Oro Loma Horizontal Levee Vegetation Report

SAVE THE BAY

NOVEMBER 1, 2017

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INTRODUCTION

The Oro Loma Horizontal Levee Project is a multi-agency and multi-jurisdictional project combining the expertise of numerous project partners to address multiple functions for the Oro Loma wastewater treatment facility (http://www.oroloma.org/wp-content/uploads/horizontal-levee-overview). The $9.1 million Horizontal Levee Project took approximately two years to complete, and will be monitored post-construction to evaluate its success. Project partners include the Oro Loma and Castro Valley Sanitary Districts, ESA Associates (http://www.esassoc.com), Peter Baye (private consultant), Whitley Burchett and Associates, ReNU-Wit, The Bay Institute, and David Sedlak and Alex Horne from UC Berkeley, The Bay Institute, and Save The Bay. The project converted a ten-acre field along the Bay's edge into an eight-million gallon holding basin connected to an adjacent horizontal levee. Water entering the treatment facility will first go through a conventional treatment process and then pumped into a wet weather treatment basin. Bulrushes and cattails are part of the design to help remove 10-30 percent of nutrients through plant and microbial uptake. The water will then seep into the adjacent horizontal levee for additional treatment (Figure 1 and Figure 2).

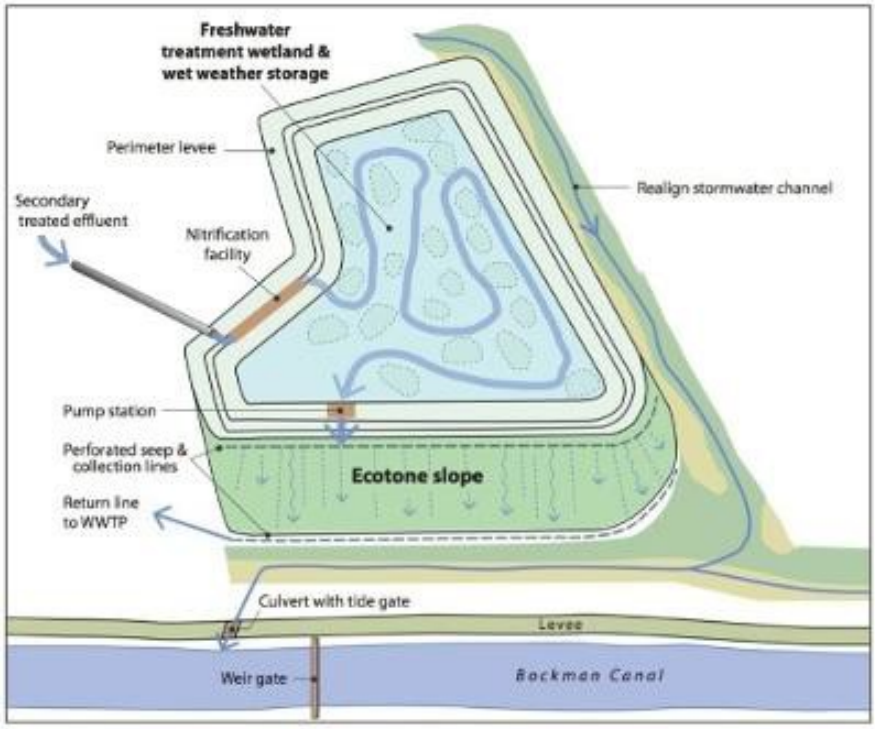

Figure 1: Plan view of the wet weather treatment basin and horizontal levee/ecotone slope (ESA).

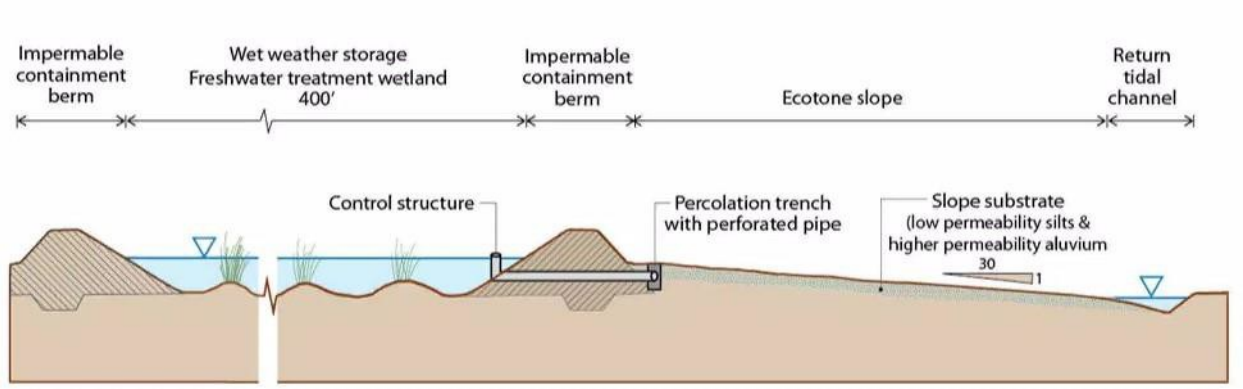

Figure 2: Side view of horizontal levee design (ESA and Baye 2012).

The horizontal levee tests multiple functions including adaptive strategies for climate change and sea level rise, filtration of wastewater, as well as provide native habitat along the ecotone slope. Unlike a traditional levee with a 1:1 slope, the horizontal levee designed by ESA (http://thebayinstitute.blob.core.windows.net/assets/SLR_Executive_Summary_web.pdf) is a 30:1 slope. The levee slope comprises 12 different "experimental beds" referred to as "cells", containing several mixtures of substrates and vegetation/habitat types. The bottom layer of each cell is impermeable clay, the middle contains porous gravel, and the top layers are varying mixtures of bay mud, sand and soil. The varying cell types will test the sediment's ability to treat wastewater flowing through the levee from the holding basin. Researchers from UC Berkeley will collect water samples from the water column beneath the horizontal levee to determine the efficacy of filtration across cell types. Additionally, vegetation installed on the levee in three distinct habitat types serve as analogs for historical habitats in the East Bay, and the Project will test the difference in the various cells and associated plant communities to remove nutrients from the wastewater moving through it.

