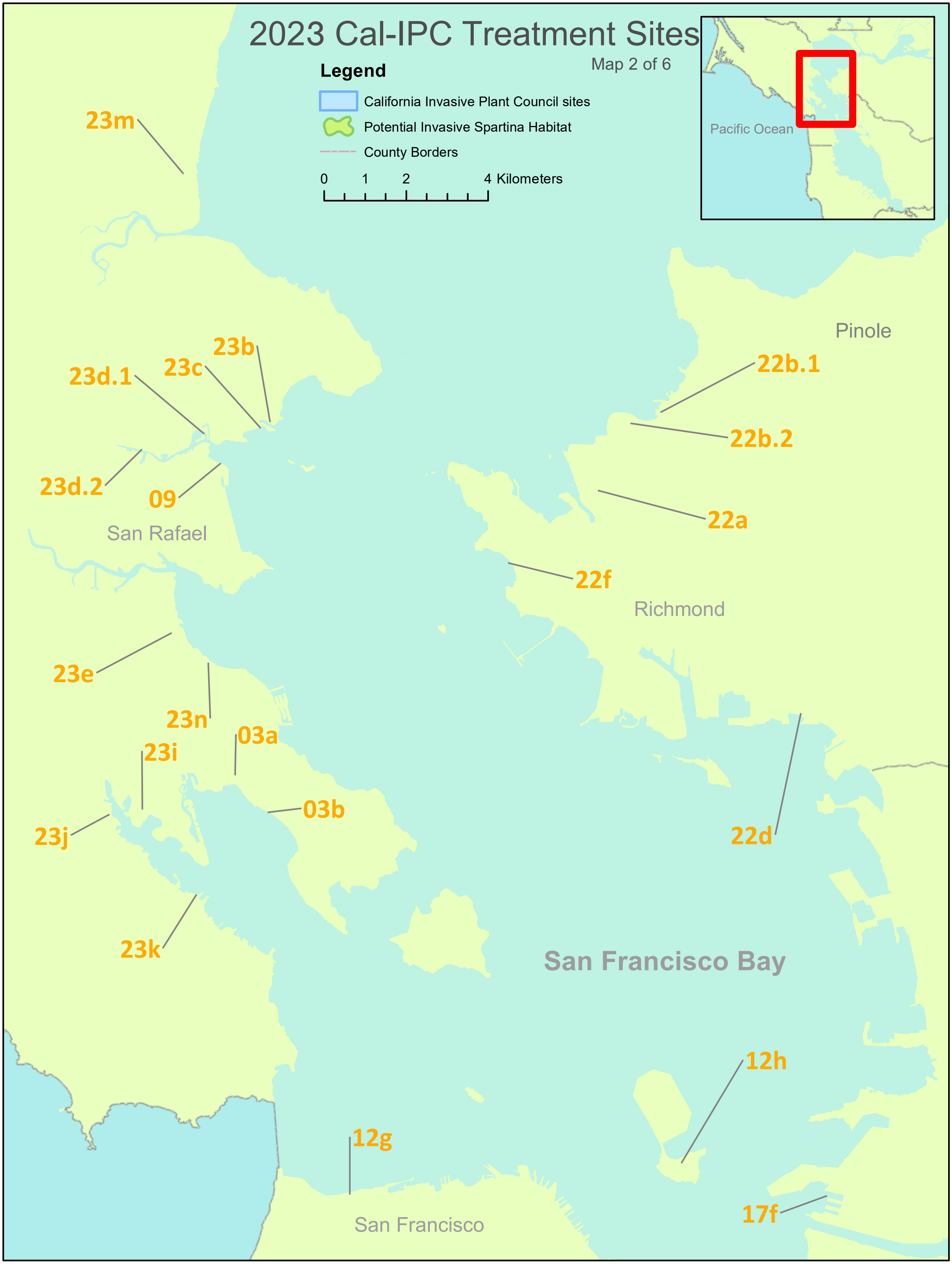
Spartina Treatment Site Locations by ISP Coalition Partner

