San Francisco Estuary

Invasive *Spartina* Project

Water Quality Monitoring Report for 2019

Prepared by

Drew Kerr

Under contract to

Olofson Environmental, Inc.
1830 Embarcadero Cove, Suite 100
Oakland, CA 94606
www.spartina.org

for the

State Coastal Conservancy
San Francisco Estuary Invasive *Spartina* Project
1330 Broadway, 13th Floor
Oakland, CA 94612

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1. Executive Summary

The California State Coastal Conservancy's San Francisco Estuary Invasive *Spartina* Project (ISP) implemented their 2019 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 following document reports on the water quality monitoring results from 2019 and compares them to the overall trends from ISP water quality monitoring since 2005.

Over the past 16 years 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 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. Pursuant to the Monitoring and Reporting Program outlined in the General NPDES Permit, the ISP Coalition was required to monitor one application site in 2019, since the results from monitoring six sites 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 2019 treatment event was 1.2 ppb, more than 11,000 ppb below this Monitoring Trigger.

The successful *Spartina* control achieved since 2005 has reduced the Estuary-wide infestation by 95% from 805 net acres to 38 net acres. The majority of the non-native *Spartina* infestations are so reduced that spot treatment by backpack sprayer is 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 achieving successful reductions with imazapyr. Fifty-two ISP sites were at the zero-detection level in 2019, an increase of 6% over 2018, showing continued progress towards the goal of eradication and the seventh consecutive year of an increase in the number of sites with no invasive *Spartina* detected.

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. Normally the one-week post-treatment sample shows a substantial reduction from the treatment event, with the four-year mean reduction from 2007-2010 at all monitored ISP sites being 95.8%. However, in 2019 the treatment event sample only captured 1.2 ppb of imazapyr, likely indicating that the full herbicide concentration in the receiving water had not circulated to the specific sampling point. The one-week post-treatment sample detected 2.7 ppb, a slight increase over the very low concentration from the treatment event, but 71% less than the 9.3 ppb detected in 2018 at the same San Pablo Marsh sampling location one week after treatment.

With the rapid degradation of this herbicide in the tidal environment, as measured by the concentration in the water at the site one week after treatment, it is anticipated that any measurable concentrations at that time 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 support 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 alter these parameters in this open 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 aggressively spread (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, 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 38 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 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 found 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 has reduced the remaining marsh acreage by 79%. 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 in salt ponds acquired 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 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 dense monocultures covering 50-100 contiguous acres of marshland and mudflat that existed at the peak of the infestation at some individual sites. The ISP has developed individual Site-Specific Plans for each of their 217 sub-areas, incorporating Integrated Pest Management (IPM) strategies that evaluate the biology of the target invader and all 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. Therefore, ISP partners in 2019 included the following:

1. California Department of Parks and Recreation (WDID#s 2 49AP00029)
2. California Invasive Plant Council (WDID# 2 01AP00040) assuming responsibility for sites previously under California Wildlife Foundation (WDID# 2 APAP00050)
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 used the aquatic formulation of imazapyr (sold under the trade names Habitat® or Polaris™) for invasive *Spartina* treatment in 2019. 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) needed for the biosynthesis of three amino acids (the branched-chain aliphatic). Animals do not produce these essential amino acids themselves but rather acquire them by consuming plants, which is one reason for imazapyr's low toxicity to animals because there is no relevant pathway of activity. 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 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 much larger 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 primarily used Liberate® (Loveland Industries) during the 2019 treatment season, 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 do not use these nonylphenol products (such as R-11® and ProSpreader®) for invasive *Spartina* control, although they are commonly used by other vegetation managers and are known to perform well by improving herbicide efficacy.

2.4 NPDES Compliance

Application of herbicides in and around 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® or Polaris®) and glyphosate (e.g. Roundup Custom®, Aquamaster® or 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. In addition, since ISP partners do not use surfactants containing nonylphenol ethoxylate (e.g. R-11® or 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 only had to monitor a single site in 2015 (and future years including 2019) 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, 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 have any water quality issues related to the application. In addition, effective treatment by ISP partners has 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. Site Type I has been considered the most likely to develop detectible levels of herbicide in the water column, so the sampling program was normally weighted slightly in this direction. The 2019 WQMP was implemented on a Type I site.

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 portable YSI Model 85 (Yellow Springs Instruments Inc., Ohio, USA), while pH was measured with an Oakton waterproof pHTestr1 (Oakton Instruments, Illinois, USA). To assure accurate and reliable temperature, electrical conductivity, salinity, and dissolved oxygen measurements, the YSI Model 85 meter was calibrated, operated, and maintained in accordance with the manual specifications found at http://www.ysi.com/media/pdfs/038503-YSI-Model-85-Operations-Manual-RevE.pdf. To assure accurate and reliable pH measurement, the pHTester1 meter was calibrated, operated, and maintained in accordance with the manual http://www.4oakton.com/Manuals/pHORPIon/WPpHTestr1_2mnl.pdf.

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 utilized the Pacific Agricultural Laboratory in Portland, OR for 2018 after they satisfactorily fulfilled their contract requirements for eight seasons 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 cooler on ice until they could be transferred to 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. 2019 *Spartina* Treatment and Water Quality Monitoring

4.1 Summary of 2019 Herbicide Applications

ISP partners utilized herbicide at 152 sites during the 2019 Treatment Season, with one site monitored for imazapyr in the adjacent receiving water pursuant to the new General NPDES Permit requirements. **Table 2** provides the site monitored, treatment date, and application method for 2019, while **Appendix V** provides the full list of treatment sites around the Estuary, the coordinates of the sites' 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 2019 Treatment Season

Site	*Site Number*	*Marsh Type*	*Treatment Date*	*Application*
San Pablo Marsh	22b.2	I (tidal marsh)	9/18/2019	Imazapyr – Airboat & Backpack

Low-pressure backpack sprayer applications were the predominant herbicide delivery system across San Pablo Marsh in 2019, with some larger stands out on the soft mudflats treated by airboat. The reliance on this spot treatment method reflects the significant progress ISP 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 2019. No water samples were broken in shipment to PAL in 2019 and none were misplaced by FedEx.

Table 3. Herbicide Concentrations in Adjacent Surface Water for 2019 *Spartina* Treatment (ND = not detected at 0.02 ppb LOQ)

Site	*Herbicide Concentration (ppb = µg/L)*			*Application*
	Pre-Treatment	*Treatment*	*One-Week Post*	
San Pablo Marsh	ND	1.2	2.7	Imazapyr – Airboat & Backpack

Table 3 shows the imazapyr levels at the one site monitored for this herbicide in 2019, San Pablo Marsh. The lab reported that no imazapyr 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. However, this was not the case in 2019 as imazapyr was not detected in the pre-treatment sample.

Treatment event monitoring reported an imazapyr concentration of 1.2 ppb as the tide waters returned to the infestation site. The one-week post-treatment sample from San Pablo Marsh reported an imazapyr concentration of 2.7 ppb in the Estuary water. The analytical reports from the lab are provided in **Appendix IV**.

Figure 1. Sheltered pocket marsh & cove at the San Pablo Marsh water quality sampling location after imazapyr treatment to hybrid *Spartina alterniflora* September 18, 2019.

4.3 Conventional Water Quality Parameters at Treatment Sites

Table 4 lists the data on the conventional parameters (water temperature, dissolved oxygen, pH, conductivity, salinity, and turbidity) collected at San Pablo Marsh in 2019.

Table 4. Conventional Water Quality Parameters Measured at 2019 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
San Pablo Marsh	23.2	21.8	27.9	2.4	2.8	1.7	7.0	6.9	7.1	31.9	32.7	36.3	20.6	22.0	21.5	20.2	27.1	20.4

The mean water temperature over all three sampling events was 24.3°C. Dissolved oxygen (DO) averaged 2.3 mg/L and varied across all sampling events as normal. The pH of the Estuary water averaged 7.0 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 31.9 mS/cm to a maximum of 36.3 mS/cm. Salinity averaged 21.4 ppt and was similar across all three events. Finally, turbidity averaged 22.6 NTU over all sampling events, ranging from a minimum of 20.2 NTU to a maximum of 27.1 NTU.

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 680,389 mg 'acid equivalent' per acre (e.g., a tank mix of 2,998 mg/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 3,600 mg/L.

The ISP imazapyr sample from the receiving waters from the 2019 treatment event was 1.2 ppb collected shortly after treatment, equivalent to 0.0012 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 more than seven orders of magnitude greater than the ISP's treatment sample from the 2019 treatment season, far below any level of concern. These LC_{50} values 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 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 often 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 2019 measured treatment concentration of 0.0012 mg/L, representing five orders of magnitude difference. In addition, with this relatively low observed environmental concentration, salt marsh birds and mammals are also 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 documented rapid excretion of imazapyr compensating for any 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 2019 measured post-treatment concentration of 0.0012 mg/L shows approximately five 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 2019 *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 95% from 805 net acres to 38 net acres by 2019. Much less herbicide is now necessary to complete the annual treatment, 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 2019, the majority of ISP sites are treated simply by backpack 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-two ISP sites were at the zero-detection level in 2018, an increase of 6% over 2018, showing continued progress towards the goal of eradication and the seventh consecutive year of an increase in the number of sites with no invasive *Spartina* detected.

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. In addition, the new 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 2019 was 1.2 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. Normally the one-week post-treatment sample shows a substantial reduction from the treatment event, with the four-year mean reduction from 2007-2010 at all monitored ISP sites being 95.8%. However, in 2019 the treatment event sample only captured 1.2 ppb of imazapyr, likely indicating that the full herbicide concentration in the receiving water had not circulated to the specific sampling point. The one-week post-treatment sample detected 2.7 ppb, a slight increase over the very low concentration from the treatment event, but 71% less than the 9.3 ppb detected in 2018 at the same San Pablo Marsh sampling location one week after treatment.

7. References

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Appendix I

ISP Coalition Certifications for
2019 Water Quality Monitoring Report

Invasive *Spartina* Project
2019 Water Quality Monitoring Report

CERTIFICATION
for 2019 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:

Liam Garland
Public Works Director
City of Alameda

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

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

CERTIFICATION
for 2019 ISP Water Quality Monitoring Report
California Invasive Species Council

In accordance with Attachment B, Section V.B.I. 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:

Doug Johnson

Doug Johnson
Executive Director
California Invasive Species 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

CERTIFICATION
for 2019 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:

Cyndy Shafer

Cyndy Shafer
Bay Area District Natural Resource Program Manager
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 2019 ISP Water Quality Monitoring Report
East Bay Regional Parks District

In accordance with Attachment B, Section V.B.I. 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:

Matt 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 2019 ISP Water Quality Monitoring Report
Friends of Corte Madera Creek Watershed

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:

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

CERTIFICATION
for 2019 ISP Water Quality Monitoring Report
City of Palo Alto

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:

Lisa Myers
Supervising Ranger

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

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

CERTIFICATION
for 2019 ISP Water Quality Monitoring Report
San Mateo County Mosquito & Vector Control 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:

Chindi Peavey

Chindi Peavey
District Manager
San Mateo County Mosquito & Vector Control District

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

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

Appendix II

2019 ISP Field Data Collection Form

Invasive *Spartina* Project
2019 Water Quality Monitoring Report

Page ___ of ___ on this date

NPDES Field Data Collection Form

San Francisco Estuary Invasive *Spartina* Project, Aquatic Pesticide Application Plan, 1830 Embarcadero Cove, Suite 100-C, Oakland, CA 94606

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

2019 Aquatic Herbicide Application Log

Invasive *Spartina* Project
2019 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
Analytical Reports

Invasive *Spartina* Project
2019 Water Quality Monitoring Report

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

Report Number: P192822
Report Date: October 03, 2019
Client Project ID: [none]

Analytical Report

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

PAL Sample ID: P192822-01
Sample Date: 9/17/19
Received Date: 9/19/19

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8321B (LC-MS/MS)					
9/24/19	10/1/19	Imazapyr	ND	0.020 ug/L	

Client Sample ID: SAPA-02-2.0h
Matrix: water

PAL Sample ID: P192822-02
Sample Date: 9/18/19
Received Date: 9/19/19

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8321B (LC-MS/MS)					
9/24/19	10/1/19	Imazapyr	1.2 ug/L	1.0 ug/L	

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

PAL Sample ID: P192822-03
Sample Date: 9/18/19
Received Date: 9/19/19

Extraction Date	Analysis Date	Analyte	Amount Detected	Limit of Quantitation	Notes
Method: Modified EPA 8321B (LC-MS/MS)					
9/24/19	10/1/19	Imazapyr	ND	0.020 ug/L	

Rick Jordan, Laboratory Manager

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

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

Report Number: P192822
Report Date: October 03, 2019
Client Project ID: [none]

Quality Assurance

Method Blank Data **Matrix:** water

Extraction Date	Analysis Date	Batch QC Sample #	Analyte	% Recovery	Expected % Recovery	Notes
9/24/19	10/1/19	9092405-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
9/24/19	10/1/19	9092405-BS1	Imazapyr	63	60-140	
9/24/19	10/1/19	9092405-BSD1	Imazapyr	71	60-140	

Rick Jordan, Laboratory Manager

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

PACIFIC AGRICULTURAL LABORATORY
A MATRIX SCIENCES COMPANY
21830 S.W. Alexander Ln. • Sherwood, OR 97140 • Ph 503.626.7943 • pacaglab.com

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

Report Number: P192931
Report Date: October 10, 2019
Client Project ID:

Client Sample ID: SAPA-03-1w
PAL Sample ID: P192931-01
Matrix: water

Sample Date: 09/25/2019
Received Date: 09/26/2019
Extraction Date: 10/02/2019

Certificate of Analysis

Analysis Date	Analyte	Amount Detected	LOQ (ug/L)	Notes
Modified EPA 8321B (LC-MS/MS)				
10/07/2019	Imazapyr	2.7 ug/L	0.20	

Notes and Definitions

Notes	Definition
LOQ	Limit of Quantitation
ND	Not Detected
*	Not included under current scope of accreditation

The results contained in this report relate only to the items tested.
The results reflect the condition of the samples as received by PAL.
Samples will be stored for a minimum of 60 days after the final report is issued, as described in our Quality Manual.
Reports should not be reproduced, except in full, without written approval from PAL.
PAL is accredited to ISO/IEC 17025:2017 Standard, by PJLA, Accreditation #64422, Testing.