Save The Bay worked in partnership with the Oro Loma Sanitary District (OLSD), ESA, and Peter Baye to collect seed and vegetative stock and to propagate and install plants for the ecotone slope at the Horizontal Levee project site. Save The Bay collected approximately 4,000,000 bulk seeds for the annual seed cover crop and propagated approximately 70,000 plants, with most of the plants propagated on site in 17 raised beds. Save The Bay collected native seeds and vegetative material in lowland and wetland habitats of the East Bay.

METHODS

Coastal Ecologist Peter Baye served as an advisor to Save The Bay and provided crucial guidance on the location of plant and seed stock in the field, as well as guidance on plant propagation methods for a project of this scale. Save The Bay collected plant material and propagated mature plants, shoots, and rhizome divisions using staff and volunteers trained and managed by Save The Bay staff. Plants were installed based on project design documents developed by ESA and under the guidance of Peter Baye.

Nursery Construction

Save The Bay constructed 17 raised beds at the Oro Loma Sanitary District to accommodate the propagation of both the rhizomatous species and some of the species grown to amplify the numbers needed for the annual seed mix. The raised bed construction included building wood frames, installing heavy plastic in each frame, and filling the frames with soil. Constructing raised beds on the project site reduced the transportation and maintenance costs for the project.

Figure 3. Save The Bay staff constructing raised beds

Each 10 ft by 20ft raised bed was constructed using new Douglas fir lumber (Figure 3). The required rooting zone of the different species of propagules determined the bed depth. Eight of the 17 beds were 12 inches deep, while the remaining nine were 6 inches deep (Figure 4). The shallower beds were planted with species less dependent on developing deep root systems. The Oro Loma Sanitary District provided the irrigation/watering for all plants. Save The Bay staff and volunteers maintained and weeded the beds throughout the project.

Figure 4. Raised bed construction at the Oro Loma Wastewater Treatment Site.

Seed and Rhizome Collection

Save the Bay began collecting seed and rhizomatous divisions for the Oro Loma project in the Fall of 2014 for planting in the Winter of 2015 - 2016. Source populations for collection were all located on the eastern side of the Bay. Collection sites included East Bay Regional Parks: Point Pinole, Coyote Hills, Lake Chabot, and Garin Park. For the annual seed mix, additional sites outside the East Bay included Sears Point in Sonoma and Foothills Park in Los Altos Hills (Figure 5). Save The Bay obtained collection permits from each park and park staff were notified prior to each day of collection.

Figure 5: Map of the propagule and seed collection sites in the East Bay. Source: East Bay Regional Parks

Coastal Ecologist, Peter Baye designed the species assemblages for the project which included plant quantities for Wet Meadow, Riparian Scrub, and Swale/Depression Wet Meadow Treatments (Table 1**)**). Locations for hard to find species were provided by Peter Baye via hand-drawn maps, locator pins on Google Earth, and email correspondence. Additional populations were located in the field using Calflora and local species lists. Qualified staff identified plants to the species level prior to collection using the Jepson Manual (Baldwin et al. 2012). Plant material collected comprised no more than 5% of the population at any individual collection site. Care was taken to minimize the impact of collection on the habitat.

Table 1. Total plant quantities for wet meadow, riparian scrub, and swale/depression wet meadow treatments (Baye 2014).

Species Name	Common Name	Propagule Type/Units	Estimated Amount/Units
Elymus triticoides/*E*. x *multiflorum*	Creeping wildrye, alkali wildrye	Shoot divisions, natural clumps 2-3 shoots, rhizome fragments	23,100
Juncus arcticus, ssp *balticus*	Baltic rush	Shoot divisions, rhizome divisions with min. 3 shoots.	9,400
Juncus phaeocephalus or mix with *Juncus xiphioides*	Brown-head rush or iris-leaved rush	Shoot divisions, rhizome divisions with min. 3 shoots.	5,775
Eleocharis macrostachya	Common spikerush	Shoot divisions, rhizome divisions with min. 3 shoots.	3,675
Baccharis glutinosa	Marsh baccharis	Shoot divisions, rhizome divisions with min.1 shoot	3,413

Species Name	Common Name	Propagule Type/Units	Estimated Amount/Units
Carex praegracilis	Field sedge	Shoot divisions, rhizome divisions with min. 3 shoots.	3,277
Carex barbarae	Basket sedge, whiteroot	Shoot divisions, rhizome divisions with min. 2 shoots.	2,362
Euthamia occidentalis	Western goldenrod	Shoot divisions, rhizome divisions with min.1 shoot	2,888
Symphyotrichum chilense	Pacific aster	Shoot divisions, rhizome divisions with min.1 shoot	2,888
Artemisia douglasiana alternate; *Ambrosia psilostachya*	Mugwort; alternate Western ragweed	Shoot divisions, rhizome divisions with min.1 shoot	2,888
Lythrum californicum	California loosestrife	Shoot divisions, rhizome divisions with min.1 shoot	2,888
Salix lasiolepis (or any East bay lowland native *Salix* sp.	Arroyo willow	First year seedling, bulk grown; alternative direct-plant dormant willow stakes	2,100
Rubus ursinus	California blackberry	Any equivalent btw D-16 to one gallon	1,575
Juncus effusus	Bog rush	Any equivalent btw D-16 to one gallon	1,050
Rosa californica	California rose	Any equivalent btw D-16 to one gallon	525
Bolboschoenus maritimus	Alkali bulrush	Single shoot or corm (dormant) to one gallon	263
Cornus sericea	Red Osier dogwood	Any equivalent btw D-16 to one gallon	263
Sambucus nigra	Blue elderberry	Any equivalent btw D-16 to one gallon	263
Total Number of Plants			**68,593**

Figure 6. Rhizome division of Baltic rush (*Juncus balticus*).