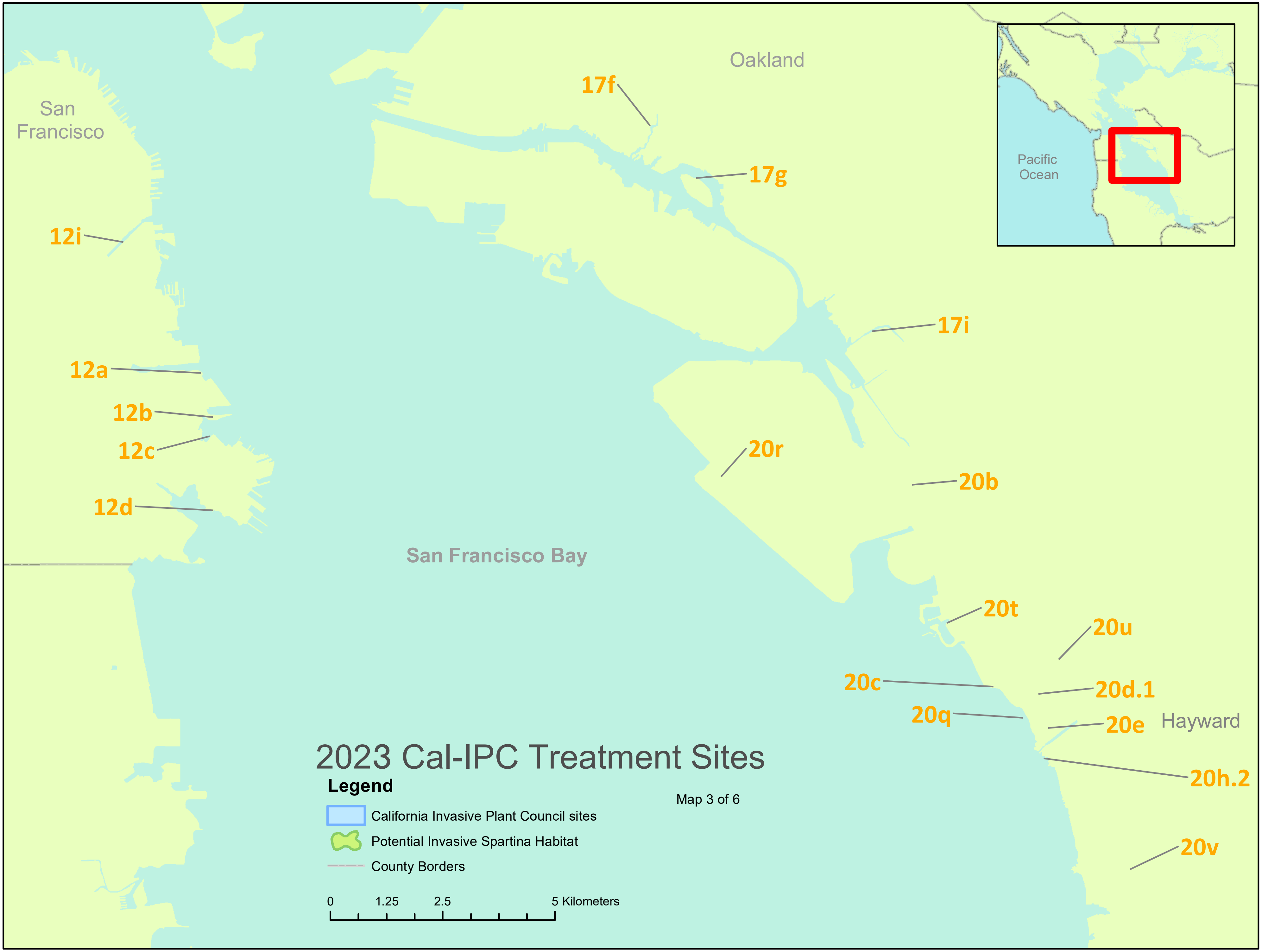
Invasive *Spartina* Project 2023 Water Quality Monitoring Report


Pacific Ocean
Oakland
Alameda
17a
17m
17b
San Francisco Bay
2023 City of Alameda Treatment Sites
Legend
City of Alameda
Potential Invasive Spartina Habitat
County Borders
0
1
2
4 Kilometers