Rick Jordan, Laboratory Manager

Appendix V

NPDES Discharger's Table

Invasive *Spartina* Project
2019 Water Quality Monitoring Report

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

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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	20.1	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Flood Control Channel	576807.5381	4157810.0568	X		X					4
01b	Lower Channel (not including mouth)	200.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Flood Control Channel	578360.9955	4158281.016	X		X					38
01c	Upper Channel	39.1	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	580899.5769	4157737.918	X		X					7
01d	Upper Channel - Union City Blvd to 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 2019						X
01e	Strip Marsh No. of Channel Mouth	39.1	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Flood Control Channel	576189.9361	4158613.5408	X		X					7
01f	Pond 3-AFCC	0.13	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Flood Control Channel	577535.9107	4158581.2734	X		X					1
02a.1a	Belmont Slough Mouth	384.1	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough, Bay Slough	566362.0750	4156428.1213	X	X	X		X			90
02a.1b	Belmont Slough Mouth South	372.9	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough	566065.8772	4155491.5067	X	X	X		X			30
02a.2	Upper Belmont Slough and Redwood Shores	2091.3	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough, Bay Slough, Redwood Shores Lagoons, Steinberger Slough	566082.5157	4154633.3787	X		X		X			458
02a.3	Bird Island	237.0	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough, Bay Slough	567418.8179	4156363.7723	X		X		X			34
02a.4	Redwood Shores Mitigation Bank	10.1	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Belmont Slough, Bay Slough, Redwood Shores Lagoons, Steinberger Slough	566472.3438	4155766.6832	X		X					2
02b.1	Corkscrew Slough	4052.2	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Redwood Creek, Steinberger Slough, Deepwater Slough	568493.0329	4153078.2898	X		X		X			1043
02b.2	Steinberger Slough South, Redwood Creek Northwest	6434.5	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Redwood Creek, Steinberger Slough, Smith Slough	568355.2157	4153771.8800	X		X		X			1272
02c.1a	B2 North Quadrant West	15687.1	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Steinberger Slough	568874.5824	4155083.5605	X		X		X			1977
02c.1b	B2 North Quadrant East	134279.1	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Steinberger Slough	569319.4725	4154586.8620	X					X		8640

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

										Application Method						
ISP Sub-Area Number	ISP Sub-Area Name	Estimated Treatment Area (m^2)	WDID#	Regulatory Measure 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)
02c.2	B2 North Quadrant South	42064.9	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Deepwater Slough, Redwood Creek	568753.8607	4153996.8675	X		X		X			3019
02d.1a	B2 South Quadrant West	314.5	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek	569924.5881	4154840.4242	X		X		X			208
02d.1b	B2 South Quadrant East	0.4	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay	570171.0739	4154599.6276	X		X		X			1
02d.2	B2 South Quadrant (2)	166.4	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough	569759.2321	4154331.9176	X		X		X			16
02d.3	B2 South Quadrant (3)	75.9	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Corkscrew Slough	570294.9192	4154262.0363	X		X					8
02e	Westpoint Slough NW	112.3	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Westpoint Slough, First Slough	571040.8501	4152180.4614	X		X		X			12
02f	Greco Island North	11418.0	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Westpoint Slough, First Slough	571707.7828	4152201.4530	X		X		X			1736
02g	Westpoint Slough SW and East	2379.6	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Westpoint Slough, First Slough	571895.9674	4150389.3685	X		X					112
02h	Greco Island South	1768.7	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Westpoint Slough, First Slough, Ravenswood Slough	573401.4651	4150787.4274	X		X		X			1382
02i	Ravenswood Slough & Mouth	494.1	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Ravenswood Slough	575260.0121	4150291.9616	X	X	X		X			62
02j.1	Ravenswood Open Space Preserve (N of Hwy 84)	26.3	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay	576795.9752	4150761.5653	X		X		X			8
02j.2	Ravenswood Open Space Preserve (S of Hwy 84)	584.4	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay	577181.0843	4150018.6035	X		X					44
02k	Redwood Creek and Deepwater Slough	11273.7	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Redwood Creek, Smith Slough, Deepwater Slough	569362.5429	4151619.3444	X		X		X			1080
02l	Inner Bair Island Restoration	171.3	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Redwood Creek, Smith Slough, Steinberger Slough	567544.0765	4150917.8264	X		X					24
02m	Pond B3 - Middle Bair Island Restoration	6252.9	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Steinberger Slough	567798.6934	4153491.6125	X				X			1482

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

APPENDIX V

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
02n	SF2	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	576559.3772	4149561.8265		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
02o	Central Bair	1036.4	2 01AP00040 2 41AP00023	n/a 341182	Cal-IPC SMCMVCD	San Francisco Bay, Corkscrew Slough, Smith Slough	576559.3772	4149561.8265	X				X			384
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 2019						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 2019						X
04a	Corte Madera Ecological Reserve (CMER)	0.25	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	543242.2392	4199188.5874							X	X
04b	College of Marin Ecology Study Area	0.5	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	540025.7477	4200463.1205							X	X
04c	Piper Park East	2.5	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	541445.9928	4199241.0019							X	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 2019						X
04e	Larkspur Ferry Landing Area	No Invasive Spartina	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	543623.8572	4199608.8718		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
04f	Riviera Circle	1.8	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	541849.0263	4199323.0762	X		X				X	1
04g	Creekside Park	42.9	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	540464.4410	4200237.4338	X		X				X	9
04h	Upper Corte Madera Creek (Above Bon Air)	31.5	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	540079.0231	4200187.2701	X		X				X	9
04i	Lower Corte Madera Creek (between Bon Air Rd & HWY 101)	58.2	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	541630.9851	4199280.0106	X		X				X	13
04j.1	Corte Madera Creek Mouth - North Bank	60.1	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	543020.8672	4199668.7449	X		X				X	8
04j.2	Corte Madera Creek Mouth - South Bank	19.3	2 21AP00010	328163	FCMCW	San Francisco Bay, Corte Madera Creek	542870.8257	4199569.0736	X		X				X	1
04k	Boardwalk No. 1 (Arkites)	0.3	n/a	n/a	n/a	San Francisco Bay, Corte Madera Creek	541153.7225	4199466.8852							X	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 2019						X
05a.1	Mowry Marsh & Slough	4670.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Mowry Slough	584085.4488	4149879.9347	X		X		X			980

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

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
05a.2	Calaveras Marsh	8132.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Coyote Creek, Alviso Slough	585433.8865	4147064.2403	X		X	X	X			1757
05b	Dumbarton/Audubon	5254.6	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Newark Slough, Plummer Creek	580752.5334	4151756.3530	X		X		X			652
05c.1	Newark Slough West	246.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Newark Slough	581007.8869	4153897.0920	X		X		X			14
05c.2	Newark Slough East	39.1	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Newark Slough	582519.4127	4153792.0368	X		X		X			16
05d	LaRiviere Marsh	257.1	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Newark Slough	582271.4863	4154643.9756	X		X					12
05e	Mayhew's Landing	33.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Newark Slough	583256.3695	4154148.8125	X		X					4
05f	Coyote Creek-Alameda County	17.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Mud Slough, Coyote Creek	591599.2199	4147451.6133	X		X					2
05g	Cargill Pond (W Hotel)	289.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Newark Slough	582751.3564	4154755.5841	X		X					38
05h	Plummer Creek Mitigation	43.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Plummer Creek	584095.9610	4152505.6441	X		X					14
05i	Island Ponds	1055.1	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Coyote Creek, Mud Slough, Guadalupe River	591432.5212	4147089.4857	X				X			198
06a	Emeryville Crescent East	333.3	2 49AP00029	341200	State Parks	San Francisco Bay	561699.8488	4187349.9580	X		X					18
06b	Emeryville Crescent West	518.4	2 01AP00022	341173	EBRPD	San Francisco Bay	560382.4104	4186763.9652	X		X					14
07a	Oro Loma Marsh-East	1115.2	2 01AP00022	341173	EBRPD	San Francisco Bay	575270.4502	4168555.9513	X		X					108
07b	Oro Loma Marsh-West	3799.7	2 01AP00022	341173	EBRPD	San Francisco Bay	574537.3296	4168456.4328	X		X		X			288

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

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
8	Palo Alto Baylands	3458.9	2 43AP00011	339196	City of Palo Alto	San Francisco Bay	579177.0832	4146088.4657	X		X					615
9	Pickleweed Park / Tiscornia Marsh	121.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Rafael Bay, San Rafael Creek	544516.6791	4202044.3461	X		X					2
10a	Whittel Marsh	0.7	2 01AP00022	341173	EBRPD	San Francisco Bay	557120.0455	4206623.3549	X		X					1
10b	Southern Marsh	59.6	2 01AP00022	341173	EBRPD	San Francisco Bay	555675.2928	4206327.0165	X		X					6
10c	Giant Marsh	28.5	2 01AP00022	341173	EBRPD	San Francisco Bay	556182.6896	4205001.3122	X		X					3
10d	Breuner Marsh Restoration	13.1	2 01AP00022	341173	EBRPD	San Francisco Bay	555762.8235	4204091.8802	X		X					1
11	Southampton Marsh	153.5	2 49AP00029	341200	State Parks	San Francisco Bay	571048.6663	4213968.1874	X		X					31
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 2019						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 2019						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 2019						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 2019						X
12e	Yosemite Channel	11.2	2 49AP00029	341200	State Parks	San Francisco Bay, South Basin, Yosemite Slough	554648.8915	4174786.1888	X		X					1
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 2019						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 2019						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 2019						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 2019						X
13a	Old Alameda Creek North Bank	1.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Creek, North Creek	578285.9047	4161172.7648	X		X					2
13b	Old Alameda Creek Island	40.6	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Creek, North Creek	578056.2824	4161048.7760	X		X					14

