San Francisco Estuary Invasive Spartina Project Restoration Program

Year 12 (2022-2023) Installation Report and Year 11 (2022) Initial Survivorship Monitoring Results

DRAFT

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INTRODUCTION

The California Coastal Conservancy initiated the Invasive *Spartina* Project (ISP) Restoration Program in 2011 to implement components of the San Francisco Estuary Invasive *Spartina* Project California Clapper Rail Habitat Enhancement, Restoration, and Monitoring Plan (Olofson Environmental, January 2012). This plan was prepared to comply with specific requirements of the U.S. Fish and Wildlife Service (USFWS 2011, Zaremba et al. August 2011; Hull, Raabe, Solvesky, pers. comm. September 15, 2011; Raabe memo November 28, 2011), with the broad objective of rapidly establishing habitat features to benefit California Ridgway's rail (formerly California clapper rail¹). The plan focused on habitat enhancements at strategic locations near where recent removal of non-native cordgrass (hybrid *Spartina alterniflora* x *foliosa* or *S. densiflora*) had caused decreases in local California Ridgway's rail populations and included reintroduction of *S. foliosa* into regions where it had been extirpated or radically reduced by the spread and eradication of hybrid *S. alterniflora* × *foliosa*. That initial five-year plan continues to guide the program and we completed a twelfth year of habitat enhancements in winter 2022-23.

A main objective of the ISP Restoration Program is to install native plant species that enhance foraging, roosting, and nesting cover as well as high tide refuge cover for the California Ridgway's rail (Olofson Environmental, 2012) and other wildlife species. To date, OEI and partners have installed more than 580,000 native tidal marsh and marsh-upland transition zone plants at over 40 sites around SF Bay.

This document reports on plant installation activities completed in Year 12 (the winter of 2022-23) and monitoring results primarily for Year 11 (2021-22) plantings. Other habitat enhancements implemented by the program, including construction of high tide refuge islands, are reported separately.

OVERVIEW OF YEAR 12 (WINTER 2022-2023) PLANT INSTALLATION

During Year 12 (2022-23), over 23,600 native tidal marsh and marsh-upland transition zone plants were planted at 16 ISP sub-areas (**Table 1, Table 2, Figure 1**). The native species planted in Year 12 included marsh gumplant (*Grindelia stricta*), Pacific cordgrass (*Spartina foliosa*), and eight marsh-upland transition zone species. As in previous years, marsh gumplant and Pacific cordgrass were planted because they grow taller than other native salt marsh plants, provide more vertical structure for cover, and are critically important vegetative components of native marshes that have populations of California Ridgway's rail. Pacific cordgrass planted at mid- to high-marsh elevations along marsh plain channels at five sub-areas. Marsh-upland transition zone species were planted at eight sub-areas to enhance high tide refuge habitat.

The wet winter resulted in multiple cancellations of groundtruthing and planting days. Boat days were cancelled due to unsafe conditions caused by windy wet weather (i.e., Whale's Tail North/Pond E9 and Bair). Both groundtruthing and planting days were cancelled because several sites were inaccessible due to wet levees that were not drivable (i.e., Cargill Mitigation Marsh and Ideal Marsh South).

¹ The Fifty-fifth Supplement to the Ornithologists' Union Check-list of North American Birds changed the name of the rail subspecies "California Clapper Rail" (*Rallus longirostris obsoletus*) to "California Ridgway's Rail" (*Rallus obsoletus obsoletus*) (Chesser et al., 2014).