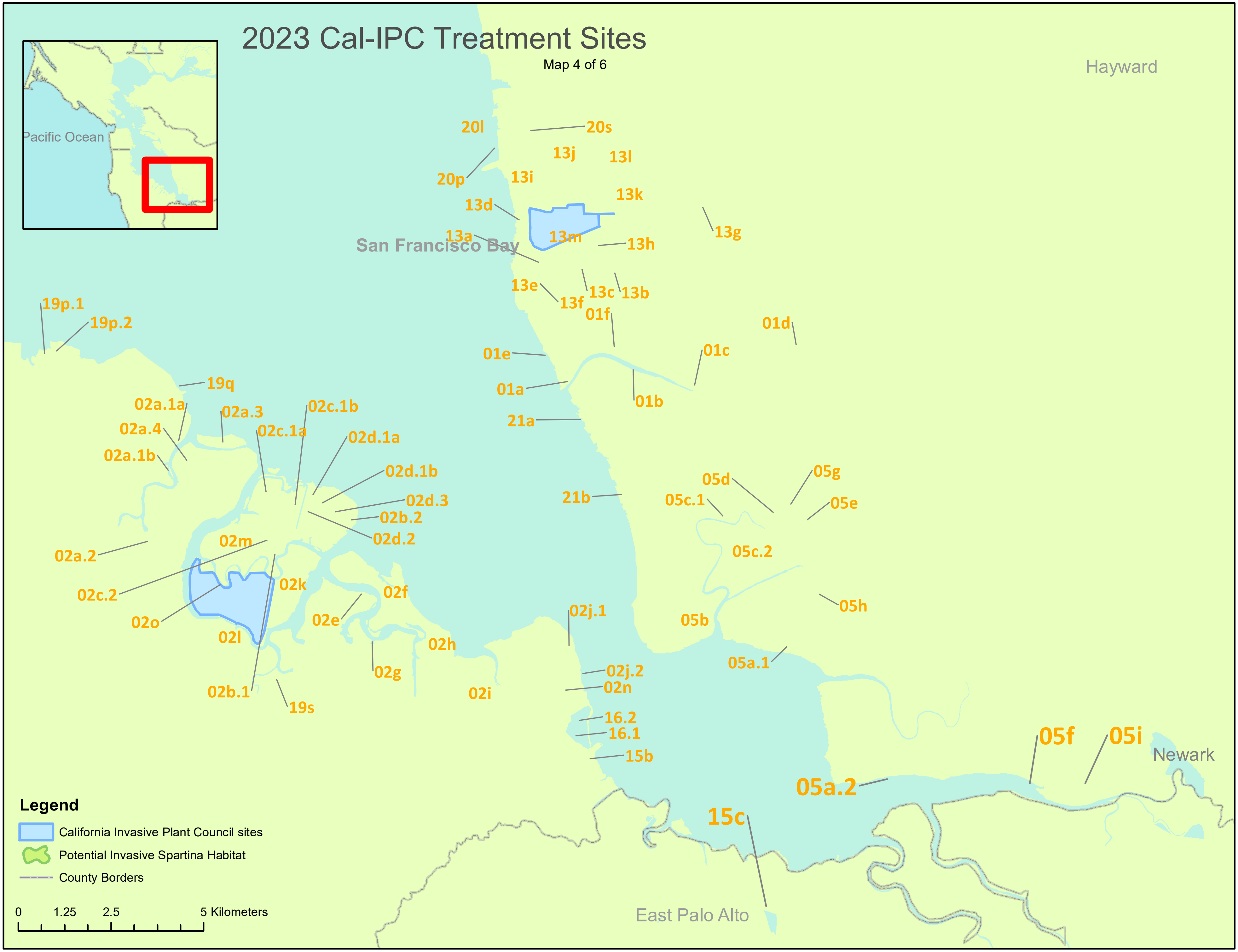

2023 California State Parks
Treatment Sites
Legend
CA State Parks
Potential Invasive Spartina Habitat
County Borders
0 1 2 4 Kilometers
San Pablo Bay
Vallejo
11
23o
San Rafael
Richmond
22f
06a
Oakland
San Francisco
12e
12f
San Francisco Bay

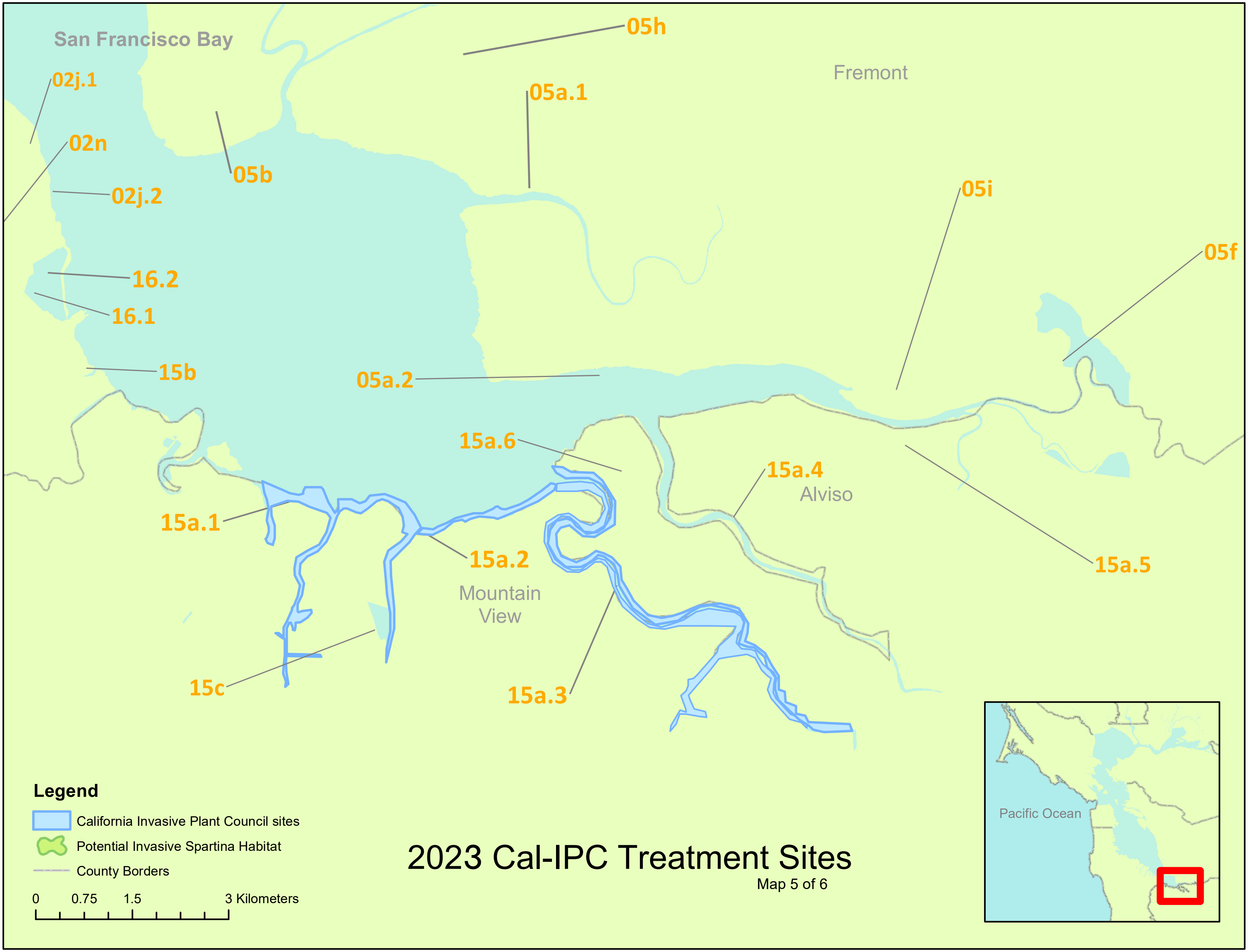

2023 Cal-IPC Treatment Sites
Map 1 of 6
Legend
California Invasive Plant Council Locations
Potential Invasive Spartina Habitat
County Borders
0 1 2 4 Kilometers
Petaluma
Napa
Pacific Ocean
24a
24c
26c
26b
Vallejo
San Pablo Bay
23m
22f
San Rafael
Pinole