Rhizome divisions were collected by Save The Bay's restoration staff using hand picks and trowels to expose rhizomes growing on the fringes of source populations (Figure 6). Some propagules were taken from within dense patches of certain species, while maintaining a standard practice of removing no more than 5% of the total population. Leaves and shoots on the divisions were cut back after harvesting to reduce evapotranspiration. The divisions were then stored in a damp bag or buckets for transport to the onsite nursery.

Annual Seed Mix Collection

The annual cover crop seed mix for the slope comprised approximately 4,000,000 seeds. The cover crop was designed to reduce competition from non-native and invasive weeds so that the perennial forbs, graminoid, and woody species could more rapidly expand. Some seed was used to grow ecotone slope species in our nurseries, but most of the seed was collected to procure a native annual seed mix. Ripened seed was collected from mature plants in the field and in sowed into amplification beds at Save The Bay's OLSD onsite nursery and in propagation flats in Save The Bay's offsite nurseries. The annual seed mix included hayfield tarweed, (*Hemizonia congesta)*, coast tarweed (*Madia sativa*), fringed willow herb *(Epilobium ciliatum),* meadow barley *(Hordeum brachyantherum,* toad rush *(Juncus bufonius),*and annual saltmarsh aster *(Symphyotrichum subulatum)(*Table 2).

Table 2. Annual seed mix species distributed across the Oro Loma Horizontal Levee Ecotone Slope

Species	Common Name
Coast tarweed	*Madia sativa*
Eastern marsh aster	*Symphyotrichum subulatum* ssp. *subulatum*
Hayfield tarweed	*Hemizonia congesta* ssp. *congesta*
Meadow barley	*Hordeum brachyantherum*
Toad rush	*Juncus bufonius*
Willow herb	*Epilobium ciliatum*

Seed Cleaning. Save The Bay staff used a seed blower machine to clean the seed to reduce chaff and extraneous plant material in the seed (Figure 7). This allowed us to determine gave us an accurate estimate of the amount of seed that we had. The project was designed to spread about 2,000,000 – 4,000,000 seeds across the cells at about 25-50 seeds/ft^2. Despite the various seed sizes of the different species, we were able to approximate the 4 million goal and ended up with about 12 pounds of seed collected and cleaned by STB staff and fellows.

Figure 7. Seed cleaning machine used for Oro Loma project.

Cleaned seeds were mixed together into one-gallon sized ziplock bags with equal parts sifted dry potting soil and vermiculite. The seeds were broadcast across the 12 cells using a 25-lb capacity handheld spreader (1 Hole by Earthway)(Figure 8). Seeds were lightly scraped into the soil with rakes in cells 2, 9, and 10. Two of the wet meadow cells were seeded before planting and the rest were seeded after planting.

Figure 8. Seeds of coast tarweed (left) and spreading seed (right) on the ecotone slope.

General Propagation Methods

Various propagation methods were used to grow plant species for the Oro Loma project. The methods used were dependent on species, time constraints, and ease of propagation. Propagation methods included using propagation/division beds for rhizomatous species, nursery grown container plants, and annual seeding.

Propagation in Division Beds. The species that were propagated in the division beds using rhizomes and vegetative material collected in the field included creeping wild rye (*Elymus triticoides*), Baltic rush (*Juncus balticus*), iris leaf rush (*J. xiphiodes*), field sedge (*Carex praegracilis*), Santa Barbara sedge (*C. barbarae*), alkali bulrush (*Bolboschoenus maritimus*), common spikerush (*Eleocharis macrostachya*), and western ragweed (*Ambrosia psilostachya*). These species were grown vegetatively primarily due to the limited timeline or difficulty of propagation by seed and the potential to easily amplify the populations over the typical method of container propagation. To calculate how many divisions were required to propagate each species, each harvested rhizome was estimated to produce 2-3 new individuals, a ratio of 1:2-3, except for creeping wildrye which was estimated to produce a higher ratio of 1:6.

Species planted in the 12-inch beds included Baltic rush (*Juncus balticus*), iris-leaved rush (*Juncus xiphiodes*), common rush (*Juncus effusus*), alkali bulrush (*Bolboschoenus maritimus*), spike rush (*Eleocharis macrostachya*), field sedge (*Carex praegracilis*), and Santa Barbara sedge (*Carex. barbarae*). All other rhizomatous species grown for the project were grown in 6-inch deep beds.

All beds were constructed onsite and lined with plastic to insure that adequate moisture was retained (Figure 9). The soil media used was purchased from Lyngso, a landscape materials company based out of San Carlos, CA. The media is called “Nursery Mix” and consists of top soil, compost and fine redwood amendment with no added fertilizer.

Figure 9. Plant propagation progression in raised beds. Source: Save The Bay photos

Propagation From Seed and Grown in Division Beds. The species that were grown in the division beds but started from seed in Save the Bay’s nurseries included pacific aster (*Symphyotrichum chilense*), marsh baccharis (*Baccharis glutinosa*), western goldenrod (*Euthamia occidentalis*), mugwort (*Artemisia douglasiana*), California loosestrife (*Lythrum californicum*), and common rush (*Juncus effusus*).

Container plants. Species grown in containers included California rose (*Rosa californica*), Red Osier dogwood (*Cornus sericea*), blue elderberry (*Sambucus nigra*) California blackberry (*Rubus ursinus*) and arroyo willow (*Salix lasiolepsis*). About half of the quantity of the willow stakes were installed as willow stakes.