Table 1. Year 12 (2022-23) ISP Sub-Areas and Planting Numbers

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jite Name/ISP Subarea Code	Phi	·2 ~3	105° 105	IPacific con	deres DA	05 TOP	MarshGur	notal psilo	stocht guri	nosa t ccharis pilul Eur	aris L anomia occi	enton solir	nus triticol	des 15 coll cernisio coll	ornice spice	and
	Pacific Cordgrass Marsh Gumplant				Marsh-Upland Transition Zone (UTZ)					TOTAL PLANTS***						
Citation Marsh Upper (20d.2a)							100	100	100	100		160	60		620	620
Citation Marsh Central (20d.2b)							200	200	60	200		300	40	40	1,040	1,040
Citation Marsh South (20d.1)				200	200	400										400
Bunker Marsh (20g)							160	160	80	160	100	280	60	80	1,080	1,080
East Marsh (20e)				200	200	400										400
Cogswell A (20m)	500		2,500				160	160	40	160		520		80	1,120	3,620
Cogswell Marsh B Bayfront (20n.1)							20	40	8	60		20		20	168	168
Cogswell Marsh B Main (20n.3)							140	120	32	100		200		60	652	652
Cogswell C (20o)							160	160	40	160	100	200		80	900	900
Whales Tail North (13d)		400	2,000													2,000
Cargill (13f)							60	60	40	60	100	520	40	40	920	920
Pond E9 (13m)	910		4,550													4,550
Ideal Marsh South (21b)	810	200	5,050													5,050
Bair B2 North West (02c.1a)				390	390	780										780
Bair B2 North East (02c.1b)				620	620	1,240										1,240
Bair B2 North - So. of Boardwalk (02c.2)				90	90	180										180
ISP 2022-23 Plant Totals	2,220	600	14,100	1,500	1,500	3,000	1,000	1,000	400	1,000	300	2,200	200	400	6,500	23,600
 1 plug contains 5 Pacific cordgrass stems 1 sod is equivalent to ~6 plugs Pacific cordgrass is reported as stems in t 	otals															

Table 2. Year 12 (2022-23) Plant Installation Schedule

Date(s) of Plant Installation	Region	Site	Contractor	Access
11/29/2022	San Mateo	Bair B2 North West (02c.1a), Bair B2 North East (02c.1b)	SOLitude	Airboat
11/30/2022	San Mateo	Bair B2 North West (02c.1a), Bair B2 North East (02c.1b), Bair B2N – SOB (02c.2)	SOLitude	Airboat
12/2/2022	San Mateo	Bair B2 North East (02c.1b)	SOLitude	Airboat
11/29-11/30/2022	Hayward	Cogswell B (20n)	RECON	Truck/foot
12/6-12/7/2022	Hayward	Bunker Marsh (20g), East Marsh (20e)	RECON	Truck/foot
12/12/2022	Hayward	East Marsh (20e)	RECON	Truck/foot
12/13/2022	Hayward	Citation Marsh Upper (20d.2a), Citation Marsh Central (20d.2b)	SOLitude	Truck/foot
12/14/2022	Hayward	Citation Marsh Central (20d.2b), Citation Marsh South (20d.1)	SOLitude	Truck/foot
12/13-12/14/2022, 1/12/2023	Hayward	Cogswell A (20m)	RECON	Truck/foot
1/18-1/19/2023	Hayward	Cogswell C (20o)	RECON	Truck/foot
1/24-1/25/2023	Union City	Whale's Tail North (13d), Pond E9 (13m)	SOLitude	Airboat
1/24-1/25/2022	Union City	Cargill Mitigation Marsh (13f)	RECON	Truck/foot
1/27/2023, 2/23/2023	Union City	Ideal Marsh South (21b)	SOLitude	Truck/foot



All activities were rescheduled successfully and remarkably all planting was completed within the required timeframe (e.g., planting was completed at all sites where Ridgway's rails were present before February 1). The record rainfall also resulted in higher water levels than predicted at sites which required additional caution while navigating the marsh plain as shown in the photo below of staff leaving Cogswell C at the end of a planting day **(Photo 1).**

Figure 1. Year 12 (2022-23) ISP Plant Installation Sites



Photo 1. Wet winter - higher water levels than predicted at Cogswell C

Plant Propagation

As shown on **Table 1** above, marsh gumplant, Pacific cordgrass and marsh-upland transition zones species including alkali heath (*Frankenia salina*), marsh baccharis (*Baccharis glutinosa*), coyotebrush (*Baccharis pilularis*), creeping wild rye (*Elymus triticoides*), saltgrass (*Distichlis spicata*), western gold-enrod (*Euthamia occidentalis*) western ragweed (*Ambrosia psilostachya*), and California sagebrush (*Artemisia californica*) were outplanted in Year 12. These plants, as in past years, were propagated at The Watershed Nursery, a commercial native plant nursery located in Point Richmond, California.

Marsh Gumplant

Marsh gumplant were propagated in two pot sizes, D16 (Deepot 16 that contains 16 cubic inches of soil) and D40 (Deepot 40 with 40 cubic inches). **Photo 2** shows an example of the D16 and D40 pot sizes. **Photo 3** shows marsh gumplant grown in D40 pots and contained in a tray that holds 20 plants. Both D16 and D40 pots are contained in trays for growing and transporting to planting sites. Plants were germinated from seed collected along Old Alameda Creek in Alameda County. No plants were salt-hardened. Plants were trimmed at the nursery, as needed, to focus growth to the roots and to reduce possible transplant stress.