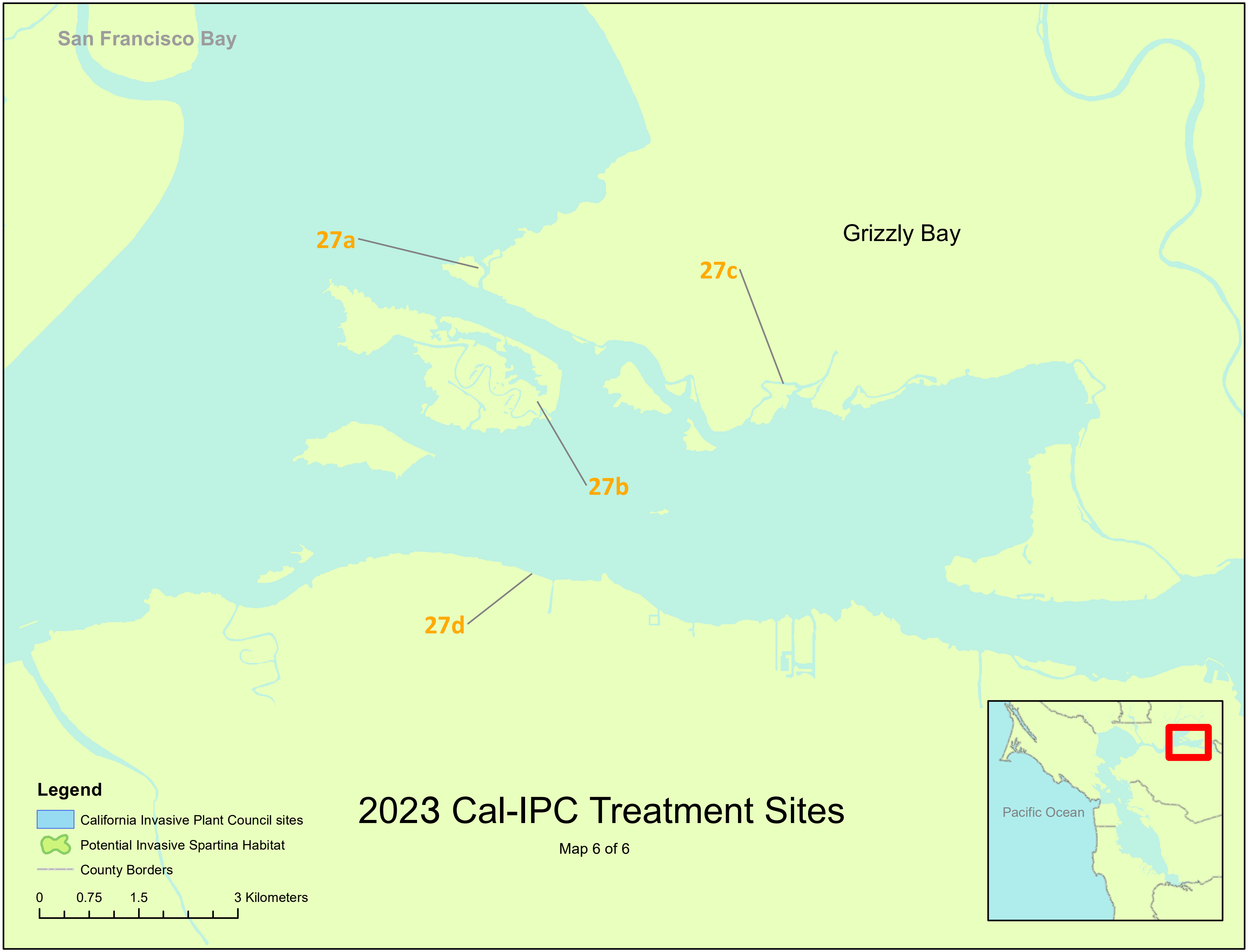

2023 Cal-IPC Treatment Sites
Map 2 of 6
Legend
California Invasive Plant Council sites
Potential Invasive Spartina Habitat
County Borders
0 1 2 4 Kilometers
Pacific Ocean
23m
23b
23c
23d.1
23d.2
09
San Rafael
Pinole
22b.1
22b.2
22a
22f
Richmond
23e
23n
03a
23i
03b
23j
22d
23k
San Francisco Bay
12h
12g
17f
San Francisco