Irrigation

Save The Bay designed the irrigation for the nursery beds and it was installed by the Oro Loma Sanitary District staff. Water was sourced from an on-site well, managed by the sanitary district (Figure 10). An overhead sprinker system comprised a two-inch diameter PVC pipe run from the source to the nursery and attached to the irrigation system (Figure 6). Ten sprinkler heads (Rainbird 25PJDAC brass impact sprinklers) were mounted on risers within the division bed area. Their radiuses were adjusted to 90, 180, and 360 degrees to ensure that the irrigation was concentrated within the nursery area (Figure 11).

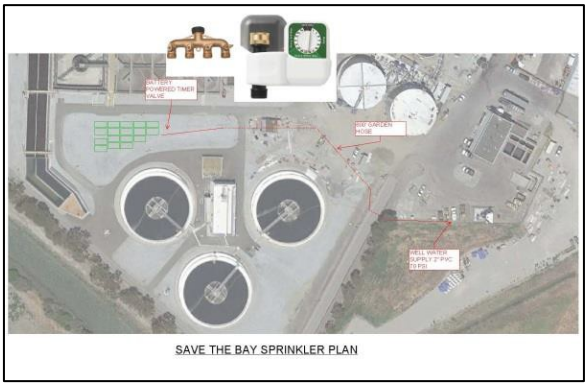

Figure 10. Location of irrigation system and water source within the OLSD site.

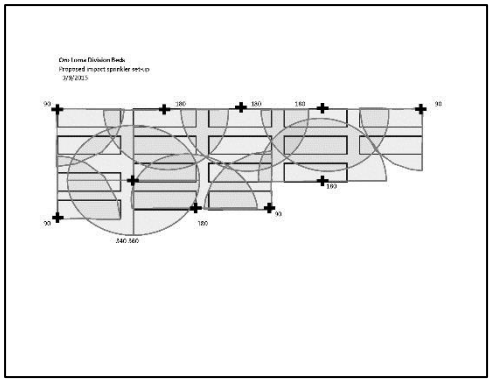

Figure 11. Irrigation system setup for the nursery beds

The irrigation system was designed to minimize cost and simplify construction so that it could be installed as quickly as possible. Due to the distance and elevation changes between the water source and the nursery, the pressure was not adequate to sufficiently feed the sprinkler heads. This led to inconsistent irrigation coverage especially in the beds furthest from the well. The two beds on the southwest corner of the nursery were largely unused due to this reason. Concurrently, the spray was not precise, wasting water and creating muddy walkways between the beds.

Site Preparation

Construction contractors completed the site preparation according to the approved design in preparation for planting. The horizontal levee was divided into 12 cells; each cell 40 feet wide and 150 ft long. From west to east, the first three cells comprised swale and depression habitats with small ponds/pools with aquatic rush species. The next three cells were wet meadow habitats with low growing forbs and grasses, and the following six cells alternated between riparian scrub habitat/willow thickets and wet meadow habitat (Figure 12).