Photo 2. Example of a D16 (left) and D40 size (right) pot



Photo 3. Example of marsh gumplant grown in D40 pots and contained in planting trays that are used for growing and transport to the planting site

Pacific Cordgrass

Pacific cordgrass was propagated in eight nursery beds according to program protocols (Thornton 2012). Year 12 beds were started with plant material held over from Year 11 propagation effort. The Pacific cordgrass beds were salt hardened prior to outplanting, following the established program protocol. Native cordgrass plant material was harvested from propagation beds for outplanting from six sources including: Golden Gate Fields in the East Bay, Starkweather Cove and Tennessee Valley in Marin County, and American Canyon, Napa River, and Port Sonoma Marina in San Pablo Bay. **Figure 2** shows the general locations where plant material from each source population was originally collected. The different colors for each source population shown in the map are used each year by the nursery and in the field to track each source from harvesting to outplanting. **Photo 4** shows several of the Pacific cordgrass beds at The Watershed Nursery.

Cordgrass plant material for outplanting was harvested from the propagation beds in two ways: plugs and sods. Plugs contained the minimum amount of plant material and soil determined by nursery staff

to be a viable planting unit which typically included ~5 stems and associated rhizome. Plugs were harvested from deeper beds and the roots/soil part of the plug typically measured ~6-8 inches long. Sods were larger chunks of plant material harvested from shallow beds, each sod was either a square (approximately 1ft by 1ft in size) or a rectangle (approximately 6-8" wide by 18-24" long). These larger-sized planting units contain more developed and intact rhizomes and more soil which may result in lower transplant stress. Sods were tested at locations where plant establishment from plugs has been low.

During outplanting, source populations were tracked at each site to help determine if source would influence initial survivorship. shows some of the Pacific cordgrass propagation beds at The Watershed Nursery. Pacific cordgrass plant material is transported from the nursery to outplanting sites in bus tubs as shown in **Photo 5** and **Photo 6**.



Figure 2. Original locations where Pacific Cordgrass plants were collected for propagation in current nursery beds





Photo 4. Pacific cordgrass propagation beds at The Watershed Nursery (October 2022).



Photo 5. Bus tubs filled with Pacific cordgrass plugs were transported by airboat to the Pond E9 planting area. Tubs are marked with colored flags indicating the source population.



Photo 6. Bus tubs containing Pacific cordgrass sods are being transported to planting areas at Whale's Tail North, Eden Landing Ecological Reserve. Blue flags indicate the source population is Port Sonoma Marina.

Planting Designs

The Year 12 planting design for marsh gumplant was the same as in previous years. Two planting designs for Pacific cordgrass were used in Year 12, plots of plugs planted in linear rows as in previous years and plots planted with sods as described below. Planting designs for marsh-upland transition zone species developed in Year 11 were also used in Year 12.

Marsh Gumplant

Marsh gumplant was planted at five subareas including Bair B2 North West (02c.1a), Bair B2 North East (02c.1b), Bair B2 North-South of Boardwalk (02c.2), Citation Marsh South (20d.1), and East Marsh (20e), using the same design as in Years 3 to 11. The plots were approximately 4.5 meters long with 20 plants in two rows, with each plant spaced 0.5 meters apart (see **Figure 3**). **Photo** 7 shows a marsh gumplant plot after installation during Year 12 at Bair B2 North West (02c.1a). For sites accessed using boats, Bair B2 North West (02c.1a), Bair B2 North East (02c.1b), Bair B2 North-South of Boardwalk (02c.2), an airboat was used to maximize the tide window the crew could be on site for planting.





Figure 3. Year 12 (2022-23) marsh gumplant planting design



Photo 7. Marsh gumplant plots being planted along a marsh channel at Bair Island by the SOLitude Lake Management crew

Pacific Cordgrass

Pacific cordgrass was planted at four sub-areas in Year 12 and planting designs included plugs and/or sods.