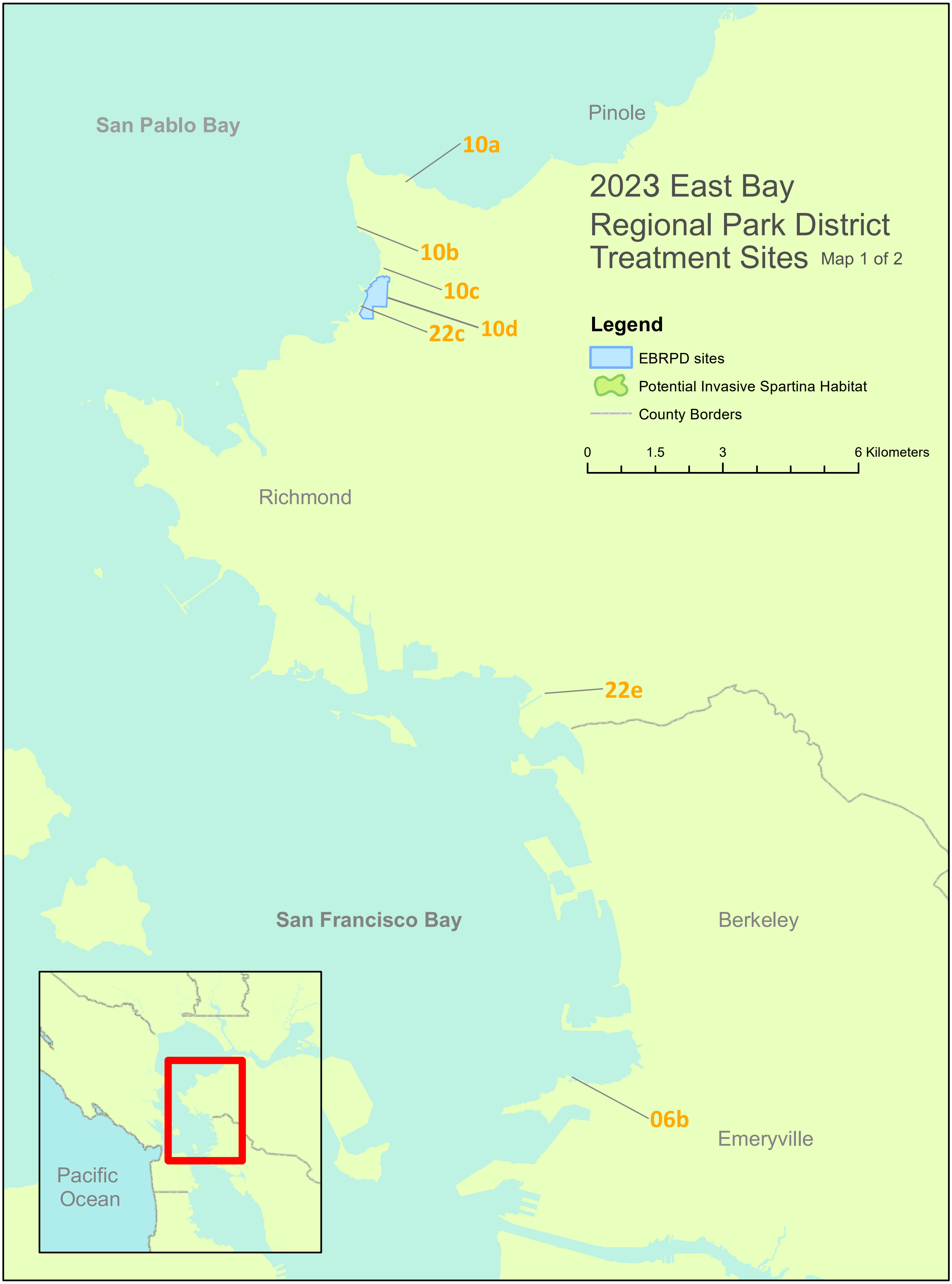


2023 Cal-IPC Treatment Sites
Legend
California Invasive Plant Council sites
Potential Invasive Spartina Habitat
County Borders
Map 3 of 6
0
1.25
2.5
5 Kilometers
San Francisco
Oakland
San Francisco Bay
Hayward
Pacific Ocean
17f
17g
17i
12i
12a
12b
12c
12d
20r
20b
20t
20u
20c
20d.1
20q
20e
20h.2
20v