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#	Regulatory Measure ID#	NOI entity*	Adjacent or Nearby Waterways	Sub-area centroid X (UTM)	Sub-area centroid Y (UTM)	Herbicide Applied	Application Method: Truck	Back-pack	Amphib-ious vehicle	Airboat	Aerial: Broad cast	Digging	Volume Imazapyr Applied (Ounces)
13c	Old Alameda Creek South Bank	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Alameda Creek, North Creek	577676.9180	4160934.9285		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
13d	Whale's Tail North Fluke	78.2	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Creek, Mt. Eden Creek	575382.9293	4162274.4760	X		X					12
13e	Whale's Tail South Fluke	12.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Creek	575549.1260	4160382.9676	X		X					6
13f	Cargill Mitigation Marsh	1.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Creek	576027.8116	4160537.6794	X		X					1
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 2019						X
13h	Eden Landing-North Creek	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, North Creek	577712.8065	4161727.4755		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
13i	Eden Landing-Pond 10	1.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Mt. Eden Creek	575558.9621	4163349.4809	X		X					1
13j	Eden Landing-Mt Eden Creek	286.6	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Mt. Eden Creek	576555.7056	4163552.6524	X		X					36
13k	Eden Landing Reserve South- North Creek Marsh	1433.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Mt. Eden Creek, North Creek	578457.9175	4162866.8947	X		X					54
13l	Eden Landing Reserve North- Mt Eden Creek Marsh	881.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Mt. Eden Creek	578609.9049	4163467.7623	X		X					112
13m	Eden Landing Pond E8A, E9, E8X	402.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alameda Creek, North Creek	576950.3669	4161521.3412	X		X		X			34
15a.1	Charleston Slough to Mountainview Slough	1119.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	581163.2100	4144605.2611	X		X					101
15a.2	Stevens Ck to Guadalupe Sl	387.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	583330.7181	4144746.8321	X		X					35
15a.3	Guadalupe Slough	Not treated in 2019	n/a	n/a	n/a	San Francisco Bay, Guadalupe Slough, Moffett Channel	587005.3597	4143439.3709		NOT TREATED IN 2019						X
15a.4	Alviso Slough	23476.4	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Alviso Slough, Coyote Creek, Guadalupe River	587728.9332	4145171.7403	X	X	X		X			4420
15a.5	Coyote Creek to Artesian Slough	491.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Coyote Creek, Mud Slough, Guadalupe River	591300.7634	4145809.2865	X		X		X			78
15a6	Knapp Tract	50.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Guadalupe Slough, Moffett Channel, Alviso Slough, Coyote Creek, Guadalupe River	586042.9779	4145699.8644	X				X			6

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

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
15b	Faber/Laumeister Marsh	3246.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Francisquito Creek	577599.4651	4147190.7879	X		X					334
15c	Shoreline Regional Park	3232.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Charleston Slough, Stevens Creek	580629.1350	4144020.5634	X		X					318
16.1	Cooley Landing Central	4481.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	577025.0576	4148338.0763	X		X		X			1921
16.2	Cooley Landing East	18585.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	577161.5535	4148618.6894	X	X	X					852
17a	Alameda Island South (Elsie Roemer Bird Sanctuary, Crab Cove)	54.0	2 01AP00013	340985	Alameda	San Francisco Bay, Tidal Channel, Airport Channel, San Leandro Bay, East Creek	564576.4152	4179452.7150	X		X					9
17b	Bay Farm Island	187.8	2 01AP00013	340985	Alameda	San Francisco Bay, San Leandro Bay	566538.2648	4177776.0313	X		X					12
17c.1	Arrowhead Marsh West	24846.0	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569196.9046	4177663.1478	X		X		X			384
17c.2	Arrowhead Marsh East	Not treated in 2019	n/a	n/a	n/a	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569343.0266	4177725.6164		NOT TREATED IN 2019						X
17d.1	MLK Regional Shoreline - Fan Marsh Shoreline	536.0	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	568699.4696	4177934.7370	X				X			69
17d.2	Airport Channel - MLK Shoreline	593.8	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569175.3023	4177345.1389	X		X					77
17d.3	East Creek -MLK Shoreline	378.6	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Tidal Canal, Colisuem Channels, Damon Slough	568767.9456	4179382.0109	X		X					49

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

APPENDIX V

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
17d.4	MLK Regional Shoreline-Damon Marsh	8930.1	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569374.5323	4178733.3863	X	X			X			1037
17d.5	Damon Sl/Elmhurst Cr - MLK Shoreline	453.9	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569699.5033	4178168.7218	X	X			X			59
17e.1	San Leandro Creek North	141.4	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Damon Slough	569907.7297	4177360.2491	X		X					18
17e.2	San Leandro Creek South	167.9	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	570581.9076	4176544.5715	X		X					22
17f	Oakland Inner Harbor	88.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Oakland Inner Harbor, Oakland Middle Harbor, Lake Merritt, Lake Merritt Channel, Brooklyn Basin, Tidal Canal, Fortmann Basin, Alaska Basin	563483.6971	4182956.2947	X		X					16
17g	Coast Guard Island	11.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Oakland Inner Harbor, Brooklyn Basin, Fortmann Basin	566098.0075	4181978.0308	X		X					2
17h	MLK New Marsh	Not treated in 2019	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 2019						X
17i	Coliseum Channels	780.4	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Coliseum Channels, East Creek Slough, San Leandro Creek, Damon Slough	570171.9029	4178869.4467	X		X					144
17j.1	Fan Marsh Wings	472.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Leandro Bay, Airport Channel, Tidal Canal, San Leandro Creek, Elmhurst Creek	568622.8884	4177686.1551	X	X	X					42
17j.2	Fan Marsh Main	Not treated in 2019	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		NOT TREATED IN 2019						X

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

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
17k	Airport Channel	45.0	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, San Leandro Creek, Elmhurst Creek, Damon Slough	569575.6733	4176600.2674	X		X		X			6
17l	Doolittle Pond	58.9	2 01AP00022	341173	EBRPD	San Francisco Bay, San Leandro Bay, Airport Channel, Tidal Canal, San Leandro Creek, Elmhurst Creek	568262.7345	4178012.4256	X		X					7
17m	Alameda Island (East: Aeolian Yacht Club & Eastern Shoreline)	248.1	2 01AP00013	340985	Alameda	San Francisco Bay, San Leandro Bay, Airport Channel, Tidal Canal, San Leandro Creek, Elmhurst Creek	567981.4525	4178863.3414	X		X		X			49
18a	Colma Creek	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	552893.2013	4166658.8629		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
18b	Navigable Slough	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	552516.1349	4166294.7372		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
18c	Old Shipyard	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	553312.8267	4166086.5650		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
18d	Inner Harbor	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	553504.2489	4166073.3490		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
18e	Sam Trans Peninsula	0.1	2 41AP00023	341182	SMCMVCD	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	553855.0371	4166240.1813	X		X					1
18f	Confluence Marsh	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	553484.8149	4166398.6648		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
18g	San Bruno Marsh	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	554005.7446	4166785.6127		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X

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

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
18h	San Bruno Creek	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Bruno Creek, Colma Creek, Navigable Slough, Old Shipyard Harbor, Inner Harbor	552715.1192	4165551.0968		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19a	Brisbane Lagoon	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Brisbane Lagoon, Oyster Cove	553456.5474	4171432.4131		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
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 2019						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 2019						X
19d	Oyster Point Marina	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Oyster Cove, Brisbane Lagoon	554681.7949	4168800.7361		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19e	Oyster Point Park	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Oyster Cove,	554776.6012	4168331.5764		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19f	Point San Bruno	No Invasive Spartina	n/a	n/a	n/a	Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor, Seaplane Harbor	554826.2418	4167481.7146		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19g	Seaplane Harbor	No Invasive Spartina	n/a	n/a	n/a	Colma Creek, Navigable Slough, San Bruno Creek, Old Shipyard Harbor, Inner Harbor	554416.5399	4165260.2112		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19h	SFO	448.6	2 41AP00023	341182	SMCMVCD	San Francisco Bay, Seaplane Harbor, Mills Creek	555678.9186	4162816.6627	X		X		X			96
19i	Mills Creek Mouth	1.8	2 41AP00023	341182	SMCMVCD	San Francisco Bay, Easton Creek, Mills Creek	554736.1754	4161836.3844	X		X		X			1
19j	Easton Creek Mouth	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Easton Creek, Mills Creek	556395.5787	4160789.7311		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19k	Sanchez Marsh	2310.1	2 41AP00023	341182	SMCMVCD	San Francisco Bay, Sanchez Marsh, Bay Front Channel, Burlingame Lagoon	556935.1249	4160354.8299	X		X				X	591
19l	Burlingame Lagoon	48.9	2 41AP00023	341182	SMCMVCD	San Francisco Bay, Sanchez Marsh, Bay Front Channel, Burlingame Lagoon, Anza Lagoon	557909.1080	4160341.2512	X		X				X	13
19m	Fisherman's Park	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Sanchez Marsh, Bay Front Channel, Burlingame Lagoon, Anza Lagoon, Coyote Point Marina/Marsh	559023.7151	4160477.7444		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X

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

APPENDIX V

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
19n	Coyote Point Marina / Marsh	0.2	2 41AP00023	341182	SMCMVCD	San Francisco Bay, Coyote Point Marina/Marsh, San Mateo Creek	560371.4138	4160420.9899	X		X					1
19o	San Mateo Creek / Ryder Park	29.6	2 41AP00023	341182	SMCMVCD	San Francisco Bay, San Mateo Creek, Seal Slough	560913.9538	4159238.4069	X		X					1
19p.1	Seal Slough Mouth - Central Marsh	320.9	2 41AP00023	341182	SMCMVCD	San Francisco Bay, San Mateo Creek, Seal Slough	562572.4336	4158728.9495	X		X					37
19p.2	Seal Slough Mouth - Peripheral Marshes	96.3	2 41AP00023	341182	SMCMVCD	San Francisco Bay, San Mateo Creek, Seal Slough, Foster City Lagoon	563160.4826	4158642.0730	X		X		X			11
19q	Foster City	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Foster City Lagoon, Belmont Slough	566144.9786	4157898.9211		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19r	Anza Lagoon	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Sanchez Marsh, Bay Front Channel, Burlingame Lagoon, San Mateo Creek	557936.6006	4160676.5827		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
19s	Maple Street Channel	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, Maple St. Channel, Redwood Creek, Smith Slough	568945.5661	4149933.6355		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
20a	Oyster Bay Regional Shoreline	157.6	2 01AP00022	341173	EBRPD	San Francisco Bay, Oyster Bay, Golf Links Channel, San Leandro Small Boat Lagoon, Estudillo Creek Channel	570801.9998	4173701.8444	X		X		X			27
20b	Oakland Metropolitan Golf Links	11.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	570754.9450	4175284.9633	X		X					3
20c	Dog Bone Marsh	22.6	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	572540.0802	4171007.8804	X		X					16
20d.1	Citation Marsh South	4215.9	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573748.5251	4170761.4745	X	X	X					1094
20d.2a	Citation Marsh North channels	Not treated in 2019	n/a	n/a	n/a	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573448.9646	4171236.3464		NOT TREATED IN 2019						X
20d.2b	Citation Marsh North main	Not treated in 2019	n/a	n/a	n/a	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573448.9646	4171236.3464		NOT TREATED IN 2019						X

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#	Regulatory Measure ID#	NOI entity*	Adjacent or Nearby Waterways	Sub-area centroid X (UTM)	Sub-area centroid Y (UTM)	Herbicide Applied	Application Method: Truck	Back-pack	Amphib-ious vehicle	Airboat	Aerial: Broad cast	Digging	Volume Imazapyr Applied (Ounces)
20e	East Marsh	1265.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573894.9872	4170003.6933	X		X					329
20f	North Marsh	Not treated in 2019	n/a	n/a	n/a	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573124.0431	4171013.8826		NOT TREATED IN 2019						X
20g	Bunker Marsh	53925.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573617.2539	4170076.4293	X	X	X	X				2995
20h.1	San Lorenzo Creek & Mouth North	174.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Lorenzo Creek Tidal Tributaries	573829.9856	4169716.9799	X		X					21
20h.2	San Lorenzo Creek & Mouth South	2108.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Lorenzo Creek, Bockman Channel	573575.6909	4169277.7370	X		X					247
20i	Bockmann Channel	274.5	2 01AP00022	341173	EBRPD	San Francisco Bay, Bockman Channel	574439.3640	4169066.3661	X		X					32
20j	Sulphur Creek	13.9	2 01AP00022	341173	EBRPD	San Francisco Bay	575682.9812	4168238.4657	X		X					2
20k	Hayward Landing	58.9	2 01AP00022	341173	EBRPD	San Francisco Bay	574480.4286	4166871.6234	X		X					7
20l	Johnson's Landing	0.2	2 01AP00022	341173	EBRPD	San Francisco Bay	575114.0955	4164936.1630	X		X					1
20m	Cogswell Marsh, Quadrant A	268.4	2 01AP00022	341173	EBRPD	San Francisco Bay	574931.9598	4166149.9615	X		X					36
20n.1	Cogswell Marsh, Quadrant B Bayfront	27134.0	2 01AP00022	341173	EBRPD	San Francisco Bay	575335.3739	4165643.2601	X	X						2304
20n.2	Cogswell Marsh, Quadrant B South	14107.9	2 01AP00022	341173	EBRPD	San Francisco Bay	575335.3739	4165643.2601	X	X	X	X				1236
20n.3	Cogswell Marsh, Quadrant B Main	142624.2	2 01AP00022	341173	EBRPD	San Francisco Bay	575335.3739	4165643.2601	X					X		1920