Cogswell A – Hayward Regional Shoreline. In Year 12, the "paired rows" planting design was used to plant 500 plugs at Cogswell A (schematics shown in **Figure 4** and **Figure 5**). The "paired rows" linear design included two rows located along the marsh edge, with one of the rows directly adjacent to the vegetated marsh edge, typically perennial pickleweed (*Salicornia pacifica*). The basic planting unit was a plot that included five plugs. The five plugs were planted in a square shape with a plug at each corner and one plug in the center as shown in **Figure 4**. The distance between plugs on the corners of each plot was 0.25m. Multiple plots were then planted together in two linear rows along wider channel banks directly adjacent to the vegetated marsh edge (**Figure 6** and **Photo 8**). Sources planted at Cogswell A included American Canyon, Napa River, Port Sonoma Marina, Starkweather Cove, and Tennessee Valley.



Figure 4. Schematic of basic Pacific cordgrass planting plot



Figure 5. Year 12 (2022-23) Pacific cordgrass planting design – "paired rows"





Figure 6. Pacific cordgrass paired rows planting design at Cogswell A



Photo 8. Pacific cordgrass plugs being planted at Cogswell A by the RECON Environmental crew.

Pond E9 - Eden Landing Ecological Reserve. In Year 12, the "paired rows" planting design was used to plant 910 plugs at Pond E9. The "paired rows" linear design included two rows located along the marsh edge, with one of the rows directly adjacent to the vegetated marsh edge, typically perennial pickleweed (*Salicornia pacifica*). The basic planting unit was a plot that included five plugs. The five plugs were planted in a square shape with a plug at each corner and one plug in the center as shown previously in **Figure 4**. The distance between plugs on the corners of each plot was 0.25m. Multiple plots were then planted together in two linear rows along wider channel banks directly adjacent to the vegetated marsh edge. **Figure 5** above shows an example section of the paired rows planting design (depicting eight plots in two rows). The distance, on center, between each plot in each row was 1 meter and the distance between rows was also 1 meter. The length of the areas planted using the "paired rows" design varied. **Figure 7** below is the plant installation map for a portion of the plantings at Pond E9. **Photo 9** shows one of the planted areas after installation. Sources planted included Napa River, Port Sonoma Marina, and Starkweather Cove.



Figure 7. Pacific cordgrass planted using the paired rows planting design at Pond E9



Photo 9. Pacific cordgrass installation at Pond E9 showing the paired rows of plots planted along the edge of the perennial pickleweed

Whale's Tail North - Eden Landing Ecological Reserve. Low survivorship of native cordgrass planted along narrow channel banks at several sites, including Whale's Tail North, led to testing larger chunks of plant material, termed sods, to potentially increase survivorship. Larger-sized planting units would have more developed and intact rhizomes as well as more soil which may result in lower transplant stress. Sods could increase survivorship at sites where plant establishment has been low. The 400 sods installed at Whale's Tail North were rectangular in shape and measured approximately 6-8 inches by 18-24 inches. These sods were called "sod ribbons" and were planted perpendicular to channel bank edges so that the upper edge was planted in perennial pickleweed and the lower edge in bay mud as shown in **Figure 8**. Planting across the suitable elevational range present on channel edges mimics the environment that natural Pacific cordgrass clones grow in with culms at lower elevations submerged while higher elevation culms have access to sunlight and air. Sixty sods in total were planted and anchored using three bamboo stakes. The upper end of each sod was staked with one bamboo and the lower elevation end was staked with two bamboos in an "X" as shown in **Figure 8**. An example of an installed sod ribbon is shown in **Photo 10**. Sods were sourced from shallow Port Sonoma Marina propagation beds.



Figure 8. Pacific cordgrass sod ribbons planting design



Photo 10. Example of Pacific cordgrass sod planted at Whale's Tail North

Ideal Marsh South - Eden Landing Ecological Reserve. Two planting designs were used along narrow marsh channel banks at Ideal Marsh South. **Figure 9** and **Photo 11** show the "shelfoli" design. A total of 810 plugs were planted in plots of ten (instead of five) in two straight lines, each line containing five plugs. This design was tested along smaller channels with narrow banks. All ten plugs in each plot were from the same source. Plug sources planted at Ideal Marsh South included Napa River, Port Sonoma Marina, Starkweather and Tennessee Valley. All sods were harvested from shallow Port Sonoma Marina beds.

A total of 200 sods were also installed at Ideal Marsh South. The planting design for sods was the same as described above for Whale's Tail North. Sods were harvested from shallow Port Sonoma Marina propagation beds.