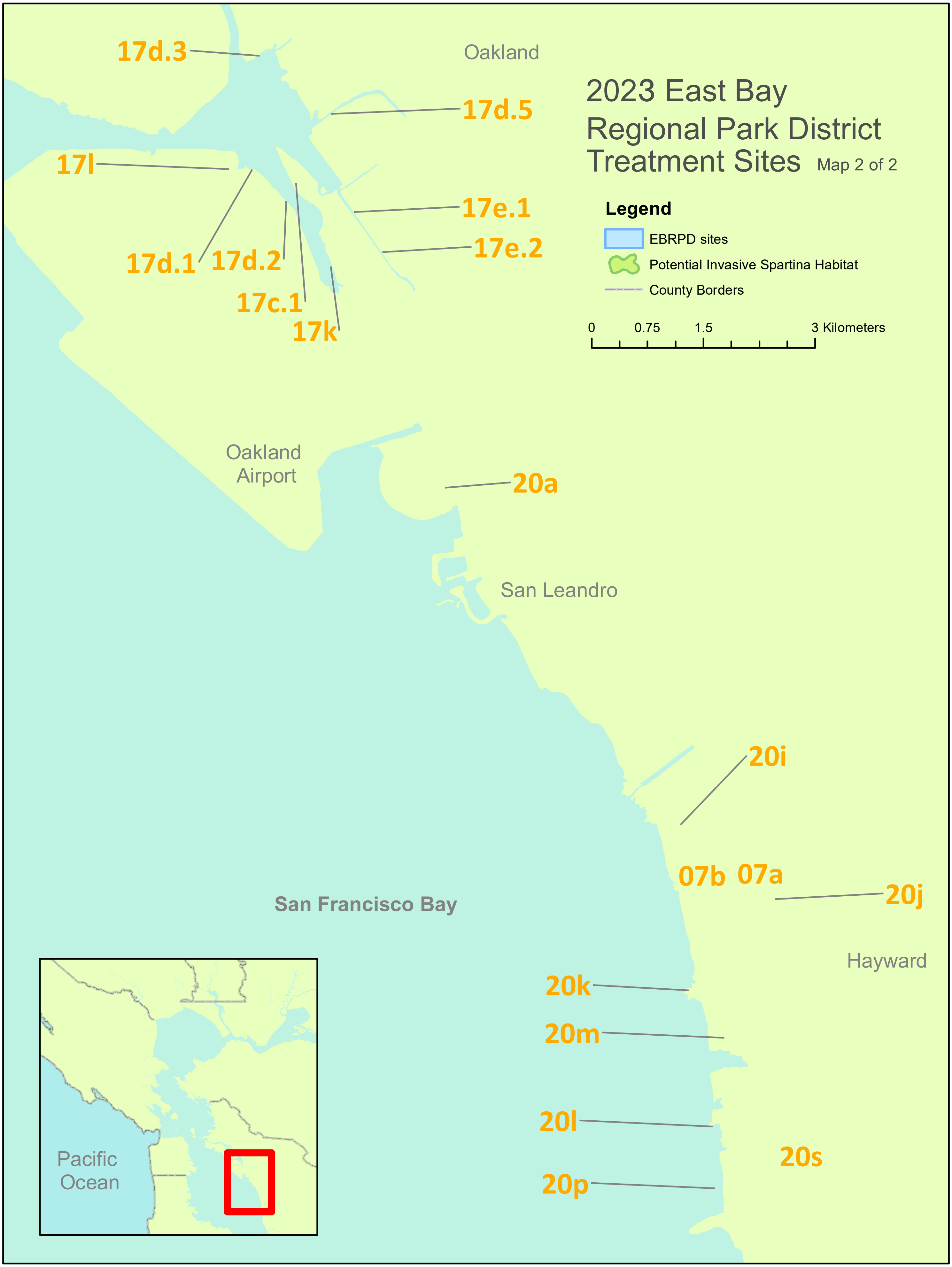

2023 Cal-IPC Treatment Sites
Map 4 of 6
Hayward
Pacific Ocean
San Francisco Bay
East Palo Alto
Newark
20l
20s
13j
13l
20p
13i
13k
13d
13g
13a
13m
13h
13e
13f
13c
13b
01f
01d
19p.1
19p.2
01e
01c
01a
01b
19q
02a.1a
02a.3
02c.1b
21a
02a.4
02c.1a
02d.1a
02a.1b
02d.1b
05d
05g
21b
05c.1
05e
02d.3
02b.2
02d.2
02m
05c.2
02a.2
02k
02f
02c.2
02j.1
05h
02o
02e
05b
02l
02h
05a.1
02g
02j.2
02n
02b.1
02i
19s
16.2
16.1
05f
05i
15b
05a.2
15c
Legend
California Invasive Plant Council sites
Potential Invasive Spartina Habitat
County Borders
0
1.25
2.5
5 Kilometers