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

										Application Method						
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20o	Cogswell Marsh, Quadrant C	22154.6	2 01AP00022	341173	EBRPD	San Francisco Bay	574956.5922	4165441.6011	X	X	X	X				1402
20p	Hayward Shoreline Outliers	76.8	2 01AP00022	341173	EBRPD	San Francisco Bay, Estudillo Creek Channel	574600.2360	4165756.5503	X		X					4
20q	San Leandro Shoreline Outliers	24.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Leandro Flood Control Channel	572880.2444	4170476.5038	X		X					85
20r	Oakland Airport Shoreline and Channels	124.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Oyster Bay	568108.0862	4174678.0156	X		X					18
20s	H.A.R.D. Marsh	270.0	2 01AP00022	341173	EBRPD	San Francisco Bay	576039.4964	4164671.5808	X		X					36
20t	San Leandro Marina	5.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Estudillo Creek Channel	571443.2484	4172293.1436	X		X					1
20u	Estudillo Creek Channel	2268.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Estudillo Creek Channel	572896.1587	4171843.5860	X	X	X					324
20v	Hayward Landing Canal	20.6	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	575733.4612	4166692.8267	X		X					2
20w	Triangle Marsh	46.8	2 01AP00022	341173	EBRPD	San Francisco Bay	574798.9094	4166726.9403	X		X					5
21a	Ideal Marsh North	14.4	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	577168.1437	4156871.9542	X		X					2
21b	Ideal Marsh South	50.1	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	578260.5253	4154929.5490	X		X					8
22a	Wildcat Marsh	1345.2	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Strait, San Pablo Bay, Wildcat Creek	553471.9133	4201446.4859	X		X		X			384
22b.1	San Pablo Marsh East	984.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Bay	555164.7368	4203396.3757	X		X		X			94
22b.2	San Pablo Marsh West	621.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Bay, San Pablo Creek	554356.0947	4203049.4775	X		X		X			60

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

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22c	Rheem Creek Area	1660.7	2 01AP00022	341173	EBRPD	San Francisco Bay	555762.8235	4204091.8802	X		X		X			159
22d	Stege Marsh	7.2	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Richmond Inner Harbor	558645.9564	4196085.9714	X		X					3
22e	Hoffman Marsh	19.5	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Richmond Inner Harbor	559733.3437	4195529.7690	X		X					1
22f	Richmond/ Albany /Pinole Shoreline	147.1	2 01AP00040 2 49AP00029	n/a 341200	Cal-IPC State Parks	San Francisco Bay, San Pablo Strait, San Pablo Bay	558964.2231	4198575.6514	X		X					17
23a	Brickyard Cove	0.7	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	546741.3839	4204071.1520	X		X				X	1
23b	Beach Drive	174.9	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Bay	545845.7691	4203107.4268	X		X					20
23c	Loch Lomond Marina	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Pablo Bay	545550.5115	4202862.4070		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
23d.1	San Rafael Canal Mouth East	819.4	2 01AP00040	n/a	Cal-IPC	San Francisco Bay	544208.8498	4202838.9725	X		X				X	100
23d.2	San Rafael Canal Mouth West	23.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Rafael Creek	544384.0636	4202417.5570	X		X					6
23e	Muzzi & Marta's Marsh	424.2	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Clemente Creek, Corte Madera Ecological Reserve Pond	543400.9387	4198048.4476	X		X				X	63
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 2019						X
23g	Greenwood Cove	0.1	n/a	n/a	n/a	San Francisco Bay	543968.0294	4194454.3149							X	X
23h	Strawberry Point	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay	543809.6824	4193371.4703		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
23i	Strawberry Cove	44.9	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Richardson Bay, Strawberry Cove, Pickleweed Inlet	542806.8182	4193556.0582	X		X					11
23j	Bothin Marsh	11.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Richardson Bay, Strawberry Cove, Pickleweed Inlet, Tennessee Creek	541869.3253	4193729.5841	X		X					4
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 2019						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 2019						X

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

APPENDIX V

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
23m	Novato	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Pablo Bay, Novato Creek, Gallinas Creek	542946.0401	4210189.9809		ZERO NON-NATIVE SPARTINA FOUND IN 2019						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 2019						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 2019						X
24a	Upper Petaluma River-Upstream of Grey's Field	178.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Bay, Petaluma River, Lynch Creek	533514.3403	4231615.3849	X		X		X			63
24b	Upper Petaluma River-Upstream of Grey's Field	13.6	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Bay, Petaluma River, Lynch Creek	533514.3403	4231615.3849	X		X		X			5
24c	Petaluma Marsh	91.0	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Bay, Petaluma River, Tule Slough, Schulz Slough, Mira Slough, Mud Hen Slough, Donahue Slough, San Antonio Creek	538235.2999	4226806.4746	X		X		X			32
25a	Tom's Point, Tomales	0.03	n/a	n/a	n/a	Tomales Bay, Lagunitas Creek, Cataract Creek, Keys Creek	510090.2733	4222167.8403							X	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 2019						X
25c	Drakes Estero	No Invasive Spartina	n/a	n/a	n/a	Drakes Estero, Limantour Estero, Barries Bay, Creamery Bay, Schooner Bay, Home Bay	505420.4630	4213621.8460		ZERO NON-NATIVE SPARTINA FOUND IN 2019						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 2019						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 2019						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 2019						X
26b	San Pablo Bay NWR & Mare Island	82.8	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, San Pablo Bay, Sonoma Creek, Mare Island Strait, Second Napa Slough, Dutchman Slough, South Slough	559560.2447	4218371.6666	X		X					13

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

APPENDIX V

										Application Method						
ISP Sub-Area Number	**ISP Sub-Area Name**	**Estimated Treatment Area (m^2)**	**WDID#**	**Regulatory Measure 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)**
26c	Sonoma Creek	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Pablo Bay, Sonoma Creek, Tolay Creek, Second Napa Slough, Third Napa Slough, Dutchman Slough, South Slough	551632.5000	4224116.4390		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
26d	Sonoma Baylands	No Invasive Spartina	n/a	n/a	n/a	San Francisco Bay, San Pablo Bay, Petaluma River, Tolay Creek, Bush Slough, Sonoma Creek	547593.7330	4220328.0882		ZERO NON-NATIVE SPARTINA FOUND IN 2019						X
27a	Point Buckler	1.2	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Suisun Bay	586305.8450	4216946.9250	X		X					1
27b	MOTCO Islands	147.4	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Suisun Bay	587588.0000	4214989.0000	X		X					20
27c	Honker Bay	39.3	2 01AP00040	n/a	Cal-IPC	San Francisco Bay, Suisun Bay	593472.0000	4214251.0000	X		X					7

Estuary Total (m^2)	649577

Total Oz.	52309

* Alameda = City of Alameda
City of Palo Alto = City of Palo Alto
CWF= California Wildlife Foundation
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
2019 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.

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-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.

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

Imidazolinone Herbicides in Water by EPA 8321B

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

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

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.

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 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

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:

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

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.

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.

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: ______________________________