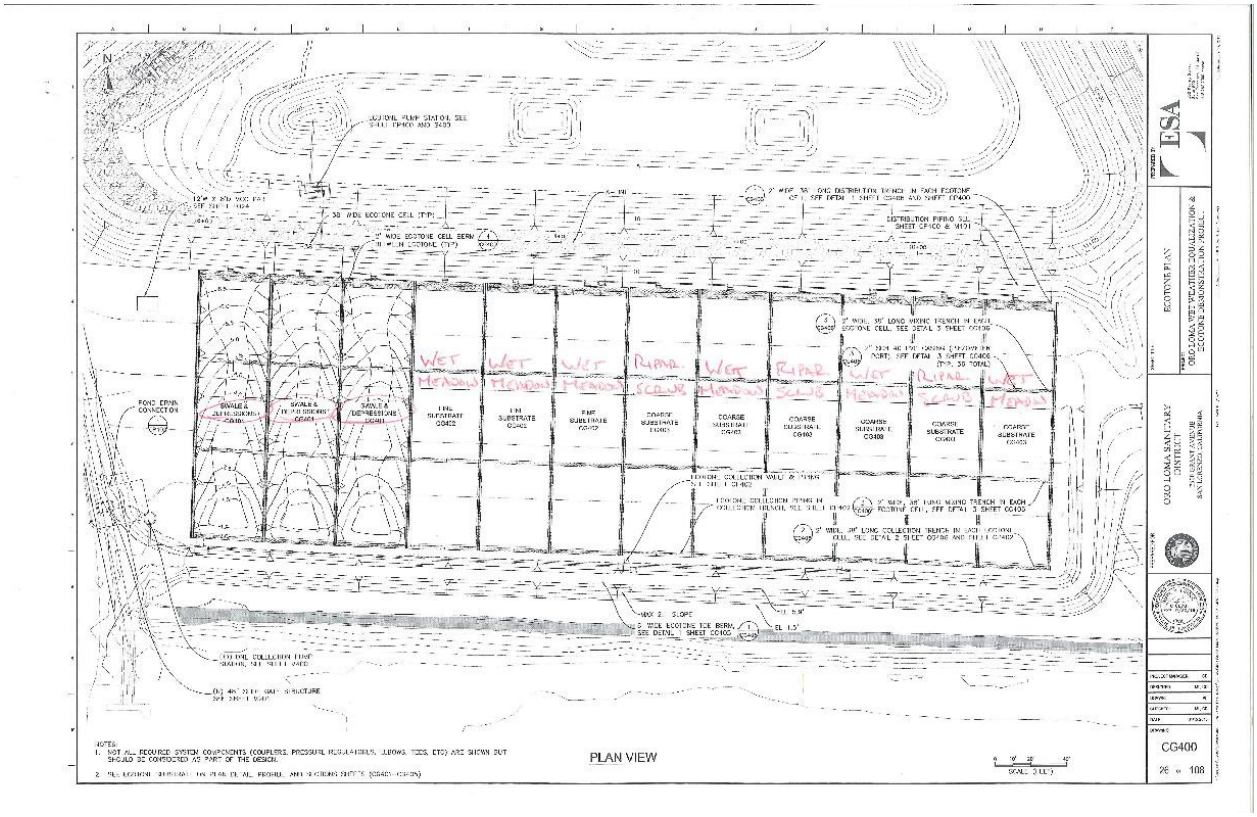

Figure 12. Placement of the different cell habitat types

Ecotone Planting

Each habitat type comprised a specific plant assemblage (Tables 3-5) and planting density. Plants installed in the wet meadow and swale-depression cells were spaced approximately one foot from each other with a total of approximately 7,000 plants in each cell. Riparian woody species installed in the riparian cells were spaced four feet apart from each other with the sedge understory roughly one foot apart, resulting in a total of 2,520 plants installed in each cell. In an attempt to replicate natural populations in the wild, species were grouped together in patches ranging from 20-60 individuals.

Table 3. Wet meadow cell planting plan (six cells)

Species	Common Name	Plants per 10 ft by 40 ft grid	Plants per cell	Plants per 1/3 cell	Total for all Wet Meadow Cells
Artemisia douglasiana	California mugwort	20	350	117	2,100
Baccharis glutinosa	Marsh baccharis	20	350	117	2,100
Carex barbarae	Santa Barbara sedge	20	350	117	2,100
Carex praegracilis	Field sedge	20	350	117	2,100

Species	Common Name	Plants per 10 ft by 40 ft grid	Plants per cell	Plants per 1/3 cell	Total for all Wet Meadow Cells
Elymus triticoides	Creeping wildrye	160	2,800	933	16,800
Euthamia occidentalis	Western goldenrod	20	350	117	2,100
Lythrum californicum	Common loosestrife	20	350	117	2,100
Juncus balticus	Baltic rush	60	1,050	350	6,300
Juncus xiphiodes	Iris-leaved rush	40	700	233	4,200
Symphotrichum chilense	California aster	20	350	117	2,100
Total					**42,000**

Table 4. Riparian scrub planting plan (three cells)

Species	Common Name	Plants per 10 ft by 40 ft grid	Plants per cell	Plants per 1/3 cell	Total for all Riparian Scrub Cells
Baccharis glutinosa	Marsh baccharis	10	175	58	525
Carex barbarae	Santa Barbara sedge	22	385	128	1,155
Carex praegracilis	Field sedge	22	385	128	1,155
Cornus sericea	Red osier dogwood	5	88	29	263
Rosa californica	California rose	10	175	58	525
Rubus ursinus	California blackberry	30	525	175	1,575
Salis lasiolepis	Arroyo willow	40	700	233	2,100
Sambucus nigra	Black elderberry	5	88	29	263
Total					**7,561**

Table 5. Swale-depression meadow planting plan (three cells)

Species	Common Name	Plants per 10 ft by 40 ft grid	Plants per cell	Plants per 1/3 cell	Total for all Swale Depression Meadow Cells
Artemisia douglasiana	California mugwort	15	263	88	788
Baccharis glutinosa	Marsh baccharis	15	263	88	788
Carex praegracilis	Field sedge	15	263	88	788

Species	Common Name	Plants per 10 ft by 40 ft grid	Plants per cell	Plants per 1/3 cell	Total for all Swale Depression Meadow Cells
Elymus triticoides	Creeping wildrye	120	2,100	700	6,300
Euthamia occidentalis	Western goldenrod	15	263	88	788
Lythrum californicum	Common loosestrife	15	263	88	788
Juncus balticus	Baltic rush	60	1,050	350	3,150
Juncus xiphiodes	Iris-leaved rush	30	525	175	1,575
Symphotrichum chilense	California aster	15	263	88	788
Pool Species					
Bolboschoenus maritimus	Alkali bulrush	5	88	29	263
Carex barbarae	Santa Barbara sedge	5	88	29	263
Eleocharis macrostachya	Common spikerush	70	1,225	408	3,675
Juncus effuses	Common rush	20	350	117	1,050
Total					**21,004**

In order for volunteers and Save The Bay staff to easily follow the planting plan, each species was assigned a specific colored flag (Figure 13). Each flag represented a cluster of five individual propagules for wet meadow and swale-depression cells, as well as for the sedge understory in the riparian cells. The woody-riparian shrubs were marked individually by a single colored flag. The colored flags worked well to both speed up the outplanting process for staff as well as limit confusion and mistakes made by volunteers. The flags were removed after the plants were installed to show that the plants had been planted. Flags were counted at the end of the planting event to verify installed plant numbers.

Figure 13. Example of plant flagging demarcating plant locations for the ecotone slope (Photo by Vivian Reed/Save The Bay)

Planting Schedule

The first day of planting occurred in conjunction with an Open House event at the OLSD on November 14, 2015. Plant installation on the ecotone slope occurred in November and December 2015 and January 2016. Implementation was dependent upon timing of construction of the ecotone slope and weather conditions during the implementation period.

Cattail and Bulrush Planting in the Wet Weather Basin

After the completion of construction at the Wet Weather Treatment basin, Save The Bay planted rhizomes/bulbs in individual cells of the basin per the plant quantities and species provided in the planting design supplied by Peter Baye and ESA PWA (Figure 14). Rhizomes were harvested from the Delta Diablo Sanitary District site under the supervision of Save The Bay's nursery manager, Jessie Olson. They were transported to the OLSD site on March 15, 2017 and subsequently planted by Save The Bay staff on March 16, 17, and 21st based on methods modified from Baye (2016)(Figure 15). Save The Bay planted 2,323 cattail bulbs and 1,806 bulrush bulbs. Planting involved dropping bulbs in dense arrays throughout the basins and tamping them in.