Figure 9. Native cordgrass planting design for marsh channels for Ideal Marsh South



Photo 11. Pacific cordgrass plugs being planted on Ideal Marsh South channels by the SOLitude Lake Management crew.

Marsh-Upland Transition Zone

Marsh-upland transition zone species were planted in Year 12 to enhance high tide refuge habitat at six restoration marshes: Cargill Mitigation Marsh, Cogswell A, Cogswell B, Cogswell C, Bunker Marsh, and Citation Marsh. The designs were intended to rapidly enhance habitat by planting dense single species plots of rhizomatous perennials that would grow together quickly to provide habitat cover. Planting designs were repeated at all sites and are shown below in Figure 10. Eight native salt tolerant perennial species were selected for planting. Six of the eight species were also rhizomatous perennials with the ability to persist and spread into new areas via rhizomes in years when rainfall is not suitable for seed germination and establishment of new plants. When established, rhizomatous perennials can form dense patches which provide year-round habitat cover. Five rhizomatous perennial species including western ragweed (Ambrosia psilostachya), western goldenrod (Euthamia occidentalis), alkali heath (Frankenia salina), saltgrass (Distichlis spicata), and marsh baccharis (Baccharis glutinosa) were planted in dense plots that contained 20 plants in a 5 by 4 grid (example shown in Photo 12). One rhizomatous perennial grass species, creeping wild rye (Elymus triticoides), was planted in linear plots of 20 plants (two rows of 10 plants, example shown in Photo 13). Two non-rhizomatous species, coyote brush (Baccharis pilularis) and California sagebrush (Artemisia californica), were selected based on stature, hardiness, and salt tolerance. Photo 14 shows an example of a planted coyote brush plot. Both species were planted in small groupings of four plants because of the large crown size of plants at maturity.



Figure 10. Marsh-upland transition zone planting designs



Photo 12. Examples of 5 x 4 grid plots planted at Cogswell C. Plot in the foreground was planted with 20 total *Baccharis glutinosa*



Photo 13. Example of a linear *Elymus triticoides* plot containing two rows of 10 plants after one growing season at Cogswell B. OEI field biologist Dorothy Aldridge shown in photo for general height reference.



Photo 14. Example of plot planted with four Baccharis pilularis at Citation Marsh



Year 12 Installation Maps and Photo Points by Site

The installation maps included below were used by ISP staff during fieldwork to complete the planned planting activities at each site. Photo point locations that were established for Year 12 plantings are included for some sites.



Citation Marsh-Robert's Landing, City of San Leandro







Photo 15. Photo Point 20dPP13 shows marsh-upland transition zone plots before planting at Citation Marsh



Figure 12. Citation Marsh plant installation map for marsh gumplant



Photo 16. Photo Point 20dPP12 shows marsh gumplant plots before planting at Citation Marsh





Bunker Marsh-Robert's Landing, City of San Leandro

Figure 13. Plant installation map for northern marsh-upland transition zone planting area at Bunker Marsh



Photo 17. Photo Point 20gPP08 shows marsh-upland transition zone plots in the foreground that were planted in 21-22 and in the background 22-23 plots before planting at Bunker Marsh



East Marsh-Robert's Landing, City of San Leandro

Figure 14. Marsh gumplant installation map at East Marsh



Cogswell A, Hayward Regional Shoreline



Figure 15. Pacific cordgrass plug installation map for Cogswell A



Photo 18. Photo point 20mPP30 showing Pacific cordgrass plugs after installation at Cogswell A





Figure 16. Marsh-upland transition zone installation map for Cogswell A



Photo 19. Photo point 20mPP29 shows marsh-upland transition zone plots after planting at Cogswell A

Cogswell B, Hayward Regional Shoreline



Figure 17. Marsh-upland transition zone installation map for Cogswell B



Photo 20. Photo Point 20nPP20 shows marsh-upland transition zone plots after installation at Cogswell B

Cogswell C, Hayward Regional Shoreline



Figure 18. Marsh-upland plant installation map for Cogswell C



Photo 21. Photo Point 20oPP26 showing plots after plant installation at Cogswell C.