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

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

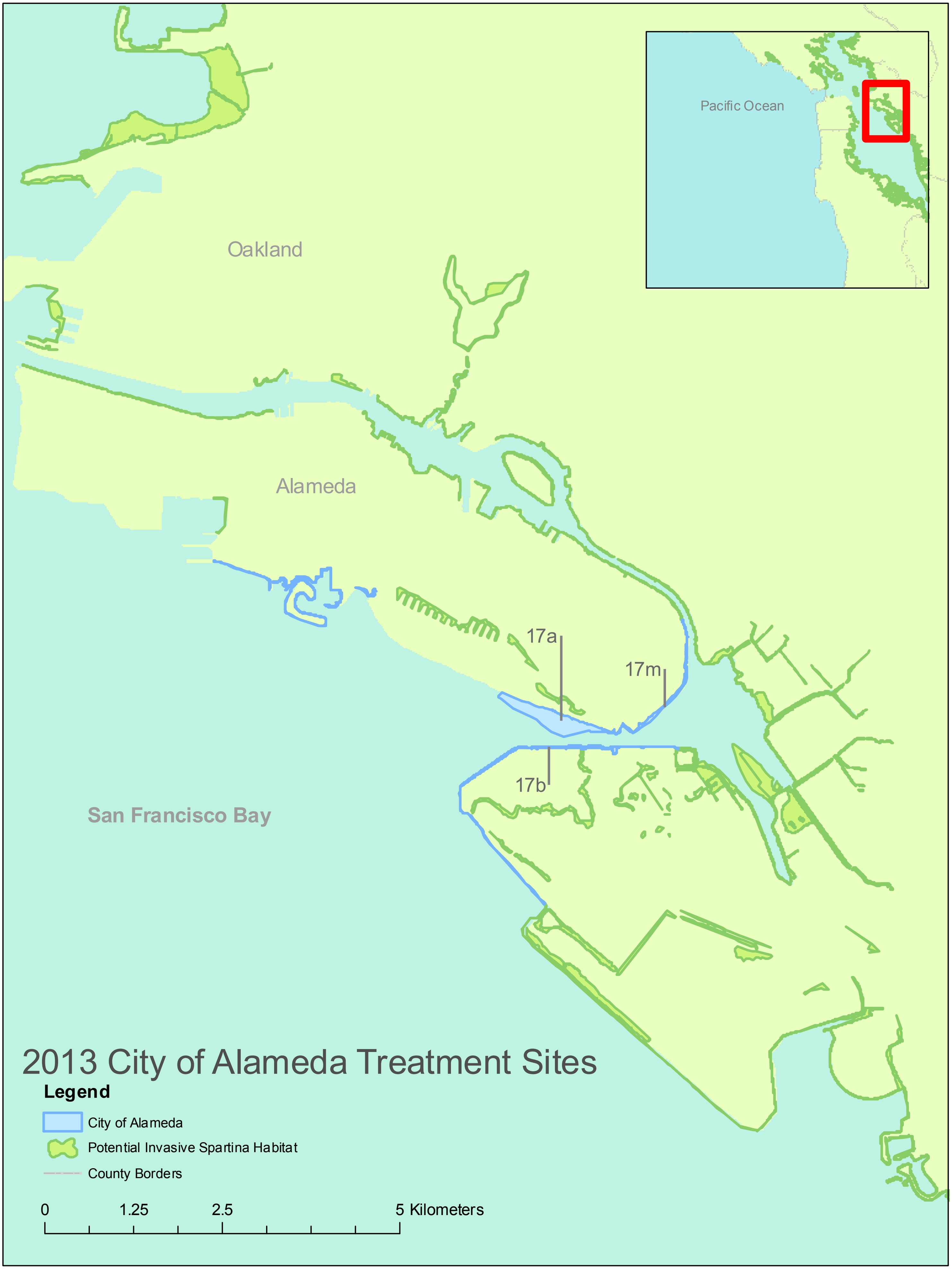
Appendix VII

Spartina Treatment Site Locations by ISP Coalition Partner

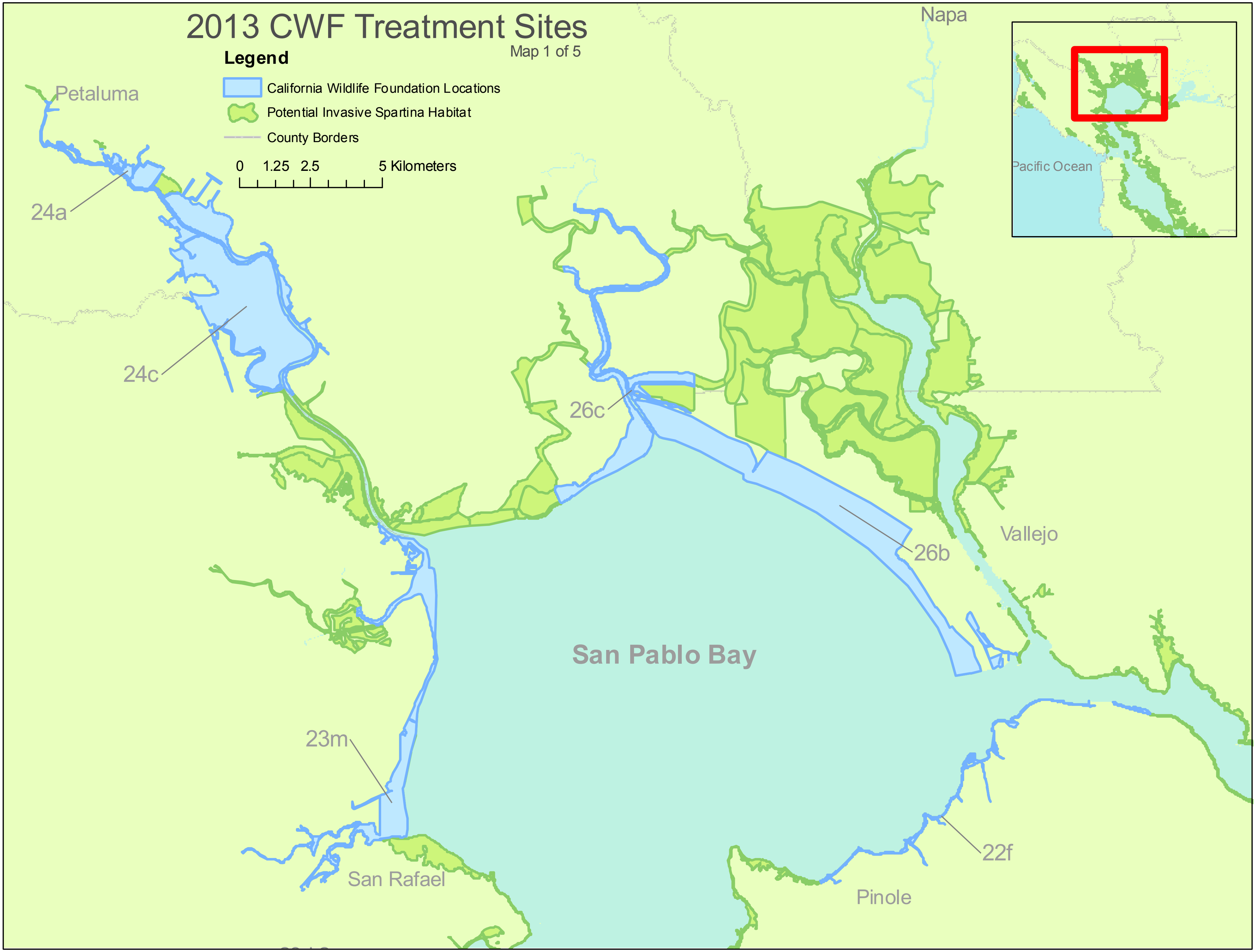
For budgetary reasons, previously produced maps have been used where there were no changes

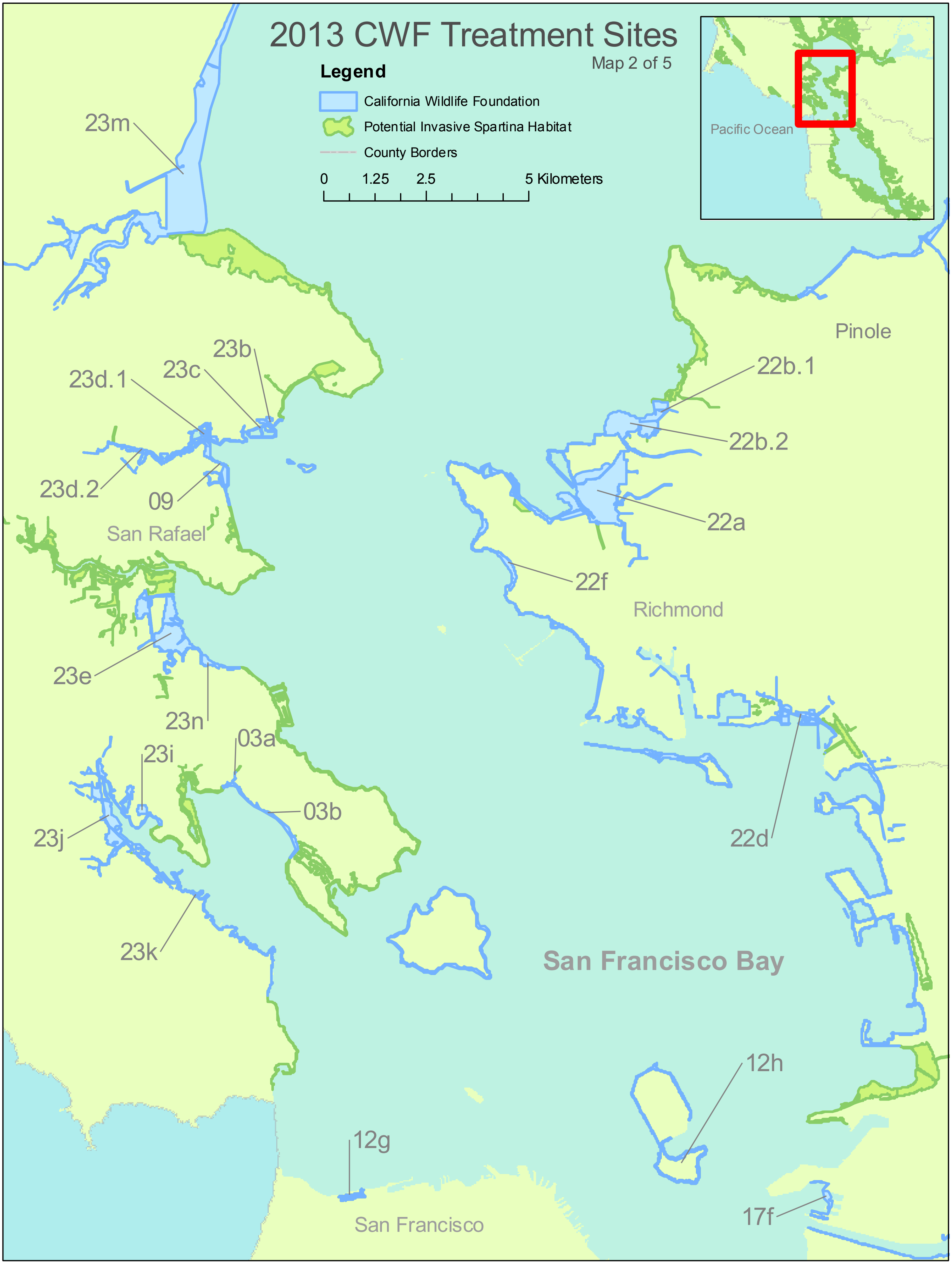
CWF (California Wildlife Foundation) sites officially transitioned to Cal-IPC (California Invasive Plant Council) in 2019

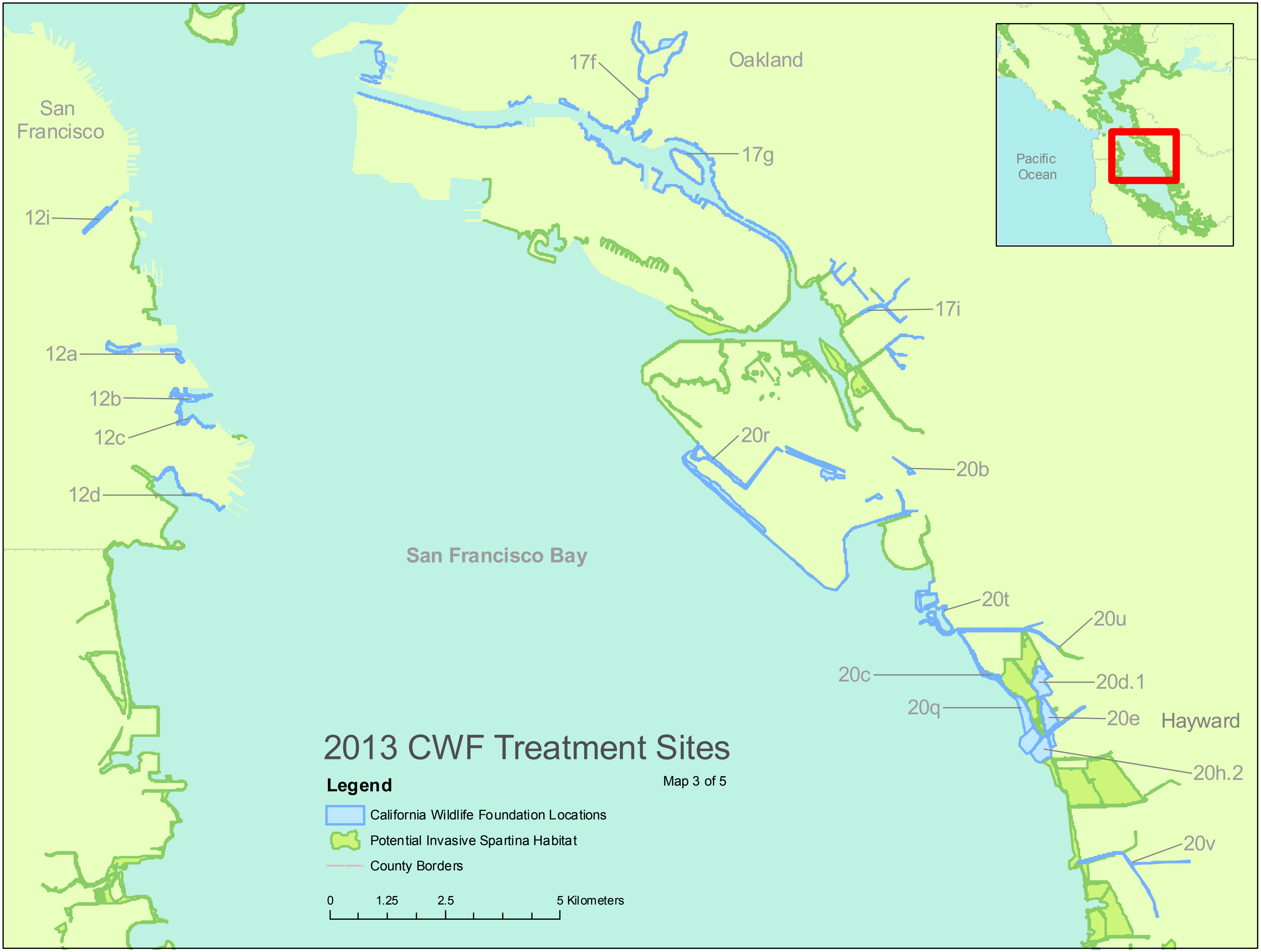
Invasive *Spartina* Project 2019 Water Quality Monitoring Report


Pacific Ocean
Oakland
Alameda
17a
17m
17b
San Francisco Bay
2013 City of Alameda Treatment Sites
Legend
City of Alameda
Potential Invasive Spartina Habitat
County Borders
0
1.25
2.5
5 Kilometers