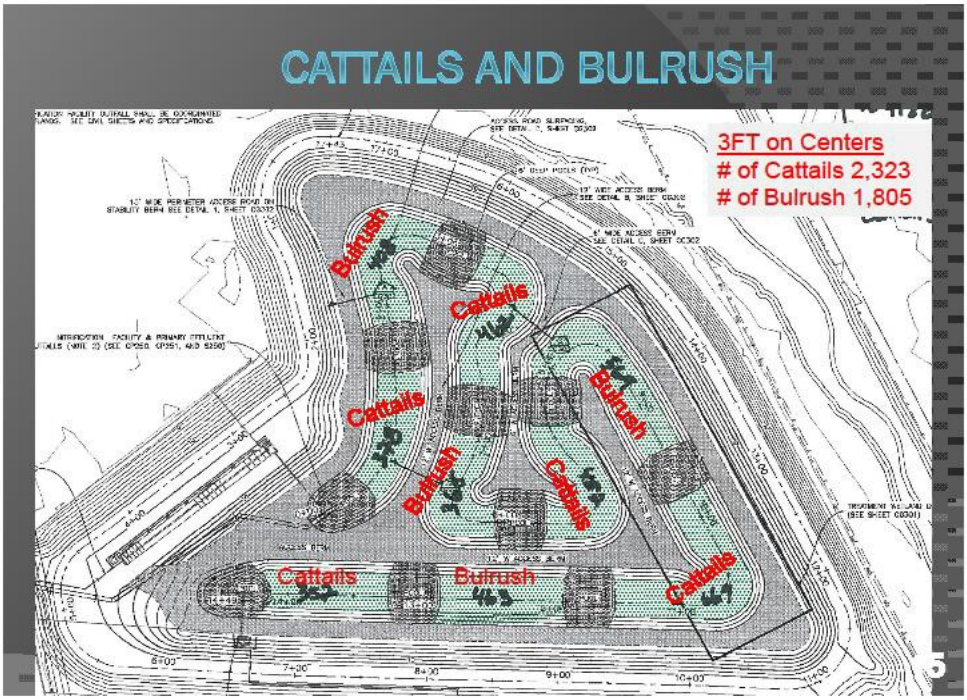

Figure 14. Planting schematic for cattail and bulrush plantings.

Figure 15. Save The Bay staff processing and planting bulrush and cattails.

Use of Volunteers for Planting

Over the past fifteen years, Save The Bay built a successful habitat restoration program based on a volunteer model to conduct transition zone (ecotone) habitat restoration. Save The Bay operates two native plant nurseries in Oakland and Palo Alto. Each year we engage almost 6,000 volunteers from diverse communities, businesses and schools to join our restoration team for hands-on restoration activities.

Save The Bay's community-based restoration model actively engages the public while contributing to project goals. Save The Bay has a small staff; therefore volunteers provide a foundation of additional labor for many of the restoration tasks including the physical removal of invasive species, plant propagation, and native species outplanting.

Community-based restoration work also allows for flexibility with changing conditions and variables. Depending on a projects size and scope, Save The Bay's restoration team has the ability to increase or decrease the need for volunteer help. The Oro Loma Project demonstrated our ability to utilize public volunteers combined with staff expertise to accomplish ambitious goals of outplanting 70,000 plants with a specific planting plan. Volunteers were also helpful in propagation activites.

To install the ~70,000 plants required for this project, Save The Bay utilized a combination of staff and volunteers. Save The Bay's restoration staff led a total of nine volunteer programs and committed 28 staff-only workdays to outplanting the Oro Loma site from mid-November 2015 until early February 2016. Our volunteer programs included a mix of public and private events (Table 6). Save The Bay hosted five public volunteer events on November 14th and 21st, December 5th and 12th and January 9th. The public programs averaged around 30 volunteers. Volunteers were limited to individuals 16 years or older due to the need for accuracy and care installing the plants. The public volunteer groups averaged planting roughly 2,000 plants during each three-hour program.

In addition to the public programs, several organizations attended private events at Oro Loma. Private volunteer groups included Save The Bay Fellows, the Presidio Trust, Acterra, a program for project partners ESA and SFEI, and an All Staff planting day with Save The Bay employees. These groups tended to be more productive because of their experience in habitat restoration.

Volunteer labor included 220 volunteers who contributed to the planting work (Table 6); however, the majority of the work was done by Save The Bay staff. Working with volunteers requires extra set up time, training on safety and planting methods, and instruction. Additionally, volunteers need to be supervised more heavily to ensure the specific planting plan is followed. Time spent managing volunteers reduces the time that staff can be involved in planting. Staff knowledgeable of the site and plants, and trained in restoration methods can ensure that a full day of work is accomplished. In addition to staff, Save The Bay recruited and trained three individual volunteers to be a part of the Save The Bay's staff planting crew for the duration of the project. The volunteer planting crew was similar to an internship in scope, committing three days a week to working with Save The Bay staff for the duration of the project. While Save The Bay gained the help of three additional people, in return, the planting crew learned valuable skills in restoration ecology to add to their resume.

Table 6. Volunteer programs and numbers of public volunteers

Volunteer Group	Number of Volunteers
Public Event 11/14/2015	56
Public Event 11/21/2015	35
Public Event 12/05/2015	31
Public Event 12/12/2015	23

Volunteer Group	Number of Volunteers
Public Event 01/09/2016	11
Private Event: Presidio Trust	11
Private Event: Acterra	4
Private Event: Save The Bay Staff	28
Private Event: SFEI/ESA	21
Total number of public volunteers	**220**

RESULTS/LESSONS LEARNED

This project was the first of its type for Save The Bay as most of Save The Bay's restoration work has been focused on growing plants in containers in two native plant nurseries. This was an opportunity to try new methods of plant propagation and for the organization to work with other collaborative partners to grow a large numbers of plants under a very tight deadline. The section below summarizes some of the results and the lessons learned on this project.