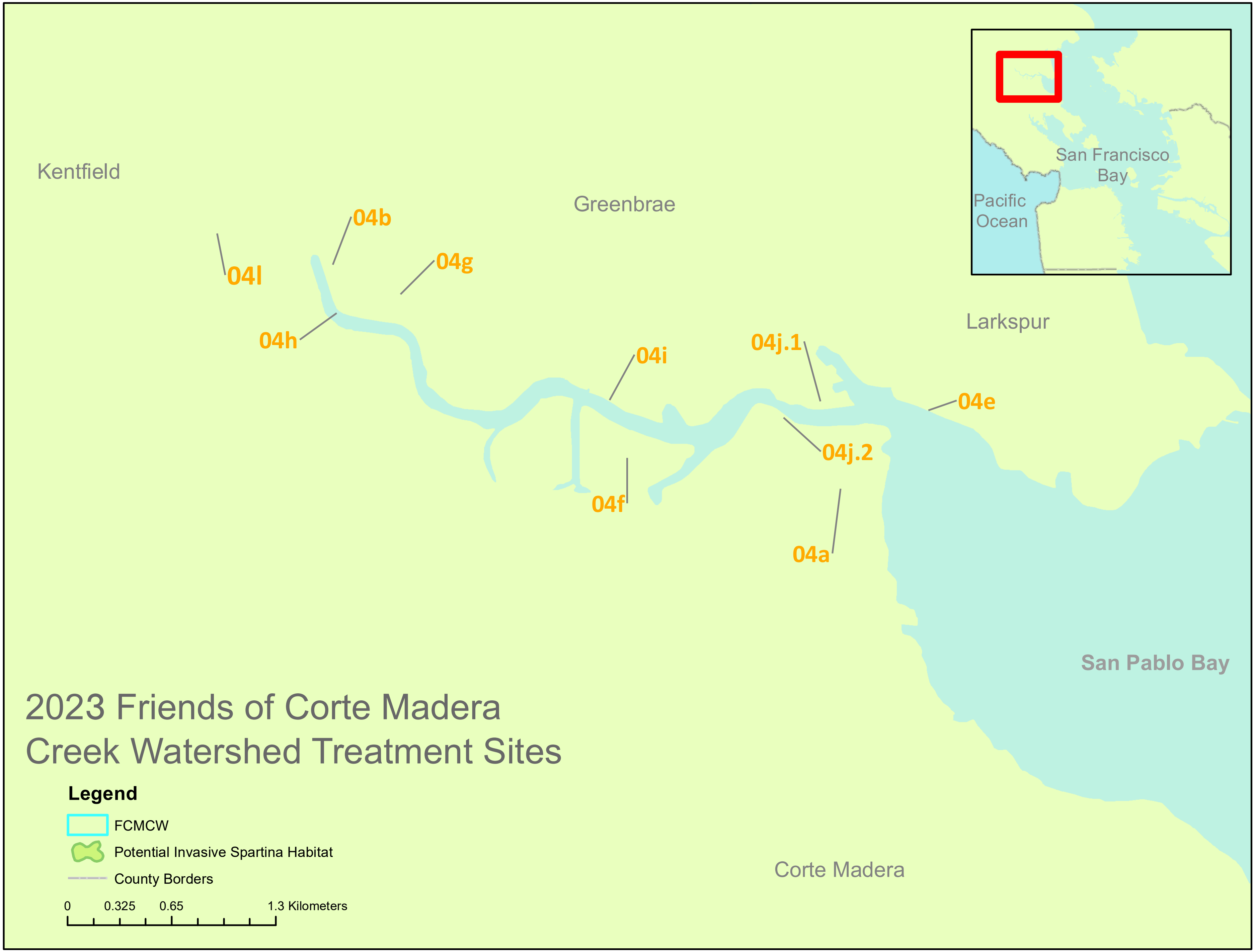

San Francisco Bay
Fremont
Alviso
Mountain View
Pacific Ocean
05h
02j.1
05a.1
02n
05b
02j.2
05i
05f
16.2
16.1
15b
05a.2
15a.6
15a.4
15a.1
15a.2
15a.5
15c
15a.3
Legend
California Invasive Plant Council sites
Potential Invasive Spartina Habitat
County Borders
0
0.75
1.5
3 Kilometers
2023 Cal-IPC Treatment Sites
Map 5 of 6


San Francisco Bay
Grizzly Bay
27a
27b
27c
27d
Legend
California Invasive Plant Council sites
Potential Invasive Spartina Habitat
County Borders
0 0.75 1.5 3 Kilometers
2023 Cal-IPC Treatment Sites
Map 6 of 6
Pacific Ocean



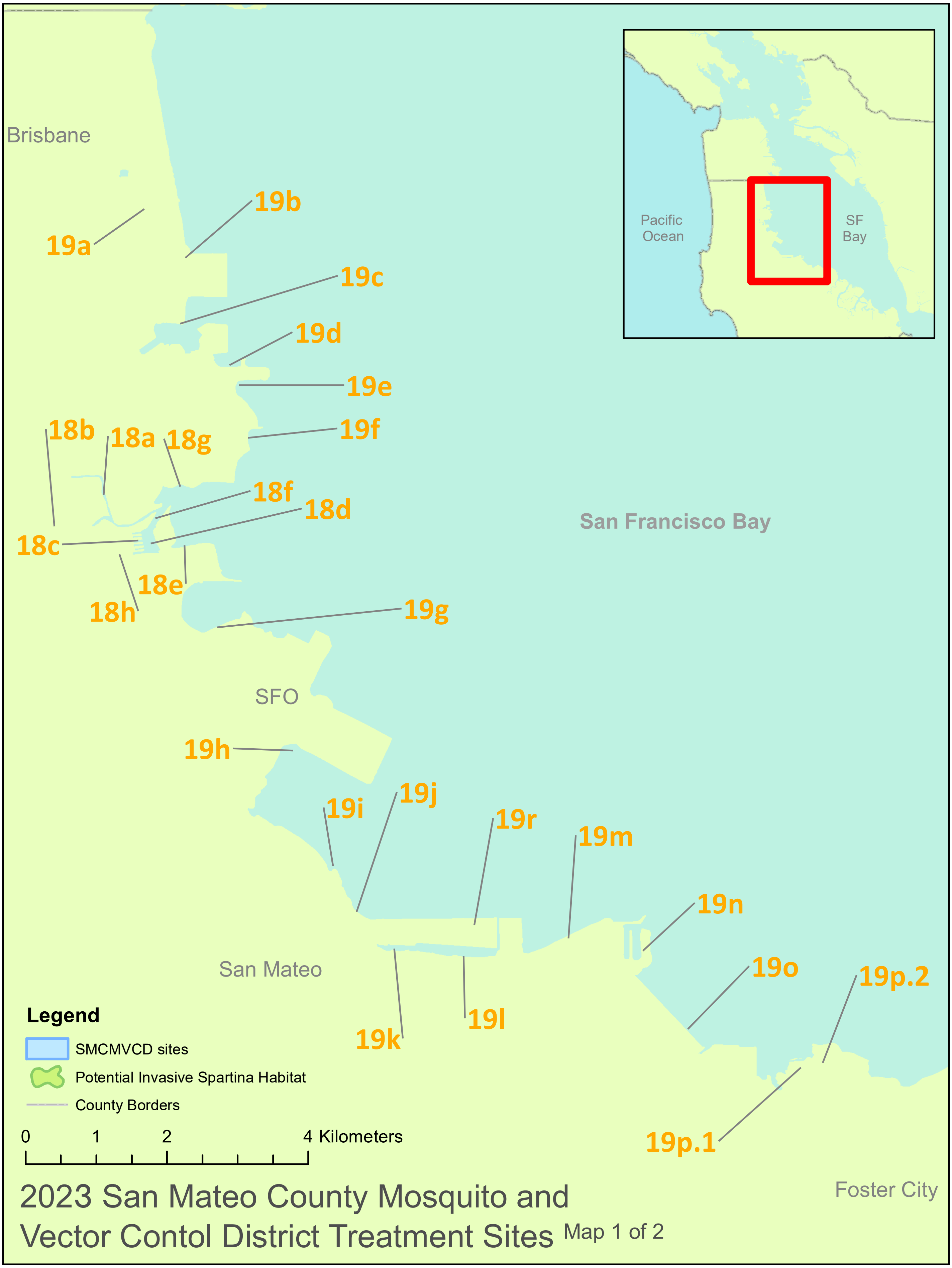
2023 East Bay
Regional Park District
Treatment Sites
Map 1 of 2
Legend
EBRPD sites
Potential Invasive Spartina Habitat
County Borders
0
1.5
3
6 Kilometers
San Pablo Bay
Pinole
10a
10b
10c
10d
22c
Richmond
22e
San Francisco Bay
Berkeley
06b
Emeryville
Pacific
Ocean