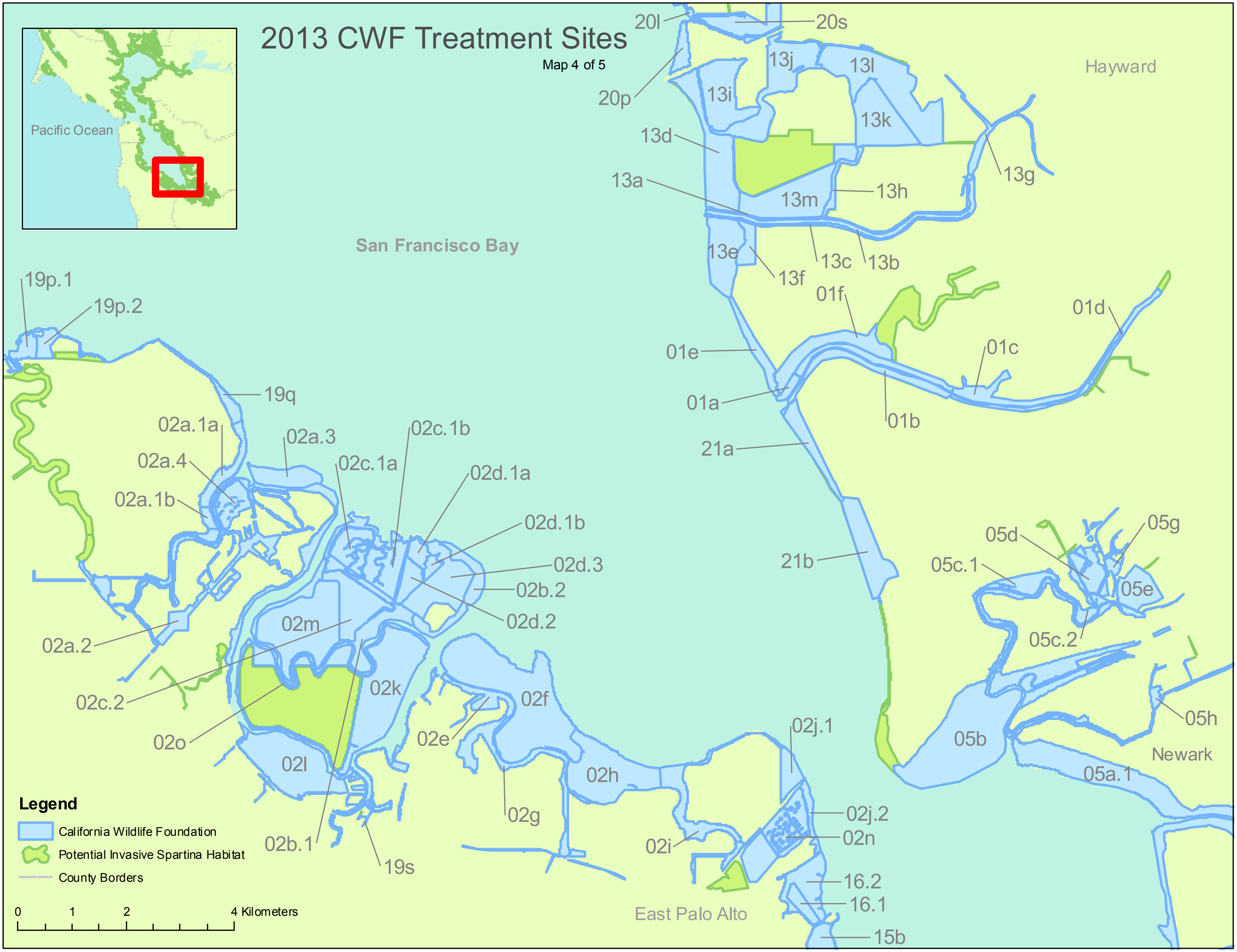

2013 California State Parks
Treatment Sites
Legend
CA State Parks
Potential Invasive Spartina Habitat
County Borders
0 1.25 2.5 5 Kilometers
San Pablo Bay
Vallejo
11
23o
San Rafael
Richmond
22f
06a
Oakland
San Francisco
12e
12f
San Francisco Bay


2013 CWF Treatment Sites
Map 1 of 5
Legend
California Wildlife Foundation Locations
Potential Invasive Spartina Habitat
County Borders
0 1.25 2.5 5 Kilometers
Napa
Petaluma
Pacific Ocean
24a
24c
26c
26b
Vallejo
San Pablo Bay
23m
22f
San Rafael
Pinole

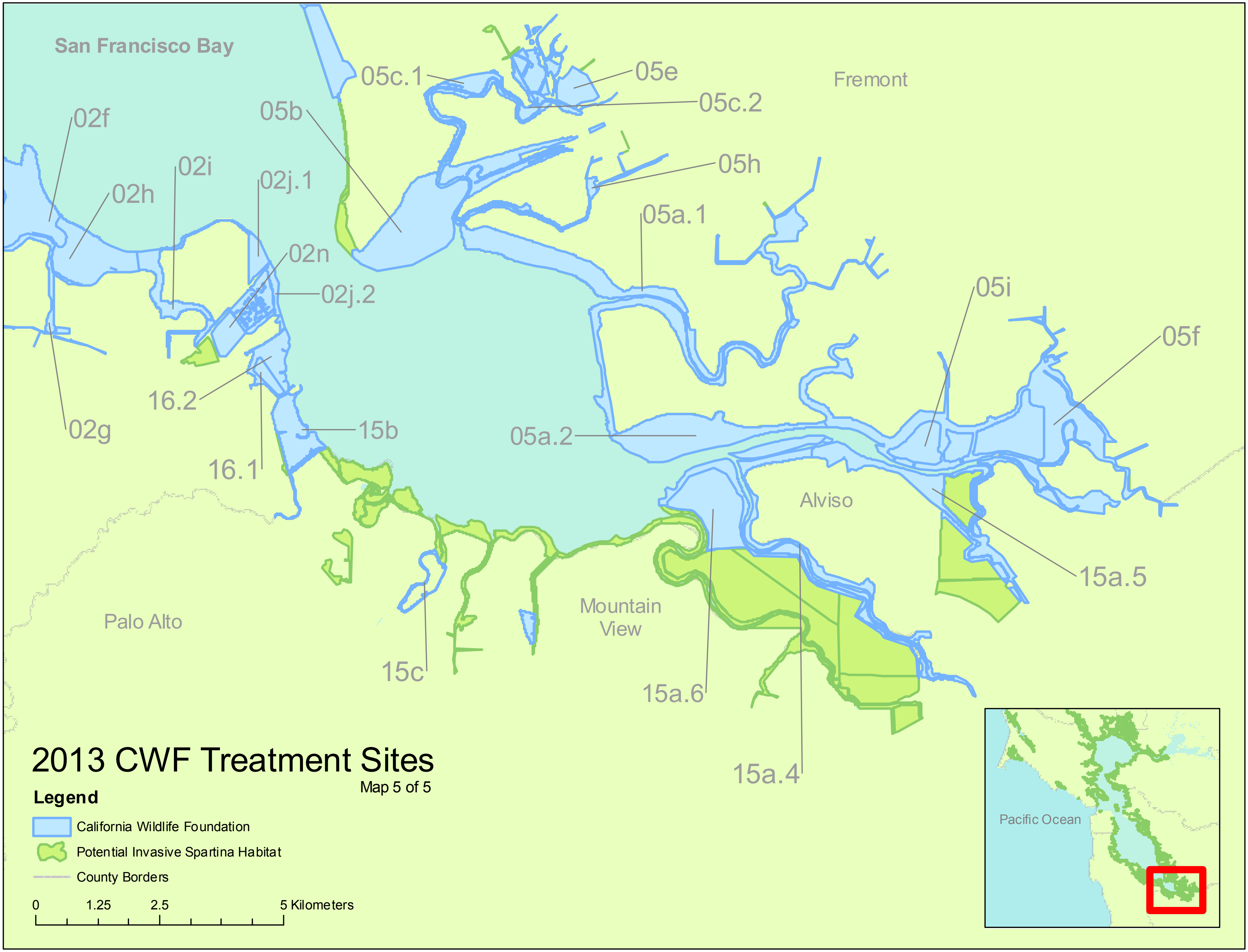

2013 CWF Treatment Sites
Map 2 of 5
Legend
California Wildlife Foundation
Potential Invasive Spartina Habitat
County Borders
0
1.25
2.5
5 Kilometers
Pacific Ocean
23m
23b
23c
23d.1
23d.2
09
San Rafael
23e
23n
03a
23i
03b
23j
23k
22b.1
22b.2
22a
22f
Pinole
Richmond
22d
San Francisco Bay
12h
12g
17f
San Francisco