Ideal Marsh South, Don Edwards San Francisco Bay NWR



Figure 19. Pacific cordgrass plugs installation map for Ideal Marsh South



Figure 20. Pacific cordgrass sods installation map for Ideal Marsh South





Photo 22. Photo point 21bPP01 shows Pacific cordgrass plots of plugs after installation along a marsh channel at Ideal Marsh South



Whale's Tail North and Pond E9, Eden Landing Ecological Reserve



Figure 21. Pacific cordgrass plant installation map for Whale's Tail North and Pond E9



Photo 23. Photo point 13dPP28 shows Pacific cordgrass sods planted along a marsh channel





Bair - B2NE, B2NW, and B2N-SOB, Don Edwards San Francisco Bay NWR

Figure 22. Marsh gumplant plant installation map for B2NE, B2NW, and B2N-SOB



Photo 24. Photo Point 02c.1bPP01 taken after marsh gumplant installation at B2NE



Photo 25. Photo Point 02c.1PP18 taken after marsh gumplant installation at B2NW

MONITORING RESULTS

Initial Survivorship Monitoring for Year 11

This section reports on the initial survivorship monitoring that was conducted in the fall of 2022 for Year 11 (2021-22) plantings at all sites. The initial survivorship monitoring for Year 12 (2022-23) plantings occurred in the fall of 2023 and monitoring results will be included in next year's report.

Plantings installed in the winter of Year 11 (2021-22) were monitored after the first growing season to determine initial survivorship. Initial survivorship monitoring data were collected on individual plants, plant plugs or sods that were outplanted at sites.

Marsh Gumplant

Data collection for initial survivorship of marsh gumplant plantings consisted of counting the total number of surviving individuals present in each planted plot. Each plot contained 20 plants in two rows of 10 plants that were all one size of pot, either D16s or D40s.

Marsh gumplant was planted at nine sub-areas in Year 11 and initial plant survivorship after one growing season was 38% overall as shown in **Table 3**. Overall initial survivorship was higher for Year 11 plots than Year 10 (38% vs. 14.6%) despite drought conditions that continued through the 22-23 winter. Low precipitation levels likely resulted in some level of transplant stress due to higher salinity conditions within marshes.

Site Name	Total # Plots Planted	# Plots Moni- tored in 2022	Mean # of Plants Surviv- ing in Plots (out of 20 to- tal plants)	% Plant Survi- vorship (Plots)	Total # Plots with at least one plant surviving	% Plots with Survivorship (at least one plant sur- vived)
Bair Island – B2 North						
South of Boardwalk	40	40	2.63	13.1%	18	45.0%
Bair Island - Deepwater						
Slough	60	58	5.69	28.4%	46	79.3%
Bunker Marsh	10	10	15.20	76.0%	10	100%
Citation Marsh	30	30	16.93	84.7%	30	100%
Hayward - Cogswell A	10	10	15.90	79.5%	10	100%
HARD Marsh	40	40	7.68	38.4%	32	80.0%
Eden Landing – Pond						
E8A	10	10	0.40	2.0%	3	30.0%
Eden Landing – Whale's						
Tail North	30	30	2.73	13.7%	13	43.3%
Eden Landing – Whale's						
Tail South	10	10	16.40	82.0%	10	100.0%
Total	240	238		38.0%	172	72.3%

Pacific Cordgrass

Data collection for initial survivorship of Pacific cordgrass involved counting the number of live plugs (plugs with green stems) in each planted plot. The number of surviving plugs in a plot (out of either 5 or 10 plugs total), the number of surviving plots (at least one plug survived per plot), the maximum stem height, and number of inflorescences were recorded for each plot.

Pacific cordgrass was planted as plugs at three sub-areas within the Eden Landing Ecological Reserve in Year 11: Pond E8A, Pond E9, and Whale's Tail South. Initial survivorship data from fall 2022 is shown in **Table 4**.

Site Name	# Plots Planted	# Plots Monitored in 2022	Mean Survivorship of Plugs per Plot (Pond E8A/E9 out of 5 total plugs or WTS out of 10 total plugs)	% Surviving Plugs	% Plots with Survivorship (at least one plug survived)
Eden Landing - Pond E8A	215	215	0.58	11.5%	27%
Eden Landing - Pond E9	114	114	3.06	61.2%	96%
Eden Landing - Whale's Tail South	37	37	2.41	24.1%	62%
Totals	366	366	2.01	28%	52%

Table 4. 2022 Initial Survivorship Monitoring Results for Year 11 (2021-22) Pacific Cordgrass Plots

Year 11 initial survivorship was lower overall than Year 10, resulting primarily from low survivorship at Pond E8A. Lower survivorship in this sub-area may be partially the result of historical land use as an evaporator salt pond. It is possible that residual levels of contaminants may be inhibiting plant establishment. Any effects will diminish with time and new recruitment from planted areas that did survive is expected in the future.