Plant Propagation Success

Save The Bay was highly successful at growing plants on the project site within a limited propagation window of about 15 months. Close co-ordination with the OLSD and Peter Baye were instrumental in this success. The OLSD provided critical irrigation of both the raised beds and the ecotone slope with well water at critical junctures in the growing season.

The raised beds were far more successful than anticipated at the outset of the project. Initially, we were concerned that the 17 beds could grow the required number of plants. However, the number of plants remaining (and that subsequently amplified) after the planting was complete indicate that we could have vegetated several projects of this size with the plants grown in the raised beds. The raised beds will be maintained and plant material is planned for use on other East Bay projects. Save The Bay maintains an MOU with the OLSD for extended use of the raise beds on site for any needed replacement plantings on the slope and for Save The Bay's other projects throughout the Bay.

Lining the beds with plastic and having access to onsite irrigation were important for the success of the propagation efforts. Save The Bay also used shadecloth on a limited basis to protect the plants from wind and sun during hot summer months and this contributed to maintaining the health of the plants.

Weed Abatement/Success of Annual Seed Mix as Cover Crop

The annual cover crop of native weedy species in addition to the dense cover of planted clonal species has been very successful in limiting establishment of any significant populations of typical weedy species such as mustard, fennel, or other problem species. Initially, some non-native species such as brass buttons (*Cotula coronopifulia*) colonized the site but these were soon outcompeted by the establishing clonal perennial species.The weedy species that have occurred in small numbers on site such as pampas grass (*Cortaderia jubata*) may have blown in from adjacent properties or may have been part of the seed bank.

Planting Success

Save The Bay was able to meet the project schedule with regard to having plants ready and available for installation on time and within budget. We were also able to get the plants in the ground fairly quickly with limited number of staff. Planting was accomplished very efficiently

within a 6-week time period. Save The Bay hoped to use volunteer labor more extensively for planting, but due to the compressed time frame and concern for quality planting work, we used trained staff for most of the planting. The volunteers that did help with the project provided quality work, and in the future we believe that we could use more volunteer labor on future projects such as this one.

Plant Establishment Success

The design specified a high number of plants (70,000) for the project acreage to encourage the plantings to establish densely in order for the Project to implement the water quality experiments within the year after planting/construction was complete. Therefore, the slope was planted more densely than would be done is typical for restoration sites. The high quality soils, irrigation for establishing plants, and subsequent water flowing through the slope resulted in rapid establishment of high quality habitat. The vegetation establishment was more rapid than expected by Save The Bay staff, and the quality of the plant community mosaic has exceeded expectations (Figure 16).

Figure 16. Vegetation establishment as of August 2017 (four photos).

Cattail and Bulrush Plantings

Many of the cattails and bulrush plantings did not initially survive. This is likely due to the fact that the water depths in the site may have restricted the plants from establishing. However, a few plants did survive, and this will likely aid establishment within the basin in the long term. A subsequent additional harvest and planting of onsite cattails will also aid in overall establishment. Given the weedy nature of both cattails and bulrush and their propensity to multiply, it is very likely that the basins will establish robust populations of both species over the coming years.

Project Scaling for Future Projects

The raised bed propagation method was a huge success for this project. This method has been used on other projects in the Bay, most notably for growing native cordgrass (*Spartina foliosa*) for outplanting into Bay marshes. Many of the species grown in raised beds for the Oro Loma project were clonal, rhizomatous transition zone species which easily sprout once buried into appropriate upland, wetland soils. This project proved that large scale propagation is possible and that raised beds can provide an unlimited supply of plants for a relatively small restoration project. Save The Bay and Peter Baye will be taking the lessons learned from this project to develop ways to scale these methods to include on site, in situ beds as well as to row farm rhizomatous species to till into restoration sites. If successful, those methods would enable projects to grow plants for larger transition zone/ecotone sites (20-30 acres).

Figure 17. Examples of potential future techniques

SAVE THE BAY OUTREACH

Save The Bay engages our community of over 60,000 constituents – including students, residents and businesses – to protect and restore San Francisco Bay through volunteer restoration programs and citizen advocacy. We used our diverse media channels, online communications such as e-newsletters, e-action alerts and social media, as well as traditional media and print publications to recruit and engage volunteers to propagate and install plants for this project and to communicate results to the general public.

In addition to the outreach work done by The Bay Institute, Save The Bay's Communications Team and other Save The Bay staff also promoted this project through online blogs, local media, Save The Bay's website, social media (Twitter, Facebook, and Instagram), public presentations, and at our volunteer programs. A compilation of the media hits and statistics for which Save The Bay was responsible is included below.