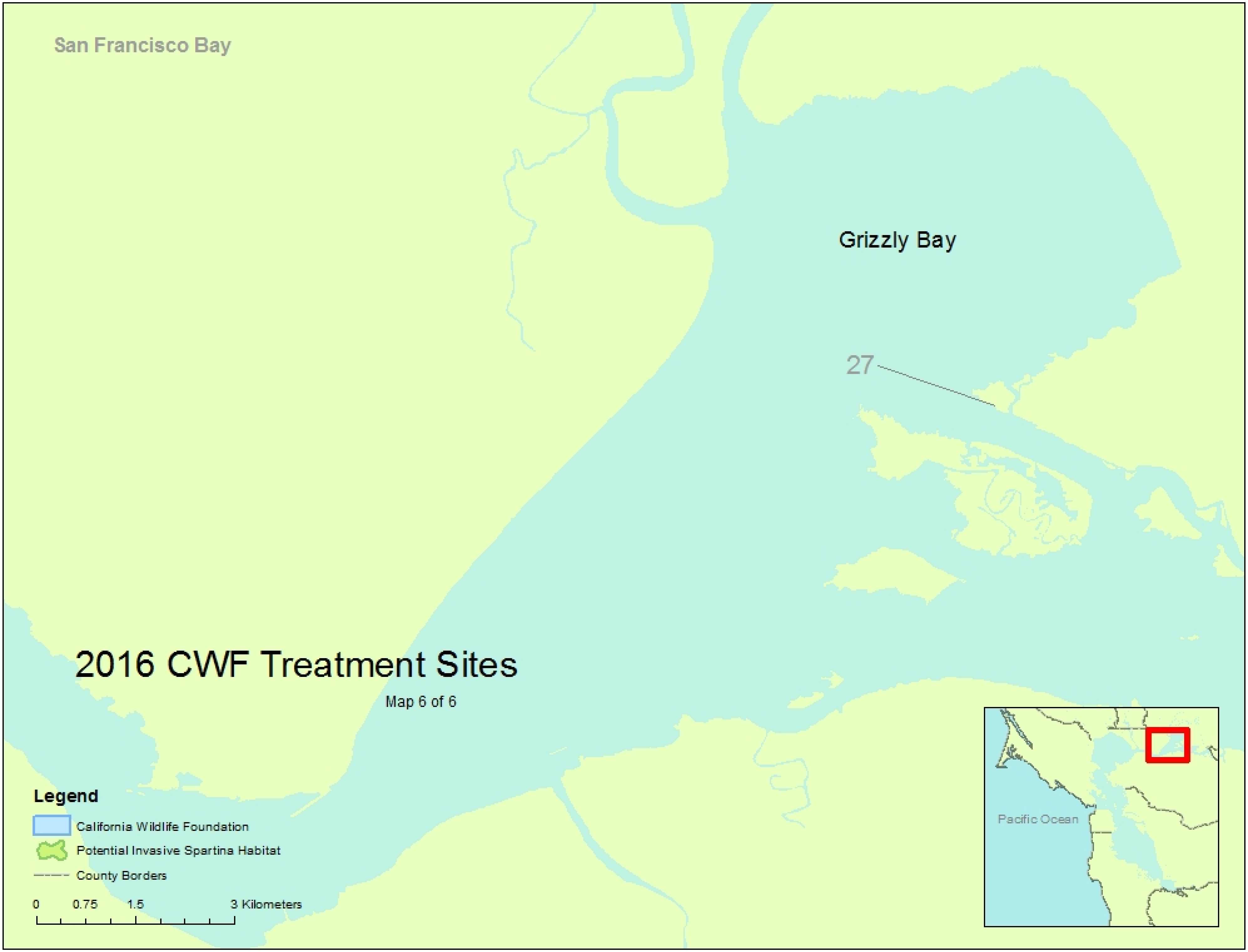


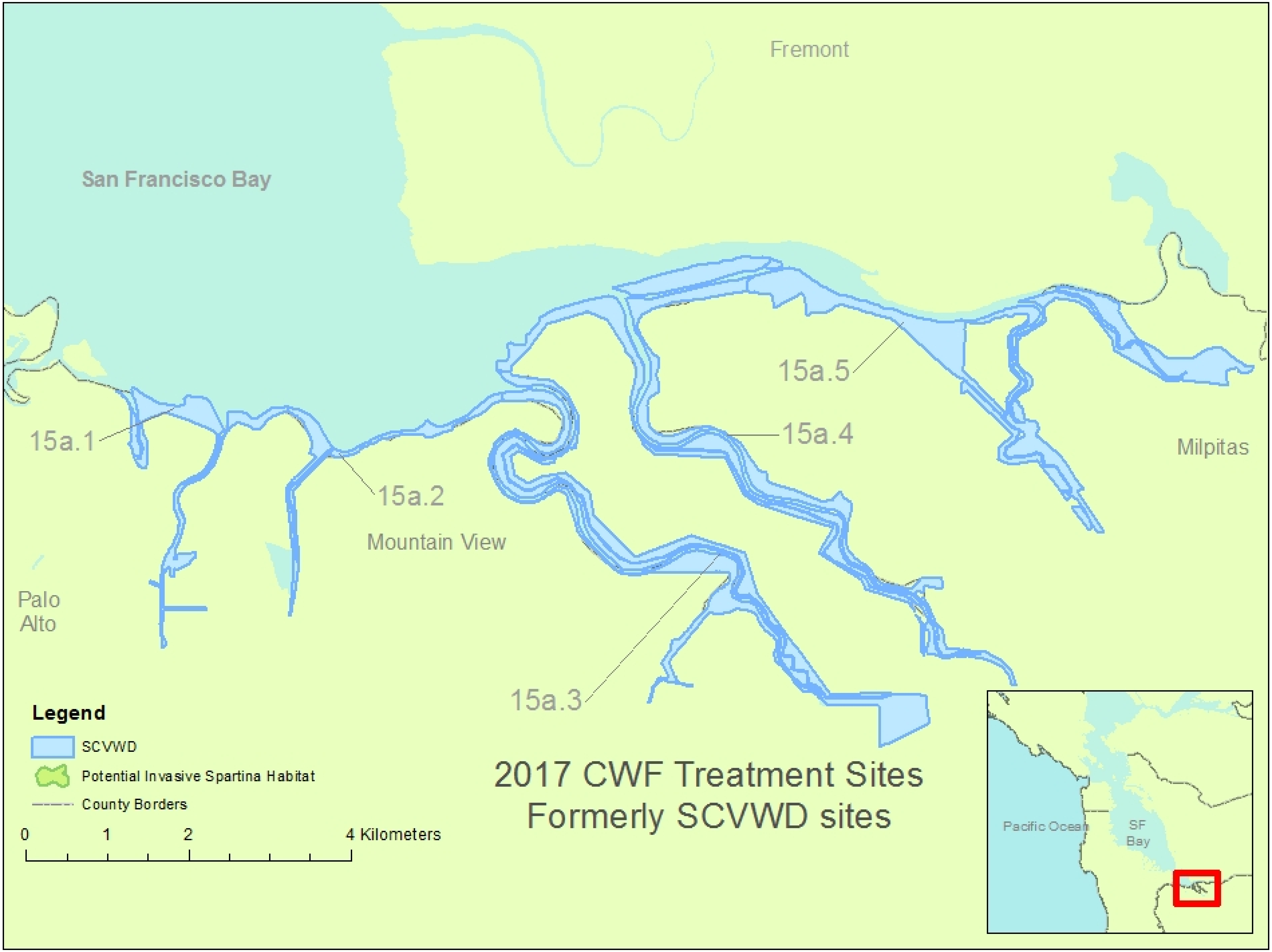
Oakland
San Francisco
12i
12a
12b
12c
12d
17f
17g
17i
20r
20b
20t
20u
20c
20d.1
20q
20e
Hayward
20h.2
20v
San Francisco Bay
Pacific Ocean
2013 CWF Treatment Sites
Map 3 of 5
Legend
California Wildlife Foundation Locations
Potential Invasive Spartina Habitat
County Borders
0
1.25
2.5
5 Kilometers



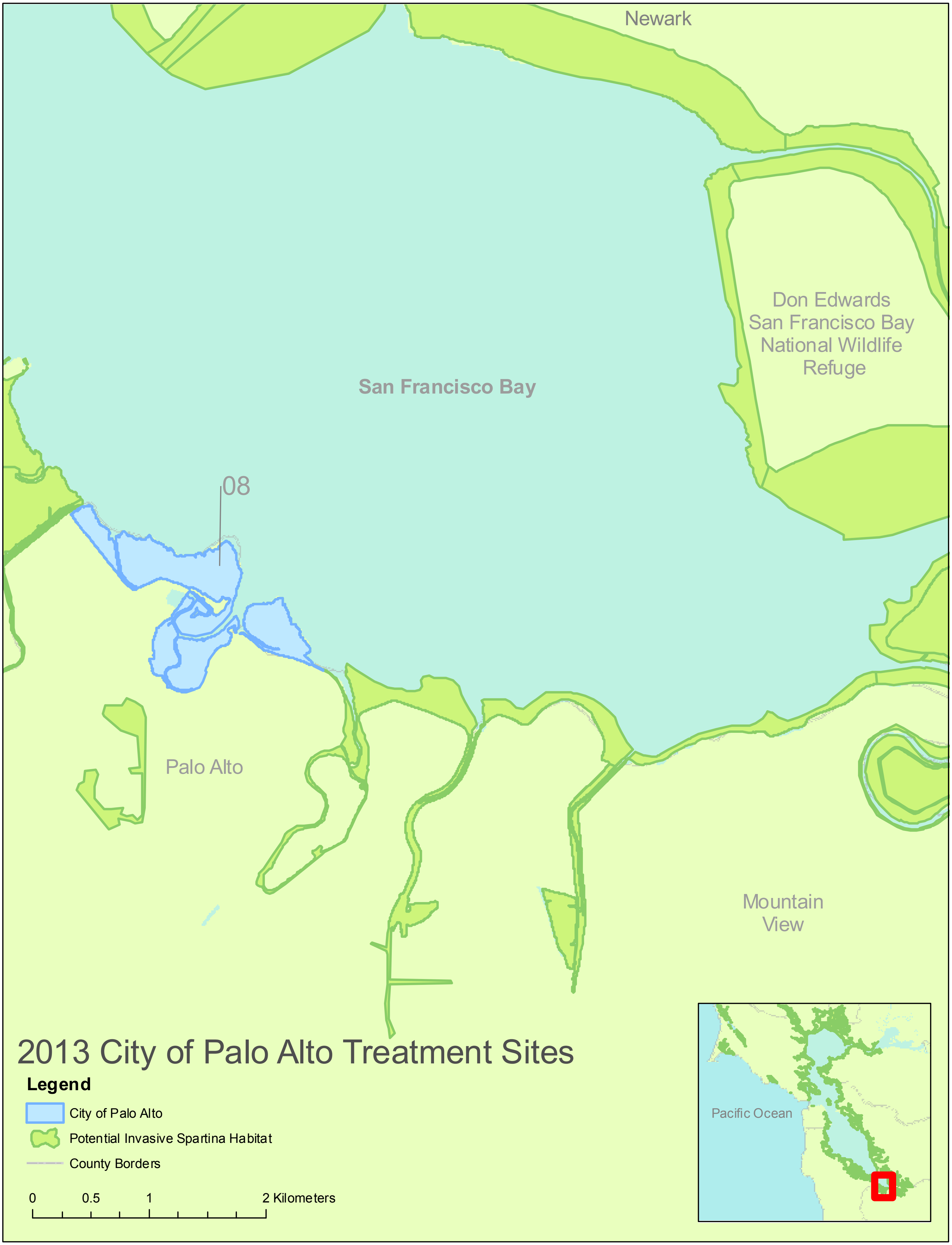
2013 CWF Treatment Sites
Map 4 of 5
Pacific Ocean
San Francisco Bay
Hayward
Newark
East Palo Alto
20l
20s
20p
13j
13l
13i
13k
13d
13a
13m
13h
13g
13e
13c
13b
13f
01f
01d
01e
01c
01a
01b
21a
21b
19p.1
19p.2
19q
02a.1a
02a.3
02c.1b
02a.4
02c.1a
02d.1a
02a.1b
02d.1b
02d.3
02b.2
02d.2
02a.2
02m
02c.2
02k
02f
02o
02e
02l
02h
02g
02i
02b.1
19s
02j.1
02j.2
02n
16.2
16.1
15b
05d
05g
05c.1
05e
05c.2
05h
05b
05a.1
Legend
California Wildlife Foundation
Potential Invasive Spartina Habitat
County Borders
0
1
2
4 Kilometers


San Francisco Bay
Fremont
05c.1
05e
05c.2
05b
02f
02i
02j.1
05h
02h
05a.1
02n
02j.2
05i
05f
16.2
02g
15b
05a.2
16.1
Alviso
15a.5
Mountain View
Palo Alto
15c
15a.6
15a.4
2013 CWF Treatment Sites
Map 5 of 5
Legend
California Wildlife Foundation
Potential Invasive Spartina Habitat
County Borders
0
1.25
2.5
5 Kilometers
Pacific Ocean

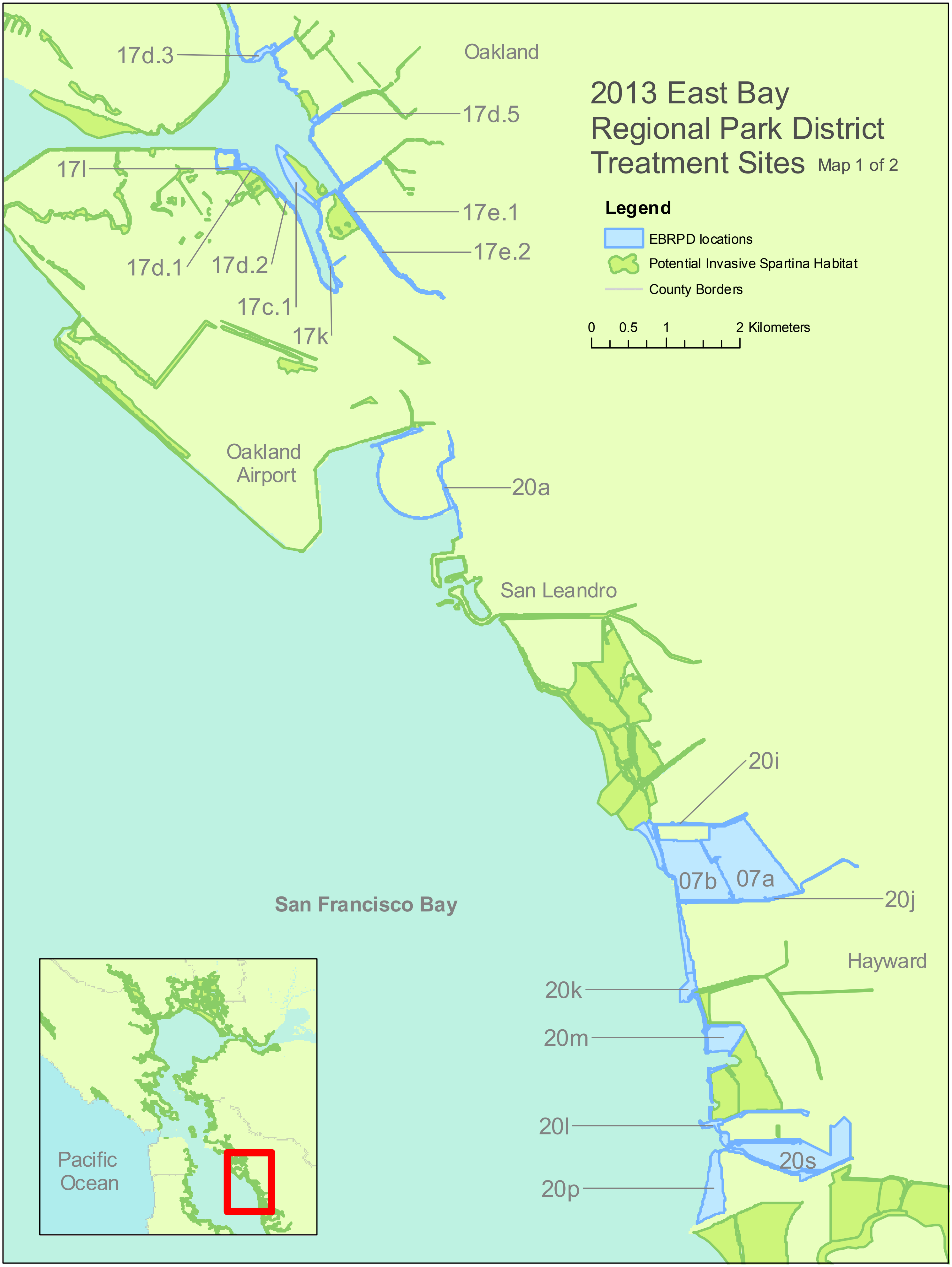

San Francisco Bay
Grizzly Bay
27
2016 CWF Treatment Sites
Map 6 of 6
Legend
California Wildlife Foundation
Potential Invasive Spartina Habitat
County Borders
0 0.75 1.5 3 Kilometers
Pacific Ocean