Whale's Tail South was originally identified by the program as a priority for enhancements because it is an existing marsh that is largely missing Pacific cordgrass to provide habitat cover along channels for Ridgway's rail and other wildlife. Previous planting efforts at Whale's Tail South along interior marsh plain channels were largely unsuccessful. This year's effort included higher density plantings targeted along one marsh channel. Initial plug survivorship of 24% is encouraging, especially considering that 62% of plots had survivorship. As Pacific cordgrass is rhizomatous, each surviving plug once established can spread laterally to provide cover over a much larger area.

The "sods" planting method was tested for the first time at Whale's Tail North to see how feasible it would be to transport and install these larger chunks of planting material (~1 ft by 1 ft) at ISP sites. Three "sods" were installed successfully and all three were still present during 2022 monitoring, how-ever, no visible green stems were present. It is possible that the "sods" were dormant and monitoring in 2023 will confirm survivorship. Staff and contractors found transport and installation of "sods" very feasible, and "sods" have potential for greater survivorship as they include larger chunks of plant material.

Marsh-Upland Transition Zone

Marsh-upland transition zone species were planted to enhance habitat at treated sites for the first time since the first two years of the program. Seven hardy, salt tolerant perennial species were installed in transition zones to provide native high tide refuge habitat at six sub-areas: Coyote brush (*Baccharis pilularis*), Creeping wild rye (*Elymus triticoides*), Marsh baccharis (*Baccharis glutinosa*), Western ragweed (*Ambrosia psilostachya*), Western goldenrod (*Euthamia occidentalis*), Alkali heath (*Frankenia salina*), and Saltgrass (*Distichlis spicata*). Monitoring results are shown below. Overall initial survivorship for coyote brush was high at 81.6%, with one site where survivorship was lower than 80%; Cogswell B (63%, **Table 5**). For creeping wild rye, overall survivorship was high at 82.1%, with lower survivorship

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at Cogswell A (67.2%, **Table 6**). Initial survivorship for the five species planted in 4x5 grids was high (over 80%) with one species, alkali heath, slightly lower at 73.5% (**Table 7**). Combined survivorship by site for these five species is shown in **Table 8**.

Frequent watering likely contributed to the high survivorship for most species at most sites. The continued drought conditions during the 2021-22 winter required consistent watering at all sites during most months (2 times per month). Our watering efforts typically initiated during the planting effort since we watered all plants immediately after planting and then continued as needed through the end of June.

Table 5. 2022 Initial Survivorship Monitoring Result	s for Year 11	(2021-22) Coyote	Brush (Baccharis	pilularis)
Plots (4 plants per plot)				

Site Name	Total # Plots Planted	# Plots Moni- tored in 2022	Mean # of Plants Surviv- ing in Plots (out of 4 total plants)	% Survivorship	Total # Plots with at least one plant surviving	% Plots with Survivorship (at least one plant sur- vived)
Cargill Mitigation Marsh	25	25	3.52	88.0%	25	100.0%
Citation	25	25	3.56	89.0%	25	100.0%
Cogswell A	25	25	3.40	85.0%	25	100.0%
Cogswell B (Main and						
Bayfront)	25	25	2.52	63.0%	23	92.0%
Total	100	100	3.26	81.6%	98	98.0%

 Table 6. 2022 Initial Survivorship Monitoring Results for Year 11 (2021-22) Creeping Wild Rye (*Elymus triticoides*)

 Plots (20 grass plugs per plot)

Site Name	Total # Plots Planted	# Plots Moni- tored in 2022	Mean # of Plants Surviv- ing in Plots (out of 20 to- tal plants)	% Survivorship	Total # Plots with at least one plant surviving	% Plots with Survivorship (at least one plant sur- vived)
Cargill Mitigation Marsh	9	9	17.67	88.3%	9	100.0%
Bunker	15	15	18.40	92.0%	15	100.0%
Citation	30	30	16.50	82.5%	30	100.0%
Cogswell A	25	25	13.44	67.2%	23	100.0%
Cogswell B (Main and	10	10	16 70	0.2 50/	10	02.0%
Bayfront)	10	10	16.70	83.5%	10	92.0%
Cogswell C	10	10	19.20	96.0%	10	100.0%
Total	99	99	16.41	82.1%	97	98.0%