Oro Loma Media Hits

- **San Lorenzo: Environmentally friendly levee could protect against sea level rise**
  Contra Costa Times, March 18, 2015
- **Restoring Marshland and Protecting Bay Shoreline From Rising Tides and Storm Events**
  KQED, September 25, 2015
- **San Lorenzo: Public viewing of experimental shoreline levee Saturday**
  Daily Democrat, November 12, 2015
- **$9 million levee project begins in East Bay**
  The Pioneer, November 19, 2015
- **Experimental Living Levee Could Battle Rising Bay Tides**
  NBC Bay Area, February 2, 2016 (Broadcast)
- **Selective Sowing/Transitions (Article about STB work at Bair/used Oro Loma photo on cover**
  March 2016
- **Oro Loma: Can Wastewater Save the Bay From Sea Level Rise?**
  Bay Nature Magazine, April – June 2016

Save The Bay Sponsored Blogs about Oro Loma

- **Going Big: Building an Experimental Habitat for a Better Bay.** In April 2015, Save The Bay published its first blog about the Oro Loma Horizontal Levee Project. This blog introduces this innovative project to the public and discusses what the Habitat Restoration Team hopes to accomplish when it's complete.
- **Restoration at Oro Loma.** Communications Fellow Caity Varian recaps her Fellowship planting day at the Oro Loma Demonstration Project nursery site.
- **Planting Begins at Oro Loma**
  In November 2015, Save The Bay hosted their first ever public planting event at the Oro

Loma Horizontal Levee site. Over fifty volunteers gathered at the Oro Loma Sanitary District treatment plant in San Lorenzo to kick off an ambitious burst of planting activity in a soon-to-be restored wetland. Attendees placed 3,200 plants into a plot of soil next to the sewage treatment plant.

- **Staff Planting Day 2015!** In December 2015, the entire Save The Bay staff spent their staff workday at the Oro Loma Sanitary District planting plants at the Horizontal Levee Project site. After four hours out in the field, the Save The Bay staff put in 2,260 plants.
- **The Science of Wetlands and Wastewater.**
  Aidan Cecchetti, a graduate student at UC Berkeley, writes about the research he's conducting at the Oro Loma Horizontal Levee Project site**.** He's testing to see if a restored habitat can thrive on the outflow from a wastewater treatment plant, as well as whether or not the habitat reduces the concentration of potentially dangerous chemicals that flow through it.
- **70,000 Planted at Oro Loma.** Mission accomplished! After a year and a half, from collecting seed and rhizomes, to building raised beds, to outplanting 70,000 plants, the final plant is in at Oro Loma.

Blogs that mention Oro Loma

- **Restoring the Bay: Ecology + Advocacy**. An interview with Beckie Zisser and Jon Backus about the ways the Policy and Restoration teams are working to save the bay. The Bay ballot measure (Measure AA) and the Oro Loma Horizontal Levee Project are mentioned in this blog.
- **State of the San Francisco Bay-Delta Estuary Conference 2015.** The main theme of the 2015 State of the SF Bay-Delta Estuary Conference was climate change. One of the projects discussed in great length was the Oro Loma Horizontal Levee Project.
  Report: The Baylands and Climate Change. Released in October 2015,
  The *Baylands and Climate Change: What We Can Do, The Baylands Ecosystem Habitat Goals Science Update* was released. This blog also highlights some of the major findings and important takeaways from the scientific publication and mentions Save The Bay's active role in restoring transition zones and the Oro Loma Horizontal Levee Project.
  Making an Impact: Bay Restoration. Emily Stanford is a sophomore at Oberlin College studying biology. She is interested in becoming an ecologist and conducting research. During her winter break, Emily visited the Bay Area and volunteered her time to help with the horizontal levee project at Oro Loma.

Public Presentations by Save The Bay Staff

The following list includes the presentations that were given by Save The Bay staff that specifically communicated the work or results of the Oro Loma Project Horizontal Levee Project.

- Lowe, J. and D. Ball. 2015. Baylands adaptation to sea level rise: Horizontal levees, green infrastructure and soft bird's beak. California Native Plant Society Conference, San Jose, CA. January 15, 2015

- Ball, D. 2015. Restoring Habitat and People at the Edge of the Bay. San Francisco Joint Venture Meeting, Hayward, CA. October 8, 2015.
- Olson, J., D.Ball, J. Warner, and P. Baye. Experimental Propagation Methods for the Oro Loma Horizontal Levee Demonstration Project. Poster presentation at the State of the Estuary Conference, Oakland CA. September 17, 2015.
- Ball, D. 2015. The Estuarine-Terrestrial Transition Zone: Valuable Now, Critical in the Future. Oral presentation at the Coastal Estuarine Research Federation Conference, November 12, 2015. Portland, OR.
- Ball, D. 2016. Working Together to Make a Difference; A vision of hope for San Francisco Bay. *At* Bay Visions Meeting – Joint meeting of all bay-area garden clubs. Oakland, CA. January 20, 2016.
- Ball, D. 2016. Saving San Francisco Bay. Marin Garden Club Meeting, Marin Art and Garden Center. Marin, CA. March 8, 2016
- Ball, D. 2016. Saving San Francisco Bay. Lecture at San Jose State University Environmental Science Class, April 19, 2016.
- Ball, D. 2016. Cost-Saving Planting Measures. Oro Loma Horizontal Levee Briefing at the Santa Clara Valley Water District. May 12, 2016
- Ball, D. J. Lowe, C. Diaz, M. Lindley, J. Warner, P. Baye, D. Sedlak, and M. Holmes. A Novel Approach to San Francisco Baylands and Sea Level Rise: Adaptation using horizontal levees. Oral presentation at Restore America's Estuaries Conference, New Orleans, LA. December 13, 2016.
- Olson, Jessie. 2016. The Oro Loma Horizontal Levee Project: Scaling up native species propagation methods to accommodate large transition zone/ecotone projects of the future. Oral presentation at Restore America's Estuaries, New Orleans, LA. December 13, 2016.

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Baye, P. 2016. Memorandum: Summary of summer translocation methods for Oro Loma treatment wetland pond/equalization basin. Memo to Kris Decker (OLSD) dates May 31, 2016.

Baye, P. 2014. Modified Oro Loma planting and seeding quantities, methods for compressed propagation schedule – updates and adaptations in progress. Memorandum to Carlos Diaz, Mark Lindley, ESA Hydrology dated April 18, 2014.

ESA PWA, Peter Baye, 2012, Oro Loma Wet Weather Equalization, Treatment Wetland and Ecotone Demonstration Project. Initial Feasibility Study. July 29, 2012.