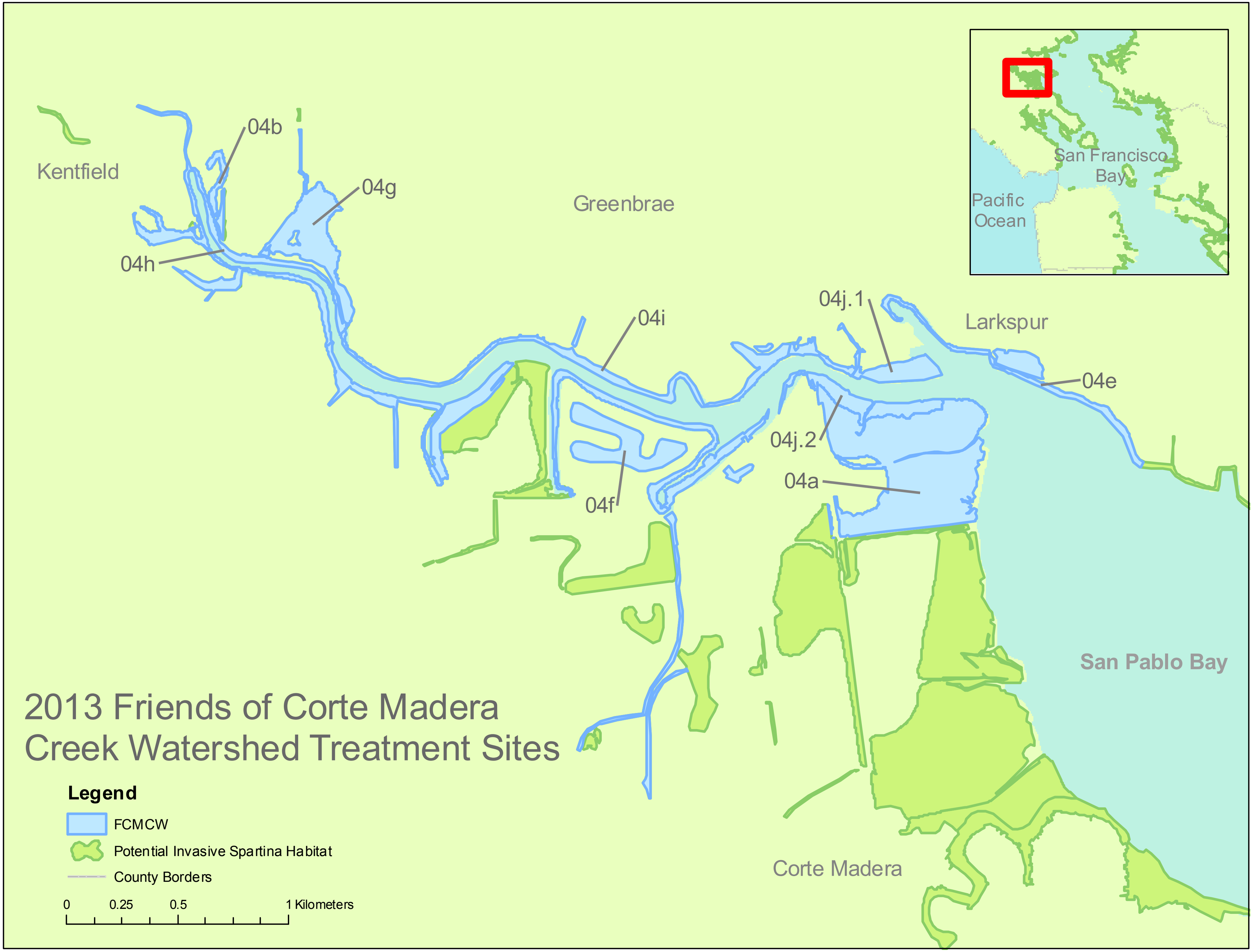


Fremont
San Francisco Bay
15a.5
15a.1
15a.4
Milpitas
15a.2
Mountain View
Palo
Alto
15a.3
Legend
SCVWD
Potential Invasive Spartina Habitat
County Borders
0
1
2
4 Kilometers
2017 CWF Treatment Sites
Formerly SCVWD sites
Pacific Ocean
SF
Bay

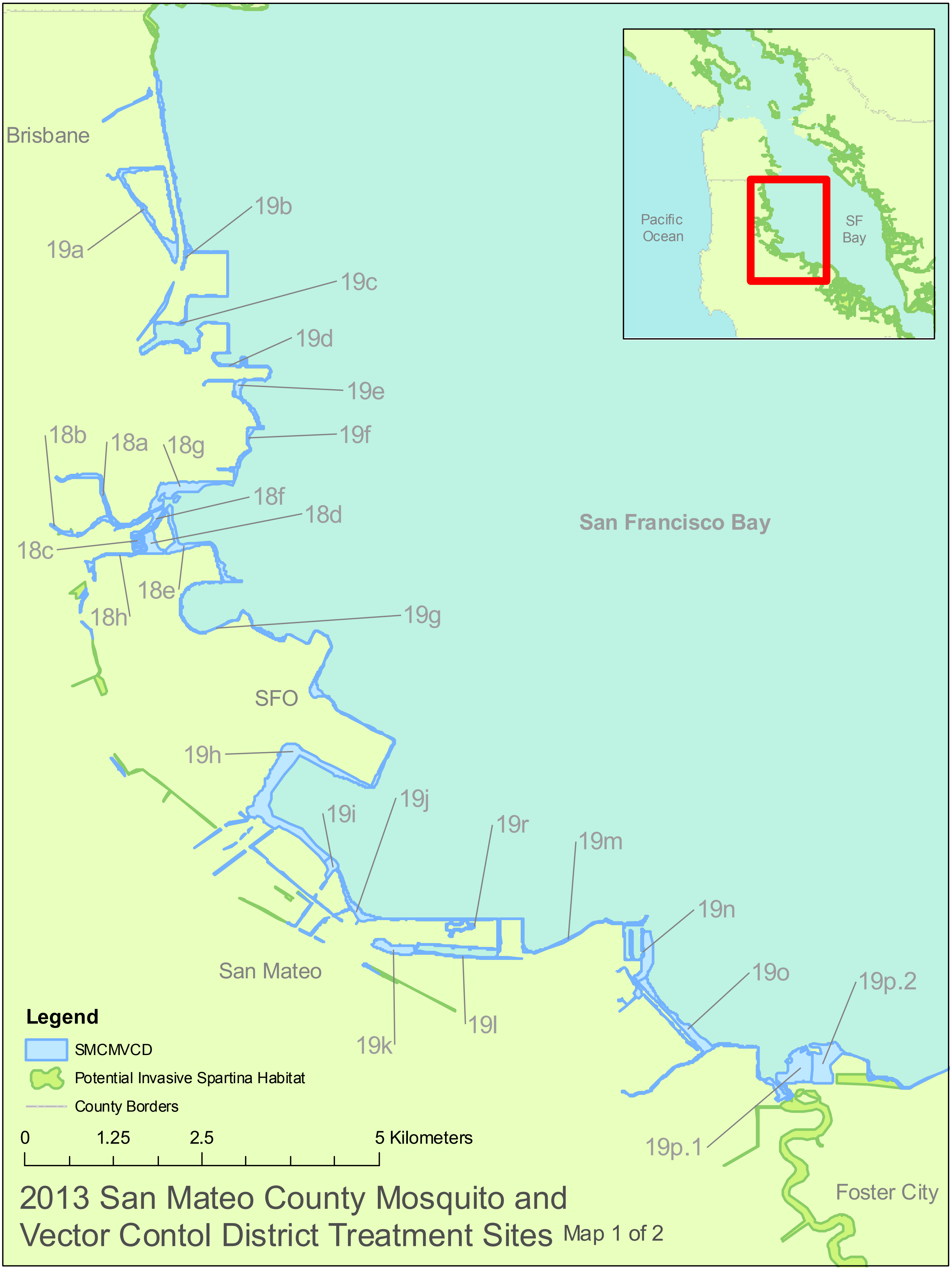

Newark
Don Edwards
San Francisco Bay
National Wildlife
Refuge
San Francisco Bay
08
Palo Alto
Mountain
View
2013 City of Palo Alto Treatment Sites
Legend
City of Palo Alto
Potential Invasive Spartina Habitat
County Borders
0
0.5
1
2 Kilometers
Pacific Ocean

2013 East Bay
Regional Park District
Treatment Sites
Map 1 of 2
Legend
EBRPD locations
Potential Invasive Spartina Habitat
County Borders
0
1.25
2.5
5 Kilometers
San Pablo Bay
Pinole
10a
10b
10c
22c
Richmond
22e
San Francisco Bay
Berkeley
Emeryville
06b
Pacific
Ocean

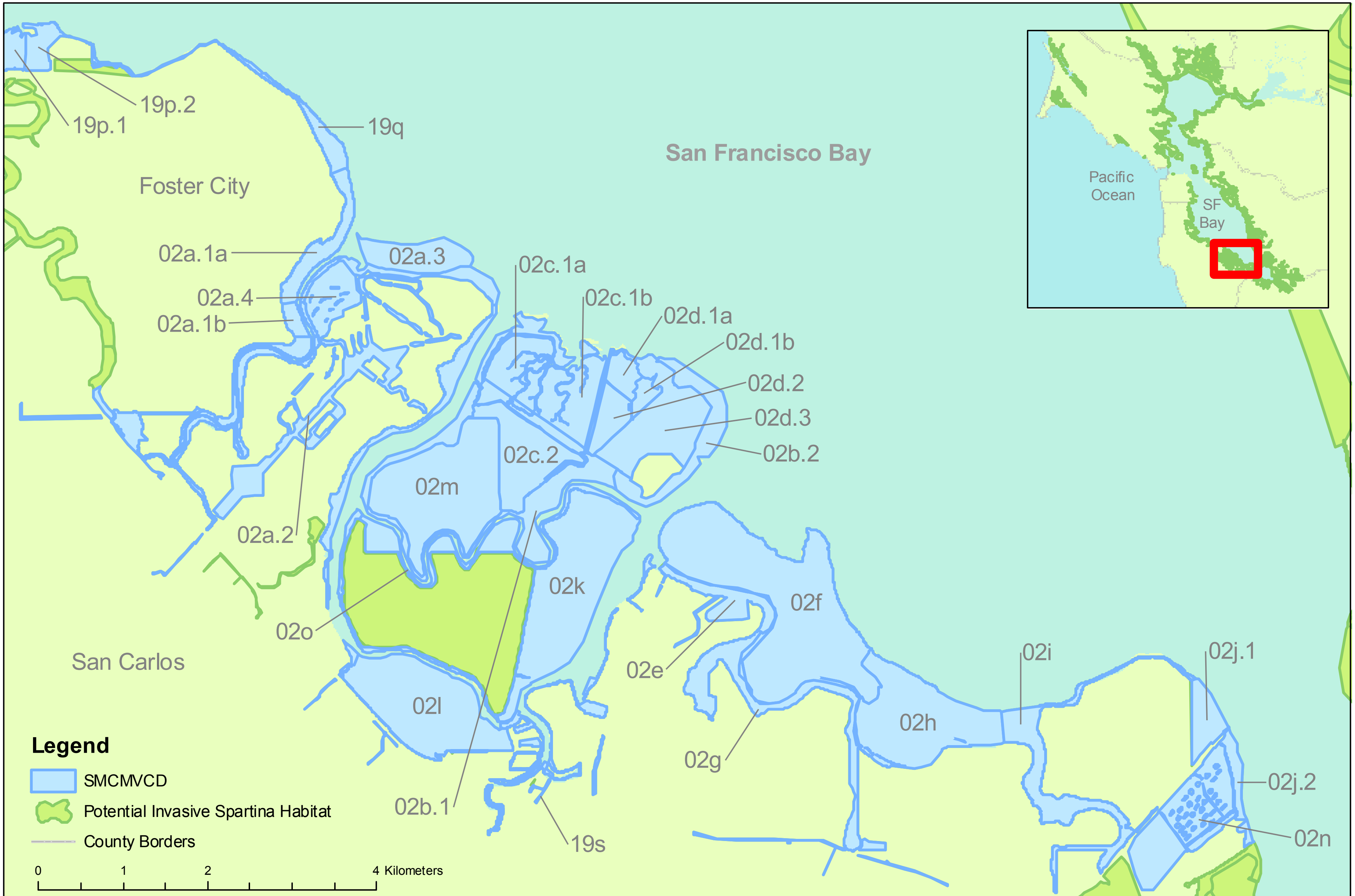

2013 East Bay
Regional Park District
Treatment Sites
Map 1 of 2
Legend
EBRPD locations
Potential Invasive Spartina Habitat
County Borders
0 0.5 1 2 Kilometers
Oakland
17d.3
17d.5
17l
17e.1
17e.2
17d.1
17d.2
17c.1
17k
Oakland Airport
20a
San Leandro
20i
07b
07a
20j
San Francisco Bay
Hayward
20k
20m
20l
20s
20p
Pacific Ocean



Kentfield
Greenbrae
Larkspur
Corte Madera
San Pablo Bay
San Francisco Bay
Pacific Ocean
04b
04g
04h
04i
04j.1
04j.2
04e
04f
04a
2013 Friends of Corte Madera Creek Watershed Treatment Sites
Legend
FCMCW
Potential Invasive Spartina Habitat
County Borders
0
0.25
0.5
1 Kilometers



2013 San Mateo County Mosquito and Vector Contol District Treatment Sites Map 1 of 2



2013 San Mateo County Mosquito and Vector Contol District Treatment Sites

Map 2 of 2