2023 East Bay
Regional Park District
Treatment Sites
Map 2 of 2
Legend
EBRPD sites
Potential Invasive Spartina Habitat
County Borders
0
0.75
1.5
3 Kilometers
Oakland
17d.3
17d.5
17l
17e.1
17e.2
17d.1
17d.2
17c.1
17k
Oakland Airport
20a
San Leandro
20i
07b
07a
20j
San Francisco Bay
Hayward
20k
20m
20l
20s
20p
Pacific Ocean

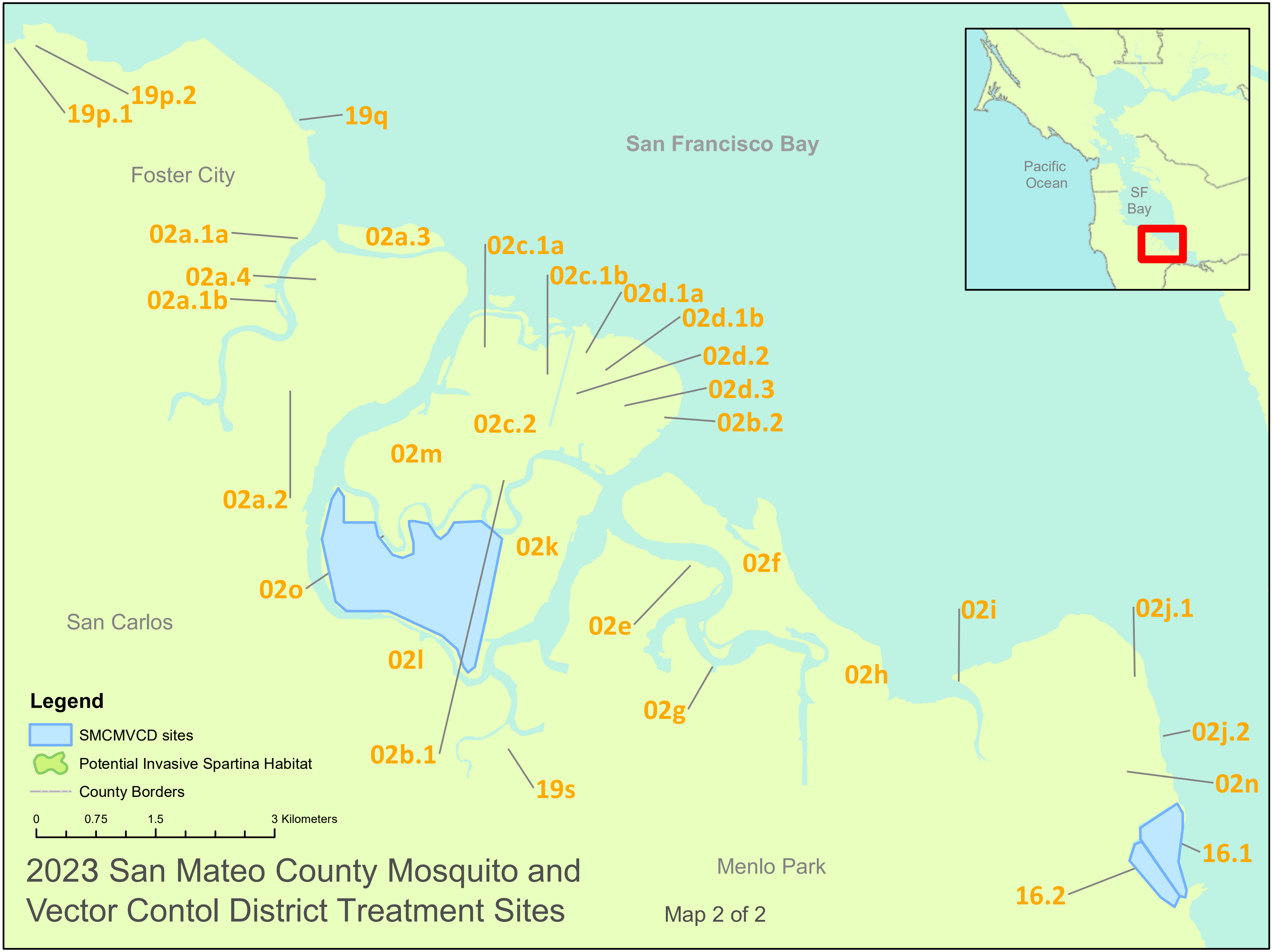


Kentfield
Greenbrae
Larkspur
04b
04l
04g
04h
04i
04j.1
04e
04j.2
04f
04a
San Francisco Bay
Pacific Ocean
San Pablo Bay
Corte Madera
2023 Friends of Corte Madera Creek Watershed Treatment Sites
Legend
FCMCW
Potential Invasive Spartina Habitat
County Borders
0
0.325
0.65
1.3 Kilometers


Newark
Don Edwards
San Francisco Bay
National Wildlife
Refuge
San Francisco Bay
08
Palo Alto
Mountain
View
Pacific Ocean
2023 City of Palo Alto Treatment Site
Legend
City of Palo Alto
Potential Invasive Spartina Habitat
County Borders
0
0.5
1
2 Kilometers



2023 San Mateo County Mosquito and Vector Contol District Treatment Sites Map 1 of 2



2023 San Mateo County Mosquito and Vector Contol District Treatment Sites

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