 Table 7. 2022 Initial Survivorship Monitoring Results for Year 11 (2021-22) Rhizomatous Perennial Marsh-Upland Transition Zone Species Planted in 4x5 Grids (20 plants per plot)

Total # Plots Planted	# Plots Moni- tored in 2022	Mean # of Plants Surviv- ing in Plots (out of 20 to- tal plants)	% Survivorship	Total # Plots with at least one plant surviving	% Plots with Survivorship (at least one plant sur- vived)
50	50	17.74	99.70/	50	100.0%
50	50	17.74	88.7%	50	100.0%
25	25	18.16	90.8%	25	100.0%
23	23	10.10	50.070	23	100.070
50	49	18.22	91.1%	49	100.0%
25	23	14.70	73.5%	23	100.0%
25	25	16 20	81.0%	23	92.0%
	Total # Plots Planted 50 25 50 25 25 25	Total # Plots# Plots Moni- tored in 202250502525504925232525	Total # Plots Plots PlantedMean # of Plants Surviv- ing in Plots (out of 20 to- tal plants)505017.74252518.16504918.22252314.70252516.20	Total # Plots Plots PlantedMean # of Plants Surviv- ing in Plots (out of 20 to- tal plants)% Survivorship505017.7488.7%252518.1690.8%504918.2291.1%252314.7073.5%252516.2081.0%	Total # Plots Plots PlantedMean # of Plants Surviv- ing in Plots (out of 20 to- tal plants)Total # Plots with at least one plant surviving505017.7488.7%50505017.7488.7%50252518.1690.8%25504918.2291.1%49252314.7073.5%23252516.2081.0%23

 Table 8. 2022 Initial Survivorship Monitoring Results by Site for Five Year 11 (2021-22) Rhizomatous Perennial

 Marsh-Upland Transition Zone Species Planted in 4x5 Grids (20 plants per plot)

Site Name	Total # Plots Planted	# Plots Moni- tored in 2022	Mean # of Plants Surviv- ing in Plots (out of 20 to- tal plants)	% Survivorship	Total # Plots with at least one plant surviving	% Plots with Survivorship (at least one plant sur- vived)
Cargill Mitigation Marsh	25	24	19.38	96.9%	24	100.0%
Bunker	45	45	18.22	91.1%	44	97.8%
Citation	35	35	16.74	83.7%	35	100.0%
Cogswell A	20	20	12.35	61.8%	20	100.0%
Cogswell B (Main and Bayfront)	25	24	17.00	85.0%	23	95.8%
Cogswell C	25	24	18.79	94.0%	24	100.0%
Total	175	172	17.24	86.2%	170	98.8%

Photo Point Monitoring

Photo points are set-up prior to plant installation and initial follow-up photos are taken immediately after planting is complete. A sub-set of the photo point photos taken immediately after planting for Year 12 sites are included above (section called Year 12 Installation Maps and Photo Points by Site). Follow-up photo points taken in 2022 that are included here represent a variety of planting years.





Photo 26. Photo Point 01aPP03 shows a Year 2 (2012-13) Pacific cordgrass planted area at the Alameda Flood Control Channel. Photo taken August 2022.



Photo 27. Photo Point 01cPP05 shows another Year 2 (2012-13) Pacific cordgrass planted area at Alameda Flood Control Channel. Photo taken August 2022.



Photo 28. Photo Point 18gPP07 shows Year 10 (2020-21) Pacific cordgrass plantings at San Bruno Marsh. Photo was taken two growing seasons after installation, August 2022.



Photo 29. Photo Point 18gPP08 shows Year 10 (2020-21) Pacific cordgrass plantings at San Bruno Marsh. Photo was taken two growing seasons after installation, August 2022.



Photo 30. Photo Point 20gPP02 shows Year 2 (2012-13) marsh gumplant at Bunker Marsh in San Leandro. Photo taken September 2022.



Photo 31. Photo Point 20dPP09 shows Year 5 (2015-16) marsh gumplant along a marsh plain channel at Citation Marsh. Photo taken August 2022.



Photo 32. Photo Point 20mPP24 shows Year 4 (2014-15) marsh gumplant at Cogswell A. Photo taken August 2022.





Photo 33. Photo Point 20nPP11 shows Year 3 (2013-14) marsh gumplant at Cogswell B. Photo taken August 2022.

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